

**MORPHO-PHYSIOLOGICAL AND BIOCHEMICAL
CHARACTERIZATION OF RICE (*Oryza sativa* L.)
GENOTYPES FOR THEIR SUITABILITY UNDER
RABI ENVIRONMENT OF KONKAN**

by

**Mrs. MINAKSHI HEMCHANDRA KELUSKAR
M.Sc. (Ag.)**

**DEPARTMENT OF AGRICULTURAL BOTANY,
FACULTY OF AGRICULTURE,
DR. BALASAHEB SAWANT KONKAN KRISHI
VIDYAPEETH, DAPOLI
DIST. RATNAGIRI - 415712 (M.S.) INDIA**

AUGUST, 2023

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A thesis submitted to the

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VIDYAPEETH, DAPOLI**
(Agricultural University)
Dist. Ratnagiri (Maharashtra state), India

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
(Agriculture)

in

PLANT PHYSIOLOGY

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**Approved by the advisory committee
: Chairman and Research Guide:**

(A. V. Mane)

Deputy Director of Research (Seed)

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth,
Dapoli, Dist. Ratnagiri.

: Members:

(A. K. Shinde)

Ex-Head,

Department of Agricultural Botany.
Dr. B.S.K.K.V., Dapoli

(R. L. Kunkerkar)

Head,

Department of Agricultural Botany
Dr. B.S.K.K.V., Dapoli

(S. B. Dodake)

Head,

Department of Soil Science and Agril.
Chemistry,
Dr. B.S.K.K.V., Dapoli.

(S. V. Sawardekar)

In-charge,

Plant Biotechnology Centre
Dr. B.S.K.K.V., Dapoli

Dr. A.V. Mane

Deputy Director of Research (Seed)

College of Agriculture Dapoli

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

Dist. Ratnagiri – 415712, (Maharashtra).

CERTIFICATE

This is to certify that the thesis entitled “**MORPHO-PHYSIOLOGICAL AND BIOCHEMICAL CHARACTERIZATION OF RICE (*Oryza sativa* L.) GENOTYPES FOR THEIR SUITABILITY UNDER *RABI* ENVIRONMENT OF KONKAN**” submitted to the Faculty of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra State in partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY (AGRICULTURE)** in **PLANT PHYSIOLOGY**, embodies the results of the piece of *bona-fide* research carried out by **Mrs. MINAKSHI HEMCHANDRA KELUSKAR** (Regd. No. ADPD/19/0314) under my guidance and supervision. No part of this thesis has been submitted for any other degree or diploma and published in other form. All the assistance and help received during the course of investigation and the sources of literature have been duly acknowledged by her.

Place: Dapoli

Date:

(A.V. Mane)
Chairman,
Advisory committee
and
Research Guide

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(Keluskar Minakshi)

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CHAPTER I

INTRODUCTION

India is the 2nd largest rice producer and the largest exporter of rice worldwide. Total production of rice in India is 130.84 million tons with 46.00 million hectare area (Anonymous, 2023).

Rice belongs to genus *Oryza*, of the family Poaceae and is widely cultivated crop (FAO, 2000; Syed and Khaliq, 2008). Genus *Oryza* contains approximately 24 species, of which 21 are wild type and two; *O. sativa* and *O. glaberrima* are cultivated world-wide (Vaughan, 2003). It is the most important food crop worldwide, representing the staple food and more than half of the world population depends on its consumption and income generation (Bucheyeki *et al.*, 2011). Rice believed to have originated in Asia. Ancient records showed that Greek introduced rice to India around 326 B.C. then after, it spread across Europe for the next 2000 years. It was brought to the new world (South and North *Glaberrima*, *Oryza sativa* is native to tropical and subtropical Southern Asia that there are three groups of *Oryza* cultivar cultivars *viz*; Japonica, Javanica and Indica.). Rice is being cultivated in 117 countries across the world in every continent except Antarctica and hence called as "global grain".

Domesticated rice belongs to Poaceae family with two species, *Oryza sativa* and *Oryza glaberrima* is the native to west Africa. Studies have suggested food grain crop of the world which constitute the principle food for about 60% of the world population. Rice contributes 43% of the total food grain production and 46% of total cereal production in India. Rice based production system provides the income and employment for more than 50 million households. One third of Asia rice production is consumed in China and one fifth in India. Rice is believed, is associated with wet, humid climate and thought it is not a tropical plant. It is probably a descendent of wild grass that was most likely cultivated in the foothills of the far Eastern Himalaya. Rice provides about two –third of the calories intake of nearly one billion people in Africa and Latin America.(Shastri *et al.*, 2000).

Rice (*Oryza sativa* L., $2n=24$) is an important cereal crop in India and staple food of more than 60% of Indian population. Total production of rice estimated at record 130.84 million tonnes (Anonymous, 2023). Rice is the second important crop of Maharashtra and is grown over an area of 14.65 lakh hectares with an annual rice production of about 32.76 lakh tonnes. Rice is one of the premier cereal crops of the World and staple food of more than half of the World's population. In India, introduction of semi-dwarf high yielding varieties was instrumental in increasing the rice production. The steady increase in rice production over the years transformed the country from food deficit to net surplus. Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli has released and notified 34 rice varieties including five hybrids and has developed improved package of practices for cultivation of rice crop since 1972. The rice production has increased from 10.06 lakh tonnes (1970) to 15.69 lakh tonnes (2016) and productivity from 2.3tha^{-1} to 4.35tha^{-1} (www.cal.researchgate.net Technological interventions boon for rice production in Konkan region, 2020).

It is believed that the second 'Green revolution' will more heavily be driven by the development of cultivars with better yielding ability. Thus, increasing the yielding ability is important (Khush and Peng, 1996). It is desirable to study yield and yield contributing traits like number of effective tillers per plant, number of grains per panicle, 1000 grain weight, days to 50 % flowering, days to maturity and plant height which have shown positive association with grain yield (Wattoo *et al.*, 2010).

The major rice districts in Maharashtra are Thane, Raigad, Ratnagiri, Sindhudurg and Palghar along with west coast and Bhandara, Gondia, Gadchiroli and Chandrapur in the eastern part of state. Konkan region occupies an area of about 3.69 lakh hectare under rice with production of about 12.94 lakh tonnes and productivity around $2.93\text{ tonnes ha}^{-1}$ (Anonymous, 2023).

Rice is the main cereal crop in Konkan and it is cultivated in *kharif* as well as in *rabi* season. During *kharif* season, the sowing of rice

is done in the month of June and should be harvested in the month of November, therefore the pre cultivation operations should be late in *rabi* season means the sowing of rice will be in the month of December. In most of the area of Raigad, Ratnagiri and Sindhudurg canal water will be provided in the month of December and harvest comes the crop at the end of May. Pre monsoon rains in May leads to lot of loss of crop as well yield. Therefore, it is very important to have shorter duration rice varieties which can harvest at end of April or the first week of May. Dr BSKKV, Dapoli has released high yielding varieties for the *kharif* and *rabi* season. The sowing time of the rice crop is important for three major reasons. Firstly, it ensures that vegetative growth occurs during a period of satisfactory temperatures and total sunshine hours. Secondly, the optimum sowing time for each cultivar ensures the cold sensitive stage occurs when the minimum night temperatures are historically the warmest. Thirdly, sowing on time guarantees that grain filling occurs when milder autumn temperatures are more likely, hence good grain quality is achieved. Results from different studies revealed that the maximum yield potential of a rice crop is usually achieved when the crop is exposed to the most appropriate temperature range, which can be controlled by sowing at the proper time.

In the present study for the *rabi* summer rice, the sowing of rice variety will be in the 48th meteorological week (1st December), S₂-50th meteorological week (15th Dec) S₃ and 52th meteorological week (30th, Dec) S₄ and keeping view to study "Morphological, physiological and biochemical attributes related to growth and yield of 40 early duration rice genotypes as influenced by different sowing window during *rabi* season in Konkan".

In the present investigation, attempts have been made to find out physiologically efficient, high yielding and stable genotypes for growing under *rabi* season-

Objectives:

1. Morphological characterization of 40 early duration rice genotypes under *kharif* and different sowing windows during *rabi* season in Konkan.

2. Physiological and biochemical characterization of 40 early duration rice genotypes under *kharif* and different sowing windows during *rabi* season.
3. Thermo and photo sensitivity response of 40 rice genotypes grown under *kharif* and different sowing windows during *rabi* season to assess correlation of weather parameters.
4. To find out physiologically efficient, high yielding and stable genotypes for growing under *rabi* season.

CHAPTER-II

REVIEW OF LITERATURE

In India, rice is cultivated on an area of 46.00 million hectare with production of 130.84 million tones and productivity of 2.8 t/ha (Anonymous, 2023). Rice is the second important crop of Maharashtra and is grown over an area of 14.99 lakh hectares with an annual rice production of about 32.37 lakh tons. The state's average productivity is 2.24 t/ha, ranking at 13th in the country.

Grain quality of rice is determined by several factors such as grain appearance, nutritional value, cooking and eating quality. Rice is consumed principally as a whole grain and therefore the texture of the whole grain is a matter of great concern. Rice quality is of great importance for all people involved in producing, processing and consuming rice, because it affects the nutritional and commercial value of grains. Further, grain quality has become an important issue affecting domestic consumption and international trade of rice (Lodh, 2002).

2.1. Phenological parameters:

2.1.1. Days to first flowering, days to 50% flowering and days to physiological maturity:

Nanda *et al.* (1982) described the characters of an early dwarf mutant of Tilak Chandan and its mutant and stated that variety TilakChandan flowered in 122 days, while its mutant in 82 days.

Muduli *et al.* (1996) reported that in Orissa all genotypes studied, recorded more or less constant trend of increase in flowering duration in dry season compared to wet season except Karnal local, indicating their sensitivity to temperature rather than photoperiod.

Thaware *et al.* (1999) reported positive direct effect of days to 50 percent flowering. The direct effect of days to maturity was positive and very high but the genotypic correlation coefficient and indirect effect via

days to 50 percent flowering, plant height, and productive tillers per plant and fertility percentage were negative.

Iftikharuddaula *et al.* (2001) reported negative correlation between days to maturity and spikelets per panicle.

Nabeela *et al.* (2004) evaluated the landrace genotype of rice for seven quantitative and eight qualitative characters and found that days to heading was positively correlated with maturity and it also exhibited high range (88 – 171 days) for maturity. Pak 2950 had shorter maturity period i.e. 88 days representing earliness and stated that minimum value for days to maturity represents that the variety has a benefit of early ripening.

Zaman *et al.* (2005) reported that the duration to 50 percent flowering showed largest contribution to the total divergence in rice.

Karim *et al.* (2007) reported that variation for days to maturity which was attributed by genetic constituent rather than environment.

Krishna *et al.* (2008) conducted the studies on genotypic correlations and path coefficients for seed yield and yield attributing components and concluded that seed yield per hill was positively and significantly correlated with days to 50 percent flowering.

Jamal *et al.* (2009) reported highly significant genetic variations among genotypes for days to 50 percent flowering. This might be due to the genetic makeup of exotic lines and genotypic environmental interaction.

Shahidullah *et al.* (2009) reported that all phenological characters were found to vary in a wide range depending on rice cultivars as well as micro and macro environments.

Faruq Golam *et al.* (2011) stated that days to maturity variation was not significant among the tested genotypes. Days to maturity among rice genotypes ranged from 105 to 117. Minimum and maximum days to maturity were observed in E3 and MRQ50, respectively.

Ranawake *et al.*(2011) reported that days to flowering (DF) used for plant height, and yield/plant (g) were measured in 102 traditional rice cultivars. Rice cultivars were grouped as 70, 80, 90, 100 DF. The effect of days to flowering on the plant height and yield/plant was greatly varied with the days to flowering.

Jeng *et al.*(2006) conducted an experiment during spring and autumn and reported that growth duration from transplanting to physiological maturity for cultivar Tainung 67 was 7-19 days longer than SA 419, and autumn crops matured an average of 16 days earlier than spring crops. As the number of days from 50 per cent flowering to physiological maturity increased, the yield also increased in hybrids and this increase in yield was due to increased number of days available for dry matter accumulation in grain.

Karim *et al.*(2007) stated that analysis of variance for days to maturity showed highly significant mean sum of square due to genotypes. The mean days ranged from 142 to 173 days. There was a pronounced variation for the character days to maturity and this variability was conserved by genetic constituent rather than environment. Rangareet *al.* (2012) suggested that days to maturity influenced the yield.

Courtney *et al.*(2011) assessed twenty diverse rice varieties from landrace, advanced and popular class. They noted the maximum days to mature (152 days) for variety Swarna and minimum in Dular (119 days).

Muhammad *et al.*(2012) evaluated ten rice genotypes during their experiment. Days to maturity showed same trend as observed in case of days to heading. The early heading lines matured early and late heading lines matured late. The maturity period ranged from 137 to 148 days. Genotypes HHZ5-Y3-SAL3-DT1 remained earlier in maturity (137 days), HUA 564 proved as medium with 141 days to maturity, variety IR-6 took 148 days to mature and was late as compared to all other genotypes.

Dhakal *et al.*(2014), conducted a study with fifty rice genotypes during kharif 2013. Maturity duration ranged from 108 to 142 days with an average of 124 days. The genotype Tulasi (108 days) was early in maturity whereas, genotypes RP 5214-18-6-2-1-1-1-B (142 days) recorded late maturity.

2.2. Physiological observations :

2.2.1.Total chlorophyll content(mg/g) :

Kariya *et al.* (1982) reported that the chlorophyll meter quantifies the greenness or relative chlorophyll content of leaves thus the critical or threshold SPAD value is important and that indicates the leaf area based critical nitrogen concentration in rice leaves.

Penget *al.* (1996) reported that chlorophyll meter or SPAD (Soil plant analysis development) offers a new strategy for synchronizing N application with actual crop demand in rice.

Miah *et al.* (1997) reported that Chlorophyll pigments play an important role in the photosynthetic process as well as biomass production. Genotypes maintaining higher leaf chlorophyll-a and chlorophyll-b during growth period may be considered potential donors for the ability of producing higher biomass and photosynthetic capacity. Higher photosynthetic rate is supported by leaf chlorophyll content in leaf blades.

Hussain *et al.* (2000) studied the use of chlorophyll meter efficiency indices for nitrogen management of irrigated rice and reported that the chlorophyll meter indicates the need of a nitrogen top dressing that would result in greater agronomic efficiency of nitrogen fertilizer than common pre-application of nitrogen.

Munshi *et al.* (2005) reported that grain yield in rice was positively correlated with chlorophyll content and showed that high yielding genotypes also showed higher chlorophyll content.

Swain *et al.* (2006) reported that highly significant and positive relation between total chlorophyll content at all the growth stages and grain number/m². The increase in the yield was attributed to the chlorophyll content in sink development and grain filling.

Hossain *et al.* (2007) reported that the biological yield had significant correlation to chlorophyll of leaves. When chlorophyll of leaves increase, the amount of photosynthetic assimilates increase and is stored in shoot of plant. But, when chlorophyll content of flag leaf is high, the photosynthetic assimilates transported to kernel and flag leaf role in production of biological yield is lower than other leaves.

PramodKumar *et al.* (2007) studied the content of total chlorophyll recorded at grain filling stage under normal planting, ranged between 1.76 to 3.19 mg / g. f. wt. while under late planting (low temperature) varied between 1.27 to 2.17 mg/g f. wt.

Gholizadeh *et al.* (2009) reported that SPAD readings are closely related to leaf N content and the SPAD meter can be used to monitor the N status of rice and thereby to adjust the rate of N fertilization in order to increase N use efficiency.

Mian *et al.* (2009) reported a linear and positive relationship of SPAD values with total chlorophyll, chlorophyll-a and leaf nitrogen % indicating the dependence of SPAD values with chlorophyll and nitrogen content of leaf at flowering.

Abdul Baset Mia *et al.* (2012) reported that total chlorophyll content decreased gradually from tillering to flowering stages. BRRIdhan32 and Ukonmodhu recorded the higher amount while Binasail showed the lowest amount of total chlorophyll at all the three stages.

Hussain *et al.* (2014) studied the SPAD value indicates chlorophyll contents and colour of crop. Japonica varieties achieved lower SPAD values at all growth stages as compared to indica and NERICA. SPAD

value decreased sharply in Nipponbare and Koshihikari from active tillering to panicle initiation stage as compared to IR-28 and NERICA-4.

Chandrika *et al.* (2015) reported that maximum SPAD values were recorded for genotype RNR 15038 throughout the crop growth period and minimum was found in Rajendra.

Chandrashekhar *et al.* (2017) reported that mean higher chlorophyll content was recorded at 90 DAT in SRI (41.77) and NTP (40.16). SRI recorded 4% of SCMR values higher than NTP. Among the nutrient management practices, T₃ recorded higher chlorophyll content in SRI at 90 DAT (41.77) followed by T₄ (40.01). Lower chlorophyll content was recorded under T₂ (control).

Vinai Kumar *et al.* (2017) studied physiological and biochemical responses of different rice (*Oryza sativa* L.) genotypes under terminal heat stress. The total chlorophyll content was maximum in rice genotype IET 20114 (2.65 mg/g fr. wt.) under control and in IET 20926 (2.55 mg/g fr.wt.) under treatment, while minimum in IET 20923 (1.71 mg/g fr. wt.) under control and in IET 20944 (1.52 mg/g fr.wt.) under treatment condition.

Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during kharif. They found that at 60 DAT, RTN-13-4-2-3-1 (2.0662 mg/g) recorded highest total chlorophyll content followed by KJTRH-21. At 90 DAS, RTNRH-10 (1.572 mg/g) recorded maximum total chlorophyll content followed by RTN-84-2-1-2.

Phule *et al.* (2018) studied the leaf chlorophyll content (viz. chlorophyll A, chlorophyll B and total chlorophyll) displayed non-significant differences under both aerobic as well as under anaerobic conditions in both the genotypes.

2.2.2 Chlorophyll stability index:

Meenakshi *et al.* (1999) carried combining ability analysis semidry rice through line x tester analysis for major yield and physiological characters related with drought tolerance. Difference due to line (L), tester (T), and L X T interaction were significant in chlorophyll stability index suggesting the importance of both additive and non-additive gene action in the inheritance of characters.

Babu *et al.* (2005) studied evolution of rice genotypes for salt tolerance. The chlorophyll stability index values were higher in the cultivars CORH2, IR68885B, CO43, and TRY(2) indicating their tolerance to salt stress.

Patel *et al.* (2006) studied performance of *kharif* rice under raised and sunken beds system. Chlorophyll stability index was found significantly higher in RCPL-29 followed by VivekDhan 82 as compared to other varieties both at vegetative and heading stages.

Reddy *et al.* (2007) studied physiological characterization of rice genotypes under periodic water stress. The higher chlorophyll stability index was recorded in Pant Dhan 4.

Ganpathy *et al.* (2008) studied variability and interrelationship between yield and physio-morphological traits in rice under moisture stress condition. Grain yield had positive and significant correlation with chlorophyll stability index.

Ganpathy *et al.* (2008) studied heterosis analysis for physio-morphological traits in relation to drought tolerance in rice. The maximum desirable heterosis over mid parent was observed for chlorophyll index (44.19). Among 40 hybrids, 28 hybrids exhibited positive heterosis over mid parent and 10 hybrids, showed significantly positive heterobeltiosis over better parent.

2.2.3. Leaf water potential:

Caio *et al.* (2018) studied two independent greenhouse experiments were conducted during middle summer and fall, in order to validate the results for high and low evapotranspiration conditions. Leaf water potential was lower in HET than in LET at 13:00, and in both cases, it decreased as the Rice plants were grown in hydroponics and the water potential was adjusted with polyethylene glycol 6000, varying from - 0.04 MPa (control) to - 0.19 MPa. Leaf water potential, water use efficiency, leaf area, and root and shoot biomass was evaluated. All assayed parameters decreased as the water potential was decreased. The water potential threshold which starts to negatively affect rice growth was between - 0.046 and - 0.056 MPa, which are values close to solution water potential was decreased. At 13:00, leaf water potential in HET plants averaged - 2.40MPa, and - 1.80MPa in LET plants. Leaf water potential was lower in HET than in LET at 13:00, and in both cases, it decreased as the solution water potential was decreased. At 13:00, leaf water potential in HET plants averaged -2.40MPa and -1.80MPa in LET plants. When soil water potential was between - 0.02 and - 0.03 MPa, when it reached -0.05 to -0.06 MPa during the vegetative (V₄–V₅) and reproductive (R₀–R₄) developmental stages.

2.3. Growth parameters:

Suzuki *et al.* (1983) reported that distribution and production of dry matter into different organs of plant varied with the growth stages at 90 DAP which was ascribed to enhancement of SLW at booting stage.

Murty *et al.* (1986) observed the variation in NAR in rice varieties which was attributed to the variation in varietal characters. There was accelerated NAR at 90 DAT which was ascribed due to enhancement of SLW at booting stage.

Burondkar *et al.* (1990) reported a significant positive correlation with pre and post flowering LAR, crop growth rate, and relative growth rate with seed yield in rice.

Pinheiro *et al.* (1990) reported that in the absence of environmental stress, yield increased with increase in LAI.

Karimi *et al.* (1991) reported that AGR at anthesis was greater for modern than old cultivars.

Mia *et al.* (1994) reported that yield was associated with higher pre-flowering AGR in short duration rice varieties and with higher post-flowering AGR in long duration rice varieties and suggested that rice yield improvements may be possible by enhancing the photosynthetic rate before anthesis.

Sahoo *et al.* (1998) reported that leaf area index, specific leaf area, leaf area ratio, relative growth rate, net assimilation rate, crop growth rate, relative leaf growth rate and leaf area duration were positively associated with grain yield and also stated that LAD from flowering to maturity, relative growth rate at 46 to 60 DAS and both LAI and LAR at flowering were found to be suitable physiological parameters to fit in regression equations for predicting grain yield of rice.

Haung *et al.* (1999) reported that higher harvest index of more than 0.6 in early maturing indica varieties was attributed to rapid increase in LAI, dry matter and reproductive tillers.

Norbakhshian *et al.* (1999) reported that relative growth rate and crop growth rate at flowering had positive correlation with grain yield in rice and also stated that LAI was correlated negatively with grain yield at flowering.

Peng *et al.* (1999) found that in all phenology stages in direct seeding and transplanting method of rice, the NAR and the LAI had positive correlation with the grain yield. At 70 and 85 days after transplanting, the NAR and LAI had no significant effect on the grain yield.

Erfani *et al.* (2000) reported that CGR, NAR and leaf area index (LAI) were higher throughout growth stages in improved genotypes than traditional genotypes.

Singh *et al.* (2000) carried out morpho-physiological analysis of growth and yield in traditional tall and improved semi tall rice cultivars and found significant varietal differences for RGR at all growth stages. The RGR was found maximum during active tillering to panicle initiation stage, but registered lower values of the same during later growth stages. Varieties also showed significant difference in NAR and LAR having inverse relation with each other in all the cultivars during various growth stages. In general, CGR was highest during active tillering to panicle initiation stage and reduced subsequently.

Chandrasekhar *et al.* (2001) reported that CGR, LAI, LAD and SLW had direct effect on dry matter production and yield whereas RGR had negative and significant correlation with grain yield (Kulmi, 1992).

Dingkuhn *et al.* (2001) found that there is a strong case for SLA being responsible to a large extent for varietal difference in tillering ability and LAI in rice. High SLA is a major factor enabling early ground cover and light interception; therefore, it determines potential growth in many situations.

Dutta *et al.* (2002) reported that high yielding rice varieties had higher LAI and greater LAR and consequently produced more dry matter and more yield.

Yun *et al.* (2002) reported a large LAI and large sink capacity, determined by grain number and grain weight, which might be due to more nitrogen absorption before anthesis.

Farrel *et al.* (2003) indicated that grain yield had positive correlation with LAI, AGR and NAR and found that there is also a correlation between tiller initiation and leaf initiation. Increase in tiller number and length of leaves were the reason for LAI increase in high and low tiller varieties.

Horie *et al.* (2003) reported that in early maturity lines, the CGR increase before flowering had significant correlation with grain yield, while in the late maturity lines CGR increase after flowering had significant correlation with yield.

Katsura *et al.* (2007) found that cultivar Liangyoupeijiu had longer growth duration and larger leaf area duration (LAD) before heading, causing larger biomass accumulation before heading than the other varieties. The high grain yield of Liangyoupeijiu was due to its large biomass accumulation before heading, which was due to large LAD.

Wuwen Ge *et al.* (2008) reported that the high yield of super hybrid rice mostly was due to the products of photosynthesis after heading, which is shown by the increased CGR at middle and later stages. It was also suggested that LAD might be used to better explain the advantage in the dry matter production of hybrid rice than LAI.

Shahidulla *et al.* (2009) reported that different aromatic rice exhibited enormous variations for leaf index (LAI), crop growth rate (CGR), relative growth rate (RGR), net assimilation rate (NAR), grain yield, total dry matter, harvest index and photosynthetic efficiency or energy use efficiency (E_p) at panicle initiation and heading stages.

Mondal *et al.* (2010) reported that the physiological and yield parameters differed significantly among the genotypes. The mutant RM 100-24 performed well with respect to physiological parameters like AGR, RGR and NAR. Moreover, RM 100-24 also manifested superiority in yield contributing characters over the genotypes and resulted in higher grain yield.

Hussain *et al.* (2014) observed that leaf area index is a measure to know the size of photosynthetic machinery of a plant. Variation of LAI with growth stages among different varieties. Nipponbare exhibited higher LAI at all growth stages while NERICA-4 was the lowest one.

Chandrika *et al.* (2015) studied physiological attributes and yield of developed rice varieties. Results showed that maximum LAI, CGR, RGR, NAR, LAD and LAR were recorded in the variety RNR-15038.

Lavanya *et al.* (2018) studied various rice genotypes for grain yield by physiological approaches. They found the mean maximum and minimum values for LAI were recorded in DRRH3 (3.4) and IR68897B (1.0) respectively and more or less similar values were recorded in all the genotypes

2.4 Photo-thermal observations:

Mohammad *et al.* (2013) reported that helio-thermal unit, photo-thermal unit, phenothermal index also significantly varied among the rice genotypes. Narendra 359 and Naveen may be the suitable choice for the optimum yield during short photo period /cloudier crop season under projected climate change scenario.

Praveen *et al.* (2013) reported that maximum growing degree days were observed in early sown crop (10th June) as compared to late sown crop (20th and 30th June). Similar results were found in the case of photo thermal unit and helio thermal unit also. At maturity stage, highest radiation use efficiency in 10th June sowing might be due to better conversion of light in to dry matter, better yield component and harvest index in 10th June sowing as compared to 30th June sowing.

Amandeep *et al.* (2014) reported that the highest growing degree days, helio-thermal units, photo thermal units and pheno-thermal index to reach the physiological maturity. Pheno-thermal index gradually increases from tillering to physiological maturity in all three transplanting dates in both the years being the lowest at emergence and highest during grain filling and physiological maturity.

Mote *et al.* (2015) observed that agro-meteorological indices viz., photothermal units (PTU), heliothermal units (HTU), photothermal index (PTI), energy degree unit (EDU) were work out for different phenological stages of the rice cultivars under different environment.

Abhilash *et al.* (2017) reported that crop transplanted on 25th June took maximum calendar days, growing degree days, helio thermal units and photo thermal units, to attain different phenological stages till physiological maturity which reduced significantly with subsequent delay in transplanting date.

Priyadarshi *et al.* (2018) observed that the crop transplanted on 10th July took maximum calendar days to attain different phenological stages till physiological maturity (143.74 days) which reduced significantly with subsequent delay in transplanting date with highest growing degree days (2677.2) for maturity, helio-thermal units (13531 degree day hours) and photo thermal units (417923 degree day hours).

Choudhari *et al.* (2019) studied thermal indices in relation to crop phenology and yield of rice (*Oryza sativa* L.) grown in the south Gujarat region. Accumulated growing degree days for two different varieties under different thermal environment varied considerably from sowing to maturity. Higher GDD, PTUE, HTUE and EDUE was observed under 18 June in varieties GGNR-3 and NAUR-1. Lowest GDD, PTUE and HTUE was observed under 28 June in both variety. Late sown rice crop faces high temperature during grain filling and ripening phases which is one of the most important factor which govern the crop phenological development and biomass production along with efficient conversion of biomass into economical yield.

2.5 Photosynthetic traits:

2.5.1 Photosynthesis rate:

Padmaja *et al.* (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes which were released during 1960's, 1970's, 1980's and 1990's. Measured rate of photosynthesis varied from 18.94 to 21.72 $\mu\text{mol CO}_2 \text{ m}^{-2}\text{s}^{-1}$. The genotypes did not differ significantly for photosynthetic rate. However, the genotypes released during 1980's and 1990's recorded relatively more values for photosynthetic rate compared to those genotypes released in 1960's and 1970's.

Cody *et al.* (2011) studied eleven spring wheat cultivars for different physiological traits. Rates of photosynthesis were determined in the field during growing seasons. Cultivar McKenzie had the highest Amax while, Snowbird exhibited the lowest Amax. The data suggested that McKenzie is photosynthetically a superior cultivar, while Snowbird may be less responsive to changing irradiance and CO₂ conditions.

Courtney *et al.* (2011) assessed twenty diverse rice varieties from landrace, advanced and popular class for various physiological traits. Among the twenty rice genotypes they noted the maximum rate of photosynthesis (27.8 $\mu\text{mol CO}_2 \text{ m}^{-2}\text{s}^{-1}$) for the advanced variety M202 and minimum rate of photosynthesis (15.2 $\mu\text{mol CO}_2 \text{ m}^{-2}\text{s}^{-1}$) was noted in landrace Pokkali.

Kiran *et al.* (2013) evaluated twenty five rice genotypes. Leaf photosynthetic characteristics were measured. Significant differences were noticed in rate of photosynthesis. It varied between 24.2 (O. *nivara*, ACC. No. CR 100097) to 6.79 (O. *glumaepatula*, ACC. No. IR 104387) with a mean of 13.2 $\mu\text{mol (CO}_2\text{) m}^{-2}\text{s}^{-1}$.

Chandrika *et al.* (2014) conducted an experiment during *rabi* 2103-14, with eleven rice genotypes. Data recorded for photosynthetic rate at different growth stages. At 75 DAT maximum photosynthetic rate of 26.96 $\mu\text{mol m}^{-2}\text{s}^{-1}$ was recorded in RNR 15048 followed by RNR 15038 (24.86 $\mu\text{mol m}^{-2}\text{s}^{-1}$) and KNR 118 (23.75 $\mu\text{mol m}^{-2}\text{s}^{-1}$) while the least value for photosynthesis was recorded in HR 12 (15.15 $\mu\text{mol m}^{-2}\text{s}^{-1}$).

Sharma *et al.* (1997) studied the physiological parameter with association of photosynthesis in rice. The experiment was carried out during *kharif* with 22 rice genotypes. Photosynthesis rate varied significantly from 26.4-38.6 mg Co₂ dm⁻² h⁻¹ among the 22 rice genotypes at flowering stage. IET13506 (38.6), IET13390 (37.7) mg Co₂ dm⁻² h⁻¹ produced high photosynthesis rate.

Pramodkumar *et al.* (2000) conducted a field experiment with 12 genotypes of barnyard millet during 1997-1998 under rainfed condition in

hills the understood the photosynthesis basis of yield. The rate of photosynthesis recorded during vegetative phase and reproductive phase ranged between 18.20 to 24.91 and 14.15 to 25.06, respectively.

Pramodkumar *et al.* (2002) studied photosynthetic and yield performance of rice genotypes under low temperature condition in hills. Rate of canopy photosynthesis recorded at seedlings, vegetative and booting stages were found almost similar under both normal and late plantings. The rate of canopy photosynthesis was obtained at booting under both the conditions, thereafter declined in later stages.

Patel *et al.* (2006) conducted field experiment during 2004 to study the performance of pre *kharif* rice under raised and sunken bed system of cultivation in mid hills of Meghalaya RCPL- 29 registered highest rate of photosynthesis both at vegetative and heading stage and this was followed by RCM 8 and vivek Dhan 82 at heading stage respectively.

Pramod Kumar *et al.* (2007) studied the rates of photosynthesis recorded during grain filling phase under normal and late (low temperature) plantings ranged between 15.90 to 20.43 and 8.53 to 19.03 $\mu\text{mol}/\text{m}^2/\text{s}$ respectively. Similarly canopy photosynthesis under normal and late plantings varied between 39.50 to 85.34 and 23.65 to 39.81 $\mu\text{mol}/\text{m}^2/\text{s}$ respectively.

Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. They found that RTNRH-10 ($18.557 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$) and RTN-13-4-2-3-1 ($23.446 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$) recorded significantly highest rate of photosynthesis at 60 DAT and 90 DAS respectively.

Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. They stated significantly lower rate of photosynthesis ($\mu \text{ mole CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) was reported in PusaSugandha 15, Basmati 370 and Taroari Basmati in comparison to PusaSugandha 5, Vallabh 21 and Pusa Basmati1.

Phule *et al.* (2018) indicated that, photosynthetic rate was significantly ($P \leq 0.05$) higher under aerobic condition as compared to anaerobic condition. Under the aerobic condition, photosynthetic rate was significantly ($P \leq 0.05$) higher in CR Dhan 202 ($14.42 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) compared to BPT 5204 ($11.51 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$).

2.5.2 Transpiration rate:

Singh *et al.* (1981) studied the effect of soil moisture content and air humidity on transpiration rate in four varieties of Japonica rice. Dryness of the air enhanced the transpiration rate although the increase was relatively less in the plants facing a simultaneous water crisis at the root surface.

Truchiya *et al.* (1993) studied salt exclusion rate in rice root in relation to ion species. They showed that the amount of Na translocated to the top decreased with an increase in the transpiration rate.

Pramodkumar *et al.* (2000) evaluated 12 genotypes of barnyard millet under rainfed conditions to understand the photosynthetic basis of yield. The study revealed that transpiration rate during vegetative phase, ranged between 6.83 to 8.86 $\text{m mole per m}^2 \text{ per sec}$.

Selvi *et al.* (2001) tested forty two hybrids and seven parents of rice for combining ability of grain yield and physiological characters including transpiration rate. The hybrid IR- 20/ ACM- 44 was the best specific combiner for transpiration rate.

Pramodkumar *et al.* (2003) studied the six wheat varieties *viz.*, Sonalika, Kalyansona, VL-616, Opal, Bezostaya and Blue boy to understand the photosynthetic basis of yield in wheat under irrigated and rainfed conditions. The wheat varieties varied considerably in transpiration rate. Rate of transpiration exhibited the significant reduction under rainfed conditions, as compared to irrigated conditions. Reduction in stomatal conductance controlled the gaseous exchange, which in turn decreased the rate of photosynthesis and transpiration, under rainfed conditions.

Courtney *et al.* (2011) they assessed twenty diverse rice varieties from landrace, advanced and popular class. Among the twenty rice genotypes they noted the maximum rate of transpiration for the landrace variety FR13A (10 mmol [H₂O] m⁻²s⁻¹) while minimum rate of transpiration (5.6 [H₂O] m⁻²s⁻¹) was noted in Li-Jiang-Xin-Tuan- Hei-Gu (LTH) variety.

Kiran *et al.* (2013) evaluated twenty five rice genotypes. Leaf photosynthetic characteristics were measured. Significant differences were noticed in rate of transpiration. It varied between 16.0 (O. langstaminata ACC. No. IR 105262) to 4.8 (O. glumaepatula. ACC No. IR 104387) with a mean of 8.52 mmol [H₂O]m⁻²s⁻¹.

Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. They stated that Vallabh 21 recorded the highest rate of transpiration (m mole H₂O m⁻²s⁻¹) in comparison to others.

Phule *et al.* (2018) indicated that, transpiration rate was significantly ($P \leq 0.05$) higher under aerobic condition as compared to that under anaerobic condition. Under the aerobic condition, transpiration rate was significantly ($P \leq 0.05$) higher in CR Dhan 202 (10.31 mmol H₂O m⁻² s⁻¹) compared to BPT 5204 (6.76 mmol H₂O m⁻²s⁻¹).

2.5.3 Stomatal conductance:

Chwen *et al.* (1991) studied the effect of high temperature (35°C) relative to 25°C occurring at the grain filling stage on stomatal behavior of rice plants. Result showed that high temperature stimulated the opening of stomata yet preserved the diurnal patterns of stomatal variations. After treatments heat treated plants had lower stomatal conductance until harvest.

Murthy *et al.* (1991) analyzed yield and some physiological traits in rice. The stomatal conductance which is a component of photosynthesis,

showed positive association with photosynthetic rate and total dry matter while it had no relationship with grain yield.

Pramodkumar *et al.* (2000) studied genotypic differences in photosynthesis and its associated parameters in barnyard millet. During vegetative stage stomatal conductance ranged between 371.66 to 778.237 mmol/m²/s and in reproductive stage it was 308.00 to 746.25 was measured.

Selvi *et al.* (2001) tested forty-two hybrid and seven parents of rice for combining ability of grain yield and physiological characters including stomatal conductance. The hybrid IR-20/ ACM-44 was found to be best specific combiner for stomatal conductance.

Maruyama *et al.* (2008) studied diurnal and seasonal variation in bulk stomatal conductance of the rice canopy maximum values of bulk stomatal conductance for saturated absorbed solar radiation rapidly decreased from 0.06 to 0.02 ms⁻¹ between the active tillering and panicle formation stages and moderately decreased from 0.02 to 0.01 ms⁻¹ during the ripening stages.

Wong *et al.* (1985) conducted an experiment and revealed that in photosynthesizing leaves, stomatal conductance (gs) is linked with the CO₂ requirement of the mesophyll so that the ratio of intercellular to ambient CO₂ concentration (C_i/C_a) is maintained constant with variation in irradiance and CO₂ similar result noted by Sharkey and Raschke (1981).

Radin *et al.* (1988) conducted an experiment and concluded that a strong correlation between photosynthetic capacity and stomatal conductance will maintain the C_i/C_a ratio constant.

Padmaja *et al.* (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes and reported stomatal conductance which varied from 0.013 to 0.028 mol [H₂O] cm⁻²s⁻¹) among the genotypes.

Courtney *et al.* (2011) they assessed twenty diverse rice varieties from landrace, advanced and popular class. They noted the maximum

stomatal conductance for the advance variety Zhenshen-97B and FR13A (0.8 mol [H₂O] m⁻²s⁻¹) and minimum stomatal conductance (0.3 mol [H₂O] m⁻²s⁻¹) noted in Li-Jiang-Xin-Tuan-Hei-Gu (LTH) variety.

Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. They found that RTN-13-4-2-3-1 (0.0497 μmol H₂O m⁻² sec⁻¹) and RTNRH-10 (0.0603 μmol H₂O m⁻² sec⁻¹) recorded significantly highest stomatal conductance at 60 and 90 DAS respectively.

Phule *et al.* (2018) indicated that, stomatal conductance was significantly ($P \leq 0.05$) higher under aerobic condition as compared to that under anaerobic condition. Under the aerobic condition, stomatal conductance was significantly ($P \leq 0.05$) higher in CR Dhan 202 (0.16 mol H₂O m⁻² s⁻¹) compared to BPT 5204 (0.10 mol H₂O m⁻² s⁻¹).

2.5.4 Leaf canopy temperature depression:

Chuan Yan *et al.* (2012) studied rice flag leaf physiology, organ and canopy temperature in response to water stress. Canopy temperature in rice plots under different water stresses were recorded thermographically, and we obtained a different infrared image of canopy, which showed the effect of water stress on the canopy temperature. The blue and red colors indicate the lower and higher temperatures respectively. Canopy temperature increased with the increase in water stress, namely $W_3 > W_2 > W_1$. The temperature difference was up to 3°C. Thus, the severer the water stresses, the higher the canopy temperature. The canopy temperature in W_3 was significantly higher than that in either W_1 or W_2 , but the canopy temperature in W_2 was not significantly higher than that in W_1 . Therefore, the plants in W_2 and W_1 had higher photosynthetic ability and transpiration rate. Compared with W_3 , W_2 and W_1 reduced panicle, leaf and canopy temperatures, and this enhanced the ability of rice. 2401 (*japonica* rice), Ilyou107 (*indica* rice), Ilyou7954 (*Indica* rice) and Zhejing22 recorded leaf canopy temperatures from 28.73 to 31.69°C, 30.74 to 32.62°C, 28.30 to 30.59°C and 28.73 to 31.69°C, respectively.

2.6.Biochemical analysis:

2.6.1.Carbohydrate content (%):

Amudha *et al.* (2007) found Carbohydrate content ranging from 71 -85 per cent in rice varieties

Juliano *et al.* (1972) reported that brown rice and milled rice contain 0.83-1.36% and 0.25-0.53% total sugars; 0.09-0.13% and 0.05-0.08% reducing sugars respectively.

Singh *et al.* (1977) reported that the level of soluble carbohydrates remained high in the caryopsis and also in milled rice after starch accumulation, suggesting that the supply of sugar precursors does not limit starch accumulation in the rice grain.

Pascual *et al.* (1978) observed the major reducing sugars are glucose and fructose; bran contains equal amounts, but milled rice contains more glucose than fructose.

Zhou *et al.* (2002) studied the sugar concentration in both brown and milled rice decreases towards the center of the kernel. Starch is the only constituent of the rice grain that increases in concentration from the periphery to the centre of the kernel. Starch constitutes 90% of the dry weight of milled rice.

Sood and Saddiq (2006) studied nutritional quality of basmati rice genotypes and the highest Carbohydrates was recorded from the variety HKR 93-402 and the lowest was the variety Haryana Basmati-11.

Buresova *et al.* (2010) studied the variation in amylose and starch content in different aromatic rice varieties might be due to the application of fertilizer (nitrogen content), growing conditions, time and also location of the growing areas.

Asaduzzaman *et al.* (2013) determined the starch content of different aromatic rice varied between 63.193 to 72.60/100 g.

Chingakham *et al.* (2016) observed that Carbohydrate content of the black rice varieties were more than 70 per cent. Therefore, the black rice varieties are good source of carbohydrate.

2.6.2. Protein (%):

Patil *et al.* (1985) reported values of protein content from 5.99 to 8.59 while Amudha *et al.* (2007) reported values of protein content from 9 to 12.05 per cent.

Onate *et al.* (1964) observed that rice varieties with low protein have more flavour and were more tender and cohesive than high protein samples.

Jennings *et al.* (1979) studied the protein content of the grain, although subject to extreme varietal and environmental variability averages about 7% in milled rice and 8% in brown rice.

Pederson *et al.* (1983) observed the variation in protein content between brown and white rice is because of bran portion, which is higher in protein and significantly increase the protein content of brown rice as reported earlier.

Hamaker *et al.* (1990) reported that protein (i.e., through its disruption using protease) as well as lipid and starch (i.e., removal of starch and lipid during the draining and washing steps) all contribute in determining cooked rice texture properties. Results from this study indicated the possibility of reducing rice cooking duration to achieve texture properties similar to that with no protease treatment. Moreover, sticky rice products can be produced by protease treatment of rice before cooking.

Probart *et al.* (1993) reported that after starch, protein is the second most abundant constituent of rice. Rice is nutritionally superior to many other cereals that are rich in carbohydrates.

Ahmed *et al.* (1998) reported that the crude protein content of nine aromatic rice cultivars ranged from 9.17 to 11.77%.

Martin *et al.* (2002) observed that high protein varieties displayed lower water absorption and restricted starch granule swelling. Despite the negative influence on the texture of cooked rice, high protein content rice is considered to be nutritious.

Frei *et al.* (2003) studied the amino acid balance of rice protein is exceptionally good. Lysine content averages about 3.8 to 4.0% of the protein. Protein quality is determined by the amino acid composition and by its digestibility.

Sood *et al.* (2006) studied nutritional quality of basmati rice genotypes and the highest crude protein was recorded from the variety Haryana Basmati-1 and the lowest was the variety PR-106.

Anjum *et al.* (2007) also observed the variation in protein content between brown and white rice is because of bran portion, which is higher in protein and significantly increase the protein content of brown rice as reported earlier.

Buresova *et al.* (2010) studied the variation in protein value in different aromatic rice varieties could be due to the application of fertilizer (nitrogen content), growing conditions and time and also location of growing areas. The highest protein content (12.4%) was assessed in cv. Kitano. The lowest protein content (8.0%) was found in a sample of cv. Lupus.

Sompong *et al.* (2011) reported protein value in rice as 7.16 to 10.85/100 g.

Abdul Baset Mia *et al.* (2012) results showed that highest protein content was recorded in Binasal (10.53%). Other cultivars showed similar protein content and they were statistically identical.

Saikia *et al.* (2012) reported that protein value in pigmented and non-pigmented aromatic rice 6.66 to 9.97/100 g. The varieties differed in size and shape of the kernels; varying from tiny to big in size, short to long in length, and round to bold in shape. KJ contained the highest amount of protein (9.9%)

Asaduzzaman *et al.* (2013) observed that the protein content of different aromatic rice varieties varied from 3.23 to 6.21/100 g. Therefore, the study indicates that aromatic rice could be used as functional food ingredients as well as sources of natural phytochemicals.

Humaira *et al.* (2017) studied a set of 19 rice accessions, including pigmented, scented landraces, Basmati-type genotypes and popular varieties of Northern Himalayan region for their biochemical and nutritional value. Total protein content was found highest in scented landrace of rice Mushkbudji (8.86%). The minimum protein content was found in Khuch (5.51%) followed by Purple rice (5.73%).

2.6.3.Nitrate reductase activity (umol/g) :

Yamamu rao *et al.* (1975) examined the translocation of nitrogen taken up at vegetative growth stages by using a ^{15}N tracer and reported that NO_3 has a tendency to accumulate in the leaf sheath more than NH_4 and also suggested that once taken up NO_3 will contribute to the photosynthesis of the different growth stages.

Barlaan *et al.* (1996) observed that varietal differences in NRA and noticed that indica had higher activity than japonica.

Yang *et al.* (1999) studied the hybrid rice with higher NUE contains more NO_3 than the conventional variety during the growth stage between late tillering to heading.

Kronzucker *et al.* (2000) examined the flow of nitrate and ammonium taken up by rice roots by using a short ^{13}N tracer, and reported that there was more efficient behavior of nitrate than ammonium.

Weixing *et al.* (2004) while studying with three alternative water managements under two nitrogen doses namely SRI, plastic ground cover system (PGS) and intermittent irrigation system (IIS) comparing with conventional flooded rice (CK) reported that soluble sugar, non-protein nitrogen content and NR activity in rice leaves at the heading stage increased compared to CK, indicating that carbon and nitrogen

assimilation are enhanced in the alternative water management systems. At high nitrogen rate, soluble sugar content and non-protein nitrogen content decreased, whereas NR activity increased in all treatments.

Fan *et al.* (2007) measured leaf nitrate reductase activity (NRA) by nitrate withdrawal from the culture solution in rice varieties with different NUE. They reported less decrease of leaf NRA after nitrite withdrawal in rice varieties with high NUE, together with a faster decrease of nitrate in the vacuoles of epidermal cells of roots and leaves.

Abdul *et al.* (2012) studied the maximum NRA was attained at flowering stage as compared to panicle initiation and tillering stages and NRA was gradually increased at tillering to flowering stages. At tillering stage, BRRIdhan32 showed the highest amount of NRA and Binasail recorded the lowest amount of NRA.

Parthasarathi *et al.* (2012) reported reduction in soluble protein content was associated with reduced nitrate reductase (NRase) activity which indicated disruption in nitrogen metabolism under water deficit condition.

Vinaikumar *et al.* (2017) reported the leaf nitrate reductase activity declined under heat stress. The percent reduction in NR activity was observed maximum in genotype IET 20924 (36%) and minimum in IET 20734 (3.00%).

2.6.4. Amylose content (%) :

Sanjiva *et al.* (1952) studied the cooking and eating characteristics of rice and reported that are influenced by the ratio of two kinds of starches; amylose and amylopectin in the rice grain.

Juliano *et al.* (1985) reported that rice with high amylose content show high volume expansion during cooking and cook dry, less tender and become hard upon cooling. While low amylose varieties cook moist and sticky.

Perez *et al.* (1987) studied the amylose content of milled rice has been found to be positively correlated with hardness values of cooked rice and negatively with stickiness values. Cooking quality of rice mainly depends on amylose content and gelatinization temperature.

Sagar *et al.* (1988) observed that the amylose content ranged from 20.00-27.70% with a mean of 22.10% in aromatic rice grains.

Cruz *et al.* (2000) reported that rice is grouped based on its, amylose content into waxy (0-2%), very low (3-9%), intermediate (20-25%) and high (>25%).

AduKwarteng *et al.* (2003) evaluated rice grain quality, amylose content can play a significant role in determining the overall cooking, eating and pasting properties such as texture, flavour, stickiness, hardness, grain elongation, gel consistency and gelatinization temperature .

Frei *et al.* (2003) studied the amylose content which determines the texture of cooked rice and rice varieties with amylose content of more than 25% absorb more water and have a fluffy texture after cooking.

Seguchi *et al.* (2003) concluded that amylose plays an important role in the maintenance of the structures of starch granules. The principal elements that compose starch granules are amylose, amylopectin, lipids, and proteins. When low amylose rice is boiled, the product is viscous and elastic. The swollen trait could be due to the characteristics of amylopectin.

Zhang *et al.* (2003) reported that amylose content varied among grains from the same panicle. It varied also between outer and inner layers of the same grain. Grains harvested from the upper position, the first branches or early flowers tend to have higher amylose content.

Adu-Kwarteng *et al.* (2003) studied the amylose content in rice is one of most important criteria of rice quality in terms of cooking and gelling properties.

Amudha *et al.* (2007) reported values for amylase content from 13.60 to 30.32 percent in rice

Buresova *et al.* (2010) observed the variation in amylose and starch content in different aromatic rice varieties might be due to the application of fertilizer (nitrogen content), growing conditions, time and location of the growing areas and degree of milling. The highest content of amylose (26.4%) was found in cv. Kitaro. The lowest amylose content (20.8%) was in cv. Lupus grown in Humpolec.

Saikia *et al.* (2012) who reported amylose content in pigmented and non-pigmented aromatic rice as 2.2 to 28.8/100 g.

Asaduzzaman *et al.* (2013) observed the variation of amylose content among different aromatic rice varieties was 15.69 to 23.01/100 g.

Srivastava *et al.* (2013) observed that amylose content is the major factor for eating quality of rice. It is an indicator of volume expansion and water absorption during cooking and correlates with hardness, whiteness and dullness of cooked rice.

Verma *et al.* (2015) studied physico-chemical and cooking characteristics of Azad basmati. They found that Azad Basmati variety was high intermediate (22.8%) in amylose content (AC) as compared to evolved basmati varieties Basmati-370, Pusa Basmati-1 and Basumathi but found lower than Type-3 and Improved Pusa Basmati-1 and, Azad Basmati was found intermediate except Basumathi.

Chingakham *et al.* (2016) observed that black rice varieties were in the category of very low amylose and the red rice, parboiled rice and Sonamasuri were classified as intermediate amylose.

Humaira *et al.* (2017) studied a set of 19 rice accessions, including pigmented, scented landraces, Basmati-type genotypes and popular varieties of Northern Himalayan region and evaluated biochemically for their nutritional value. They concluded that amylose content ranged from 18.23 to 24.43%, with minimum in Zag-10 and maximum in

Shalimar rice-1. Shalimar rice-1, being a white rice variety, has the higher level of amylose content and therefore can show retrogradation. On the contrary, Zag-10 showing least amylose content will not be prone to retrogradation.

Subhalakshmi *et al.* (2018) reported that amylose content is recognized as the most important determinant of rice quality. The highest starch % was observed in IR 64 (86.18%) and the lowest was observed in Atebuium (69.80%). The two rice varieties Kithou and Thomuh had the lowest amylose content of 2.14 and 2.77 respectively and thus were waxy varieties.

2.6.5. Iron content (ppm) :

Dutta *et al.* (1978) conducted field experiment at Jorhat for evaluation of nutritional quality of some rice varieties grown in Assam and found that iron content in different rice varieties varied from 1.66 to 1.92 mg per 100 g rice.

Kumar and Kapoor (1984) studied mineral composition of different varieties of cereals and legumes at Hissar and observed 4.16, 4.16 and 4.15 mg iron per 100 g rice in Pusa-221, Jhona -349 and Basmatti-370 respectively.

Patil *et al.* (1985) conducted field experiment at Dapoli for evaluation of quality characteristics of promising rice varieties grown in Konkan and revealed that iron content in rice varieties varied from 2.26 to 9.54 mg per 100 g rice.

Singh (1998) studied quality characteristics of six rice varieties grown in Himachal Pradesh and observed that iron content of brown rice varied from 2.41 to 4.50 mg per 100 g rice while that of milled rice varied from 1.21 to 3.06 mg per 100 g rice.

Ghadi *et al.* (2001) while evaluating of promising rice varieties grown in Konkan region at Dapoli found that the content of iron in twelve rice varieties ranged from 6.34 to 13.81 mg per 100 g rice respectively.

Amudha *et al.*(2007) while studying nutritional aspects of rice observed that the iron content in all the six genotypes ranged between 10.85 to 16.42 mg per 100 g in brown rice samples and between 8.95 to 14.72mg per kg in polished rice samples.

2.6.6. Zinc content (ppm) :

Sanjeev *et al.*(2007) studied zinc content of the popular varieties of rice as 13 mg/kg and RDA of zinc as 12 mg/kg for male and 10 mg/kg for female, the zinc intake through rice consumption is 2.9 g/day per person

2.7. Yield and yield attributes

2.7.1. Plant height (cm):

Plant height is one of the important agronomic traits in rice .Plant height is a genetic character of a variety and found to be affected by environmental conditions. It is an important trait which is often associated with lodging of plants under unfavorable situations. In general plant height increased gradually from tillering to flowering stages and remained almost constant till maturity.

Yadava *et al.* (1988) showed that canopy height increased with crop age in rice. Tall canopy associated with better display of leaf area resulted in initial advantage in dry matter production via favorable light penetration in the canopy, but it was not maintained for longer period due to decline in the leaf area much earlier i.e. 45 days after transplanting (DAT). In contrast, dwarf genotypes being short stature coupled with high tiller number, formed a compact canopy at initial stage, but soon it was followed by high mortality of tillers making an open canopy with high leaf area for prolonged period. It provided photosynthetic area leading to higher dry matter production.

Singh *et al.* (2000) found that high and moderate levels of NPK though did not significant register significant difference in the height of rice plant at tillering, but at later growth stage, the structure of plant

was significantly higher under high nutrient level. The plant height increased gradually from tillering to flowering and remained almost constant thereafter till maturity.

Chandrasekhar *et al.* (2001) studied physiological analysis of growth and productivity in hybrid rice. The growth in terms of plant height increased rapidly at 60 DAT and later the increase was not much in all the cultivars. The cultivar differed significantly in plant height at different stages of growth.

Golam *et al.* (2001) studied the physiological basis for yield of 11 hybrids and 2 varieties of rice. Significant differences were recorded in plant height in all 13 genotypes. Plant height increased continuously up to harvest in 13 genotypes.

Padmaja *et al.* (2001) conducted an experiment with ten genotypes during *kharif*, 1998 and 1999. The plant height measured at maximum tillering stage ranged from 45 cm (Swara) to 85 cm (SLO-13). Among (SLO-13), MTU-1 and Mahsuri were at par but recorded significantly maximum plant height compared to other genotypes.

Mohammad *et al.* (2002) reported that plant height is mostly governed by the genetic makeup of the cultivar, but the environmental factors also influence it.

Enamul Kabir *et al.* (2004) found that plant height did not vary significantly among the varieties at 35 and 50 days after transplanting (DAT) but during harvest significant variations in plant height were found among the varieties tested.

Ashrafuzzaman *et al.* (2009) reported that plant height varied significantly among the entries from 107.90 cm to 93.40 cm. Kalizira was the tallest (107.90 cm) of all the varieties. It had shown no significant difference with BR38 (107.80 cm) and BR34 (106.70 cm). Chiniatop was the shortest and was insignificant to Kataribhog (95.30

cm).The shorter plant height in Chiniatop (93.40 cm) was due to shorter internode length.

Poonam *et al.* (2009) studied agro-physiological parameters of rice hybrid with 32 treatments in combination of 8 hybrids and 4 dates of planting during each rainy and winter season. Plant grew taller (120 cm) during rainy season and highest plant height (110.0 cm) observed in February.

Satish Chandra *et al.* (2009) found that plant height registered significant positive association with number of productive tillers per plant, panicle length and number of grains per panicle indicating that the increase in panicle length and number of grains per panicle could be positive with increase in plant height.

Courtney *et al* (2011) assessed twenty diverse rice varieties from landraces, advanced and popular class for various morphological traits. They measured the plant height and noted the maximum height(180cm) for the variety Li-Jiang -Xin -Tuan-Hei -GU and minimum in Swara (90cm)an advanced variety .

Selvaraj *et al* (2011) studied 21 rice genotypes and analysis of variance revealed that considerable variability was observed among all characters studied. They observed that characters like plant height, number of tillers per plant, panicle length and test weight had significant association with grain yield.

Muhammad *et al*, (2012) evaluated ten rice genotypes and observed that the plant height significantly differed in rice genotypes. A wide range of plant height with medium and tall plants ranging from 86.67 to 114.67 cm was observed .Maximum height was noted in genotypes HUA564 (114.67) and shortest height was noted in the genotypes HHZ5-Y3-SAL3-DT1.They recommended plant height as an important trait for selection of high yielding rice plants .Significant variation in plant height has also been reported by some other workers (Akram *et al.* 2007 and Sabouri *et al.* 2008).

Augustina *et al.* (2013) conducted two experiments and evaluated fifteen rice genotypes during 2007 and 2008. Correlation coefficient and estimates of heritability of 15 characters associated with grain yield for the combined data showed wide significant genetic variability ($p < 0.0001$) amongst all genotypes. Of all the characters evaluated, plant height had positive and significant correlation with plant height ($r = 0.417$).

Dutta *et al.* (2013) evaluated sixty eight genotypes of rice and in their experiment they recorded 132.70 cm as mean height of genotypes. Maximum height was recorded in the Dolbao (200 cm) and minimum height recorded in Ijong (78.80 cm). They suggested that plant height is an important trait which helps in contributing yield.

Dhakal *et al.* (2014) conducted a study with fifty rice genotypes during kharif 2013. The range for plant height was from 50.63 to 111.56 cm with an average plant height 89.17 cm. The genotype PBNR-03-07 (111.56 cm) had recorded significantly superior plant height. Whereas, the genotype PAU 3832-79-4-3-1 recorded lowest plant height (50.63 cm).

Hussain *et al.* (2014) observed that plant length increased in all varieties steadily from transplanting to full heading stage. The rate of increase was higher from panicle initiation to full heading stage in all varieties. The length became constant from full heading to maturity for all varieties except IR-28 whose length increased upto grain development stage but the rate of increase was lower than previous stages.

Maria *et al.* (2016) observed that different genotypes evaluated, tallest plant height of 121.7 cm was observed in Dipaocan, followed by Capaocan, Peneliza, H2OS1 and Porac 1 with means of 115.6 cm, 100.9 cm, 100.4 cm and 92.1 cm, respectively. Lowest plant height was with Laila, LR-2, Ginesking, Pusa Basmati and CLSH1-C.

Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the

yield variation during *kharif*. They found that highest plant height (98.87cm) was recorded in KJTRH-21 followed by RTNRH-17, RTNRH-10, RTNRH-18, RTN-49-1-1-2 and RTN-1-1-2-1.

2.7.2. Number of tillers per plant:

Yoshida *et al.* (1972) studied the physiological aspect of high yields in rice and reported that number of panicles per unit area is the most important component of rice yield. It accounts for 89% of the variation in grain yield.

Gallagher *et al.* (1978) found that tiller number directly affects the number of panicle and as a consequence affects the total yield.

Miller *et al.* (1991) found that tiller number directly affects the number of panicle and as a consequence affects the total yield.

Peng *et al.* (1996) showed that a low tillering new plant type bears the advantage of higher nitrogen use efficiency compared to a high-tillering rice cultivar, when both of them are grown with high N supply.

Chandrasekhar *et al.* (2001) studied physiological analysis of growth and productivity in hybrid rice. The tiller number increased upto 60 DAT and remained almost constant during later growth stages. Maximum tillers (12.7/plant) were produced by APHR-2 than other cultivars.

Enamul *et al.* (2004) studied the yield performance of three aromatic fine rice genotypes in coastal low land and found that the number of tiller per hill was significantly influenced by the variety at three different stages (35 and 50 DAT and at harvest). The highest number of tillers was found in Chinigura-1 (8.00) at 35 DAT, in Kalijira (10.50) at 50 DAT and lowest in Begunbitchi (7.25) at 50 DAT. At harvest Kalijira produced the maximum effective tillers (8.50) among the varieties.

Ahmad *et al.* (2005) reported that excessive tillering leads to high tiller abortion, poor grain setting, small panicle size and reduction in grain yield. Excessive branching is often considered expensive, as formation of low productive tillers becomes investment loss for a plant (Dun *et al.*, 2006).

Zahid *et al.* (2005) also reported a highly significant variation for different traits including the number of productive tillers per plant which was correlated with total yield.

Wiangsamut *et al.* (2006) studied the tiller formation in five rice genotypes and found that tiller number per square meter increased up to 40 DAT and after 40 DAT, the tiller number among the five genotypes started to decrease.

Hossain *et al.* (2008) conducted a study to estimate the relationship between grain yield and morphological parameters in five local and three modern aromatic rice genotypes and found that the highest number of fertile tillers per hill was obtained in BRRI dhan-37 (11.7) which was identically followed by Radhunipagal, Badshabhog and lowest fertile tillers per hill was obtained from Kalizera (9.8) and concluded that grain yield is directly associated with number of fertile tillers.

Jamal *et al.* (2009) evaluated five exotic rice genotypes along with a local check for yield and yield contributing traits and found that tillers per plant among rice genotypes ranged from 10 to 13. Maximum number of 13 tillers per hill was recorded in variety IRI 384 and minimum number of 10 was recorded in variety PR 26881-JP 16-4B-78-5-1. They further concluded that grain yield was directly associated with number of effective tillers

Satish Chandra *et al.* (2009) studied correlation and path analysis for yield and yield components in rice and revealed that grain yield is positively associated with number of productive tillers per plant.

Shahidullah *et al.* (2009) conducted an experiment with thirty aromatic rice genotypes to evaluate the tillering patterns and to explore its relationship with grain yield. Much variation was observed in tillering dynamics among the genotypes. They found that the number of panicles was positively correlated with maximum number of tillers and grain yield. Total number of tillers at harvest had the direct effect on grain yield.

Sinha *et al.* (2009) found that the number of tillers increased continuously and attained maximum values at 60 day after transplanting. Among the varieties Taroari Bas produced the highest number of tillers at all stages of development followed by Bas 386 and CRM-2203-4 whereas TulsiBhog recorded lowest number of tiller per square meter.

Mohammad Shamim *et al.* (2010) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. They stated that among genotypes, significantly lower number of tillers m⁻² was reported in Pusa Sugandha 5 (263.7) and highest in Taroari Basmati (312.1).

Abdul Baset Mia *et al.* (2012) reported that there was significant difference in number of tillers hill⁻¹ among the cultivars. It was apparent that the tiller producing capacity of Kataribhough, Ukonmodhu and Binasail were not similar but the maximum number of total tillers hill⁻¹ was recorded in Kataribhough and the minimum number of total tillers hill⁻¹ was in Binasail.

Mehta *et al.* (2013) observed that number of tillers per square meter was found up to 60 DAT after that declined up to the maturity because of drying of unproductive tillers. Maximum number of effective tillers per square meter (308) was produced by the genotype RNR 2354 and whereas minimum of 264 were produced in Pusa1121 and Chittimuthyalu (264) at harvest.

Hussain *et al.* (2014) studied the number of tillers per unit area increased from transplanting to maximum tillering stage in all varieties,

however, NERICA-4 produced significantly lower numbers/m² (403) as compared to other varieties. Nipponbare produced the highest numbers (790) but it was statistically at par with Koshihikari and IR-28.

Arooj *et al.* (2015) evaluated agronomic traits for yield and yield components in advance breeding lines of rice. And found maximum tillers/plant was recorded for Line-18 (24.67) followed by Bas-385, Line-186, Line-25, Line-161-S, Line59, Line-77, Line-103, Line-NPT-1, Line-93, Line-188, Line5, Line-9, Line-188-S and Line-99. The minimum tillers/plant was recorded for Line-184 (7.333).

Javaid Ahmed Shah *et al.* (2016) evaluated non-aromatic rice varieties for growth and yield under different rates of soil applied boron. They found that the maximum number of tillers (8.7) in both genotypes was noted with the application of 2.0 kg B ha⁻¹, whereas, the minimum (6.8) in control.

Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. They found that highest total number of tillers per plants was recorded in RTNRH17(15.27) followed by genotypes RTNRH-10 and RTNRH-18.

Lavanya *et al.* (2018) studied various rice genotypes for grain yield by physiological approaches. They found that maximum productive tiller number was observed in the genotypes DRRH2 and RPHR1005 (15.7) followed by KRH2 (15.3) and minimum productive tiller number was observed in PUSA5A X BR827-35 (8.7).

Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. They stated that among genotypes, significantly lower number of tillers m⁻² was reported in Pusa Sugandha 5 (263.7) and highest in Taroari Basmati (312.1).

Muhammad *et al.* (2019) evaluate the effect of different sowing dates on yield and yield components of the direct sown coarse rice

including six sowing dates i.e. 31st May, 10th June, 20th June, 30th June, 10th July and 20th July during the *kharif* season of 2008. Results revealed that direct seeded rice sown on 20th June sowing also gave maximum number of productive tillers, numbers of kernels per panicle, 1000 grain weight.

2.7.3.Total number panicles of per plant:

Padmaja *et al.* (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes which were released during 1960's, 1970's, 1980's and 1990's. There was significant difference among the genotypes for number of panicles per m². For all the genotypes the number of panicles per m² was more in *kharif* 1999 compared to *kharif* 1998. Decade wise data of mean values for number of panicles/m varied from 155 to 248. The numbers of panicles per m were significantly more in all the genotypes released 1980's and 1990's than the genotypes released in 1960's and 1970's.

Lohidas *et al.* (2003) studied five hybrids during the season *kharif*, 2001 and 2002. On average rice hybrids produced a maximum number of 9-12 panicles per plant. Among the hybrids PHB-71 recorded significantly higher number of panicles (around 5) during both the years.

Katsura *et al.*, (2007) conducted an experiment during the years 2003 and 2004 with three rice varieties. They recorded the number of panicles/m during both the years for Liangyoupeijiu, Takanari, and Nipponbare were (223, 239 and 326) and (217, 274 and 304) respectively. Nipponbare showed a significantly larger number of panicles per unit land area than the Liangyoupeijiu and Takanari.

Dutta *et al.* (2013) evaluated sixty eight genotypes of rice. Among genotypes minimum panicles per plant were noted in Adoliabao (7) and maximum (29) panicles per plant were noted in Ronjit, with mean (11.30) panicles per plant.

2.7.4 Panicle length (cm):

Fageria *et al.* (2001) reported that panicle length and spikelet number had the highest correlation with grain yield. Panicle length had the high positive and significant correlation to number of grains per panicle and significant and negative correlation to grain yield.

Sharma *et al.* (2002) reported that there had been significant variation in panicle length in aromatic rice varieties

Ashrafuzzaman *et al.* (2009) working on yield and yield contributing characters in aromatic rice reported that BR34 possessed the longest panicle (19.73 cm) and Kataribhog had the shortest panicle (16.20 cm).

Faruq Golam *et al.* (2011) observed that significant variation was observed in length of panicle among the genotypes at 5% levels. The data for panicle length ranged from 19.30 to 26.77. The minimum panicle length was recorded in E15 while maximum panicle length in E26.

Abdul Baset Mia *et al.* (2012) reported that Binasail recorded the longest and BRRIdhan32 showed the shortest panicle length. The result also showed that there was no significant difference in panicle length of Binasail, Ukonmodhu and Kataribhough but varied in BRRIdhan32.

Arooj *et al.* (2015) evaluated agronomic traits for yield and yield components in advance breeding lines of rice. They reported that the maximum panicle length was recorded for Line-77 (33.22 cm) followed by Line-103, Line-93, Line-186, Line-NPT-1, Line-188-S, Line-5, Bas-385, Line-99, Line-59, Line-188, Line-9, Line-18, Line-184 and Line-161-S. The minimum panicle length was recorded for Line- 29 (21.40 cm).

Chandrika *et al.* (2015) observed that maximum panicle length of 28.4 cm was recorded in genotype RNR 15038 and minimum panicle length of 22.4 cm was recorded in genotype Rajendra.

Chandrashekhar *et al.* (2017) reported that significantly more panicle length in SRI compared to NTP. Higher mean panicle length was recorded in SRI (25.6 cm) compared to NTP (24.8 cm). Among the nutrient management practices, T₃ recorded higher panicle length (25.6 cm) followed by T₄ (25.3 cm). Lower panicle length was observed in T₂ (24.7 cm) which was significantly inferior to all other treatments.

Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. Stated that the highest panicle length was reported in Pusa Basmati 1460 (35.7 cm) whereas, it was shortest in Taroari Basmati (45.4 cm).

Kaveh *et al.* (2018) studied evaluating the effect of different planting dates on panicle growth trend and performance of rice varieties in Khuzestan region iran that the length of panicle had its most growth rate in the first two planting dates while the number of branches was not affected by date of planting.

2.7.5. Total number of spikelet per panicle

Kusutani *et al.* (2000) reported that the variety which produced highest number of effective tillers per hill and highest number of grains per panicle also showed highest grain yield in rice.

Fageria *et al.* (2001) reported that grain number per panicle had a positive and significant correlation with grain yield.

Lohidas (2003) studied five hybrids during the season *kharif*, 2001 and 2002. The number of spikelets ranging from 565 (PHB-71) to 686 (APHR-1) in *kharif*, 2001 and 2002.

Katsura *et al.* (2007) conducted an experiment during the years 2003 and 2004 with three rice varieties. They recorded the number of spikelets/panicles during both the years. The number of spikelet recorded during 2003 by Liangyoupeijiu, Takanari, and Nipponbare were

170, 172 and 92 and during 2004 recorded as 231, 179 and 98. Liangyoupei and Takanari had a significantly larger number of spikelets per panicle than Nipponbare.

Tahir *et al.* (2002) reported significant variation among the different genotypes for number of spikelets per panicle.

Padmaja *et al.* (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes of rice. Decade wise data of mean values for number of spikelets/panicles varied from 125.5 to 144. The recorded values for number of spikelets per panicle did not differ significantly among the genotypes.

Patel *et al.* (2010) found that among the yield components assessed, spike size (spikelets per panicle) contributed more to the yield and is considered to be most important factor responsible for yield gap between aerobic and flooded rice.

Dutta *et al.* (2013) evaluated sixty eight genotypes of rice. Spikelets per panicle varies from 99.6 (Ronjit) to 447.8 (Katibora) with mean value of 237.22.

Chandrika *et al.* (2015) reported that maximum number of spikelets per panicle (165) was found in the genotype and minimum number of spikelets per panicle (109) was found in the rice genotype.

Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. And found that number of spikelets per panicles were highest in RTN-491-1-2 and RTNRH-10.

Padmaja (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes of rice. Decade wise data of mean values for number of spikelets/panicles varied from 125.5 to 144. The recorded values for number of spikelets per panicle did not differ significantly among the genotypes.

Lohidas *et al.* (2003) studied five hybrids during the season *kharif*, 2001 and 2002. The number of spikelets ranging from 565 (PHB-71) to 686 (APHR-1) in *kharif*, 2001 and 2002.

Katsura *et al.* (2007) conducted an experiment during the years 2003 and 2004 with three rice varieties. They recorded the number of spikelets/panicles during both the years. The number of spikelets recorded during 2003 by Liangyoupeijiu, Takanari, and Nipponbare were 170, 172 and 92 and during 2004 recorded as 231, 179 and 98. Liangyoupeijiu and Takanari had a significantly larger number of spikelets per panicle than Nipponbare.

Dutta *et al.* (2013) evaluated sixty eight genotypes of rice. Spikelets per panicle varies from 99.6 (Ronjit) to 447.8 (Katibora) with mean value of 237.22.

2.7.6. Number of filled spikelet per panicle:

Samonte *et al.* (1998) also found that number of filled grains per panicle had significant positive effect on rice grain yield.

Padmaja *et al.* (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes of rice. Decade wise data of mean values for filled grains varied from 83.50 to 87.49 per cent. The recorded values for per cent filled grain did not differ significantly among the genotypes.

Rasheed *et al.* (2002) reported that fertility percentage showed positive but non-significant correlation with grain yield per plant.

Lohidas *et al.* (2003) evaluated five hybrids during the season *kharif*, 2001 and 2002 for different parameters. The filled grain percentage% as significantly higher in PHB-71 during *kharif*, 2001 (82.40 %) and 2002 (82.80 %). APHR-1 recorded significantly the lower (59 %) grain filling percentage during *kharif*, 2001 and 2002.

Krishna *et al.* (2008) reported that filled grains and spikelet fertility were significantly correlated with grain yield.

Dutta *et al.* (2013) evaluated sixty eight genotypes of rice. Among genotypes percentage grain filling was varied from 68.32 % (Harmoni) to 97.36 % (Moubora) with mean value of 87.71%.

Nahida Islam *et al.* (2013) evaluated the performance of local aromatic rice cultivars *viz.* Kalijira, Khaskani, Kachra, Raniselute, Morichsail and Badshabhog. Stated that the number of filled grains panicle⁻¹ were found highest (100) with the variety Khaskani and the lowest was recorded in the variety Raniselute.

Hussain *et al.* (2014) found that NERICA-4 produced the highest number of spikelets/panicle but it was at par with IR-28 and significantly higher than japonica varieties. Spikelets in IR-28 were statistically at par with all other varieties. IR-28 and NERICA4 produced higher number of spikelet because of their high sink size characteristics which is the product of spikelet number.

Arooj *et al.* (2015) evaluated agronomic traits for yield and yield components in advance breeding lines of rice. Maximum filled spikelet were recorded for Line-186 (269.2) followed by Line-9, Line-93, Line-77, Line-103, Line-188-S, Line-5, Line-188, Line-161-S, Line-18, Line-59, Line-NPT-1, Line-184, Bas-385, Line-99. The minimum filled spikelet were recorded for Line-25 (120.5). While maximum unfilled spikelets were recorded for Line-188- S (179.8) followed by Line-9, Line-NPT-1, Line-93 Line-103, Line-186, Line-188, Line-77, Line-59, Line-161-S, Line-99, Line-5, Line-18, Bas-385, Line-184. The minimum unfilled spikelet was recorded for Line-25 (16.22).

Chandrashekhar *et al.* (2017) reported that significantly more number of spikelets per panicle compared to NTP. Maximum mean numbers of spikelets per panicle were recorded in SRI (12) and NTP (10). Among the nutrient management practices, T₃ recorded higher number of spikelet per panicle 12 followed by T₄ (11). Lower number of spikelet per panicle were found in T₂ (9). T₃ recorded 25% higher spikelet than T₂.

Several scientists (Kishor *et al.* 2007, Shet *et al.* 2012 and Huang *et al.* 2013) suggested the importance of percent filling grains in yield performance of the crop.

2.7.7. 1000 grain weight (g)

Mirza *et al.* (1992) observed the positive and significant correlation between 1000-grain weight and grain yield per plant.

Sidhu *et al.* (1992) recorded 1000 grain weight of 15.80 g with Basmati 385 variety, 15.70 g with Basmati 370 and 16.50 g with Pusa Basmati-1.

Cheema *et al.* (1998) found positive and significant correlation between 1000-grain weight and grain yield per plant.

Brar *et al.* (2001) studied phenology, heat units accumulation and dry matter partitioning behavior of two rice cultivars transplanted on different dates. The yield attributing characters *viz.*, panicle m⁻², grain panicle⁻¹ and 1000 grain weight did not influence significantly less under June 25 transplanting time from June 15 to July 5. Spikelet sterility was significantly less under June 25 transplanted crop as compared to July 5 transplanted crop.

Padmaja *et al.* (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes. Decade-wise data of mean values for 1000 grain weight varied from 19.28 to 21.54 g. The recorded values for 1000 grain weight did not differ significantly among the genotypes.

Adu-Kwarteng *et al.* (2003) studied the values of 1000-grain weight between 20 and 30g are considered good while those less than 20g could be indicative of the presence of immature, damaged and unfilled grains.

Lohidas *et al.* (2003) conducted an experiment during the season *kharif*, 2001 and 2002 studied five hybrids for different yield parameters. From the data, PHB-71 recorded significantly higher 1000 grain weight (23 g) during *kharif*, 2001 and 2002 compared to significantly lower weight (20 g) in APCR-1 during *kharif*, 2001 and 2002.

Mondalet *et al.* (2005) reported the significant difference among the cultivars studied for 1000- grain weight.

Ashrafuzzaman *et al.* (2009) revealed that there was significant difference of 1000- grain weight among the varieties. The highest 1000-grain weight was recorded in BR38 (20.13 g) and the lowest was recorded in BR34 (12.17 g).

Jamal *et al.* (2009) reported minimum 1000-grain weight in IRI384, while maximum 1000-grain weight with variety ILLABONG.

Meena *et al.* (2010) pointed that the 1000-grain weight ranged between 11.36 and 20.18g.

Diako *et al.* (2011) observed 1000 grain weight ranged between 21.1-22.3 g in different rice varieties.

Faruq Golam *et al.* (2011) observed that significant variation was not observed among the tested genotypes in replications and among all varieties. The 1000 grain weight ranged from 15.33 g to 31.33 g. Minimum 1000 grain weight was recorded in MRQ50, while maximum in E3.

Abdul Baset Mia *et al.* (2012) reported that there were spectacular and significant differences of 1000-grain weight among the cultivars. The highest 1000-grain weight was recorded in BRRIdhan32. The Ukonmodhu showed the lowest 1000-grain weight.

Kanchana *et al.* (2012) showed that different rice varieties have 1000-grain weight ranged between 14.0-18.5g.

Muhammad *et al.* (2012) evaluated ten rice genotypes during their experiment and observed that 1000 grain weight differed significantly in different rice lines which ranged from 16.26 to 28.13 g. Maximum seed weight was recorded in line HUA564 (28.13 g). Line HHZ5-Y3-SAL3-DT1 recorded less grain weight (16.26 g).

Dutta *et al.* (2013) evaluated sixty eight genotypes of rice. The 1000 grain weight varies from 10.45 g (Katibora) to 40.86 g (Pokhoribora)

with mean value of 23.77 g. The genotypic and phenotypic coefficients of variation were high for 1000 grain weight and the difference was very close indicating apparent variation with negligible environmental influence and possibility of yield improvement through selection of this trait. Results were also supported by Habib *et al.* (2005) and Karim *et al.* (2007)

Nahida Islam *et al.* (2013) evaluated the performance of local aromatic rice cultivars *viz.* Kalijira, Khaskani, Kachra, Raniselute, Morichsail and Badshabhog. Stated that raniselute produced the highest 1000-grain weight (32.09 g) and the lowest (13.32 g) was recorded from the variety Kalijira.

Srivastava *et al.* (2013) observed that 1000 grain weight ranged from 9.1 to 19.3 g for short grain types, 13.4 to 23.2g for high yielding varieties and 19.4 to 25.2g for basmati type lines.

Thomas *et al.* (2013) showed significant differences on results of the 1000-kernel weight of different rice varieties. They determined that glutinous rice had highest 1000-kernel weight (19.43 g) followed by Bario rice (19.23 g) and brown rice (18.66 g) respectively. The lightest 1000-kernel weight was recorded for the white rice variety (16.97 g).

Dhakal *et al.* (2014) evaluated fifty rice genotypes during khari/2013. The 1000 grain weight ranged from 12.46 to 28.53 g with average value of 20.05 g. Among all the genotypes, RP Bio 4918-166-9 (12.46 g) had recorded lowest 1000 grain weight followed by RP 5216-13-7-2-1-1-1 (13.20 g) and RP 5214-18-6-2-1-1-1-B (13.53 g).

Hussain *et al.* (2014) observed that non-significant difference in 1000 grain weight of all varieties, however, it varied between 28.5 to 29.9 g.

Arooj *et al.* (2015) evaluated agronomic traits for yield and yield components in advance breeding rice. Found that the maximum 1000 grains weight was recorded for Line-188 (32 g), while the minimum weight was recorded for Bas-385 (21.2g).

Chandrika *et al.* (2015) observed that the highest 1000 grains weight was recorded in (22.5 g) due to the bold grain while lowest 1000 grain weight was recorded for the genotype HR-12 (11.10 g) due to fine grain nature.

Sajid *et al.* (2015) observed 1000-grain weight of different rice genotypes ranged from 20.2-26.45g with an average of 22.99g.

Saravanan Ponnappan *et al.* (2017) evaluated the data pertaining to the 1000 grain weight, volume, bulk density and true density of selected rice varieties. The 1000 grain weight was maximum in glutinous white rice (22.25g) followed by TPS-1 (20.80g), TKM-9 (19.82) and black rice (17.50g).

Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. They found that 1000 grain weight was maximum in RTNRH 17 and RTNRH-10.

Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. Stated that the significantly higher 1000 grains weight (g) was recorded in Pusa Sugandha 4, Pusa Sugandha 5 and Vallabh 21 whereas; it was lower in Basmati370 and Taroari Basmati.

Subhalakshmi *et al.* (2018) studied the 1000-grain weight of the varieties studied ranged from 21.53 to 34.96 g. Among the varieties, Athebuium had the lowest grain weight and Chakhaoangouba 1 had the highest grain weight (34.96).

Variations in 1000 grain weight among rice genotypes have been reported by earlier workers (Zheng-Jin *et al.* 2006, Kishor *et al.* 2007, Zhang *et al.* 2009, Shet *et al.* 2012 and Huang *et al.* 2013).

2.7.8. Grain yield per plant (g):

Miah *et al.* (1996) reported that high yield is determined by physiological process leading to a high net accumulation of photosynthates and their partitioning to sink.

Biswas *et al.* (1998) reported varietal differences in grain yield in rice. Chandrasekhar *et al.* (2001) reported that the yield differences were due to the significant difference in their yield components.

Padmaja *et al.* (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten-genotypes which were released during 1960's, 1970's, 1980's and 1990's. In general the yield ranged from 3.6 to 6.9 t/ha. However the yield was significantly more in all the genotypes released during 1980's and 1990's than the genotypes released in 1960's and 1970's.

Soomro *et al.* (2001) studied that effect of transplanting dates on yield and its related traits in rice. Early planted (May,16) rice taken greater days to heading (110.4 days) maturity (136 days) and plant height(102.25cm) .Number of panicle /hill (79.13g) .1000 grain weight (36.10g) and grain yield (5750 kg ha^{-1}) were significantly greater in 1st June planted rice.

Horie *et al.* (2003) studied the effect of time of transplanting of rice hybrids on growth and yield. The highest panicle weight and grain yield were recorded in 25th June transplanting and were significantly superior to other dates except in 1993. There was 10, 3 and 43 % and 11, 5 and 78 % increase grain yield with 25th June transplanting over 15th June, 5th June and 25th July in 1993 and 1994 respectively.

Lohidas *et al.* (2003) studied five rice hybrids during the season *kharif*, 2001 and 2002. The hybrid PHB-71 recorded significantly higher grain yield around 7.2 t ha^{-1} during both the years.

Ramarao *et al.* (2004) studied dry matter production and its distribution in different parts of six hybrids of rice. There was a

significant difference between the rice hybrids for grain yield. Among the hybrids, TNRH-16 recorded maximum grain yield of 6470 kg ha⁻¹ followed by DRRH-1 (5750 kg ha⁻¹).

Balochi *et al.* (2006) studied growth and yield of rice as affected by seedling per hill under high temperature. June 20th planted crop gave highest paddy yield.

Katsura *et al.* (2007) conducted an experiment during the years 2003 and 2004 with three rice varieties. They recorded the grain yield during both the years for Liangyoupeijiu, Takanari, and Nipponbare was (9.9, 9.6 and 7.6 t ha⁻¹) and (11.8, 11.4 and 7.7 t ha⁻¹), respectively.

Rajesh kumar *et al.* (2008) carried out morpho-physiological analysis of yield in different rice genotypes under lowland situation and found that genotype PHB-71 recorded highest grain yield and was significantly superior to all the genotypes studied which was due to higher number of total tiller, effective tiller and number of filled grains per panicle.

Ashrafuzzaman *et al.* (2009) revealed that different varieties exhibited significant differences in grain yield. BR34 produced the maximum grain yield and Basmati produced the lowest.

Nadeem *et al.* (2010) studied effect of different sowing dates on the yield and yield components of direct seeded fine rice during *kharif* 2008 includes six different sowing dates. Yield components like tillers per metre square (328.7), kernel per panicle (94.47). 1000 kernel weight (18.82 g) and paddy yield (4468 kg ha⁻¹).

Patel *et al.* (2010) studied effect of different sowing date on phenology, growth and yield of rice. Maximum yield potential of rice crop is usually achieved when the crop is exposed to the most appropriate temperature range which can be controlled by sowing time.

Abdul *et al.* (2012) results showed that BRRIdhan32 produced the maximum grain yield. On the other hand, varieties Ukonmodhu and Kataribhough produced similar grain yield. The highest grain yield in BRRIdhan32 might be due to highest total dry matter production.

Muhammad *et al.* (2012) evaluated ten rice genotypes during the experiment. All genotypes produced variable grain yield ranging from 1.64 to 3.43 tons per hectare. Higher paddy yield was harvested from cultivar KS-133. It was noted that the lowest paddy yields were produced by well adopted cultivars IR 6.

Dutta *et al.* (2013) evaluated sixty eight genotypes of rice. Among genotypes minimum grain weight per plant was recorded in Adoliabao genotype (116.89 g) and maximum grain weight per plant (2757.82 g) was recorded in Bhuibao genotype with average weight of 680.81 g.

Mehta *et al.* (2013) revealed that varieties exhibited significant differences in grain yield. Among the varieties highest grain yield of 6176 kg ha⁻¹ was recorded in genotypes RNR 2354 followed by RNR 2378 with 5850 kg ha⁻¹. The lowest grain yield was recorded in Pusa 1121 (3960 kg ha⁻¹).

Nahida Islam *et al.* (2013) evaluated the performance of local aromatic rice cultivars *viz.* Kalijira, Khaskani, Kachra, Raniselute, Morichsail and Badshabhog. They stated that the variety Morichsail produced the highest grain yield (2.53 t ha⁻¹) followed by Kachra (2.41 t ha⁻¹), Raniselute (2.13 t ha⁻¹) and Badshabhog (2.09 t ha⁻¹) and the lowest grain yield (1.80 t ha⁻¹) was obtained from Kalijira.

Dhakal *et al.* (2014) conducted a study with fifty rice genotypes during *kharif* and recorded grain yield per plant which ranged from 4.49 g to 30.18 g with an average value of 11.94 g. Significantly superior grain yield per plant was recorded by 21 genotypes over check Basmati-370 (7.29 g). The highest grain yield per plant was recorded by check Avishkar (30.18 g). However, none of the cultivar had recorded significantly superior grain yield per plant over the check Avishkar.

Hussain *et al.* (2014) reported that IR-28 gave the highest paddy yields (6.79 t/ha) followed by Koshihikari (6.70 t/ha) and Nipponbare (6.46 t/ha). NERICA-4 produced the lowest yields (5.77 t/ha) which may be due to lower number of panicles/m².

Chandrika *et al.* (2015) observed that rice genotypes exhibited significant differences in grain yield. Among the genotypes RNR 15038 recorded highest grain yield of 6142 kg.ha⁻¹ followed by RNR 15048 with (5788kg.ha⁻¹). The lowest grain yield was recorded in Rajendra (3597 kg ha⁻¹) followed by HR-12 (3733 kg.ha⁻¹).

Islam *et al.* (2016) investigated genetic variability among 113 aromatic and fine local rice genotypes of which five were exotic in origin. They found that the grain yield was significantly and positively correlated with days to flowering, days to maturity, panicle length, filled grains per panicle, and 1000 grain weight.

Javaid Ahmed Shah *et al.* (2016) evaluated non-aromatic rice varieties for growth and yield under different rates of soil applied boron. Found that the Sarshar produced the highest paddy yield (5691 kg ha⁻¹) at the rate of 1.5 kg B ha⁻¹ and was 18% greater than control, Shandar produced the highest yield (6075 kg ha⁻¹) at the rate of 1.0 kg B ha⁻¹ and was 5% greater than control.

Chandrashekhar *et al.* (2017) reported that significantly higher grain yield of 5.76 tons ha⁻¹ in SRI as compared to NTP (5.09 tons ha⁻¹). The SRI obtained 11% higher grain yield than NTP. Among the nutrient management practices, T₃ recorded higher grain yield (6.01 tons ha⁻¹) followed by T₄ (5.87 tons ha⁻¹). Lower grain yield was recorded by T₂ (4.14 tons ha⁻¹) over other treatments.

Jagtap *et al.* (2017) studied response of rice varieties to different sowing windows under Konkan conditions. Results that rice crop sown on 23rd Met. Week recorded significantly higher grain yield (5782 kg ha⁻¹), as well straw yield (6462 kg ha⁻¹). Long durations rice variety Swarna recorded the maximum grain yield (5782 kg ha⁻¹) as well as straw yield (6462 kg ha⁻¹), which was significantly higher over all other varieties under the study except variety Jaya which was at par.

Vinai Kumar *et al.* (2017) studied physiological and biochemical responses of different rice (*Oryza sativa* L.) genotypes under terminal

heat stress. The maximum grain yield per plant (33.97 g) in control and IET 20734 (29.00 g) had highest grain yield in treatment condition, whereas IET 20944 had lowest grain yield (19.01 g) in control and (16.76 g) in treatment.

Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. They found that the RTNRH-10 (31.76g/plant) recorded highest grain yield per plant followed by RTNRH- 17 (30.40g /plant) as compared to other genotypes.

Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. Stated that maximum LAI was notice at 63 DAT ranging from 4.22 (Pusa Sugandha) to 5.13 (Vallabh-21). Maximum LAI was correlated positively and strongly with grain yield.

Tiwari, *et al.* (2018) studied effect of sowing date on physiological parameters, productivity and economical grain of different rice varieties under rainfed condition. PS -3 and then PS-5 resulted in maximum physiological parameters, grain yield upto 38.54 q/ha . PS -3 or PS-5 grown on 3rd July was suitable to obtain maximum productivity from rice under rainfed conditions .

Meena, R.L., *et al.* (2019) studied performance of rice varieties in relation to crop growth, yield, physiological parameters and agro meteorological indices under different date of transplanting. Results showed that all growth parameters value and leaf area duration was recorded higher during growth up to harvest and significantly higher grain yield was obtained under July 23rd transplanting .Early transplanting of *kharif* rice give highest yield than delayed transplanting where in case of varieties MTU 1010 shows better results than other tested varieties.

Chandini *et al.* (2020) studied that effect of planting dates on dry weight, flowering and yield of different rice varieties. The results reveal that under delay planting condition NDR 97 when planted on 5th August out yielded other varieties and as the planting gets delayed beyond the first week of August the yield of rice decreases progressively.

D. Anil *et.al.* (2020) studied evaluation of pre released rice genotypes under different sowing dates in rainy season genotypes KNM1638 sown on 5th July recorded maximum growth parameters and highest grain yield (7455 kg) and followed by sown on 20th June.

Many scientists (Zhou *et al.*, 2007 and Zhang *et al.* 2009) reported significant variation in yield and other traits of rice genotypes grown under irrigated and rainfed conditions.

2.7.9.Straw yield per plant (g):

Nimje *et al.*(2010) reported production of straw yield is total biomass production efficiency of any crop.

Gimhavanekar *et. al.* (2020) reported variation in straw yield in different rice genotype. Significantly maximum straw yield was recorded in kalakrishna (29.92 g per plant) which was at par with Pusasugandha (29.79 g per plant) Ghansal regional (29.65 g per plant), Basmati-107(29.53 g per plant), Kala Jeera (28.73 g per plant) Shrabanmasi (28.72 g per plant) and Parag (28.71 g per plant).

Ral *et al.* (2008) reported variation in straw yield in rice genotypes. Significantly maximum straw yield was recorded in D₂-1 July planting (5671 Kg/ha) which was at par with D₁-15 June planting (5629 Kg/ha).

2.7.10. Harvest index (%):

Murthy *et al.* (1991) observed that harvest index (HI) had positive and significant association with grain yield indicating efficient translocation of photosynthate from source to sink.

Sharma *et al.* (1997) studied the physiological parameters and their association with photosynthesis in rice and reported significant

difference among genotypes for HI and significant association of photosynthate rate with HI. Among different genotypes IET13506 produced high grain yield with high HI.

Kusutani *et al.* (2000) conducted the studies on the varietal differences in harvest index and morphological characteristics of rice and highlighted the contribution of high harvest index to yields.

Chandrasekhar *et al.* (2001) conducted experiment on 5 rice hybrid along with a local check. Harvest index was maximum in MGR1 (57.72%) followed by KHR1 (51.09%) and lowest in NLR33358 (42.94%).

Padmaja *et al.* (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes of rice which were released during 1960's, 1970's, 1980's and 1990's. The harvest index for all the genotypes ranged from 0.38 % to 0.49 %. However, the harvest index was more in a.11 the genotypes released during 1980's and 1990's than the genotypes released in 1960's and 1970's.

Lohidas *et al.* (2003) studied five rice hybrids for different yield parameters during the season *kharif*, 2001 and 2002. The values for harvest index did not differ significantly among the hybrids. However, the maximum value around 48 % was recorded in PHB 71 during both the years.

Jadhav *et al.* (2007) carried foliar spray of oxadiargyl @ 0.08 kg/ha 1+ 0.4 @ kg/ha and recorded maximum harvest index followed by weed free (46.00) as against weed check (36.36).

Ashrafuzzaman *et al.* (2009) found that the highest harvest index of 34.94% was recorded in BR34 and the lowest harvest index of 31.51% was obtained from Basmati and stated that harvest index is a vital character having physiological importance. It reflects the ability of a variety to translocate photosynthates to the economic parts.

Malarwizhi *et al.* (2010) conducted an experiment and evaluated rice genotypes and reported that harvest index ranged hi the varieties

from 0.42 % (Brown gora and Prasanna) to 0.57 % (Sneha). They concluded that the rice genotypes have desirable genes which have lot of expression on high harvest index which in turn increased the grain yield and the efficiency of the genotypes to partition total dry matter into grain and straw yield.

Courtney *et al.* (2011) assessed twenty diverse rice varieties from landrace, advanced and popular class for various yield parameters. They noted the highest harvest index (0.70%) in advance variety Li-Jiang-Xin-Tuan-Hei-Gu (LTH) and minimum harvest index was observed in landrace variety Moroberekan (0.13 %).

Dutta *et al.* (2013) evaluated sixty eight genotypes of rice and recorded 35.73 % as mean harvest index of genotypes. Harvest index varies from 8.06% to 59.09 %. Maximum harvest index was recorded in Ahuinsali (59.09 %) and minimum (8.06 %) in Adoliabao.

Nahida Islam *et al.* (2013) evaluated the performance of local aromatic rice cultivars *viz.* Kalijira, Khaskani, Kachra, Raniselute, Morichsail and Badshabhog. Stated that the highest harvest index (36.06%) was recorded from the variety Khaskani and the lowest (25.48%) was calculated from the variety Kachra.

Hussain *et al.* (2014) calculated harvest index values in different varieties, however, NERICA-4 gave the highest values (47%) followed by Nipponbare and Koshihikari. The lowest harvest index was determined in IR-28 (37%) which was due to higher straw yields.

Chandrika *et al.* (2015) observed that highest harvest index of 0.49 was recorded in genotype RNR 15038 followed by RNR 15048 (0.48) and the lowest harvest index of 0.31 was recorded in Swarna.

Lavanya *et al.* (2018) studied various rice genotypes for grain yield by physiological approaches. Found that the maximum and minimum harvest index was observed in APMS6A X BCW56 (0.51) and PUSA5A X BR827-35 (0.21), respectively.

CHAPTER – III

MATERIAL AND METHODS

The present investigation entitled “Morpho-physiological and biochemical characterization of rice genotypes for their suitability under *rabi* environment of Konkan” was carried out at Regional Agricultural Research Station, Karjat, Dist. Raigad (MH) during *kharif*, 2020 and *kharif*, 2021 as well as *rabi* 2020-21 and *rabi* 2021-22. The details of geographical area, climate and methodologies adopted during the course of investigation are briefly described hereunder.

3.1 Climatic and weather condition:

Geographically, Karjat is situated in the western part of Maharashtra at 18°91'67" North latitude and 73°33' East longitude with an altitude of 194 meters (636 ft) above the mean sea level with warm and humid conditions throughout the year. The mean annual precipitation is 3500 mm, which is generally received during the period from June to November at the location. The meteorological observations during the period of experimentation i.e. June to October *kharif*, 2020 and *kharif*, 2021 as well as December to April *rabi* 2020-21 and *rabi* 2021-22 were recorded at the meteorological observation at the Regional Agriculture Research Station, Karjat. In general, the season was quite favorable for the rice crop. The details of the meteorological data are given in Appendix – I and Appendix – II.

3.2 Experimental details:

The experiment was laid out with 40 early duration rice germplasms in Split Plot Design with three replications during *kharif*, 2020 and *kharif*, 2021 as well as *rabi* 2020-21 and *rabi* 2021-22 with different sowing windows. The experiment details are given below:

Crop	:	Rice
Season	:	<i>kharif</i> -2020 and <i>kharif</i> -2021 <i>rabi</i> -2020-21 and <i>rabi</i> -2021-22
Design	:	Split Plot Design
Rice genotypes	:	40
Plot size	:	2.10m×0.75 m
Number of replications	:	03
Date of nursery sowing	:	1)14 th June, 2020 (<i>Kharif</i> 2020) and 14 th June,2021(<i>Kharif</i> 2021) (S ₁) 2)1 st December (S ₂), 15 th December (S ₃),30 th December (S ₄)(<i>Rabi</i> 2020-21 and <i>Rabi</i> 2021-22)
Date of transplanting	:	1)10 th July, 2020 (<i>Kharif</i> 2020) (S ₁)and 10 th July, 2021(<i>Kharif</i> 2021) (S ₁) 1),1 st January,2021 (S ₂), 15 th January,2021 (S ₃),30 th January,2021 (S ₄) (<i>Rabi</i> ,2020-21),1 st January, 2022 (S ₂), 15 th January (S ₃), 2022,30 th January, 2022 (S ₄) (<i>Rabi</i> ,2021-22)
Spacing	:	Plant to Plant - 15 cm and Row to Row - 15 cm
Treatment details	:	Forty rice germplasms as given below in Table No. 1

Table 1.List of rice genotypes as treatments:

Sr. No	Genotypes	Source	Sr. No	Genotypes	Source
1	Karjat-1	RARS, Karjat	21	IRRI-27	Dept of Agril Botany,Dapoli
2	Karjat-3	RARS, Karjat	22	IRRI-28	Dept of Agril Botany, Dapoli
3	Karjat-4,	RARS, Karjat	23	IRRI-34	Dept of Agril Botany, Dapoli
4	Karjat-7	RARS, Karjat	24	IRRI-36	Dept of Agril Botany, Dapoli
5	Karjat-184	RARS, Karjat	25	IRRI-47	Dept of Agril Botany, Dapoli
6	Sahyadri-2	RARS, Karjat	26	IRRI-52	Dept of Agril Botany, Dapoli
7	Sahyadri-4	RARS, Karjat	27	IRRI-53	Dept of Agril Botany, Dapoli
8	Phondaghat-1	RARS, Karjat	28	IRRI-55	Dept of Agril Botany,Dapoli
9	Ratnagiri-1	ARS, Ratnagiri	29	IRRI-62	Dept of Agril Botany,Dapoli

Sr. No	Genotypes	Source	Sr. No	Genotypes	Source
10	Ratnagiri-5	ARS, Ratnagiri	30	IR-35	RARS, Karjat
11	Ratnagiri- 6	ARS, Ratnagiri	31	Laldodaki	RARS, Karjat
12	Ratnagiri- 7	ARS, Ratnagiri	32	IR2289-6-22-5	RARS, Karjat
13	Ratnagiri -24	ARS, Ratnagiri	33	Narmada	RARS, Karjat
14	Ratnagiri-73	ARS, Ratnagiri	34	Ananda	RARS, Karjat
15	Ratnagiri-711	ARS, Ratnagiri	35	Ambpandhari	RARS, Karjat
16	IRRI-14	Dept of Agril Botany, Dapoli	36	Hira	RARS, Karjat
17	IRRI-15	Dept of Agril Botany, Dapoli	37	OR-1516-1-5-A	RARS, Karjat
18	IRRI-20	Dept of Agril Botany, Dapoli	38	China	Shri.MadhukarKerkar, Kochara
19	IRRI-21	Dept of Agril Botany, Dapoli	39	Sorati	Shri. Madhukar, KerkarKochara
20	IRRI-22	Dept of Agril Botany, Dapoli	40	Mhadi	MAE FARM,RARS,Karjat

3.3 Experimental design:

The experiment comprised of forty genotypes of rice, laid out in Spilt Plot Design with three replications. The seeds were sown on 2nd week of June, 2020 and 2021 during *kharif* season and 1st, 2nd and 3rd sowing on 1st December, 15th December and 30th, December during *rabi* season on raised beds. After 25 days, seedlings were transplanted with spacing of 15 cm between row and 15 cm between plants in rows with plot size 2.10 x 0.75 m. for each variety in the plot. The field experiment was conducted at normal fertility level on lateritic soil. Fertilizers applications were done @ 100 kg N, 50 kg P₂O₅ and 50 kg K₂O per hectare.

3.4 Experimental material:

The material used for study comprised of 40 rice genotypes. The tested rice genotypes were collected from breeding section, Regional Agricultural Research Station, Karjat, Dist. Raigad, Agricultural Research Station, Shirgaon, Dist. Ratnagiri and Botany Farm, Department of Agriculture Botany, College of Agriculture Dapoli, Dist. Ratnagiri.

3.5 Cultural practices

3.5.1 Raising of nursery:

Well pulverized raised nursery beds were prepared. The size of each nursery beds were 1 x 0.25 m² and drainage channel of 30 cm width was provided between the bed. The basal dose of fertilizers was given at the time of nursery bed preparation. The seeds were sown in lines on the raised nursery beds with frequent irrigation as desired.

3.5.2 Field preparation:

The final preparation of the field was done by two criss-cross tractor ploughing followed by harrowing. The soil surface was leveled well and the field was divided into three of each sowing and it was laid out as per plan.

3.5.3 Fertilizer application:

The fertilizers were applied as per the requirement of crop 100:50:50 kg ha⁻¹ N:P:K was applied in the form of urea, SSP and MOP, respectively. The halfdose of N was applied as basal dressing and the rest half Nitrogen was applied in three split dose, first dose 50% at 10-15 day after transplanting, 2nddose 25% at active tillering and 3rddose 25% at panicle initiation (PI) stage. The whole amount of phosphorus and potash was applied as basal during transplanting.

3.5.4 Transplanting:

The 30 days old seedlings in *Kharif* season and 35 days old seedlings in *Rabi* season were transplanted in the field. The one seedling was planted in each hill.

3.5.5 Weed management:

The crop was kept weed free throughout its growth period for avoiding crop weed competition. The hand weeding was done during the crop growth.

3.5.6 Water management during *rabi* season:

After transplanting, the soil was kept saturated until seedlings get established and 5±2 cm water level was maintained until grain hardening stage (10 days prior to harvesting). The water was drained out from the field prior to every top dressing of nitrogen and reflooded again for 24 hours.

3.5.7 Plant protection:

Plant protection measures were adopted as and when required during the crop growth period.

3.5.8 Harvesting and threshing:

The experimental crop plants were harvested after maturity with the help of *Vaibhav* sickles by manual labourers. Harvested produce was left on the plot itself for sun drying. After sun drying the produce was weighed plot wise. The material was threshed with the help of wooden sticks. The threshed material from each plot was kept separately and grains were separated from the chaff and straw by winnowing with the help of *supa* and weight of clean grain were recorded.

3.6 Phenological observations:

The following phenological parameters were recorded

- a. Days to first flowering
- b. Days to 50 per cent flowering
- c. Days to physiological maturity

3.6.1 Days to first flowering:

The number of days required for first flowering in almost half of the plant population is termed as days to first flowering. After visual observations days were recorded for each treatment.

3.6.2 Days to 50 % flowering:

The number of days required for flowering in almost half of the plant population is termed as days to 50% flowering. After visual observations days were recorded for each treatment.

3.6.3 Days to physiological maturity:

The maturity stage was determined, when the golden yellow colour of the grain and senescence of the lower leaves was seen. The stage was also determined by grain hardness.

3.7 Morphological observations:

Regarding the morphological observations, five plants were randomly selected in each treatment plot. These five plants were tagged with aluminum foil tags. The following observations were recorded at 30 days interval till the physiological maturity.

- a. Plant height (cm)
- b. Number of tillers/plant (No.)
- c. Number of leaves/plant (No.)
- d. Leaf area/plant (dm²)

3.7.1 Plant height (cm):

Plant height was recorded randomly selected five tagged plants in each plot. The height was recorded in centimeter from ground level to uppermost leaf tip of main axis of the plant.

3.7.2 Number of tillers per plant:

The number of tillers on the five randomly selected plants was recorded and then the average number of tillers per plant was calculated and expressed in tillers plant⁻¹.

3.7.3 Number of leaves per plant:

The Number of green leaves on the five randomly selected plants was recorded and then the average number of leaves per plant was calculated.

3.7.4 Observations at sampling:

Five plants from each treatment plot and replications were randomly selected and uprooted carefully. Observations were taken at an interval of 30 days from the date of transplanting. The plants were brought to the laboratory and washed, blotted dry and separated into stem and leaf. The stem and leaf thus obtained from five plants were used.

3.7.5 Dry matter production (g):

For dry matter studies, five plants were selected randomly at 30 days after transplanting till harvest at 30 days interval. At each sampling were separated into stem, leaves, roots and panicle. These were properly labeled and dried in a hot air oven at 80°C for first one hour and then at constant temperature at 60°C. When plant parts were completely dried, the dry weights were recorded separately for each plants part i.e. stems, leaves, root and panicle. Summing up the weight of stem, leaves, root and panicle of the same plant gave the total dry matter per plant.

3.7.6 Leaf area per plant (dm²):

Leaf area per plant was calculated with the help of formula given by Tsunoda (1964).

$$\text{L.A.} = \text{Length of the leaf} \times \text{Breadth of the leaf} \times \text{Correlation factor (0.725)} \\ \times \text{Number of leaves per plant.}$$

3.8 Physio-chemical parameters

Physio-chemical observations were recorded at 30 days interval till the physiological maturity.

3.8.1 Total Chlorophyll contents (mg/g fresh weight):

Principle

The chlorophyll pigment of the plant leaf (material) is extracted with dimethyl sulfoxide (DMSO) and estimated spectrophotometrically at 663 and 645 nm as chlorophyll 'a' and 'b' absorbs this wavelength.

Apparatus and Reagent:

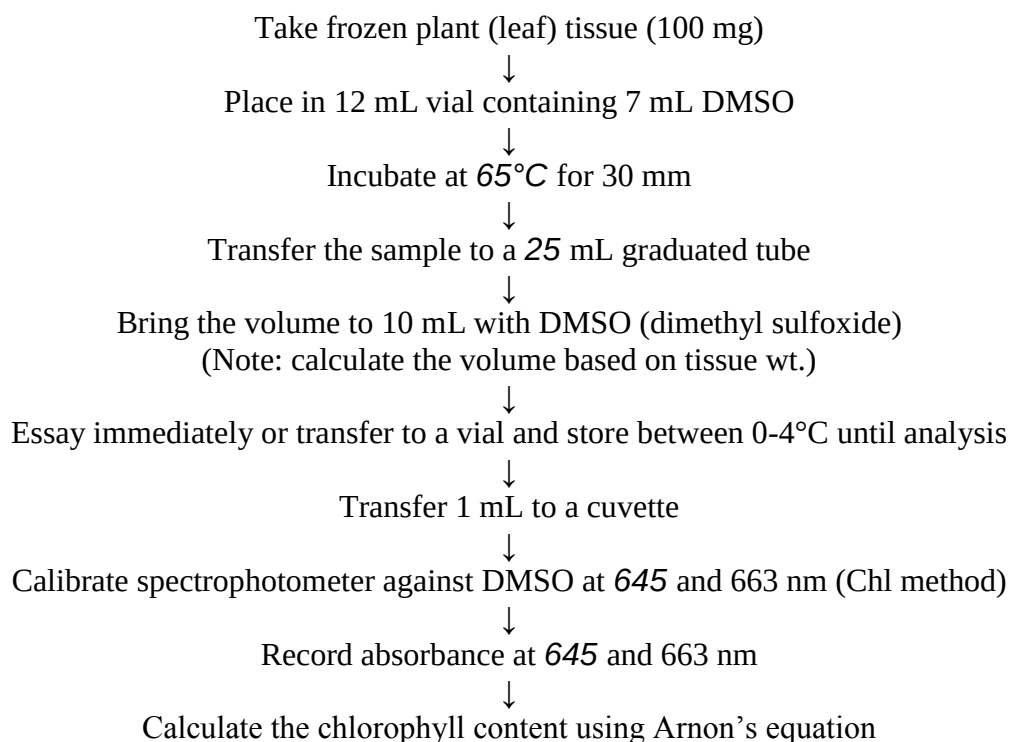
1. Test tubes
2. Spectrophotometer
3. Pipette
4. Incubator
5. Dimethyl sulfoxide (DMSO)

Procedure

1. The chlorophyll content was determined by the method of Hiscox and Israelstam (1979).
2. 50 mg of fresh leaf was chopped into small pieces and placed in to test tube containing 10 ml of DMSO.
3. The tubes containing leaf tissue and DMSO are kept in oven, adjusted at 65°C temperature for 3 hr.
4. During incubation chlorophyll are extracted into fluid and these are transferred to graduated tubes and made upto a total volume of 10 ml by adding DMSO.
5. 3.0 ml of sample of chlorophyll extract was transferred into cuvette and absorbance or optical density is measured at 663 nm and 645 nm using spectrophotometry.
6. Chlorophyll 'a' and chlorophyll 'b' or total chlorophyll content was calculated by the equation of Arnon. and expressed as mg/g fresh leaf weight.

Equation:

Total chlorophyll (mg/g fresh wt.) = $22.2 \times \text{O.D. at } 663 + 8.02 \times \text{O.D. at } 645$
Method

Extraction and Determination of Chlorophyll**3.8.2 Chlorophyll stability index:**

Chlorophyll stability index was estimated by spectrophotometric method as suggested by Kaloyreas (1958). It was done at 30 days interval from sowing during the course of plant growth. Two clean glass tubes were taken and five grams of representative leaf sample was placed in them with 50 ml of distilled water. One tube was then subjected to heat in water bath at $56^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for exactly 30 minutes. Other tube was kept as control. The leaves were then grounded by a mortar for five minutes with 100 ml of 80% acetone. The slurry was then filtered with Whatman No.1 filter paper. The chlorophyll extract was further examined immediately under spectrophotometer using 645 nm and 663 nm wavelength. The difference in two readings (Reading without heating and Reading after heating $56^{\circ}\text{C} = \Delta R$) was defined as chlorophyll stability

index. The chlorophyll stability index was calculated using following formula.

$$CSI = \frac{\text{Total Chlorophyll content at heated sample}}{\text{Total Chlorophyll content in normal sample}}$$

3.9 Photosynthetic traits:

Physiological observations were recorded at 30 DAT at harvest.

3.9.1 Photosynthesis rate ($\mu\text{mol Co}_2\text{m}^{-2}\text{sec}^{-1}$):

Photosynthesis rate of the leaves of each genotype was measured at different interval *i.e.* 30, 60, 90 DAT and at harvest with infrared gas analyzer LICOR 6400 (IRGA) model and expressed as $\mu\text{mol Co}_2\text{m}^{-2} \text{Sec}^{-1}$.

3.9.2 Rate of transpiration ($\mu\text{mol H}_2\text{O m}^{-2} \text{sec}^{-1}$):

Transpiration rates were measured with infrared gas analyzer LICOR 6400 (IRGA) model and expressed as $\mu\text{mol H}_2\text{O m}^{-2} \text{sec}^{-1}$.

3.9.3 Stomatal conductance ($\text{mmol m}^{-2}\text{S}^{-1}$):

Stomata conductance of the leaves of each genotype was measured at different growth stage upto harvest with infrared gas analyzer LICOR 6400 (IRGA) model and expressed as $\text{mmol m}^{-2}\text{S}^{-1}$.

3.9.4 Leaf canopy temperature:

Leaf canopy temperature of the leaves of each genotype was measured at different growth stage upto harvests with infrared gas analyzer LICOR 6400 (IRGA) model and expressed as degree celcius ($^{\circ}\text{C}$).

3.9.5 Leaf water potential(bar) :

A portable pressure chamber (Arimad-3000) was used to estimate leaf water potential. Fully expanded leaf from recently mature shoot was selected. The equilibrium pressure required to bring water to the cut petiole was recorded as the leaf water potential in bar.

3.10 Growth parameters

Periodical data obtained from dry matter studies were used for computing the following growth rates.

- a. Absolute growth rate (AGR) g/day
- b. Relative growth rate.(RGR) g/g/day
- c. Net assimilation rate.(NAR) g/dm²/day
- d. Leaf area index (LAI)

3.10.1 Absolute Growth Rate (AGR) (g/day):

AGR was calculated from total dry matter accumulation by using formula given by Radford (1967). It is expressed in g/day.

$$AGR = \frac{w_2 - w_1}{t_2 - t_1}$$

Where,

w_2 and w_1 refer as weight of total dry matter per plant at time t_2 and t_1 , respectively in days.

3.10.2 Relative Growth Rate (RGR) (g/ g⁻¹/day):

The increase in dry weight per unit original dry weight of the plant per unit time is called relative growth rate. The RGR was calculated according the following formula (Leopold, 1964). It is expressed in (g/g/day)

$$RGR = \frac{(\text{Log}_e w_2 - \text{Log}_e w_1)}{(t_2 - t_1)}$$

Where,

w_1 = dry weight of the whole plant at start of the test period.

w_2 = dry weight of whole plant at the end of the test period.

$(t_2 - t_1)$ = period in days between initial and final observations.

3.10.3 Net Assimilation Rate (NAR) (g dm⁻²day⁻¹):

Net assimilation rate is the net gain of assimilates (net photosynthesis) per unit of leaf area and time. It is expressed in g/dm⁻²/day⁻¹. Net assimilation rate was calculated with the following formula Watson (1947).

$$\text{NAR} = \frac{(w_2 - w_1)}{(L_2 - L_1)} \times \frac{(\text{Log}_e L_2 - \text{Log}_e L_1)}{(t_2 - t_1)}$$

Where,

w_1 = Total dry weight of plant in g at time t_1

w_2 = Total dry weight of plant in g at time t_2

t_1 = Initial time of observation

t_2 = Final time of observation

l_1 = Leaf area plant⁻¹ at time t_1

l_2 = Leaf area plant⁻¹ at time t_2

3.10.4 Leaf Area Index (LAI):

Leaf area index was determined by taking a statistically significant sample of foliage from a plant canopy, measuring the leaf area per sample plot and dividing it by the plot land surface area. Leaf area index (LAI) was calculated as per the formula given by Watson (1947).

$$\text{LAI} = \frac{\text{Leaf area per plant (cm}^2\text{)}}{\text{Occupied land area per plant (cm}^2\text{)}}$$

3.11 Enzymatic activity

3.11.1 Estimation of Nitrate reductase activity:

Nitrate reductase activity was estimated by the method suggested by Hageman and Reed (1980) involving the spectrophotometer. Enzymatic activity was recorded at 30 DAT intervals.

i. Principle: In in-vitro assay of nitrate reductase (NR) present in plant homogenate, the reduction of nitrate to nitrite requires the presence of externally added reduced pyridine nucleotide, NADH (Nicotinamide adenine dinucleotide reduced) as an electron donor because NADH present in plant tissue is oxidized to NAD⁺ during the preparation of homogenate. Nitrite thus formed by catalytic action was estimated colorimetrically by diazotization reaction using sulphanil amide and N (1-naphthyl) ethylene diaminedihydrochloride.

ii. Equipments and glass wares:

- A. Colorimeter /spectrophotometer
- B. Metabolic water bath
- C. Mortar and Pestle
- D. Volumetric flask, 100 ml
- E. Pipettes, 1ml, 5 ml and 10ml
- F. Test Tubes, 10ml

iii. Reagents:

1. Extraction medium: It consists of 0.1M Phosphate buffer (pH 7.5), 5mM cysteine hydrochloride and 5mM EDTA. Dissolved 0.218g of KH₂PO₄ (Mol wt. 136), 1.462g K₂HPO₄ (Mol wt. 174), 0.0878 of cysteine hydrochloride monohydrate (Mol wt. 175.6) and 0.186 g EDTA-disodium salt (Mol wt. 372.2) in 50ml water. The pH of the medium is adjusted to 7.5 with KOH and volume was made up to 100ml with distilled water.
2. Phosphate buffer 0.1M (7.5 pH)
3. Potassium nitrate solution (20μmoles per ml): Dissolved 202mg of potassium nitrate (mol wt. 101) in 100ml distilled water.
4. NADH solution (1μmole per ml): Dissolved 7.41 mg dipotassium salt of NADH (mol wt. 741.5) or 7.09 mg disodium salt of NADH in 10 ml of 0.1M of sodium bicarbonate solution.

5. Zinc acetate solution (1M): Dissolved 21.95g of Zinc acetate dihydrate (mol wt. 219.5) in 100 ml distilled water.
6. Ethyl alcohol: 75% (v/v)
7. Sulphanil amide solution (Reagent A): 1% (w/v) in 1N HCL
8. N (1-Naphthyl) ethylene diaminedihydrochloride (NEDD)
(Reagent B):0.02% (W/V) in distilled water.

i) Reagent A preparation: 1% sulphanil amide in 1N HCl solution.

Diluted 85ml concentrated HCl (sp.gr 1.18, 36% concentration) to approximately 500ml with distilled water. Dissolved 10 gram sulphanil amide in it and made up the volume to one liter with distilled water.

ii) Reagent B: 0.02% N (1-naphthyl) ethylene diaminedihydrochloride (NEED) solution. Dissolved 200mg of NEED in approximately 500ml distilled water and make up the volume to one litre with distilled water. Reagents A and B were stored in amber colored bottles.

Procedure:

Extraction of enzymes:

- i) Rice leaves were cut into small pieces (8-10mm).
- ii) After thorough mixing, a representative sample of 0.5g was drawn and extracted with 5 ml ice cold extraction medium using mortar and pestle, in cold (0-4°C).
- iii) Extracted homogenate is transferred to ice cold centrifuge tubes.
- iv) Centrifuged the homogenate for 15 minutes at 10,000 rpm at 4°C.
- v) Decanted the supernatant, which was used as crude enzyme extract for enzyme assay.

Assay of enzyme activity:

For the assay of the enzyme activity, two test tubes each for control as well as sample were taken. To these tubes, the reaction mixture (RM) consisting of the following reagents in the final volume of 2.5ml was added.

- The reaction was initiated by adding 0.5ml NADH solution as the last component. In control tube NADH is omitted, instead 0.5 ml of distilled water was added.
- Incubated the tubes in water-bath maintained at 30°C for 30min.
- Reaction was terminated by adding 0.2ml of 1M Zinc acetate solution, which precipitates the protein followed by 1.8ml of 75% ethyl alcohol.
- The precipitate was then removed by centrifugation at 2,000 rpm for 5 min at room temperature. Supernatant was decanted.
- Nitrite formed by the reduction of nitrate was then estimated in suitable aliquot of supernatant by adding 1 ml each of sulphanilamide and NEDD solution respectively. The pink colour was allowed to develop for 20min, after which volume was made to 6 ml with distilled water.
- The absorbance of pink color solution was read at 540 nm using spectrophotometer.
- By using the standard curve, the nitrate content in the sample was calculated.

3.11.2 Estimation of Amylose:

Materials:

- (1) Balance (mg), (2) Water bath, (3) Tri pod (4) Gas burner (5)100 ml volumetric flask (6) pipettes (1 ml,5 ml, 10 ml, (7) 1 ml automatically dispensing pipettes (8) Absolute Alcohol (9)

Methanol (10) 1.0 N sodium hydroxide (11) 1.0 N Acetic acid (13)
Stock Iodine solution (0.2% in 2.0% KI and (14) Amylose (purified
potato Sigma)

Reagent:

1.0 N sodium hydroxide: 40 gm of Anhydrous NaOH was dissolved in
one liter of distilled water

1.0 N Acetic acid : 5775 ml of glacial acetic acid was dissolved in one
litre of distilled water

Iodine Solution :(0.2% I₂ in 2.0% KI) 2 grams of Iodine and 20 grams
of KI dissolved in one liter water

Absolute alcohol : above 95% alcohol (rectified spirit)

Standard amylose Solution: Take 100 mg of Std. amylose add 1 ml of
absolute alcohol (Ethanol) and 9.0ml 1.0 N Sodium hydroxide shake well
boil over water bath for 15 min and make the solution to 100 ml
volumetric flask

Working Solution: Take 10ml from standard amylose solution and
make the volume of 100ml

Preparation of amylose Standard curve

Protocol

Amylose solution	0.0	0.2	0.4	0.6	0.8	1.0
I ₂ -KI reagent	2.0	2.0	2.0	2.0	2.0	2.0
H ₂ O	7.0	6.8	6.6	6.4	6.2	6.0
1.0 N Acetic acid	1.0	1.0	1.0	1.0	1.0	1.0

Mix and after 20 minutes read at 620 cm

Procedure for analysis of amylose content in rice

- (1) **Prepare Standard rice samples:** Make sure that all samples to
be used have been stored in the same room for at least 2 days to

ensure amylose content. In choosing standard sample include a range of rice representing the low , intermediate and high amylose content. Grind 20 lots of each sample to a fine power in a wig-I – Bug amalgamator or similar device for 40 seconds a UD cyclone mill with 100 mesh sieve may also be used for grinding.

- (2) Take 100 mg rice flour in long test tube (2x19.5 cm) add 1 ml absolute alcohol (Ethanol) and add 9 ml of 1.0 N sodium hydroxide
- (3) Shake thoroughly and heat the test tube on water bath for 15 minutes, pour the sample after digestion in a volumetric flask (100 ml) twice with hot distilled water and later make up to the sample to 100 ml.
- (4) Draw 5 each solution in three replication into three 100 ml volumetric flasks.
- (5) For each 5 ml solution add 1 ml of acetic acid and 2 ml of I₂ –KI reagent and make it to 100 ml a volumetric flask.
- (6) Cover the all flasks with black cloths as I₂ –KI loses color when exposed to light
- (7) Adjust the spectrophotometer for 620 nm and take the readings.
- (8) Amylose content is assigned as per the presence of its presence given below

Waxy	1-2%
Very Low	2-9%
Low	9-20%
Intermediate	20-25%
High	25-33%

$$\text{Amylose content (\%)} = \frac{\text{Reading} \times \text{Graph factor} \times \text{Total volume} \times 10^{-4}}{\text{Taken volume} \times \text{Sample weight (g)}}$$

3.12 Nutritive quality:

3.12.1 Carbohydrate content:

Determination of Total Carbohydrate by Anthrone Method:

Carbohydrates are the important components of storage and structural materials in the plants. They exist as free sugars and polysaccharides. The basic units of carbohydrates are the monosaccharide which cannot be split by hydrolysis into more simpler sugars. The carbohydrate content can be measured by hydrolysing the polysaccharides into simple sugars by acid hydrolysis and estimating the resultant monosaccharide.

Principle:

Carbohydrates are first hydrolysed into simple sugars using dilute hydrochloric acid. In hot acidic medium glucose is dehydrated to hydroxymethyl furfural. This compound forms with anthrone a green coloured product with an absorption maximum at 630 nm.

Materials

- _ 2.5 N HCl
- _ Anthrone reagent: Dissolve 200 mg anthrone in 100 mL of ice-cold 95% H₂SO₄. Prepare fresh before use.
- _ Standard glucose: Stock—Dissolve 100 mg in 100 mL water. Working standard—10 mL of stock diluted to 100 mL with distilled water. Store refrigerated after adding a few drops of toluene.

Procedure

1. Weigh 100 mg of the sample into a boiling tube.
2. Hydrolyse by keeping it in a boiling water bath for three hours with 5 mL of 2.5 N HCl and cool to room temperature.

3. Neutralise it with solid sodium carbonate until the effervescence ceases.
4. Make up the volume to 100 mL and centrifuge.
5. Collect the supernatant and take 0.5 and 1 mL aliquots for analysis.
6. Prepare the standards by taking 0, 0.2, 0.4, 0.6, 0.8 and 1 mL of the working standard. '0' serves as blank.
7. Make up the volume to 1 mL in all the tubes including the sample tubes by adding distilled water.
8. Then add 4 mL of anthrone reagent.
9. Heat for eight minutes in a boiling water bath.
10. Cool rapidly and read the green to dark green colour at 630 nm.
11. Draw a standard graph by plotting concentration of the standard on the X-axis versus absorbance on the Y-axis.
12. From the graph calculate the amount of carbohydrate present in the sample tube.

Calculation:

$$\text{Total Carbohydrate (\%)} = \frac{\text{Reading} \times \text{Graph factor} \times \text{Total volume} \times 10^{-4}}{\text{Taken volume} \times \text{Sample weight (g)}}$$

Note:

Cool the contents of all the tubes on ice before adding ice-cold anthrone reagent.

3.12.2 Protein content:

Total nitrogen content from seeds was determined using the standard Kjeldhal method by A.O.A.C. (1965). The grain-protein percentage was calculated after multiplying Kjeldhal nitrogen by a

conversion factor of 6.25 and expressed on a dry weight basis. Forty milligram of seed powder was taken in the glass digestion tubes. 2ml concentrated H_2SO_4 and the digestion mixture (1:3 of CuSO_4 and K_2SO_4) was added to the tubes. Then the tubes were transferred on electric burner for 2 hrs to carry out the digestion. After digestion the content of the tube became colorless which is the indication of the complete digestion. Then 10-15 ml of double distilled water followed by 10 ml of 40% NaOH was added to the digestion tubes as a result whole solution turned black. In a 250 ml conical flask 10 ml of 4% boric acid was taken and 2 drops of mixed indicator was added to it. Then the digestion tube containing the solution was steam distilled in the Kelplus machine and the ammonia was trapped in the boric acid as a result of which the solution in the conical flask turned blue. This solution was titrated with 0.02 N H_2SO_4 .

The amount of total protein was calculated as

$$\% \text{ Nitrogen} = \frac{(\text{Titrate value} - \text{blank}) \times \text{Normality of } \text{H}_2\text{SO}_4 \times 100 \times 14.007}{\text{Weight of sample (g)}}$$

$$\text{Crude protein} = \% \text{N} \times 5.95$$

3.12.3 Zinc and Iron content (ppm):

Estimation of Zn and Fe in the digested extract can be done using an atomic adsorption spectrophotometer (Lindsay and Norvell, 1978). Zinc, iron are estimated in plant digest obtained from dry ashing or from wet digestion by HNO_3 and HClO_4 . Triacid digestion ($\text{HNO}_3 : \text{H}_2\text{SO}_4 : \text{HClO}_4$ - 9:4:1) and digestion of plant samples with H_2SO_4 and H_2O_2 is avoided, as H_2SO_4 used in digestion can contribute some micronutrients and heavy metals.

Principle

Atoms of metallic elements (Zn, Fe, Cu, Mn etc.) absorb energy when subjected to radiations of specific wavelength. The absorption of radiation is proportional to the concentration of atoms of that element.

Atomic adsorption spectrophotometer (AAS) has distinct advantage over flame emission spectroscopy, as the absorption of radiation by the atoms is independent of the wavelength of radiations and temperature of the atoms. AAS also have greater sensitivity and accuracy.

Standard working solutions:

The standard working solution of different cations *viz*; Zn and Fe should be prepared following the standard procedure given as under:

Zinc: Transfer 10 ml standard stock solution to 100 ml volumetric flask and dilute up to the mark with DTPA extracting solution to make stock solution of 10 µg Zn/ml or 10 ppm. Take 0, 1, 2, 4, 6 and 8 ml quantity of stock solution (10 µg Zn/ml) to a series of 100 ml volumetric flask and dilute each to the mark with DTPA extracting solution. This will give standard solutions having zinc concentration 0, 0.1, 0.2, 0.4, 0.6, and 0.8 µg/ml or ppm.

Iron: Transfer 0, 1, 2, 4, 6 and 8 ml of stock solution (100 µg Fe/ml or 100 ppm Fe) to a series of 100 ml volumetric flasks and dilute each to the mark with dilute HNO₃ (0.25 M). This will give standards solution having iron concentration of 0, 1, 2, 4, 6 and 8 ppm.

Procedure

Grain sample is digested either in HNO₃-HClO₄ mixture, digestion method is most preferred method for digestion of grain samples. Also carry blank digestion using all steps.

Determination of Zn and Fe in grain sample

Zn and Fe concentration in grain sample can be determined using atomic absorption spectrophotometer. The steps are as follows:

1. Read operator's manual carefully before start of the instrument (AAS).
2. Adjust the turret lamp position of the particular element to be tested.

3. Set zero of the instrument with blank (blank digest).
4. Feed standards of element to be determined to the AAS to standardize the instrument for element in sample.
5. Feed grain digest and record the absorbance/concentration of the element to be estimated.
6. Repeat the above steps for every element with specific turret lamp position.
7. In case the instrument shows a sign of over for some element in a particular sample, then make further dilution of the sample (say 2-5 times) and feed again to record absorbance or concentration.
8. Most of the modern AASs are calibrated to display the concentration of micronutrient in mg/litre directly. If the AAS displays the reading in absorbance then a standard curve has to be prepared on graph and the absorbance readings should be converted into concentration (mg/litre or ppm) from the curve.
9. No dilution of dry ash and diacid digest is usually required; if the solutions must be diluted to use 0.25 M HNO₃. If concentration is too low to read accurately, make final volume of dry ash digest up to 10 ml instead of 20 ml. In case diacid digest (HNO₃-HClO₄) is used, make final volume of digest upto 20 ml instead of 50 ml.
10. Contamination is a serious problem in the analysis of trace elements, and consequently, all glassware and laboratory ware must be cleaned in 1+1 HCl, followed by a distilled water rinse. Generally distilled water contains some amount of Cu, and therefore a reagent blank must be carried through the procedure. Silica may interfere with Mn determination; this should not be a problem if the silica has been properly dehydrated.

Calculation

Zn and Fe in grain sample (ppm) = AAS reading (mg/litre) x dilution

$$\text{Where dilution} = \frac{\text{Final Volume (ml)}}{\text{Weight of grain sample (g)}}$$

3.13 Photo-thermal index:

Photo-thermal observations were recorded at 50% flowering and physiological maturity.

3.13.1 Growing degree days:

The Growing Degree Days for a given day calculated by taking the average of the daily maximum and minimum temperatures compared to a base temperature. The base temperature of rice crop of 10°C was used for computation of GDD on daily basis (Thomas, 1957). As an equation:

$$\text{Growing degree days(GDD)} = \frac{T_{\text{max}} + T_{\text{min}}}{2} - T_{\text{base}}$$

3.13.2 Photo-thermal Unit:

The product of GDD and corresponding day length for that day were computed on daily basis as follows:

$$\text{PTU} = \text{GDD} \times \text{Day Length}$$

Where,

Day Length = Day length refers to maximum possible sunshine hours.

3.13.3 Helio-thermal Unit:

The product of GDD and corresponding actual sunshine hours for that day were computed on daily basis as

$$\text{HTU} = \text{GDD} \times \text{Actual Sunshine hours}$$

3.13.4 Phenothermal index (PTI) :

Phenothermal index (PTI) for each phenophase was calculated as per following formula given by Sastry and Chakravarty (1982)

$$\text{PTI} = \frac{\text{Growing Degree Days}}{\text{No. of days taken between two phenophases}}$$

3.14 Yield and yield attributes

Harvesting was done when plants reached to physiological maturity. Five randomly selected plants from each plot were harvested separately and observations on these selected plants were recorded as follows.

1. Number of tillers per plant
2. Total No. of panicles per plant
3. Panicle length (cm)
4. Total number of spikelet per panicle
5. Number of filled spikelet per panicle
6. 1000grain weight (g)
7. Grain yield per plant (g)
8. Straw weight per plant (g)
9. Harvest index

3.14.1 Number of tillers per plant: The total number of tillers per plant were counted and recorded.

3.14.2. Total No. of panicles per plant: One thousand healthy seeds were counted from the bulk produce of one plant

3.14.3. Panicle length (cm):

The length of panicle was measured from base to the tip of panicle in centimeters at the time of harvest.

3.14.4. Total number of spikelet per panicle:

The observation on number of spikelet panicle⁻¹ was made at harvesting stage. Ear bearing spikelets were counted from each plot and then number of spikelets panicle⁻¹ were worked out.

3.14.5. Number of filled spikelet per panicle:

Number of filled spikelet panicle⁻¹ was measured after the harvesting and from the total spikelet; filled spikelet were counted and separated manually.

3.14.6. 1000 grain weight (g):

One thousand healthy seeds were counted from the bulk produce of one plant and were dried in an oven at 60°C for 20-24 hours and maintain moisture up to 12 % and weighed after proper drying through electronic balance.

3.14.7 Grain yield per plant (g):

The weight of grains (filled) of each plant in gram per meter square was recorded. Grain yield was taken from plot, the whole plot after harvesting was threshed and the yield was taken for per plant.

3.14.8 Straw weight per plant (g):

After removing the panicles, the dry matter (straw) obtained from five plants were dried in sunlight, weighted and recorded in grams and mean was calculated.

3.14.9 Harvest index:

The ratio of economic yield (seed) to the total dry matter above ground biomass at harvest (Donald, 1962) was calculated by given formula.

$$\text{Harvest index} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Where,

Economic Yield = Grain Yield

Biological Yield = Grain Yield + Straw Yield

3.15 Statistical analysis

3.15.1 Analysis of variance:

Statistical analysis of the data obtained during the course of investigation was carried out by using standard statistical analysis method of analysis of variance and correlation coefficient, as described by Panse and Sukhatme (1985).

3.15.2 Mean:

The mean was recorded by summing up all the observation and then dividing by the total number of observations.

$$\bar{X} = \frac{\sum x}{n}$$

Where,

$\bar{X}$ = Sum of all observations

n = Total number of observations

3.15.3 Descriptive analysis:

Descriptive analysis (mean, critical difference and Standard error) of Morphological, Physio-chemical, Physiological, Growth parameters and Yield and yield attributed under field condition.

3.15.4 Critical difference:

CD = S Ed × t value at 5% at error degree of freedom

$$S\ Ed = \sqrt{\frac{2EMS}{r}}$$

Where,

SEd = Standard error of difference between two treatment means

EMS = Error mean sum of square

r = Number of replications

3.15.5 Standard error of mean:

$$SEm = \sqrt{\frac{EMS}{r}}$$

Where,

SEm = Standard mean of difference between two treatment

EMS = Error mean sum of square

r = Number of replications

3.15.6 Stability analysis

3.15.6.1 Analysis of variance for genotype x environment interactions and stability parameters

This statistical analysis for genotype x environment interactions and stability parameters were worked out according to Eberhart and Russell model (1966) for all the characters under study. According to them, the mean performance of i^{th} genotype in j^{th} environment, Y_{ij} is defined as:

$$Y_{ij} = \bar{X}_i + \beta_i I_j + \delta_{ij}$$

Where,

Y_{ij} = The phenotypic expression of a particular genotype (i) in a specific environment (j) where, $i=1, 2 \dots G$ genotypes, $j=1, 2, \dots, E$ environments

$\bar{X}_i$ = Mean of i^{th} genotypes overall environments

β_i = The regression coefficient that measures the linear regression of i^{th} genotype to varying environments

I_j = The environment index is obtained as the mean of all the genotypes at j^{th} environment minus the grand mean

$$I_j = (\sum_i Y_{ij} / g) - \sum_i \sum_j Y_{ij} / ge$$

Where,

$$\sum_i I_j = 0$$

δ_{ij} = The deviation from regression of the i^{th} genotype at the j^{th} environment

The model provides means of partitioning the genotype environment interaction into two parts.

- i) The variation due to response of i^{th} genotype to varying environmental indices i.e. sum of squares due to regression and
- ii) The deviation from regression

Partitioning the analysis of variance in this model was done as shown in Table 3.6.

Where,

r, e and g represent number of replications, environments and genotypes, respectively. The term S^2_e represent mean square due to pooled error so that

$$S^2_e = \sum_j 1/er S^2_j / (r - 1)(g - 1)$$

S^2_e = Error sum of squares at j^{th} environment ($j = 1, 2, e \dots$ environments)

r = Number of replications within each environment

g = Number of genotypes

For the f test, the mean square due to pooled deviations (MS_3) was tested against S^2_e (mean square for pooled error).

The appropriate f test for testing the significance among genotypic means i.e. $H_0 = \mu_1 = \mu_2 \dots \mu_g$ was obtained as $F \equiv MS_1/MS_3$ (where MS_1 is mean square for genotypes) and the hypothesis that there is no genetic differences among genotypes for the regression of their means on environmental indices can also be tested approximately by f test [where MS_2 is mean square for $G \times E$ (linear)].

$H_0 = \beta_1 = \beta_2 = \beta_g$ can be tested by $F = MS_2/MS_3$

The various stability parameters were then arrived for each of genotypes following these steps.

i) Mean ($\bar{X}_i$):

The mean values of i^{th} genotype over all environments

$$X_i = \sum_j Y_{ij} / e$$

ii) Regression coefficient

The regression coefficient 'b' arrived at in this study corresponds to the value of Perkins and Jinks (1968) in relation to the regression coefficient of Eberhart and Russell (1966).

$$b = 1 + \beta_1$$

Thus, b = regression of Y_{ij} on I_j

$$\sum_j Y_{ij} I_j / \sum_j I_j^2$$

Where,

$$I_j = \text{Environmental index} = \bar{X}_{.j} - \bar{X}_{..} \text{ such that } \sum_j I_j = 0$$

Where,

$$\bar{X}_{.j} = \text{Environmental mean}$$

$$\bar{X}_{..} = \text{General mean} = \sum_i \sum_j Y_{ij} / ge$$

Test of significance of 'b'

$$t(n-2) = b / \text{SE}(b)$$

$$\text{S.E.}(b) = \frac{(\text{Pooled deviation})^{1/2}}{I_j^2}$$

iii) Deviation from regression (S^2_{di}):

Non-linear component of genotype-environment interactions:

$$S^2_{di} = [\sum_j \delta^2_{ij} / (e-2)] - S^2_e / r$$

Where,

$$\sum \delta^2_{ij} = \left(\sum_j Y^2_{ij} - Y^2 \frac{i.}{e} \right) - \left(\sum_j Y_{ij} I_j \right)^2 / \sum_j I^2_j$$

The significance of the deviation from regression for each genotype was tested by the appropriate test as suggested by Eberhart and Russell (1966).

$$F = \left[\frac{\frac{\sum_j \delta^2_{ij}}{e-2}}{\text{Pooled error m.s.}} \right]$$

Table 3.15.7 Analysis of variance for genotype × environmental interactions and stability analysis.

Source of variation	d.f.	S.S.	M.S.	F
Genotype (G)	(g-1)	$\frac{1}{e} \sum_i Y^2_{i.} - \frac{(\sum Y_{ij})^2}{eg}$	M ₁	M ₁ /M ₆
Environment (E)	(e-1)	$\frac{1}{g} \sum_j Y^2_{.j} - \frac{(\sum Y_{ij})^2}{eg}$	M ₂	M ₂ /M ₆
G×E	(g-1)(e-1)	$\sum_i \sum_j Y^2_{ij} + \frac{(\sum Y_{ij})^2}{eg} - \text{E.S.S.} - \text{G.S.S.}$	M ₃	M ₃ /M ₇
E+(G×E)	g(e-1)	$\sum_i \sum_j Y^2_{ij} - \frac{1}{e} \sum_i Y^2_{i.}$	-	-
Environmental (linear)	1	$\frac{\frac{1}{g} (\sum_j Y_{ij} I_j)^2}{\sum_j I^2 j}$	M ₄	M ₄ / M ₆
G×E linear	(g-1)	$j \left[\frac{(\sum_j Y_{ij} I_j)^2}{\sum_j I^2 j} \right] - \text{E.S.S (linear)}$	M ₅	M ₅ / M ₆
Pooled deviation	g(e-2)	$\sum_i \sum_j \delta^2_{ij}$	M ₆	M ₆ / M ₇
Genotype 1	(e-2)	$\left[\sum_j Y^2_{ij} - \frac{(Y_{i.})^2}{e} - \frac{(\sum Y_{ij} I_j)^2}{\sum_j I^2 j} \right] = \sum \delta^2_{ij}$	-	-
Genotype 2	(e-2)	$\left[\sum_j Y^2_{gj} - \frac{(Y_{g.})^2}{e} - \frac{(\sum Y_{gj} I_j)^2}{\sum_j I^2 j} \right] = \sum \delta^2_{gj}$	-	-
Pooled error	e(g-1)(r-1)	S ² _e	M ₇	-

CHAPTER – IV

EXPERIMENTAL RESULTS

The present investigation entitled, “Morpho-physiological and biochemical characterization of rice (*Oryza sativa* L.) genotypes for their suitability under *rabi* environment of Konkan” was carried out at Regional Agriculture Research Station Karjat Dist-Raigad (MH) during *kharif* -2020, *kharif*-2021, *rabi*-20-21 and *rabi*-21-22. In the present investigation attempts have been made to find out physiologically efficient, high yielding and stable genotype for growing under *rabi* season. The experimental findings of the present investigation have been described under the following heads:

1. Morphological and phonological parameters
2. Physiological parameters
3. Leaf Gas Exchange parameters
4. Biochemical analysis
5. Yield and yield attributes

4.1 Morphological and phonological Parameters:

4.1.1. Plant height (cm):

Data regarding mean plant height of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 2 in graphically depicted in fig.1. It was observed that, the mean plant height was higher during 2021-22 as compared to 2020-21. The data clearly revealed that, the mean plant height went on increasing with increase in age of crop and was maximum at harvest stage during both years and in pooled mean.

The mean height was 57.09, 59.97 and 58.53 cm at tillering stage, 88.48, 92.86 and 90.67 cm at flowering stage and 91.18, 95.51

and 93.34 cm at harvest stage was recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 2 revealed that, the mean plant height of rice at different stages of crop growth was significantly influenced due to different sowing dates.

Generally, crop sown during *kharif* season i.e. S₁(24th MW) produced significantly taller plant (115.81 cm) as compared to other sowing dates of *rabi* season i.e. S₂(48th MW), S₃(50th MW), S₄(52th MW) for all growth stages of rice i.e. tillering, flowering and harvesting stages during 2020-21, 2021-22 and pooled mean.

The rice crop sown during *rabi* season, the S₃ i.e. 50th MW date of sowing recorded significantly higher plant height at harvest (90.27 cm) as compared to crop sown during S₂ i.e. 48th MW (86.30 cm) and S₄ i.e. 52th MW (80.99 cm) similarly for all growth stages in both year and pooled mean. Significantly lower plant height was recorded S₄ (80.99 cm) as compared to other sowing dates S₁, S₂ and S₃.

Effect of genotypes:

The plant height of rice was influenced significantly due to the different genotypes at all growth stages during both year and pooled mean. The rice genotype V₃₉ (Sorati) recorded significantly higher plant height at tillering, flowering and harvesting stages during 2020-21 (74.08 cm, 114.24 cm and 116.79 cm), 2021-22 (76.65 cm, 117.65 cm and 120.23 cm) and (75.36 cm, 115.94 cm and 118.51 cm) followed by variety China, Mhadi and rest of all other genotypes. Significantly lower plant height was recorded V₃₆ i.e. Hira (76.60 cm) which was at par with V₃ i.e. Karjat -4 (78.74 cm) over other genotypes.

Table 2 : Effect of different treatments on plant height (cm) of rice genotypes

Treatments	Plant height (cm)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)									
S ₁ : 24 th MW	65.19	63.04	64.11	112.08	114.04	113.06	114.85	116.77	115.81
S ₂ : 48 th MW	52.43	61.38	56.91	77.49	89.92	83.71	80.12	92.49	86.30
S ₃ : 50 th MW	58.46	63.93	61.20	85.14	90.06	87.60	87.83	92.71	90.27
S ₄ : 52 th MW	52.28	51.53	51.90	79.22	77.43	78.33	81.92	80.07	80.99
SE ±	0.31	0.72	0.43	0.58	0.70	0.52	0.53	0.71	0.49
C.D. at 5%	1.09	2.55	1.30	2.01	2.43	1.80	1.82	2.46	1.71
B) Sub plot (Varieties)									
V ₁ :Karjat-1	61.37	56.76	59.07	82.21	85.10	83.65	84.38	87.78	86.08
V ₂ :Karjat-3	58.32	63.28	60.80	88.40	92.03	90.22	91.14	94.83	92.99
V ₃ :Karjat-4,	56.88	54.31	55.60	74.88	76.89	75.89	77.95	79.54	78.74
V ₄ :Karjat-7	51.89	55.83	53.86	79.22	81.99	80.61	81.40	84.56	82.98
V ₅ :Karjat-184	57.27	59.18	58.22	81.60	86.34	83.97	84.19	88.98	86.58
V ₆ :Sahyadri-2	62.65	60.53	61.59	91.81	91.70	91.75	94.50	94.36	94.43
V ₇ :Sahyadri-4	58.84	60.41	59.63	87.43	91.66	89.55	90.24	93.89	92.07
V ₈ :Phondaghat -1	60.73	64.07	62.40	94.65	99.66	97.15	97.54	102.03	99.79
V ₉ :Ratnagiri-1	54.92	64.25	59.58	83.75	96.33	90.04	86.51	99.13	92.82
V ₁₀ :Ratnagiri-5	56.18	59.42	57.80	81.93	89.50	85.71	84.58	92.24	88.41
V ₁₁ :Ratnagiri- 6	61.19	63.91	62.55	91.44	95.82	93.63	93.91	98.75	96.33
V ₁₂ :Ratnagiri- 7	60.21	69.26	64.73	88.96	98.01	93.48	91.08	100.47	95.78
V ₁₃ :Ratnagiri -24	49.51	58.98	54.24	78.01	89.13	83.57	80.53	91.77	86.15
V ₁₄ :Ratnagiri-73	54.54	58.97	56.75	77.87	81.63	79.75	80.54	84.39	82.47
V ₁₅ :Ratnagiri-711	55.59	57.26	56.43	83.34	86.60	84.97	85.44	89.11	87.28
V ₁₆ :IRRI-14	54.19	59.95	57.07	90.94	96.62	93.78	93.82	99.74	96.78
V ₁₇ :IRRI-15	57.76	58.91	58.34	95.76	98.91	97.33	98.69	101.20	99.94
V ₁₈ :IRRI-20	55.12	57.98	56.55	91.29	97.06	94.17	94.35	99.36	96.85
V ₁₉ :IRRI-21	58.53	59.83	59.18	93.95	94.99	94.47	96.44	97.72	97.08
V ₂₀ :IRRI-22	52.88	57.32	55.10	94.46	99.32	96.89	97.18	102.40	99.79
V ₂₁ :IRRI-27	48.37	49.55	48.96	81.29	84.38	82.84	84.01	87.63	85.82
V ₂₂ :IRRI-28	59.54	62.73	61.13	85.37	91.98	88.68	87.92	94.44	91.18
V ₂₃ :IRRI-34	52.79	64.07	58.43	89.37	98.74	94.06	92.11	101.31	96.71
V ₂₄ :IRRI-36	51.38	53.63	52.51	85.88	92.55	89.22	88.83	94.81	91.82
V ₂₅ :IRRI-47	53.61	59.27	56.44	88.11	94.69	91.40	90.81	97.71	94.26
V ₂₆ :IRRI-52	54.36	57.46	55.91	90.36	94.80	92.58	92.99	97.06	95.03
V ₂₇ :IRRI-53	49.86	51.54	50.70	81.69	85.46	83.57	84.31	88.14	86.23
V ₂₈ :IRRI-55	58.75	58.40	58.58	93.17	98.48	95.83	96.04	101.17	98.60
V ₂₉ :IRRI-62	53.61	60.29	56.95	86.70	96.79	91.74	89.63	99.30	94.46
V ₃₀ :IR-35	58.64	61.53	60.08	96.72	96.61	96.67	99.44	99.74	99.59
V ₃₁ :Laldodaki	59.48	62.61	61.04	91.81	94.94	93.37	94.56	97.44	96.00
V ₃₂ :IR2289-6-22-5	54.91	55.84	55.37	83.49	84.67	84.08	86.45	86.66	86.55
V ₃₃ :Narmada	50.99	57.33	54.16	80.41	85.58	82.99	83.38	88.56	85.97
V ₃₄ :Ananda	60.35	62.35	61.35	90.68	95.01	92.85	93.66	97.58	95.62
V ₃₅ :Ambpandhari	51.19	55.34	53.27	86.78	90.84	88.81	89.12	93.58	91.35
V ₃₆ :Hira	49.37	53.66	51.52	72.20	75.58	73.89	74.98	78.23	76.60
V ₃₇ :OR-1516-1-5-A	62.93	66.69	64.81	95.93	99.10	97.52	98.92	102.05	100.49
V ₃₈ :China	74.73	66.03	70.38	107.14	101.61	104.38	109.48	104.14	106.81
V ₃₉ :Sorati	74.08	76.65	75.36	114.24	117.65	115.94	116.79	120.23	118.51
V ₄₀ :Mhadi	66.16	63.36	64.76	99.58	98.28	98.93	102.56	100.66	101.61
SE ±	1.83	1.77	1.27	1.45	1.32	0.96	1.415	1.295	0.94
C.D. at 5%	5.10	4.93	3.54	4.03	3.66	2.67	3.937	3.602	2.63
Interaction Effect (S x M)									
SE ±	3.63	3.57	2.55	2.90	2.63	1.92	2.830	2.589	1.89
C.D. at 5%	10.13	10.04	7.07	8.06	7.32	5.35	7.874	7.203	5.25
General Mean	57.09	59.97	58.53	88.48	92.86	90.67	91.18	95.508	93.34

S₁ : 24th MW (11th-17th June)S₃ : 50th MW (10th-16th December)S₂ : 48th MW (26th November-2nd December)S₄ : 52th MW (24th-31st December)

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of plant height (Table 3). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype with V₃₉ i.e. Sorati recorded significantly higher plant height (171.67 cm) over others genotypes.

In case of *rabi* season S₃V₃₉ i.e. crop sown S₃ i.e. 50th MW with rice variety Sorati recorded significantly higher plant height (108.39cm, 113.47cm, 110.93cm) during both years and pooled mean at harvest stage. Interaction S₄V₃ recorded significantly lowest plant height (62.22cm) over other genotypes.

4.1.2. Days to first flowering:

Data regarding mean days to first flowering of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 4 in graphically depicted in fig.2. The mean days to first flowering was 83.054 days, 82.827 days and 82.941days recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table4revealed that, the mean days to first flowering of rice genotypes was significantly influenced duet different sowing dates.

Crop sown during S₁-*kharif* season(24th MW)produced significantly minimum days to first flowering (80.50 days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

The rice crop sown during *rabi* season, S₂(48th MW)date of sowing recorded significantly maximum days to first flowering (84.02 days) which was at par with S₄(52th MW) (83.73 days) and over other in pooled mean.

Table3 : Interaction effect of plant height (cm) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₇	V ₈	V ₉	V ₁₀
S ₁	83.00	107.33	100.00	100.00	97.33	129.33	115.00	121.67	118.33	114.67
S ₂	87.00	92.89	75.89	74.22	68.33	76.89	80.67	82.89	70.45	75.67
S ₃	84.56	83.11	74.56	77.33	91.00	83.56	82.78	96.28	83.39	82.00
S ₄	82.97	81.23	61.33	74.03	80.10	88.23	82.53	89.33	73.87	65.97
Sowing dates	Varieties									
	V ₁₁	V ₁₂	V ₁₃	V ₁₄	V ₁₅	V ₁₆	V ₁₇	V ₁₈	V ₁₉	V ₂₀
S ₁	116.00	110.67	106.33	87.67	94.33	117.67	118.33	115.00	115.33	119.00
S ₂	84.56	82.78	76.22	74.11	79.22	80.44	92.78	78.55	86.45	81.11
S ₃	88.17	86.11	83.94	85.42	84.78	91.94	92.83	95.50	90.22	104.61
S ₄	86.90	84.77	82.47	74.97	83.43	85.23	90.80	88.33	93.77	84.00
Sowing dates	Varieties									
	V ₂₁	V ₂₂	V ₂₃	V ₂₄	V ₂₅	V ₂₆	V ₂₇	V ₂₈	V ₂₉	V ₃₀
S ₁	90.00	100.33	100.00	124.00	122.33	128.00	102.00	112.67	102.33	140.33
S ₂	76.67	72.78	84.55	71.33	78.11	74.78	77.00	88.11	80.89	86.00
S ₃	92.72	96.67	96.00	86.67	84.28	94.17	94.06	92.17	84.72	86.94
S ₄	76.67	81.90	87.90	73.33	78.53	75.00	64.20	91.20	90.57	84.47
Sowing dates	Varieties									
	V ₃₁	V ₃₂	V ₃₃	V ₃₄	V ₃₅	V ₃₆	V ₃₇	V ₃₈	V ₃₉	V ₄₀
S ₁	140.67	107.00	104.67	119.33	117.33	72.33	158.67	145.00	172.67	147.33
S ₂	77.78	84.22	78.22	83.22	79.00	72.66	72.22	89.11	98.11	78.78
S ₃	75.89	85.67	74.78	85.00	74.61	74.78	94.00	99.06	108.39	90.44
S ₄	83.90	68.90	75.87	87.10	85.53	80.13	70.80	104.77	88.00	93.67
SE $\pm$		2.830								
C.D. at 5%		7.874								

Year 2021-22

Sowing dates	Varieties									
	V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₇	V ₈	V ₉	V ₁₀
S ₁	91.67	112.67	105.33	101.67	102.33	134.33	115.00	116.33	129.00	124.67
S ₂	88.00	87.33	74.53	79.90	86.33	81.00	87.00	104.90	98.03	90.20
S ₃	88.57	92.00	75.17	82.57	92.13	90.23	87.00	103.43	94.67	83.10
S ₄	82.89	87.33	63.11	74.11	75.11	71.89	86.56	83.46	74.80	71.00
Sowing dates	Varieties									
	V ₁₁	V ₁₂	V ₁₃	V ₁₄	V ₁₅	V ₁₆	V ₁₇	V ₁₈	V ₁₉	V ₂₀
S ₁	121.33	114.67	121.00	91.00	96.00	120.33	120.00	120.33	111.33	117.00
S ₂	91.00	102.57	106.23	84.67	88.03	102.77	98.57	94.10	90.43	101.47
S ₃	95.23	90.20	93.10	85.57	88.00	91.30	95.00	97.43	93.57	107.67
S ₄	87.42	94.46	77.33	76.33	84.42	84.54	91.23	85.57	95.53	83.46
Sowing dates	Varieties									
	V ₂₁	V ₂₂	V ₂₃	V ₂₄	V ₂₅	V ₂₆	V ₂₇	V ₂₈	V ₂₉	V ₃₀
S ₁	90.67	106.67	111.00	114.67	115.33	121.67	105.00	108.33	107.67	133.33
S ₂	90.10	86.30	97.57	92.67	101.87	96.80	79.43	102.67	102.80	85.33
S ₃	93.67	99.23	109.10	97.43	92.57	97.57	96.23	100.90	94.50	96.20
S ₄	76.10	85.56	87.56	74.47	81.09	72.22	71.89	92.77	92.22	84.09
Sowing dates	Varieties									
	V ₃₁	V ₃₂	V ₃₃	V ₃₄	V ₃₅	V ₃₆	V ₃₇	V ₃₈	V ₃₉	V ₄₀
S ₁	132.33	111.33	116.67	123.00	123.00	77.00	161.33	131.33	170.67	143.67
S ₂	88.43	81.00	86.33	97.20	92.00	79.90	83.77	111.90	112.57	93.77
S ₃	86.00	90.53	78.80	85.77	77.20	73.57	94.33	106.77	113.47	98.77
S ₄	82.99	63.78	72.42	84.36	82.13	82.44	68.78	66.56	84.22	66.44
SE $\pm$		2.589								
C.D. at 5%		7.203								

Pooled

Sowing dates	Varieties									
	V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₇	V ₈	V ₉	V ₁₀
S ₁	87.33	110.00	102.67	100.83	99.83	131.83	115.00	119.00	123.67	119.67
S ₂	87.50	90.11	75.21	77.06	77.33	78.95	83.83	93.89	84.24	82.93
S ₃	86.56	87.56	74.86	79.95	91.57	86.90	84.89	99.86	89.03	82.55
S ₄	82.93	84.28	62.22	74.07	77.61	80.06	84.55	86.40	74.33	68.48
Sowing dates	Varieties									
	V ₁₁	V ₁₂	V ₁₃	V ₁₄	V ₁₅	V ₁₆	V ₁₇	V ₁₈	V ₁₉	V ₂₀
S ₁	118.67	112.67	113.67	89.33	95.17	119.00	119.17	117.67	113.33	118.00
S ₂	87.78	92.67	91.23	79.39	83.63	91.61	95.67	86.33	88.44	91.29
S ₃	91.70	88.16	88.52	85.49	86.39	91.62	93.92	96.47	91.90	106.14
S ₄	87.16	89.61	79.90	75.65	83.93	84.89	91.02	86.95	94.65	83.73
Sowing dates	Varieties									
	V ₂₁	V ₂₂	V ₂₃	V ₂₄	V ₂₅	V ₂₆	V ₂₇	V ₂₈	V ₂₉	V ₃₀
S ₁	90.33	103.50	105.50	119.33	118.83	124.83	103.50	110.50	105.00	136.83
S ₂	83.38	79.54	91.06	82.00	89.99	85.79	78.22	95.39	91.85	85.67
S ₃	93.20	97.95	102.55	92.05	88.42	95.87	95.15	96.53	89.61	91.57
S ₄	76.38	83.73	87.73	73.90	79.81	73.61	68.05	91.98	91.40	84.28
Sowing dates	Varieties									
	V ₃₁	V ₃₂	V ₃₃	V ₃₄	V ₃₅	V ₃₆	V ₃₇	V ₃₈	V ₃₉	V ₄₀
S ₁	136.50	109.17	110.67	121.17	120.17	74.67	160.00	138.17	171.67	145.50
S ₂	83.11	82.61	82.28	90.21	85.50	76.28	78.00	100.51	105.34	86.27
S ₃	80.95	88.10	76.79	85.38	75.91	74.17	94.17	102.91	110.93	94.61
S ₄	83.45	66.34	74.15	85.73	83.83	81.29	69.79	85.66	86.11	80.06
SE ±		1.890								
C.D. at 5%		5.250								

Effect of genotypes:

The days to first flowering of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 4). The rice genotype V₃₇ i.e. OR-1516-1-5A recorded significantly minimum (Early) days to first flowering (65.42 days) which was at par with V₃₆ i.e. Hira (65.63 days) over others. Rice genotype V₁₀ i.e. Ratnagiri-5 recorded significantly maximum days to first flowering (89.13 days) which was at par with V₁₁ i.e. Ratnagiri-6 (89.04 days) V₃₁ i.e. Laldodki (88.54 days) over others during 2020-21, 2021-22 and pooled mean.

Table 4: Effect of different treatments on days to first flowering of rice genotypes

Treatments	Days to first flowering		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S ₁ : 24 th MW	80.93	80.07	80.50
S ₂ : 48 th MW	83.67	84.38	84.02
S ₃ : 50 th MW	83.65	83.38	83.51
S ₄ :52 th MW	83.97	83.49	83.73
SE $\pm$	0.103	0.167	0.100
C.D. at 5%	0.355	0.577	0.345
B)Sub plot (Varieties)			
V ₁ :Karjat-1	80.92	81.42	81.17
V ₂ :Karjat-3	82.33	81.75	82.04
V ₃ :Karjat-4,	84.67	83.83	84.25
V ₄ :Karjat-7	85.33	84.92	85.13
V ₅ :Karjat-184	76.00	74.67	75.33
V ₆ :Sahyadri-2	84.50	83.42	83.96
V ₇ :Sahyadri-4	85.67	85.17	85.42
V ₈ :Phondaghat -1	86.75	86.00	86.38
V ₉ :Ratnagiri-1	87.33	86.92	87.13
V ₁₀ :Ratnagiri-5	87.92	90.33	89.13
V ₁₁ :Ratnagiri- 6	88.17	89.92	89.04
V ₁₂ :Ratnagiri- 7	85.42	85.42	85.42
V ₁₃ :Ratnagiri -24	69.77	68.38	69.08
V ₁₄ :Ratnagiri-73	68.00	66.83	67.42
V ₁₅ :Ratnagiri-711	84.17	86.50	85.33
V ₁₆ :IRRI-14	86.33	85.58	85.96
V ₁₇ :IRRI-15	84.50	85.17	84.83
V ₁₈ :IRRI-20	83.17	84.33	83.75
V ₁₉ :IRRI-21	85.08	84.33	84.71
V ₂₀ :IRRI-22	83.75	83.17	83.46
V ₂₁ :IRRI-27	83.42	82.00	82.71
V ₂₂ :IRRI-28	83.92	83.92	83.92
V ₂₃ :IRRI-34	88.08	88.17	88.13
V ₂₄ :IRRI-36	87.50	85.50	86.50
V ₂₅ :IRRI-47	84.67	85.08	84.88
V ₂₆ :IRRI-52	85.17	84.50	84.83
V ₂₇ :IRRI-53	86.00	84.42	85.21
V ₂₈ :IRRI-55	85.42	85.58	85.50
V ₂₉ :IRRI-62	85.25	85.42	85.33
V ₃₀ :IR-35	85.83	85.50	85.67
V ₃₁ :Laldodaki	86.92	90.17	88.54
V ₃₂ :IR2289-6-22-5	87.58	88.75	88.17
V ₃₃ :Narmada	85.33	85.33	85.33
V ₃₄ :Ananda	83.42	81.42	82.42
V ₃₅ :Ambpandhari	84.50	85.83	85.17
V ₃₆ :Hira	65.58	65.67	65.63
V ₃₇ :OR-1516-1-5-A	65.83	65.00	65.42
V ₃₈ :China	77.17	76.08	76.63
V ₃₉ :Sorati	78.17	75.83	77.00
V ₄₀ :Mhadi	86.83	85.17	86.00
SE $\pm$	0.43	0.40	0.305
C.D. at 5%	1.19	1.11	0.850
Interaction Effect (S x V)			
SE $\pm$	0.856	0.800	0.611
C.D. at 5%	2.380	2.225	1.700
General Mean	83.054	82.827	82.941

S₁ : 24th MW (11th-17th June)

S₂ : 48th MW (26th November-2nd December)

S₃ : 50th MW (10th-16th December)

S₄ :52th MW (24th-31st December)

Table 5: Interaction effect of days to first flowering on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	78.33	81.67	81.67	83.00	72.33	81.67	83.33	84.33	85.00	84.67
S2	83.00	82.67	87.67	85.33	77.00	83.67	85.33	88.00	88.33	90.67
S3	82.00	82.33	82.00	86.00	76.33	84.00	87.00	87.67	88.33	88.67
S4	80.33	82.67	87.33	87.00	78.33	88.67	87.00	87.00	87.67	87.67
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	86.67	82.67	76.00	66.00	81.67	86.00	83.33	81.00	82.67	81.33
S2	88.33	85.33	75.00	68.33	84.67	86.67	85.33	83.67	86.00	84.00
S3	89.00	87.33	75.33	69.33	86.00	86.67	85.00	84.00	86.00	84.00
S4	88.67	86.33	76.00	68.33	84.33	86.00	84.33	84.00	85.67	85.67
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	80.67	82.00	86.00	84.67	82.67	84.00	83.67	82.67	83.00	84.00
S2	84.67	84.67	89.00	88.33	85.33	85.67	86.33	86.00	85.67	87.00
S3	83.33	83.67	88.67	88.33	85.00	85.00	87.67	86.67	86.33	86.67
S4	85.00	85.33	88.67	88.67	85.67	86.00	86.33	86.33	86.00	85.67
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	85.33	85.33	83.67	82.67	81.00	62.67	62.67	75.67	75.33	86.33
S2	86.67	88.33	85.33	83.00	84.00	65.33	66.67	77.67	80.00	88.00
S3	87.33	88.67	86.33	84.67	87.00	66.00	66.33	77.33	77.67	86.33
S4	88.33	88.00	86.00	83.33	86.00	68.33	67.67	78.00	79.67	86.67
SE $\pm$		0.856								
C.D. at 5%		2.380								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	81.00	80.33	82.00	80.67	70.67	80.00	81.67	83.00	85.00	87.67
S2	84.00	82.33	85.33	86.00	75.33	85.33	86.67	87.67	88.00	91.00
S3	80.67	82.67	84.33	86.00	77.00	83.33	86.67	88.00	88.00	91.67
S4	80.00	81.67	83.67	87.00	75.67	85.00	85.67	85.33	86.67	91.00
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	86.00	81.00	71.00	64.33	81.67	82.67	83.33	81.67	81.00	80.00
S2	90.00	86.67	74.67	68.67	86.00	86.67	86.00	86.00	85.67	84.67
S3	91.00	85.00	73.33	68.00	85.67	86.33	86.33	83.00	86.00	83.67
S4	92.67	89.00	77.33	66.33	92.67	86.67	85.00	86.67	84.67	84.33
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	79.00	79.67	86.33	83.00	83.33	82.67	82.00	83.67	83.33	82.67
S2	82.67	87.00	89.33	87.67	86.33	85.00	86.00	86.67	86.33	88.00
S3	83.00	84.00	88.33	86.67	85.00	85.33	85.33	86.33	86.00	86.33
S4	83.33	85.00	88.67	84.67	85.67	85.00	84.33	85.67	86.00	85.00
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	87.00	86.00	82.33	78.67	83.33	62.33	62.33	73.33	74.00	83.00
S2	92.67	91.33	89.67	85.33	86.67	67.00	67.33	78.00	78.00	87.33
S3	90.67	88.67	84.67	82.00	86.00	66.33	66.00	76.00	76.33	85.33
S4	90.33	89.00	84.67	79.67	87.33	67.00	64.33	77.00	75.00	85.00
SE $\pm$		0.800								
C.D. at 5%		2.225								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	79.67	81.00	81.83	81.83	71.50	80.83	82.50	83.67	85.00	86.17
S2	83.50	82.50	86.50	85.67	76.17	84.50	86.00	87.83	88.17	90.83
S3	81.33	82.50	83.17	86.00	76.67	83.67	86.83	87.83	88.17	90.17
S4	80.17	82.17	85.50	87.00	77.00	86.83	86.33	86.17	87.17	89.33
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	86.33	81.83	73.50	65.17	81.67	84.33	83.33	81.33	81.83	80.67
S2	89.17	86.00	74.83	68.50	85.33	86.67	85.67	84.83	85.83	84.33
S3	90.00	86.17	74.33	68.67	85.83	86.50	85.67	83.50	86.00	83.83
S4	90.67	87.67	76.67	67.33	88.50	86.33	84.67	85.33	85.17	85.00
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	79.83	80.83	86.17	83.83	83.00	83.33	82.83	83.17	83.17	83.33
S2	83.67	85.83	89.17	88.00	85.83	85.33	86.17	86.33	86.00	87.50
S3	83.17	83.83	88.50	87.50	85.00	85.17	86.50	86.50	86.17	86.50
S4	84.17	85.17	88.67	86.67	85.67	85.50	85.33	86.00	86.00	85.33
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	86.17	85.67	83.00	80.67	82.17	62.50	62.50	74.50	74.67	84.67
S2	89.67	89.83	87.50	84.17	85.33	66.17	67.00	77.83	79.00	87.67
S3	89.00	88.67	85.50	83.33	86.50	66.17	66.17	76.67	77.00	85.83
S4	89.33	88.50	85.33	81.50	86.67	67.67	66.00	77.50	77.33	85.83
SE $\pm$		0.611								
C.D. at 5%		1.700								

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of days to first flowering (Table5). The rice crop sown S₁ i.e. *kharif* season (24th MW) with variety V₁₁ i.e. Ratnagiri-6 recorded significantly maximum days to first flowering (86.33 days) which was at par with V₉ Ratnagiri-1 (85.00days), V₁₀ i.e. Ratnagiri5 (86.17days), V₁₆ i.e. IRRI14(84.33days), V₂₃ i.e. IRRI34(86.17days), V₃₁ i.e. Laldodki (86.17days), V₃₂ i.e. IR2289-6-22-5(85.67days) and V₄₀ i.e. Mhadi (84.67days) over other treatment combination during 2020-21, 2021-22 years and pooled mean.

In case of *rabi* season S₂V₁₀ i.e. crop sown in S₂ date of sowing (48th MW) with Ratnagiri-5 was recorded significantly higher days to first flowering (90.83days) which was at par with S₂V₁₁ (89.17days), S₂V₂₃ (89.17days), S₂V₃₁(89.67days), S₂V₃₂(89.83days), i.e. crop sown in S₂ date of sowing (48th MW), S₃V₁₀(90.17days) date S₃V₁₁ (90.00 days) i.e. crop sown in S₃ date of sowing (50th MW) and S₄V₁₀(89.33days), S₄V₁₁(90.67days), S₄V₃₁(89.33days) i.e. crop sown in S₄ date of sowing (52th MW).

1.3. Days to 50 % flowering:

Data regarding mean days for 50% flowering of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 6 in graphically depicted in fig.3. The data clearly revealed that the mean days for 50% flowering was 87.492 days, 87.244 days and 87.368 days recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 6 revealed that, the mean days to 50% flowering of rice genotypes was significantly influence due to different sowing dates.

Crop sown during S₁-*kharif* season (24th MW) produced significantly minimum days to 50% flowering (84.89days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

The rice crop sown during S₂i.e.date of sowing in *rabi* season (48th MW) recorded significantly maximum days to 50% flowering (88.48days) as compared to crop sown during S₃ i.e. date of sowing in *rabi* season (50th MW) (87.94days) and S₄ i.e. date of sowing in *rabi* season (52th MW)(88.17days) in both year and pooled mean.

Effect of genotypes:

The days to 50% flowering of rice was influenced significantly due to the different genotypes during both year and pooled mean. The rice genotype Hira and OR-1516-1-5-A recorded significantly minimum (Early)

Table 6: Effect of different treatment on days to 50% flowering of rice genotypes.

Treatments	Days to 50% flowering		
	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)			
S1 : 24 th MW	85.30	84.48	84.89
S2 : 48 th MW	88.14	88.81	88.48
S3 : 50 th MW	88.11	87.77	87.94
S4 :52 th MW	88.42	87.93	88.17
SE $\pm$	0.103	0.160	0.093
C.D. at 5%	0.357	0.555	0.322
B)Sub plot (Varieties)			
V1:Karjat-1	85.50	85.58	85.54
V2:Karjat-3	86.92	86.25	86.58
V3:Karjat-4,	89.17	88.25	88.71
V4:Karjat-7	89.67	89.33	89.50
V5:Karjat-184	80.50	79.17	79.83
V6:Sahyadri-2	88.83	88.00	88.42
V7:Sahyadri-4	89.92	89.33	89.63
V8:Phondaghat -1	91.25	90.50	90.88
V9:Ratnagiri-1	91.92	91.33	91.63
V10:Ratnagiri-5	92.33	94.75	93.54
V11:Ratnagiri- 6	92.67	94.58	93.63
V12:Ratnagiri- 7	89.92	89.67	89.79
V13:Ratnagiri -24	73.92	72.54	73.23
V14:Ratnagiri-73	72.50	71.25	71.88
V15:Ratnagiri-711	88.58	90.58	89.58
V16:IRRI-14	90.42	90.00	90.21
V17:IRRI-15	88.67	89.42	89.04
V18:IRRI-20	87.83	88.83	88.33
V19:IRRI-21	89.42	88.83	89.13
V20:IRRI-22	88.42	87.75	88.08
V21:IRRI-27	87.75	86.58	87.17
V22:IRRI-28	88.50	88.33	88.42
V23:IRRI-34	92.50	92.67	92.58
V24:IRRI-36	91.92	90.00	90.96
V25:IRRI-47	89.08	89.33	89.21
V26:IRRI-52	89.50	88.67	89.08
V27:IRRI-53	90.50	89.00	89.75
V28:IRRI-55	90.00	89.83	89.92
V29:IRRI-62	89.50	90.00	89.75
V30:IR-35	90.25	89.92	90.08
V31:Laldodaki	91.25	94.50	92.88
V32:IR2289-6-22-5	92.17	93.33	92.75
V33:Narmada	89.92	89.67	89.79
V34:Ananda	87.75	85.83	86.79
V35:Ambpandhari	89.08	90.42	89.75
V36:Hira	69.83	69.83	69.83
V37:OR-1516-1-5-A	70.25	69.42	69.83
V38:China	81.67	80.50	81.08
V39:Sorati	82.50	80.17	81.33
V40:Mhadi	91.25	89.75	90.50
SE $\pm$	0.406	0.380	0.296
C.D. at 5%	1.129	1.057	0.823
Interaction Effect (S x V)			
SE $\pm$	0.811	0.760	0.592
C.D. at 5%	2.257	2.114	1.646
General Mean	87.492	87.244	87.368

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

to 50% flowering (69.83 days) followed by genotype V₁₄ i.e. Ratnagiri-73(71.88 days) and V₁₃ i.e. Ratnagiri-24 (73.23days). Rice genotype V₁₁ i.e. Ratnagiri-6 recorded significantly maximum days to 50% flowering (93.69 days) which was at par with V₁₀ i.e. Ratnagiri 5(93.54days), V₉ i.e. Ratnagiri1(91.63days), V₃₁ i.e. Laldodki (92.88days) and V₃₂ i.e. IR2289-6-22-5(92.75days) over others for pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotype was significant in respect of days to 50% flowering (Table 7). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₁₀ i.e. Ratnagiri-5 recorded significantly higher days to 50% flowering (90.67 days) which was at par with S₁V₉ (89.50 days), S₁V₁₁(90.83 days), S₁V₂₃(90.67days), S₁V₃₁ (90.50 days) and S₁V₃₂ (90.17 days) during pooled mean.

In case of *rabi* season S₂V₁₀ i.e. crop sown in S₂ date of sowing (48th MW) with V₁₀ i.e. Ratnagiri-5 was recorded significantly higher days to 50% flowering (95.33days) which was at par with S₂V₁₁(93.83days), S₂V₂₃(93.50days) S₂V₃₁(93.83days), S₂V₃₂(94.50days) i.e. crop sown in S₂ date of sowing (48th MW) and S₃V₁₀(94.17days), S₃V₁₁(94.67days), S₃V₃₁(93.50days), S₃V₃₂(93.17days) i.e. crop sown in S₃ date of sowing (50th MW) and S₄V₁₁(95.17days), S₄V₁₀(94.00 days), S₄V₂₃ (93.17days), S₄V₃₁(93.67days), S₄V₃₂(93.17days) i.e. crop sown in S₄ date of sowing (52th MW) during pooled mean over others. However, S₃V₃₆ i.e. crop sown in S₃ date of sowing (50th MW) with rice variety Hira was significantly minimum days to 50% flowering(70.17days) which was at par with S₂V₃₆(70.67days), S₂V₃₇(71.17days) i.e. crop sown S₂ date of sowing (48th MW), S₃V₃₇(70.50days) i.e. crop sown S₃ date of sowing (50th MW) and S₄V₃₆ (71.83 days) i.e. crop sown S₄ date of sowing (52th MW) during pooled mean.

4.1.4. Days to physiological maturity:

Data regarding mean days to physiological maturity of rice as influenced by different sowing dates and genotype during both years and in the pooled, the data are presented in Table 8 in graphically depicted

Table 7 : Interaction effect of days to 50% flowering on sowing dates and varieties
Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	82.67	86.33	86.00	87.00	77.00	85.67	88.00	89.00	89.33	89.33
S2	87.67	87.33	92.33	89.67	81.67	88.00	89.67	92.67	93.00	95.00
S3	86.67	87.00	86.67	90.33	81.00	88.33	91.00	91.67	93.00	92.67
S4	85.00	87.00	91.67	91.67	82.33	93.33	91.00	91.67	92.33	92.33
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	91.00	87.00	80.67	70.67	86.00	89.00	87.33	85.67	86.67	86.00
S2	93.00	89.67	79.33	73.00	88.67	91.33	89.33	88.33	90.67	88.67
S3	93.67	92.00	80.00	73.67	90.67	91.00	89.33	88.67	90.67	88.67
S4	93.00	91.00	80.33	72.67	89.00	90.33	88.67	88.67	89.67	90.33
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	85.33	86.33	90.33	89.33	87.00	88.00	87.67	87.67	87.00	88.33
S2	89.00	89.33	93.33	92.67	89.67	90.33	91.00	90.33	90.33	91.33
S3	87.67	88.33	93.00	92.33	89.33	89.33	92.33	91.33	90.67	91.33
S4	89.00	90.00	93.33	93.33	90.33	90.33	91.00	90.67	90.00	90.00
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	89.67	90.00	88.00	87.33	85.33	67.00	67.33	79.67	80.00	90.33
S2	91.00	93.00	90.00	87.33	88.67	69.67	70.67	82.33	84.00	92.67
S3	91.67	93.00	91.00	88.67	91.67	70.00	71.00	82.00	82.33	90.67
S4	92.67	92.67	90.67	87.67	90.67	72.67	72.00	82.67	83.67	91.33
SE $\pm$		0.811								
C.D. at 5%		2.257								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	85.00	85.00	86.00	85.33	75.33	84.67	86.00	87.67	89.67	92.00
S2	88.00	87.00	90.00	90.67	79.67	89.67	90.67	92.00	92.33	95.67
S3	84.67	86.67	89.00	90.00	81.67	88.00	91.00	92.33	92.67	95.67
S4	84.67	86.33	88.00	91.33	80.00	89.67	89.67	90.00	90.67	95.67
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	90.67	85.33	75.00	68.67	85.67	87.00	87.67	86.33	85.67	84.33
S2	94.67	91.00	79.33	73.00	90.33	91.33	90.00	90.67	89.67	89.33
S3	95.67	89.00	78.00	72.67	89.67	91.00	90.33	87.67	90.67	88.33
S4	97.33	93.33	82.00	70.67	96.67	90.67	89.67	90.67	89.33	89.00
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	83.67	84.00	91.00	87.33	87.33	86.67	86.67	87.67	88.00	87.33
S2	87.33	91.33	93.67	92.33	91.00	89.67	90.33	91.33	90.67	92.00
S3	87.33	88.33	93.00	91.00	89.00	89.33	90.00	90.33	90.67	91.00
S4	88.00	89.67	93.00	89.33	90.00	89.00	89.00	90.00	90.67	89.33
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	91.33	90.33	87.00	82.67	88.00	66.33	67.00	78.00	78.00	87.67
S2	96.67	96.00	93.67	90.00	91.33	71.67	71.67	82.33	82.67	91.67
S3	95.33	93.33	89.00	86.67	90.33	70.33	70.00	80.67	80.33	90.00
S4	94.67	93.67	89.00	84.00	92.00	71.00	69.00	81.00	79.67	89.67
SE $\pm$		0.760								
C.D. at 5%		2.114								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	83.83	85.67	86.00	86.17	76.17	85.17	87.00	88.33	89.50	90.67
S2	87.83	87.17	91.17	90.17	80.67	88.83	90.17	92.33	92.67	95.33
S3	85.67	86.83	87.83	90.17	81.33	88.17	91.00	92.00	92.83	94.17
S4	84.83	86.67	89.83	91.50	81.17	91.50	90.33	90.83	91.50	94.00
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	90.83	86.17	77.83	69.67	85.83	88.00	87.50	86.00	86.17	85.17
S2	93.83	90.33	79.33	73.00	89.50	91.33	89.67	89.50	90.17	89.00
S3	94.67	90.50	79.00	73.17	90.17	91.00	89.83	88.17	90.67	88.50
S4	95.17	92.17	81.17	71.67	92.83	90.50	89.17	89.67	89.50	89.67
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	84.50	85.17	90.67	88.33	87.17	87.33	87.17	87.67	87.50	87.83
S2	88.17	90.33	93.50	92.50	90.33	90.00	90.67	90.83	90.50	91.67
S3	87.50	88.33	93.00	91.67	89.17	89.33	91.17	90.83	90.67	91.17
S4	88.50	89.83	93.17	91.33	90.17	89.67	90.00	90.33	90.33	89.67
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	90.50	90.17	87.50	85.00	86.67	66.67	67.17	78.83	79.00	89.00
S2	93.83	94.50	91.83	88.67	90.00	70.67	71.17	82.33	83.33	92.17
S3	93.50	93.17	90.00	87.67	91.00	70.17	70.50	81.33	81.33	90.33
S4	93.67	93.17	89.83	85.83	91.33	71.83	70.50	81.83	81.67	90.50
SE $\pm$		0.592								
C.D. at 5%		1.646								

in fig.4. The mean days to physiological maturity was 116.55 days, 116.044 days and 116.295 days recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 8 revealed that, the mean days to physiological maturity of rice genotypes was significantly influence due to different sowing dates.

Crop sown during S₁-*kharif* season (24thMW) produced significantly minimum days to physiological maturity (113.81days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during pooled mean.

Table 8 Effect of different treatment on days to maturity of rice genotypes

Treatments	Days to maturity		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	114.23	113.40	113.81
S2 : 48 th MW	116.95	116.98	116.96
S3 : 50 th MW	117.44	117.10	117.27
S4 : 52 th MW	117.57	116.70	117.13
SE $\pm$	0.087	0.135	0.103
C.D. at 5%	0.303	0.466	0.357
B) Sub plot (Varieties)			
V1:Karjat-1	113.5	112.1	112.79
V2:Karjat-3	115.8	115.1	115.42
V3:Karjat-4,	118.3	117.3	117.83
V4:Karjat-7	118.9	118.0	118.46
V5:Karjat-184	108.8	107.8	108.33
V6:Sahyadri-2	117.5	116.5	117.00
V7:Sahyadri-4	119.5	118.8	119.13
V8:Phondaghat -1	120.0	119.4	119.71
V9:Ratnagiri-1	121.5	119.9	120.71
V10:Ratnagiri-5	121.7	123.8	122.71
V11:Ratnagiri- 6	122.3	122.1	122.17
V12:Ratnagiri- 7	119.3	116.9	118.08
V13:Ratnagiri -24	99.8	98.8	99.31
V14:Ratnagiri-73	99.7	98.6	99.13
V15:Ratnagiri-711	117.7	117.8	117.75
V16:IRRI-14	119.9	119.3	119.63
V17:IRRI-15	118.0	118.3	118.17
V18:IRRI-20	116.8	117.8	117.29
V19:IRRI-21	118.8	117.8	118.29
V20:IRRI-22	118.0	117.0	117.50
V21:IRRI-27	116.8	116.3	116.54
V22:IRRI-28	117.5	117.3	117.38
V23:IRRI-34	122.2	121.3	121.75
V24:IRRI-36	121.5	119.3	120.38
V25:IRRI-47	117.8	118.2	118.00
V26:IRRI-52	118.5	118.3	118.42
V27:IRRI-53	119.3	118.6	118.96
V28:IRRI-55	119.8	118.6	119.17
V29:IRRI-62	118.9	119.1	119.00
V30:IR-35	119.3	119.2	119.21
V31:Laldodaki	120.7	123.6	122.13
V32:IR2289-6-22-5	121.8	122.8	122.29
V33:Narmada	119.4	118.2	118.79
V34:Ananda	115.6	116.1	115.83
V35:Ambpandhari	117.7	118.8	118.21
V36:Hira	98.9	98.6	98.75
V37:OR-1516-1-5-A	99.7	98.7	99.17
V38:China	111.3	109.8	110.50
V39:Sorati	111.3	109.4	110.33
V40:Mhadi	120.2	118.5	119.33
SE $\pm$	0.298	0.273	0.223
C.D. at 5%	0.829	0.759	0.621
Interaction Effect (S x V)			
SE $\pm$	0.596	0.546	0.446
C.D. at 5%	1.659	1.518	1.241
General Mean	116.55	116.044	116.295

S1 : 24th MW (11th-17th June)
S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)
S4 : 52th MW (24th-31st December)

The rice crop sown during *rabi* season, S₃(50thMW) date of sowing recorded significantly maximum days to physiological maturity (117.27days) as compared to crop sown during S₂(48thMW) (116.96days) and S₄(52thMW) (117.13days) in pooled mean.

Effect of genotypes:

The days to physiological maturity of rice was influenced significantly due to the different genotypes during both year and pooled mean. The rice genotype V₃₆ i.e. Hira recorded significantly minimum (Early) days to physiological maturity (98.75days) which was at par with V₁₃ -Ratnagiri-24 (99.31days), V₁₄-Ratnagiri-73(99.13 days and V₃₇-OR-1516-1-5-A 97.17days) and over others. Rice genotype V₁₀ i.e. Ratnagiri-5 recorded significantly maximum days to physiological maturity (122.71days) which was at par with V₁₁ i.e.Ratnagiri-6 (122.17days), V₃₁ i.e. Laldodaki (122.13days) and V₃₂ i.e.IR2289-6-22-5 (122.29 days) over others during pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of days to physiological maturity (Table 9). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₁₀ i.e. Ratnagiri-5 recorded significantly higher days to physiological maturity (120.67days) which was at par with V₁₁ -Ratnagiri -6 (119.83 days), V₂₃-IRRI-34(119.83days) V₃₁-Laldodaki (119.83days) and V₃₂-IR2289-6-22-5(119.83 days) over others during pooled mean.

In case of *rabi* season S₃V₁₀ i.e. crop sown in S₃ date of sowing (50th MW) with V₁₀-Ratnagiri-5 was recorded significantly higher days to physiological maturity (123.67days) which was at par with S₂V₁₀ (122.50 days), S₂V₁₁(122.67days) and S₂V₃₂ (122.50days)i.e. crop sown in S₂ date of sowing (48th MW) and S₃V₁₀(122.67days), S₃V₁₁(123.33days), S₃V₃₁(123.33 days) and S₃V₃₂(123.00days) i.e. crop sown in S₃ date of sowing (50thMW) and S₄V₁₀(123.00days), S₄V₁₁(122.83days), S₄V₂₃ (123.17days), S₄V₃₁(122.83 days), S₄V₃₂(123.17days) i.e. crop sown in S₄ date of sowing (52th MW) over others during pooled mean. However,

Table 9: Interaction effect of days to maturity on sowing dates and varieties
Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	110.67	113.33	116.00	116.67	106.33	115.00	117.33	117.67	119.33	119.33
S2	115.00	116.67	118.33	118.33	109.33	118.00	119.67	120.33	122.00	123.00
S3	114.00	116.00	119.00	120.00	110.00	118.00	120.67	121.00	122.33	122.33
S4	114.33	117.00	120.00	120.67	109.67	119.00	120.33	121.00	122.33	122.00
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	120.00	117.00	105.67	97.33	115.33	117.67	116.00	114.00	116.67	115.33
S2	122.67	119.33	108.67	99.67	118.00	120.67	118.33	117.00	119.00	118.00
S3	123.33	120.33	109.67	101.33	118.67	121.00	119.00	117.67	120.00	118.67
S4	123.00	120.33	108.67	100.33	118.67	120.33	118.67	118.33	119.33	120.00
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	114.33	115.00	120.00	119.33	115.33	116.67	117.33	117.67	117.00	117.33
S2	118.00	118.00	122.67	121.67	118.67	119.33	119.67	119.33	119.67	119.00
S3	117.00	118.33	122.67	122.33	117.67	118.67	120.67	121.33	119.67	121.00
S4	117.67	118.67	123.33	122.67	119.67	119.33	119.67	120.67	119.33	119.67
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	118.33	119.33	117.33	112.67	114.67	96.67	97.33	109.00	108.67	118.33
S2	121.00	122.33	119.00	115.67	118.33	99.33	99.67	112.00	112.00	120.67
S3	121.67	123.00	121.00	117.00	119.00	99.33	100.33	111.67	111.67	120.67
S4	121.67	122.67	120.33	117.00	118.67	100.33	101.33	112.33	112.67	121.00
SE $\pm$		0.596								
C.D. at 5%		1.659								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	108.67	112.00	114.67	115.00	104.33	113.00	116.00	116.67	117.33	122.00
S2	114.00	116.67	118.33	118.67	108.33	118.33	119.00	120.33	120.67	124.00
S3	113.00	116.00	118.33	119.67	109.33	117.00	120.67	121.00	121.67	125.00
S4	112.67	115.67	118.00	118.67	109.33	117.67	119.33	119.67	120.00	124.00
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	119.67	113.33	104.00	95.67	115.67	116.67	117.00	115.67	115.00	113.67
S2	122.67	120.00	107.67	100.00	118.33	119.33	119.00	119.33	118.33	118.00
S3	123.33	117.33	108.00	100.00	118.67	121.00	119.00	117.67	120.00	118.33
S4	122.67	117.00	108.33	98.67	118.67	120.33	118.33	118.67	118.00	118.00
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	113.67	113.67	119.67	116.33	116.00	116.67	116.33	115.67	117.00	116.67
S2	117.67	117.67	120.00	121.33	118.33	119.00	119.00	119.67	119.00	120.00
S3	117.00	118.33	122.67	120.33	118.67	118.67	120.00	119.67	120.67	120.67
S4	117.00	119.33	123.00	119.00	119.67	119.00	119.00	119.33	119.67	119.33
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	121.33	120.33	116.33	112.67	116.67	96.00	96.00	107.00	106.00	116.00
S2	124.00	124.00	119.00	118.33	118.67	99.67	100.67	111.33	112.00	118.67
S3	125.00	123.00	118.67	116.67	119.67	99.67	99.33	110.33	110.00	120.00
S4	124.00	123.67	118.67	116.67	120.00	99.00	98.67	110.33	109.67	119.33
SE $\pm$		0.546								
C.D. at 5%		1.518								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	109.67	112.67	115.33	115.83	105.33	114.00	116.67	117.17	118.33	120.67
S2	114.50	116.67	118.33	118.50	108.83	118.17	119.33	120.33	121.33	123.50
S3	113.50	116.00	118.67	119.83	109.67	117.50	120.67	121.00	122.00	123.67
S4	113.50	116.33	119.00	119.67	109.50	118.33	119.83	120.33	121.17	123.00
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	119.83	115.17	104.83	96.50	115.50	117.17	116.50	114.83	115.83	114.50
S2	122.67	119.67	108.17	99.83	118.17	120.00	118.67	118.17	118.67	118.00
S3	123.33	118.83	108.83	100.67	118.67	121.00	119.00	117.67	120.00	118.50
S4	122.83	118.67	108.50	99.50	118.67	120.33	118.50	118.50	118.67	119.00
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	114.00	114.33	119.83	117.83	115.67	116.67	116.83	116.67	117.00	117.00
S2	117.83	117.83	121.33	121.50	118.50	119.17	119.33	119.50	119.33	119.50
S3	117.00	118.33	122.67	121.33	118.17	118.67	120.33	120.50	120.17	120.83
S4	117.33	119.00	123.17	120.83	119.67	119.17	119.33	120.00	119.50	119.50
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	119.83	119.83	116.83	112.67	115.67	96.33	96.67	108.00	107.33	117.17
S2	122.50	123.17	119.00	117.00	118.50	99.50	100.17	111.67	112.00	119.67
S3	123.33	123.00	119.83	116.83	119.33	99.50	99.83	111.00	110.83	120.33
S4	122.83	123.17	119.50	116.83	119.33	99.67	100.00	111.33	111.17	120.17
SE $\pm$		0.446								
C.D. at 5%		1.241								

S₁V₃₆ i.e. crop sown in S₁ date of sowing (24th MW) with rice variety Hira recorded significantly minimum days to physiological maturity (96.33 days) which was at par with S₁V₁₄ (96.50days) and S₁V₃₇ (96.67 days) i.e. crop sown S₁ date of sowing (24thMW)over others.

4.2. Physiological Parameters:

4.2.1. Total chlorophyll content (mg/g):

Data pertaining to the total chlorophyll content (mg/g) as influenced periodically by the different treatments at various crop growth stages are summarized in Table 10 in graphically depicted in fig.5.The data indicated that, the total chlorophyll content (mg/g) increased with

Table 10 Effect of different treatment on total chlorophyll content (mg/g) of rice genotypes

Treatments	Total chlorophyll content(mg/g)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)									
S1 : 24 th MW	1.94	2.01	1.97	4.06	4.13	4.09	0.99	1.03	1.01
S2 : 48 th MW	1.92	1.83	1.87	3.83	3.66	3.74	0.96	0.92	0.94
S3 : 50 th MW	1.97	2.00	1.99	3.98	4.00	3.99	0.98	1.00	0.99
S4 :52 th MW	1.82	1.86	1.84	3.72	3.71	3.72	0.92	0.93	0.92
SE $\pm$	0.044	0.081	0.023	0.07	0.06	0.03	0.02	0.02	0.01
C.D. at 5%	NS	0.023	0.070	N.S.	0.22	NS	N.S.	0.06	0.038
B)Sub plot (Varieties)									
V1:Karjat-1	1.75	1.82	1.79	3.55	3.76	3.66	0.89	0.94	0.92
V2:Karjat-3	1.81	1.79	1.80	3.88	3.58	3.73	0.94	0.90	0.92
V3:Karjat-4,	1.82	1.86	1.84	4.15	3.88	4.01	0.95	0.97	0.96
V4:Karjat-7	1.69	1.85	1.77	4.04	3.87	3.95	0.88	0.97	0.93
V5:Karjat-184	1.99	1.89	1.94	3.97	3.77	3.87	0.99	0.95	0.97
V6:Sahyadri-2	1.96	1.87	1.92	3.93	3.91	3.92	0.97	0.98	0.98
V7:Sahyadri-4	1.92	1.88	1.90	3.69	3.75	3.72	0.91	0.94	0.92
V8:Phondaghat -1	1.96	2.06	2.01	4.18	4.12	4.15	1.04	1.03	1.04
V9:Ratnagiri-1	1.70	1.87	1.79	3.42	3.73	3.57	0.85	0.93	0.89
V10:Ratnagiri-5	1.89	1.99	1.94	3.81	3.98	3.90	0.95	1.00	0.98
V11:Ratnagiri- 6	1.97	2.02	2.00	4.00	4.03	4.02	0.99	1.01	1.00
V12:Ratnagiri- 7	2.02	1.91	1.97	3.89	3.87	3.88	0.97	0.97	0.97
V13:Ratnagiri -24	2.19	2.04	2.12	4.41	4.01	4.21	1.12	1.00	1.06
V14:Ratnagiri-73	2.03	1.96	1.99	4.01	4.01	4.01	0.98	1.00	0.99
V15:Ratnagiri-711	1.96	1.90	1.93	3.95	3.89	3.92	0.99	0.97	0.98
V16:IRRI-14	1.81	2.05	1.93	3.65	4.14	3.89	0.91	1.04	0.97
V17:IRRI-15	1.97	1.92	1.95	3.97	3.84	3.90	0.99	0.96	0.98
V18:IRRI-20	2.07	1.96	2.01	4.19	3.91	4.05	1.03	0.98	1.00
V19:IRRI-21	1.97	1.89	1.93	3.80	3.81	3.80	0.95	0.95	0.95
V20:IRRI-22	1.88	1.96	1.92	3.59	3.90	3.75	0.88	0.98	0.93
V21:IRRI-27	1.93	2.01	1.97	3.99	3.91	3.95	1.00	0.98	0.99
V22:IRRI-28	1.83	1.84	1.84	3.66	3.61	3.63	0.91	0.91	0.91
V23:IRRI-34	1.85	1.89	1.87	3.71	3.78	3.74	0.92	0.95	0.94
V24:IRRI-36	1.84	1.91	1.88	3.68	3.81	3.75	0.91	0.95	0.93
V25:IRRI-47	1.98	1.99	1.99	3.97	3.98	3.98	0.98	1.00	0.99
V26:IRRI-52	1.95	1.88	1.91	3.92	3.92	3.92	0.98	0.98	0.98
V27:IRRI-53	1.92	1.98	1.95	3.83	3.95	3.89	0.95	0.99	0.97
V28:IRRI-55	1.85	2.01	1.93	3.85	4.01	3.93	0.96	1.01	0.99
V29:IRRI-62	2.15	1.85	2.00	4.25	3.71	3.98	1.01	0.93	0.97
V30:IR-35	1.75	2.07	1.91	3.90	4.15	4.02	0.98	1.04	1.01
V31:Laldodaki	1.72	2.01	1.87	3.63	4.02	3.82	0.91	1.01	0.96
V32:IR2289-6-22-5	1.82	1.91	1.86	3.70	3.98	3.84	0.90	1.00	0.95
V33:Narmada	1.95	1.94	1.95	3.91	3.88	3.90	0.98	0.97	0.98
V34:Ananda	1.99	2.05	2.02	3.97	4.10	4.03	0.99	1.03	1.01
V35:Ambpandhari	1.86	1.90	1.88	4.05	3.81	3.93	1.01	0.95	0.98
V36:Hira	1.93	1.87	1.90	3.87	3.75	3.81	0.97	0.94	0.95
V37:OR-1516-1-5-A	1.88	1.74	1.81	3.92	3.48	3.70	0.98	0.87	0.93
V38:China	1.89	1.93	1.91	3.78	3.86	3.82	0.95	0.97	0.96
V39:Sorati	1.91	1.86	1.88	3.86	3.71	3.78	0.97	0.93	0.95
V40:Mhadi	2.08	1.87	1.98	4.37	3.90	4.13	0.96	0.94	0.95
SE $\pm$	0.072	NS	0.052	0.13	0.15	0.05	0.03	0.04	0.03
C.D. at 5%	0.20	0.08	0.15	0.36	NS	0.14	0.09	N.S.	0.07
Interaction Effect (S x M)									
SE $\pm$	0.15	NS	0.104	0.27	0.29	0.07	0.07	0.07	0.05
C.D. at 5%	0.43	0.15	0.29	0.76	NS	NS	0.20	N.S.	0.14
General Mean	1.91	1.94	1.92	3.90	3.88	3.89	0.96	0.97	0.96

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

increase in age of the crop up to flowering stage, thereafter, it decreased. There was significant difference in the total chlorophyll content (mg/g) at tillering, flowering and harvesting stage during both the year 2020-21 and 2021-22 year and pooled mean. General mean of total chlorophyll content (mg/g) at flowering stage both years and pooled mean were found to be 3.90 mg/g, 3.88 mg/g and 3.89 mg/g respectively.

Effect of sowing windows:

The data presented in Table 10 indicated that, the total chlorophyll content (mg/g) was significantly influenced due to the different sowing windows during both the seasons and in the pooled data.

At flowering stage, the date of sowing during *kharif* season recorded significantly higher total chlorophyll content (4.09 mg/g) than rest of the date of sowing in *rabi* season S₂ i.e. crop sown S₂ date of sowing (48th MW) (3.74 mg/g), S₃ i.e. crop sown S₃ date of sowing (50th MW) (3.99 mg/g) and S₄ i.e. crop sown S₄ date of sowing (52th MW) (3.72 mg/g) during pooled mean. However the sowing dates S₃ recorded significantly maximum total chlorophyll content (3.99 mg/g) over S₂ i.e. crop sown S₂ date of sowing (48th MW) (3.74 mg/g) and S₄ i.e. crop sown S₄ date of sowing (52th MW) (3.72 mg/g).

At harvesting stage, the date of sowing during *kharif* season recorded significantly higher total chlorophyll content (1.01 mg/g) than rest of the date of sowing in *rabi* season S₂ i.e. crop sown S₂ date of sowing (48th MW) (0.94 mg/g), S₃ i.e. crop sown S₃ date of sowing (50th MW) (0.99 mg/g) and S₄ i.e. crop sown S₄ date of sowing (52th MW) (0.92 mg/g) during the pooled mean. However the sowing dates S₃ (50th MW) recorded significantly maximum total chlorophyll content (0.99 mg/g) over S₂ i.e. crop sown S₂ date of sowing (48th MW) (0.94 mg/g) and S₄ i.e. crop sown S₄ date of sowing (52th MW) (0.92 mg/g).

Effect of Genotypes:

Total chlorophyll content (mg/g) was influenced significantly due to the different genotypes during both the year and pooled means (Table

10). At flowering stage, significantly maximum chlorophyll content was recorded in V₁₃(4.21mg/g) which was followed by V₈(4.15mg/g) and V₄₀(4.13 mg/g). However the sowing dates S₃ recorded maximum total chlorophyll content (3.99mg/g) over S₂ and S₄.

Interaction effect:

The pooled mean data of total chlorophyll content (mg/g) in different genotypes of rice for the two seasons of *kharif* and *rabi* are presented in Table 11.

Interaction effect between sowing dates of genotypes was significant in respect of total chlorophyll content (mg/g). The rice crop sown S₁ i.e. *kharif* season with V₈ i.e. Phondaghat-1 recorded significantly higher total chlorophyll content (1.22mg/g) significantly which was at par with S₁V₁₀, S₁V₁₂, S₁V₁₃, S₁V₃₀, S₁V₃₅ and over others. The pooled data of total chlorophyll content (mg/g) during *kharif* season indicated significant differences in total chlorophyll content (mg/g) among the genotypes. Among *rabi* season, S₂V₁₃ i.e. sowing 48th MW with genotype Ratnagiri-24 recorded significantly higher chlorophyll content than other interaction.

4.2.2. Chlorophyll stability index:

Data pertaining to the chlorophyll stability index (mg/g) at different growth stage for rice genotypes are presented in Table 12. It is evident from the data that the chlorophyll stability index progressively increased with the advancing age of the crop, up to flowering stage, there after decreased. There was non significant difference in the chlorophyll stability index at tillering, flowering and harvesting stage during both the year 2020-21 and 2021-22 year and pooled mean. General mean of chlorophyll stability index (mg/g) both year and pooled mean were found to be 0.651 mg/g, 0.642mg to be 0.651mg/g, 0.642mg/g, 0.647mg/g and 1.092mg/g, 1.049 mg/g 1.070 mg/g and 0.442mg/g, 0.439mg/g and 0.438 mg/g at tillering, flowering and harvesting stage respectively.

Table 11 Effect of different treatment on total chlorophyll content (mg/g) of rice genotypes

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.88	0.92	1.01	0.79	1.04	1.03	0.91	1.22	0.78	1.11
S2	0.94	0.81	0.83	0.81	0.93	0.93	0.85	0.88	0.82	0.92
S3	0.99	1.08	0.95	0.93	0.99	0.95	1.00	0.95	0.95	0.95
S4	0.75	0.95	0.99	1.00	1.00	0.99	0.86	1.10	0.86	0.83
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1.07	1.19	1.13	1.00	1.04	0.92	0.90	0.95	1.02	0.88
S2	0.97	0.87	1.39	1.12	1.06	1.13	1.16	1.11	1.07	0.90
S3	0.95	0.89	1.04	0.85	1.00	0.79	1.02	1.04	0.96	0.96
S4	0.95	0.92	0.93	0.94	0.85	0.80	0.89	1.02	0.76	0.77
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.97	0.75	0.92	0.98	0.98	0.93	1.08	1.09	1.10	1.07
S2	1.07	0.88	0.90	0.87	0.90	0.93	0.79	0.82	0.97	0.86
S3	0.98	0.96	1.02	1.04	0.97	0.98	0.95	0.93	1.05	1.01
S4	0.98	1.04	0.85	0.76	1.09	1.08	0.97	1.01	0.92	0.97
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.90	1.04	1.06	1.00	1.10	1.07	0.88	1.02	0.91	0.86
S2	0.85	0.93	0.95	1.01	1.02	1.01	1.05	1.00	0.86	1.14
S3	0.98	0.94	1.10	0.97	0.94	1.00	1.00	0.99	0.99	1.09
S4	0.90	0.70	0.81	1.00	0.99	0.80	0.99	0.78	1.10	0.75
SE $\pm$		0.042								
C.D. at 5%		0.122								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1.03	0.84	0.94	1.03	0.99	1.04	1.04	1.22	0.90	1.13
S2	0.86	0.89	0.88	0.86	0.92	0.86	0.84	0.96	0.92	0.86
S3	1.08	1.02	1.13	1.06	1.00	1.04	1.03	0.99	1.05	1.11
S4	0.81	0.84	0.93	0.92	0.87	0.97	0.85	0.95	0.86	0.90
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1.09	1.08	1.12	1.11	0.93	1.02	0.96	1.03	0.98	0.99
S2	0.93	0.99	0.96	0.89	0.98	1.09	0.96	0.91	1.01	0.90
S3	1.04	0.94	1.04	1.08	1.00	1.05	1.04	0.98	0.95	1.03
S4	0.99	0.86	0.89	0.93	0.98	0.98	0.88	0.99	0.87	0.99
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1.01	0.93	1.01	1.00	1.02	1.05	1.07	0.94	0.99	1.22
S2	0.91	0.83	0.77	0.82	1.00	0.91	0.90	1.09	0.88	0.89
S3	1.06	0.93	1.01	1.00	0.97	1.06	1.10	0.98	0.94	1.04
S4	0.92	0.94	1.00	0.99	1.00	0.91	0.87	1.01	0.89	1.00
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1.06	1.15	1.07	1.07	1.14	1.13	0.82	1.18	0.97	0.87
S2	1.04	0.92	0.97	1.00	0.83	0.90	0.86	0.87	0.87	0.92
S3	1.01	1.00	0.93	1.02	0.86	0.94	0.93	0.82	0.84	0.98
S4	0.91	0.91	0.93	1.01	0.98	0.78	0.87	1.00	1.04	0.97
SE $\pm$		0.038								
C.D. at 5%		0.106								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.96	0.88	0.98	0.91	1.02	1.04	0.98	1.22	0.84	1.12
S2	0.90	0.85	0.86	0.84	0.93	0.90	0.85	0.92	0.87	0.89
S3	1.04	1.05	1.04	1.00	1.00	1.00	1.02	0.97	1.00	1.03
S4	0.78	0.90	0.96	0.96	0.94	0.98	0.86	1.03	0.86	0.86
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1.08	1.14	1.13	1.06	0.99	0.97	0.93	0.99	1.00	0.94
S2	0.95	0.93	1.18	1.01	1.02	1.11	1.06	1.01	1.04	0.90
S3	1.00	0.91	1.04	0.97	1.00	0.92	1.03	1.01	0.96	0.99
S4	0.97	0.89	0.91	0.94	0.92	0.89	0.89	1.01	0.81	0.88
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.99	0.84	0.96	0.99	1.00	0.99	1.07	1.02	1.05	1.15
S2	0.99	0.86	0.84	0.84	0.95	0.92	0.85	0.96	0.93	0.87
S3	1.02	0.95	1.02	1.02	0.97	1.02	1.03	0.95	1.00	1.03
S4	0.95	0.99	0.92	0.87	1.04	0.99	0.92	1.01	0.91	0.98
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.98	1.09	1.06	1.03	1.12	1.10	0.85	1.10	0.94	0.87
S2	0.95	0.93	0.96	1.01	0.92	0.96	0.96	0.93	0.87	1.03
S3	1.00	0.97	1.01	0.99	0.90	0.97	0.97	0.90	0.91	1.04
S4	0.91	0.81	0.87	1.01	0.99	0.79	0.93	0.89	1.07	0.86
SE $\pm$		0.038								
C.D. at 5%		0.107								

Effect of sowing windows:

The data presented in Table 12 indicated that, the Chlorophyll stability index was non significant difference due to the different sowing windows during both the seasons and in the pooled data at flowering and harvesting stage.

At tillering stage, the date of sowing during *kharif* season recorded maximum chlorophyll stability index than rest of the date of sowing in *rabi* season during 2020-21 and 2021-22 seasons and in the pooled mean. However the sowing dates in *rabi* season, S₃ recorded maximum chlorophyll stability index over S₂ and S₄ at tillering stage.

Table 12 Effect of different treatment on chlorophyll stability index of rice genotypes

Treatments	Chlorophyll stability index								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)									
S1 : 24 th MW	0.666	0.642	0.654	1.106	1.076	1.091	0.442	0.438	0.440
S2 : 48 th MW	0.638	0.644	0.640	1.075	1.093	1.084	0.430	0.434	0.432
S3 : 50 th MW	0.648	0.647	0.648	1.099	1.086	1.093	0.439	0.438	0.438
S4 :52 th MW	0.652	0.638	0.645	1.087	0.941	1.014	1.410	1.479	1.444
SE $\pm$	0.015	0.007	0.008	0.017	0.069	0.033	0.011	0.017	0.006
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
B)Sub plot (Varieties)									
V1:Karjat-1	0.638	0.613	0.626	1.102	1.049	1.075	0.443	0.425	0.434
V2:Karjat-3	0.648	0.641	0.645	1.073	1.048	1.061	0.447	0.448	0.448
V3:Karjat-4,	0.613	0.654	0.633	1.058	1.064	1.061	0.447	0.436	0.441
V4:Karjat-7	0.620	0.648	0.634	1.052	1.075	1.063	0.459	0.465	0.462
V5:Karjat-184	0.642	0.634	0.638	1.073	1.037	1.055	0.440	0.438	0.439
V6:Sahyadri-2	0.663	0.593	0.628	1.108	1.027	1.068	0.461	0.443	0.452
V7:Sahyadri-4	0.623	0.613	0.618	1.082	1.004	1.043	0.458	0.445	0.451
V8:Phondaghat -1	0.678	0.625	0.652	1.127	1.063	1.095	0.458	0.448	0.453
V9:Ratnagiri-1	0.675	0.613	0.644	1.125	1.039	1.082	0.431	0.439	0.435
V10:Ratnagiri-5	0.669	0.650	0.660	1.114	1.042	1.078	0.438	0.428	0.433
V11:Ratnagiri- 6	0.682	0.675	0.679	1.123	1.053	1.088	0.436	0.453	0.445
V12:Ratnagiri- 7	0.668	0.611	0.640	1.112	0.999	1.055	0.454	0.441	0.448
V13:Ratnagiri -24	0.656	0.626	0.641	1.025	0.942	0.983	0.426	0.403	0.415
V14:Ratnagiri-73	0.667	0.626	0.646	1.100	1.027	1.063	0.409	0.426	0.418
V15:Ratnagiri-711	0.663	0.613	0.638	1.090	0.992	1.041	0.443	0.429	0.436
V16:IRRI-14	0.653	0.614	0.633	1.098	1.034	1.066	0.426	0.384	0.405
V17:IRRI-15	0.669	0.652	0.660	1.118	1.056	1.087	0.434	0.430	0.432
V18:IRRI-20	0.648	0.620	0.634	1.078	1.030	1.054	0.452	0.420	0.436
V19:IRRI-21	0.623	0.655	0.639	1.079	1.080	1.080	0.403	0.441	0.422
V20:IRRI-22	0.637	0.648	0.642	1.074	1.036	1.055	0.394	0.417	0.405
V21:IRRI-27	0.635	0.659	0.647	1.096	1.088	1.092	0.407	0.453	0.430
V22:IRRI-28	0.652	0.640	0.646	1.086	1.034	1.060	0.426	0.444	0.435
V23:IRRI-34	0.666	0.643	0.655	1.098	1.074	1.086	0.418	0.419	0.418
V24:IRRI-36	0.674	0.669	0.672	1.101	1.065	1.083	0.435	0.450	0.443
V25:IRRI-47	0.648	0.641	0.645	1.108	1.061	1.085	0.433	0.448	0.440
V26:IRRI-52	0.653	0.641	0.647	1.114	1.064	1.089	0.451	0.423	0.437
V27:IRRI-53	0.649	0.644	0.647	1.064	1.027	1.045	0.435	0.459	0.447
V28:IRRI-55	0.637	0.643	0.640	1.093	1.092	1.093	0.428	0.436	0.432
V29:IRRI-62	0.650	0.690	0.670	1.102	1.102	1.102	0.434	0.449	0.442
V30:IR-35	0.625	0.651	0.638	1.068	1.063	1.065	0.451	0.452	0.451
V31:Laldodaki	0.659	0.650	0.655	1.075	1.033	1.054	0.458	0.439	0.448
V32:IR2289-6-22-5	0.662	0.682	0.672	1.100	1.085	1.093	0.463	0.443	0.453
V33:Narmada	0.654	0.683	0.668	1.096	1.075	1.085	0.448	0.434	0.441
V34:Ananda	0.633	0.618	0.625	1.066	1.018	1.042	0.427	0.443	0.435
V35:Ambpandhari	0.639	0.642	0.640	1.074	1.035	1.055	0.433	0.446	0.440
V36:Hira	0.652	0.649	0.650	1.089	1.058	1.073	0.440	0.446	0.443
V37:OR-1516-1-5-A	0.669	0.675	0.672	1.098	1.069	1.083	0.459	0.427	0.443
V38:China	0.658	0.663	0.660	1.102	1.066	1.084	0.448	0.458	0.453
V39:Sorati	0.636	0.639	0.638	1.051	1.018	1.035	0.441	0.424	0.433
V40:Mhadi	0.650	0.613	0.650	1.098	1.060	1.079	0.427	0.440	0.434
SE $\pm$	0.020	0.019	0.014	0.021	0.024	0.018	0.016	0.014	0.011
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction Effect (S x M)									
SE $\pm$	0.042	0.038	0.027	0.048	0.049	0.035	0.032	0.029	0.022
C.D. at 5%	0.122	0.106	0.076	0.134	NS	NS	NS	NS	NS
General Mean	0.651	0.642	0.647	1.092	1.049	1.070	0.442	0.439	0.438

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

S₄ i.e. crop sown S₄ date of sowing (52thMW) recorded minimum chlorophyll stability index (1.014) than rest of the date of sowing during pooled mean at flowering stage. S₂ i.e. crop sown S₂ date of sowing (48thMW) recorded minimum chlorophyll stability index (0.432) than rest of the date of sowing during pooled mean at harvesting stage. However S₁ i.e. crop sown S₁ date of sowing (24th MW) recorded maximum chlorophyll stability index (1.091) than rest of the date of sowing during pooled mean at flowering stage. S₄ i.e. crop sown S₄ date of sowing (52th MW) recorded maximum chlorophyll stability index (1.444) than rest of the date of sowing during pooled mean at harvesting stage.

Effect of genotypes:

Chlorophyll stability index was not significant difference due to the different genotypes during both year and pooled mean (Table 12). At tillering stage, maximum chlorophyll stability index was recorded in Ratnagiri- 6 (0.679mg/g) which was followed by IR2289-6-22-5 (0.672 mg/g), OR-1516-1-5-A (0.672 mg/g) and IRRI-36(0.672 mg/g).

At flowering stage, maximum chlorophyll stability index was recorded in V₈ i.e. Phondaghat-1 (1.095 mg/g) which was followed by V₂₈ i.e. IRRI-55 (1.093 mg/g), V₃₂ i.e. IR2289-6-22-5 (1.093 mg/g), V₂₁ i.e. IRRI-27 (1.092 mg/g).

At harvesting stage, maximum chlorophyll stability index was recorded in Karjat-7 (0.462mg/g) which was followed by V₈ i.e. Phondaghat -1 (0.453 mg/g), V₃₂ i.e. IR2289-6-22-5 (0.453 mg/g) and V₃₈ i.e. China (0.453 mg/g).

Interaction effect:

The pooled mean data of chlorophyll stability index (mg/g) in different genotypes of rice for the two seasons of *kharif* and *rabi* are presented in Table 13.

Interaction effect between sowing dates of genotypes was significant in respect of chlorophyll stability index (mg/g). The rice crop sown S₁ i.e. *kharif* season with V₁ i.e. Karjat-1 (0.477mg/g) and V₂ i.e. Karjat-3

Table 13 Interaction effect of chlorophyll stability index at harvesting stage sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.487	0.440	0.430	0.483	0.407	0.457	0.457	0.477	0.403	0.437
S2	0.437	0.460	0.460	0.470	0.460	0.437	0.477	0.437	0.407	0.430
S3	0.423	0.463	0.453	0.410	0.480	0.443	0.483	0.487	0.427	0.403
S4	0.427	0.423	0.443	0.473	0.413	0.507	0.413	0.433	0.487	0.480
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.413	0.433	0.453	0.410	0.453	0.450	0.423	0.457	0.410	0.423
S2	0.460	0.470	0.467	0.393	0.430	0.413	0.400	0.433	0.300	0.277
S3	0.440	0.467	0.470	0.430	0.447	0.400	0.443	0.453	0.467	0.443
S4	0.430	0.447	0.457	0.403	0.440	0.440	0.470	0.463	0.433	0.433
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.450	0.407	0.413	0.433	0.443	0.473	0.453	0.440	0.430	0.447
S2	0.290	0.453	0.390	0.423	0.427	0.453	0.423	0.400	0.467	0.453
S3	0.443	0.427	0.420	0.423	0.407	0.447	0.437	0.420	0.413	0.427
S4	0.443	0.417	0.447	0.460	0.453	0.430	0.427	0.453	0.427	0.477
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.417	0.490	0.443	0.473	0.433	0.443	0.450	0.437	0.427	0.457
S2	0.490	0.483	0.450	0.397	0.427	0.447	0.473	0.440	0.477	0.420
S3	0.457	0.443	0.423	0.390	0.430	0.417	0.423	0.473	0.443	0.443
S4	0.467	0.437	0.477	0.447	0.443	0.453	0.490	0.440	0.417	38.960
SE $\pm$		0.032								
C.D. at 5%		NS								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.467	0.453	0.420	0.453	0.420	0.427	0.457	0.463	0.480	0.467
S2	0.403	0.467	0.443	0.440	0.473	0.477	0.463	0.460	0.407	0.397
S3	0.413	0.443	0.473	0.470	0.420	0.417	0.443	0.410	0.410	0.403
S4	0.417	0.430	0.407	0.497	0.437	0.453	0.417	0.457	0.460	0.447
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.473	0.423	0.437	0.400	0.440	0.397	0.370	0.430	0.433	0.403
S2	0.427	0.423	0.413	0.460	0.463	0.277	0.437	0.413	0.507	0.417
S3	0.457	0.463	0.430	0.433	0.400	0.403	0.450	0.407	0.397	0.443
S4	0.457	0.453	0.467	0.410	0.413	0.460	0.463	0.430	0.427	0.403
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.480	0.460	0.407	0.423	0.450	0.423	0.450	0.437	0.440	0.480
S2	0.457	0.447	0.400	0.463	0.410	0.400	0.480	0.450	0.427	0.463
S3	0.420	0.447	0.453	0.473	0.460	0.440	0.463	0.430	0.457	0.447
S4	0.457	0.423	0.417	0.440	0.473	0.427	0.443	0.427	0.473	0.417
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.410	0.440	0.400	0.420	0.447	0.480	0.397	0.467	0.440	0.450
S2	0.447	0.420	0.443	0.437	0.443	0.407	0.430	0.457	0.410	0.413
S3	0.427	0.487	0.450	0.450	0.450	0.410	0.437	0.420	0.420	0.477
S4	0.473	0.427	0.443	0.467	0.443	0.487	0.443	0.487	0.427	41.877
SE $\pm$		0.029								
C.D. at 5%		NS								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.477	0.447	0.425	0.468	0.413	0.442	0.457	0.470	0.442	0.452
S2	0.420	0.463	0.452	0.455	0.467	0.457	0.470	0.448	0.407	0.413
S3	0.418	0.453	0.463	0.440	0.450	0.430	0.463	0.448	0.418	0.403
S4	0.422	0.427	0.425	0.485	0.425	0.480	0.415	0.445	0.473	0.463
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.443	0.428	0.445	0.405	0.447	0.423	0.397	0.443	0.422	0.413
S2	0.443	0.447	0.440	0.427	0.447	0.345	0.418	0.423	0.403	0.347
S3	0.448	0.465	0.450	0.432	0.423	0.402	0.447	0.430	0.432	0.443
S4	0.443	0.450	0.462	0.407	0.427	0.450	0.467	0.447	0.430	0.418
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.465	0.433	0.410	0.428	0.447	0.448	0.452	0.438	0.435	0.463
S2	0.373	0.450	0.395	0.443	0.418	0.427	0.452	0.425	0.447	0.458
S3	0.432	0.437	0.437	0.448	0.433	0.443	0.450	0.425	0.435	0.437
S4	0.450	0.420	0.432	0.450	0.463	0.428	0.435	0.440	0.450	0.447
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.413	0.465	0.422	0.447	0.440	0.462	0.423	0.452	0.433	0.453
S2	0.468	0.452	0.447	0.417	0.435	0.427	0.452	0.448	0.443	0.417
S3	0.442	0.465	0.437	0.420	0.440	0.413	0.430	0.447	0.432	0.460
S4	0.470	0.432	0.460	0.457	0.443	0.470	0.467	0.463	0.422	0.404
SE $\pm$		0.022								
C.D. at 5%		NS								

(0.477mg/g), V15 i.e. Ratnagiri711 (0.477mg/g) and V₃₄ i.e. Ananda(0.477mg/g) recorded higher chlorophyll stability index (mg/g) which was followed by S₂V₁₅ and over the other treatment combination.

4.2.3. Leaf water potential:

Data pertaining to the leaf water potential (bar) at different growth stage for rice genotypes are presented in Table 14. There was significant difference in the leaf water potential (bar) at tillering, flowering and harvesting stage during both the year 2020-21 and 2021-22 year and pooled mean. General mean of leaf water potential (bar) of both years and pooled mean were found to be -0.78bar, -0.74bar, -0.76bar and -5.64bar, -5.97bar, -5.80bar and -1.50bar, -1.43bar and -1.47bar at tillering, flowering and harvesting stage, respectively.

Table 14 Effect of different treatment on leaf water potential (Bar)rice genotypes

Treatments	Leaf water potential (Bar)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)									
S1 : 24 th MW	-1.34	-1.42	-1.38	-4.64	-5.98	-5.31	-1.39	-1.18	-1.29
S2 : 48 th MW	-0.68	-0.62	-0.65	-5.91	-5.85	-5.88	-1.61	-1.40	-1.51
S3 : 50 th MW	-0.68	-0.48	-0.58	-6.30	-5.90	-6.10	-1.45	-1.47	-1.46
S4 :52 th MW	-0.43	-0.43	-0.43	-5.71	-6.14	-5.93	-1.56	-1.67	-1.61
SE $\pm$	0.12	0.10	0.06	0.28	0.17	0.19	0.11	0.09	0.05
C.D. at 5%	0.42	0.36	0.21	0.97	0.59	0.64	0.39	0.31	0.17
B)Sub plot (Varieties)									
V1:Karjat-1	-0.93	-0.70	-0.81	-5.30	-5.89	-5.60	-1.52	-1.58	-1.55
V2:Karjat-3	-0.86	-0.97	-0.91	-5.73	-6.34	-6.03	-1.37	-1.25	-1.31
V3:Karjat-4,	-0.67	-0.91	-0.79	-5.71	-6.33	-6.02	-1.18	-1.34	-1.26
V4:Karjat-7	-0.71	-0.62	-0.66	-5.48	-6.18	-5.83	-1.28	-1.47	-1.38
V5:Karjat-184	-0.69	-0.75	-0.72	-5.09	-6.77	-5.93	-1.44	-1.53	-1.48
V6:Sahyadri-2	-0.53	-0.54	-0.54	-4.94	-6.68	-5.81	-1.67	-1.51	-1.59
V7:Sahyadri-4	-0.63	-0.81	-0.72	-3.98	-5.48	-4.73	-1.57	-1.24	-1.40
V8:Phondaghat -1	-0.87	-1.04	-0.95	-4.79	-6.42	-5.60	-1.35	-1.32	-1.33
V9:Ratnagiri-1	-1.14	-1.23	-1.18	-7.48	-5.83	-6.66	-1.63	-1.44	-1.54
V10:Ratnagiri-5	-1.38	-1.01	-1.20	-6.37	-5.81	-6.09	-1.35	-1.60	-1.48
V11:Ratnagiri- 6	-1.03	-0.78	-0.90	-6.39	-5.95	-6.17	-1.38	-1.41	-1.39
V12:Ratnagiri- 7	-0.80	-0.78	-0.79	-6.10	-5.36	-5.73	-1.23	-1.51	-1.37
V13:Ratnagiri -24	-1.18	-1.47	-1.32	-6.00	-5.40	-5.70	-1.38	-1.18	-1.28
V14:Ratnagiri-73	-1.29	-1.50	-1.40	-5.88	-6.53	-6.20	-1.49	-1.24	-1.37
V15:Ratnagiri-711	-0.72	-0.58	-0.65	-6.37	-5.51	-5.94	-1.78	-1.24	-1.51
V16:IRRI-14	-0.72	-0.80	-0.76	-5.52	-5.48	-5.50	-1.62	-1.41	-1.51
V17:IRRI-15	-1.10	-0.88	-0.99	-5.03	-5.15	-5.09	-1.41	-1.37	-1.39
V18:IRRI-20	-0.68	-0.48	-0.58	-6.17	-4.60	-5.38	-1.88	-1.40	-1.64
V19:IRRI-21	-0.61	-0.68	-0.64	-5.80	-5.54	-5.67	-1.90	-1.45	-1.68
V20:IRRI-22	-0.56	-0.68	-0.62	-5.03	-5.93	-5.48	-1.82	-1.51	-1.66
V21:IRRI-27	-0.69	-0.53	-0.61	-5.66	-5.84	-5.75	-1.39	-1.61	-1.50
V22:IRRI-28	-0.69	-0.55	-0.62	-6.83	-5.90	-6.37	-1.21	-1.31	-1.26
V23:IRRI-34	-0.51	-0.78	-0.64	-5.68	-6.07	-5.87	-1.34	-1.77	-1.55
V24:IRRI-36	-0.59	-0.63	-0.61	-5.70	-5.81	-5.75	-1.60	-1.75	-1.68
V25:IRRI-47	-0.62	-0.57	-0.59	-6.58	-5.85	-6.22	-1.53	-1.64	-1.59
V26:IRRI-52	-1.23	-0.41	-0.82	-6.09	-6.04	-6.07	-1.83	-1.26	-1.55
V27:IRRI-53	-1.15	-0.68	-0.92	-6.02	-6.03	-6.02	-1.99	-1.35	-1.67
V28:IRRI-55	-1.06	-0.60	-0.83	-6.21	-5.70	-5.95	-1.40	-1.40	-1.40
V29:IRRI-62	-0.81	-0.55	-0.68	-5.84	-6.43	-6.14	-1.50	-1.45	-1.48
V30:IR-35	-0.47	-0.67	-0.57	-5.47	-6.12	-5.79	-1.36	-1.39	-1.38
V31:Laldodaki	-0.56	-0.78	-0.67	-5.56	-6.74	-6.15	-1.38	-1.32	-1.35
V32:IR2289-6-22-5	-0.68	-0.73	-0.70	-5.70	-6.69	-6.20	-1.44	-1.38	-1.41
V33:Narmada	-0.44	-0.66	-0.55	-5.36	-6.10	-5.73	-1.49	-1.60	-1.55
V34:Ananda	-0.70	-0.53	-0.61	-5.33	-6.37	-5.85	-1.66	-1.63	-1.64
V35:Ambpandhari	-0.71	-0.49	-0.60	-4.92	-6.02	-5.47	-1.35	-1.33	-1.34
V36:Hira	-0.57	-0.50	-0.53	-4.59	-6.48	-5.54	-1.43	-1.25	-1.34
V37:OR-1516-1-5-A	-0.49	-0.54	-0.52	-4.57	-5.85	-5.21	-1.27	-1.41	-1.34
V38:China	-0.69	-0.67	-0.68	-4.95	-5.83	-5.39	-1.33	-1.60	-1.46
V39:Sorati	-0.71	-0.91	-0.81	-5.48	-5.76	-5.62	-1.58	-1.36	-1.47
V40:Mhadi	-0.66	-0.45	-0.55	-5.54	-5.36	-5.45	-1.63	-1.37	-1.50
SE $\pm$	0.21	0.16	0.12	0.42	0.38	0.29	0.17	0.16	0.11
C.D. at 5%	NS	0.45	0.33	1.18	1.05	0.80	0.46	0.44	0.32
Interaction Effect (S x M)									
SE $\pm$	0.42	0.33	0.24	0.85	0.75	0.58	0.33	0.32	0.23
C.D. at 5%	NS	0.91	0.66	2.35	2.09	1.60	0.92	0.88	0.63
General Mean	-0.78	-0.74	-0.76	-5.64	-5.97	-5.80	-1.50	-1.43	-1.47

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

Effect of sowing windows:

The data presented in Table 14 indicated that, the leaf water potential (bar) was observed significantly influenced due to the different sowing windows during both the seasons and in the pooled data at flowering and harvesting stage.

At tillering stage, the date of sowing during *kharif* season recorded maximum leaf water potential (-1.38bar) than rest of the date of sowing in *rabi* season during pooled mean. However the sowing dates in *rabi* season, S₂ recorded maximum leaf water potential (-0.65 bar) over S₃ and S₄ at tillering stage.

At flowering stage, date of sowing during *kharif* season recorded minimum leaf water potential (-5.31bar) than rest of the date of sowing in *rabi* season during in the pooled mean. However the sowing dates in *rabi* season, S₃ recorded maximum leaf water potential (-6.10bar) over S₂ and S₄ at flowering stage. S₃ recorded maximum leaf water potential (-1.46bar) over S₂ and S₄ at harvesting stage. General mean of leaf water potential (bar) of both years and pooled mean were found to be -0.78bar, -0.74bar and -0.76bar -5.64 bar,-5.97 bar,-5.80 bar,-1.50 bar,-1.43bar and -1.47 bar, respectively at tillering, flowering and harvesting stage.

Effect of genotypes:

Leaf water potential (bar) was not significant difference due to the different genotypes during first year and significant difference due to the different genotypes during second year and pooled mean at tillering stage (Table 14).

At tillering stage, maximum leaf water potential (bar) was recorded in V₁₄ i.e. Ratnagiri- 73 (-1.40 bar) which was at par with V₉-Ratnagiri-1 (-1.18 bar), V₁₀-Ratnagiri-5(-1.20 bar), V₂₄-Ratnagiri-24 (-1.32bar) and over others. At flowering stage, maximum leaf water potential (bar) was recorded in V₉ i.e. Ratnagiri-1(-6.66 bar), which was at par with V₂ i.e.Karjat-3,V₃ i.e.Karjat-4, V₅ i.e.Karjat-184, V₁₀ i.e Ratnagiri-5, V₁₁ i.e.Ratnagiri-6, V₁₄ i.e.Ratnagiri-73 and over other. At harvesting stage,

maximum leaf water potential was recorded in V₁₉ i.e. IRRI-21 (-1.68 bar) and V₂₄ i.e. IRRI-36 (-1.68 bar) which was at par with all genotypes and over others.

Interaction effect:

The pooled mean data of leaf water potential (bar) in different genotypes of rice for the two seasons of *kharif* and *rabi* at tillering and harvesting stage are presented in Table 15 and Table 16, respectively.

Interaction effect between sowing dates of genotypes was significant in respect of leaf water potential (bar). At tillering stage, the rice crop sown S₁ i.e. *kharif* season with V₁₃ i.e. Ratnagiri-24 recorded significantly higher leaf water potential (-3.62 bar) which was at par with S₁V₁₄ i.e. Ratnagiri-73. The rice crop sown S₂ i.e. *rabi* season with V₁₆ i.e. IRRI-14 recorded significantly higher leaf water potential (-1.35 bar) which was at par with S₂V₁, S₂V₇, S₂V₈, S₂V₉, S₂V₁₀, S₂V₁₁, S₂V₁₃, S₂V₁₄, S₂V₁₅, S₂V₁₇, S₂V₂₀, S₂V₂₁, S₂V₃₂, S₃V₂, S₃V₃, S₃V₅, S₃V₁₀, S₃V₁₇, S₃V₂₃, S₃V₂₅, S₃V₂₇, S₄V₂₈, S₄V₂₉, S₄V₃₂.

At harvesting stage, the rice crop sown S₁ i.e. *kharif* season with V₂₇ i.e. IRRI-53 recorded significantly higher leaf water potential (-2.20 bar) which was at par with S₁V₆ i.e. Sahyadri-2. The rice crop sown S₂ i.e. *rabi* season with V₁₉ i.e. IRRI-21 recorded significantly higher leaf water potential (-2.22 bar) which was at par with S₄V₁, S₄V₂₃ and S₄V₃₃.

4.2.4. Absolute growth rate (AGR) g/day:

Data pertaining to the absolute growth rate (AGR) g/day at different growth stage for rice genotypes are presented in Table 17. There was significant difference in the absolute growth rate (AGR) g/day at tillering, flowering and harvesting stage during both the year 2020-21 and 2021-22 year and pooled mean. There was continuous increased in AGR from tillering to harvesting stage. General mean of absolute growth rate (AGR) g/day of both years and pooled mean were found to be 0.1310 g/day, 0.1290 g/day, 0.1300 g/day and 0.3934 g/day, 0.3889 g/day, 0.3911 g/day and 1.0379 g/day, 1.0300 g/day and 1.0340 g/day at tillering, flowering and harvesting stage, respectively.

Table 15: Interaction effect of leaf water potential (Bar) at tillering stage on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	-1.23	-1.37	-1.10	-1.70	-1.23	-0.73	-0.97	-1.63	-1.97	-2.20
S2	-0.83	-0.47	-0.23	-0.20	-0.37	-0.43	-0.90	-0.93	-1.23	-1.27
S3	-0.87	-1.03	-0.90	-0.60	-0.73	-0.53	-0.30	-0.50	-1.10	-1.77
S4	-0.77	-0.57	-0.43	-0.33	-0.43	-0.43	-0.33	-0.40	-0.27	-0.30
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	-2.50	-1.40	-2.47	-2.43	-0.73	-1.07	-0.93	-0.53	-0.63	-0.87
S2	-0.50	-0.93	-1.70	-1.70	-1.33	-1.03	-1.13	-0.57	-0.43	-0.50
S3	-0.73	-0.63	-0.67	-0.70	-0.43	-0.43	-1.50	-0.83	-0.70	-0.30
S4	-0.37	-0.23	-0.27	-0.33	-0.37	-0.33	-0.83	-0.77	-0.67	-0.57
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	-1.47	-1.13	-1.07	-1.10	-1.37	-1.90	-1.77	-2.47	-1.80	-1.07
S2	-0.63	-0.70	-0.23	-0.50	-0.27	-1.20	-0.97	-0.47	-0.23	-0.37
S3	-0.23	-0.43	-0.23	-0.33	-0.93	-0.87	-1.43	-1.00	-0.90	-0.23
S4	-0.43	-0.50	-0.50	-0.43	-0.43	-0.93	-0.43	-0.30	-0.30	-0.20
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	-1.30	-1.40	-0.63	-1.07	-1.53	-0.67	-0.87	-1.07	-1.20	-0.90
S2	-0.43	-0.67	-0.57	-0.93	-0.43	-0.63	-0.10	-0.53	-0.50	-0.80
S3	-0.17	-0.27	-0.30	-0.43	-0.43	-0.47	-0.87	-0.80	-0.83	-0.67
S4	-0.33	-0.37	-0.27	-0.37	-0.43	-0.50	-0.33	-0.37	-0.30	-0.27
SE $\pm$		0.42								
C.D. at 5%		NS								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	-1.37	-2.10	-2.10	-0.67	-1.47	-1.00	-1.23	-1.87	-3.43	-2.87
S2	-0.70	-0.67	-0.50	-0.90	-0.40	-0.47	-0.97	-1.23	-0.53	-0.47
S3	-0.37	-0.67	-0.53	-0.57	-0.77	-0.40	-0.27	-0.50	-0.50	-0.37
S4	-0.37	-0.43	-0.50	-0.33	-0.37	-0.30	-0.77	-0.57	-0.43	-0.33
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	-1.20	-1.90	-4.77	-4.43	-0.57	-0.83	-1.13	-0.53	-0.87	-0.87
S2	-1.07	-0.30	-0.33	-0.77	-1.17	-1.67	-1.23	-0.63	-0.77	-0.97
S3	-0.43	-0.50	-0.33	-0.37	-0.30	-0.40	-0.93	-0.43	-0.30	-0.30
S4	-0.43	-0.43	-0.93	-0.43	-0.30	-0.30	-0.20	-0.33	-0.77	-0.57
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	-0.57	-0.97	-0.80	-0.73	-0.53	-0.80	-1.90	-1.27	-0.63	-1.30
S2	-0.90	-0.57	-0.67	-0.37	-0.23	-0.13	-0.30	-0.40	-0.37	-0.27
S3	-0.20	-0.33	-1.20	-1.00	-0.97	-0.37	-0.40	-0.50	-0.70	-0.63
S4	-0.43	-0.33	-0.43	-0.43	-0.53	-0.33	-0.13	-0.23	-0.50	-0.47
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	-1.10	-1.37	-1.17	-1.00	-1.13	-1.20	-1.17	-1.10	-2.23	-0.77
S2	-0.47	-0.77	-0.80	-0.40	-0.27	-0.10	-0.37	-0.50	-0.57	-0.47
S3	-1.17	-0.47	-0.33	-0.23	-0.23	-0.37	-0.33	-0.30	-0.27	-0.13
S4	-0.40	-0.30	-0.33	-0.47	-0.33	-0.33	-0.30	-0.77	-0.57	-0.43
SE $\pm$		0.33								
C.D. at 5%		0.91								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	-1.30	-1.73	-1.60	-1.18	-1.35	-0.87	-1.10	-1.75	-2.70	-2.53
S2	-0.77	-0.57	-0.37	-0.55	-0.38	-0.45	-0.93	-1.08	-0.88	-0.87
S3	-0.62	-0.85	-0.72	-0.58	-0.75	-0.47	-0.28	-0.50	-0.80	-1.07
S4	-0.57	-0.50	-0.47	-0.33	-0.40	-0.37	-0.55	-0.48	-0.35	-0.32
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	-1.85	-1.65	-3.62	-3.43	-0.65	-0.95	-1.03	-0.53	-0.75	-0.87
S2	-0.78	-0.62	-1.02	-1.23	-1.25	-1.35	-1.18	-0.60	-0.60	-0.73
S3	-0.58	-0.57	-0.50	-0.53	-0.37	-0.42	-1.22	-0.63	-0.50	-0.30
S4	-0.40	-0.33	-0.60	-0.38	-0.33	-0.32	-0.52	-0.55	-0.72	-0.57
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	-1.02	-1.05	-0.93	-0.92	-0.95	-1.35	-1.83	-1.87	-1.22	-1.18
S2	-0.77	-0.63	-0.45	-0.43	-0.02	-0.67	-0.63	-0.43	-0.30	-0.32
S3	-0.22	-0.38	-0.72	-0.67	-0.95	-0.62	-0.92	-0.75	-0.80	-0.43
S4	-0.43	-0.42	-0.47	-0.43	-0.48	-0.63	-0.28	-0.27	-0.40	-0.33
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	-1.20	-1.38	-0.90	-1.03	-1.33	-0.93	-1.02	-1.08	-1.72	-0.83
S2	-0.45	-0.72	-0.68	-0.67	-0.35	-0.37	-0.13	-0.52	-0.53	-0.63
S3	-0.67	-0.37	-0.32	-0.33	-0.33	-0.42	-0.60	-0.55	-0.55	-0.40
S4	-0.37	-0.33	-0.30	-0.42	-0.38	-0.42	-0.32	-0.57	-0.43	-0.35
SE $\pm$		0.24								
C.D. at 5%		0.66								

Effect of sowing windows:

The data presented in Table 17 indicated that, the absolute growth rate (AGR) g/day was observed non significant effect due to the different sowing windows during both the seasons and in the pooled data at tillering, flowering and harvesting stage.

At tillering stage, the date of sowing during *kharif* season recorded minimum absolute growth rate (AGR) g/day than rest of the date of sowing in *rabi* season during 2020-21 and 2021-22 seasons and in the pooled mean. However the sowing dates in *rabi* season, S₂ recorded maximum absolute growth rate (AGR) g/day over S₃ and S₄ at tillering stage.

Table 16: Interaction effect of leaf water potential (Bar) at harvesting stage on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	-1.67	-1.23	-0.73	-1.10	-1.13	-2.53	-1.90	-1.13	-1.60	-0.77
S2	-1.33	-1.53	-1.27	-1.33	-1.43	-1.50	-1.53	-1.47	-2.03	-1.90
S3	-1.53	-1.43	-1.60	-1.30	-1.57	-1.27	-1.47	-1.33	-1.70	-1.50
S4	-1.53	-1.27	-1.13	-1.40	-1.63	-1.37	-1.37	-1.47	-1.20	-1.23
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	-1.03	-0.40	-0.83	-1.10	-2.03	-1.50	-1.03	-1.40	-1.27	-2.17
S2	-1.63	-1.70	-2.27	-2.03	-1.63	-2.10	-1.60	-2.27	-3.13	-2.03
S3	-1.43	-1.27	-1.47	-1.57	-1.50	-1.33	-1.23	-1.43	-1.30	-1.57
S4	-1.40	-1.53	-1.43	-1.27	-1.93	-1.53	-1.77	-2.43	-1.90	-1.50
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	-1.43	-0.83	-1.00	-1.23	-1.87	-3.03	-3.33	-1.33	-1.93	-1.20
S2	-1.70	-1.13	-1.50	-1.60	-1.47	-1.40	-1.43	-1.40	-1.40	-1.40
S3	-1.17	-1.53	-1.33	-2.07	-1.40	-1.63	-1.63	-1.53	-1.43	-1.43
S4	-1.27	-1.33	-1.53	-1.50	-1.40	-1.27	-1.57	-1.33	-1.23	-1.40
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	-1.20	-1.37	-1.77	-2.00	-0.77	-1.03	-0.93	-0.57	-0.93	-1.43
S2	-1.57	-1.60	-1.33	-1.33	-1.27	-1.33	-1.43	-1.50	-1.40	-1.40
S3	-1.27	-1.27	-1.43	-1.47	-1.40	-1.27	-1.23	-1.53	-1.57	-1.53
S4	-1.50	-1.53	-1.43	-1.83	-1.97	-2.10	-1.47	-1.70	-2.40	-2.13
SE $\pm$		0.17								
C.D. at 5%		0.46								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	-1.30	-1.13	-0.80	-0.70	-1.37	-1.63	-0.80	-1.00	-1.43	-1.90
S2	-1.57	-1.17	-1.27	-1.47	-1.37	-1.43	-1.37	-1.43	-1.30	-1.50
S3	-1.17	-1.27	-1.47	-1.37	-1.43	-1.37	-1.43	-1.30	-1.50	-1.40
S4	-2.27	-1.43	-1.83	-2.33	-1.93	-1.60	-1.37	-1.53	-1.53	-1.60
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	-1.37	-1.67	-0.80	-1.10	-0.87	-1.30	-1.27	-1.40	-1.10	-1.27
S2	-1.23	-1.43	-1.47	-1.37	-1.40	-1.57	-1.43	-1.17	-1.30	-1.37
S3	-1.40	-1.57	-1.60	-1.33	-1.33	-1.27	-1.33	-1.23	-1.43	-1.30
S4	-1.63	-1.37	-1.27	-1.17	-1.37	-1.50	-1.43	-1.80	-1.97	-2.10
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	-1.83	-1.13	-1.03	-1.53	-1.73	-0.57	-1.07	-1.10	-1.70	-0.80
S2	-1.43	-1.43	-1.83	-2.03	-1.27	-1.60	-1.30	-1.37	-1.30	-1.43
S3	-1.57	-1.17	-1.53	-1.33	-2.07	-1.60	-1.37	-1.53	-1.27	-1.27
S4	-1.60	-1.50	-2.67	-2.10	-1.50	-1.27	-1.67	-1.60	-1.53	-2.07
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	-0.90	-1.17	-1.07	-1.40	-1.03	-0.53	-0.77	-1.43	-1.20	-1.03
S2	-1.40	-1.40	-1.23	-1.23	-1.27	-1.53	-1.33	-1.27	-1.33	-1.47
S3	-1.47	-1.40	-1.43	-2.00	-1.43	-1.60	-2.23	-2.17	-1.37	-1.47
S4	-1.50	-1.57	-2.67	-1.87	-1.57	-1.33	-1.30	-1.53	-1.53	-1.50
SE $\pm$		0.16								
C.D. at 5%		0.44								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	-1.48	-1.18	-0.77	-0.90	-1.25	-2.08	-1.35	-1.07	-1.52	-1.33
S2	-1.45	-1.35	-1.27	-1.40	-1.40	-1.47	-1.45	-1.45	-1.67	-1.70
S3	-1.35	-1.35	-1.53	-1.33	-1.50	-1.32	-1.45	-1.32	-1.60	-1.45
S4	-1.90	-1.35	-1.48	-1.87	-1.78	-1.48	-1.37	-1.50	-1.37	-1.42
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	-1.20	-1.03	-0.82	-1.10	-1.45	-1.40	-1.15	-1.40	-1.18	-1.72
S2	-1.43	-1.57	-1.87	-1.70	-1.52	-1.83	-1.52	-1.72	-2.22	-1.70
S3	-1.42	-1.42	-1.53	-1.45	-1.42	-1.30	-1.28	-1.33	-1.37	-1.43
S4	-1.52	-1.45	-1.35	-1.22	-1.65	-1.52	-1.60	-2.12	-1.93	-1.80
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	-1.63	-0.98	-1.02	-1.38	-1.80	-1.80	-2.20	-1.22	-1.82	-1.00
S2	-1.57	-1.28	-1.67	-1.82	-1.37	-1.50	-1.37	-1.38	-1.35	-1.42
S3	-1.37	-1.35	-1.43	-1.70	-1.73	-1.62	-1.50	-1.53	-1.35	-1.35
S4	-1.43	-1.42	-2.10	-1.80	-1.45	-1.27	-1.62	-1.47	-1.38	-1.73
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	-1.05	-1.27	-1.42	-1.70	-0.90	-0.78	-0.85	-1.00	-1.07	-1.23
S2	-1.48	-1.50	-1.28	-1.28	-1.27	-1.43	-1.38	-1.38	-1.37	-1.43
S3	-1.37	-1.33	-1.43	-1.73	-1.42	-1.43	-1.73	-1.85	-1.47	-1.50
S4	-1.50	-1.55	-2.05	-1.85	-1.77	-1.72	-1.38	-1.62	-1.97	-1.82
SE $\pm$		0.11								
C.D. at 5%		0.32								

At flowering stage, S₂ i.e. crop sown S₂ date of sowing (48th MW) recorded maximum absolute growth rate (0.3983 g/day)than rest of the date of sowing S₁ i.e. crop sown S₁ date of sowing (24th MW), S₃ i.e. crop sown S₃ date of sowing (50th MW), S₄ i.e. crop sown S₄ date of sowing (52th MW) during 2020-21 and 2021-22 seasons and in the pooled mean. However the sowing dates in *rabi* season, S₄ recorded minimum absolute growth rate (AGR)g/day at tillering stage. S₃ recorded minimum absolute growth rate (AGR)g/day over S₂ and S₄ at harvesting stage.

Table 17 Effect of different sowing dates on absolute growth rate (g/day/plant) in rice genotypes

Treatments	Absolute growth rate (g/day/plant)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)									
S1 : 24 th MW	0.1308	0.1254	0.1281	0.3979	0.3870	0.3925	1.0441	1.0267	1.0354
S2 : 48 th MW	0.1311	0.1310	0.1311	0.3825	0.3983	0.3904	1.0154	1.0510	1.0332
S3 : 50 th MW	0.1303	0.1305	0.1304	0.3891	0.3875	0.3883	1.0296	1.0254	1.0275
S4 : 52 th MW	0.1317	0.1290	0.1304	0.4041	0.3827	0.3934	1.0627	1.0168	1.0397
SE ±	0.0018	0.0020	0.0011	0.0063	0.0064	0.0020	0.0149	0.0177	0.0053
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
B) Sub plot (Varieties)									
V1:Karjat-1	0.1404	0.1200	0.1302	0.4239	0.3517	0.3878	1.1348	0.9144	1.0246
V2:Karjat-3	0.1613	0.1317	0.1465	0.4893	0.4277	0.4585	1.3245	1.1501	1.2373
V3:Karjat-4,	0.1324	0.1175	0.1250	0.4078	0.3426	0.3752	1.0173	0.9178	0.9675
V4:Karjat-7	0.1376	0.1390	0.1383	0.3993	0.4230	0.4112	1.0290	1.0947	1.0618
V5:Karjat-184	0.1321	0.1254	0.1288	0.3950	0.3662	0.3806	1.0577	0.9632	1.0104
V6:Sahyadri-2	0.1246	0.1252	0.1249	0.3813	0.3697	0.3755	1.0292	0.9844	1.0068
V7:Sahyadri-4	0.1233	0.1376	0.1305	0.3579	0.4383	0.3981	0.9082	1.1302	1.0192
V8:Phondaghat -1	0.1506	0.1398	0.1452	0.4311	0.4025	0.4168	1.1595	1.0989	1.1292
V9:Ratnagiri-1	0.1273	0.1270	0.1272	0.3787	0.3891	0.3839	1.0160	1.0363	1.0261
V10:Ratnagiri-5	0.1365	0.1360	0.1362	0.3844	0.3922	0.3883	0.9693	1.0354	1.0024
V11:Ratnagiri- 6	0.1191	0.1338	0.1264	0.3654	0.3897	0.3776	0.9395	1.0408	0.9902
V12:Ratnagiri- 7	0.1295	0.1274	0.1285	0.3924	0.3770	0.3847	1.1001	1.0114	1.0558
V13:Ratnagiri -24	0.1164	0.1168	0.1166	0.3599	0.3378	0.3488	0.9755	0.9172	0.9464
V14:Ratnagiri-73	0.1389	0.1307	0.1348	0.4244	0.3963	0.4103	1.1068	1.0736	1.0902
V15:Ratnagiri-711	0.1198	0.1357	0.1277	0.3584	0.3864	0.3724	0.9615	1.0215	0.9915
V16:IRRI-14	0.1446	0.1225	0.1335	0.4365	0.3813	0.4089	1.1421	0.9757	1.0589
V17:IRRI-15	0.1295	0.1275	0.1285	0.3985	0.3802	0.3893	1.0208	1.0150	1.0179
V18:IRRI-20	0.1373	0.1212	0.1292	0.4332	0.3669	0.4000	1.1760	0.9536	1.0648
V19:IRRI-21	0.1162	0.1214	0.1188	0.3669	0.3687	0.3678	0.9802	0.9837	0.9820
V20:IRRI-22	0.1390	0.1232	0.1311	0.4156	0.3858	0.4007	1.1037	1.0222	1.0630
V21:IRRI-27	0.1202	0.1524	0.1363	0.3606	0.4417	0.4012	0.9423	1.2210	1.0817
V22:IRRI-28	0.1242	0.1498	0.1370	0.3758	0.4612	0.4185	1.0194	1.2417	1.1305
V23:IRRI-34	0.1405	0.1377	0.1391	0.4364	0.4165	0.4265	1.1651	1.1163	1.1407
V24:IRRI-36	0.1262	0.1290	0.1276	0.3838	0.3969	0.3904	1.0247	1.0452	1.0349
V25:IRRI-47	0.1242	0.1159	0.1201	0.3768	0.3446	0.3607	1.0017	0.9059	0.9538
V26:IRRI-52	0.1368	0.1177	0.1272	0.3836	0.3490	0.3663	1.0032	0.9160	0.9596
V27:IRRI-53	0.1289	0.1290	0.1290	0.3801	0.3751	0.3776	0.9780	1.0198	0.9989
V28:IRRI-55	0.1210	0.1140	0.1175	0.3550	0.3293	0.3422	0.9114	0.8777	0.8945
V29:IRRI-62	0.1386	0.1210	0.1298	0.4062	0.3769	0.3916	1.0573	0.9942	1.0258
V30:IR-35	0.1209	0.1238	0.1224	0.3771	0.4040	0.3905	0.9918	1.0341	1.0130
V31:Laldodaki	0.1338	0.1349	0.1343	0.3897	0.4170	0.4033	1.0270	1.0331	1.0300
V32:IR2289-6-22-5	0.1321	0.1250	0.1286	0.3786	0.3508	0.3647	1.0416	0.9375	0.9896
V33:Narmada	0.1231	0.1211	0.1221	0.3601	0.3666	0.3633	0.9243	0.9538	0.9391
V34:Ananda	0.1304	0.1326	0.1315	0.4032	0.4143	0.4087	1.0388	1.0975	1.0682
V35:Ambpandhari	0.1215	0.1454	0.1334	0.3554	0.4267	0.3910	0.9243	1.1359	1.0301
V36:Hira	0.1331	0.1377	0.1354	0.4303	0.4751	0.4527	1.1190	1.2664	1.1927
V37:OR-1516-1-5-A	0.1260	0.1223	0.1241	0.3774	0.3707	0.3741	0.9952	0.9639	0.9796
V38:China	0.1329	0.1180	0.1255	0.4013	0.3534	0.3774	1.0850	0.9580	1.0215
V39:Sorati	0.1316	0.1424	0.1370	0.3977	0.4199	0.4088	1.0515	1.1096	1.0805
V40:Mhadi	0.1277	0.1193	0.1235	0.3775	0.3644	0.3709	0.9831	0.9546	0.9689
SE ±	0.0062	0.0072	0.0049	0.0242	0.0262	0.0184	0.0654	0.0747	0.0512
C.D. at 5%	0.0172	0.0199	0.0136	NS	0.0729	0.0513	0.1819	0.2078	0.1426
Interaction Effect (S x M)									
SE ±	0.0124	0.0143	0.0098	0.0484	0.0524	0.0369	0.1307	0.1494	0.1025
C.D. at 5%	0.0345	0.0399	0.0272	0.1346	0.1458	0.1025	0.3638	0.4155	0.2851
General Mean	0.1310	0.1290	0.1300	0.3934	0.3889	0.3911	1.0379	1.0300	1.0340

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 : 52th MW (24th-31st December)

Effect of genotypes:

Absolute growth rate (AGR) g/day was significant difference due to the different genotypes during in both years and pooled mean at tillering stage, flowering stage and at harvesting stage (Table 17).

At tillering stage, maximum absolute growth rate (AGR)g/day was recorded in V₂ i.e.Karjat-3 (0.1465g/day/plant) which was at par with V₄ i.e.Karjat-7,V₈-Karjat-184,V₁₀-Ratnagiri -5, V₁₄-Ratnagiri-73, V₁₆- IRRI-14, V₂₁- IRRI-27, V₂₂- IRRI-28, V₃₁-Laldodki, V₃₅-Ambepandhari,V₃₆- Hira V₃₉-Sorati over others genotypes.

At flowering stage, the ricegenotypeV₂ i.e. Karjat-3 recorded maximum absolute growth rate (AGR) 0.4585 g/day which was at par with V₄ i.e.Karjat-7,V₈-Karjat-184,V₁₄- Ratnagiri -73, V₂₂- IRRI-28, V₂₃-IRRI-34, V₃₄ -Ananda ,V₃₅-Ambepandhari, V₃₆- Hira V₃₉-Soratiover others genotypes.

At harvesting stage, the rice genotype V₂ i.e. Karjat-3 recorded maximum absolute growth rate (AGR) 1.2373 g/day which was at par with V₄ i.e. V₈-Karjat-184,V₁₄- Ratnagiri -73, V₂₂-IRRI-28, V₂₃- IRRI -34, V₃₆-Hiraover others genotypes.

Interaction effect:

The pooled mean data of absolute growth rate (AGR)g/day in different genotypes of rice for the two seasons of *kharif*and *rabi* are presented in Table 18.

Interaction effect between sowing dates of genotypes was significant in respect of absolute growth rate (AGR)g/day. At harvesting stage, the rice crop sown S₁ i.e. *kharif* season with V₄i.e. Karjat-7 recorded significantly higher absolute growth rate (AGR) 1.3368 g/day which was at par withS₁V₂, S₁V₅, S₁V₆, S₁V₁₂, S₁V₁₃, S₁V₁₄, S₁V₁₈, S₁V₂₀, S₁V₂₁, S₁V₂₇, S₁V₃₄, S₁V₃₆ and S₁V₃₈ over others. The rice crop sown S₂ i.e.*rabi* season with V₃₆ i.e. Hira recorded significantly higher absolute growth rate (1.4340 g/day/plant) which was at par with S₂V₈, S₂V₁₀, S₂V₂₁, S₂V₂₂, S₂V₂₃, S₂V₃₅, S₃V₁, S₃V₂, S₃V₈, S₃V₉, S₃V₂₂, S₃V₂₄, S₃V₃₁, S₄V₂, S₄V₇, S₄V₁₃, S₄V₁₆, S₄V₁₇, S₄V₂₀, S₄V₂₂ and S₄V₃₄ and over others genotypes.

Table 18: Interaction effect of absolute growth rate (g/day/plant)on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1.0000	1.4404	0.8595	1.1776	1.2988	1.3106	1.0103	0.9033	0.8698	0.8635
S2	1.1868	0.9450	0.8473	0.8518	1.0202	0.9586	0.8545	1.2768	0.8967	1.1165
S3	1.4602	1.3120	1.0764	0.9301	0.7374	0.8828	0.8477	1.2969	1.2957	1.0846
S4	0.8923	1.6008	1.2860	1.1562	1.1745	0.9648	0.9202	1.1610	1.0017	0.8124
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.9511	1.3435	1.1538	1.2656	1.0030	1.0744	0.9300	1.4285	1.0120	0.9873
S2	1.1246	0.9337	0.8903	1.0090	0.9861	1.1606	1.0425	1.1089	0.7355	1.2013
S3	0.8516	1.1083	0.8192	1.2704	0.9625	0.8516	0.8811	1.1742	1.0513	0.8096
S4	0.8307	1.0149	1.3638	0.8821	0.8943	1.4817	1.2294	0.9921	1.1221	1.4165
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1.1616	0.9135	0.9942	0.9154	0.9281	0.9772	1.0379	0.9491	0.9986	0.8845
S2	0.9269	0.9068	1.4189	0.8460	1.2744	0.9343	0.9022	1.0150	0.9934	1.0108
S3	0.8063	1.0131	1.1459	1.3120	1.0148	0.9943	0.9999	0.8457	1.1419	1.0187
S4	0.8745	1.2441	1.1014	1.0252	0.7894	1.1068	0.9722	0.8356	1.0954	1.0533
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.9552	1.1133	0.8357	1.0392	0.9742	1.0222	0.9819	1.2614	1.0404	0.8985
S2	1.1850	0.9859	0.8735	0.8593	0.9352	1.3668	0.9485	1.0728	0.9018	1.1116
S3	1.0937	1.1020	1.0918	0.9650	0.8739	0.8981	1.0861	0.8954	1.1894	0.9907
S4	0.8740	0.9653	0.8962	1.2918	0.9141	1.1890	0.9644	1.1105	1.0742	0.9318
SE $\pm$		0.1307								
C.D. at 5%		0.3638								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.8424	1.0141	1.0600	1.4960	0.9866	1.3149	1.0261	0.8949	0.8635	0.9066
S2	0.8711	1.1175	0.8386	1.0048	1.0382	0.9120	1.0789	1.1658	1.0931	1.3006
S3	0.9719	1.3131	0.9278	0.9853	0.8558	0.7950	1.0359	1.2670	1.1015	0.9543
S4	0.9722	1.1558	0.8446	0.8929	0.9720	0.9156	1.3800	1.0681	1.0870	0.9803
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.8424	0.8619	1.1254	1.2106	0.9104	1.0087	1.0941	1.1670	0.9623	1.2165
S2	1.0523	1.0623	0.8225	1.2396	1.0877	1.0221	0.9437	0.7673	1.0104	0.9082
S3	0.9408	1.1117	1.0572	0.9004	0.7990	0.8606	0.9407	1.0428	0.9528	0.9722
S4	1.3277	1.0097	0.9696	0.9438	1.2889	1.0111	1.0812	0.8373	1.0093	0.9920
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.9452	0.9848	0.8934	0.8742	0.8267	0.9313	1.0968	0.8439	1.0972	1.0898
S2	1.4458	1.4867	1.3482	1.2423	0.9572	0.9571	1.1346	0.9375	0.8205	0.7715
S3	1.1668	1.3255	1.1226	1.0766	0.9552	0.8086	1.0451	0.8848	1.0225	1.0540
S4	1.3262	1.1697	1.1011	0.9878	0.8844	0.9671	0.8028	0.8447	1.0368	1.2211
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.8282	0.9473	1.0198	1.2222	1.0469	1.5373	0.8797	1.0920	0.9972	1.1104
S2	0.8743	0.9043	0.7972	0.9403	1.3672	1.5011	0.9226	1.0115	1.2999	0.9843
S3	1.2583	0.9697	1.0248	1.2098	1.3672	1.2338	0.9300	0.8824	1.0015	0.8904
S4	1.1714	0.9287	0.9734	1.0178	0.7624	0.7932	1.1234	0.8461	1.1398	0.8334
SE $\pm$		0.1494								
C.D. at 5%		0.4155								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.9212	1.2272	0.9598	1.3368	1.1427	1.3127	1.0182	0.8991	0.8667	0.8851
S2	1.0289	1.0313	0.8430	0.9283	1.0292	0.9353	0.9667	1.2213	0.9949	1.2085
S3	1.2160	1.3126	1.0021	0.9577	0.7966	0.8389	0.9418	1.2819	1.1986	1.0194
S4	0.9323	1.3783	1.0653	1.0245	1.0732	0.9402	1.1501	1.1145	1.0444	0.8964
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.8968	1.1027	1.1396	1.2381	0.9567	1.0415	1.0121	1.2978	0.9872	1.1019
S2	1.0885	0.9980	0.8564	1.1243	1.0369	1.0914	0.9931	0.9381	0.8730	1.0548
S3	0.8962	1.1100	0.9382	1.0854	0.8807	0.8561	0.9109	1.1085	1.0021	0.8909
S4	1.0792	1.0123	1.1667	0.9129	1.0916	1.2464	1.1553	0.9147	1.0657	1.2042
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1.0534	0.9492	0.9438	0.8948	0.8774	0.9543	1.0674	0.8965	1.0479	0.9872
S2	1.1863	1.1968	1.3835	1.0442	1.1158	0.9457	1.0184	0.9762	0.9069	0.8912
S3	0.9866	1.1693	1.1343	1.1943	0.9850	0.9015	1.0225	0.8652	1.0822	1.0364
S4	1.1003	1.2069	1.1013	1.0065	0.8369	1.0369	0.8875	0.8402	1.0661	1.1372
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.8917	1.0303	0.9277	1.1307	1.0106	1.2798	0.9308	1.1767	1.0188	1.0045
S2	1.0297	0.9451	0.8354	0.8998	1.1512	1.4340	0.9356	1.0422	1.1009	1.0479
S3	1.1760	1.0359	1.0583	1.0874	1.1205	1.0660	1.0081	0.8889	1.0955	0.9406
S4	1.0227	0.9470	0.9348	1.1548	0.8382	0.9911	1.0439	0.9783	1.1070	0.8826
SE $\pm$		0.1025								
C.D. at 5%		0.2851								

4.2.5. Relative growth rate(RGR)g/g/day:

Data pertaining to the relative growth rate (RGR)g/g/day at different growth stage for rice genotypes are presented in Table 19. There was non significant difference in the relative growth rate (RGR) g/g/day at tillering, flowering and harvesting stage during both the year 2020-21 and 2021-22 year and pooled mean. General mean of relative growth rate (RGR)g/day of both years and pooled mean were found to be 0.0373 g/g/day, 0.0393 g/g/day, 0.0383 g/g/day and 0.0131 g/g/day, 0.0140 g/g/day, 0.0135 g/g/day and 0.0177 g/g/day, 0.0185 g/g/day and 0.0181 g/g/day at tillering, flowering and harvesting stage respectively.

Table 19 Effect of different treatment on relative growth rate (g/g/day) rice genotypes

Treatments	Relative growth rate (g/g/day)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)									
S1 : 24 th MW	0.0338	0.0413	0.0375	0.0122	0.0155	0.0138	0.0167	0.0200	0.0184
S2 : 48 th MW	0.0408	0.0391	0.0399	0.0134	0.0132	0.0133	0.0180	0.0177	0.0179
S3 : 50 th MW	0.0384	0.0417	0.0400	0.0130	0.0138	0.0134	0.0176	0.0184	0.0180
S4 : 52 th MW	0.0361	0.0352	0.0357	0.0138	0.0135	0.0136	0.0184	0.0181	0.0182
SE $\pm$	0.0015	0.0034	0.0021	0.0007	0.0015	0.0010	0.0006	0.0014	0.0009
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
B) Sub plot (Varieties)									
V1: Karjat-1	0.0319	0.0334	0.0326	0.0123	0.0129	0.0126	0.0162	0.0168	0.0165
V2: Karjat-3	0.0333	0.0545	0.0439	0.0110	0.0198	0.0154	0.0157	0.0245	0.0201
V3: Karjat-4,	0.0321	0.0320	0.0320	0.0119	0.0120	0.0120	0.0168	0.0169	0.0168
V4: Karjat-7	0.0297	0.0324	0.0310	0.0105	0.0114	0.0109	0.0150	0.0159	0.0155
V5: Karjat-184	0.0350	0.0331	0.0340	0.0121	0.0115	0.0118	0.0168	0.0162	0.0165
V6: Sahyadri-2	0.0594	0.0553	0.0573	0.0198	0.0186	0.0192	0.0243	0.0231	0.0237
V7: Sahyadri-4	0.0336	0.0344	0.0340	0.0126	0.0132	0.0129	0.0170	0.0176	0.0173
V8: Phondaghat -1	0.0323	0.0328	0.0326	0.0112	0.0115	0.0114	0.0159	0.0162	0.0161
V9: Ratnagiri-1	0.0317	0.0587	0.0452	0.0113	0.0211	0.0162	0.0157	0.0256	0.0206
V10: Ratnagiri-5	0.0323	0.0354	0.0338	0.0123	0.0138	0.0130	0.0168	0.0182	0.0175
V11: Ratnagiri- 6	0.0335	0.0327	0.0331	0.0121	0.0118	0.0120	0.0169	0.0166	0.0168
V12: Ratnagiri- 7	0.0571	0.0357	0.0464	0.0216	0.0130	0.0173	0.0259	0.0173	0.0216
V13: Ratnagiri -24	0.0297	0.0324	0.0310	0.0109	0.0119	0.0114	0.0151	0.0161	0.0156
V14: Ratnagiri-73	0.0331	0.0335	0.0333	0.0120	0.0122	0.0121	0.0167	0.0168	0.0167
V15: Ratnagiri-711	0.0340	0.0584	0.0462	0.0116	0.0201	0.0158	0.0160	0.0245	0.0202
V16: IRRI-14	0.0329	0.0332	0.0331	0.0112	0.0114	0.0113	0.0157	0.0159	0.0158
V17: IRRI-15	0.0349	0.0357	0.0353	0.0124	0.0125	0.0124	0.0170	0.0171	0.0171
V18: IRRI-20	0.0614	0.0353	0.0484	0.0212	0.0119	0.0166	0.0259	0.0166	0.0212
V19: IRRI-21	0.0364	0.0313	0.0338	0.0127	0.0110	0.0119	0.0172	0.0155	0.0164
V20: IRRI-22	0.0346	0.0310	0.0328	0.0115	0.0103	0.0109	0.0160	0.0148	0.0154
V21: IRRI-27	0.0330	0.0724	0.0527	0.0113	0.0229	0.0171	0.0156	0.0272	0.0214
V22: IRRI-28	0.0342	0.0580	0.0461	0.0119	0.0204	0.0161	0.0164	0.0249	0.0206
V23: IRRI-34	0.0589	0.0334	0.0461	0.0207	0.0118	0.0163	0.0253	0.0164	0.0208
V24: IRRI-36	0.0330	0.0357	0.0343	0.0118	0.0129	0.0123	0.0162	0.0173	0.0168
V25: IRRI-47	0.0374	0.0583	0.0479	0.0138	0.0245	0.0191	0.0186	0.0293	0.0239
V26: IRRI-52	0.0331	0.0348	0.0339	0.0125	0.0134	0.0129	0.0173	0.0182	0.0177
V27: IRRI-53	0.0336	0.0350	0.0343	0.0119	0.0125	0.0122	0.0167	0.0173	0.0170
V28: IRRI-55	0.0297	0.0318	0.0308	0.0108	0.0116	0.0112	0.0154	0.0162	0.0158
V29: IRRI-62	0.0343	0.0323	0.0333	0.0121	0.0114	0.0118	0.0166	0.0160	0.0163
V30: IR-35	0.0329	0.0577	0.0453	0.0115	0.0198	0.0157	0.0159	0.0242	0.0201
V31: Laldodaki	0.0326	0.0325	0.0325	0.0113	0.0113	0.0113	0.0158	0.0158	0.0158
V32: IR2289-6-22-5	0.0345	0.0325	0.0335	0.0122	0.0116	0.0119	0.0167	0.0160	0.0163
V33: Narmada	0.0329	0.0311	0.0320	0.0114	0.0109	0.0112	0.0160	0.0154	0.0157
V34: Ananda	0.0348	0.0322	0.0335	0.0131	0.0122	0.0126	0.0177	0.0168	0.0172
V35: Ambpandhari	0.0359	0.0596	0.0478	0.0126	0.0185	0.0155	0.0171	0.0231	0.0201
V36: Hira	0.0596	0.0318	0.0457	0.0183	0.0110	0.0147	0.0231	0.0159	0.0195
V37: OR-1516-1-5-A	0.0571	0.0330	0.0450	0.0180	0.0118	0.0149	0.0225	0.0163	0.0194
V38: China	0.0335	0.0340	0.0337	0.0117	0.0119	0.0118	0.0162	0.0165	0.0163
V39: Sorati	0.0334	0.0364	0.0349	0.0123	0.0135	0.0129	0.0169	0.0181	0.0175
V40: Mhadi	0.0344	0.0367	0.0356	0.0121	0.0130	0.0125	0.0165	0.0174	0.0170
SE $\pm$	0.0097	0.0116	0.0075	0.0032	0.0042	0.0027	0.0032	0.0042	0.0026
C.D. at 5%	0.0270	0.0322	0.0208	0.0089	0.0117	0.0074	0.0089	0.0117	0.0074
Interaction Effect (S x M)									
SE $\pm$	0.0194	0.0231	0.0149	0.0064	0.0084	0.0053	0.0064	0.0084	0.0053
C.D. at 5%	0.0539	0.0643	0.0415	0.0178	0.0235	0.0147	0.0178	0.0235	0.0147
General Mean	0.0373	0.0393	0.0383	0.0131	0.0140	0.0135	0.0177	0.0185	0.0181

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 : 52th MW (24th-31st December)

Effect of sowing windows:

The data presented in Table 19 indicated that, the relative growth rate (RGR) g/g/day was non significant effect due to the different sowing windows during both the seasons and in the pooled data at flowering and harvesting stage.

At tillering stage, crop sown S₁ i.e. *kharif* season (24th MW) recorded low relative growth rate (RGR) 0.375 g/g/day. Crop sown S₄ i.e. *rabi* season (52th MW) recorded lowest relative growth rate 0.357 g/g/day during 2020-21 and 2021-22 seasons and in the pooled mean. However the sowing dates in *rabi* season, S₃ date of sowing (50th MW) of *rabi* season recorded maximum relative growth rate (0.400g/g/day) over S₂ date of sowing (48th MW) and S₄ date of sowing (52th MW) of *rabi* season at tillering stage.

At flowering and harvesting stage, date of sowing (24th MW) in *kharif* season recorded maximum relative growth rate (RGR) 0.0138g/g/day and 0.0184g/g/day than rest of the date of sowing. Crop sown S₄ i.e. *rabi* season recorded maximum relative growth rate (RGR) 0.0136 g/g/day and 0.0182 g/g/day over S₂ and S₃ at flowering and harvesting stage.

Effect of genotypes:

Relative growth rate (RGR)g/g/day was significant difference due to the different genotypes during in both years and pooled mean at tillering stage, flowering stage and at harvesting stage. At tillering stage, maximum relative growth rate (RGR) was recorded in V₆ i.e. Sahyadri-2 (0.0573g/g/day) which was at par with V₂ i.e.Karjat-3, V₉-Ratnagiri -1, V₁₂- Ratnagiri -7, V₁₅- Ratnagiri -711, V₁₈- IRRI-20, V₂₁- IRRI-27,V₂₂-IRRI-28, V₂₃-IRRI-34, V₂₅-IRRI-47, V₃₀-IR-35, V₃₅-Ambepandhari, V₃₆-Hira V₃₇-OR-1516-1-5A and over others genotypes. General mean of relative growth rate (RGR G)g/g/day of both years and pooled mean were found to be 0.0373, 0.0393, 0.0383, 0.0131, 0.0140, 0.0135, 0.0177, 0.0185, 0.0181g/dm²/day, respectively at tillering, flowering and harvesting stage.

At flowering stage, the rice variety V₆ i.e. Sahyadri-2 recorded maximum relative growth rate (RGR) 0.0192 g/g/day which was at par with V₁-Karjat-1, V₂-Karjat-3, V₃-Karjat-4, V₅-Karjat-184, V₆-Sahyadri-2, V₇-Sahyadri-4, V₉-Ratnagiri-1, V₁₀-Ratnagiri-5, V₁₁-Ratnagiri-6, V₁₂-Ratnagiri-7, V₁₄-Ratnagiri-73, V₁₅-Ratnagiri-711, V₁₇-IRRI-15, V₁₈-IRRI-20, V₁₉-IRRI-21, V₂₁-IRRI-27, V₂₂-IRRI-28, V₂₃-IRRI-34, V₂₄-IRRI-36, V₂₅-IRRI-47, V₂₆-IRRI-52, V₂₇-IRRI-53, V₃₄-Ananda, V₃₅-Ambpandhari, V₃₆-Hira, V₃₇-OR-1516-1-5A, V₃₈-China, V₃₉-Sorati, V₄₀-Mhadiover other genotypes.

At harvesting stage, the rice variety V₆ i.e. Sahyadri-2 recorded maximum relative growth rate (RGR) 0.0237g/g/day which was at par with V₁-Karjat-1, V₂-Karjat-3, V₃-Karjat-4, V₅-Karjat-184, V₆-Sahyadri-2, V₇-Sahyadri-4, V₉-Ratnagiri-1, V₁₀-Ratnagiri-5, V₁₁-Ratnagiri-6, V₁₂-Ratnagiri-7, V₁₄-Ratnagiri-73, V₁₅-Ratnagiri-711, V₁₇-IRRI-15, V₁₈-IRRI-20, V₁₉-IRRI-21, V₂₁-IRRI-27, V₂₂-IRRI-28, V₂₃-IRRI-34, V₂₄-IRRI-36, V₂₅-IRRI-47, V₂₆-IRRI-52, V₂₉-IRRI-62, V₃₀-IR-35, V₃₂-IR-2289-6-22-5, V₃₄-Ananda, V₃₅-Ambpandhari, V₃₆-Hira, V₃₇-OR, V₃₈-China, V₃₉-Sorati, V₄₀-Mhadi and over others genotypes.

Interaction effect:

The pooled mean data of relative growth rate (RGR) g/g/day in different genotypes of rice for the two seasons of *kharif* and *rabi* are presented in Table 20.

Interaction effect between sowing dates of genotypes was significant in respect of relative growth rate (RGR) g/g/day. At harvesting stage, the rice crop sowed S₁ i.e. *kharif* season with V₂₅ i.e. IRRI-47 recorded significantly higher relative growth rate (RGR) 0.0424 g/g/day which was at par with S₁V₂ and S₁V₂₂ over others. The rice crop sown S₄ i.e. *rabi* season with V₁₂ i.e. Ratnagiri-7 recorded significantly higher relative growth rate (RGR) 0.0371g/g/day which was at par with S₂V₆, S₂V₁₅, S₂V₂₁, S₃V₆, S₂V₁₅, S₃V₁₈, S₃V₂₃, S₃V₃₀, S₃V₃₅, S₃V₃₆, S₃V₃₇, S₄V₆, S₄V₉ over other genotypes.

Table 20: Interaction effect of relative growth rate (g/g/day))on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.0154	0.0151	0.0173	0.0167	0.0152	0.0177	0.0179	0.0169	0.0171	0.0153
S2	0.0197	0.0147	0.0149	0.0158	0.0182	0.0467	0.0152	0.0146	0.0149	0.0197
S3	0.0139	0.0157	0.0179	0.0131	0.0166	0.0161	0.0137	0.0165	0.0130	0.0157
S4	0.0159	0.0171	0.0171	0.0145	0.0171	0.0169	0.0212	0.0157	0.0178	0.0164
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.0175	0.0165	0.0180	0.0171	0.0173	0.0148	0.0166	0.0166	0.0170	0.0173
S2	0.0166	0.0163	0.0141	0.0169	0.0147	0.0160	0.0181	0.0181	0.0193	0.0140
S3	0.0153	0.0147	0.0170	0.0156	0.0169	0.0139	0.0153	0.0520	0.0138	0.0151
S4	0.0184	0.0562	0.0164	0.0170	0.0151	0.0181	0.0180	0.0168	0.0188	0.0175
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.0179	0.0163	0.0159	0.0163	0.0182	0.0178	0.0163	0.0177	0.0141	0.0166
S2	0.0134	0.0134	0.0168	0.0143	0.0186	0.0163	0.0148	0.0135	0.0173	0.0144
S3	0.0130	0.0179	0.0518	0.0167	0.0195	0.0158	0.0179	0.0146	0.0174	0.0141
S4	0.0181	0.0179	0.0167	0.0176	0.0180	0.0193	0.0179	0.0157	0.0176	0.0186
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.0148	0.0173	0.0157	0.0171	0.0182	0.0184	0.0179	0.0169	0.0159	0.0156
S2	0.0143	0.0166	0.0145	0.0176	0.0151	0.0400	0.0418	0.0163	0.0150	0.0170
S3	0.0170	0.0152	0.0177	0.0162	0.0162	0.0161	0.0147	0.0140	0.0178	0.0170
S4	0.0171	0.0175	0.0158	0.0197	0.0191	0.0181	0.0156	0.0177	0.0188	0.0165
SE $\pm$		0.0064								
C.D. at 5%		0.0178								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.0206	0.0533	0.0206	0.0170	0.0188	0.0150	0.0192	0.0174	0.0182	0.0177
S2	0.0160	0.0142	0.0147	0.0157	0.0163	0.0143	0.0185	0.0148	0.0159	0.0165
S3	0.0152	0.0157	0.0162	0.0154	0.0140	0.0474	0.0138	0.0165	0.0154	0.0192
S4	0.0153	0.0148	0.0161	0.0155	0.0155	0.0157	0.0190	0.0162	0.0528	0.0195
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.0165	0.0148	0.0177	0.0145	0.0162	0.0145	0.0170	0.0147	0.0169	0.0142
S2	0.0165	0.0171	0.0169	0.0168	0.0493	0.0153	0.0187	0.0167	0.0146	0.0148
S3	0.0167	0.0194	0.0157	0.0180	0.0174	0.0147	0.0165	0.0180	0.0145	0.0153
S4	0.0168	0.0179	0.0195	0.0179	0.0149	0.0192	0.0163	0.0170	0.0160	0.0148
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.0185	0.0508	0.0155	0.0147	0.0666	0.0203	0.0176	0.0188	0.0165	0.0159
S2	0.0600	0.0152	0.0140	0.0169	0.0150	0.0171	0.0152	0.0159	0.0151	0.0142
S3	0.0149	0.0163	0.0175	0.0190	0.0200	0.0145	0.0183	0.0146	0.0151	0.0476
S4	0.0155	0.0173	0.0186	0.0186	0.0155	0.0209	0.0182	0.0153	0.0172	0.0193
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.0169	0.0182	0.0158	0.0173	0.0183	0.0152	0.0177	0.0165	0.0196	0.0161
S2	0.0157	0.0170	0.0138	0.0174	0.0149	0.0145	0.0155	0.0161	0.0155	0.0165
S3	0.0150	0.0129	0.0152	0.0144	0.0404	0.0178	0.0134	0.0169	0.0183	0.0171
S4	0.0156	0.0160	0.0170	0.0180	0.0187	0.0159	0.0187	0.0163	0.0189	0.0199
SE $\pm$		0.0084								
C.D. at 5%		0.0235								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.0180	0.0342	0.0189	0.0168	0.0170	0.0163	0.0185	0.0172	0.0177	0.0165
S2	0.0179	0.0145	0.0148	0.0158	0.0173	0.0305	0.0169	0.0147	0.0154	0.0181
S3	0.0145	0.0157	0.0171	0.0142	0.0153	0.0318	0.0138	0.0165	0.0142	0.0175
S4	0.0156	0.0159	0.0166	0.0150	0.0163	0.0163	0.0201	0.0160	0.0353	0.0179
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.0170	0.0156	0.0179	0.0158	0.0168	0.0147	0.0168	0.0157	0.0169	0.0158
S2	0.0165	0.0167	0.0155	0.0169	0.0320	0.0157	0.0184	0.0174	0.0169	0.0144
S3	0.0160	0.0171	0.0163	0.0168	0.0172	0.0143	0.0159	0.0350	0.0142	0.0152
S4	0.0176	0.0371	0.0179	0.0174	0.0150	0.0187	0.0171	0.0169	0.0174	0.0162
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.0182	0.0336	0.0157	0.0155	0.0424	0.0191	0.0170	0.0183	0.0153	0.0162
S2	0.0367	0.0143	0.0154	0.0156	0.0168	0.0167	0.0150	0.0147	0.0162	0.0143
S3	0.0139	0.0171	0.0346	0.0179	0.0197	0.0151	0.0181	0.0146	0.0163	0.0308
S4	0.0168	0.0176	0.0177	0.0181	0.0168	0.0201	0.0180	0.0155	0.0174	0.0190
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.0158	0.0178	0.0157	0.0172	0.0183	0.0168	0.0178	0.0167	0.0178	0.0158
S2	0.0150	0.0168	0.0142	0.0175	0.0150	0.0273	0.0287	0.0162	0.0153	0.0168
S3	0.0160	0.0141	0.0165	0.0153	0.0283	0.0169	0.0140	0.0154	0.0180	0.0171
S4	0.0164	0.0168	0.0164	0.0189	0.0189	0.0170	0.0172	0.0170	0.0188	0.0182
SE $\pm$		0.0053								
C.D. at 5%		0.0147								

4.2.6. Net assimilation rate.(NAR)g/dm²/day:

Data pertaining to the net assimilation rate(NAR)g/dm²/day at different growth stage for rice genotypes are presented in Table 21. There was significant difference in the net assimilation rate.(NAR) g/dm²/day at tillering, flowering and harvesting stage during both the year 2020-21 and 2021-22 year and pooled mean. General mean of net assimilation rate (NAR)g/dm²/day of both years and pooled mean were found to be 0.0200g/dm²/day, 0.0198g/dm²/day, 0.0199g/dm²/day and 0.0213g/dm²/day, 0.0241g/dm²/day, 0.0242g/dm²/day and 0.0485g/dm²/day, 0.0545 g/dm²/day and 0.0515 g/dm²/day at tillering, flowering and harvesting stage respectively.

Table 21 Effect of different treatment on net assimilation rate (g/dm²/day) rice genotypes

Treatments	Net assimilation rate (g/dm ² /day)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)									
S1 : 24 th MW	0.0170	0.0209	0.0190	0.0213	0.0251	0.0232	0.0358	0.0396	0.0377
S2 : 48 th MW	0.0220	0.0205	0.0212	0.0265	0.0250	0.0257	0.0398	0.0383	0.0390
S3 : 50 th MW	0.0211	0.0192	0.0201	0.0253	0.0234	0.0243	0.0804	0.1042	0.0923
S4 : 52 th MW	0.0198	0.0188	0.0193	0.0242	0.0231	0.0236	0.0379	0.0357	0.0368
SE ±	0.0006	0.0004	0.0003	0.0006	0.0004	0.0003	0.0136	0.0018	0.0073
C.D. at 5%	0.0020	0.0012	0.0009	0.0020	0.0013	0.0010	0.0469	0.0064	0.0251
B) Sub plot (Varieties)									
V1:Karjat-1	0.0183	0.0182	0.0183	0.0231	0.0229	0.0230	0.0616	0.0711	0.0663
V2:Karjat-3	0.0228	0.0173	0.0201	0.0265	0.0210	0.0237	0.0574	0.0619	0.0596
V3:Karjat-4,	0.0186	0.0199	0.0192	0.0223	0.0236	0.0229	0.0556	0.0670	0.0613
V4:Karjat-7	0.0156	0.0128	0.0142	0.0194	0.0166	0.0180	0.0539	0.0608	0.0573
V5:Karjat-184	0.0201	0.0176	0.0188	0.0237	0.0212	0.0225	0.0534	0.0597	0.0565
V6:Sahyadri-2	0.0240	0.0219	0.0229	0.0285	0.0264	0.0274	0.0583	0.0647	0.0615
V7:Sahyadri-4	0.0225	0.0198	0.0211	0.0271	0.0245	0.0258	0.0553	0.0623	0.0588
V8:Phondaghat -1	0.0242	0.0164	0.0203	0.0284	0.0207	0.0246	0.0773	0.0807	0.0790
V9:Ratnagiri-1	0.0180	0.0172	0.0176	0.0218	0.0209	0.0213	0.0501	0.0581	0.0541
V10:Ratnagiri-5	0.0193	0.0174	0.0183	0.0234	0.0215	0.0225	0.0591	0.0679	0.0635
V11:Ratnagiri- 6	0.0188	0.0175	0.0181	0.0225	0.0212	0.0218	0.0495	0.0589	0.0542
V12:Ratnagiri- 7	0.0175	0.0119	0.0147	0.0219	0.0163	0.0191	0.0581	0.0611	0.0596
V13:Ratnagiri -24	0.0169	0.0280	0.0224	0.0209	0.0320	0.0265	0.0485	0.0690	0.0588
V14:Ratnagiri-73	0.0207	0.0344	0.0276	0.0253	0.0390	0.0322	0.0563	0.0809	0.0686
V15:Ratnagiri-711	0.0245	0.0139	0.0192	0.0289	0.0182	0.0235	0.0613	0.0629	0.0621
V16:IRRI-14	0.0235	0.0278	0.0257	0.0277	0.0320	0.0299	0.0559	0.0562	0.0560
V17:IRRI-15	0.0180	0.0216	0.0198	0.0225	0.0260	0.0242	0.0517	0.0684	0.0600
V18:IRRI-20	0.0219	0.0179	0.0199	0.0258	0.0218	0.0238	0.0581	0.0646	0.0613
V19:IRRI-21	0.0206	0.0178	0.0192	0.0251	0.0223	0.0237	0.0442	0.0422	0.0432
V20:IRRI-22	0.0192	0.0308	0.0250	0.0238	0.0354	0.0296	0.0440	0.0567	0.0503
V21:IRRI-27	0.0200	0.0213	0.0206	0.0247	0.0260	0.0254	0.0368	0.0391	0.0380
V22:IRRI-28	0.0165	0.0213	0.0189	0.0210	0.0259	0.0234	0.0324	0.0384	0.0354
V23:IRRI-34	0.0172	0.0226	0.0199	0.0217	0.0271	0.0244	0.0333	0.0409	0.0371
V24:IRRI-36	0.0180	0.0227	0.0203	0.0227	0.0273	0.0250	0.0344	0.0402	0.0373
V25:IRRI-47	0.0194	0.0217	0.0206	0.0240	0.0262	0.0251	0.0353	0.0387	0.0370
V26:IRRI-52	0.0167	0.0223	0.0195	0.0210	0.0266	0.0238	0.0505	0.0573	0.0539
V27:IRRI-53	0.0117	0.0194	0.0155	0.0160	0.0237	0.0198	0.0277	0.0371	0.0324
V28:IRRI-55	0.0273	0.0219	0.0246	0.0317	0.0263	0.0290	0.0427	0.0385	0.0406
V29:IRRI-62	0.0212	0.0205	0.0208	0.0258	0.0251	0.0254	0.0378	0.0381	0.0380
V30:IR-35	0.0224	0.0157	0.0190	0.0265	0.0198	0.0232	0.0371	0.0317	0.0344
V31:Laldodaki	0.0231	0.0207	0.0219	0.0275	0.0251	0.0263	0.0380	0.0366	0.0373
V32:IR2289-6-22-5	0.0156	0.0218	0.0187	0.0202	0.0264	0.0233	0.0494	0.0684	0.0589
V33:Narmada	0.0186	0.0220	0.0203	0.0226	0.0260	0.0243	0.0556	0.0691	0.0624
V34:Ananda	0.0228	0.0225	0.0227	0.0272	0.0269	0.0271	0.0384	0.0394	0.0389
V35:Ambpandhari	0.0214	0.0178	0.0196	0.0256	0.0220	0.0238	0.0371	0.0346	0.0358
V36:Hira	0.0212	0.0156	0.0184	0.0254	0.0199	0.0227	0.0364	0.0320	0.0342
V37:OR-1516-1-5-A	0.0216	0.0166	0.0191	0.0263	0.0213	0.0238	0.0593	0.0635	0.0614
V38:China	0.0220	0.0165	0.0193	0.0264	0.0209	0.0237	0.0549	0.0615	0.0582
V39:Sorati	0.0187	0.0133	0.0160	0.0234	0.0180	0.0207	0.0657	0.0725	0.0691
V40:Mhadi	0.0180	0.0146	0.0163	0.0226	0.0192	0.0209	0.0226	0.0202	0.0214
SE ±	0.0018	0.0024	0.0015	0.0019	0.0024	0.0015	0.0062	0.0043	0.0045
C.D. at 5%	0.0051	0.0067	0.0041	0.0052	0.0067	0.0041	0.0171	0.0120	0.0125
Interaction Effect (S x M)									
SE ±	0.0037	0.0048	0.0030	0.0037	0.0048	0.0030	0.0123	0.0086	0.0090
C.D. at 5%	0.0103	0.0134	0.0082	0.0103	0.0135	0.0083	0.0342	0.0240	0.0251
General Mean	0.0200	0.0198	0.0199	0.0213	0.0241	0.0242	0.0485	0.0545	0.0515

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 : 52th MW (24th-31st December)

Effect of sowing windows:

The data presented in Table 21 indicated that, the net assimilation rate. (NAR)g/dm²/day was observed significant effect due to the different sowing windows during both the year 2020-21 and in the pooled data at flowering and harvesting stage.

At tillering stage , the date of sowing during *kharif* season recorded minimum net assimilation rate(NAR) 0.0190 g/dm²/day than rest of the date of sowing in *rabi* season during 2020-21 and 2021-22 seasons and in the pooled mean. However the sowing dates in *rabi* season, S₂ recorded significantly maximum net assimilation rate.(NAR) 0.0212g/dm²/day over S₂ and S₄ at tillering stage.

At flowering and harvesting stage, date of sowing during *kharif* season recorded minimum net assimilation rate. (NAR)g/dm²/day than rest of the date of sowing in *rabi* season during 2020-21 and 2021-22 seasons and in the pooled mean. However the sowing dates in *rabi* season, S₂ recorded significantly maximum net assimilation rate.(NAR) 0.0257g/dm²/day over S₃ and S₄ at flowering stage.S₃recorded significantly maximum net assimilation rate.(NAR)g/dm²/day over S₂ and S₄ at harvesting stage.

Effect of genotypes:

Net assimilation rate (NAR) g/dm²/day, there was significant difference due to the different genotypes during in both years and pooled mean at tillering stage, flowering stage and at harvesting stage (Table 23).

At tillering stage, maximum net assimilation rate.(NAR)g/dm²/day was recorded in V₁₄ i.e. Ratnagiri -24(0.0276 g/dm²/day) which was at par with V₁₆ i.e. IRRI-14 and V₂₀ i.e. IRRI-22.General mean of net assimilation rate.(NAR) g/dm²/day of both years and pooled mean were found to be 0.0200 g/dm²/day, 0.0198 g/dm²/day, 0.0199 g/dm²/day, 0.0213 g/dm²/day, 0.0241 g/dm²/day, 0.0242 g/dm²/day, 0.0485 g/dm²/day, 0.0545 g/dm²/day, 0.0515 g/dm²/day respectively at tillering, flowering and harvesting stage.

At flowering stage, the rice genotype V₁₄ i.e. Ratnagiri -73 recorded maximum net assimilation rate.(NAR)0.0322 g/dm²/day which was at par with V₁₆ i.e.IRRI-14, V₂₈ i.e. IRRI-55 and over other genotype. At harvesting stage, the rice genotype V₈ i.e. Phondaghat-1 recorded maximum net assimilation rate.(NAR)0.0790 g/dm²/day which was at par with V₁₄ i.e. Ratnagiri -73and V₃₉ i.e. Sorati over others genotypes.

Interaction effect:

The pooled mean data of net assimilation rate.(NAR)g/dm²/day in different genotypes of rice for the two seasons of *kharif* and *rabi* are presented in Table 22.

Interaction effect between sowing dates of genotypes was significant in respect of net assimilation RATE (NAR) g/dm²/day. At harvesting stage, the rice crop sown S₁i.e.*kharif* season with V₈ i.e. Phondaghat -1 recorded significantly higher net assimilation rate(NAR) 0.1104 g/dm²/day. The rice crop sown S₃ i.e. *rabi* season with V₁ i.e. Karjat -1 recorded significantly higher net assimilation rate.(NAR) 0.1636 g/dm²/day which was at par with S₃V₁₀, S₃V₁₅, S₃V₁₈ and over others genotypes.

4.2.7. Leaf area index.(LAI):

Data pertaining to the leaf area index.(LAI) for rice genotypes at tillering, flowering and harvesting stage are presented in Table 23. There was significant difference in LAI during 2020 year and pooled mean at harvesting stage. General mean of leaf area index (LAI) of both years and pooled mean were found to be 1.836, 1.785, 1.811 and 4.651, 4.566, 4.608 and 4.121, 3.974, 4.047 at tillering, flowering and harvesting stage respectively.

Effect of sowing windows:

The data presented in Table 23 indicated that, the leaf area index.(LAI)was observed significantly influenced due to the date of sowing of *kharif* season. At tillering stage, the date of sowing during

Table 22: Interaction effect of net assimilation rate (g/dm²/day) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.0319	0.0365	0.0426	0.0377	0.0306	0.0328	0.0317	0.1142	0.0315	0.0367
S2	0.0353	0.0392	0.0356	0.0322	0.0434	0.0509	0.0479	0.0451	0.0353	0.0286
S3	0.1518	0.1181	0.1190	0.1086	0.1000	0.1000	0.0955	0.1065	0.0975	0.1334
S4	0.0274	0.0358	0.0251	0.0370	0.0396	0.0494	0.0461	0.0435	0.0358	0.0378
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.0371	0.0370	0.0342	0.0329	0.0369	0.0288	0.0291	0.0334	0.0356	0.0312
S2	0.0387	0.0251	0.0371	0.0423	0.0539	0.0452	0.0444	0.0356	0.0321	0.0309
S3	0.0872	0.1312	0.1055	0.1152	0.1279	0.1119	0.1082	0.1308	0.0432	0.0395
S4	0.0350	0.0392	0.0334	0.0349	0.0266	0.0376	0.0249	0.0325	0.0657	0.0742
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.0357	0.0332	0.0354	0.0397	0.0335	0.0317	0.0271	0.0299	0.0338	0.0363
S2	0.0420	0.0323	0.0343	0.0321	0.0388	0.0373	0.0267	0.0810	0.0399	0.0343
S3	0.0298	0.0297	0.0282	0.0326	0.0327	0.0957	0.0217	0.0265	0.0374	0.0447
S4	0.0396	0.0344	0.0353	0.0331	0.0361	0.0374	0.0353	0.0334	0.0400	0.0331
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.0333	0.0330	0.0362	0.0297	0.0340	0.0360	0.0409	0.0350	0.0202	0.0333
S2	0.0334	0.0346	0.0419	0.0514	0.0474	0.0461	0.0368	0.0642	0.0201	0.0334
S3	0.0997	0.1121	0.0342	0.0273	0.0307	0.1138	0.0980	0.1235	0.0225	0.0997
S4	0.0310	0.0427	0.0414	0.0401	0.0336	0.0414	0.0439	0.0400	0.0275	0.0310
SE ±	0.0123									
C.D. at 5%	0.0342									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.0371	0.0298	0.0436	0.0287	0.0317	0.0372	0.0353	0.1066	0.0319	0.0385
S2	0.0393	0.0358	0.0384	0.0322	0.0346	0.0357	0.0367	0.0280	0.0258	0.0320
S3	0.1753	0.1509	0.1519	0.1513	0.1382	0.1511	0.1490	0.1598	0.1325	0.1717
S4	0.0325	0.0311	0.0341	0.0310	0.0343	0.0348	0.0282	0.0282	0.0422	0.0293
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.0372	0.0270	0.0796	0.1029	0.0322	0.0352	0.0348	0.0348	0.0370	0.0249
S2	0.0312	0.0289	0.0432	0.0323	0.0373	0.0297	0.0398	0.0370	0.0292	0.0832
S3	0.1371	0.1550	0.1350	0.1477	0.1562	0.1293	0.1600	0.1535	0.0415	0.0507
S4	0.0303	0.0334	0.0413	0.0407	0.0258	0.0806	0.0390	0.0330	0.0613	0.0679
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.0259	0.0310	0.0311	0.0365	0.0358	0.0445	0.0412	0.0502	0.0499	0.0431
S2	0.0423	0.0509	0.0482	0.0439	0.0359	0.0390	0.0360	0.0375	0.0326	0.0307
S3	0.0485	0.0421	0.0402	0.0382	0.0417	0.1089	0.0328	0.0275	0.0380	0.0251
S4	0.0397	0.0296	0.0442	0.0422	0.0413	0.0366	0.0383	0.0387	0.0320	0.0278
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.0358	0.0396	0.0362	0.0388	0.0328	0.0316	0.0287	0.0385	0.0253	0.0232
S2	0.0418	0.0514	0.0493	0.0441	0.0376	0.0281	0.0398	0.0261	0.0659	0.0207
S3	0.0335	0.1577	0.1578	0.0373	0.0309	0.0321	0.1525	0.1461	0.1660	0.0140
S4	0.0353	0.0251	0.0332	0.0374	0.0369	0.0363	0.0330	0.0354	0.0329	0.0229
SE ±	0.0089									
C.D. at 5%	0.0249									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.0345	0.0332	0.0431	0.0332	0.0312	0.0350	0.0335		0.0317	0.0376
S2	0.0373	0.0375	0.0370	0.0322	0.0390	0.0433	0.0423	0.0365	0.0306	0.0303
S3	0.1636	0.1345	0.1354	0.1299	0.1191	0.1256	0.1223	0.1332	0.1150	0.1526
S4	0.0300	0.0334	0.0296	0.0340	0.0369	0.0421	0.0371	0.0359	0.0390	0.0336
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.0372	0.0320	0.0569	0.0679	0.0345	0.0320	0.0319	0.0341	0.0363	0.0281
S2	0.0349	0.0270	0.0402	0.0373	0.0456	0.0375	0.0421	0.0363	0.0307	0.0570
S3	0.1121	0.1431	0.1203	0.1315	0.1420	0.1206	0.1341	0.1422	0.0423	0.0451
S4	0.0326	0.0363	0.0373	0.0378	0.0262	0.0591	0.0320	0.0327	0.0635	0.0711
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.0308	0.0321	0.0333	0.0381	0.0347	0.0381	0.0341	0.0400	0.0419	0.0397
S2	0.0422	0.0416	0.0412	0.0380	0.0373	0.0382	0.0314	0.0593	0.0363	0.0325
S3	0.0392	0.0359	0.0342	0.0354	0.0372	0.1023	0.0273	0.0270	0.0377	0.0349
S4	0.0397	0.0320	0.0397	0.0377	0.0387	0.0370	0.0368	0.0361	0.0360	0.0305
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.0363	0.0365	0.0346	0.0375	0.0313	0.0328	0.0324	0.0397	0.0302	0.0217
S2	0.0401	0.0424	0.0419	0.0430	0.0445	0.0377	0.0429	0.0315	0.0651	0.0204
S3	0.0379	0.1287	0.1350	0.0358	0.0291	0.0314	0.1331	0.1221	0.1447	0.0183
S4	0.0350	0.0281	0.0380	0.0394	0.0385	0.0350	0.0372	0.0397	0.0365	0.0252
SE $\pm$		0.0091								
C.D. at 5%		0.0253								

crop sown S₁ i.e. *kharif* season recorded higher LAI than rest of the date of sowing in *rabi* season during 2020-21 and 2021-22 seasons and in the pooled mean. However the sowing dates S₁ recorded maximum LAI over rest of the date of sowing in *rabi* season. However the sowing dates in *rabi* season, S₄ recorded maximum LAI at tillering stage. S₃ recorded maximum LAI at flowering and harvesting stage.

Effect of genotypes:

Leaf area index was non significant difference due to the different genotypes during first year and pooled mean. At tillering stage, maximum LAI was recorded in V₃₅ i.e. Ambpandhari (2.104) which was followed by V₆ i.e. Sahyadri-2 (2.033). At harvesting stage, maximum LAI

Table 23.Effect of different treatment on Leaf area index of rice genotypes

Treatments	Leaf area index								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)									
S1 : 24 th MW	1.957	1.899	1.928	4.183	4.096	4.139	3.656	3.479	3.568
S2 : 48 th MW	1.865	1.657	1.761	4.69	4.652	4.671	4.196	4.095	4.145
S3 : 50 th MW	1.664	1.703	1.684	4.993	4.683	4.838	4.440	4.123	4.281
S4 :52 th MW	1.858	1.879	1.869	4.737	4.831	4.784	4.190	4.198	4.194
SE $\pm$	0.050	0.060	0.039	0.076	0.097	0.069	0.107	0.250	0.077
C.D. at 5%	0.177	NS	0.118	0.267	0.341	0.208	0.376	0.697	0.232
B)Sub plot (Varieties)									
V1:Karjat-1	2.157	1.608	1.882	4.204	4.633	4.419	3.684	3.974	3.829
V2:Karjat-3	1.857	1.788	1.823	4.405	4.375	4.390	3.871	4.177	4.024
V3:Karjat-4,	1.977	1.719	1.848	4.164	4.550	4.357	3.828	4.172	4.000
V4:Karjat-7	1.902	1.779	1.840	4.092	4.418	4.255	3.376	3.828	3.602
V5:Karjat-184	1.766	1.723	1.744	4.559	4.491	4.525	3.892	4.020	3.956
V6:Sahyadri-2	2.060	2.006	2.033	4.515	4.711	4.613	4.046	4.070	4.058
V7:Sahyadri-4	2.120	1.713	1.916	4.653	4.560	4.606	4.078	3.938	4.008
V8:Phondaghat -1	1.948	1.853	1.901	4.703	4.663	4.683	4.125	3.961	4.043
V9:Ratnagiri-1	1.899	1.936	1.918	4.429	4.867	4.648	3.891	4.421	4.156
V10:Ratnagiri-5	1.932	1.753	1.843	5.018	4.357	4.687	4.575	4.039	4.307
V11:Ratnagiri- 6	1.658	1.824	1.741	4.748	4.278	4.513	3.868	3.382	3.625
V12:Ratnagiri- 7	1.613	1.948	1.780	4.831	4.603	4.717	4.193	3.907	4.050
V13:Ratnagiri -24	1.683	1.920	1.801	4.618	4.106	4.362	4.368	3.622	3.995
V14:Ratnagiri-73	1.781	1.599	1.690	4.812	4.858	4.835	4.378	3.890	4.134
V15:Ratnagiri-711	1.626	1.558	1.592	4.909	4.631	4.770	3.969	3.747	3.858
V16:IRRI-14	1.834	1.823	1.828	4.699	4.683	4.691	4.293	4.271	4.282
V17:IRRI-15	1.785	1.896	1.840	5.042	4.917	4.979	4.620	4.386	4.503
V18:IRRI-20	1.973	1.678	1.826	4.671	4.685	4.678	4.213	3.829	4.021
V19:IRRI-21	1.568	1.933	1.750	4.775	4.703	4.739	4.430	4.360	4.395
V20:IRRI-22	1.636	1.636	1.636	5.042	4.713	4.878	4.428	4.098	4.263
V21:IRRI-27	2.084	1.885	1.985	5.200	4.986	5.093	4.755	4.483	4.619
V22:IRRI-28	1.788	1.798	1.793	4.697	4.640	4.668	4.409	4.117	4.263
V23:IRRI-34	1.684	1.552	1.618	4.473	4.309	4.391	4.175	3.719	3.947
V24:IRRI-36	1.645	1.798	1.722	4.748	4.501	4.625	4.024	3.926	3.975
V25:IRRI-47	1.713	1.858	1.786	4.701	4.431	4.566	4.341	3.897	4.119
V26:IRRI-52	1.923	1.797	1.860	4.621	4.653	4.637	4.183	4.147	4.165
V27:IRRI-53	1.859	1.921	1.890	4.393	4.247	4.320	3.934	3.786	3.860
V28:IRRI-55	1.615	1.866	1.740	4.514	4.354	4.434	4.237	3.643	3.940
V29:IRRI-62	1.831	1.738	1.784	4.101	4.288	4.195	3.594	3.736	3.665
V30:IR-35	1.828	1.998	1.913	4.446	4.780	4.613	4.101	3.899	4.000
V31:Laldodaki	2.107	1.707	1.907	4.667	4.461	4.564	3.977	3.799	3.888
V32:IR2289-6-22-5	1.641	1.873	1.757	4.650	4.754	4.702	4.448	4.258	4.353
V33:Narmada	1.644	1.783	1.713	4.746	4.202	4.474	4.328	3.788	4.058
V34:Ananda	1.618	1.456	1.537	4.898	4.663	4.780	3.599	3.695	3.647
V35:Ambpandhari	2.239	1.969	2.104	4.776	4.890	4.833	3.923	4.145	4.034
V36:Hira	1.892	1.675	1.783	4.643	4.540	4.591	4.284	4.012	4.148
V37:OR-1516-1-5-A	1.989	1.503	1.746	4.683	4.615	4.649	4.391	4.335	4.363
V38:China	1.731	1.748	1.740	4.658	4.548	4.603	3.952	4.024	3.988
V39:Sorati	1.939	1.868	1.903	4.875	4.333	4.604	4.443	3.585	4.014
V40:Mhadi	1.895	1.893	1.894	4.654	4.614	4.634	3.593	3.869	3.731
SE $\pm$	0.144	0.138	0.100	0.232	0.198	0.069	0.250	0.224	0.168
C.D. at 5%	0.401	NS	NS	NS	NS	0.208	0.697	NS	0.467
Interaction Effect (S x V)									
SE $\pm$	0.289	0.279	0.199	0.465	0.402	0.305	0.250	0.454	0.336
C.D. at 5%	NS	0.786	0.554	1.304	1.137	0.847	0.697	NS	0.933
General Mean	1.836	1.785	1.811	4.651	4.566	4.608	4.121	3.974	4.047

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th DecemberS2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

was recorded in V₂₁ i.e. IRRI-27(4.619) which was at par with V₉ i.e. Ratnagiri-1, V₁₀ i.e. Ratnagiri -5, V₁₆ i.e. IRRI-14, V₁₇ i.e. IRRI-15, V₁₉ i.e. IRRI-21, V₂₀ i.e. IRRI-22, V₂₁ i.e. IRRI-27, V₂₂ i.e. IRRI-28, V₂₆ i.e. V₃₂ i.e. IRRI-52, V₃₆ i.e. Hira over others at pooled mean.

Interaction effect:

The pooled mean data of LAI in different genotypes of rice for the two seasons of *kharif* and *rabi* are presented in Table 24. Interaction effect between sowing dates of genotypes was significant in respect of LAI. At harvesting stage, the rice crop sown S₁ i.e. *kharif* season with V₂₁ i.e. IRRI-27 recorded significantly higher LAI (5.107) which was at par with S₁V₉ i.e. Ratnagiri-1, S₁V₁₉ i.e. IRRI-21, S₁V₂₀ i.e. IRRI-22, S₁V₂₂ i.e. IRRI-28, S₁V₃₅ i.e. Ambepandhari and S₁V₃₇ i.e. OR-1516-1-5-A over others. Crop sown S₃ i.e. *kharif* season (50th MW) with V₃₀ i.e. IR-35 recorded significantly higher LAI (5.118) which was at par with S₂V₄, S₂V₆, S₂V₇, S₂V₁₀, S₂V₁₂, S₂V₁₃, S₂V₁₄, S₂V₁₆, S₂V₁₇, S₂V₂₁, S₂V₂₂, S₂V₃₀, S₂V₃₁, S₂V₃₂, S₂V₃₃, S₂V₃₄, S₂V₃₆, S₂V₃₇, S₂V₃₉, S₃V₂, S₃V₆, S₃V₁₀, S₃V₁₃, S₃V₁₄, S₃V₁₆, S₃V₁₇, S₃V₁₈, S₃V₁₉, S₃V₂₁, S₃V₂₂, S₃V₂₃, S₃V₂₄, S₃V₂₅, S₃V₂₆, S₃V₂₇, S₃V₂₈, S₃V₂₉, S₃V₃₁, S₃V₃₂, S₃V₃₃, S₃V₃₈, S₄V₁, S₄V₃, S₄V₅, S₄V₈, S₄V₁₀, S₄V₁₇, S₄V₁₈, S₄V₁₉, S₄V₂₀, S₄V₂₂, S₄V₂₄, S₄V₂₅, S₄V₂₆, S₄V₂₇, S₄V₂₈, S₄V₃₂, S₄V₃₃, S₄V₃₅, S₄V₃₆, S₄V₃₇, S₄V₃₈ and S₄V₃₉ over others .

4.2.8. Growing degree days (° days) :

Data regarding mean growing degree days (° days) at first flowering stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 25. The mean growing degree days (° days) at first flowering stage was 1244.8 ° days, 1238.1 ° days and 1241.4 ° days recorded during 2020-21, 2021-22 and pooled mean, respectively.

Effect of sowing dates:

The data presented in Table 25 revealed that, the mean growing degree days (° days) at first flowering stage of rice genotypes was significantly influenced due to different sowing dates.

Table 24: Interaction effect of leaf area index on sowing dates and varieties at maturity stage.
Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3.190	3.427	2.820	2.960	3.847	3.310	3.550	4.250	4.193	4.683
S2	3.140	3.270	3.633	4.167	3.863	4.300	5.103	3.713	4.083	4.980
S3	4.047	4.847	4.017	3.100	3.657	4.377	3.617	3.833	3.390	4.447
S4	4.360	3.940	4.840	3.277	4.200	4.197	4.040	4.703	3.897	4.190
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	3.923	4.710	3.497	3.283	3.563	4.137	4.040	3.537	4.300	4.233
S2	4.230	4.227	5.567	4.940	4.380	4.207	4.970	4.243	3.877	4.150
S3	4.053	3.923	4.530	4.933	4.603	4.767	4.907	4.430	4.803	4.993
S4	3.263	3.913	3.877	4.353	3.330	4.063	4.563	4.643	4.740	4.337
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	6.177	3.483	3.497	3.500	3.970	3.927	3.080	4.077	3.157	3.080
S2	4.713	4.960	4.967	3.277	3.790	3.750	3.540	3.410	3.030	4.003
S3	4.210	4.677	4.593	5.080	4.987	4.460	4.693	5.057	4.720	5.660
S4	3.920	4.517	3.643	4.240	4.617	4.593	4.423	4.403	3.470	3.660
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	2.490	3.103	3.020	2.740	4.190	3.640	3.903	3.163	3.537	3.063
S2	4.643	4.780	4.760	4.293	3.973	4.417	4.227	3.897	4.840	3.507
S3	4.610	5.383	5.177	3.740	3.547	4.340	4.420	4.327	4.860	3.783
S4	4.163	4.527	4.353	3.623	3.980	4.740	5.013	4.420	4.537	4.017
SE $\pm$		0.506								
C.D. at 5%		NS								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3.663	3.653	3.473	2.663	3.037	3.317	3.003	2.827	4.447	3.080
S2	4.067	4.520	4.103	4.587	4.130	4.543	4.260	4.383	4.170	4.250
S3	4.057	4.183	4.327	4.437	4.483	4.307	4.433	4.013	4.917	4.470
S4	4.107	4.350	4.787	3.627	4.433	4.113	4.053	4.620	4.153	4.357
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2.690	2.483	2.653	3.483	3.210	3.120	3.493	3.897	4.380	3.993
S2	3.567	4.503	4.007	4.200	3.810	5.230	4.527	3.497	4.330	3.957
S3	3.883	4.357	4.160	4.047	4.103	4.567	4.683	4.000	3.917	4.217
S4	3.390	4.283	3.667	3.833	3.860	4.163	4.843	3.920	4.810	4.227
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	4.037	3.337	4.160	3.333	3.460	4.027	3.440	3.500	2.723	3.693
S2	4.803	4.173	3.347	3.463	3.173	3.610	3.120	3.200	3.797	4.193
S3	4.927	4.513	3.870	4.690	4.253	4.220	4.133	3.573	4.787	4.577
S4	4.163	4.440	3.500	4.213	4.703	4.737	4.450	4.297	3.640	3.130
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	3.360	4.383	2.403	3.950	4.587	3.267	4.227	3.737	3.207	3.770
S2	3.820	4.263	3.997	3.867	3.953	5.087	4.457	3.903	4.703	4.247
S3	3.860	3.687	4.013	3.117	3.503	3.200	3.823	4.160	2.547	3.900
S4	4.157	4.700	4.743	3.843	4.540	4.493	4.833	4.297	3.883	3.563
SE $\pm$		0.454								
C.D. at 5%		NS								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3.427	3.540	3.147	2.812	3.442	3.313	3.277	3.538	4.320	3.882
S2	3.603	3.895	3.868	4.377	3.997	4.422	4.682	4.048	4.127	4.615
S3	4.052	4.515	4.172	3.768	4.070	4.342	4.025	3.923	4.153	4.458
S4	4.233	4.145	4.813	3.452	4.317	4.155	4.047	4.662	4.025	4.273
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	3.307	3.597	3.075	3.383	3.387	3.628	3.767	3.717	4.340	4.113
S2	3.898	4.365	4.787	4.570	4.095	4.718	4.748	3.870	4.103	4.053
S3	3.968	4.140	4.345	4.490	4.353	4.667	4.795	4.215	4.360	4.605
S4	3.327	4.098	3.772	4.093	3.595	4.113	4.703	4.282	4.775	4.282
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	5.107	3.410	3.828	3.417	3.715	3.977	3.260	3.788	2.940	3.387
S2	4.758	4.567	4.157	3.370	3.482	3.680	3.330	3.305	3.413	4.098
S3	4.568	4.595	4.232	4.885	4.620	4.340	4.413	4.315	4.753	5.118
S4	4.042	4.478	3.572	4.227	4.660	4.665	4.437	4.350	3.555	3.395
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	2.925	3.743	2.712	3.345	4.388	3.453	4.065	3.450	3.372	3.417
S2	4.232	4.522	4.378	4.080	3.963	4.752	4.342	3.900	4.772	3.877
S3	4.235	4.535	4.595	3.428	3.525	3.770	4.122	4.243	3.703	3.842
S4	4.160	4.613	4.548	3.733	4.260	4.617	4.923	4.358	4.210	3.790
SE $\pm$		0.336								
C.D. at 5%		0.933								

Crop sown during *S*₁-*kharif* season (24th MW) produced significantly maximum growing degree days (1268° days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. General mean growing degree days (°days) at first flowering stage of both years and pooled mean were found to be 1244.8° days, 1238.1° days and 1241.4° days, respectively.

The rice crop sown during *rabi* season, *S*₃ (the 50th MW) date of sowing recorded significantly maximum growing degree days (°days) at first flowering stage (1234.8° days) as compared to crop sown during *S*₂ (48th MW) and *S*₄ (52th MW) in both year and pooled mean. Significantly maximum growing degree days (°days) was recorded in *S*₁ (1268 °days) which was superior over the other date of sowing.

Table 25 Effect of different treatment on growing degree days (° days) at first flowering Stage of rice genotypes

Treatments	Growing degree days (° days) at first flowering Stage		
	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)			
S1 : 24 th MW	1,276.1	1,259.9	1,268.0
S2 : 48 th MW	1,234.1	1,222.5	1,228.3
S3 : 50 th MW	1,234.1	1,235.4	1,234.8
S4 :52 th MW	1,234.8	1,234.5	1,234.6
SE ±	0.752	5.285	9.892
C.D. at 5%	2.652	18.644	27.474
B)Sub plot (Varieties)			
V1:Karjat-1	1,182.5	1,187.8	1,185.2
V2:Karjat-3	1,161.0	1,160.9	1,160.9
V3:Karjat-4,	1,257.6	1,214.4	1,236.0
V4:Karjat-7	1,257.7	1,215.7	1,236.7
V5:Karjat-184	1,155.6	1,158.2	1,156.9
V6:Sahyadri-2	1,444.2	1,444.2	1,444.2
V7:Sahyadri-4	1,444.2	1,444.2	1,444.2
V8:Phondaghat -1	1,153.0	1,153.0	1,153.0
V9:Ratnagiri-1	1,379.6	1,379.6	1,379.6
V10:Ratnagiri-5	1,153.0	1,153.0	1,153.0
V11:Ratnagiri- 6	1,274.9	1,273.6	1,274.3
V12:Ratnagiri- 7	1,161.1	1,162.4	1,161.7
V13:Ratnagiri -24	1,415.8	1,414.1	1,415.0
V14:Ratnagiri-73	1,167.5	1,167.5	1,167.5
V15:Ratnagiri-711	1,465.0	1,477.6	1,471.3
V16:IRRI-14	1,211.8	1,209.1	1,210.4
V17:IRRI-15	1,240.4	1,241.7	1,241.1
V18:IRRI-20	1,153.0	1,153.0	1,153.0
V19:IRRI-21	1,470.6	1,348.1	1,409.3
V20:IRRI-22	1,199.9	1,201.2	1,200.5
V21:IRRI-27	1,163.9	1,163.9	1,163.9
V22:IRRI-28	1,195.9	1,195.9	1,195.9
V23:IRRI-34	1,238.7	1,238.7	1,238.7
V24:IRRI-36	1,233.2	1,233.2	1,233.2
V25:IRRI-47	1,226.5	1,227.9	1,227.2
V26:IRRI-52	1,244.7	1,246.4	1,245.6
V27:IRRI-53	1,163.9	1,163.9	1,163.9
V28:IRRI-55	1,201.2	1,201.2	1,201.2
V29:IRRI-62	1,239.2	1,190.5	1,214.8
V30:IR-35	1,229.2	1,227.9	1,228.5
V31:Laldodaki	1,174.6	1,174.6	1,174.6
V32:IR2289-6-22-5	1,264.6	1,257.8	1,261.2
V33:Narmada	1,385.0	1,385.0	1,385.0
V34:Ananda	1,349.3	1,350.4	1,349.9
V35:Ambpandhari	1,470.6	1,463.0	1,466.8
V36:Hira	927.6	929.2	928.4
V37:OR-1516-1-5-A	1,017.8	1,017.7	1,017.8
V38:China	1,174.5	1,174.5	1,174.5
V39:Sorati	1,146.7	1,153.5	1,150.1
V40:Mhadi	1,396.2	1,369.5	1,382.9
SE ±	4.868	19.176	1,185.2
C.D. at 5%	13.553	53.387	1,160.9
Interaction Effect (S x V)			
SE ±	9.643	38.237	19.785
C.D. at 5%	26.890	106.996	54.946
General Mean	1244.8	1238.1	1241.4

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

Effect of genotypes:

The growing degree days ($^{\circ}$ days) at first flowering stage of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 25). The rice genotype V₁₅ i.e. Ratnagiri-711 recorded significantly maximum growing degree days (1471.3 $^{\circ}$ days) at first flowering stage which was at par with genotype V₆ i.e. Sahyadri-2, V₇ i.e. Sahyadri-4 and V₃₅ i.e. Ambepandhari over rest genotypes. Rice genotype V₃₆ i.e. Hira (928.4 $^{\circ}$ days) recorded significantly minimum growing degree days ($^{\circ}$ days) at first flowering stage during pooled mean over other genotypes.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of growing degree days ($^{\circ}$ days) at first flowering stage (Table 26). The rice crop sown S₁ i.e. *kharif* season (24th MW) with variety V₁₅ i.e. Ratnagiri-711 recorded higher growing degree days (1473.9 $^{\circ}$) at first flowering stage which was at par with V₆ i.e. Sahyadri-2, V₇ i.e. Sahyadri-4, V₁₁ i.e. Ratnagiri-6, V₁₃ i.e. Ratnagiri-24, V₁₉ i.e. IRRI-21, V₃₅ i.e. Ambepandhari during pooled mean.

In case of *rabi* season S₂V₁₅ i.e. crop sown in S₂ date of sowing (48th MW) and S₄V₁₅ i.e. crop sown in S₄ date of sowing (52th MW) with Ratnagiri-711 was recorded significantly higher growing degree days (1477.8 $^{\circ}$ days) at first flowering stages which was at par with S₂V₆, S₂V₇, S₂V₁₅, S₂V₃₅, S₃V₆, S₃V₇, S₃V₁₅, S₃V₃₅, S₄V₆, S₄V₇, S₄V₁₅, S₄V₃₅. However, S₁V₃₆, S₂V₃₆, S₃V₃₆, S₄V₃₆, S₂V₃₇, S₃V₃₇ and S₄V₃₇ with rice variety Hira and OR-1516-1-5-A recorded significantly minimum growing degree days over others.

Data regarding mean growing degree days ($^{\circ}$ days) at 50% flowering stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 26. The mean growing degree days ($^{\circ}$ days) at 50% flowering stage was 1429.9 $^{\circ}$ days, 1446.7 $^{\circ}$ days and 1438.3 $^{\circ}$ days recorded during 2020-21, 2021-22 and pooled mean, respectively.

Table 26: Interaction effect of growing degree days (o days) at first flowering Stage on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,185.3	1,201.3	1,379.6	1,385.0	1,212.0	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S2	1,179.9	1,147.5	1,217.0	1,217.0	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S3	1,179.8	1,147.5	1,217.0	1,211.7	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S4	1,185.1	1,147.5	1,217.0	1,217.0	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1,438.1	1,185.3	1,420.2	1,227.6	1,470.6	1,212.0	1,363.4	1,153.0	1,470.6	1,201.2
S2	1,217.0	1,153.0	1,408.7	1,147.5	1,477.8	1,211.7	1,195.9	1,153.0	1,470.6	1,195.9
S3	1,222.3	1,153.0	1,420.2	1,147.5	1,434.0	1,211.7	1,201.2	1,153.0	1,470.6	1,201.2
S4	1,222.3	1,153.0	1,414.1	1,147.5	1,477.8	1,211.7	1,201.2	1,153.0	1,470.6	1,201.2
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1,163.9	1,196.0	1,238.7	1,233.3	1,228.0	1,402.3	1,163.9	1,201.2	1,385.0	1,233.2
S2	1,163.9	1,195.9	1,238.7	1,233.2	1,227.9	1,190.4	1,163.9	1,201.2	1,190.5	1,227.9
S3	1,163.9	1,195.9	1,238.7	1,233.2	1,222.3	1,190.4	1,163.9	1,201.2	1,190.5	1,227.9
S4	1,163.9	1,195.9	1,238.7	1,233.2	1,227.9	1,195.8	1,163.9	1,201.2	1,190.5	1,227.9
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,174.6	1,390.8	1,385.0	1,190.7	1,470.6	870.7	1,201.3	1,174.6	1,255.3	1,407.7
S2	1,174.6	1,222.6	1,385.0	1,402.3	1,470.6	946.6	956.6	1,174.5	1,105.2	1,390.5
S3	1,174.6	1,222.6	1,385.0	1,408.0	1,470.6	946.6	956.6	1,174.5	1,121.0	1,396.2
S4	1,174.6	1,222.6	1,385.0	1,396.2	1,470.6	946.6	956.6	1,174.5	1,105.2	1,390.5
SE $\pm$		9.643								
C.D. at 5%		26.890								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,195.8	1,201.2	1,217.0	1,217.0	1,222.3	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S2	1,185.1	1,147.5	1,206.5	1,211.7	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S3	1,185.2	1,147.5	1,217.0	1,217.0	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S4	1,185.1	1,147.5	1,217.0	1,217.0	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1,438.1	1,190.5	1,420.2	1,227.6	1,477.1	1,211.7	1,363.4	1,153.0	1,440.3	1,201.2
S2	1,211.7	1,153.0	1,414.1	1,147.5	1,477.8	1,201.2	1,201.2	1,153.0	1,010.9	1,201.2
S3	1,222.3	1,153.0	1,414.1	1,147.5	1,477.8	1,211.7	1,201.2	1,153.0	1,470.6	1,201.2
S4	1,222.3	1,153.0	1,408.0	1,147.5	1,477.8	1,211.7	1,201.2	1,153.0	1,470.6	1,201.2
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1,163.9	1,195.9	1,238.7	1,233.2	1,227.9	1,414.1	1,163.9	1,201.2	1,190.5	1,227.9
S2	1,163.9	1,195.9	1,238.7	1,233.2	1,227.9	1,190.4	1,163.9	1,201.2	1,190.5	1,227.9
S3	1,163.9	1,195.9	1,238.7	1,233.2	1,227.9	1,190.4	1,163.9	1,201.2	1,190.5	1,227.9
S4	1,163.9	1,195.9	1,238.7	1,233.2	1,227.9	1,190.4	1,163.9	1,201.2	1,190.5	1,227.9
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,174.6	1,363.4	1,385.0	1,201.1	1,440.3	877.0	1,201.2	1,174.5	1,266.8	1,306.4
S2	1,174.6	1,222.6	1,385.0	1,408.0	1,470.6	946.6	956.6	1,174.5	1,105.2	1,390.5
S3	1,174.6	1,222.6	1,385.0	1,396.2	1,470.6	946.6	956.6	1,174.5	1,136.9	1,390.5
S4	1,174.6	1,222.6	1,385.0	1,396.2	1,470.6	946.6	956.6	1,174.5	1,105.2	1,390.5
SE $\pm$		38.237								
C.D. at 5%		106.996								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,190.6	1,201.3	1,298.3	1,301.0	1,217.2	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S2	1,182.5	1,147.5	1,211.7	1,214.4	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S3	1,182.5	1,147.5	1,217.0	1,214.4	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
S4	1,185.1	1,147.5	1,217.0	1,217.0	1,136.8	1,444.2	1,444.2	1,153.0	1,379.6	1,153.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1,438.1	1,187.9	1,420.2	1,227.6	1,473.9	1,211.9	1,363.4	1,153.0	1,455.4	1,201.2
S2	1,214.4	1,153.0	1,411.4	1,147.5	1,477.8	1,206.4	1,198.5	1,153.0	1,240.8	1,198.5
S3	1,222.3	1,153.0	1,417.2	1,147.5	1,455.9	1,211.7	1,201.2	1,153.0	1,470.6	1,201.2
S4	1,222.3	1,153.0	1,411.1	1,147.5	1,477.8	1,211.7	1,201.2	1,153.0	1,470.6	1,201.2
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1,163.9	1,196.0	1,238.7	1,233.3	1,227.9	1,408.2	1,163.9	1,201.2	1,287.8	1,230.5
S2	1,163.9	1,195.9	1,238.7	1,233.2	1,227.9	1,190.4	1,163.9	1,201.2	1,190.5	1,227.9
S3	1,163.9	1,195.9	1,238.7	1,233.2	1,225.1	1,190.4	1,163.9	1,201.2	1,190.5	1,227.9
S4	1,163.9	1,195.9	1,238.7	1,233.2	1,227.9	1,193.1	1,163.9	1,201.2	1,190.5	1,227.9
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,174.6	1,377.1	1,385.0	1,195.9	1,455.4	873.9	1,201.3	1,174.6	1,261.1	1,357.1
S2	1,174.6	1,222.6	1,385.0	1,405.2	1,470.6	946.6	956.6	1,174.5	1,105.2	1,390.5
S3	1,174.6	1,222.6	1,385.0	1,402.1	1,470.6	946.6	956.6	1,174.5	1,129.0	1,393.4
S4	1,174.6	1,222.6	1,385.0	1,396.2	1,470.6	946.6	956.6	1,174.5	1,105.2	1,390.5
SE $\pm$		19.785								
C.D. at 5%		54.946								

Effect of sowing dates:

The data presented in Table 27 revealed that, the mean growing degree days ($^{\circ}$ days) at 50% flowering stage of rice genotypes was significantly influence due to different sowing dates.

Crop sown during S₁ –*kharif* season (24th MW) produced significantly maximum growing degree days (1435.5 $^{\circ}$ days) as compared to other sowing dates of *rabi* season S₂ (48th MW) and S₃ (50th MW) during 2020-21, 2021-22 and pooled mean. General mean growing degree days ($^{\circ}$ days) at 50% flowering stage of both years and pooled mean were found to be 1429.9 $^{\circ}$ days, 1446.7 $^{\circ}$ days and 1438.3 $^{\circ}$ days respectively.

Table 27 Effect of different treatment on growing degree days (o days) at 50 % flowering Stage of rice genotypes

Treatments	Growing degree days (o days) at 50 % flowering Stage		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	1,416.1	1,454.8	1,435.5
S2 : 48 th MW	1,416.2	1,416.1	1,416.2
S3 : 50 th MW	1,416.6	1,446.2	1,431.4
S4 :52 th MW	1,470.8	1,469.5	1,470.2
SE $\pm$	2.301	20.355	10.161
C.D. at 5%	8.118	NS	30.821
B)Sub plot (Varieties)			
V1:Karjat-1	1,538.2	1,586.5	1,562.3
V2:Karjat-3	1,538.2	1,533.5	1,535.9
V3:Karjat-4,	1,439.6	1,505.0	1,472.3
V4:Karjat-7	1,492.5	1,490.8	1,491.7
V5:Karjat-184	1,361.3	1,402.2	1,381.8
V6:Sahyadri-2	1,502.8	1,557.4	1,530.1
V7:Sahyadri-4	1,460.7	1,473.2	1,466.9
V8:Phondaghat -1	1,468.5	1,495.9	1,482.2
V9:Ratnagiri-1	1,463.7	1,483.4	1,473.6
V10:Ratnagiri-5	1,454.4	1,474.2	1,464.3
V11:Ratnagiri- 6	1,518.8	1,580.1	1,549.5
V12:Ratnagiri- 7	1,465.4	1,476.5	1,471.0
V13:Ratnagiri -24	1,505.2	1,525.2	1,515.2
V14:Ratnagiri-73	1,455.4	1,475.2	1,465.3
V15:Ratnagiri-711	1,533.5	1,532.4	1,532.9
V16:IRRI-14	1,406.5	1,409.5	1,408.0
V17:IRRI-15	1,395.6	1,403.3	1,399.4
V18:IRRI-20	1,425.9	1,447.8	1,436.8
V19:IRRI-21	1,390.5	1,399.6	1,395.0
V20:IRRI-22	1,483.6	1,483.6	1,483.6
V21:IRRI-27	1,464.1	1,471.7	1,467.9
V22:IRRI-28	1,483.6	1,484.9	1,484.3
V23:IRRI-34	1,560.2	1,564.4	1,562.3
V24:IRRI-36	1,526.4	1,526.5	1,526.5
V25:IRRI-47	1,538.7	1,532.6	1,535.7
V26:IRRI-52	1,480.2	1,483.4	1,481.8
V27:IRRI-53	1,464.1	1,467.3	1,465.7
V28:IRRI-55	1,483.6	1,489.6	1,486.6
V29:IRRI-62	1,483.6	1,488.0	1,485.8
V30:IR-35	1,483.6	1,486.5	1,485.0
V31:Laldodaki	1,317.4	1,354.4	1,335.9
V32:IR2289-6-22-5	1,322.8	1,362.6	1,342.7
V33:Narmada	1,325.4	1,348.7	1,337.0
V34:Ananda	1,508.5	1,517.6	1,513.0
V35:Ambpandhari	1,283.8	1,315.2	1,299.5
V36:Hira	1,048.8	1,055.7	1,052.2
V37:OR-1516-1-5-A	1,198.5	1,195.9	1,197.2
V38:China	1,201.2	1,231.5	1,216.3
V39:Sorati	1,195.9	1,228.9	1,212.4
V40:Mhadi	1,526.4	1,526.4	1,526.4
SE $\pm$	4.565	11.350	6.117
C.D. at 5%	12.709	31.599	16.989
Interaction Effect (S x V)			
SE $\pm$	9.304	30.278	12.234
C.D. at 5%	26.325	94.471	33.977
General Mean	1,429.9	1,446.7	1,438.3

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum growing degree days (°days) at 50% flowering stage (1470.2° days) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in both year and pooled mean.

Effect of genotypes:

The growing degree days (° days) at 50% flowering stage of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 27). The rice genotype V₂₃ i.e. IRRI-34 recorded significantly maximum growing degree days (1562.3° days) at 50% flowering stage over the other variety. Rice genotype V₃₆ i.e. Hira (1048.8° days), (1055.7° days) and (1052.2° days) recorded significantly minimum growing degree days (° days) at 50% flowering stage during 2020-21, 2021-22 and pooled mean respectively over others genotypes.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of growing degree days (° days) at 50% flowering stage (Table 28). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₂₃ i.e. IRRI-34 significantly higher growing degree days (1577.9 ° days) recorded at 50% flowering stage which was at par with V₂₅ i.e. IRRI-47 with treatment combination during pooled mean.

In case of *rabi* season S₄ V₁ i.e. crop sown in S₂ date of sowing with IRRI-34 (48th MW) was recorded significantly higher growing degree days (° days) at 50% flowering stage (1683.3° days) which was at par with S₄V₂, S₄V₁₁, S₄V₁₂, S₄V₁₃, S₄V₁₄, S₄V₁₅ over other genotypes during pooled mean. However, S₁V₃₆, S₂V₃₆, S₃V₃₆, S₄V₃₆, with rice genotype Hira recorded significantly minimum growing degree days over others.

Data regarding mean growing degree days (° days) at maturity stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 29. The mean growing degree days (° days) at maturity stage was 1927.3° days, 1760.6° days and 1844.0° days recorded during 2020-21, 2021-22 and pooled mean, respectively.

Table28: Interaction effect of growing degree days (o days) at 50 % flowering stage on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,489.9	1,489.9	1,385.0	1,489.3	1,322.9	1,457.5	1,457.5	1,457.5	1,457.5	1,445.3
S2	1,489.9	1,489.9	1,385.0	1,489.3	1,322.9	1,457.5	1,457.5	1,457.5	1,457.5	1,451.4
S3	1,489.9	1,489.9	1,385.0	1,477.1	1,322.9	1,464.1	1,457.5	1,464.1	1,457.5	1,444.7
S4	1,683.1	1,683.1	1,603.4	1,514.2	1,476.6	1,632.1	1,470.3	1,495.1	1,482.3	1,476.2
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1,464.1	1,396.8	1,434.1	1,379.6	1,483.6	1,425.9	1,407.7	1,425.9	1,390.5	1,483.6
S2	1,464.1	1,396.8	1,434.1	1,379.6	1,483.6	1,425.9	1,407.7	1,425.9	1,390.5	1,483.6
S3	1,464.1	1,385.0	1,464.1	1,379.6	1,483.6	1,425.9	1,413.8	1,425.9	1,390.5	1,483.6
S4	1,683.1	1,683.1	1,688.5	1,683.1	1,683.1	1,348.1	1,353.1	1,425.9	1,390.5	1,483.6
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1,464.1	1,483.6	1,563.3	1,526.4	1,544.9	1,476.9	1,464.1	1,483.6	1,483.6	1,483.6
S2	1,464.1	1,483.6	1,563.3	1,526.4	1,544.9	1,476.9	1,464.1	1,483.6	1,483.6	1,483.6
S3	1,464.1	1,483.6	1,557.0	1,526.4	1,532.6	1,483.4	1,464.1	1,483.6	1,483.6	1,483.6
S4	1,464.1	1,483.6	1,557.0	1,526.4	1,532.6	1,483.4	1,464.1	1,483.6	1,483.6	1,483.6
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,317.4	1,317.3	1,327.8	1,508.5	1,283.8	1,046.0	1,201.2	1,201.2	1,195.9	1,526.4
S2	1,317.4	1,317.3	1,327.8	1,508.5	1,283.8	1,046.0	1,201.2	1,201.2	1,195.9	1,526.4
S3	1,317.4	1,328.3	1,322.9	1,508.5	1,283.8	1,051.5	1,195.9	1,201.2	1,195.9	1,526.4
S4	1,317.4	1,328.3	1,322.9	1,508.5	1,283.8	1,051.5	1,195.9	1,201.2	1,195.9	1,526.4
SE ±	9.304									
C.D. at 5%	26.325									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,489.9	1,483.4	1,428.3	1,457.9	1,332.8	1,501.3	1,494.6	1,529.5	1,511.6	1,499.4
S2	1,489.9	1,489.9	1,385.0	1,477.1	1,322.9	1,464.1	1,457.5	1,464.1	1,457.5	1,444.7
S3	1,683.1	1,483.4	1,603.4	1,514.2	1,476.6	1,632.1	1,470.3	1,495.1	1,482.3	1,476.2
S4	1,683.0	1,677.3	1,603.4	1,514.2	1,476.6	1,632.1	1,470.3	1,495.1	1,482.3	1,476.2
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1,518.2	1,446.7	1,501.3	1,446.7	1,489.9	1,432.0	1,402.0	1,475.8	1,415.0	1,477.1
S2	1,464.1	1,385.0	1,457.5	1,379.6	1,483.6	1,425.9	1,407.7	1,425.9	1,390.5	1,483.6
S3	1,660.4	1,396.8	1,470.6	1,396.8	1,489.9	1,432.0	1,445.2	1,463.5	1,402.3	1,489.9
S4	1,677.6	1,677.3	1,671.6	1,677.6	1,666.2	1,348.1	1,358.4	1,425.9	1,390.5	1,483.6
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1,501.3	1,514.3	1,592.5	1,532.6	1,544.9	1,489.8	1,476.9	1,514.3	1,514.3	1,514.3
S2	1,464.1	1,483.6	1,557.0	1,526.4	1,532.6	1,483.4	1,464.1	1,483.6	1,483.6	1,483.6
S3	1,457.5	1,458.3	1,550.9	1,520.5	1,520.5	1,476.9	1,464.1	1,477.1	1,470.5	1,464.4
S4	1,464.1	1,483.6	1,557.0	1,526.4	1,532.6	1,483.4	1,464.1	1,483.6	1,483.6	1,483.6
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,444.8	1,450.2	1,405.3	1,532.8	1,382.9	1,057.1	1,195.9	1,327.7	1,322.5	1,544.9
S2	1,317.4	1,322.9	1,322.9	1,508.5	1,283.8	1,051.5	1,195.9	1,201.2	1,195.9	1,526.4
S3	1,338.1	1,349.0	1,343.6	1,520.5	1,310.4	1,062.6	1,195.8	1,195.8	1,201.2	1,507.7
S4	1,317.4	1,328.3	1,322.9	1,508.5	1,283.8	1,051.5	1,195.9	1,201.2	1,195.9	1,526.4
SE ±	30.278									
C.D. at 5%	94.471									

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,489.9	1,486.7	1,406.7	1,473.6	1,327.8	1,479.4	1,476.1	1,493.5	1,484.5	1,472.4
S2	1,489.9	1,489.9	1,385.0	1,483.2	1,322.9	1,460.8	1,457.5	1,460.8	1,457.5	1,448.1
S3	1,586.5	1,486.7	1,494.2	1,495.7	1,399.7	1,548.1	1,463.9	1,479.6	1,469.9	1,460.5
S4	1,683.0	1,680.2	1,603.4	1,514.2	1,476.6	1,632.1	1,470.3	1,495.1	1,482.3	1,476.2
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	1,491.2	1,421.8	1,467.7	1,413.2	1,486.8	1,429.0	1,404.8	1,450.9	1,402.8	1,480.4
S2	1,464.1	1,390.9	1,445.8	1,379.6	1,483.6	1,425.9	1,407.7	1,425.9	1,390.5	1,483.6
S3	1,562.3	1,390.9	1,467.4	1,388.2	1,486.8	1,429.0	1,429.5	1,444.7	1,396.4	1,486.8
S4	1,680.3	1,680.2	1,680.1	1,680.3	1,674.6	1,348.1	1,355.8	1,425.9	1,390.5	1,483.6
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1,482.7	1,498.9	1,577.9	1,529.5	1,544.9	1,483.4	1,470.5	1,498.9	1,498.9	1,498.9
S2	1,464.1	1,483.6	1,560.2	1,526.4	1,538.7	1,480.2	1,464.1	1,483.6	1,483.6	1,483.6
S3	1,460.8	1,471.0	1,554.0	1,523.5	1,526.6	1,480.2	1,464.1	1,480.4	1,477.0	1,474.0
S4	1,464.1	1,483.6	1,557.0	1,526.4	1,532.6	1,483.4	1,464.1	1,483.6	1,483.6	1,483.6
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,381.1	1,383.7	1,366.6	1,520.7	1,333.4	1,051.6	1,198.5	1,264.5	1,259.2	1,535.7
S2	1,317.4	1,320.1	1,325.4	1,508.5	1,283.8	1,048.8	1,198.5	1,201.2	1,195.9	1,526.4
S3	1,327.8	1,338.7	1,333.2	1,514.5	1,297.1	1,057.1	1,195.9	1,198.5	1,198.5	1,517.1
S4	1,317.4	1,328.3	1,322.9	1,508.5	1,283.8	1,051.5	1,195.9	1,201.2	1,195.9	1,526.4
SE $\pm$		12.234								
C.D. at 5%		33.977								

Effect of sowing dates:

The data presented in Table 29 revealed that, the mean growing degree days ($^{\circ}$ days) at maturity stage of rice genotype was significantly influenced due to different sowing dates.

Crop sown during S₁ –*kharif* season (24th MW) produced significantly maximum growing degree days (2005.3 $^{\circ}$ days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW)during 2020-21, 2021-22 and pooled mean. General mean growing degree days ($^{\circ}$ days) at maturity stage of both years and pooled mean were found to be 1927.3 $^{\circ}$ days, 1760.6 $^{\circ}$ days and 1844.0 $^{\circ}$ days, respectively.

The rice crop sown during *rabi* season, S₂ (the 48th MW) date of sowing recorded significantly maximum growing degree days (° days) at maturity stage (1791.9° days) as compared to crop sown during S₃ (50th MW) and S₄ (52th MW) in both year and pooled mean. Significantly maximum growing degree days (° days) was recorded in S₁ (2005.3° days) which was superior over the other date of sowing.

Effect of genotypes:

The growing degree days (°days) at maturity stage of rice was influenced significantly due to the different genotype during both year and pooled mean (Table 29). The rice variety V₁₅ i.e. Ratnagiri-711 recorded significantly maximum growing degree days (2078.5° days) at maturity stage over the other variety. Rice variety V₃₆ i.e. Hira (1513.2° days) recorded minimum growing degree days (° days) at maturity stage during pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotypes was non significant in respect of growing degree days (°days) at maturity stage (Table 30). The rice crop sown S₁ i.e. *kharif* season (24th MW) with variety V₁₅ i.e. Ratnagiri-711 higher growing degree days (2216.67° days) were recorded at maturity with treatment combination during pooled mean.

In case of *rabi* season S₂V₁₅ i.e. crop sown in S₂ date of sowing (48th MW) and S₄V₁₅ with Ratnagiri-711 was recorded higher growing degree days (°days) at maturity stage (2018.17° days) for pooled mean. However, S₂V₃₆, S₃V₃₆, S₄V₃₆, S₂V₃₇, S₃V₃₇ and S₄V₃₇ with rice genotype Hira and OR-1516-1-5-A recorded minimum growing degree days (° days) at maturity stage during pooled mean.

4.2.9. Photo-thermal units (°hr):

Data regarding mean photo-thermal units (°hr) at first flowering stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled. The data are presented in Table 31. The mean

Table 29. Effect of different treatment on growing degree days (o days) at maturity Stage of rice genotypes

Treatments	Growing degree days (o days) at maturity stage		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	2,046.5	1,964.2	2,005.3
S2 : 48 th MW	1,885.3	1,698.4	1,791.9
S3 : 50 th MW	1,889.4	1,688.2	1,788.8
S4 :52 th MW	1,887.8	1,691.8	1,789.8
SE $\pm$	2.917	6.779	2.943
C.D. at 5%	10.289	23.914	8.927
B)Sub plot (Varieties)			
V1:Karjat-1	1,870.2	1,706.3	1,788.3
V2:Karjat-3	1,939.1	1,765.2	1,852.1
V3:Karjat-4,	1,922.0	1,764.1	1,843.0
V4:Karjat-7	1,904.3	1,726.6	1,815.4
V5:Karjat-184	1,725.8	1,566.0	1,645.9
V6:Sahyadri-2	1,938.5	1,780.7	1,859.6
V7:Sahyadri-4	1,947.7	1,790.5	1,869.1
V8:Phondaghat -1	1,950.7	1,797.7	1,874.2
V9:Ratnagiri-1	1,980.6	1,812.2	1,896.4
V10:Ratnagiri-5	2,020.9	1,855.8	1,938.4
V11:Ratnagiri- 6	2,011.2	1,844.8	1,928.0
V12:Ratnagiri- 7	1,967.1	1,669.5	1,818.3
V13:Ratnagiri -24	1,956.7	1,793.3	1,875.0
V14:Ratnagiri-73	1,609.6	1,469.5	1,539.5
V15:Ratnagiri-711	2,154.7	2,002.4	2,078.5
V16:IRRI-14	1,914.2	1,756.8	1,835.5
V17:IRRI-15	1,943.2	1,786.3	1,864.7
V18:IRRI-20	1,946.3	1,783.3	1,864.8
V19:IRRI-21	1,924.8	1,765.9	1,845.4
V20:IRRI-22	1,894.8	1,739.6	1,817.2
V21:IRRI-27	1,958.8	1,805.0	1,881.9
V22:IRRI-28	1,969.2	1,798.9	1,884.0
V23:IRRI-34	1,984.0	1,820.4	1,902.2
V24:IRRI-36	1,969.3	1,806.3	1,887.8
V25:IRRI-47	1,966.1	1,796.3	1,881.2
V26:IRRI-52	1,934.1	1,777.3	1,855.7
V27:IRRI-53	1,934.0	1,789.0	1,861.5
V28:IRRI-55	1,961.5	1,794.8	1,878.2
V29:IRRI-62	1,970.6	1,797.6	1,884.1
V30:IR-35	1,950.6	1,783.1	1,866.8
V31:Laldodaki	2,033.1	1,842.7	1,937.9
V32:IR2289-6-22-5	2,050.1	1,881.8	1,966.0
V33:Narmada	1,959.8	1,795.5	1,877.7
V34:Ananda	1,963.0	1,789.2	1,876.1
V35:Ambpandhari	1,961.1	1,781.9	1,871.5
V36:Hira	1,580.3	1,446.1	1,513.2
V37:OR-1516-1-5-A	1,585.4	1,457.3	1,521.4
V38:China	1,936.5	1,718.3	1,827.4
V39:Sorati	1,946.1	1,775.9	1,861.0
V40:Mhadi	1,955.1	1,791.8	1,873.5
SE $\pm$	7.994	22.149	5.886
C.D. at 5%	22.256	61.663	17.853
Interaction Effect (S x V)			
SE $\pm$	16.054	44.263	16.651
C.D. at 5%	45.089	124.001	NS
General Mean	1,927.3	1,760.6	1,844.0

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

Table 30: Interaction effect of growing degree days (o days) at maturity stage on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,923.0	2,066.0	2,010.3	2,054.0	1,859.0	2,066.0	2,072.3	2,047.7	2,136.3	2,152.7
S2	1,849.0	1,889.0	1,865.7	1,855.0	1,709.7	1,900.0	1,900.3	1,930.7	1,930.7	1,961.0
S3	1,854.3	1,900.7	1,906.0	1,854.0	1,646.3	1,894.0	1,906.0	1,906.0	1,924.7	1,985.0
S4	1,854.3	1,900.7	1,906.0	1,854.0	1,688.3	1,894.0	1,912.0	1,918.3	1,930.7	1,985.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2,142.0	2,107.3	2,078.0	1,693.3	2,254.7	2,024.7	2,066.7	2,078.0	2,029.0	2,004.0
S2	1,955.3	1,924.3	1,912.0	1,585.0	2,092.7	1,900.0	1,900.0	1,888.7	1,894.3	1,871.7
S3	1,973.7	1,918.3	1,918.3	1,575.0	2,135.7	1,866.0	1,906.0	1,906.3	1,888.0	1,849.0
S4	1,973.7	1,918.3	1,918.3	1,585.0	2,135.7	1,866.0	1,900.0	1,912.3	1,888.0	1,854.3
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	2,078.0	2,084.3	2,119.0	2,078.7	2,078.0	2,047.7	2,041.3	2,078.0	2,090.0	2,078.0
S2	1,895.3	1,924.7	1,930.7	1,930.7	1,924.7	1,912.7	1,888.7	1,912.3	1,930.7	1,918.3
S3	1,937.0	1,937.0	1,937.0	1,937.0	1,937.0	1,882.0	1,900.0	1,937.0	1,937.0	1,900.0
S4	1,924.7	1,930.7	1,949.3	1,930.7	1,924.7	1,894.0	1,906.0	1,918.7	1,924.7	1,906.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	2,188.3	2,177.0	2,066.0	2,078.0	2,090.0	1,688.7	1,688.7	2,090.0	2,066.0	2,090.0
S2	1,924.7	1,967.3	1,942.7	1,912.3	1,924.3	1,561.3	1,548.0	1,924.3	1,906.0	1,918.3
S3	2,028.0	2,028.0	1,900.0	1,937.0	1,918.0	1,533.0	1,548.0	1,918.0	1,900.0	1,912.0
S4	1,991.3	2,028.0	1,930.7	1,924.7	1,912.0	1,538.0	1,557.0	1,813.7	1,912.3	1,900.0
SE $\pm$		16.054								
C.D. at 5%		45.089								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,836.7	1,940.0	1,952.3	1,875.3	1,779.7	2,001.0	1,995.0	2,001.0	2,042.0	2,048.3
S2	1,653.7	1,699.3	1,670.7	1,699.7	1,520.3	1,711.0	1,722.3	1,728.0	1,739.3	1,791.7
S3	1,664.7	1,710.7	1,716.7	1,665.7	1,477.3	1,705.3	1,722.3	1,733.7	1,728.0	1,791.7
S4	1,670.3	1,710.7	1,716.7	1,665.7	1,486.7	1,705.3	1,722.3	1,728.0	1,739.3	1,791.7
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2,042.3	2,030.3	1,989.0	1,649.0	2,178.7	1,995.0	1,995.0	1,983.0	1,970.7	1,958.7
S2	1,779.0	1,728.0	1,728.0	1,409.7	1,943.7	1,677.3	1,716.7	1,716.7	1,693.7	1,670.3
S3	1,779.0	1,191.7	1,728.0	1,409.7	1,943.7	1,677.3	1,716.7	1,716.7	1,699.7	1,664.7
S4	1,779.0	1,728.0	1,728.0	1,409.7	1,943.7	1,677.3	1,716.7	1,716.7	1,699.7	1,664.7
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	2,030.3	1,989.0	2,007.0	2,007.0	2,007.0	1,970.7	1,989.0	2,001.0	1,995.0	1,976.7
S2	1,722.3	1,728.0	1,762.0	1,739.3	1,722.3	1,711.0	1,711.0	1,728.0	1,733.7	1,716.7
S3	1,733.7	1,739.3	1,756.3	1,739.3	1,733.7	1,705.3	1,716.7	1,728.0	1,733.7	1,716.7
S4	1,733.7	1,739.3	1,756.3	1,739.3	1,722.3	1,722.3	1,739.3	1,722.3	1,728.0	1,722.3
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	2,082.7	2,082.7	1,958.3	2,007.0	1,989.0	1,632.0	1,643.3	1,970.7	1,970.7	1,995.0
S2	1,756.3	1,784.7	1,716.7	1,722.3	1,716.7	1,397.0	1,397.0	1,728.0	1,705.3	1,739.3
S3	1,820.7	1,833.0	1,739.3	1,733.7	1,722.3	1,371.3	1,388.3	1,728.0	1,705.3	1,739.3
S4	1,711.0	1,827.0	1,767.7	1,693.7	1,699.7	1,384.0	1,400.7	1,446.3	1,722.3	1,693.7
SE $\pm$		44.263								
C.D. at 5%		124.001								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,879.83	2,003.00	1,981.33	1,964.67	1,819.33	2,033.50	2,033.67	2,024.33	2,089.17	2,100.50
S2	1,751.33	1,794.17	1,768.17	1,777.33	1,615.00	1,805.50	1,811.33	1,829.33	1,835.00	1,876.33
S3	1,759.50	1,805.67	1,811.33	1,759.83	1,561.83	1,799.67	1,814.17	1,819.83	1,826.33	1,888.33
S4	1,762.33	1,805.67	1,811.33	1,759.83	1,587.50	1,799.67	1,817.17	1,823.17	1,835.00	1,888.33
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2,092.17	2,068.83	2,033.50	1,671.17	2,216.67	2,009.83	2,030.83	2,030.50	1,999.83	1,981.33
S2	1,867.17	1,826.17	1,820.00	1,497.33	2,018.17	1,788.67	1,808.33	1,802.67	1,794.00	1,771.00
S3	1,876.33	1,555.00	1,823.17	1,492.33	2,039.67	1,771.67	1,811.33	1,811.50	1,793.83	1,756.83
S4	1,876.33	1,823.17	1,823.17	1,497.33	2,039.67	1,771.67	1,808.33	1,814.50	1,793.83	1,759.50
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	2,054.2	2,036.7	2,063.0	2,042.8	2,042.5	2,009.2	2,015.2	2,039.5	2,042.5	2,027.3
S2	1,808.8	1,826.3	1,846.3	1,835.0	1,823.5	1,811.8	1,799.8	1,820.2	1,832.2	1,817.5
S3	1,835.3	1,838.2	1,846.7	1,838.2	1,835.3	1,793.7	1,808.3	1,832.5	1,835.3	1,808.3
S4	1,829.2	1,835.0	1,852.8	1,835.0	1,823.5	1,808.2	1,822.7	1,820.5	1,826.3	1,814.2
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	2,135.5	2,129.8	2,012.2	2,042.5	2,039.5	1,660.3	1,666.0	2,030.3	2,018.3	2,042.5
S2	1,840.5	1,876.0	1,829.7	1,817.3	1,820.5	1,479.2	1,472.5	1,826.2	1,805.7	1,828.8
S3	1,924.3	1,930.5	1,819.7	1,835.3	1,820.2	1,452.2	1,468.2	1,823.0	1,802.7	1,825.7
S4	1,851.2	1,927.5	1,849.2	1,809.2	1,805.8	1,461.0	1,478.8	1,630.0	1,817.3	1,796.8
SE $\pm$		16.651								
C.D. at 5%		NS								

photo-thermal units($^{\circ}$ hr) at first flowering stage was 13134.5 $^{\circ}$ hr, 11980.6 $^{\circ}$ hr, and 12557.5 $^{\circ}$ hr recorded during 2020-21, 2021-22 and pooled mean, respectively.

Effect of sowing dates:

The data presented in Table 31 revealed that, the mean photo-thermal units ($^{\circ}$ hr) at first flowering stage of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during S₁-*kharif* season (24th MW) produced significantly maximum photo-thermal units (15956.4 $^{\circ}$ hr) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW)during 2020-21, 2021-22 and pooled mean. General mean photo-thermal units ($^{\circ}$ hr) at first flowering stage of both years and pooled mean were found to be 13134.5 $^{\circ}$ hr, 11980.6 $^{\circ}$ hr, and 12557.5 $^{\circ}$ hr respectively.

Table 31 Effect of different treatment on photo-thermal units(o hr)at first flowering stage of rice genotypes

Treatments	Photo-thermal units(o hr)at first flowering Stage		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	16,296.2	15,616.5	15,956.4
S2 : 48 th MW	11,853.8	10,512.1	11,183.0
S3 : 50 th MW	11,720.6	10,755.1	11,237.9
S4 :52 th MW	12,667.2	11,038.8	11,853.0
SE $\pm$	17.739	45.593	24.773
C.D. at 5%	62.579	160.838	75.140
B)Sub plot (Varieties)			
V1:Karjat-1	12,462.1	11,245.0	11,853.5
V2:Karjat-3	12,199.8	10,961.5	11,580.7
V3:Karjat-4,	13,299.9	11,565.3	12,432.6
V4:Karjat-7	13,211.9	11,566.9	12,389.4
V5:Karjat-184	12,140.7	10,939.2	11,539.9
V6:Sahyadri-2	15,439.0	14,171.3	14,805.1
V7:Sahyadri-4	15,439.0	14,171.3	14,805.1
V8:Phondaghat -1	12,097.3	10,867.8	11,482.5
V9:Ratnagiri-1	14,660.5	14,238.4	14,449.5
V10:Ratnagiri-5	12,097.3	10,867.8	11,482.5
V11:Ratnagiri- 6	13,434.3	12,301.8	12,868.0
V12:Ratnagiri- 7	12,197.1	10,973.7	11,585.4
V13:Ratnagiri -24	15,154.9	14,268.9	14,711.9
V14:Ratnagiri-73	11,752.5	10,809.5	11,281.0
V15:Ratnagiri-711	15,245.5	14,673.2	14,959.3
V16:IRRI-14	12,827.3	11,558.0	12,192.6
V17:IRRI-15	13,174.3	11,964.5	12,569.4
V18:IRRI-20	12,097.3	10,713.4	11,405.3
V19:IRRI-21	15,956.4	14,712.5	15,334.5
V20:IRRI-22	12,674.3	11,380.3	12,027.3
V21:IRRI-27	12,224.3	10,827.3	11,525.8
V22:IRRI-28	12,597.8	11,379.0	11,988.4
V23:IRRI-34	13,023.5	12,270.9	12,647.2
V24:IRRI-36	12,883.3	11,978.6	12,430.9
V25:IRRI-47	12,911.3	11,935.8	12,423.6
V26:IRRI-52	13,204.4	11,976.8	12,590.6
V27:IRRI-53	12,224.3	11,029.5	11,626.9
V28:IRRI-55	12,674.3	11,438.7	12,056.5
V29:IRRI-62	13,136.0	11,305.1	12,220.5
V30:IR-35	12,910.5	11,935.8	12,423.2
V31:Laldodaki	12,348.8	11,116.0	11,732.4
V32:IR2289-6-22-5	13,352.6	12,334.6	12,843.6
V33:Narmada	14,730.3	14,309.6	14,519.9
V34:Ananda	14,394.3	13,222.3	13,808.3
V35:Ambpandhari	15,956.4	14,696.3	15,326.3
V36:Hira	9,559.3	8,491.8	9,025.5
V37:OR-1516-1-5-A	10,672.8	9,582.7	10,127.8
V38:China	12,333.8	11,099.7	11,716.7
V39:Sorati	11,998.9	10,834.7	11,416.8
V40:Mhadi	14,680.7	13,509.4	14,095.0
SE $\pm$	75.736	106.493	65.339
C.D. at 5%	210.850	296.478	181.466
Interaction Effect (S x V)			
SE $\pm$	150.615	215.192	130.678
C.D. at 5%	420.867	606.281	362.933
General Mean	13,134.5	11,980.6	12,557.5

S1 : 24th MW (11th-17th June)

S2 : 48th MW (26th November-2nd December)

S3 : 50th MW (10th-16th December)

S4 :52th MW (24th-31st December)

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum photo-thermal units (°hr) at first flowering stage (11853°hr) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in both year and pooled mean. Significantly maximum photo-thermal units (°hr) was recorded in S₁ (15956.4°hr) which was superior over the other date of sowing.

Effect of genotypes:

The photo-thermal units (°hr) at first flowering stage of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 31). The rice genotype V₁₉ i.e. IRRI-21 recorded significantly maximum photo-thermal units (15334.5°hr) at first flowering stage which at par with genotype V₃₅ i.e. Ambephandhari (15326.3°hr) over others. Rice genotype V₃₆ i.e. Hira (9025.5°hr) recorded significantly minimum photo-thermal units (°hr) at first flowering stage during pooled mean over others.

Interaction effect:

Interaction effect between sowing dates and genotype was significant in respect of photo-thermal units (°hr) at first flowering stage (Table 32). The rice crop sown S₁ i.e. *kharif* season (24th MW) with variety V₁₅ i.e. Ratnagiri-711, significantly higher photo-thermal units (18722.5° hr) recorded at first flowering stage which was at par with V₁₉ i.e. IRRI-21 (18686.8° hr) and V₃₅ i.e. i.e. Ambephandhari (18686.8 °hr) with treatment combination over others during pooled mean.

In case of *rabi* season S₄V₁₉ and S₄V₃₅ was recorded significantly higher photo-thermal units (°hr) at first flowering stage (15160.7°hr) over others. S₃V₃₆ recorded significantly low photo-thermal units (°hr) at par with S₂V₃₆, S₄V₃₆, S₃V₃₇ and S₄V₃₇ over others.

Data regarding mean photo-thermal units (°hr) at 50% flowering stage of rice as influenced by different sowing dates and genotype during both years and in the pooled, the data are presented in Table 33. The mean photo-thermal units (°hr) at 50% flowering stage was 15966.4° hr,

Table 32: Interaction effect of photo-thermal units(o hr)at first flowering Stage on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	15,247.3	15,445.3	17,644.3	17,710.7	15,576.0	18,434.0	18,434.0	14,848.7	17,644.3	14,848.7
S2	11,286.0	10,963.0	11,650.7	11,652.7	10,855.7	14,008.0	14,008.0	11,017.3	13,343.0	11,017.3
S3	11,297.3	10,873.0	11,478.3	11,054.0	10,754.3	13,843.0	13,843.0	10,935.0	13,066.7	10,935.0
S4	12,017.7	11,518.0	12,426.3	12,430.3	11,376.7	15,471.0	15,471.0	11,588.0	14,588.0	11,588.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	18,359.3	15,248.0	18,140.3	13,656.0	18,991.3	15,576.0	17,445.3	14,848.7	18,991.3	15,445.3
S2	11,704.3	11,017.3	13,766.7	10,963.0	13,717.3	11,597.0	11,493.7	11,017.3	14,455.3	11,493.7
S3	11,175.7	10,935.0	13,563.7	10,873.0	13,982.7	11,781.0	11,537.7	10,935.0	14,330.7	11,537.7
S4	12,497.7	11,588.0	15,149.0	11,518.0	14,290.7	12,355.0	12,220.3	11,588.0	16,048.3	12,220.3
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	14,984.0	15,380.0	15,909.3	15,840.7	15,775.3	17,921.3	14,984.0	15,445.3	17,710.7	15,772.0
S2	11,126.0	11,442.0	11,860.7	11,809.3	11,755.7	11,392.3	11,126.0	11,493.7	11,391.3	11,755.7
S3	11,059.0	11,416.0	11,610.3	11,241.7	11,544.3	11,419.0	11,059.0	11,537.7	11,356.7	11,544.3
S4	11,728.0	12,153.0	12,713.7	12,641.3	12,570.0	12,085.0	11,728.0	12,220.3	12,085.3	12,570.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	15,116.0	17,781.0	17,710.7	15,313.7	18,991.3	11,328.0	15,445.3	15,115.3	16,116.0	16,673.7
S2	11,231.3	11,704.0	13,405.0	13,706.3	14,455.3	8,980.3	9,091.7	11,235.3	10,517.0	13,647.0
S3	11,178.0	11,422.7	13,137.3	13,492.0	14,330.7	8,822.3	8,927.7	11,178.3	10,397.7	13,418.0
S4	11,869.7	12,502.7	14,668.0	15,065.3	16,048.3	9,106.3	9,226.7	11,806.0	10,965.0	14,984.0
SE $\pm$	150.615									
C.D. at 5%	420.867									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	14,794.0	14,854.0	15,047.3	15,051.7	15,114.7	17,888.0	17,888.0	14,307.7	17,148.3	14,307.7
S2	10,034.0	9,691.0	10,316.0	10,317.3	9,583.7	12,456.0	12,456.0	9,741.0	11,828.0	9,741.0
S3	9,832.3	9,438.0	10,178.7	10,176.3	9,326.7	12,821.0	12,821.0	9,494.0	15,075.3	9,494.0
S4	10,319.7	9,863.0	10,719.0	10,722.3	9,731.7	13,520.0	13,520.0	9,928.7	12,902.0	9,928.7
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	17,819.0	14,731.0	17,615.3	14,246.0	18,453.7	14,980.0	16,957.3	14,307.7	18,382.3	14,854.0
S2	10,363.0	9,741.0	12,225.0	9,691.0	12,599.3	10,269.0	10,177.7	9,741.0	12,883.0	10,079.7
S3	10,235.3	9,494.0	13,559.7	9,438.0	13,895.0	10,122.0	10,004.0	8,876.3	13,311.7	10,004.0
S4	10,790.0	9,928.7	13,675.7	9,863.0	13,744.7	10,861.0	10,719.0	9,928.7	14,273.0	10,583.7
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	14,431.0	14,791.0	15,326.0	15,254.0	15,186.7	17,477.7	14,611.0	14,854.0	14,731.0	15,186.7
S2	9,841.0	10,132.0	10,498.7	10,454.3	10,407.3	10,079.7	9,841.0	10,177.7	10,083.0	10,407.3
S3	8,977.0	9,945.0	12,259.3	11,275.7	11,219.0	9,891.3	9,606.0	10,004.0	9,888.7	11,219.0
S4	10,060.0	10,648.0	10,999.7	10,930.3	10,930.3	10,458.3	10,060.0	10,719.0	10,517.7	10,930.3
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	14,551.0	16,957.3	17,212.7	14,857.0	18,382.3	10,798.0	14,854.0	14,551.0	15,702.0	16,197.7
S2	9,938.0	10,361.7	11,884.0	12,166.3	12,818.0	8,019.3	8,116.7	9,937.0	9,278.0	12,110.0
S3	9,719.0	11,160.0	15,157.7	12,492.7	13,311.7	7,604.0	7,701.0	9,719.3	9,025.7	12,430.0
S4	10,256.0	10,859.3	12,984.0	13,373.3	14,273.0	7,546.0	7,659.0	10,191.3	9,333.0	13,300.0
SE $\pm$	215.192									
C.D. at 5%	606.281									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	15,020.7	15,149.7	16,345.8	16,381.2	15,345.3	18,161.0	18,161.0	14,578.2	17,396.3	14,578.2
S2	10,660.0	10,327.0	10,983.3	10,985.0	10,219.7	13,232.0	13,232.0	10,379.2	12,585.5	10,379.2
S3	10,564.8	10,155.5	10,828.5	10,615.2	10,040.5	13,332.0	13,332.0	10,214.5	14,071.0	10,214.5
S4	11,168.7	10,690.5	11,572.7	11,576.3	10,554.2	14,495.5	14,495.5	10,758.3	13,745.0	10,758.3
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	18,089.2	14,989.5	17,877.8	13,951.0	18,722.5	15,278.0	17,201.3	14,578.2	18,686.8	15,149.7
S2	11,033.7	10,379.2	12,995.8	10,327.0	13,158.3	10,933.0	10,835.7	10,379.2	13,669.2	10,786.7
S3	10,705.5	10,214.5	13,561.7	10,155.5	13,938.8	10,951.5	10,770.8	9,905.7	13,821.2	10,770.8
S4	11,643.8	10,758.3	14,412.3	10,690.5	14,017.7	11,608.0	11,469.7	10,758.3	15,160.7	11,402.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	14,707.5	15,085.5	15,617.7	15,547.3	15,481.0	17,699.5	14,797.5	15,149.7	16,220.8	15,479.3
S2	10,483.5	10,787.0	11,179.7	11,131.8	11,081.5	10,736.0	10,483.5	10,835.7	10,737.2	11,081.5
S3	10,018.0	10,680.5	11,934.8	11,258.7	11,381.7	10,655.2	10,332.5	10,770.8	10,622.7	11,381.7
S4	10,894.0	11,400.5	11,856.7	11,785.8	11,750.2	11,271.7	10,894.0	11,469.7	11,301.5	11,750.2
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	14,833.5	17,369.2	17,461.7	15,085.3	18,686.8	11,063.0	15,149.7	14,833.2	15,909.0	16,435.7
S2	10,584.7	11,032.8	12,644.5	12,936.3	13,636.7	8,499.8	8,604.2	10,586.2	9,897.5	12,878.5
S3	10,448.5	11,291.3	14,147.5	12,992.3	13,821.2	8,213.2	8,314.3	10,448.8	9,711.7	12,924.0
S4	11,062.8	11,681.0	13,826.0	14,219.3	15,160.7	8,326.2	8,442.8	10,998.7	10,149.0	14,142.0
SE $\pm$		130.678								
C.D. at 5%		362.933								

14439.0⁰hr and 15202.7⁰hr recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 33 revealed that, the mean growing degree days ($^{\circ}$ days) at 50% flowering stage of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during S₁-*kharif* season (24th MW) produced significantly maximum photo-thermal units (18105.4⁰hr) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. General mean photo-thermal units

Table 33 Effect of different treatment on photo-thermal units (°hr) at 50 % flowering Stage of rice genotypes

Treatments	Photo-thermal units (°hr)at 50 % flowering Stage		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	18,296.4	17,914.4	18,105.4
S2 : 48 th MW	15,976.5	12,348.9	14,162.7
S3 : 50 th MW	13,732.1	13,128.2	13,430.2
S4 :52 th MW	15,860.7	14,364.4	15,112.6
SE ±	26.502	121.021	58.599
C.D. at 5%	93.491	426.930	177.742
B)Sub plot (Varieties)			
V1:Karjat-1	17,106.4	15,067.8	16,087.1
V2:Karjat-3	17,106.4	14,976.3	16,041.4
V3:Karjat-4,	14,922.5	14,005.1	14,463.8
V4:Karjat-7	17,001.8	15,008.3	16,005.1
V5:Karjat-184	14,499.4	13,915.7	14,207.5
V6:Sahyadri-2	16,889.7	15,589.7	16,239.7
V7:Sahyadri-4	16,425.0	14,709.6	15,567.3
V8:Phondaghat -1	16,447.7	14,905.5	15,676.6
V9:Ratnagiri-1	16,503.6	14,838.0	15,670.8
V10:Ratnagiri-5	16,300.1	14,683.8	15,492.0
V11:Ratnagiri- 6	17,249.5	15,977.5	16,613.5
V12:Ratnagiri- 7	16,173.8	15,336.6	15,755.2
V13:Ratnagiri -24	16,826.1	15,414.2	16,120.1
V14:Ratnagiri-73	15,826.2	15,175.5	15,500.8
V15:Ratnagiri-711	17,680.4	15,601.9	16,641.2
V16:IRRI-14	15,640.3	13,945.9	14,793.1
V17:IRRI-15	15,493.7	13,796.3	14,645.0
V18:IRRI-20	15,921.0	14,256.4	15,088.7
V19:IRRI-21	14,851.3	14,306.9	14,579.1
V20:IRRI-22	17,021.8	14,919.8	15,970.8
V21:IRRI-27	16,591.0	14,753.6	15,672.3
V22:IRRI-28	17,021.8	14,903.0	15,962.4
V23:IRRI-34	17,653.6	15,711.7	16,682.6
V24:IRRI-36	17,324.1	15,432.0	16,378.0
V25:IRRI-47	17,432.6	15,502.3	16,467.4
V26:IRRI-52	16,777.6	14,918.4	15,848.0
V27:IRRI-53	16,591.0	14,720.6	15,655.8
V28:IRRI-55	17,021.8	14,953.3	15,987.5
V29:IRRI-62	17,021.8	14,935.6	15,978.7
V30:IR-35	17,021.8	14,918.7	15,970.2
V31:Laldodaki	13,859.9	13,130.3	13,495.1
V32:IR2289-6-22-5	13,912.7	13,233.5	13,573.1
V33:Narmada	13,955.3	13,111.0	13,533.1
V34:Ananda	17,107.3	15,290.2	16,198.8
V35:Ambpandhari	13,458.4	12,403.2	12,930.8
V36:Hira	10,899.7	9,859.1	10,379.4
V37:OR-1516-1-5-A	12,625.8	11,364.9	11,995.3
V38:China	12,657.8	11,394.6	12,026.2
V39:Sorati	16,839.5	15,192.8	16,016.2
V40:Mhadi	16,997.8	15,398.8	16,198.3
SE ±	110.523	145.320	91.287
C.D. at 5%	307.697	404.573	253.532
Interaction Effect (S x V)			
SE ±	219.869	311.458	182.574
C.D. at 5%	614.492	902.075	507.065
General Mean	15,966.4	14,439.0	15,202.7

S1 : 24th MW (11th-17th June) S2 : 48th MW (26th November-2nd December)
S3 : 50th MW (10th-16th December) S4 :52th MW (24th-31st January)

(°hr) at 50% flowering stage of both years and pooled mean were found to be 15966.4° hr, 14439.0 °hr and 15202.7 °hr respectively.

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum photo-thermal units (°hr) at 50% flowering stage (15112.6° hr) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in both year and pooled mean. Significantly maximum photo-thermal units (°hr) were recorded in S₁ (18105.4° hr) which was superior over the other date of sowing.

Effect of genotypes:

The photo-thermal units (°hr) at 50% flowering stage of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 33). The rice genotype V₂₃ i.e. IRRI-34 recorded significantly maximum photo-thermal units (16682.6° hr) at par with V₁ i.e. Karjat-1, V₂ i.e. Karjat-3, V₄ i.e. Karjat-4, V₆ i.e. Sahyadri-2, V₁₁ i.e. Ratnagiri-6, V₁₃ i.e. Ratnagiri-24, V₁₅ i.e. Ratnagiri-711, V₂₄ i.e. IRRI-36, V₂₅ i.e. IRRI-47, V₂₈ i.e. IRRI-55, V₂₉ i.e. IRRI-62 over others. Rice genotype V₃₆ i.e. Hira recorded significantly minimum photo-thermal units (°hr) at 50% flowering stage during pooled mean over others.

Interaction effect:

Interaction effect between sowing dates and genotype was significant in respect of photo-thermal units (°hr) at 50% flowering stage (Table 34). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₂₃ i.e. IRRI-34 significantly higher photo-thermal units (19749.5° hr) recorded at 50% flowering stage which was at par with V₂₄, i.e. IRRI-36, V₂₅ i.e. IRRI-47 over others for pooled mean.

In case of *rabi* season S₄V₁₁ and S₄ V₁₄ was recorded significantly higher photo-thermal units (°hr) at 50% flowering stage (18243.2° hr) which was superior over the other treatment combination during both years and pooled mean. However, S₃V₃₆ with rice genotype Hira recorded significantly minimum photo-thermal units (°hr) than other genotypes.

Table 34 : Interaction effect of Photo-thermal units(o hr)at 50 % flowering Stage on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	19,217.7	19,217.7	17,710.7	19,215.0	16,946.0	18,595.3	18,674.7	18,595.3	18,754.0	18,520.7
S2	18,052.7	18,052.7	13,400.0	17,775.7	12,682.3	16,944.0	17,015.3	16,944.0	17,086.7	16,876.0
S3	14,545.3	14,545.3	13,348.0	14,403.3	12,325.7	14,045.0	14,048.7	14,045.0	14,048.7	13,842.7
S4	16,610.0	16,610.0	15,231.3	16,613.3	16,043.7	17,974.3	15,961.3	16,206.3	16,125.0	15,961.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	18,755.3	17,855.0	18,389.3	17,644.3	19,217.7	18,210.0	17,988.0	18,210.0	17,777.0	19,146.0
S2	17,082.3	14,448.0	15,837.3	13,338.0	17,983.7	16,606.0	16,384.0	16,606.0	13,462.0	18,254.0
S3	14,116.0	13,348.0	14,116.0	13,278.0	14,476.0	13,640.0	13,418.0	13,640.0	13,418.0	14,476.0
S4	19,044.3	19,044.3	18,961.7	19,044.3	19,044.3	14,105.3	14,184.7	15,228.0	14,748.0	16,211.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	18,914.0	19,146.0	19,958.7	19,659.3	19,809.0	19,063.0	18,914.0	19,146.0	19,146.0	19,146.0
S2	17,225.0	18,254.0	18,185.7	17,915.0	18,050.3	17,366.7	17,225.0	18,254.0	18,254.0	18,254.0
S3	14,258.0	14,476.0	15,287.0	14,948.3	15,015.7	14,472.7	14,258.0	14,476.0	14,476.0	14,476.0
S4	15,967.0	16,211.0	17,183.0	16,773.7	16,855.3	16,208.0	15,967.0	16,211.0	16,211.0	16,211.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	16,879.0	16,877.3	17,007.0	19,435.7	16,464.7	13,517.0	15,445.3	15,445.3	19,585.0	19,659.3
S2	12,623.7	12,568.3	12,743.0	17,716.0	12,225.7	9,933.0	11,488.7	11,488.7	17,848.0	16,610.0
S3	12,265.3	12,386.0	12,325.7	14,749.7	11,882.0	9,822.0	11,416.0	11,477.0	14,746.0	14,948.3
S4	13,671.7	13,819.0	13,745.3	16,528.0	13,261.3	10,326.7	12,153.0	12,220.3	15,179.0	16,773.7
SE ±	219.869									
C.D. at 5%	614.492									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	18,592.7	18,521.3	17,762.7	18,172.3	16,544.7	18,510.3	18,512.0	18,852.0	18,715.3	18,575.0
S2	13,075.7	13,075.7	11,884.0	12,948.0	11,260.7	12,626.0	12,633.3	12,626.0	12,633.3	12,453.7
S3	13,660.0	13,450.0	12,628.3	13,804.0	13,313.3	14,746.0	13,240.7	13,455.7	13,384.7	13,247.3
S4	14,942.7	14,858.3	13,745.3	15,109.0	14,544.0	16,476.3	14,452.3	14,688.3	14,618.7	14,459.3
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	18,785.0	17,899.3	18,581.7	17,148.3	18,592.7	18,163.7	17,344.7	17,891.0	17,621.7	18,453.7
S2	12,690.0	11,884.0	12,633.3	11,828.0	13,013.0	12,279.0	12,110.0	12,279.0	11,940.0	13,013.0
S3	14,993.0	14,283.7	13,242.0	14,283.7	13,518.7	12,685.7	12,911.0	13,108.7	14,366.0	13,518.7
S4	17,442.0	17,279.3	17,199.7	17,442.0	17,283.3	12,655.3	12,819.7	13,747.0	13,300.0	14,694.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	18,653.0	18,795.7	19,540.3	19,061.7	19,131.0	18,589.0	18,450.0	18,795.7	18,795.7	18,795.7
S2	12,818.0	13,013.0	13,390.0	13,518.0	13,646.0	13,010.7	12,818.0	13,013.0	13,013.0	13,013.0
S3	13,102.3	13,109.3	14,229.3	13,873.7	13,873.7	13,381.3	13,173.3	13,310.7	13,239.7	13,172.0
S4	14,441.0	14,694.0	15,687.0	15,274.7	15,358.3	14,692.7	14,441.0	14,694.0	14,694.0	14,694.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	16,475.0	16,545.7	16,268.3	18,997.3	15,686.7	13,104.7	14,791.0	14,734.0	18,994.3	19,131.0
S2	11,210.3	11,260.7	11,260.7	13,264.0	10,900.7	8,828.3	10,132.0	10,177.7	13,327.0	13,454.3
S3	12,560.7	12,706.7	12,643.0	13,873.7	11,255.7	8,619.0	9,888.7	9,947.7	13,590.3	13,735.3
S4	12,275.0	12,421.0	12,272.0	15,025.7	11,769.7	8,884.3	10,648.0	10,719.0	14,859.7	15,274.7
SE ±	311.458									
C.D. at 5%	902.075									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	18,905.2	18,869.5	17,736.7	18,693.7	16,745.3	18,552.8	18,593.3	18,723.7	18,734.7	18,547.8
S2	15,564.2	15,564.2	12,642.0	15,361.8	11,971.5	14,785.0	14,824.3	14,785.0	14,860.0	14,664.8
S3	14,102.7	13,997.7	12,988.2	14,103.7	12,819.5	14,395.5	13,644.7	13,750.3	13,716.7	13,545.0
S4	15,776.3	15,734.2	14,488.3	15,861.2	15,293.8	17,225.3	15,206.8	15,447.3	15,371.8	15,210.2
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	18,770.2	17,877.2	18,485.5	17,396.3	18,905.2	18,186.8	17,666.3	18,050.5	17,699.3	18,799.8
S2	14,886.2	13,166.0	14,235.3	12,583.0	15,498.3	14,442.5	14,247.0	14,442.5	12,701.0	15,633.5
S3	14,554.5	13,815.8	13,679.0	13,780.8	13,997.3	13,162.8	13,164.5	13,374.3	13,892.0	13,997.3
S4	18,243.2	18,161.8	18,080.7	18,243.2	18,163.8	13,380.3	13,502.2	14,487.5	14,024.0	15,452.5
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	18,783.5	18,970.8	19,749.5	19,360.5	19,470.0	18,826.0	18,682.0	18,970.8	18,970.8	18,970.8
S2	15,021.5	15,633.5	15,787.8	15,716.5	15,848.2	15,188.7	15,021.5	15,633.5	15,633.5	15,633.5
S3	13,680.2	13,792.7	14,758.2	14,411.0	14,444.7	13,927.0	13,715.7	13,893.3	13,857.8	13,824.0
S4	15,204.0	15,452.5	16,435.0	16,024.2	16,106.8	15,450.3	15,204.0	15,452.5	15,452.5	15,452.5
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	16,677.0	16,711.5	16,637.7	19,216.5	16,075.7	13,310.8	15,118.2	15,089.7	19,289.7	19,395.2
S2	11,917.0	11,914.5	12,001.8	15,490.0	11,563.2	9,380.7	10,810.3	10,833.2	15,587.5	15,032.2
S3	12,413.0	12,546.3	12,484.3	14,311.7	11,568.8	9,220.5	10,652.3	10,712.3	14,168.2	14,341.8
S4	12,973.3	13,120.0	13,008.7	15,776.8	12,515.5	9,605.5	11,400.5	11,469.7	15,019.3	16,024.2
SE $\pm$		182.574								
C.D. at 5%		507.065								

Data regarding mean photo-thermal units ($^{\circ}\text{hr}$) at maturity stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 35. The mean growing degree days ($^{\circ}\text{days}$) at maturity stage was 23384.9°hr , 21608.4°hr and 22496.6°hr recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 35 revealed that, the mean photo-thermal unit ($^{\circ}\text{hr}$) at maturity stage of rice genotypes was significantly influenced due to different sowing dates.

Table 35 Effect of different treatment on photo-thermal units(°hr)at maturity stage of rice genotypes

Treatments	Photo-thermal units(°hr)at maturity Stage		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	25,608.2	24,706.7	25,157.4
S2 : 48 th MW	21,281.9	19,529.0	20,405.4
S3 : 50 th MW	21,820.2	20,744.5	21,282.4
S4 :52 th MW	24,829.1	21,453.3	23,141.2
SE ±	32.271	20.405	10.262
C.D. at 5%	113.843	71.983	31.127
B)Sub plot (Varieties)			
V1:Karjat-1	22,685.5	21,255.3	21,970.4
V2:Karjat-3	23,650.5	22,066.4	22,858.5
V3:Karjat-4,	23,447.5	21,927.6	22,687.5
V4:Karjat-7	23,059.2	21,270.6	22,164.9
V5:Karjat-184	21,315.1	18,122.3	19,718.7
V6:Sahyadri-2	23,628.3	21,980.6	22,804.4
V7:Sahyadri-4	23,782.5	22,160.2	22,971.3
V8:Phondaghat -1	23,835.3	22,287.8	23,061.5
V9:Ratnagiri-1	24,223.7	22,676.2	23,449.9
V10:Ratnagiri-5	24,874.4	23,248.2	24,061.3
V11:Ratnagiri- 6	24,716.3	23,086.5	23,901.4
V12:Ratnagiri- 7	24,040.7	22,554.3	23,297.5
V13:Ratnagiri -24	23,916.2	22,437.3	23,176.7
V14:Ratnagiri-73	18,833.4	15,918.3	17,375.9
V15:Ratnagiri-711	26,813.2	24,966.0	25,889.6
V16:IRRI-14	23,404.8	22,053.9	22,729.3
V17:IRRI-15	23,709.3	22,322.1	23,015.7
V18:IRRI-20	23,756.8	22,312.3	23,034.5
V19:IRRI-21	23,446.3	22,062.7	22,754.5
V20:IRRI-22	22,989.2	21,721.2	22,355.2
V21:IRRI-27	23,959.2	22,581.3	23,270.3
V22:IRRI-28	24,107.8	22,529.5	23,318.6
V23:IRRI-34	24,309.1	22,810.8	23,560.0
V24:IRRI-36	24,112.2	22,617.5	23,364.8
V25:IRRI-47	24,060.1	22,465.0	23,262.5
V26:IRRI-52	23,568.1	22,217.4	22,892.8
V27:IRRI-53	23,593.3	22,378.7	22,986.0
V28:IRRI-55	23,992.3	22,449.7	23,221.0
V29:IRRI-62	24,100.2	22,497.3	23,298.7
V30:IR-35	23,788.1	22,295.5	23,041.8
V31:Laldodaki	25,062.2	23,020.8	24,041.5
V32:IR2289-6-22-5	25,333.9	23,621.7	24,477.8
V33:Narmada	23,849.0	22,453.8	23,151.4
V34:Ananda	24,019.6	22,349.8	23,184.7
V35:Ambpandhari	23,933.0	22,258.7	23,095.8
V36:Hira	18,391.8	15,541.1	16,966.5
V37:OR-1516-1-5-A	18,482.8	15,718.3	17,100.5
V38:China	21,307.0	17,818.2	19,562.6
V39:Sorati	21,424.0	18,010.8	19,717.4
V40:Mhadi	23,873.3	22,268.9	23,071.1
SE ±	98.009	98.013	69.304
C.D. at 5%	272.859	272.869	192.480
Interaction Effect (S x V)			
SE ±	196.225	194.633	138.609
C.D. at 5%	550.239	543.451	384.960
General Mean	23,384.9	21,608.4	22,496.6

S1 : 24th MW (11th-17th June) S2 : 48th MW (26th November-2nd December)
S3 : 50th MW (10th-16th December) S4 :52th MW (24th-31st December)

Crop sown during S₁-*kharif* season (24th MW) produced significantly maximum photo-thermal units (25157.4° hr) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. General mean photo-thermal units (°hr) at maturity stage of both years and pooled mean were found to be 23384.9° hr, 21608.4° hr and 22496.6° hr, respectively.

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum photo-thermal units (°hr) at maturity stage (23141.2°hr) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in both year and pooled mean. Significantly maximum photo-thermal units (°hr) was recorded in S₁ (25157.4°hr) which was superior over the other date of sowing.

Effect of genotypes:

The photo-thermal units (°hr) at maturity stage of rice were influenced significantly due to the different genotypes during both year and pooled mean (Table 35). The rice variety V₁₅ i.e. Ratnagiri-711 recorded significantly maximum photo-thermal units (25889.6° hr) at maturity stage over the other variety. Rice genotype V₃₆ i.e. Hira (16966.5°hr) recorded. Significantly minimum photo-thermal units (°hr) at maturity stage which was at par with V₃₇ i.e. over other genotypes. OR-1516-1-5-A over other genotypes

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of photo-thermal units (°hr) at maturity stage (Table 36). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₁₅ i.e. Ratnagiri-711, significantly higher photo-thermal units (27599.5° hr) recorded at maturity with treatment combination during 2020-21, 2021-22 years and pooled mean.

In case of *rabi* season S₄V₁₅ i.e. crop sown in S₄ date of sowing (52th MW) was recorded significantly higher photo-thermal units (°hr) at maturity stage (27473.8° hr) which was superior over other treatment

Table 36: Interaction effect of growing degree days (° days) at maturity Stage on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	24,226.3	25,951.7	25,286.3	25,812.0	23,456.7	25,951.7	26,030.0	25,733.7	26,759.0	26,942.7
S2	20,868.0	21,427.7	21,106.0	20,946.3	18,842.7	21,593.0	21,593.3	21,999.0	21,999.0	22,399.7
S3	21,395.3	22,097.3	22,160.0	21,221.7	18,708.7	21,955.3	22,160.0	22,153.3	22,460.3	23,484.3
S4	24,252.3	25,125.3	25,237.7	24,256.7	24,252.3	25,013.0	25,346.7	25,455.3	25,676.3	26,671.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	26,824.0	26,430.3	26,094.3	21,725.0	27,947.3	25,456.0	25,965.7	26,094.3	25,510.0	25,211.3
S2	22,317.7	21,919.0	21,757.0	17,153.7	24,204.0	21,593.0	21,593.0	21,429.7	21,511.3	21,188.0
S3	23,269.7	22,358.0	22,358.0	17,160.0	26,164.7	21,557.0	22,153.3	22,160.0	21,859.7	21,305.0
S4	26,453.7	25,455.3	25,455.3	19,295.0	28,936.7	25,013.0	25,125.3	25,343.0	24,904.0	24,252.3
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	26,094.3	26,172.7	26,563.3	26,108.3	26,094.3	25,736.7	25,658.3	26,094.3	26,172.7	26,030.0
S2	21,513.3	21,917.0	21,999.0	21,999.0	21,917.0	21,755.3	21,429.7	21,755.0	21,999.0	21,837.0
S3	22,665.0	22,665.0	22,665.0	22,665.0	22,665.0	21,764.0	22,051.0	22,665.0	22,665.0	22,051.0
S4	25,564.0	25,676.3	26,009.0	25,676.3	25,564.0	25,016.3	25,234.3	25,455.0	25,564.0	25,234.3
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	27,334.7	27,210.7	25,951.7	26,094.3	26,108.3	21,859.0	21,859.0	23,802.7	23,802.0	26,172.7
S2	21,917.0	22,467.0	22,159.0	21,755.0	21,919.0	16,802.0	16,600.0	20,047.0	20,209.3	21,837.0
S3	24,216.0	24,216.0	22,051.0	22,665.0	22,358.0	16,438.0	16,673.0	19,584.0	19,588.0	22,358.0
S4	26,781.0	27,442.0	25,234.3	25,564.0	25,346.7	18,468.3	18,799.0	21,794.3	22,096.7	25,125.3
SE ±		196.225								
C.D. at 5%		550.239								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	23,305.7	24,552.3	24,692.7	23,788.0	22,635.0	25,226.7	25,156.3	25,226.7	25,701.3	25,843.7
S2	19,116.7	19,783.3	18,736.0	18,780.7	17,168.7	18,948.0	19,116.7	19,199.7	20,355.3	21,064.0
S3	20,369.3	21,051.3	21,311.3	20,374.3	20,413.3	20,962.0	21,306.0	21,569.0	21,306.0	21,917.0
S4	22,229.7	22,878.7	22,970.3	22,139.3	12,272.0	22,785.7	23,061.7	23,155.7	23,342.0	24,168.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	25,705.0	25,562.3	25,094.0	21,087.0	27,251.7	25,156.3	25,156.3	25,028.7	24,895.3	24,763.7
S2	20,905.3	20,193.3	20,193.3	15,437.7	23,136.3	19,866.0	20,031.3	20,112.0	19,782.0	19,615.3
S3	21,745.0	21,306.0	21,306.0	16,218.3	23,465.0	20,876.7	21,131.3	21,136.7	20,879.0	20,369.3
S4	23,990.7	23,155.7	23,155.7	10,930.3	26,011.0	22,316.7	22,969.3	22,972.0	22,694.3	22,136.3
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	25,569.3	25,102.0	25,292.0	25,292.0	25,292.0	24,895.3	25,094.0	25,229.7	25,164.3	24,957.7
S2	20,112.0	20,193.3	20,669.0	20,355.3	20,112.0	19,947.3	19,947.3	20,193.3	20,274.7	20,031.3
S3	21,394.3	21,480.7	21,657.0	21,480.7	21,394.3	20,965.3	21,131.3	21,311.3	21,394.3	21,131.3
S4	23,249.7	23,342.0	23,625.3	23,342.0	23,061.7	23,061.7	23,342.0	23,064.3	23,155.7	23,061.7
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	26,182.0	26,182.0	24,755.0	25,292.0	25,094.0	20,868.7	21,010.3	22,703.7	23,305.7	25,156.3
S2	20,590.3	20,979.3	20,031.3	20,112.0	20,028.7	15,236.3	15,228.0	17,729.3	17,491.7	20,355.3
S3	22,433.0	22,604.0	21,219.7	21,394.3	21,217.7	15,546.7	15,844.7	18,102.0	18,102.0	20,963.0
S4	22,878.0	24,721.3	23,809.3	22,601.0	22,694.3	10,512.7	10,790.0	12,737.7	13,144.0	22,601.0
SE ±		194.633								
C.D. at 5%		543.451								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	23,766.0	25,252.0	24,989.5	24,800.0	23,045.8	25,589.2	25,593.2	25,480.2	26,230.2	26,393.2
S2	19,992.3	20,605.5	19,921.0	19,863.5	18,005.7	20,270.5	20,355.0	20,599.3	21,177.2	21,731.8
S3	20,882.3	21,574.3	21,735.7	20,798.0	19,561.0	21,458.7	21,733.0	21,861.2	21,883.2	22,700.7
S4	23,241.0	24,002.0	24,104.0	23,198.0	18,262.2	23,899.3	24,204.2	24,305.5	24,509.2	25,419.5
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	26,264.5	25,996.3	25,594.2	21,406.0	27,599.5	25,306.2	25,561.0	25,561.5	25,202.7	24,987.5
S2	21,611.5	21,056.2	20,975.2	16,295.7	23,670.2	20,729.5	20,812.2	20,770.8	20,646.7	20,401.7
S3	22,507.3	21,832.0	21,832.0	16,689.2	24,814.8	21,216.8	21,642.3	21,648.3	21,369.3	20,837.2
S4	25,222.2	24,305.5	24,305.5	15,112.7	27,473.8	23,664.8	24,047.3	24,157.5	23,799.2	23,194.3
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	25,831.8	25,637.3	25,927.7	25,700.2	25,693.2	25,316.0	25,376.2	25,662.0	25,668.5	25,493.8
S2	20,812.7	21,055.2	21,334.0	21,177.2	21,014.5	20,851.3	20,688.5	20,974.2	21,136.8	20,934.2
S3	22,029.7	22,072.8	22,161.0	22,072.8	22,029.7	21,364.7	21,591.2	21,988.2	22,029.7	21,591.2
S4	24,406.8	24,509.2	24,817.2	24,509.2	24,312.8	24,039.0	24,288.2	24,259.7	24,359.8	24,148.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	26,758.3	26,696.3	25,353.3	25,693.2	25,601.2	21,363.8	21,434.7	23,253.2	23,553.8	25,664.5
S2	21,253.7	21,723.2	21,095.2	20,933.5	20,973.8	16,019.2	15,914.0	18,888.2	18,850.5	21,096.2
S3	23,324.5	23,410.0	21,635.3	22,029.7	21,787.8	15,992.3	16,258.8	18,843.0	18,845.0	21,660.5
S4	24,829.5	26,081.7	24,521.8	24,082.5	24,020.5	14,490.5	14,794.5	17,266.0	17,620.3	23,863.2
SE ±		138.609								
C.D. at 5%		384.960								

Combination during both years and pooled mean. However, S₄V₃₆ recorded significantly minimum photo-thermal units (°hr) at par with S₄V₃₇ over other genotypes.

4.2.10. Helio thermal unit(°hr):

Data regarding mean helio thermal unit (°hr) at first flowering stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 37. The mean helio thermal unit (°hr) at first flowering stage was 5665.5° hr, 5641.9° hr and 5654.2° hr recorded during 2020-21, 2021-22 and pooled mean respectively.

Table 37. Effect of different treatment on helio thermal unit(⁰hr) at first flowering of rice genotypes

Treatments	Helio thermal unit(⁰ hr) at first flowering		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	2,206.3	2,119.5	2,162.9
S2 : 48 th MW	5,135.5	6,280.2	5,707.9
S3 : 50 th MW	7,410.3	6,880.0	7,145.1
S4 : 52 th MW	7,913.9	7,287.9	7,600.9
SE ±	59.567	3.984	29.828
C.D. at 5%	210.136	14.053	90.476
B) Sub plot (Varieties)			
V1: Karjat-1	4,808.1	5,287.1	5,047.6
V2: Karjat-3	4,629.8	5,098.0	4,863.9
V3: Karjat-4,	5,070.9	5,453.3	5,262.1
V4: Karjat-7	5,079.5	5,447.8	5,263.7
V5: Karjat-184	5,384.6	5,069.0	5,226.8
V6: Sahyadri-2	7,722.4	6,986.1	7,354.3
V7: Sahyadri-4	7,722.4	6,986.1	7,354.3
V8: Phondaghat -1	4,657.6	5,100.3	4,879.0
V9: Ratnagiri-1	7,278.2	6,631.9	6,955.0
V10: Ratnagiri-5	4,657.6	5,100.3	4,879.0
V11: Ratnagiri- 6	5,181.5	5,771.0	5,476.2
V12: Ratnagiri- 7	4,657.6	5,104.9	4,881.3
V13: Ratnagiri -24	7,560.8	6,853.7	7,207.3
V14: Ratnagiri-73	4,629.8	5,071.9	4,850.8
V15: Ratnagiri-711	7,745.6	7,050.9	7,398.2
V16: IRRI-14	4,971.8	5,424.5	5,198.1
V17: IRRI-15	4,980.1	5,596.8	5,288.4
V18: IRRI-20	4,657.6	5,100.3	4,879.0
V19: IRRI-21	8,018.0	7,195.5	7,606.7
V20: IRRI-22	4,914.8	5,355.9	5,135.3
V21: IRRI-27	4,713.4	5,157.2	4,935.3
V22: IRRI-28	4,886.3	5,321.6	5,103.9
V23: IRRI-34	5,948.6	5,552.4	5,750.5
V24: IRRI-36	5,502.0	5,522.3	5,512.2
V25: IRRI-47	5,474.1	5,493.5	5,483.8
V26: IRRI-52	4,941.4	5,616.8	5,279.1
V27: IRRI-53	4,713.4	5,157.2	4,935.3
V28: IRRI-55	4,914.8	5,355.9	5,135.3
V29: IRRI-62	4,929.2	5,295.8	5,112.5
V30: IR-35	5,473.8	5,519.7	5,496.8
V31: Laldodaki	4,771.0	5,212.0	4,991.5
V32: IR2289-6-22-5	5,944.9	5,687.4	5,816.1
V33: Narmada	7,321.3	6,681.4	7,001.4
V34: Ananda	7,409.5	6,545.5	6,977.5
V35: Ambpandhari	8,018.0	7,183.6	7,600.8
V36: Hira	4,703.5	3,921.8	4,312.7
V37: OR-1516-1-5-A	4,858.2	4,129.5	4,493.9
V38: China	4,753.5	5,215.3	4,984.4
V39: Sorati	5,636.4	4,852.5	5,244.5
V40: Mhadi	7,418.3	6,569.2	6,993.7
SE ±	164.499	25.688	83.246
C.D. at 5%	457.967	71.516	231.201
Interaction Effect (S x V)			
SE ±	330.275	50.886	166.493
C.D. at 5%	927.480	141.900	462.402
General Mean	5665.5	5641.9	5654.2

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 : 52th MW (24th-31st December)

Effect of sowing dates:

The data presented in Table 37 revealed that, the mean helio thermal unit ($^{\circ}\text{hr}$) at first flowering stage of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during S_1 -*kharif* season (24^{th} MW) produced significantly minimum helio thermal unit ($^{\circ}\text{hr}$) as compared to other sowing dates of *rabi* season (48^{th} MW, 50^{th} MW, 52^{th} MW) during 2020-21, 2021-22 and pooled mean. General mean helio thermal unit ($^{\circ}\text{hr}$) at first flowering stage of both years and pooled mean were found to be 5665.5° hr, 5641.9° hr and 5654.2° hr, respectively.

The rice crop sown during *rabi* season, S_4 (the 52^{th} MW) date of sowing recorded significantly maximum helio thermal unit ($^{\circ}\text{hr}$) at first flowering stage (7600.9°hr) as compared to crop sown during S_3 (50^{th} MW) and S_4 (52^{th} MW) in both year and pooled mean. Significantly maximum helio thermal unit ($^{\circ}\text{hr}$) was recorded in S_4 (7600.9°hr) which was superior over the other date of sowing.

Effect of genotypes:

The helio thermal unit ($^{\circ}\text{hr}$) at first flowering stage of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 37). The rice genotype V_{19} i.e. IRRI-21 recorded significantly maximum helio thermal unit (7606.7° hr) at first flowering stage which was at par with genotype V_6 i.e. Sahyadri-2, V_7 i.e. Sahyadri-4, V_{13} i.e. Ratnagiri-24, V_{15} i.e. Ratnagiri-711, V_{35} i.e. Ambepandhari over other genotypes. Rice genotype V_{36} i.e. Hira recorded significantly minimum helio thermal unit (4312°hr) at first flowering stage during 2020-21, 2021-22 and pooled mean over others genotypes.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of helio thermal unit ($^{\circ}\text{hr}$) at first flowering stage (Table 38). The rice crop sown S_1 i.e. *kharif* season (24^{th} MW) with genotype V_{15} i.e. Ratnagiri-711, significantly higher helio thermal unit

Table38 : Interaction effect of helio thermal unit(⁰hr) at first flowering on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	2,030.4	2,030.4	2,315.4	2,352.5	2,030.4	2,629.1	2,629.1	2,030.4	2,315.4	2,030.4
S2	2,785.9	2,604.6	2,981.0	2,987.3	5,799.4	9,452.8	9,452.8	2,637.9	9,036.9	2,637.9
S3	6,949.6	6,699.3	7,219.9	7,212.5	6,634.6	9,140.1	9,140.1	6,728.3	8,648.4	6,728.3
S4	7,466.7	7,184.7	7,767.1	7,765.7	7,073.9	9,667.7	9,667.7	7,233.9	9,112.0	7,233.9
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2,597.3	2,030.4	2,517.5	2,030.4	2,840.2	2,030.4	2,291.6	2,030.4	2,840.2	2,030.4
S2	3,002.8	2,637.9	9,300.5	2,604.6	9,254.0	2,959.3	2,928.4	2,637.9	9,696.0	2,928.4
S3	7,260.3	6,728.3	8,963.7	6,699.3	9,255.9	7,179.5	7,084.0	6,728.3	9,489.3	7,084.0
S4	7,865.5	7,233.9	9,461.7	7,184.7	9,632.3	7,717.8	7,616.3	7,233.9	10,046.4	7,616.3
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	2,030.4	2,030.4	2,032.7	2,031.5	2,031.5	2,437.7	2,030.4	2,030.4	2,352.5	2,030.4
S2	2,704.5	2,912.9	6,398.7	4,711.6	4,689.9	2,813.2	2,704.5	2,928.4	2,855.3	4,689.9
S3	6,786.2	7,036.2	7,399.3	7,350.0	7,309.6	6,997.4	6,786.2	7,084.0	6,992.9	7,309.6
S4	7,332.4	7,565.5	7,963.8	7,914.8	7,865.5	7,517.5	7,332.4	7,616.3	7,516.1	7,865.5
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	2,030.4	2,381.8	2,352.5	2,030.4	2,840.2	1,647.7	2,030.4	2,030.4	2,051.7	2,186.5
S2	2,774.0	6,321.3	9,073.2	9,259.5	9,696.0	6,609.0	6,678.6	2,728.3	7,324.6	9,219.6
S3	6,869.5	7,261.8	8,703.9	8,935.2	9,489.3	5,134.5	5,210.1	6,866.3	6,410.3	8,906.9
S4	7,410.1	7,814.7	9,155.7	9,412.7	10,046.4	5,422.8	5,513.8	7,389.0	6,759.1	9,360.1
SE ±	330.275									
C.D. at 5%	927.480									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,734.5	1,752.9	1,880.6	1,860.0	1,909.4	3,085.0	3,085.0	1,648.2	2,797.8	1,648.2
S2	5,921.8	5,674.7	6,096.8	6,105.6	5,586.4	7,731.6	7,731.6	5,711.2	7,254.9	5,711.2
S3	6,526.3	6,207.9	6,775.9	6,775.7	6,112.5	8,355.3	8,355.3	6,254.9	8,026.7	6,254.9
S4	6,965.7	6,756.6	7,060.0	7,050.0	6,667.7	8,772.6	8,772.6	6,786.9	8,448.1	6,786.9
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	3,064.8	1,666.6	3,007.5	1,648.2	3,331.1	1,851.8	2,716.4	1,648.2	3,302.6	1,752.9
S2	6,130.4	5,711.2	7,479.2	5,674.7	7,828.7	6,063.2	6,013.6	5,711.2	8,051.3	6,013.6
S3	6,820.2	6,254.9	8,260.1	6,207.9	8,305.1	6,731.5	6,642.4	6,254.9	8,456.3	6,642.4
S4	7,068.5	6,786.9	8,667.9	6,756.6	8,738.6	7,051.6	7,014.7	6,786.9	8,971.8	7,014.7
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1,648.2	1,703.5	1,826.0	1,882.1	1,853.3	2,965.6	1,648.2	1,752.9	1,685.1	1,853.3
S2	5,784.2	5,988.8	6,306.2	6,197.8	6,164.2	5,946.6	5,784.2	6,013.6	5,955.3	6,268.9
S3	6,348.9	6,597.8	6,959.8	6,912.2	6,867.8	6,570.8	6,348.9	6,642.4	6,562.0	6,867.8
S4	6,847.5	6,996.2	7,117.5	7,097.2	7,088.8	6,984.2	6,847.5	7,014.7	6,981.0	7,088.8
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,666.6	2,716.4	2,855.3	1,783.9	3,302.6	1,096.1	1,752.9	1,648.2	1,772.6	1,975.3
S2	5,852.4	6,139.4	7,302.0	7,526.4	8,003.7	4,527.2	4,552.6	5,853.6	5,349.2	7,490.6
S3	6,431.9	6,823.3	8,071.2	8,240.8	8,456.3	4,852.3	4,920.5	6,443.3	5,853.7	8,206.5
S4	6,897.1	7,070.3	8,497.3	8,631.0	8,971.8	5,211.7	5,292.1	6,916.2	6,434.5	8,604.2
SE ±	50.886									
C.D. at 5%	141.900									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	1,882.5	1,891.7	2,098.0	2,106.3	1,969.9	2,857.1	2,857.1	1,839.3	2,556.6	1,839.3
S2	4,353.8	4,139.7	4,538.9	4,546.5	5,692.9	8,592.2	8,592.2	4,174.6	8,145.9	4,174.6
S3	6,737.9	6,453.6	6,997.9	6,994.1	6,373.5	8,747.7	8,747.7	6,491.6	8,337.6	6,491.6
S4	7,216.2	6,970.7	7,413.6	7,407.9	6,870.8	9,220.1	9,220.1	7,010.4	8,780.1	7,010.4
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2,831.1	1,848.5	2,762.5	1,839.3	3,085.7	1,941.1	2,504.0	1,839.3	3,071.4	1,891.7
S2	4,566.6	4,174.6	8,389.8	4,139.7	8,541.3	4,511.3	4,471.0	4,174.6	8,873.6	4,471.0
S3	7,040.3	6,491.6	8,611.9	6,453.6	8,780.5	6,955.5	6,863.2	6,491.6	8,972.8	6,863.2
S4	7,467.0	7,010.4	9,064.8	6,970.7	9,185.5	7,384.7	7,315.5	7,010.4	9,509.1	7,315.5
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1,839.3	1,867.0	1,929.3	1,956.8	1,942.4	2,701.6	1,839.3	1,891.7	2,018.8	1,941.9
S2	4,244.4	4,450.9	6,352.5	5,454.7	5,427.1	4,379.9	4,244.4	4,471.0	4,405.3	5,479.4
S3	6,567.6	6,817.0	7,179.6	7,131.1	7,088.7	6,784.1	6,567.6	6,863.2	6,777.5	7,088.7
S4	7,090.0	7,280.9	7,540.7	7,506.0	7,477.1	7,250.8	7,090.0	7,315.5	7,248.5	7,477.1
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,848.5	2,549.1	2,603.9	1,907.2	3,071.4	1,371.9	1,891.7	1,839.3	1,912.1	2,080.9
S2	4,313.2	6,230.4	8,187.6	8,392.9	8,849.8	5,568.1	5,615.6	4,291.0	6,336.9	8,355.1
S3	6,650.7	7,042.6	8,387.5	8,588.0	8,972.8	4,993.4	5,065.3	6,654.8	6,132.0	8,556.7
S4	7,153.6	7,442.5	8,826.5	9,021.9	9,509.1	5,317.3	5,403.0	7,152.6	6,596.8	8,982.1
SE ±	166.493									
C.D. at 5%	462.402									

(3085.7° hr) recorded at first flowering stage which was at par with S₁V₇, S₁V₁₃, S₁V₂₆ treatment combination during 2020-21, 2021-22 years and pooled mean over others.

In case of *rabi* season S₄V₁₉ and S₄V₃₅ i.e. crop sown in S₄ date of sowing (52th MW) was recorded significantly higher helio thermal unit (9509.1° hr) at first flowering stage which was at par with S₄V₆, S₄V₇, S₄V₁₃, S₄V₁₅, S₄V₃₄, S₄V₃₅ during pooled mean. However, S₁V₃₆ with rice genotype Hira recorded significantly minimum helio thermal unit (1371.9° hr) at first flowering stage for pooled mean over others.

Data regarding mean helio thermal unit ($^{\circ}\text{hr}$) at 50% flowering stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 39. The mean growing degree days ($^{\circ}\text{days}$) at 50% flowering stage was 7834.9 $^{\circ}\text{hr}$, 6933.1 $^{\circ}\text{hr}$ and 7384.0 $^{\circ}\text{hr}$ recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 39 revealed that, the mean helio thermal unit ($^{\circ}\text{hr}$) at 50% flowering stage of rice genotype was significantly influenced due to different sowing dates.

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum helio thermal unit (2927 $^{\circ}\text{hr}$) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. General mean helio thermal unit ($^{\circ}\text{hr}$) at 50% flowering stage of both years and pooled mean were found to be 7834.9 $^{\circ}\text{hr}$, 6933.1 $^{\circ}\text{hr}$ and 7384.0 $^{\circ}\text{hr}$, respectively.

The rice crop sown during *rabi* season, S_4 (the 52th MW) date of sowing recorded significantly maximum helio thermal unit (9461.4 $^{\circ}\text{hr}$) at 50% flowering stage (1470.2 $^{\circ}$ days) as compared to crop sown during S_2 (48th MW) and S_3 (50th MW) in both year and pooled mean. Significantly maximum helio thermal unit ($^{\circ}\text{hr}$) were recorded in S_4 (9461.4 $^{\circ}\text{hr}$) which was superior over the other date of sowing.

Effect of genotypes:

The helio thermal unit ($^{\circ}\text{hr}$) at 50% flowering stage of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 39). The rice genotype V_{13} i.e. Ratnagiri-24 recorded significantly maximum helio thermal unit (9263.8 $^{\circ}\text{hr}$) at 50% flowering stage over the other genotypes. Rice genotype V_{36} i.e. Hira recorded significantly minimum helio thermal unit (5036.8 $^{\circ}\text{hr}$) at 50% flowering stage during pooled means over others genotypes.

Table 39. Effect of different treatment on Helio thermal unit(0 hr) at 50% flowering of rice genotypes

Treatments	Helio thermal unit(0 hr) at 50% flowering		
	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)			
S1 : 24 th MW	2,984.8	2,869.2	2,927.0
S2 : 48 th MW	9,350.1	7,590.5	8,470.3
S3 : 50 th MW	9,035.5	8,318.9	8,677.2
S4 :52 th MW	9,969.0	8,953.8	9,461.4
SE $\pm$	66.982	40.416	38.739
C.D. at 5%	236.294	142.576	117.503
B) Sub plot (Varieties)			
V1:Karjat-1	8,219.5	7,293.0	7,756.2
V2:Karjat-3	8,219.5	7,249.9	7,734.7
V3:Karjat-4,	7,410.6	6,825.7	7,118.1
V4:Karjat-7	8,197.1	7,272.8	7,735.0
V5:Karjat-184	7,254.2	6,574.3	6,914.3
V6:Sahyadri-2	8,235.5	7,641.2	7,938.3
V7:Sahyadri-4	7,904.8	7,034.6	7,469.7
V8:Phondaghat -1	7,926.5	7,060.1	7,493.3
V9:Ratnagiri-1	7,948.0	7,082.7	7,515.4
V10:Ratnagiri-5	7,831.2	7,015.5	7,423.4
V11:Ratnagiri- 6	8,461.8	7,849.4	8,155.6
V12:Ratnagiri- 7	8,081.2	7,284.1	7,682.7
V13:Ratnagiri -24	11,012.5	7,515.0	9,263.8
V14:Ratnagiri-73	8,017.9	7,237.1	7,627.5
V15:Ratnagiri-711	8,612.7	7,680.7	8,146.7
V16:IRRI-14	7,439.3	6,807.3	7,123.3
V17:IRRI-15	7,383.4	6,756.0	7,069.7
V18:IRRI-20	7,595.7	6,978.1	7,286.9
V19:IRRI-21	7,364.4	6,777.1	7,070.7
V20:IRRI-22	8,129.3	7,248.6	7,688.9
V21:IRRI-27	8,001.5	7,169.9	7,585.7
V22:IRRI-28	8,129.3	7,227.6	7,678.4
V23:IRRI-34	8,608.2	7,535.5	8,071.8
V24:IRRI-36	8,419.6	7,408.8	7,914.2
V25:IRRI-47	8,477.5	7,430.4	7,954.0
V26:IRRI-52	8,119.6	7,227.6	7,673.6
V27:IRRI-53	8,001.5	7,168.4	7,584.9
V28:IRRI-55	8,129.3	7,244.6	7,686.9
V29:IRRI-62	8,129.3	7,240.0	7,684.6
V30:IR-35	8,129.3	7,236.2	7,682.7
V31:Laldodaki	6,853.6	6,018.2	6,435.9
V32:IR2289-6-22-5	6,923.5	6,015.6	6,469.5
V33:Narmada	6,910.0	6,027.6	6,468.8
V34:Ananda	8,318.0	7,335.8	7,826.9
V35:Ambpandhari	6,622.1	5,839.6	6,230.8
V36:Hira	5,378.1	4,695.6	5,036.8
V37:OR-1516-1-5-A	6,089.5	5,329.2	5,709.4
V38:China	6,114.1	5,351.2	5,732.7
V39:Sorati	8,351.1	7,259.0	7,805.0
V40:Mhadi	8,444.9	7,379.7	7,912.3
SE $\pm$	221.922	59.728	114.910
C.D. at 5%	617.834	166.284	319.140
Interaction Effect (S x V)			
SE $\pm$	443.350	124.686	229.819
C.D. at 5%	1,241.819	356.870	638.280
General Mean	7,834.9	6,933.1	7,384.0

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of helio thermal unit ($^{\circ}\text{hr}$) at 50% flowering stage (Table 40). The rice crop sown S_1 i.e. *kharif* season (24th MW) with genotype V_{25} i.e. IRRI-47 significantly higher helio thermal unit (3350.6 $^{\circ}\text{hr}$) recorded at 50% flowering stage which was at par with V_1 , i.e. Karjat-1, V_2 i.e. Karjat-3, V_4 i.e. Karjat-7, V_6 i.e. Sahyadri-2, V_7 i.e. Sahyadri-4, V_9 i.e. Ratnagiri-1, V_{10} i.e. Ratnagiri-5, V_{11} i.e. Ratnagiri-6, V_{12} i.e. Ratnagiri-7, V_{14} , i.e. Ratnagiri-7, V_{15} i.e. Ratnagiri-711, V_{16} i.e. IRRI-14, V_{17} i.e. IRRI-15, V_{18} i.e. IRRI-20, V_{21} i.e. IRRI-27, V_{22} i.e. IRRI-28, V_{23} i.e. IRRI-34, V_{24} i.e. IRRI-36, V_{25} i.e. IRRI-47, V_{26} i.e. IRRI-52, V_{27} i.e. IRRI-53, V_{28} i.e. IRRI-55, V_{29} i.e. IRRI-62, V_{30} i.e. IR-35, V_{34} i.e. Ananda, V_{39} i.e. Sorati, V_{40} i.e. Mhadiover others genotypes with treatment combination during pooled mean.

In case of *rabi* season S_4V_{11} i.e. crop sown in S_4 date of sowing with Ratnagiri-6 (52th MW) was recorded significantly higher helio thermal unit ($^{\circ}\text{hr}$) at 50% flowering stage (11415.3 $^{\circ}\text{hr}$) which was at par with S_4V_{12} (11370.3 $^{\circ}\text{hr}$), S_4V_{13} (11286.2 $^{\circ}\text{hr}$) S_4V_{15} for pooled mean over others genotypes. However, S_1V_{36} with rice genotype Hira recorded significantly minimum which was at par with S_1V_5 , S_1V_{31} , S_1V_{32} , S_1V_{33} , S_1V_{35} , S_1V_{37} , S_1V_{38} over others genotypes.

Data regarding mean helio thermal unit ($^{\circ}\text{hr}$) at maturity stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 41. The mean helio thermal unit ($^{\circ}\text{hr}$) at maturity stage was 12090.6 $^{\circ}\text{hr}$, 10439.1 $^{\circ}\text{hr}$ and 11264.8 $^{\circ}\text{hr}$ recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 41 revealed that, the mean helio thermal unit ($^{\circ}\text{hr}$) at maturity stage of rice genotypes was significantly influenced due to different sowing dates.

Table 40: Interaction effect of helio thermal unit(0 hr) at 50% flowering on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3,032.4	3,032.4	2,352.5	3,035.6	2,220.2	2,745.6	2,782.0	2,745.6	2,818.4	2,713.8
S2	9,796.0	9,796.0	9,073.2	9,801.9	8,647.7	9,524.3	9,558.8	9,524.3	9,593.4	9,486.4
S3	9,636.9	9,636.9	8,703.9	9,538.3	8,100.6	9,292.3	9,290.9	9,292.3	9,290.9	9,141.4
S4	10,412.7	10,412.7	9,512.7	10,412.7	10,048.3	11,379.7	9,987.7	10,143.7	10,089.3	9,983.3
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2,840.2	2,400.5	13,345.8	2,315.4	3,032.4	2,533.7	2,477.4	2,533.7	2,389.7	3,008.3
S2	9,594.6	9,149.8	9,408.1	9,036.9	9,760.5	9,339.2	9,219.6	9,339.2	9,109.4	9,760.5
S3	9,341.6	8,703.9	9,341.6	8,648.4	9,587.3	8,991.8	8,906.9	8,991.8	8,759.3	9,587.3
S4	12,070.7	12,070.7	11,954.3	12,070.7	12,070.7	8,892.3	8,929.7	9,518.0	9,199.0	10,161.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	2,913.0	3,008.3	3,334.8	3,214.2	3,274.5	2,968.9	2,913.0	3,008.3	3,008.3	3,008.3
S2	9,663.7	9,760.5	10,156.8	10,009.2	10,083.0	9,769.7	9,663.7	9,760.5	9,760.5	9,760.5
S3	9,440.3	9,587.3	10,152.1	9,940.6	9,989.9	9,587.9	9,440.3	9,587.3	9,587.3	9,587.3
S4	9,989.0	10,161.0	10,789.0	10,514.3	10,562.7	10,152.0	9,989.0	10,161.0	10,161.0	10,161.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	2,220.2	2,206.3	2,220.2	3,115.6	2,133.3	2,030.4	2,030.4	2,030.4	3,185.5	3,214.2
S2	8,612.1	8,611.3	8,690.4	10,009.2	8,383.1	7,164.3	7,725.5	7,725.5	10,064.4	10,110.6
S3	8,052.9	8,148.3	8,100.6	9,787.8	7,767.5	6,028.7	7,036.2	7,084.0	9,790.0	9,940.6
S4	8,529.3	8,728.0	8,628.7	10,359.3	8,204.3	6,289.0	7,566.0	7,616.7	10,364.3	10,514.3
SE ±	443.350									
C.D. at 5%	1,241.819									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3,302.6	3,302.6	3,022.4	2,995.5	1,999.1	2,837.1	2,845.4	2,606.6	2,823.5	2,766.7
S2	8,063.0	8,063.0	7,302.0	8,095.2	6,772.2	7,864.6	7,867.9	7,864.6	7,867.9	7,731.4
S3	8,632.9	8,496.5	8,278.6	8,722.2	8,510.0	9,656.2	8,469.6	8,645.7	8,579.1	8,555.4
S4	9,173.3	9,137.3	8,700.0	9,278.3	9,016.0	10,206.7	8,955.3	9,123.7	9,060.3	9,008.7
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2,849.9	3,028.7	3,082.1	2,797.8	3,377.7	3,160.7	2,886.3	3,107.7	3,033.3	3,274.1
S2	7,912.2	7,302.0	7,912.2	7,254.9	8,139.1	7,597.9	7,490.6	7,597.9	7,349.0	8,139.1
S3	9,875.6	8,135.8	8,447.9	8,135.8	8,537.1	8,324.8	8,399.1	8,521.7	8,180.2	8,537.1
S4	10,760.0	10,670.0	10,618.0	10,760.0	10,669.0	8,146.0	8,248.0	8,685.0	8,546.0	9,044.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	3,327.1	3,327.1	3,200.8	3,426.7	3,426.7	3,349.2	3,302.6	3,327.1	3,327.1	3,327.1
S2	8,007.4	8,139.1	8,248.8	8,055.7	8,091.4	8,019.1	8,007.4	8,139.1	8,139.1	8,139.1
S3	8,409.1	8,400.1	9,059.2	8,782.7	8,782.7	8,496.5	8,427.6	8,468.2	8,449.7	8,434.4
S4	8,936.0	9,044.0	9,633.0	9,370.0	9,421.0	9,045.7	8,936.0	9,044.0	9,044.0	9,044.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1,829.7	1,581.9	1,727.5	3,402.2	1,852.6	1,545.8	1,769.9	1,769.9	3,420.3	3,426.7
S2	6,731.2	6,772.2	6,772.2	7,947.3	6,522.7	5,660.3	5,988.8	6,013.6	7,983.6	8,055.7
S3	7,700.6	7,788.3	7,745.0	8,782.7	7,503.1	5,553.1	6,562.0	6,606.6	8,496.5	8,666.5
S4	7,811.3	7,920.0	7,865.7	9,211.0	7,480.0	6,023.0	6,996.0	7,014.7	9,135.7	9,370.0
SE ±	124.686									
C.D. at 5%	356.870									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3,167.5	3,167.5	2,687.5	3,015.5	2,109.7	2,791.4	2,813.7	2,676.1	2,821.0	2,740.2
S2	8,929.5	8,929.5	8,187.6	8,948.6	7,710.0	8,694.4	8,713.4	8,694.4	8,730.6	8,608.9
S3	9,134.9	9,066.7	8,491.2	9,130.2	8,305.3	9,474.3	8,880.3	8,969.0	8,935.0	8,848.4
S4	9,793.0	9,775.0	9,106.3	9,845.5	9,532.2	10,793.2	9,471.5	9,633.7	9,574.8	9,496.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2,845.0	2,714.6	8,214.0	2,556.6	3,205.1	2,847.2	2,681.8	2,820.7	2,711.5	3,141.2
S2	8,753.4	8,225.9	8,660.2	8,145.9	8,949.8	8,468.6	8,355.1	8,468.6	8,229.2	8,949.8
S3	9,608.6	8,419.8	8,894.8	8,392.1	9,062.2	8,658.3	8,653.0	8,756.8	8,469.8	9,062.2
S4	11,415.3	11,370.3	11,286.2	11,415.3	11,369.8	8,519.2	8,588.8	9,101.5	8,872.5	9,602.5
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	3,120.0	3,167.7	3,267.8	3,320.4	3,350.6	3,159.1	3,107.8	3,167.7	3,167.7	3,167.7
S2	8,835.6	8,949.8	9,202.8	9,032.5	9,087.2	8,894.4	8,835.6	8,949.8	8,949.8	8,949.8
S3	8,924.7	8,993.7	9,605.7	9,361.6	9,386.3	9,042.2	8,933.9	9,027.7	9,018.5	9,010.9
S4	9,462.5	9,602.5	10,211.0	9,942.2	9,991.8	9,598.8	9,462.5	9,602.5	9,602.5	9,602.5
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	2,025.0	1,894.1	1,973.9	3,258.9	1,993.0	1,788.1	1,900.2	1,900.2	3,302.9	3,320.4
S2	7,671.7	7,691.8	7,731.3	8,978.2	7,452.9	6,412.3	6,857.2	6,869.6	9,024.0	9,083.1
S3	7,876.8	7,968.3	7,922.8	9,285.3	7,635.3	5,790.9	6,799.1	6,845.3	9,143.2	9,303.6
S4	8,170.3	8,324.0	8,247.2	9,785.2	7,842.2	6,156.0	7,281.0	7,315.7	9,750.0	9,942.2
SE $\pm$		229.819								
C.D. at 5%		638.280								

Crop sown during S₁-*kharif* season (24th MW) produces significantly minimum helio thermal unit (4266.1° hr) than others. S₄-*rabi* season (52th MW) produced significantly maximum helio thermal unit (14426.7° hr) as compared to other sowing dates of *kharif* season (24th MW) and *rabi* season (48th MW and 50th MW) during 2020-21, 2021-22 and pooled mean. General mean helio thermal unit (°hr) at maturity stage of both years and pooled mean were found to be 12090.6° hr, 10439.1° hr and 11264.8° hr respectively.

Effect of genotypes:

The helio thermal unit (°hr) at maturity stage of rice was influenced significantly due to the different genotypes during both year and pooled

Table 41. Effect of different treatment on helio thermal unit(⁰hr) at maturity of rice genotypes

Treatments	Helio thermal unit(⁰ hr) at maturity		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	4,664.3	3,867.9	4,266.1
S2 : 48 th MW	15,390.3	11,710.1	13,550.2
S3 : 50 th MW	12,864.2	12,768.3	12,816.3
S4 : 52 th MW	15,443.4	13,410.0	14,426.7
SE ±	15.420	19.232	9.583
C.D. at 5%	54.398	67.845	29.069
B) Sub plot (Varieties)			
V1: Karjat-1	11,788.9	10,076.8	10,932.9
V2: Karjat-3	12,240.7	10,473.7	11,357.2
V3: Karjat-4,	12,185.3	10,468.0	11,326.7
V4: Karjat-7	11,914.4	10,210.0	11,062.2
V5: Karjat-184	10,609.4	9,134.1	9,871.8
V6: Sahyadri-2	12,221.8	10,568.5	11,395.2
V7: Sahyadri-4	12,343.6	10,673.8	11,508.7
V8: Phondaghat -1	12,385.9	10,733.8	11,559.9
V9: Ratnagiri-1	12,503.3	10,834.8	11,669.0
V10: Ratnagiri-5	12,836.8	11,265.8	12,051.3
V11: Ratnagiri- 6	12,752.6	11,159.4	11,956.0
V12: Ratnagiri- 7	12,432.3	10,761.4	11,596.9
V13: Ratnagiri -24	12,390.1	10,719.0	11,554.5
V14: Ratnagiri-73	9,553.5	8,338.5	8,946.0
V15: Ratnagiri-711	13,705.9	12,199.2	12,952.6
V16: IRR-14	12,103.0	10,391.7	11,247.3
V17: IRR-15	12,266.5	10,632.6	11,449.6
V18: IRR-20	12,286.8	10,611.2	11,449.0
V19: IRR-21	12,170.9	10,455.5	11,313.2
V20: IRR-22	11,973.9	10,243.6	11,108.7
V21: IRR-27	12,405.8	10,767.4	11,586.6
V22: IRR-28	12,517.5	10,755.8	11,636.7
V23: IRR-34	12,586.4	10,954.3	11,770.4
V24: IRR-36	12,531.0	10,810.8	11,670.9
V25: IRR-47	12,500.9	10,710.4	11,605.7
V26: IRR-52	12,265.0	10,568.1	11,416.5
V27: IRR-53	12,201.0	10,670.1	11,435.5
V28: IRR-55	12,451.6	10,686.9	11,569.2
V29: IRR-62	12,517.5	10,734.2	11,625.8
V30: IR-35	12,290.3	10,617.4	11,453.9
V31: Laldodaki	12,913.6	11,058.4	11,986.0
V32: IR2289-6-22-5	13,070.4	11,490.4	12,280.4
V33: Narmada	12,464.9	10,766.3	11,615.6
V34: Ananda	12,468.9	10,635.3	11,552.1
V35: Ambpandhari	12,437.6	10,594.3	11,516.0
V36: Hira	9,278.7	8,181.4	8,730.0
V37: OR-1516-1-5-A	9,308.5	8,264.2	8,786.3
V38: China	11,172.1	9,322.6	10,247.3
V39: Sorati	11,259.0	9,378.6	10,318.8
V40: Mhadi	12,316.5	10,644.9	11,480.7
SE ±	65.547	50.961	41.414
C.D. at 5%	182.484	141.875	115.018
Interaction Effect (S x V)			
SE ±	130.361	102.460	82.827
C.D. at 5%	364.282	287.935	230.037
General Mean	12,090.6	10,439.1	11,264.8

S1 : 24th MW (11th-17th June)S2 : 48th MW (26th November-2nd December)S3 : 50th MW (10th-16th December)S4 : 52th MW (24th-31st December)

mean (Table 41). The rice variety V₁₅ i.e. Ratnagiri-711 recorded significantly maximum helio thermal unit (12952.6 °hr) at maturity stage over the other genotypes. Rice genotype V₃₆ i.e. Hira (8730° hr) recorded significantly minimum helio thermal unit (°hr) at maturity stage during pooled means over others genotypes.

Interaction effect:

Interaction effect between sowing dates and genotype was significant in respect of helio thermal unit (°hr) at maturity stage (Table 42). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₁₅ i.e. Ratnagiri-711, significantly higher helio thermal unit (5297.8° hr) recorded at maturity with treatment combination during pooled mean than others.

In case of *rabi* season S₄V₁₅ i.e. crop sown in S₄ date of sowing (52th MW) was recorded significantly higher helio thermal unit (°hr) at maturity stage (16728.8° hr) which was superior over other treatment combination during both years and pooled mean. However, S₁V₃₆, S₂V₃₆, S₃V₃₆, with rice variety Hira recorded significantly minimum helio thermal unit (°hr) than others.

4.2.11. Phenothermal index

Data regarding mean phenothermal index from sowing to 50% flowering stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 43. The mean phenothermal index from sowing to 50% flowering stage was 17.305, 17.406, and 17.356 recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 43 revealed that, the mean phenothermal index from sowing to 50% flowering stage of rice genotypes was non significantly influenced due to different sowing dates.

Table 42: Interaction effect of helio thermal unit(⁰ hr) at maturity on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	4,252.3	4,824.0	4,624.3	4,817.7	3,833.3	4,824.0	4,836.0	4,805.7	4,926.0	4,927.0
S2	15,157.3	15,606.3	15,340.2	15,202.4	13,295.8	15,707.5	15,692.3	16,018.0	16,018.0	16,283.1
S3	12,520.0	12,811.3	13,030.3	12,470.7	12,253.3	12,717.7	13,030.3	12,830.3	13,051.3	13,662.7
S4	15,226.0	15,721.0	15,746.4	15,166.9	13,055.3	15,638.2	15,815.7	15,889.8	16,018.0	16,474.2
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	4,927.0	4,876.7	4,836.0	3,477.3	5,416.0	4,673.0	4,836.0	4,836.0	4,715.0	4,581.0
S2	16,208.3	15,943.9	15,815.7	12,302.3	17,274.1	15,707.5	15,707.5	15,569.0	15,638.2	15,385.6
S3	13,550.7	13,019.0	13,019.0	10,132.0	14,360.3	12,717.7	12,830.3	12,906.3	12,761.3	12,520.0
S4	16,324.6	15,889.8	15,889.8	12,302.3	17,773.2	15,313.8	15,692.3	15,835.7	15,569.0	15,408.9
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	4,836.0	4,848.0	4,899.7	4,848.0	4,836.0	4,811.3	4,799.3	4,836.0	4,848.0	4,836.0
S2	15,583.3	15,963.9	16,018.0	16,018.0	15,963.9	15,820.5	15,569.0	15,835.7	16,018.0	15,889.8
S3	13,240.0	13,240.0	13,240.0	13,240.0	13,240.0	12,805.0	12,674.0	13,240.0	13,240.0	12,674.0
S4	15,963.9	16,018.0	16,188.1	16,018.0	15,963.9	15,623.1	15,761.6	15,894.6	15,963.9	15,761.6
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5,117.7	5,079.7	4,824.0	4,836.0	4,848.0	3,477.3	3,477.3	4,042.7	4,031.7	4,595.3
S2	15,963.9	16,287.1	16,103.6	15,835.7	15,943.9	12,012.1	11,839.5	13,517.0	13,668.0	15,889.8
S3	14,019.0	14,019.0	12,980.0	13,240.0	13,143.0	9,905.0	9,963.0	13,586.0	13,598.0	13,088.7
S4	16,553.8	16,895.8	15,951.9	15,963.9	15,815.7	11,720.3	11,954.1	13,542.7	13,738.4	15,692.3
SE ±	130.361									
C.D. at 5%	364.282									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3,214.0	3,662.0	3,744.3	3,309.7	3,133.3	4,032.0	4,003.3	4,032.0	4,256.0	4,323.0
S2	11,367.2	11,726.1	11,494.8	11,728.9	10,496.8	11,831.0	11,938.3	12,003.9	12,123.1	12,607.1
S3	12,571.0	12,964.5	13,030.5	12,572.4	11,057.5	12,921.3	13,088.7	13,175.6	13,121.0	13,663.0
S4	13,155.0	13,542.0	13,602.3	13,229.0	11,848.7	13,489.7	13,664.7	13,723.7	13,839.0	14,470.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	4,253.7	4,197.0	3,973.7	2,865.7	5,179.7	4,003.3	4,003.3	3,932.3	3,856.3	3,790.7
S2	12,502.8	12,003.9	12,057.5	9,419.2	13,572.4	11,597.9	11,884.7	11,899.2	11,675.1	11,478.6
S3	13,551.0	13,121.0	13,121.0	10,163.9	14,360.6	12,672.7	13,034.1	13,008.2	12,863.2	12,571.0
S4	14,330.0	13,723.7	13,723.7	10,905.3	15,684.3	13,292.7	13,608.3	13,605.0	13,427.3	13,134.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	4,183.7	3,972.7	4,073.3	4,073.3	4,073.3	3,856.3	3,973.7	4,043.7	4,002.3	3,886.0
S2	11,950.2	12,003.9	12,361.0	12,123.1	11,950.2	11,833.6	11,833.6	12,003.9	12,057.5	11,884.7
S3	13,153.2	13,207.8	13,338.1	13,207.8	13,153.2	12,917.8	13,034.1	13,095.1	13,153.2	13,034.1
S4	13,782.7	13,839.0	14,044.7	13,839.0	13,664.7	13,664.7	13,839.0	13,605.0	13,723.7	13,664.7
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	4,474.7	4,474.7	3,774.0	4,073.3	3,973.7	2,833.7	2,868.3	3,121.0	3,214.0	4,003.3
S2	12,298.3	12,565.1	11,884.7	11,950.2	11,887.3	9,351.1	9,367.0	10,856.4	10,709.1	12,123.1
S3	13,914.5	14,018.6	13,221.8	13,153.2	13,088.7	9,924.7	10,019.4	11,188.5	11,188.5	13,088.7
S4	13,546.0	14,903.3	14,184.7	13,364.3	13,427.3	10,616.0	10,802.0	12,124.3	12,403.0	13,364.3
SE ±	102.460									
C.D. at 5%	287.935									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3,733.2	4,243.0	4,184.3	4,063.7	3,483.3	4,428.0	4,419.7	4,418.8	4,591.0	4,625.0
S2	13,262.2	13,666.2	13,417.5	13,465.7	11,896.3	13,769.2	13,815.3	14,010.9	14,070.5	14,445.1
S3	12,545.5	12,887.9	13,030.4	12,521.5	11,655.4	12,819.5	13,059.5	13,003.0	13,086.2	13,662.8
S4	14,190.5	14,631.5	14,674.4	14,198.0	12,452.0	14,564.0	14,740.2	14,806.7	14,928.5	15,472.1
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	4,590.3	4,536.8	4,404.8	3,171.5	5,297.8	4,338.2	4,419.7	4,384.2	4,285.7	4,185.8
S2	14,355.6	13,973.9	13,936.6	10,860.7	15,423.2	13,652.7	13,796.1	13,734.1	13,656.7	13,432.1
S3	13,550.8	13,070.0	13,070.0	10,148.0	14,360.5	12,695.2	12,932.2	12,957.3	12,812.3	12,545.5
S4	15,327.3	14,806.7	14,806.7	11,603.8	16,728.8	14,303.2	14,650.3	14,720.4	14,498.2	14,271.5
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	4,509.8	4,410.3	4,486.5	4,460.7	4,454.7	4,333.8	4,386.5	4,439.8	4,425.2	4,361.0
S2	13,766.7	13,983.9	14,189.5	14,070.5	13,957.0	13,827.1	13,701.3	13,919.8	14,037.8	13,887.2
S3	13,196.6	13,223.9	13,289.1	13,223.9	13,196.6	12,861.4	12,854.1	13,167.5	13,196.6	12,854.1
S4	14,873.3	14,928.5	15,116.4	14,928.5	14,814.3	14,643.9	14,800.3	14,749.8	14,843.8	14,713.1
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	4,796.2	4,777.2	4,299.0	4,454.7	4,410.8	3,155.5	3,172.8	3,581.8	3,622.8	4,299.3
S2	14,131.1	14,426.1	13,994.1	13,892.9	13,915.6	10,681.6	10,603.3	12,186.7	12,188.5	14,006.4
S3	13,966.8	14,018.8	13,100.9	13,196.6	13,115.9	9,914.9	9,991.2	12,387.3	12,393.3	13,088.7
S4	15,049.9	15,899.6	15,068.3	14,664.1	14,621.5	11,168.2	11,378.1	12,833.5	13,070.7	14,528.3
SE $\pm$		82.827								
C.D. at 5%		230.037								

Crop sown during S₁ –*kharif* season (24th MW) produced 17.409 phenothermal index from sowing to 50% flowering stage as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. General mean phenothermal index from sowing to 50% flowering stage of both years and pooled mean were found to be 17.305, 17.406 and 17.356, respectively.

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded maximum phenothermal index from sowing to 50% flowering stage (17.414) as compared to other sowing date in both year and pooled mean.

Effect of genotypes:

The phenol thermal index from sowing to 50% flowering stage of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 43). The rice genotype V₃ i.e. Karjat-4 recorded significantly maximum phenol thermal index (18.192) from sowing to 50% flowering stage which was at par with V₁ i.e. Karjat-1 superior over the other genotype. Rice genotype V₃₉ i.e. Sorati (13.855) recorded significantly minimum phenol thermal index from sowing to 50% flowering stage during pooled mean over others genotypes.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of phenol thermal index from sowing to 50% flowering stage (Table 44). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₃₈ i.e. China showed significantly higher phenol thermal index (18.627) recorded from sowing to 50% flowering stage which was at par with S₁V₃₅ over other treatment combination during pooled mean.

In case of *rabi* season S₄V₃ was recorded significantly higher phenol thermal index from sowing to 50% flowering stage (19.550) which was at par with S₄V₁, S₄V₂ over other sowing date of sowing (48th MW and 52th MW) during pooled mean. However, S₂V₃₉ i.e. crop sown in S₂ date of sowing (48th MW) with Sorati was recorded significantly minimum phenol thermal index which was at par with treatment combination S₃V₃₉ and S₄V₃₉ over others genotypes.

Data regarding mean phenol thermal index from 50% flowering to maturity stage of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 45. The mean phenol thermal index from 50% flowering to maturity stage was 16.516, 15.118 and 15.817 recorded during 2020-21, 2021-22 and pooled mean respectively.

Table 43. Effect of different treatment on phenothermal index from sowing to 50% flowering of rice genotypes

Treatments	Phenothermal index from sowing to 50% flowering		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	17.268	17.549	17.409
S2 : 48 th MW	17.272	17.270	17.271
S3 : 50 th MW	17.274	17.382	17.328
S4 : 52 th MW	17.407	17.421	17.414
SE ±	0.012	0.138	0.068
C.D. at 5%	0.041	NS	NS
B) Sub plot (Varieties)			
V1: Karjat-1	17.742	18.302	18.022
V2: Karjat-3	17.742	17.776	17.759
V3: Karjat-4,	17.925	18.458	18.192
V4: Karjat-7	17.253	17.268	17.261
V5: Karjat-184	17.439	17.389	17.414
V6: Sahyadri-2	17.439	17.465	17.452
V7: Sahyadri-4	17.337	17.330	17.333
V8: Phondaghat -1	17.414	17.413	17.413
V9: Ratnagiri-1	17.303	17.332	17.318
V10: Ratnagiri-5	17.384	17.378	17.381
V11: Ratnagiri- 6	17.328	17.363	17.346
V12: Ratnagiri- 7	17.348	17.388	17.368
V13: Ratnagiri -24	17.350	17.348	17.349
V14: Ratnagiri-73	17.348	17.563	17.455
V15: Ratnagiri-711	17.229	17.251	17.240
V16: IRRI-14	17.400	17.304	17.352
V17: IRRI-15	17.408	17.398	17.403
V18: IRRI-20	17.390	17.478	17.434
V19: IRRI-21	17.380	17.368	17.374
V20: IRRI-22	17.250	17.249	17.250
V21: IRRI-27	17.220	17.259	17.240
V22: IRRI-28	17.250	17.283	17.266
V23: IRRI-34	17.368	17.350	17.359
V24: IRRI-36	17.283	17.283	17.283
V25: IRRI-47	17.323	17.303	17.313
V26: IRRI-52	17.242	17.246	17.244
V27: IRRI-53	17.220	17.242	17.231
V28: IRRI-55	17.250	17.287	17.268
V29: IRRI-62	17.250	17.284	17.267
V30: IR-35	17.250	17.283	17.267
V31: Laldodaki	17.487	17.854	17.670
V32: IR2289-6-22-5	17.483	17.849	17.666
V33: Narmada	17.477	17.793	17.635
V34: Ananda	17.273	17.295	17.284
V35: Ambpandhari	17.503	17.885	17.694
V36: Hira	17.827	17.819	17.823
V37: OR-1516-1-5-A	17.585	17.611	17.598
V38: China	17.580	18.105	17.843
V39: Sorati	13.643	14.068	13.855
V40: Mhadi	17.283	17.298	17.290
SE ±	0.019	0.145	0.073
C.D. at 5%	0.052	0.403	0.203
Interaction Effect (S x V)			
SE ±	0.038	0.317	0.146
C.D. at 5%	0.110	0.928	0.406
General Mean	17.305	17.406	17.356

S1 : 24th MW (11th-17th June)

S2 : 48th MW (26th November-2nd December)

S3 : 50th MW (10th-16th December)

S4 : 52th MW (24th-31st December)

Table 44 Interaction effect of phenol thermal index from sowing to 50% flowering on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	17.257	17.257	17.383	17.250	17.483	17.420	17.350	17.420	17.280	17.343
S2	17.257	17.257	17.383	17.250	17.483	17.420	17.350	17.420	17.280	17.417
S3	17.257	17.257	17.383	17.240	17.483	17.430	17.350	17.430	17.350	17.407
S4	19.197	19.197	19.550	17.273	17.307	17.487	17.297	17.387	17.303	17.370
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	17.360	17.387	17.347	17.387	17.183	17.390	17.380	17.390	17.380	17.250
S2	17.360	17.387	17.347	17.387	17.250	17.390	17.380	17.390	17.380	17.250
S3	17.360	17.383	17.360	17.387	17.250	17.390	17.453	17.390	17.380	17.250
S4	17.233	17.233	17.347	17.233	17.233	17.430	17.420	17.390	17.380	17.250
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	17.220	17.250	17.437	17.283	17.360	17.237	17.220	17.250	17.250	17.250
S2	17.220	17.250	17.437	17.283	17.360	17.237	17.220	17.250	17.250	17.250
S3	17.220	17.250	17.300	17.283	17.287	17.247	17.220	17.250	17.250	17.250
S4	17.220	17.250	17.300	17.283	17.287	17.247	17.220	17.250	17.250	17.250
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	17.487	17.487	17.470	17.273	17.503	17.830	17.580	17.580	13.590	17.283
S2	17.487	17.487	17.470	17.273	17.503	17.830	17.580	17.580	13.590	17.283
S3	17.487	17.480	17.483	17.273	17.503	17.823	17.590	17.580	13.697	17.283
S4	17.487	17.480	17.483	17.273	17.503	17.823	17.590	17.580	13.697	17.283
SE ±	0.038									
C.D. at 5%	0.110									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	17.257	17.247	17.350	17.287	17.460	17.457	17.377	17.447	17.370	17.363
S2	17.257	17.257	17.383	17.240	17.483	17.430	17.350	17.430	17.350	17.407
S3	19.347	17.247	19.550	17.273	17.307	17.487	17.297	17.387	17.303	17.370
S4	19.347	19.353	19.550	17.273	17.307	17.487	17.297	17.387	17.303	17.370
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	17.380	17.427	17.387	18.240	17.257	17.003	17.453	17.773	17.327	17.240
S2	17.360	17.383	17.350	17.387	17.250	17.390	17.380	17.390	17.380	17.250
S3	17.477	17.387	17.300	17.387	17.257	17.393	17.347	17.357	17.383	17.257
S4	17.237	17.353	17.353	17.237	17.240	17.430	17.413	17.390	17.380	17.250
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	17.317	17.337	17.503	17.287	17.360	17.253	17.237	17.337	17.337	17.337
S2	17.220	17.250	17.300	17.283	17.287	17.247	17.220	17.250	17.250	17.250
S3	17.280	17.293	17.297	17.280	17.280	17.237	17.290	17.310	17.300	17.297
S4	17.220	17.250	17.300	17.283	17.287	17.247	17.220	17.250	17.250	17.250
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	18.990	18.987	18.753	17.353	19.063	17.820	17.590	19.673	14.960	17.360
S2	17.487	17.483	17.483	17.273	17.503	17.823	17.590	17.580	13.643	17.283
S3	17.453	17.447	17.450	17.280	17.470	17.810	17.673	17.587	13.863	17.263
S4	17.487	17.480	17.483	17.273	17.503	17.823	17.590	17.580	13.803	17.283
SE ±	0.317									
C.D. at 5%	0.928									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	17.257	17.252	17.367	17.268	17.472	17.438	17.363	17.433	17.325	17.353
S2	17.257	17.257	17.383	17.245	17.483	17.425	17.350	17.425	17.315	17.412
S3	18.302	17.252	18.467	17.257	17.395	17.458	17.323	17.408	17.327	17.388
S4	19.272	19.275	19.550	17.273	17.307	17.487	17.297	17.387	17.303	17.370
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	17.370	17.407	17.367	17.813	17.220	17.197	17.417	17.582	17.353	17.245
S2	17.360	17.385	17.348	17.387	17.250	17.390	17.380	17.390	17.380	17.250
S3	17.418	17.385	17.330	17.387	17.253	17.392	17.400	17.373	17.382	17.253
S4	17.235	17.293	17.350	17.235	17.237	17.430	17.417	17.390	17.380	17.250
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	17.268	17.293	17.470	17.285	17.360	17.245	17.228	17.293	17.293	17.293
S2	17.220	17.250	17.368	17.283	17.323	17.242	17.220	17.250	17.250	17.250
S3	17.250	17.272	17.298	17.282	17.283	17.242	17.255	17.280	17.275	17.273
S4	17.220	17.250	17.300	17.283	17.287	17.247	17.220	17.250	17.250	17.250
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	18.238	18.237	18.112	17.313	18.283	17.825	17.585	18.627	14.275	17.322
S2	17.487	17.485	17.477	17.273	17.503	17.827	17.585	17.580	13.617	17.283
S3	17.470	17.463	17.467	17.277	17.487	17.817	17.632	17.583	13.780	17.273
S4	17.487	17.480	17.483	17.273	17.503	17.823	17.590	17.580	13.750	17.283
SE $\pm$		0.146								
C.D. at 5%		0.406								

Effect of sowing dates:

The data presented in Table 45 revealed that, the mean phenol thermal index from 50% flowering to maturity stage of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during *S₁-kharif* season (24th MW) produced significantly maximum phenol thermal index as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. General mean phenol thermal index from 50% flowering to maturity stage of both years and pooled mean were found to be 16516, 15118 and 15817, respectively.

Table 45. Effect of different treatment on Pheno thermal index from 50% flowering to maturity of rice genotypes

Treatments	Pheno thermal index from 50% flowering to maturity		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	17.487	16.923	17.205
S2 : 48 th MW	16.197	14.571	15.384
S3 : 50 th MW	16.196	14.460	15.328
S4 : 52 th MW	16.183	14.518	15.350
SE $\pm$	0.032	0.054	0.026
C.D. at 5%	0.113	0.191	0.079
B) Sub plot (Varieties)			
V1: Karjat-1	16.403	15.026	15.715
V2: Karjat-3	16.432	15.075	15.753
V3: Karjat-4,	16.420	15.073	15.747
V4: Karjat-7	16.411	15.040	15.725
V5: Karjat-184	16.303	14.830	15.567
V6: Sahyadri-2	16.427	15.088	15.758
V7: Sahyadri-4	16.436	15.101	15.768
V8: Phondaghat -1	16.441	15.108	15.775
V9: Ratnagiri-1	16.452	15.117	15.784
V10: Ratnagiri-5	16.481	15.165	15.823
V11: Ratnagiri- 6	16.482	15.156	15.819
V12: Ratnagiri- 7	16.446	13.983	15.214
V13: Ratnagiri -24	16.443	15.105	15.774
V14: Ratnagiri-73	16.355	14.946	15.650
V15: Ratnagiri-711	16.629	15.455	16.042
V16: IRRI-14	16.418	15.061	15.739
V17: IRRI-15	16.432	15.096	15.764
V18: IRRI-20	16.433	15.094	15.764
V19: IRRI-21	16.418	15.074	15.746
V20: IRRI-22	16.405	15.039	15.722
V21: IRRI-27	16.448	15.111	15.779
V22: IRRI-28	16.455	15.112	15.783
V23: IRRI-34	16.461	15.134	15.798
V24: IRRI-36	16.457	15.118	15.787
V25: IRRI-47	16.453	15.106	15.779
V26: IRRI-52	16.427	15.088	15.758
V27: IRRI-53	16.424	15.100	15.762
V28: IRRI-55	16.448	15.105	15.777
V29: IRRI-62	16.467	15.109	15.788
V30: IR-35	16.448	15.094	15.771
V31: Laldodaki	16.488	15.146	15.817
V32: IR2289-6-22-5	16.508	15.198	15.853
V33: Narmada	16.447	15.111	15.779
V34: Ananda	16.449	15.097	15.773
V35: Ambpandhari	16.468	15.092	15.780
V36: Hira	16.402	14.970	15.686
V37: OR-1516-1-5-A	16.399	14.958	15.679
V38: China	17.925	15.830	16.878
V39: Sorati	17.948	16.503	17.225
V40: Mhadi	16.451	15.097	15.774
SE $\pm$	0.039	0.184	0.094
C.D. at 5%	0.107	0.511	0.260
Interaction Effect (S x V)			
SE $\pm$	0.083	0.366	0.188
C.D. at 5%	0.239	NS	0.521
General Mean	16.516	15.118	15.817

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 : 52th MW (24th-31st December)

The rice crop sown during *rabi* season, S₂ (the 48th MW) date of sowing recorded significantly maximum phenol thermal index from 50% flowering to maturity stage (15.384) which was at par with S₃ and S₄ pooled mean. Significantly maximum phenol thermal index were recorded in S₁ (17.126) which was superior over the other date of sowing.

Effect of genotypes:

The phenol thermal index from 50% flowering to maturity stage of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 45). The rice genotype V₃₉ i.e. Sorati recorded significantly maximum phenol thermal index (17.225) from 50% flowering to maturity stage over others genotypes. Rice genotype V₁₂ i.e. Ratnagiri-6(15.214) recorded significantly minimum phenol thermal index from 50% flowering to maturity stage over others genotypes.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of phenol thermal index from 50% flowering to maturity stage (Table46). The rice crop sown S₁ i.e. *kharif* season (24th MW) with variety V₃₈ i.e. Sorati significantly higher phenol thermal index (18.882) recorded from 50% flowering to maturity stage which was at par with S₁V₃₉i.e. Sorati with treatment combination during pooled mean over others.

In case of *rabi* season S₃V₃₉ i.e. crop sown in S₃ date of sowing with Sorati (50th MW) was recorded significantly higher phenothermal index from 50% flowering to maturity stage (16.918) which was at par with S₂V₃₈(16.888) and S₂V₃₉ (16.715) ,S₃V₃₈ (16.547) over others. However, S₃V₁₂ with rice genotype Ratnagiri-24 recorded significantly minimum phenothermal index over others.

Table 46: Interaction effect of Photo-thermal index from 50% flowering to maturity on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	17.373	17.413	17.377	17.407	17.373	17.413	17.417	17.403	17.413	17.403
S2	16.080	16.100	16.083	16.083	16.027	16.100	16.103	16.133	16.133	16.160
S3	16.080	16.107	16.110	16.077	15.783	16.097	16.110	16.107	16.127	16.180
S4	16.080	16.107	16.110	16.077	16.030	16.097	16.113	16.120	16.133	16.180
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	17.410	17.417	17.417	17.223	17.433	17.403	17.417	17.417	17.390	17.373
S2	16.157	16.127	16.113	16.063	16.267	16.100	16.100	16.093	16.097	16.087
S3	16.180	16.120	16.120	16.070	16.303	16.083	16.107	16.110	16.093	16.080
S4	16.180	16.120	16.120	16.063	16.513	16.083	16.103	16.113	16.093	16.080
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	17.417	17.420	17.417	17.420	17.417	17.400	17.397	17.417	17.467	17.463
S2	16.107	16.127	16.133	16.133	16.127	16.117	16.093	16.113	16.133	16.120
S3	16.140	16.140	16.140	16.140	16.140	16.090	16.100	16.140	16.140	16.100
S4	16.127	16.133	16.153	16.133	16.127	16.100	16.107	16.123	16.127	16.107
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	17.417	17.417	17.413	17.417	17.513	17.237	17.237	19.230	19.013	17.467
S2	16.127	16.173	16.140	16.113	16.127	16.093	16.120	17.877	17.593	16.120
S3	16.220	16.220	16.100	16.140	16.120	16.140	16.130	17.763	17.590	16.113
S4	16.187	16.220	16.133	16.127	16.113	16.137	16.110	16.830	17.597	16.103
SE $\pm$		0.083								
C.D. at 5%		0.239								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	16.800	16.823	16.833	16.793	16.790	16.867	16.863	16.867	16.880	16.840
S2	14.423	14.483	14.447	14.487	14.300	14.500	14.513	14.520	14.533	14.607
S3	14.437	14.497	14.507	14.440	14.027	14.493	14.513	14.527	14.520	14.607
S4	14.443	14.497	14.507	14.440	14.203	14.493	14.513	14.520	14.533	14.607
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	16.883	16.877	16.860	16.773	16.933	16.863	16.863	16.857	16.847	16.840
S2	14.580	14.520	14.520	14.337	14.833	14.460	14.507	14.507	14.477	14.443
S3	14.580	10.013	14.520	14.337	15.027	14.460	14.507	14.507	14.487	14.437
S4	14.580	14.520	14.520	14.337	15.027	14.460	14.507	14.507	14.487	14.437
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	16.877	16.860	16.870	16.870	16.870	16.847	16.860	16.867	16.863	16.850
S2	14.513	14.520	14.560	14.533	14.513	14.500	14.500	14.520	14.527	14.507
S3	14.527	14.533	14.553	14.533	14.527	14.493	14.507	14.520	14.527	14.507
S4	14.527	14.533	14.553	14.533	14.513	14.513	14.533	14.513	14.520	14.513
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	16.890	16.890	16.837	16.870	16.860	16.770	16.770	18.533	18.030	16.863
S2	14.553	14.587	14.507	14.513	14.507	14.353	14.353	15.900	15.837	14.533
S3	14.640	14.660	14.533	14.527	14.513	14.387	14.367	15.330	16.247	14.513
S4	14.500	14.653	14.567	14.477	14.487	14.370	14.343	13.557	15.897	14.477
SE $\pm$		0.366								
C.D. at 5%		NS								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	17.087	17.118	17.105	17.100	17.082	17.140	17.140	17.135	17.147	17.122
S2	15.252	15.292	15.265	15.285	15.163	15.300	15.308	15.327	15.333	15.383
S3	15.258	15.302	15.308	15.258	14.905	15.295	15.312	15.317	15.323	15.393
S4	15.262	15.302	15.308	15.258	15.117	15.295	15.313	15.320	15.333	15.393
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	17.147	17.147	17.138	16.998	17.183	17.133	17.140	17.137	17.118	17.107
S2	15.368	15.323	15.317	15.200	15.550	15.280	15.303	15.300	15.287	15.265
S3	15.380	13.067	15.320	15.203	15.665	15.272	15.307	15.308	15.290	15.258
S4	15.380	15.320	15.320	15.200	15.770	15.272	15.305	15.310	15.290	15.258
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	17.147	17.140	17.143	17.145	17.143	17.123	17.128	17.142	17.165	17.157
S2	15.310	15.323	15.347	15.333	15.320	15.308	15.297	15.317	15.330	15.313
S3	15.333	15.337	15.347	15.337	15.333	15.292	15.303	15.330	15.333	15.303
S4	15.327	15.333	15.353	15.333	15.320	15.307	15.320	15.318	15.323	15.310
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	17.153	17.153	17.125	17.143	17.187	17.003	17.003	18.882	18.522	17.165
S2	15.340	15.380	15.323	15.313	15.317	15.223	15.237	16.888	16.715	15.327
S3	15.430	15.440	15.317	15.333	15.317	15.263	15.248	16.547	16.918	15.313
S4	15.343	15.437	15.350	15.302	15.300	15.253	15.227	15.193	16.747	15.290
SE $\pm$		0.188								
C.D. at 5%		0.521								

4.3. Leaf gas exchange observations:

4.3.1. Rate of photosynthesis ($\mu\text{mol Co}_2^{-1}\text{m}^2\text{sec}^{-1}$):

Data on rate of photosynthesis of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 47. The general mean rate of photosynthesis was 15.088, 15.596, 15.342, 19.435, 17.829, 18.632, 17.20, 15.616 and 16.409 $\mu\text{molCo}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ recorded at tillering, flowering and harvesting during 2020-21, 2021-22 and pooled mean respectively

Effect of sowing dates:

The data presented in Table 47 revealed that, the mean rate of photosynthesis of rice at different stages of crop growth was significantly influenced due to different sowing dates.

At tillering stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum rate of photosynthesis 13.34 $\mu\text{mol Co}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW) during pooled mean. The rice crop sown during *rabi* season, the S₃ i.e. 50th MW date of sowing recorded significantly higher rate of photosynthesis 16.29 $\mu\text{mol Co}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ as compared to crop sown during S₂ i.e. 48th MW and S₄ i.e. 52th MW during pooled mean.

At flowering stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum rate of photosynthesis 16.69 $\mu\text{mol Co}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW) during pooled mean. The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher rate of photosynthesis 19.54 $\mu\text{mol Co}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ which was at par with S₃ i.e. 50th MW date of sowing 19.53 $\mu\text{mol Co}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ during pooled mean over others.

At harvesting stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum rate of photosynthesis 14.46 $\mu\text{mol Co}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW) during pooled mean. The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher rate of photosynthesis 17.32 $\mu\text{mol Co}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ which was at par with S₃ i.e. 50th MW date of sowing 17.30 $\mu\text{mol Co}_2^{-1}\text{m}^{-2}\text{sec}^{-1}$ during pooled mean.

Effect of genotypes:

The rate of photosynthesis of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 47).

Table 47. Effect of different treatment on rate of photosynthesis ($\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) of rice genotypes

Treatments	Rate of photosynthesis ($\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)									
S1 : 24 th MW	12.99	13.69	13.34	17.46	15.92	16.69	15.23	13.69	14.46
S2 : 48 th MW	15.76	15.54	15.65	19.78	17.77	18.77	17.55	15.57	16.56
S3 : 50 th MW	15.99	16.59	16.29	20.21	18.84	19.53	17.97	16.63	17.30
S4 :52 th MW	15.61	16.57	16.09	20.29	18.79	19.54	18.07	16.58	17.32
SE $\pm$	0.176	0.197	0.136	0.156	0.187	0.130	0.159	0.189	0.135
C.D. at 5%	0.609	0.683	0.472	0.540	0.648	0.449	0.549	0.653	0.466
B) Sub plot (Varieties)									
V1:Karjat-1	13.71	14.39	14.05	19.12	16.70	17.91	16.81	14.61	15.71
V2:Karjat-3	15.30	12.80	14.05	22.63	15.00	18.81	20.43	12.80	16.61
V3:Karjat-4,	14.40	13.96	14.18	17.23	16.16	16.69	15.03	14.03	14.53
V4:Karjat-7	15.08	15.08	15.08	18.54	17.29	17.92	16.32	15.05	15.69
V5:Karjat-184	14.56	15.82	15.19	19.39	18.01	18.70	17.20	15.85	16.52
V6:Sahyadri-2	15.36	17.11	16.23	23.62	19.36	21.49	21.37	17.13	19.25
V7:Sahyadri-4	16.55	15.22	15.88	23.95	17.44	20.69	21.73	14.97	18.35
V8:Phondaghat -1	16.09	15.98	16.04	19.56	18.24	18.90	17.30	16.01	16.66
V9:Ratnagiri-1	15.37	16.14	15.75	19.25	18.32	18.78	17.08	16.13	16.60
V10:Ratnagiri-5	13.64	14.35	13.99	16.97	16.67	16.82	14.66	14.44	14.55
V11:Ratnagiri- 6	15.01	15.29	15.15	19.15	17.52	18.33	16.92	15.28	16.10
V12:Ratnagiri- 7	16.39	16.66	16.53	20.83	18.95	19.89	18.54	16.74	17.64
V13:Ratnagiri -24	14.67	13.77	14.22	18.62	15.78	17.20	16.61	13.70	15.16
V14:Ratnagiri-73	14.80	16.35	15.57	22.43	18.65	20.54	20.13	16.52	18.32
V15:Ratnagiri-711	14.75	15.41	15.08	19.13	17.69	18.41	16.84	15.51	16.18
V16:IRRI-14	12.96	15.31	14.14	16.73	17.65	17.19	14.39	15.42	14.90
V17:IRRI-15	15.16	15.75	15.45	19.27	17.92	18.60	17.10	15.76	16.43
V18:IRRI-20	15.98	15.41	15.69	20.39	17.61	19.00	18.19	15.41	16.80
V19:IRRI-21	14.25	16.46	15.35	17.61	18.73	18.17	15.35	16.53	15.94
V20:IRRI-22	14.18	16.69	15.44	17.75	18.91	18.33	15.53	16.68	16.10
V21:IRRI-27	15.74	15.16	15.45	20.48	17.39	18.93	18.25	15.19	16.72
V22:IRRI-28	13.64	14.92	14.28	17.32	17.15	17.23	15.08	14.97	15.02
V23:IRRI-34	14.08	15.52	14.80	18.14	17.70	17.92	15.96	15.53	15.74
V24:IRRI-36	14.93	15.95	15.44	18.38	18.11	18.24	16.21	15.95	16.08
V25:IRRI-47	16.47	16.31	16.39	20.66	18.50	19.58	18.48	16.34	17.41
V26:IRRI-52	15.50	16.02	15.76	20.08	18.19	19.13	17.91	15.99	16.95
V27:IRRI-53	13.71	16.15	14.93	16.97	18.30	17.64	14.82	16.12	15.47
V28:IRRI-55	14.38	16.16	15.27	18.14	18.33	18.24	15.96	16.13	16.04
V29:IRRI-62	14.86	15.10	14.98	19.44	17.27	18.36	17.27	14.98	16.13
V30:IR-35	16.29	16.60	16.45	19.63	18.79	19.21	17.44	16.53	16.99
V31:Laldodaki	15.58	16.06	15.82	19.41	18.28	18.84	17.20	15.98	16.59
V32:IR2289-6-22-5	15.85	16.54	16.20	19.89	18.73	19.31	17.71	16.50	17.10
V33:Narmada	14.36	15.85	15.10	18.13	18.12	18.13	15.87	15.97	15.92
V34:Ananda	15.72	14.90	15.31	19.40	17.21	18.31	17.10	15.03	16.06
V35:Ambpandhari	15.56	15.62	15.59	19.32	17.92	18.62	17.02	15.73	16.38
V36:Hira	15.37	14.29	14.83	18.53	16.36	17.44	16.46	14.15	15.31
V37:OR-1516-1-5-A	16.08	14.92	15.50	20.43	17.41	18.92	17.95	15.21	16.58
V38:China	16.01	15.65	15.83	19.75	17.75	18.75	17.65	15.47	16.56
V39:Sorati	14.23	16.78	15.50	19.42	19.09	19.26	17.11	16.81	16.96
V40:Mhadi	15.75	16.25	16.00	20.15	18.65	19.40	17.75	16.39	17.07
SE $\pm$	0.546	0.561	0.404	0.565	0.563	0.415	0.564	0.565	0.414
C.D. at 5%	1.519	1.561	1.125	1.572	1.567	1.154	1.568	1.573	1.151
Interaction Effect (S x M)									
SE $\pm$	1.092	1.122	0.809	1.130	1.127	0.830	1.127	1.131	0.827
C.D. at 5%	3.038	3.122	2.250	3.145	3.135	2.309	3.137	3.145	2.302
General Mean	15.088	15.596	15.342	19.435	17.829	18.632	17.202	15.616	16.409

S1 : 24th MW (11th-17th June)
S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)
S4 :52th MW (24th-31st December)

At tillering stage, the rice genotype V₁₂ i.e. Ratnagiri-7 recorded significantly higher rate of photosynthesis (16.53 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) which was at par with V₆, V₇, V₈, V₉, V₁₂, V₁₄, V₁₇, V₁₈, V₂₀, V₂₄, V₂₅, V₂₆, V₃₀, V₃₁, V₃₂, V₃₅ and V₃₇ and over others. Significantly lower rate of photosynthesis was recorded V₁ i.e. Karjat-1 and V₂ i.e. Karjat-3 (14.05 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) which was at par with V₃, V₄, V₁₀, V₁₁, V₁₃, V₁₆, V₂₂, V₂₃, V₂₇, V₂₉, V₃₃, V₃₆ over others.

At flowering stage, the rice genotype V₆ i.e. Sahyadri-2 recorded significantly higher rate of photosynthesis (21.49 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) which was at par with V₇ i.e. Sahyadri-4 (20.69 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₁₄ i.e. (20.54 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) and over others. Significantly lower rate of photosynthesis was recorded V₃ i.e. Karjat -4 (16.69 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) which was at par with V₁ i.e. Karjat-1 (17.91 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₅ i.e. Karjat-184 (17.92 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₁₀ i.e. Ratnagiri-5 (16.82 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₁₃ i.e. Ratnagiri-24 (17.20 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₁₆ i.e. IRRI-14 (17.19 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₁₉ i.e. IRRI-21 (18.17 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₂₂ i.e. IRRI -28 (17.44 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₂₃ i.e. IRRI -28 (17.92 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₂₄ i.e. IRRI -28 (18.24 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₂₇ i.e. IRRI-28 (17.56 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₂₈ i.e. IRRI -28 (18.24 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$), V₁₃ i.e. Narmada, V₃₆ i.e. Hira (17.44 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) over others.

At harvesting stage, the rice genotype V₆ i.e. Sahyadri-2 recorded significantly higher rate of photosynthesis (19.25 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) which was at par with V₇ i.e. Sahyadri-4 (18.35 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) and V₁₄ i.e. Ratnagiri-73 (18.32 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) over others. Significantly lower rate of photosynthesis was recorded V₁ i.e. Karjat-1 and V₁₆ i.e. IRRI-14 (14.90 $\mu\text{molCo}_2\text{m}^{-2}\text{Sec}^{-1}$) which was at par with V₁, V₄, V₁₀, V₁₃, V₁₆, V₁₉, V₂₂, V₂₃, V₂₄, V₂₇, V₂₈, V₃₆ over others.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of rate of photosynthesis (Table 48). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype with V₆ i.e. Sahyadri-2 recorded significantly higher rate of photosynthesis (17.83

Table48 : Interaction effect of rate of photosynthesis (($\mu\text{molCo}_2\text{m}^{-2}\text{sec}^{-1}$)) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	15.68	18.06	16.61	16.72	12.34	19.66	18.89	13.96	15.82	18.13
S2	17.37	20.93	16.02	17.43	16.77	21.00	22.63	17.67	17.40	12.93
S3	16.22	21.08	14.38	14.90	20.01	22.54	22.68	16.86	18.94	14.77
S4	17.99	21.63	13.10	16.25	19.67	22.27	22.72	20.73	16.15	12.79
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	15.46	17.46	16.70	18.04	16.38	12.13	15.97	17.41	11.97	13.07
S2	17.95	17.73	17.80	19.90	16.67	14.00	20.37	18.97	16.43	15.35
S3	19.20	17.95	17.13	21.55	18.57	17.66	15.49	19.44	15.43	18.01
S4	15.08	21.00	20.35	21.01	15.76	13.77	16.56	16.94	17.55	15.67
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	17.45	13.58	16.00	12.10	15.95	17.46	13.41	12.12	15.44	13.34
S2	18.57	16.67	17.90	16.90	17.79	18.00	14.30	16.75	15.50	18.73
S3	18.80	13.64	15.27	20.50	20.87	18.67	13.51	15.99	17.27	17.06
S4	18.20	16.44	14.68	15.33	19.31	17.51	18.07	18.99	20.87	20.64
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	16.41	14.57	11.56	14.10	11.66	11.13	15.89	15.59	16.22	14.61
S2	16.10	17.05	17.50	18.40	18.60	18.79	19.50	15.83	14.35	19.27
S3	18.13	19.03	16.45	18.42	18.54	17.97	19.16	19.64	18.97	18.06
S4	18.15	20.18	17.95	17.46	19.28	17.95	17.25	19.52	18.89	19.08
SE $\pm$		1.115								
C.D. at 5%		3.128								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	15.60	11.70	13.20	11.67	10.97	16.00	12.83	13.27	15.60	12.73
S2	14.10	11.63	11.60	16.47	17.63	17.63	13.63	17.13	17.47	13.50
S3	13.97	15.67	15.20	16.10	19.47	18.63	16.07	16.03	17.40	16.60
S4	14.77	12.20	16.10	15.97	15.33	16.27	17.33	17.60	14.03	14.93
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	13.87	16.00	13.47	14.37	15.70	14.73	13.50	14.13	13.20	14.03
S2	14.43	16.20	11.37	18.33	12.03	12.83	15.10	16.07	15.70	16.53
S3	16.67	18.73	16.77	16.90	17.63	18.33	17.30	15.43	18.03	16.97
S4	16.17	16.03	17.77	16.47	16.67	15.77	17.13	16.00	19.17	19.20
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	13.17	14.50	12.27	12.87	16.73	13.20	14.43	14.67	12.80	16.23
S2	15.73	13.57	14.63	16.10	16.53	18.67	17.67	15.33	13.87	16.20
S3	15.57	15.97	17.90	18.70	15.77	16.77	15.90	16.60	17.27	17.83
S4	16.30	15.83	17.30	16.13	16.33	15.33	16.47	17.90	16.00	15.87
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	13.33	12.57	11.80	13.40	11.80	13.80	12.93	13.53	14.33	12.73
S2	16.03	17.37	18.40	16.43	16.93	12.93	15.47	14.60	17.93	18.83
S3	15.50	17.83	16.93	13.60	15.80	14.23	16.80	14.77	16.53	17.07
S4	19.07	18.23	16.73	16.70	18.40	15.63	15.63	18.97	18.43	16.93
SE $\pm$		1.137								
C.D. at 5%		3.196								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	15.64	14.88	14.91	14.19	11.66	17.83	15.86	13.61	15.71	15.43
S2	15.73	16.28	13.81	16.95	17.20	19.32	18.13	17.40	17.43	13.22
S3	15.09	18.37	14.79	15.50	19.74	20.59	19.37	16.45	18.17	15.69
S4	16.38	16.92	14.60	16.11	17.50	19.27	20.03	19.16	15.09	13.86
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	14.66	16.73	15.08	16.20	16.04	13.43	14.74	15.77	12.58	13.55
S2	16.19	16.97	14.58	19.12	14.35	13.42	17.73	17.52	16.07	15.94
S3	17.94	18.34	16.95	19.23	18.10	18.00	16.40	17.44	16.73	17.49
S4	15.62	18.52	19.06	18.74	16.21	14.77	16.85	16.47	18.36	17.44
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	15.31	14.04	14.13	12.48	16.34	15.33	13.92	13.39	14.12	14.79
S2	17.15	15.12	16.27	16.50	17.16	18.33	15.98	16.04	14.68	17.47
S3	17.18	14.80	16.58	19.60	18.32	17.72	14.70	16.29	17.27	17.45
S4	17.25	16.14	15.99	15.73	17.82	16.42	17.27	18.45	18.43	18.25
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	14.87	13.57	11.68	13.75	11.73	12.47	14.41	14.56	15.28	13.67
S2	16.07	17.21	17.95	17.42	17.77	15.86	17.48	15.22	16.14	19.05
S3	16.82	18.43	16.69	16.01	17.17	16.10	17.98	17.21	17.75	17.56
S4	18.61	19.21	17.34	17.08	18.84	16.79	16.44	19.25	18.66	18.01
SE $\pm$		0.794								
C.D. at 5%		2.205								

$\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) which was at par with S₁V₆, S₁V₇, S₁V₈, S₁V₉, S₁V₁₂, S₁V₁₄, S₁V₁₇, S₁V₁₈, S₁V₂₀ over others.

In case of *rabi* season S₃V₆ i.e. crop sown S₃ date of sowing (50th MW) with rice genotype V₆ i.e. Sahyadri-2 recorded significantly higher rate of photosynthesis ($20.59 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) over others. Interaction S₂V₁₆ i.e. IRRI-14 recorded lowest rate of photosynthesis ($13.14 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$).

4.3.2. Leaf transpiration rate ($\mu\text{mol H}_2\text{O m}^{-2} \text{sec}^{-1}$):

Data on leaf transpiration rate of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the

data are presented in Table 49. The mean leaf transpiration rate was recorded 4.374, 4.315, 4.344 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ and 6.178, 6.121, 6.149 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ and 6.133, 6.062, 6.098 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 49 revealed that, the mean leaf transpiration rate of rice at different stages of crop growth was significantly influenced due to different sowing dates.

Crop sown during *kharif* season i.e. S₁(24th MW) produced significantly minimum rate of leaf transpiration 3.78 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂(48th MW), S₃ (50th MW) and S₄ (52th MW) during pooled mean.

The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf transpiration rate 4.71 ($\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) at tillering stage as compared to crop sown during S₂ i.e. 48th MW and S₃ i.e. 50th MW in pooled mean. Significantly lower leaf transpiration rate was recorded S₂ (4.38 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) as compared to other sowing of *rabi* season dates S₃ and S₄.

At flowering stage, crop sown during *kharif* season i.e. S₁(24th MW) produced significantly minimum rate of leaf transpiration 5.61 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂(48th MW), S₃ (50th MW) and S₄ (52th MW) during pooled mean.

The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf transpiration rate 6.51 ($\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) at flowering stage as compared to crop sown during S₃ i.e. 50th MW and S₂ i.e. 48th MW in pooled mean. Significantly lower leaf transpiration rate was recorded S₂ (6.20 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) as compared to other sowing of *rabi* season dates S₃ and S₄.

At harvesting stage, crop sown during *kharif* season i.e. S₁(24th MW) produced significantly minimum rate of leaf transpiration 5.48 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂(48th MW), S₃ (50th MW) and S₄ (52th MW) during pooled mean.

Table 49. Effect of different treatment on leaf transpiration rate ($\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) of rice genotypes

Treatments	Leaf transpiration rate ($\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)									
S1 : 24 th MW	3.74	3.82	3.78	5.56	5.66	5.61	5.53	5.42	5.48
S2 : 48 th MW	4.44	4.32	4.38	6.23	6.18	6.20	6.17	6.18	6.17
S3 : 50 th MW	4.57	4.46	4.51	6.33	6.21	6.27	6.27	6.21	6.24
S4 : 52 th MW	4.75	4.67	4.71	6.59	6.44	6.51	6.56	6.44	6.50
SE $\pm$	0.078	0.042	0.045	0.091	0.058	0.054	0.090	0.048	0.047
C.D. at 5%	0.271	0.145	0.154	0.315	0.202	0.187	0.311	0.166	0.162
B) Sub plot (Varieties)									
V1:Karjat-1	4.07	3.74	3.90	5.93	5.59	5.76	5.81	5.52	5.67
V2:Karjat-3	4.42	4.33	4.38	6.26	6.22	6.24	6.20	6.16	6.18
V3:Karjat-4,	4.82	4.73	4.78	6.77	6.47	6.62	6.73	6.42	6.57
V4:Karjat-7	4.58	4.28	4.43	6.36	5.65	6.01	6.35	5.60	5.98
V5:Karjat-184	4.00	4.26	4.13	5.82	6.14	5.98	5.80	6.09	5.95
V6:Sahyadri-2	4.37	4.07	4.22	6.22	5.80	6.01	6.18	5.75	5.97
V7:Sahyadri-4	4.21	3.62	3.92	5.84	5.57	5.70	5.82	5.52	5.67
V8:Phondaghat -1	4.31	4.33	4.32	6.17	6.12	6.15	6.17	6.07	6.12
V9:Ratnagiri-1	4.36	4.05	4.21	6.19	5.84	6.01	6.17	5.80	5.98
V10:Ratnagiri-5	4.52	4.34	4.43	6.41	6.31	6.36	6.35	6.27	6.31
V11:Ratnagiri- 6	4.41	4.48	4.45	6.09	6.27	6.18	6.03	6.22	6.13
V12:Ratnagiri- 7	4.57	3.88	4.23	6.36	5.75	6.05	6.33	5.71	6.02
V13:Ratnagiri -24	3.99	4.02	4.00	5.57	5.78	5.68	5.55	5.76	5.66
V14:Ratnagiri-73	4.17	4.54	4.35	5.98	6.31	6.15	5.96	6.29	6.13
V15:Ratnagiri-711	4.13	4.40	4.26	6.05	6.19	6.12	5.97	6.13	6.05
V16:IRRI-14	4.10	4.02	4.06	5.85	5.87	5.86	5.79	5.84	5.81
V17:IRRI-15	4.77	4.39	4.58	6.64	6.33	6.49	6.59	6.27	6.43
V18:IRRI-20	4.06	4.35	4.21	6.02	6.24	6.13	5.98	6.19	6.08
V19:IRRI-21	3.50	3.94	3.72	5.28	5.85	5.57	5.23	5.80	5.51
V20:IRRI-22	3.96	4.28	4.12	5.72	6.19	5.95	5.66	6.12	5.89
V21:IRRI-27	3.89	4.01	3.95	5.83	5.75	5.79	5.81	5.70	5.76
V22:IRRI-28	4.60	4.13	4.37	6.51	5.84	6.17	6.49	5.78	6.13
V23:IRRI-34	4.37	4.11	4.24	6.05	6.03	6.04	6.04	5.99	6.01
V24:IRRI-36	4.73	4.58	4.65	6.56	6.14	6.35	6.54	6.09	6.32
V25:IRRI-47	4.13	4.62	4.38	5.97	6.43	6.20	5.88	6.38	6.13
V26:IRRI-52	4.23	4.44	4.34	6.11	6.32	6.21	6.00	6.27	6.14
V27:IRRI-53	4.24	4.73	4.49	6.06	6.49	6.27	6.04	6.44	6.24
V28:IRRI-55	4.36	4.09	4.23	6.10	4.93	5.51	6.04	4.87	5.45
V29:IRRI-62	4.24	4.21	4.23	5.56	6.06	5.81	5.54	6.00	5.77
V30:IR-35	4.67	4.43	4.55	6.53	6.32	6.42	6.43	6.27	6.35
V31:Laldodaki	4.92	4.57	4.74	6.74	6.48	6.61	6.64	6.43	6.53
V32:IR2289-6-22-5	4.33	4.66	4.50	6.18	6.50	6.34	6.16	6.44	6.30
V33:Narmada	4.56	4.66	4.61	6.40	6.54	6.47	6.38	6.33	6.36
V34:Ananda	5.01	4.40	4.71	6.86	6.29	6.57	6.84	6.02	6.43
V35:Ambpandhari	4.69	4.35	4.52	6.46	6.18	6.32	6.44	6.13	6.29
V36:Hira	4.79	4.28	4.53	6.62	6.08	6.35	6.53	6.05	6.29
V37:OR-1516-1-5-A	4.41	4.42	4.41	6.36	6.41	6.38	6.32	6.34	6.33
V38:China	4.30	4.25	4.28	5.76	6.07	5.92	5.69	6.02	5.86
V39:Sorati	4.71	4.57	4.64	6.51	6.35	6.43	6.46	6.30	6.38
V40:Mhadi	4.13	4.69	4.41	5.98	6.66	6.32	5.96	6.60	6.28
SE $\pm$	0.176	0.181	0.127	0.208	0.204	0.145	0.210	0.208	0.148
C.D. at 5%	0.489	0.505	0.353	0.577	0.569	0.403	0.583	0.578	0.412
Interaction Effect (S x M)									
SE $\pm$	0.352	0.363	0.254	0.415	0.409	0.290	0.419	0.416	0.296
C.D. at 5%	0.979	1.010	0.706	1.155	1.138	0.806	1.166	1.156	0.823
General Mean	4.374	4.315	4.344	6.178	6.121	6.149	6.133	6.062	6.098

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 : 52th MW (24th-31st December)

The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf transpiration rate 6.50 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ at harvesting stage as compared to crop sown during S₃ i.e. 50th MW and S₂ i.e. 48th MW in pooled mean. Significantly lower leaf transpiration rate was recorded S₂ (6.17 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) as compared to other sowing of *rabi* season dates S₃ and S₄.

Effect of genotypes:

The leaf transpiration rate of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 49). At tillering stage, the rice genotype V₃ i.e. Karjat-4 recorded significantly higher leaf transpiration rate (4.78 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) which was at par with V₂, V₄, V₈, V₁₀, V₁₁, V₁₄, V₁₅, V₁₇, V₂₂, V₂₄, V₂₅, V₂₆, V₂₇, V₃₀, V₃₀, V₃₁, V₃₂, V₃₃, V₃₄, V₃₅, V₃₆, V₃₇, V₃₈, V₃₉ and V₄₀. The rice genotype V₃ i.e. Karjat-4 recorded significantly higher leaf transpiration rate (6.62 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) at flowering stage which was at par with V₂, V₃, V₁₀, V₁₇, V₂₄, V₂₇, V₃₀, V₃₁, V₃₂, V₃₃, V₃₄, V₃₅, V₃₆, V₃₇, V₃₈, V₃₉ and V₄₀. The rice genotype V₃ i.e. Karjat-4 recorded significantly higher leaf transpiration rate (6.57 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) at harvesting stage which was at par with V₂, V₁₀, V₁₇, V₂₄, V₂₇, V₃₀, V₃₁, V₃₂, V₃₃, V₃₄, V₃₅, V₃₆, V₃₇, V₃₉ and V₄₀. Significantly lower leaf transpiration rate was recorded V₂₈ i.e. IRRI-55 (5.45 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$).

Interaction effect:

Interaction effect between sowing dates and genotype was significant in respect of leaf transpiration rate (Table 50). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₉ i.e. Ratnagiri-1 recorded significantly higher leaf transpiration rate (6.19 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) at harvesting stage over others treatment combinations during pooled mean.

In case of *rabi* season S₂ V₁₁ i.e. crop sown S₂ date of sowing (48th MW) with rice genotype V₁₁ i.e. Ratnagiri-6 recorded significantly higher leaf transpiration rate (6.69 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) over others. Interaction S₄ V₄ V₄ i.e. Karjat-7 recorded lowest leaf transpiration rate (3.12 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$).

Table 50: Interaction effect of Leaf transpiration rate ($\mu\text{mol H}_2\text{O m}^{-2} \text{sec}^{-1}$) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	4.74	3.06	2.69	3.18	3.97	4.68	4.55	3.79	5.91	5.07
S2	4.17	5.57	4.93	4.80	2.63	9.87	5.13	6.50	4.73	5.37
S3	4.48	4.98	7.07	4.66	4.80	5.40	3.18	5.12	3.90	5.20
S4	3.23	3.44	4.79	3.54	3.89	4.23	3.75	3.71	3.75	3.10
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	5.06	5.92	5.91	4.60	4.10	4.45	4.22	5.41	3.17	4.39
S2	8.07	5.50	4.67	6.33	4.10	5.43	4.36	4.00	5.12	4.22
S3	5.00	5.32	5.79	4.32	4.27	2.85	5.04	4.66	4.98	4.73
S4	3.99	3.16	3.23	3.25	3.69	4.24	4.59	3.76	3.51	3.18
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	4.03	3.96	3.50	4.14	3.89	4.30	3.88	3.26	3.08	5.09
S2	5.10	5.45	4.50	3.59	4.60	6.13	4.43	5.00	5.67	5.23
S3	3.80	6.15	5.17	4.52	4.79	6.73	4.09	6.15	5.85	4.90
S4	3.68	4.63	4.67	4.90	3.51	3.53	3.86	4.20	4.37	3.41
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.79	5.63	3.32	4.48	5.39	5.12	4.14	5.17	4.09	5.46
S2	5.37	4.53	5.00	5.83	5.10	5.17	7.33	5.70	5.50	6.23
S3	4.61	5.40	5.47	5.57	5.20	4.04	4.90	4.08	5.17	4.62
S4	4.06	3.75	4.96	5.27	3.01	4.47	3.57	3.66	3.04	3.33
SE $\pm$		0.702								
C.D. at 5%		1.969								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	2.83	4.89	4.92	3.48	5.13	5.35	4.37	3.88	6.47	4.90
S2	4.82	5.23	3.86	5.99	5.50	6.08	5.13	4.70	5.49	7.07
S3	4.74	3.42	5.12	5.62	5.41	4.27	5.14	4.76	4.32	4.68
S4	2.57	2.47	5.04	2.69	3.00	4.59	2.85	3.64	2.93	3.71
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	4.27	5.46	3.63	4.42	6.29	2.69	4.76	5.38	5.52	3.84
S2	5.31	4.37	5.75	6.13	4.34	5.58	3.99	4.13	6.13	4.67
S3	4.23	4.46	5.35	5.83	5.30	3.78	5.22	5.83	3.78	4.30
S4	5.46	3.56	4.02	3.78	3.01	3.69	4.25	4.74	3.00	3.65
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	4.17	3.99	4.67	3.70	5.27	3.65	5.22	3.63	5.29	3.38
S2	4.97	4.66	4.88	4.67	4.15	3.75	4.73	4.60	5.06	4.15
S3	4.02	5.10	4.33	4.49	4.20	4.80	5.42	3.46	4.08	5.38
S4	3.21	3.76	3.54	4.45	4.85	4.24	4.88	3.03	4.07	3.82
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.24	3.92	4.42	4.45	5.18	5.22	4.56	3.85	5.26	5.09
S2	4.76	5.47	5.82	5.61	6.18	3.68	4.77	5.21	4.15	4.76
S3	3.92	5.16	4.08	4.93	4.21	3.92	4.37	4.67	5.43	5.20
S4	4.02	4.07	4.30	4.28	3.16	4.28	3.98	3.62	3.76	4.70
SE $\pm$		0.676								
C.D. at 5%		NS								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	3.79	3.97	3.81	3.33	4.55	5.02	4.46	3.84	6.19	4.99
S2	4.49	5.40	4.40	5.39	4.07	7.97	5.13	5.60	5.11	6.22
S3	4.61	4.20	6.09	5.14	5.11	4.84	4.16	4.94	4.11	4.94
S4	3.40	3.46	4.91	3.12	3.94	4.41	3.30	3.18	3.34	3.40
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	4.67	5.69	4.77	4.51	5.20	3.57	4.49	5.40	4.35	4.12
S2	6.69	4.93	5.21	6.23	4.22	5.50	4.17	4.07	5.63	4.45
S3	4.62	4.89	5.57	5.08	4.79	3.32	5.13	5.25	4.38	4.52
S4	4.22	3.36	3.63	3.52	3.35	3.97	4.42	4.25	3.76	3.42
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	4.10	3.98	4.09	3.92	4.58	3.98	4.55	3.45	4.19	4.23
S2	5.04	5.06	4.69	4.13	4.37	4.94	4.58	4.80	5.37	4.69
S3	3.91	5.63	4.75	4.51	4.49	5.76	4.75	4.81	4.97	5.14
S4	3.95	4.20	4.10	4.68	3.68	3.88	4.37	3.61	4.22	3.62
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.52	4.78	3.87	4.47	5.28	5.17	4.35	4.51	4.68	5.27
S2	5.06	5.00	5.41	5.72	5.64	4.42	6.05	5.46	4.82	5.50
S3	4.27	5.28	4.77	5.25	4.71	3.98	4.63	4.38	5.30	4.91
S4	4.04	3.41	4.63	4.78	3.08	4.38	3.78	3.64	3.40	4.01
SE $\pm$		0.489								
C.D. at 5%		1.359								

4.3.3. Leaf canopy temperature (°C):

Data on leaf canopy temperature (°C) of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 51. The mean leaf canopy temperature was 35.713, 35.875, 35.794, 37.601, 37.773, 37.687, 38.390, 38.554 and 38.194°C recorded during 2020-21, 2021-22 and pooled mean at tillering, flowering and harvesting respectively.

Effect of sowing dates:

The data presented in Table 51 revealed that, the mean leaf canopy temperature of rice at different stages of crop growth was significantly influenced due to different sowing dates.

Table 51.Effect of different treatment on Leaf canopy temperature (°C)of rice genotypes

Treatments	Leaf canopy temperature (°C)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)									
S1 : 24 th MW	33.957	34.779	34.368	36.474	37.137	36.806	37.116	36.474	36.795
S2 : 48 th MW	36.446	35.319	35.883	38.305	36.977	37.641	38.258	38.034	38.146
S3 : 50 th MW	36.063	36.436	36.250	37.696	38.386	38.041	37.070	37.898	37.490
S4 :52 th MW	36.387	36.966	36.676	37.928	38.591	38.259	38.271	38.238	38.254
SE ±	0.260	0.250	0.134	0.178	0.294	0.151	0.137	0.135	0.110
C.D. at 5%	0.901	0.865	0.464	0.614	1.018	0.522	0.474	0.468	0.382
B)Sub plot (Varieties)									
V1:Karjat-1	36.312	36.959	36.635	38.228	38.543	38.385	37.143	37.473	37.368
V2:Karjat-3	36.143	36.335	36.239	37.727	38.002	37.864	37.853	38.093	37.973
V3:Karjat-4,	35.501	36.471	35.986	37.251	38.138	37.694	37.946	37.560	37.753
V4:Karjat-7	35.210	35.817	35.513	37.043	37.483	37.263	37.511	38.318	37.915
V5:Karjat-184	36.036	35.944	35.990	38.036	37.778	37.907	37.418	37.284	37.351
V6:Sahyadri-2	36.425	36.489	36.457	38.342	37.989	38.165	37.232	37.938	37.585
V7:Sahyadri-4	36.049	36.005	36.027	38.049	37.505	37.777	37.054	37.518	37.286
V8:Phondaghat -1	36.164	35.900	36.032	38.414	37.900	38.157	37.044	37.297	37.170
V9:Ratnagiri-1	36.453	36.156	36.304	38.619	38.073	38.346	37.589	37.585	37.587
V10:Ratnagiri-5	35.886	35.215	35.550	37.469	37.298	37.384	37.547	37.542	37.544
V11:Ratnagiri- 6	35.989	36.504	36.247	37.573	38.421	37.997	37.273	37.232	37.253
V12:Ratnagiri- 7	36.085	37.108	36.597	38.168	39.192	38.680	37.303	37.091	37.197
V13:Ratnagiri -24	33.605	33.549	33.577	35.297	35.549	35.423	35.055	34.715	34.885
V14:Ratnagiri-73	36.144	36.368	36.256	38.144	37.951	38.048	37.401	38.833	38.117
V15:Ratnagiri-711	35.513	36.476	35.994	37.096	38.559	37.828	38.477	38.497	38.487
V16:IRRI-14	35.235	36.437	35.836	37.068	38.770	37.919	37.614	38.328	37.971
V17:IRRI-15	35.361	36.525	35.943	37.111	38.775	37.943	37.960	38.413	38.187
V18:IRRI-20	35.109	36.158	35.634	36.776	38.242	37.509	37.443	38.447	37.945
V19:IRRI-21	35.987	36.105	36.046	38.320	38.272	38.296	38.375	38.269	38.322
V20:IRRI-22	35.948	35.018	35.483	37.782	37.102	37.442	37.998	38.771	38.384
V21:IRRI-27	36.226	35.009	35.618	37.976	37.176	37.576	37.807	37.543	37.675
V22:IRRI-28	35.962	36.379	36.170	37.795	38.629	38.212	37.429	38.473	37.951
V23:IRRI-34	35.878	34.779	35.329	38.045	36.696	37.370	37.306	36.939	37.123
V24:IRRI-36	36.448	34.938	35.693	38.031	36.855	37.443	37.158	37.140	37.149
V25:IRRI-47	35.453	34.747	35.100	37.453	36.747	37.100	37.803	36.625	37.214
V26:IRRI-52	36.003	34.473	35.238	38.169	36.306	37.238	37.370	37.175	37.273
V27:IRRI-53	35.210	33.548	34.379	36.960	35.715	36.338	37.716	36.653	37.184
V28:IRRI-55	35.036	34.076	34.556	36.703	36.076	36.389	38.352	36.625	37.488
V29:IRRI-62	35.129	35.276	35.203	37.379	37.109	37.244	37.301	36.672	36.986
V30:IR-35	35.412	36.734	36.073	37.328	38.651	37.990	38.403	36.939	37.671
V31:Laldodaki	35.012	36.205	35.608	36.595	38.288	37.442	38.144	37.781	37.963
V32:IR2289-6-22-5	35.388	37.030	36.209	37.554	38.780	38.167	37.832	37.308	37.570
V33:Narmada	35.917	36.019	35.968	37.917	37.853	37.885	37.432	37.650	37.541
V34:Ananda	35.840	34.938	35.389	37.673	36.938	37.306	38.376	37.370	37.873
V35:Ambpandhari	35.562	34.990	35.276	37.562	36.823	37.193	37.708	38.685	38.197
V36:Hira	34.953	36.648	35.800	37.119	38.398	37.758	37.171	38.118	37.645
V37:OR-1516-1-5-A	34.246	35.554	34.900	36.079	37.221	36.650	37.721	37.991	37.856
V38:China	35.178	36.314	35.746	37.178	37.898	37.538	38.037	36.844	37.440
V39:Sorati	35.308	35.918	35.613	36.975	37.752	37.363	38.092	37.217	37.654
V40:Mhadi	36.423	37.085	36.754	38.090	38.502	38.296	37.842	38.598	38.220
SE ±	0.414	0.484	0.323	0.455	0.511	0.346	0.330	0.364	0.250
C.D. at 5%	1.153	1.348	0.898	1.266	1.423	0.961	0.919	1.012	0.695
Interaction Effect (S x M)									
SE ±	0.829	0.969	0.646	0.910	1.023	0.691	0.661	0.727	0.500
C.D. at 5%	2.306	2.695	1.797	2.532	2.846	1.923	1.838	2.023	1.391
General Mean	35.713	35.875	35.794	37.601	37.773	37.687	37.679	37.661	37.671

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

At tillering stage, crop sown during *kharif* season i.e. S₁(24th MW) produced significantly minimum leaf canopy temperature (34.368°C) as compared to other sowing dates of *rabi* season i.e. S₂(48th MW), S₃ (50th MW) and S₄ (52th MW) during pooled mean.

The rice crop sown during *rabi* season, the S₂ i.e. 48th MW date of sowing recorded significantly higher leaf canopy temperature (35.883°C) at tillering stage as compared to crop sown during S₃ i.e. 50th MW and S₄ i.e. 52nd MW in pooled mean.

At flowering stage, crop sown during *kharif* season i.e. S₁(24th MW) produced significantly minimum leaf canopy temperature (36.806°C) as compared to other sowing dates of *rabi* season i.e. S₂(48th MW), S₃ (50th MW) and S₄ (52th MW) during pooled mean.

The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf canopy temperature (38.259°C) at flowering stage as compared to crop sown during S₃ i.e. 50th MW and S₂ i.e. 48nd MW in pooled mean.

At harvesting stage, crop sown during *kharif* season i.e. S₁(24th MW) produced significantly minimum leaf canopy temperature (36.795°C) as compared to other sowing dates of *rabi* season i.e. S₂(48th MW), S₃ (50th MW) and S₄ (52th MW) during pooled mean.

The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf canopy temperature (38.254°C) at harvesting stage as compared to crop sown during S₃ i.e. 50th MW and S₂ i.e. 48nd MW in pooled mean.

Effect of genotypes:

The leaf canopy temperature (°C) of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 51). The rice genotype V₄₀ i.e. Mhadi recorded significantly higher leaf canopy temperature (36.754 °C) at tillering stage which was superior over others. Significantly lower leaf canopy temperature was recorded V₁₆. i.e. Ratnagiri-24 (33.577°C).

At flowering stage, the rice genotype V₁₂ i.e. Ratnagiri-7 recorded significantly higher leaf canopy temperature (38.680°C) which was superior over others. Significantly lower leaf canopy temperature was recorded V₁₆ i.e. Ratnagiri-24 (35.423°C).

At harvesting stage, the rice genotype V₁₅ i.e. Ratnagiri-711 recorded significantly higher leaf canopy temperature (38.487°C) which was superior over others. Significantly lower leaf canopy temperature was recorded V₁₁ i.e. Ratnagiri-24 (34.885°C).

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of leaf canopy temperature (°C) (Table 52). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₃₇ i.e. OR-1516-1-5-A recorded significantly higher leaf canopy temperature (38.672°C) at harvesting stage over others treatment combinations during pooled means.

In case of *rabi* season S₂V₁₈ i.e. crop sown S₂ date of sowing (48th MW) with rice variety V₁₈ i.e. IRRI-20 recorded significantly higher leaf canopy temperature (39.322°C) over others. Interaction S₂V₃₃ i.e. Narmada recorded lowest leaf canopy temperature (36.478°C).

4.3.5. Stomatal conductance (molH₂O m⁻²Sec⁻¹):

Data on stomatal conductance of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 53. The general mean of stomatal conductance was 0.220, 0.222, 0.221, 0.348, 0.346, 0.347, 0.325, 0.326 and 0.326 molH₂O m⁻²Sec⁻¹ recorded at tillering, flowering and harvesting during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates

The data presented in Table 53 revealed that, the mean stomatal conductance of rice at different stages of crop growth was significantly influenced due to different sowing dates.

Table 52: Interaction effect of leaf canopy temperature depression(⁰c) (⁰c) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	35.733	37.330	37.023	37.023	36.587	37.023	36.497	36.537	37.530	37.190
S2	38.340	39.077	38.407	38.273	36.760	37.920	37.157	37.240	38.160	38.160
S3	36.647	37.037	37.957	36.317	38.250	36.270	36.483	36.043	36.427	36.573
S4	37.850	37.970	38.397	38.430	38.077	37.713	38.080	38.357	38.240	38.263
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	36.670	36.253	37.737	37.687	37.910	36.197	37.480	36.537	37.183	38.093
S2	37.613	38.023	38.927	36.800	38.657	39.567	39.117	38.013	38.287	38.913
S3	36.767	36.410	36.510	36.407	36.917	36.643	36.510	37.490	37.607	36.677
S4	38.043	38.523	38.733	38.710	40.423	38.050	38.733	37.733	40.423	38.307
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	36.517	36.833	35.730	34.520	37.230	34.363	36.220	38.537	37.813	37.907
S2	38.320	38.687	39.143	39.833	38.850	39.403	39.057	39.883	37.270	40.473
S3	38.637	37.353	36.480	36.723	36.423	37.150	36.433	36.440	36.337	37.377
S4	37.753	36.843	37.870	37.557	38.710	38.563	39.153	38.547	37.783	37.853
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	36.923	36.710	38.870	39.147	38.370	36.963	38.277	38.357	37.840	37.273
S2	39.833	39.500	35.187	38.910	35.697	36.917	36.790	37.200	38.290	37.683
S3	38.850	36.503	37.433	36.510	38.077	37.817	38.033	38.140	37.973	38.183
S4	36.970	38.613	38.237	38.937	38.690	36.987	37.783	38.450	38.263	38.227
SE ±	0.661									
C.D. at 5%	1.838									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	37.023	37.203	37.807	38.537	35.687	38.623	37.453	36.587	37.043	35.373
S2	36.590	38.027	36.790	37.413	38.177	37.477	37.593	38.250	38.200	38.553
S3	38.377	38.950	38.487	38.600	38.153	38.237	37.467	37.720	37.573	38.030
S4	37.900	38.193	37.157	38.723	37.120	37.413	37.560	36.630	37.523	38.210
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	34.787	35.713	37.870	38.810	38.080	36.760	36.980	37.357	37.610	38.333
S2	39.053	38.473	37.770	39.023	38.470	38.353	40.280	40.630	39.933	38.940
S3	37.227	37.647	37.343	38.067	38.217	38.350	39.143	37.867	38.530	38.897
S4	37.860	36.530	37.447	39.433	39.220	39.850	37.250	37.933	37.003	38.913
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	37.153	37.347	36.400	35.033	34.457	33.517	32.183	33.017	33.017	34.303
S2	36.680	38.273	36.150	37.077	35.297	38.397	37.487	38.100	38.077	37.033
S3	38.050	38.520	37.130	38.150	37.523	38.590	38.763	37.100	36.337	38.020
S4	38.287	39.753	38.077	38.300	39.223	38.197	38.177	38.283	39.257	38.400
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	36.943	37.187	36.333	36.820	37.680	37.987	39.067	35.033	34.457	37.407
S2	37.790	36.533	37.770	38.933	39.357	38.647	38.147	37.563	38.730	37.337
S3	37.250	36.460	37.537	36.467	39.290	37.350	36.647	36.703	37.863	39.280
S4	39.140	39.050	38.960	37.260	38.413	38.490	38.103	38.077	37.817	40.367
SE ±	0.727									
C.D. at 5%	2.023									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	36.378	37.267	37.415	37.780	36.137	37.823	36.975	36.562	37.287	36.282
S2	37.465	38.552	37.598	37.843	37.468	37.698	37.375	37.745	38.180	38.357
S3	37.755	37.993	38.222	37.458	38.202	37.253	36.975	36.882	37.000	37.302
S4	37.875	38.082	37.777	38.577	37.598	37.563	37.820	37.493	37.882	38.237
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	35.728	35.983	37.803	38.248	37.995	36.478	37.230	36.947	37.397	38.213
S2	38.333	38.248	38.348	37.912	38.563	38.960	39.698	39.322	39.110	38.927
S3	36.997	37.028	36.927	37.237	37.567	37.497	37.827	37.678	38.068	37.787
S4	37.952	37.527	38.090	39.072	39.822	38.950	37.992	37.833	38.713	38.610
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	36.835	37.090	36.065	34.777	35.843	33.940	34.202	35.777	35.415	36.105
S2	37.500	38.480	37.647	38.455	37.073	38.900	38.272	38.992	37.673	38.753
S3	38.343	37.937	36.805	37.437	36.973	37.870	37.598	36.770	36.337	37.698
S4	38.020	38.298	37.973	37.928	38.967	38.380	38.665	38.415	38.520	38.127
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	36.933	36.948	37.602	37.983	38.025	37.475	38.672	36.695	36.148	37.340
S2	38.812	38.017	36.478	38.922	37.527	37.782	37.468	37.382	38.510	37.510
S3	38.050	36.482	37.485	36.488	38.683	37.583	37.340	37.422	37.918	38.732
S4	38.055	38.832	38.598	38.098	38.552	37.738	37.943	38.263	38.040	39.297
SE $\pm$		0.500								
C.D. at 5%		1.391								

At tillering stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum stomatal conductance (0.161 molH₂O m⁻²Sec⁻¹) as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW) during pooled mean. The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher stomatal conductance 0.256 molH₂O m⁻²Sec⁻¹ as compared to crop sown during S₂ i.e. 48th MW and S₃ i.e. 50th MW during pooled mean.

At flowering stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum stomatal conductance 0.293 molH₂O m⁻² Sec⁻¹ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW) during pooled mean. The rice crop sown

during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher stomatal conductance (0.382 molH₂O m⁻²Sec⁻¹) which was at par with S₃ i.e. 50nd MW date of sowing (0.356 molH₂O m⁻²Sec⁻¹) over others during pooled mean.

At harvesting stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum stomatal conductance 0.269 mol m⁻²Sec⁻¹ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW) during pooled mean. The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher stomatal conductance (0.362 molH₂O m⁻²Sec⁻¹) which was superior over other date of sowing S₂ i.e. 48nd MW date of sowing (0.337 molH₂O m⁻²Sec⁻¹) S₃ i.e. 50nd MW date of sowing (0.335 molH₂O m⁻²Sec⁻¹) during pooled mean.

Effect of genotypes:

The stomatal conductance of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 53).

At tillering stage, the rice genotype V₃ i.e. Karjat-4 recorded significantly higher stomatal conductance (0.244 molH₂O m⁻²Sec⁻¹) which was at par with V₇, V₁₂, V₁₇, V₁₈, V₁₉, V₂₄, V₃₀, V₃₃, V₃₅, V₃₇, V₃₈, V₃₉, V₄₀ over others. Significantly lower stomatal conductance was recorded V₁₃ i.e. Ratnagiri -24 (0.197 molH₂O m⁻²Sec⁻¹) which was at par with V₁, V₄, V₅, V₈, V₁₀, V₂₉, V₃₂ over others.

At flowering stage, the rice genotype V₃₅ i.e. Ambepandhari recorded significantly higher stomatal conductance (0.363 molH₂O m⁻²Sec⁻¹) which was at par with V₁, V₃, V₅, V₇, V₈, V₉, V₁₂, V₁₄, V₁₅, V₁₆, V₁₇, V₁₈, V₁₉, V₂₀, V₂₁, V₂₂, V₂₄, V₂₆, V₂₇, V₃₀, V₃₁, V₃₂, V₃₃, V₃₆, V₃₇, V₃₈, V₃₉, V₄₀ over others. Significantly lower stomatal conductance was recorded V₁₃ i.e. Ratnagiri -24 (0.318 molH₂O m⁻²Sec⁻¹) which was at par with V₁₃ i.e. Ratnagiri -24 (0.318 molH₂O m⁻²Sec⁻¹) which was at par with V₄, V₂₃, V₂₅ over others.

Table 53. Effect of different treatment on stomatal conductance($\mu\text{molH}_2\text{O}/\text{m}^2/\text{m}^2$) of rice genotypes

Treatments	Stomatal conductance($\mu\text{molH}_2\text{O}/\text{m}^2/\text{sec}$)								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)									
S1 : 24 th MW	0.160	0.163	0.161	0.293	0.293	0.293	0.266	0.271	0.269
S2 : 48 th MW	0.230	0.234	0.232	0.360	0.358	0.359	0.338	0.336	0.337
S3 : 50 th MW	0.236	0.233	0.234	0.359	0.353	0.356	0.337	0.333	0.335
S4 :52 th MW	0.255	0.257	0.256	0.381	0.382	0.382	0.360	0.365	0.362
SE $\pm$	0.002	0.004	0.0023	0.003	0.002	0.002	0.003	0.002	0.001
C.D. at 5%	0.008	0.012	0.0078	0.010	0.007	0.005	0.009	0.007	0.005
B)Sub plot (Varieties)									
V1:Karjat-1	0.211	0.218	0.214	0.344	0.347	0.346	0.324	0.322	0.323
V2:Karjat-3	0.226	0.214	0.220	0.352	0.339	0.345	0.327	0.324	0.325
V3:Karjat-4,	0.250	0.238	0.244	0.363	0.361	0.362	0.337	0.335	0.336
V4:Karjat-7	0.206	0.200	0.203	0.342	0.316	0.329	0.320	0.311	0.316
V5:Karjat-184	0.204	0.225	0.215	0.343	0.353	0.348	0.316	0.327	0.322
V6:Sahyadri-2	0.215	0.213	0.214	0.346	0.332	0.339	0.324	0.316	0.320
V7:Sahyadri-4	0.233	0.224	0.229	0.358	0.347	0.353	0.338	0.318	0.328
V8:Phondaghat -1	0.219	0.198	0.208	0.354	0.333	0.343	0.329	0.308	0.319
V9:Ratnagiri-1	0.218	0.223	0.221	0.349	0.342	0.346	0.324	0.318	0.321
V10:Ratnagiri-5	0.198	0.200	0.199	0.328	0.331	0.330	0.309	0.311	0.310
V11:Ratnagiri- 6	0.221	0.216	0.219	0.348	0.336	0.342	0.323	0.315	0.319
V12:Ratnagiri- 7	0.226	0.229	0.228	0.363	0.361	0.362	0.338	0.336	0.337
V13:Ratnagiri -24	0.187	0.207	0.197	0.311	0.325	0.318	0.284	0.304	0.294
V14:Ratnagiri-73	0.206	0.226	0.216	0.335	0.353	0.344	0.314	0.334	0.324
V15:Ratnagiri-711	0.202	0.238	0.220	0.325	0.364	0.345	0.302	0.348	0.325
V16:IRRI-14	0.217	0.221	0.219	0.339	0.349	0.344	0.327	0.320	0.323
V17:IRRI-15	0.227	0.226	0.226	0.355	0.356	0.355	0.325	0.341	0.333
V18:IRRI-20	0.232	0.232	0.232	0.357	0.359	0.358	0.337	0.338	0.338
V19:IRRI-21	0.219	0.234	0.226	0.346	0.364	0.355	0.322	0.339	0.331
V20:IRRI-22	0.218	0.239	0.228	0.340	0.353	0.346	0.321	0.333	0.327
V21:IRRI-27	0.232	0.210	0.221	0.354	0.337	0.346	0.330	0.317	0.324
V22:IRRI-28	0.230	0.216	0.223	0.353	0.335	0.344	0.334	0.311	0.322
V23:IRRI-34	0.203	0.218	0.210	0.328	0.337	0.332	0.312	0.321	0.317
V24:IRRI-36	0.228	0.231	0.230	0.361	0.349	0.355	0.338	0.346	0.342
V25:IRRI-47	0.210	0.202	0.206	0.341	0.317	0.329	0.319	0.296	0.307
V26:IRRI-52	0.219	0.228	0.223	0.356	0.347	0.352	0.330	0.332	0.331
V27:IRRI-53	0.221	0.211	0.216	0.353	0.341	0.347	0.331	0.321	0.326
V28:IRRI-55	0.208	0.227	0.218	0.323	0.343	0.333	0.296	0.318	0.307
V29:IRRI-62	0.190	0.236	0.213	0.321	0.363	0.342	0.293	0.336	0.315
V30:IR-35	0.242	0.224	0.233	0.368	0.351	0.360	0.344	0.336	0.340
V31:Laldodaki	0.225	0.218	0.221	0.355	0.353	0.354	0.331	0.319	0.325
V32:IR2289-6-22-5	0.227	0.199	0.213	0.354	0.328	0.341	0.324	0.312	0.318
V33:Narmada	0.231	0.228	0.230	0.360	0.352	0.356	0.340	0.327	0.334
V34:Ananda	0.221	0.213	0.217	0.351	0.332	0.341	0.326	0.312	0.319
V35:Ambpandhari	0.246	0.221	0.233	0.374	0.352	0.363	0.350	0.331	0.341
V36:Hira	0.208	0.225	0.216	0.338	0.348	0.343	0.315	0.331	0.323
V37:OR-1516-1-5-A	0.231	0.228	0.229	0.369	0.348	0.359	0.344	0.345	0.345
V38:China	0.228	0.229	0.229	0.349	0.351	0.350	0.327	0.338	0.333
V39:Sorati	0.229	0.236	0.233	0.352	0.363	0.357	0.327	0.337	0.332
V40:Mhadi	0.223	0.240	0.232	0.350	0.366	0.358	0.331	0.349	0.340
SE $\pm$	0.009	0.009	0.006	0.010	0.010	0.007	0.009	0.011	0.007
C.D. at 5%	0.025	0.026	0.018	0.028	0.028	0.020	0.026	0.029	0.020
Interaction Effect (S x M)									
SE $\pm$	0.018	0.019	0.013	0.020	0.020	0.014	0.019	0.021	0.016
C.D. at 5%	0.050	0.052	0.036	0.055	0.056	0.040	0.052	0.058	0.047
General Mean	0.220	0.222	0.221	0.348	0.346	0.347	0.325	0.326	0.326

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

At harvesting stage, the rice genotype V₃₇ i.e. OR-1516-1-5 A recorded significantly higher stomatal conductance (0.345 molH₂O m⁻² Sec⁻¹) which was at par with V₂, V₃, V₄, V₁₁, V₁₇, V₁₈, V₁₉, V₂₀, V₂₅, V₂₆, V₃₀, V₃₁, V₃₃, V₃₅, V₃₇, V₃₈, V₃₉, V₄₀ and over others. Significantly lower stomatal conductance was recorded V₁₃-Ratnagiri -24 (0.294 molH₂O m⁻² Sec⁻¹) which was at par with V₁₀, V₁₃, V₂₅, V₂₈, V₃₂ over others.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of stomatal conductance (Table 54). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype with V₂₄ i.e. IRRI-36 recorded significantly higher stomatal conductance (0.318 molH₂O m⁻² Sec⁻¹) which was at par with S₁V₃, S₁V₅, S₁V₈, S₁V₁₅, S₁V₁₇, S₁V₃₅, S₁V₃₆, S₁V₃₈ and over others.

In case of *rabi* season S₄V₃₇ i.e. crop sown S₄ i.e. 52th MW with rice variety V₃₇ i.e. OR-1516-1-5A recorded significantly maximum stomatal conductance (0.404 molH₂O m⁻² Sec⁻¹) which was at par with treatment combination S₄V₁, S₄V₂, S₄V₃, S₄V₇, S₄V₁₀, S₄V₁₂, S₂V₁₄, S₄V₂₂, S₄V₂₄, S₂V₂₅, S₄V₂₆, S₄V₂₇, S₄V₂₉, S₄V₃₀, S₄V₃₃, S₄V₃₄, S₄V₃₅, S₄V₃₆ and S₄V₄₀ during pooled mean. S₃V₂₅ i.e. crop sown S₃ i.e. 50th MW with rice variety V₂₅ i.e. IRRI-47 recorded lowest stomatal conductance (0.306 molH₂O m⁻² Sec⁻¹) over others.

4.4.1. Carbohydrate content (%):

Data regarding mean carbohydrate content (%) of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 55 in graphically depicted in fig.6. The mean carbohydrate content was 80.78, 80.66 and 80.72 % recorded during 2020-21, 2021-22 and pooled mean respectively.

Table 54 Interaction effect of stomatal conductance ($\mu\text{molH}_2\text{O}/\text{m}^2/\text{m}^2$) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.245	0.301	0.249	0.295	0.273	0.256	0.268	0.267	0.235	0.242
S2	0.300	0.326	0.342	0.356	0.281	0.343	0.357	0.363	0.373	0.355
S3	0.377	0.315	0.378	0.300	0.340	0.343	0.344	0.333	0.323	0.253
S4	0.373	0.366	0.377	0.331	0.371	0.355	0.382	0.354	0.366	0.385
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.256	0.251	0.278	0.269	0.294	0.266	0.283	0.270	0.261	0.248
S2	0.335	0.379	0.345	0.366	0.324	0.308	0.337	0.346	0.321	0.345
S3	0.356	0.326	0.290	0.296	0.347	0.385	0.337	0.365	0.348	0.340
S4	0.346	0.395	0.319	0.323	0.242	0.348	0.345	0.368	0.358	0.352
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.257	0.281	0.281	0.335	0.239	0.280	0.236	0.244	0.223	0.290
S2	0.339	0.362	0.319	0.264	0.318	0.376	0.321	0.307	0.311	0.357
S3	0.373	0.308	0.315	0.366	0.337	0.313	0.379	0.276	0.292	0.360
S4	0.350	0.383	0.334	0.385	0.382	0.351	0.390	0.356	0.345	0.367
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.254	0.256	0.260	0.270	0.291	0.293	0.273	0.278	0.275	0.238
S2	0.337	0.337	0.344	0.348	0.341	0.306	0.355	0.356	0.338	0.380
S3	0.369	0.351	0.378	0.304	0.385	0.296	0.340	0.339	0.341	0.349
S4	0.363	0.349	0.377	0.383	0.385	0.367	0.409	0.337	0.355	0.356
SE $\pm$		0.019								
C.D. at 5%		0.052								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.304	0.252	0.312	0.251	0.286	0.284	0.257	0.300	0.249	0.261
S2	0.301	0.323	0.279	0.344	0.341	0.352	0.357	0.308	0.314	0.338
S3	0.328	0.356	0.334	0.276	0.331	0.265	0.311	0.305	0.363	0.259
S4	0.355	0.366	0.416	0.371	0.351	0.361	0.348	0.319	0.345	0.386
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.246	0.289	0.252	0.264	0.294	0.243	0.293	0.244	0.268	0.281
S2	0.356	0.335	0.381	0.364	0.346	0.355	0.361	0.356	0.363	0.318
S3	0.332	0.324	0.331	0.337	0.377	0.338	0.355	0.355	0.359	0.379
S4	0.327	0.396	0.352	0.369	0.374	0.343	0.355	0.396	0.367	0.355
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.283	0.247	0.264	0.300	0.254	0.259	0.276	0.258	0.303	0.255
S2	0.313	0.298	0.336	0.333	0.308	0.351	0.345	0.308	0.319	0.351
S3	0.301	0.336	0.322	0.373	0.274	0.336	0.311	0.364	0.338	0.369
S4	0.373	0.362	0.361	0.379	0.348	0.382	0.353	0.343	0.385	0.369
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.280	0.260	0.254	0.279	0.265	0.290	0.246	0.278	0.256	0.316
S2	0.342	0.315	0.352	0.316	0.341	0.333	0.367	0.304	0.369	0.351
S3	0.323	0.296	0.343	0.294	0.337	0.335	0.368	0.386	0.367	0.349
S4	0.330	0.378	0.359	0.359	0.382	0.367	0.398	0.383	0.358	0.380
SE $\pm$		0.021								
C.D. at 5%		0.058								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	0.275	0.276	0.281	0.273	0.280	0.270	0.263	0.284	0.242	0.252
S2	0.301	0.324	0.310	0.350	0.311	0.348	0.357	0.336	0.344	0.346
S3	0.353	0.335	0.356	0.288	0.336	0.304	0.327	0.319	0.343	0.256
S4	0.364	0.366	0.397	0.351	0.361	0.358	0.365	0.337	0.356	0.385
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	0.251	0.270	0.265	0.267	0.294	0.254	0.288	0.257	0.265	0.265
S2	0.346	0.357	0.363	0.365	0.335	0.331	0.349	0.351	0.342	0.331
S3	0.344	0.325	0.311	0.317	0.362	0.361	0.346	0.360	0.354	0.360
S4	0.337	0.396	0.336	0.346	0.308	0.346	0.350	0.382	0.362	0.354
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	0.270	0.264	0.273	0.318	0.246	0.270	0.256	0.251	0.263	0.273
S2	0.326	0.330	0.328	0.299	0.313	0.364	0.333	0.307	0.315	0.354
S3	0.337	0.322	0.319	0.370	0.306	0.325	0.345	0.320	0.315	0.365
S4	0.362	0.373	0.348	0.382	0.365	0.367	0.371	0.350	0.365	0.368
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	0.267	0.258	0.257	0.275	0.278	0.291	0.260	0.278	0.265	0.277
S2	0.339	0.326	0.348	0.332	0.341	0.320	0.361	0.330	0.354	0.365
S3	0.346	0.324	0.361	0.299	0.361	0.315	0.354	0.362	0.354	0.349
S4	0.347	0.363	0.368	0.371	0.383	0.367	0.404	0.360	0.357	0.368
SE $\pm$		0.014								
C.D. at 5%		0.040								

Effect of sowing dates:

The data presented in Table 55 revealed that, the mean carbohydrate content (%) of rice genotypes was significantly influence due to different sowing dates.

Crop sown during S₁ -*kharif* season (24th MW) produced significantly minimum carbohydrate content (78.68 %) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

The rice crop sown during *rabi* season, S₄ (the 50th MW) date of sowing recorded significantly maximum carbohydrate content (82.18 %) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) during pooled mean over others.

Table 55. Effect of different treatments on carbohydrate content (%) of grains in rice genotypes

Treatments	Carbohydrate content (%)		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	78.82	78.53	78.68
S2 : 48 th MW	80.57	80.65	80.61
S3 : 50 th MW	81.34	81.46	81.40
S4 : 52 th MW	82.38	81.98	82.18
SE ±	0.06	0.018	0.028
C.D. at 5%	0.22	0.064	0.099
B) Sub plot (Varieties)			
V1: Karjat-1	82.07	82.15	82.11
V2: Karjat-3	81.73	81.50	81.61
V3: Karjat-4,	80.33	80.04	80.18
V4: Karjat-7	83.13	80.95	82.04
V5: Karjat-184	79.31	79.29	79.30
V6: Sahyadri-2	82.97	82.59	82.78
V7: Sahyadri-4	83.36	83.11	83.23
V8: Phondaghat -1	81.52	81.07	81.29
V9: Ratnagiri-1	82.37	82.18	82.28
V10: Ratnagiri-5	80.94	81.03	80.98
V11: Ratnagiri- 6	78.37	78.07	78.22
V12: Ratnagiri- 7	80.25	80.28	80.27
V13: Ratnagiri -24	73.82	73.96	73.89
V14: Ratnagiri-73	81.90	81.66	81.78
V15: Ratnagiri-711	82.88	82.66	82.77
V16: IRRI-14	81.74	81.77	81.75
V17: IRRI-15	80.36	80.38	80.37
V18: IRRI-20	82.23	82.33	82.28
V19: IRRI-21	80.02	79.55	79.78
V20: IRRI-22	79.74	79.66	79.70
V21: IRRI-27	79.15	79.54	79.35
V22: IRRI-28	79.31	79.28	79.30
V23: IRRI-34	78.65	78.38	78.51
V24: IRRI-36	79.07	78.96	79.01
V25: IRRI-47	80.94	81.03	80.98
V26: IRRI-52	79.25	79.34	79.30
V27: IRRI-53	78.27	78.51	78.39
V28: IRRI-55	81.87	81.79	81.83
V29: IRRI-62	79.34	79.23	79.28
V30: IR-35	82.22	82.00	82.11
V31: Laldodaki	80.78	81.29	81.04
V32: IR2289-6-22-5	81.28	81.27	81.27
V33: Narmada	78.64	78.23	78.44
V34: Ananda	80.08	79.87	79.97
V35: Ambpandhari	78.71	78.88	78.80
V36: Hira	82.38	82.53	82.46
V37: OR-1516-1-5-A	79.72	79.60	79.66
V38: China	82.15	82.20	82.18
V39: Sorati	82.74	82.47	82.60
V40: Mhadi	81.38	81.44	81.41
SE ±	0.073	0.044	0.042
C.D. at 5%	0.204	0.123	0.116
Interaction Effect (S x V)			
SE ±	0.146	0.088	0.083
C.D. at 5%	0.407	0.245	0.231
General Mean	80.777	80.655	80.716

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 : 52th MW (24th-31st December)

Effect of genotypes:

The carbohydrate content of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 55). Rice genotype V₇ i.e. Sahyadri-4 recorded significantly maximum carbohydrate content (83.23 %) which was superior over other genotypes during pooled mean. The rice genotype Ratnagiri-24 recorded significantly minimum carbohydrate content (73.89 %) which was followed by V₁₁ i.e. Ratnagiri-6 (78.22 %).

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of carbohydrate content (Table 56). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₇ i.e. Sahyadri-4 recorded significantly maximum carbohydrate content (82.57%) which was superior over other treatment combination during pooled mean.

In case of *rabi* season S₄V₄ i.e. crop sown in S₄ date of sowing (52th MW) with Karjat-7 was recorded significantly higher carbohydrate content (85.48%) which was superior with all treatment combinations during pooled mean over others. However, S₂V₃₃ with rice genotype Narmada recorded significantly minimum carbohydrate content (77.08%) which was followed by S₂V₃₅ (78.47%).

4.4.2. Protein content (%):

Data regarding mean protein content (%) of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 57 in graphically depicted in fig7. The mean protein content was 5.939, 5.975 and 5.957% recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 57 revealed that, the mean protein content (%) of rice genotypes was significantly influence due to different sowing dates.

Table 56 Interaction effect of carbohydrate content (%) of rice grains due to sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	79.67	81.17	79.73	80.60	78.97	81.97	82.50	78.53	81.63	80.43
S2	82.60	81.50	79.77	81.27	78.83	82.27	83.13	81.50	82.00	80.27
S3	82.93	81.83	80.43	81.23	79.23	83.33	83.67	82.60	82.57	81.17
S4	83.07	82.40	81.37	89.43	80.20	84.30	84.13	83.43	83.27	81.90
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	74.67	79.43	78.77	80.43	81.90	81.07	78.80	79.23	78.93	78.57
S2	78.67	79.87	79.83	81.60	82.10	81.40	79.63	82.70	78.90	79.67
S3	79.80	80.27	80.53	82.03	83.40	81.97	80.93	83.07	80.70	80.13
S4	80.33	81.43	80.77	83.53	84.13	82.53	82.07	83.90	81.53	80.60
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	76.40	76.40	76.33	77.10	78.20	76.43	75.27	79.90	76.37	80.60
S2	79.47	79.27	78.03	78.67	81.70	79.30	78.50	81.80	79.23	81.10
S3	79.40	80.17	79.73	79.50	81.73	80.27	79.30	82.17	80.40	82.83
S4	81.33	81.40	80.50	81.00	82.13	81.00	80.00	83.60	81.37	84.33
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	77.60	80.30	76.37	76.43	77.23	80.20	77.43	78.43	80.27	78.50
S2	80.80	80.87	78.07	81.37	78.23	82.47	79.70	82.73	82.67	81.50
S3	82.00	81.90	79.60	81.00	79.07	82.90	80.37	83.37	83.47	82.53
S4	82.73	82.03	80.53	81.50	80.30	83.97	81.37	84.07	84.57	82.97
SE $\pm$		0.146								
C.D. at 5%		0.407								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	79.67	80.60	78.93	79.83	77.57	81.17	82.63	78.60	80.87	80.17
S2	82.47	81.70	79.63	81.13	79.07	81.77	82.63	81.10	81.90	80.70
S3	82.97	81.77	80.67	81.30	79.80	83.00	83.33	82.40	82.93	81.47
S4	83.50	81.93	80.93	81.53	80.73	84.43	83.83	82.17	83.03	81.77
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	73.67	79.40	78.63	80.10	80.60	80.37	78.13	80.03	77.80	78.60
S2	78.87	80.07	80.10	81.57	82.70	81.77	80.43	82.30	78.93	79.50
S3	79.67	80.57	80.77	81.90	83.37	82.10	81.20	83.23	80.13	79.90
S4	80.07	81.10	81.00	83.07	83.97	82.83	81.77	83.73	81.33	80.63
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	76.57	76.07	76.20	77.27	78.47	76.37	75.70	78.60	76.20	79.73
S2	79.67	79.07	78.03	79.03	81.53	78.93	78.80	82.53	79.67	80.97
S3	80.87	80.67	79.30	79.27	81.80	80.80	79.63	82.97	79.90	83.53
S4	81.07	81.33	79.97	80.27	82.30	81.27	79.90	83.07	81.13	83.77
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	78.80	79.93	76.07	75.70	76.93	80.20	77.77	78.27	79.63	79.53
S2	81.37	81.70	77.90	80.70	78.70	82.50	79.03	83.03	82.90	81.53
S3	82.40	81.77	78.97	81.40	79.63	83.57	80.47	83.70	83.33	81.87
S4	82.60	81.67	80.00	81.67	80.27	83.87	81.13	83.80	84.00	82.83
SE $\pm$		0.088								
C.D. at 5%		0.245								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	79.67	80.88	79.33	80.22	78.27	81.57	82.57	78.57	81.25	80.30
S2	82.53	81.60	79.70	81.20	78.95	82.02	82.88	81.30	81.95	80.48
S3	82.95	81.80	80.55	81.27	79.52	83.17	83.50	82.50	82.75	81.32
S4	83.28	82.17	81.15	85.48	80.47	84.37	83.98	82.80	83.15	81.83
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	74.17	79.42	78.70	80.27	81.25	80.72	78.47	79.63	78.37	78.58
S2	78.77	79.97	79.97	81.58	82.40	81.58	80.03	82.50	78.92	79.58
S3	79.73	80.42	80.65	81.97	83.38	82.03	81.07	83.15	80.42	80.02
S4	80.20	81.27	80.88	83.30	84.05	82.68	81.92	83.82	81.43	80.62
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	76.48	76.23	76.27	77.18	78.33	76.40	75.48	79.25	76.28	80.17
S2	79.57	79.17	78.03	78.85	81.62	79.12	78.65	82.17	79.45	81.03
S3	80.13	80.42	79.52	79.38	81.77	80.53	79.47	82.57	80.15	83.18
S4	81.20	81.37	80.23	80.63	82.22	81.13	79.95	83.33	81.25	84.05
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	78.20	80.12	76.22	76.07	77.08	80.20	77.60	78.35	79.95	79.02
S2	81.08	81.28	77.98	81.03	78.47	82.48	79.37	82.88	82.78	81.52
S3	82.20	81.83	79.28	81.20	79.35	83.23	80.42	83.53	83.40	82.20
S4	82.67	81.85	80.27	81.58	80.28	83.92	81.25	83.93	84.28	82.90
SE $\pm$		0.083								
C.D. at 5%		0.231								

Crop sown during S₁-*kharif* season (24th MW) produced significantly minimum protein content (5.75 %) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during pooled mean.

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum protein content (6.27 %) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in pooled mean.

Table 57.Effect of different treatment on protein content (%)of grains in rice genotypes

Treatments	Protein content (%)		
	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)			
S1 : 24 th MW	5.72	5.77	5.75
S2 : 48 th MW	5.78	5.83	5.81
S3 : 50 th MW	5.99	6.02	6.01
S4 :52 th MW	6.26	6.28	6.27
SE $\pm$	0.005	0.014	0.008
C.D. at 5%	0.018	0.048	0.028
B)Sub plot (Varieties)			
V1:Karjat-1	6.80	6.83	6.81
V2:Karjat-3	5.48	5.70	5.59
V3:Karjat-4,	6.64	6.64	6.64
V4:Karjat-7	5.94	5.88	5.91
V5:Karjat-184	5.45	5.45	5.45
V6:Sahyadri-2	5.20	5.27	5.23
V7:Sahyadri-4	5.27	5.35	5.31
V8:Phondaghat -1	6.12	6.15	6.14
V9:Ratnagiri-1	6.65	6.78	6.71
V10:Ratnagiri-5	5.28	5.39	5.34
V11:Ratnagiri- 6	6.42	6.54	6.48
V12:Ratnagiri- 7	5.41	5.30	5.35
V13:Ratnagiri -24	5.37	5.43	5.40
V14:Ratnagiri-73	6.32	6.31	6.31
V15:Ratnagiri-711	5.17	5.23	5.20
V16:IRRI-14	6.25	6.08	6.16
V17:IRRI-15	6.11	6.11	6.11
V18:IRRI-20	6.64	6.75	6.69
V19:IRRI-21	6.19	6.25	6.22
V20:IRRI-22	5.59	5.38	5.48
V21:IRRI-27	5.47	5.60	5.53
V22:IRRI-28	5.29	5.28	5.28
V23:IRRI-34	6.48	6.57	6.53
V24:IRRI-36	5.82	5.85	5.84
V25:IRRI-47	5.85	5.92	5.88
V26:IRRI-52	5.45	5.43	5.44
V27:IRRI-53	6.09	6.08	6.09
V28:IRRI-55	7.05	7.14	7.09
V29:IRRI-62	6.29	6.25	6.27
V30:IR-35	5.81	5.79	5.80
V31:Laldodaki	6.04	5.97	6.00
V32:IR2289-6-22-5	5.33	5.50	5.41
V33:Narmada	6.24	6.24	6.24
V34:Ananda	5.33	5.40	5.36
V35:Ambpandhari	7.03	7.04	7.04
V36:Hira	5.89	5.98	5.93
V37:OR-1516-1-5-A	5.43	5.55	5.49
V38:China	5.94	6.08	6.01
V39:Sorati	5.90	5.91	5.90
V40:Mhadi	6.15	6.17	6.16
SE $\pm$	0.028	0.037	0.023
C.D. at 5%	0.077	0.103	0.063
Interaction Effect (S x V)			
SE $\pm$	0.055	0.074	0.045
C.D. at 5%	0.153	0.207	0.126
General Mean	5.939	5.975	5.957

S1 : 24th MW (11th-17th June)
S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)
S4 :52th MW (24th-31st December)

Effect of genotypes:

The protein content (%) of rice genotypes was influenced significantly due to the different genotypes during both year and pooled means (Table 57). Rice genotype V₂₈ i.e. IRRI-53 recorded significantly maximum protein content (7.09%) which was at par with V₃₅ i.e. Ambpandhari (7.04%) pooled mean over others. The rice genotype Ratnagiri-711 recorded significantly minimum protein content (5.20%) which was at par with Sahyadri-2(5.23%) over others.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of protein content (%) (Table.58). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₃₅ i.e. Ambepandhari recorded significantly higher protein content (6.84%) which was superior over other treatment combination during pooled mean and over others.

In case of *rabi* season S₄V₂₈ i.e. crop sown in S₄ date of sowing (52th MW) with IRRI-55 was recorded significantly higher protein content (7.67 %) which was at par with S₄V₉ (7.58%), S₄V₂₉ (7.54 %) over others during pooled mean. However, S₂V₆ with rice genotype Ratnagiri -711 recorded significantly minimum protein content (5.03%) which was at par with S₂V₆ (5.03%) and S₂V₃₄ (5.10%) over other.

4.4.3. Nitrate reductase activity (μmol/g):

Data regarding mean nitrate reductase activity (μmolg⁻¹) of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 59 in graphically depicted in fig.8. The mean nitrate reductase activity (μmolg⁻¹) at tillering and flowering stage was 1.723, 2.032, 1.877, 2.081, 2.363 and 2.222 μmolg⁻¹ recorded during 2020-21, 2021-22 and pooled mean respectively.

Table 58 Interaction effect of protein content (%) of rice grains due to sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	6.48	6.01	6.32	5.65	5.17	4.91	5.03	6.64	6.39	5.98
S2	6.76	5.02	6.50	6.00	5.31	5.04	5.17	5.85	6.24	4.93
S3	6.93	5.27	6.77	5.96	5.64	5.10	5.22	5.94	6.44	4.94
S4	7.03	5.61	6.96	6.14	5.67	5.74	5.64	6.04	7.53	5.27
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	6.22	5.32	5.14	6.49	4.95	6.62	5.51	6.42	6.10	5.27
S2	6.06	5.34	5.85	5.94	5.04	6.07	6.12	6.52	5.93	5.16
S3	6.52	5.27	5.95	6.22	5.23	6.19	6.32	6.56	6.27	6.24
S4	6.89	5.71	6.33	6.62	5.46	6.11	6.49	7.07	6.44	5.67
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	5.16	5.00	6.23	5.44	5.34	4.92	6.12	6.60	5.85	6.33
S2	5.29	5.18	6.15	5.64	5.78	5.48	5.97	6.93	6.21	5.42
S3	5.71	5.52	6.51	6.21	5.99	5.55	6.09	7.05	6.44	5.52
S4	5.71	5.46	7.03	6.00	6.29	5.85	6.18	7.61	6.67	5.96
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.53	4.86	5.91	5.11	6.85	5.26	5.01	5.48	5.64	5.65
S2	5.96	5.35	6.05	5.04	6.92	5.85	5.37	5.91	5.94	6.07
S3	6.10	5.46	6.29	5.30	6.90	6.06	5.51	6.21	5.91	6.24
S4	6.56	5.64	6.69	5.85	7.46	6.37	5.84	6.15	6.10	6.63
SE $\pm$		0.055								
C.D. at 5%		0.153								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	6.56	6.43	6.62	5.44	5.10	5.12	5.16	6.67	6.61	6.08
S2	6.63	5.31	6.34	5.94	5.40	5.17	5.25	5.86	6.33	5.04
S3	6.91	5.58	6.65	6.06	5.60	5.30	5.29	5.98	6.55	5.23
S4	7.21	5.48	6.93	6.06	5.71	5.48	5.70	6.10	7.63	5.22
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	6.22	5.00	5.18	6.31	4.93	6.65	5.81	6.35	5.93	5.41
S2	6.34	5.38	5.99	6.03	5.03	5.83	5.95	6.72	6.02	5.29
S3	6.69	5.34	5.93	6.19	5.21	5.89	6.40	6.64	6.48	5.07
S4	6.92	5.49	6.44	6.71	5.73	5.95	6.29	7.27	6.57	5.74
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	5.44	5.14	6.18	5.24	5.58	5.04	6.02	6.66	6.06	6.18
S2	5.42	5.00	6.29	5.81	5.92	5.45	6.06	6.92	6.07	5.50
S3	5.72	5.32	6.81	5.96	6.01	5.32	6.10	7.26	6.47	5.48
S4	5.81	5.64	6.99	6.39	6.15	5.93	6.13	7.73	6.41	6.00
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.34	4.97	5.93	5.07	6.82	5.53	4.92	5.64	5.78	5.69
S2	6.06	5.49	5.94	5.08	6.79	5.95	5.69	6.13	5.81	5.93
S3	6.23	5.68	6.22	5.49	7.23	6.19	5.72	6.21	6.00	6.40
S4	6.25	5.85	6.87	5.97	7.32	6.25	5.87	6.33	6.05	6.67
SE $\pm$		0.074								
C.D. at 5%		0.207								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	6.52	6.22	6.47	5.55	5.14	5.02	5.09	6.65	6.50	6.03
S2	6.69	5.16	6.42	5.97	5.36	5.10	5.21	5.86	6.29	4.99
S3	6.92	5.43	6.71	6.01	5.62	5.20	5.26	5.96	6.50	5.09
S4	7.12	5.54	6.95	6.10	5.69	5.61	5.67	6.07	7.58	5.25
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	6.22	5.16	5.16	6.40	4.94	6.63	5.66	6.39	6.02	5.34
S2	6.20	5.36	5.92	5.99	5.03	5.95	6.03	6.62	5.98	5.23
S3	6.61	5.31	5.94	6.20	5.22	6.04	6.36	6.60	6.38	5.66
S4	6.91	5.60	6.38	6.66	5.59	6.03	6.39	7.17	6.51	5.71
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	5.30	5.07	6.21	5.34	5.46	4.98	6.07	6.63	5.96	6.25
S2	5.35	5.09	6.22	5.73	5.85	5.46	6.02	6.93	6.14	5.46
S3	5.72	5.42	6.66	6.09	6.00	5.43	6.10	7.16	6.46	5.50
S4	5.76	5.55	7.01	6.20	6.22	5.89	6.16	7.67	6.54	5.98
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.43	4.92	5.92	5.09	6.84	5.40	4.96	5.56	5.71	5.67
S2	6.01	5.42	6.00	5.06	6.86	5.90	5.53	6.02	5.87	6.00
S3	6.16	5.57	6.26	5.40	7.07	6.13	5.62	6.21	5.96	6.32
S4	6.41	5.74	6.78	5.91	7.39	6.31	5.86	6.24	6.07	6.65
SE $\pm$		0.045								
C.D. at 5%		0.126								

Effect of sowing dates:

The data presented in Table 59 revealed that, the mean nitrate reductase activity (μmolg^{-1}) of rice genotypes was significantly influence due to different sowing dates.

Crop sown during S₁ -*kharif* season (24th MW) produced significantly minimum nitrate reductase activity $1.562\mu\text{molg}^{-1}$ and $1.923\mu\text{molg}^{-1}$ at tillering and flowering stage respectively compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW)during pooled mean.

Table 59.Effect of different treatments on leaf nitrate reductase activity (μ mol g⁻¹) of rice genotypes

Treatments	At tillering			At flowering		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)						
S ₁ : 24 th MW	1.453	1.672	1.562	1.784	2.062	1.923
S ₂ : 48 th MW	1.664	1.998	1.831	2.030	2.344	2.187
S ₃ : 50 th MW	1.811	2.157	1.984	2.169	2.448	2.308
S ₄ :52 th MW	1.964	2.299	2.131	2.342	2.597	2.469
SE $\pm$	0.034	0.014	0.017	0.011	0.019	0.013
C.D. at 5%	0.117	0.049	0.060	0.039	0.065	0.046
B)Sub plot (Varieties)						
V ₁ :Karjat-1	1.737	1.988	1.863	2.106	2.334	2.220
V ₂ :Karjat-3	2.197	2.517	2.357	2.563	2.785	2.674
V ₃ :Karjat-4,	1.499	1.843	1.671	2.001	2.188	2.094
V ₄ :Karjat-7	1.962	2.174	2.068	2.288	2.448	2.368
V ₅ :Karjat-184	1.878	2.203	2.040	2.274	2.530	2.402
V ₆ :Sahyadri-2	2.160	2.518	2.339	2.513	2.809	2.661
V ₇ :Sahyadri-4	2.163	2.538	2.350	2.503	2.813	2.658
V ₈ :Phondaghat -1	1.702	1.981	1.841	2.013	2.332	2.172
V ₉ :Ratnagiri-1	2.013	2.246	2.129	2.378	2.642	2.510
V ₁₀ :Ratnagiri-5	1.768	2.089	1.929	2.058	2.436	2.247
V ₁₁ :Ratnagiri- 6	1.712	2.061	1.886	2.086	2.397	2.241
V ₁₂ :Ratnagiri- 7	1.786	2.165	1.975	2.176	2.506	2.341
V ₁₃ :Ratnagiri -24	1.590	1.877	1.733	1.912	2.202	2.057
V ₁₄ :Ratnagiri-73	1.908	2.225	2.066	2.268	2.487	2.377
V ₁₅ :Ratnagiri-711	1.776	2.061	1.918	2.122	2.359	2.240
V ₁₆ :IRRI-14	1.531	1.879	1.705	1.892	2.176	2.034
V ₁₇ :IRRI-15	1.543	1.933	1.738	1.878	2.208	2.043
V ₁₈ :IRRI-20	1.835	2.078	1.957	2.129	2.418	2.273
V ₁₉ :IRRI-21	1.544	1.898	1.721	1.885	2.207	2.046
V ₂₀ :IRRI-22	1.493	1.918	1.705	1.858	2.237	2.047
V ₂₁ :IRRI-27	1.764	2.045	1.905	2.102	2.426	2.264
V ₂₂ :IRRI-28	1.502	1.751	1.626	1.856	2.075	1.965
V ₂₃ :IRRI-34	1.974	2.319	2.147	2.388	2.735	2.562
V ₂₄ :IRRI-36	1.968	2.188	2.078	2.318	2.578	2.448
V ₂₅ :IRRI-47	1.408	1.658	1.533	1.766	2.062	1.914
V ₂₆ :IRRI-52	1.301	1.598	1.449	1.644	1.919	1.782
V ₂₇ :IRRI-53	1.561	1.773	1.667	1.895	2.112	2.003
V ₂₈ :IRRI-55	1.322	1.663	1.493	1.677	1.983	1.830
V ₂₉ :IRRI-62	1.688	2.030	1.859	2.057	2.359	2.208
V ₃₀ :IR-35	1.707	1.980	1.843	2.042	2.273	2.157
V ₃₁ :Laldodaki	1.588	1.933	1.761	1.930	2.194	2.062
V ₃₂ :IR2289-6-22-5	1.728	2.108	1.918	2.089	2.428	2.258
V ₃₃ :Narmada	1.774	2.022	1.898	2.118	2.367	2.243
V ₃₄ :Ananda	1.316	1.563	1.440	1.658	1.896	1.777
V ₃₅ :Ambpandhari	1.493	1.850	1.672	1.863	2.195	2.029
V ₃₆ :Hira	1.586	1.894	1.740	1.945	2.247	2.096
V ₃₇ :OR-1516-1-5-A	1.444	1.728	1.586	1.819	2.094	1.957
V ₃₈ :China	1.708	2.076	1.892	2.074	2.384	2.229
V ₃₉ :Sorati	2.096	2.341	2.218	2.484	2.743	2.614
V ₄₀ :Mhadi	2.073	2.397	2.235	2.463	2.749	2.606
SE $\pm$	0.053	0.035	0.032	0.017	0.015	0.011
C.D. at 5%	0.148	0.096	0.088	0.047	0.042	0.031
Interaction Effect (S x M)						
SE $\pm$	0.106	0.069	0.063	0.034	0.030	0.022
C.D. at 5%	0.296	0.192	0.175	0.095	0.085	0.062
General Mean	1.723	2.032	1.877	2.081	2.363	2.222

S₁ : 24th MW (11th-17th June)
S₃ : 50th MW (10th-16th December)

S₂ : 48th MW (26th November-2nd December)
S₄ :52th MW (24th-31st December)

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum nitrate reductase activity 2.131 μmolg^{-1} and 2.469 μmolg^{-1} at tillering and flowering stage respectively as compared to crop sown in S₂(48th MW) and S₃ (50thMW) during pooled mean.

Effect of genotypes:

The nitrate reductase activity (μmolg^{-1}) of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 59). The rice variety Ananda recorded significantly minimum nitrate reductase activity (1.440 μmolg^{-1}) during pooled mean. Rice genotype V₂ i.e. Karjat-3 recorded significantly maximum nitrate reductase activity (2.357 μmolg^{-1}) which was followed by variety V₆ i.e. Sahyadri-2 (2.339 μmolg^{-1}), V₇i.e.Sahyadri-4(2.350 μmolg^{-1}) during pooled mean and over others at tillering stage.

At flowering stage, rice genotype V₂-Karjat-3 recorded significantly maximum nitrate reductase activity (2.674 μmolg^{-1}) which was followed by genotype V₆ i.e. Sahyadri-2 (2.661 μmolg^{-1}), V₇-Sahyadri-4 (2.658 μmolg^{-1}), V₃₉-Sorati (2.614 μmolg^{-1}), V₄₀-Mhadi (2.606 μmolg^{-1}) during pooled mean over others.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of nitrate reductase activity (μmolg^{-1}) (Table 60). The rice crop sown S₁i.e.*kharif* season (24th MW) with genotypeV₃₉ i.e. Sorati recorded significantly higher nitrate reductase activity (2.400 μmolg^{-1}) which was superior over other treatment combination during pooled mean over others.

In case of *rabi* season S₄V₄₀i.e. crop sown in S₄ date of sowing (52th MW) with Mhadi was recorded significantly higher nitrate reductase activity (2.400 μmolg^{-1}) which was superior over other treatment combination during pooled mean. However, S₂V₃₄ with rice genotype Ananda recorded significantly minimum nitrate reductase activity (1.672 μmolg^{-1}) during pooled mean.

Table 60 Interaction effect of nitrate reductase activity (μ mol g⁻¹) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S ₁	2.073	2.457	2.013	2.380	2.167	2.133	2.033	1.670	1.953	1.570
S ₂	1.923	2.373	1.820	2.097	2.083	2.540	2.513	2.030	2.440	2.090
S ₃	2.160	2.540	1.887	2.280	2.333	2.570	2.670	2.173	2.513	2.187
S ₄	2.267	2.880	2.283	2.397	2.513	2.807	2.793	2.177	2.603	2.383
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S ₁	1.893	1.830	1.830	2.030	1.740	1.727	1.620	1.753	1.660	1.533
S ₂	1.980	2.137	2.020	2.163	2.070	1.863	1.853	2.050	1.863	1.683
S ₃	2.157	2.287	2.090	2.253	2.207	1.893	1.877	2.353	1.877	1.953
S ₄	2.313	2.450	2.347	2.623	2.470	2.083	2.160	2.360	2.140	2.260
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S ₁	1.720	1.633	1.863	1.717	1.407	1.467	1.510	1.503	1.567	1.723
S ₂	2.047	1.817	2.267	2.390	1.713	1.547	1.893	1.567	2.153	1.997
S ₃	2.233	1.873	2.600	2.477	1.863	1.700	2.023	1.680	2.220	2.160
S ₄	2.407	2.100	2.823	2.690	2.080	1.863	2.153	1.957	2.287	2.287
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S ₁	1.637	1.713	1.743	1.503	1.470	1.583	1.477	1.727	2.137	2.203
S ₂	1.823	2.023	2.263	1.590	1.837	1.903	1.700	2.123	2.500	2.460
S ₃	2.030	2.267	2.150	1.743	2.020	2.070	1.973	2.203	2.627	2.567
S ₄	2.230	2.353	2.317	1.793	2.127	2.223	2.127	2.243	2.673	2.623
SE $\pm$		0.034								
C.D. at 5%		0.095								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S ₁	2.117	2.283	2.007	2.267	2.253	2.603	2.307	2.173	2.193	1.900
S ₂	2.273	2.753	2.037	2.427	2.430	2.800	2.830	2.313	2.597	2.577
S ₃	2.447	2.900	2.287	2.487	2.587	2.893	3.030	2.290	2.810	2.633
S ₄	2.500	3.203	2.420	2.610	2.850	2.940	3.087	2.550	2.967	2.633
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S ₁	2.117	2.200	2.153	2.240	1.977	2.037	1.870	2.043	1.927	1.790
S ₂	2.563	2.433	2.333	2.380	2.313	2.100	2.183	2.407	2.117	2.110
S ₃	2.450	2.593	2.387	2.533	2.563	2.160	2.233	2.547	2.257	2.293
S ₄	2.457	2.797	2.667	2.793	2.583	2.407	2.547	2.673	2.527	2.753
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S ₁	2.073	1.900	2.237	2.047	1.777	1.757	1.737	1.843	1.930	2.013
S ₂	2.400	1.990	2.803	2.620	2.120	1.830	2.200	1.943	2.440	2.227
S ₃	2.493	2.110	2.847	2.793	2.123	1.977	2.240	2.053	2.463	2.340
S ₄	2.737	2.300	3.053	2.850	2.227	2.113	2.270	2.090	2.603	2.510
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S ₁	1.880	2.033	1.993	1.837	2.087	1.983	1.833	2.133	2.320	2.597
S ₂	2.157	2.430	2.457	1.753	2.133	2.253	2.107	2.290	2.827	2.817
S ₃	2.317	2.540	2.433	1.963	2.317	2.387	2.120	2.420	2.850	2.757
S ₄	2.423	2.707	2.583	2.030	2.243	2.363	2.317	2.693	2.977	2.827
SE $\pm$		0.030								
C.D. at 5%		0.085								

Pooled

Sowing dates	Varieties									
	V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₇	V ₈	V ₉	V ₁₀
S1	2.095	2.370	2.010	2.323	2.210	2.368	2.170	1.922	2.073	1.735
S2	2.098	2.563	1.928	2.262	2.257	2.670	2.672	2.172	2.518	2.333
S3	2.303	2.720	2.087	2.383	2.460	2.732	2.850	2.232	2.662	2.410
S4	2.383	3.042	2.352	2.503	2.682	2.873	2.940	2.363	2.785	2.508
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	2.005	2.015	1.992	2.135	1.858	1.882	1.745	1.898	1.793	1.662
S2	2.272	2.285	2.177	2.272	2.192	1.982	2.018	2.228	1.990	1.897
S3	2.303	2.440	2.238	2.393	2.385	2.027	2.055	2.450	2.067	2.123
S4	2.385	2.623	2.507	2.708	2.527	2.245	2.353	2.517	2.333	2.507
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	1.897	1.767	2.050	1.882	1.592	1.612	1.623	1.673	1.748	1.868
S2	2.223	1.903	2.535	2.505	1.917	1.688	2.047	1.755	2.297	2.112
S3	2.363	1.992	2.723	2.635	1.993	1.838	2.132	1.867	2.342	2.250
S4	2.572	2.200	2.938	2.770	2.153	1.988	2.212	2.023	2.445	2.398
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	1.758	1.873	1.868	1.670	1.778	1.783	1.655	1.930	2.228	2.400
S2	1.990	2.227	2.360	1.672	1.985	2.078	1.903	2.207	2.663	2.638
S3	2.173	2.403	2.292	1.853	2.168	2.228	2.047	2.312	2.738	2.662
S4	2.327	2.530	2.450	1.912	2.185	2.293	2.222	2.468	2.825	2.725
SE ±		0.022								
C.D. at 5%		0.062								

4.4.4. Amylose content (%):

Data regarding mean amylose content (%) of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 61 in graphically depicted in fig. 9.

The mean amylose content was 21.866, 21.86 and 21.862% recorded during 2020-21, 2021-22 and pooled mean, respectively.

Effect of sowing dates:

The data presented in Table 61 revealed that, the mean amylose content (%) of rice genotypes was significantly influenced due to different sowing dates.

Table 61 .Effect of different treatments on amylose content (%) of grains in rice genotypes .

Treatments	Amylose content(%)		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	22.470	22.457	22.46
S2 : 48 th MW	22.043	22.018	22.03
S3 : 50 th MW	21.728	21.684	21.71
S4 :52 th MW	21.224	21.272	21.25
SE ±	0.002	0.025	0.012
C.D. at 5%	0.007	0.085	0.043
B)Sub plot (Varieties)			
V1:Karjat-1	21.50	21.57	21.53
V2:Karjat-3	23.59	23.39	23.49
V3:Karjat-4,	23.74	23.68	23.71
V4:Karjat-7	24.64	24.55	24.59
V5:Karjat-184	20.74	20.60	20.67
V6:Sahyadri-2	19.93	19.89	19.91
V7:Sahyadri-4	19.44	19.33	19.38
V8:Phondaghat -1	20.69	20.69	20.69
V9:Ratnagiri-1	22.15	22.10	22.12
V10:Ratnagiri-5	20.99	20.82	20.90
V11:Ratnagiri- 6	21.40	21.43	21.42
V12:Ratnagiri- 7	19.86	19.86	19.86
V13:Ratnagiri -24	20.97	20.90	20.93
V14:Ratnagiri-73	23.55	23.67	23.61
V15:Ratnagiri-711	21.85	21.91	21.88
V16:IRRI-14	23.16	23.11	23.13
V17:IRRI-15	21.54	21.47	21.50
V18:IRRI-20	20.48	20.50	20.49
V19:IRRI-21	21.35	21.43	21.39
V20:IRRI-22	21.02	21.34	21.18
V21:IRRI-27	22.15	22.14	22.14
V22:IRRI-28	22.28	22.25	22.27
V23:IRRI-34	24.60	24.39	24.50
V24:IRRI-36	23.77	23.94	23.86
V25:IRRI-47	20.94	21.00	20.97
V26:IRRI-52	23.22	23.26	23.24
V27:IRRI-53	23.35	23.32	23.34
V28:IRRI-55	21.93	21.87	21.90
V29:IRRI-62	24.37	24.34	24.35
V30:IR-35	21.26	21.21	21.23
V31:Laldodaki	20.32	20.31	20.31
V32:IR2289-6-22-5	20.70	20.85	20.77
V33:Narmada	21.41	21.41	21.41
V34:Ananda	20.31	20.26	20.29
V35:Ambpandhari	20.54	20.55	20.55
V36:Hira	22.37	22.37	22.37
V37:OR-1516-1-5-A	21.45	21.33	21.39
V38:China	22.22	22.36	22.29
V39:Sorati	22.00	22.09	22.04
V40:Mhadi	21.13	21.11	21.12
SE ±	0.032	0.04	0.026
C.D. at 5%	0.090	0.11	0.072
Interaction Effect (S x V)			
SE ±	0.065	0.08	0.052
C.D. at 5%	0.180	0.22	0.144
General Mean	21.866	21.86	21.862

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

Crop sown during S₁ -*kharif* season (24th MW) produced significantly maximum amylose content (22.46 %) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during pooled mean.

The rice crop sown during *rabi* season, S₂ (the 48th MW) date of sowing recorded significantly maximum amylose content (22.03%) which was superior over others crop sown during S₃ (50th MW) and S₄ (52th MW) pooled mean

Effect of genotypes:

The amylose content (%) of rice was influenced significantly due to the different genotypes during pooled mean (Table 61). The rice genotype Karjat-7 recorded significantly maximum amylose content (24.59%) followed by variety IRRI-34 (24.50%) and IRRI-62 (24.35 %). Rice genotype V₇ i.e. Sahyadri-4 (19.) recorded significantly minimum amylose content (19.38.%) which was followed by V₆ i.e. Sahyadri-2 (19.91 %.) during pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of amylose content (%) (Table 62). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₄ i.e. Karjat -7 recorded significantly higher amylose content (24.92%) which was at par with V₂₉ i.e. IRRI-62 (24.79 %) treatment combination during pooled mean over others.

In case of *rabi* season S₂V₄ i.e. crop sown in S₂ date of sowing (48th MW) with Karjat-7 was recorded significantly maximum amylose content (24.65 %) which was at par with S₂V₂₃ (24.60%) i.e. crop sown in S₂ date of sowing (48th MW) and S₃V₄ (24.55%) i.e. crop sown in S₃ date of sowing (50th MW) during pooled mean. However, S₃V₇ with rice genotype Sahyadri-4 recorded significantly minimum amylose content (19.17%) which was superior over other.

Table 62 Interaction effect of amylose content (%) of rice grains due to sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	21.96	24.22	24.47	25.00	21.26	20.80	20.01	21.28	22.72	21.60
S2	21.71	23.77	23.92	24.66	20.93	20.29	19.58	20.91	22.28	21.12
S3	21.36	23.34	23.57	24.59	20.77	19.60	19.26	20.72	22.06	20.81
S4	20.96	23.02	23.02	24.29	20.00	19.05	18.90	19.87	21.52	20.43
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	21.77	20.43	23.15	24.01	22.67	23.69	21.94	21.20	21.99	21.74
S2	21.54	20.12	22.65	23.49	21.70	23.34	21.86	20.60	21.60	21.06
S3	21.29	19.48	22.54	23.48	21.64	22.93	21.35	20.24	21.73	20.99
S4	21.01	19.41	22.52	23.22	21.38	22.65	21.01	19.89	20.07	20.31
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	22.77	22.93	25.08	24.44	22.13	24.11	23.74	22.85	24.84	22.00
S2	22.50	22.45	24.63	24.04	21.00	23.10	23.46	22.31	24.49	21.68
S3	21.90	22.07	24.52	23.60	20.64	23.04	23.27	21.54	24.22	21.38
S4	21.45	21.68	24.17	23.00	20.00	22.63	22.93	21.01	23.92	19.97
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	20.87	21.14	21.82	21.02	21.26	22.98	22.10	22.65	22.51	21.66
S2	20.65	20.98	21.52	20.46	20.91	22.69	21.73	22.26	22.31	21.42
S3	20.23	20.53	21.23	20.30	20.42	22.26	21.43	22.05	21.86	20.86
S4	19.52	20.15	21.06	19.46	19.57	21.56	20.53	21.90	21.34	20.59
SE $\pm$		0.065								
C.D. at 5%		0.180								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	22.49	24.13	24.45	24.84	21.21	20.50	19.91	21.11	22.70	21.44
S2	21.56	23.50	23.69	24.64	20.85	20.35	19.54	20.87	22.39	20.98
S3	21.31	23.06	23.68	24.50	20.41	19.62	19.07	20.65	21.83	20.62
S4	20.90	22.86	22.91	24.23	19.94	19.11	18.79	20.14	21.49	20.23
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	21.82	20.33	22.94	24.06	22.86	23.63	21.92	21.31	22.06	21.90
S2	21.46	20.06	22.55	23.56	21.83	23.16	21.62	20.55	21.78	21.50
S3	21.40	19.75	22.66	23.51	21.67	22.94	21.35	20.20	21.51	21.24
S4	21.04	19.29	22.41	23.55	21.27	22.72	20.98	19.95	20.35	20.74
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	22.48	23.34	24.68	24.60	22.08	24.45	23.89	22.94	24.73	21.80
S2	22.39	22.52	24.57	24.14	21.13	23.09	23.36	22.07	24.44	21.84
S3	21.93	21.95	24.42	23.70	20.56	22.83	23.12	21.55	24.21	21.28
S4	21.75	21.18	23.88	23.33	20.23	22.65	22.93	20.92	23.97	19.91
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	20.70	21.26	21.80	20.97	21.19	23.06	21.91	22.77	22.49	21.56
S2	20.66	21.02	21.81	20.27	20.84	22.77	21.63	22.28	22.25	21.23
S3	20.17	20.58	21.14	20.27	20.36	21.96	21.33	22.19	21.94	20.88
S4	19.70	20.54	20.88	19.53	19.83	21.70	20.45	22.20	21.67	20.76
SE $\pm$		0.08								
C.D. at 5%		0.22								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	22.23	24.18	24.46	24.92	21.23	20.65	19.96	21.19	22.71	21.52
S2	21.64	23.64	23.81	24.65	20.89	20.32	19.56	20.89	22.33	21.05
S3	21.34	23.20	23.63	24.55	20.59	19.61	19.17	20.69	21.95	20.72
S4	20.93	22.94	22.96	24.26	19.97	19.08	18.85	20.00	21.51	20.33
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	21.80	20.38	23.04	24.03	22.77	23.66	21.93	21.26	22.02	21.82
S2	21.50	20.09	22.60	23.52	21.77	23.25	21.74	20.58	21.69	21.28
S3	21.35	19.61	22.60	23.49	21.65	22.94	21.35	20.22	21.62	21.11
S4	21.03	19.35	22.46	23.39	21.32	22.69	21.00	19.92	20.21	20.52
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	22.62	23.14	24.88	24.52	22.11	24.28	23.81	22.90	24.79	21.90
S2	22.44	22.49	24.60	24.09	21.07	23.09	23.41	22.19	24.47	21.76
S3	21.91	22.01	24.47	23.65	20.60	22.94	23.19	21.55	24.21	21.33
S4	21.60	21.43	24.03	23.16	20.11	22.64	22.93	20.96	23.95	19.94
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	20.79	21.20	21.81	21.00	21.22	23.02	22.01	22.71	22.50	21.61
S2	20.65	21.00	21.67	20.36	20.88	22.73	21.68	22.27	22.28	21.33
S3	20.20	20.55	21.19	20.29	20.39	22.11	21.38	22.12	21.90	20.87
S4	19.61	20.35	20.97	19.50	19.70	21.63	20.49	22.05	21.50	20.68
SE $\pm$		0.052								
C.D. at 5%		0.144								

4.4.5. Iron content (ppm):

Data regarding mean iron content (ppm) of rice as influenced by different sowing dates and *genotypes* during the pooled mean, the data are presented in Table 63 in graphically depicted in fig.10. The mean iron content (ppm) was 9.463, 9.445 and 9.447ppm recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 63revealed that, the mean iron content (ppm) of rice genotypes was significantly influenced due to different sowing dates.

Table 63.Effect of different treatment on iron content (ppm) of rice genotypes

Treatments	Iron content (ppm)		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	8.74	8.62	8.68
S2 : 48 th MW	9.21	9.22	9.21
S3 : 50 th MW	9.67	9.64	9.65
S4 :52 th MW	10.23	10.30	10.27
SE $\pm$	0.035	0.016	0.016
C.D. at 5%	0.120	0.056	0.055
B)Sub plot (Varieties)			
V1:Karjat-1	9.96	9.76	9.86
V2:Karjat-3	8.09	7.84	7.97
V3:Karjat-4	20.89	20.97	20.93
V4:Karjat-7	7.76	7.94	7.85
V5:Karjat-184	10.82	10.81	10.82
V6:Sahyadri-2	6.62	6.80	6.71
V7:Sahyadri-4	8.27	8.72	8.50
V8:Phondaghat -1	9.67	9.96	9.82
V9:Ratnagiri-1	10.55	10.53	10.54
V10:Ratnagiri-5	8.76	8.68	8.72
V11:Ratnagiri- 6	9.86	10.33	10.10
V12:Ratnagiri- 7	15.52	15.59	15.56
V13:Ratnagiri -24	7.95	8.38	8.16
V14:Ratnagiri-73	8.83	8.65	8.74
V15:Ratnagiri-711	8.90	9.29	9.09
V16:IRRI-14	7.65	7.65	7.65
V17:IRRI-15	7.03	6.80	6.91
V18:IRRI-20	8.25	8.32	8.28
V19:IRRI-21	7.40	7.41	7.40
V20:IRRI-22	7.84	7.64	7.74
V21:IRRI-27	9.48	9.56	9.52
V22:IRRI-28	8.98	8.99	8.98
V23:IRRI-34	6.98	6.75	6.87
V24:IRRI-36	7.27	7.17	7.22
V25:IRRI-47	10.24	10.14	10.19
V26:IRRI-52	6.60	6.25	6.43
V27:IRRI-53	11.44	11.35	11.40
V28:IRRI-55	8.65	8.39	8.52
V29:IRRI-62	10.61	10.50	10.55
V30:IR-35	11.04	11.14	11.09
V31:Laldodaki	5.12	5.21	5.17
V32:IR2289-6-22-5	11.23	11.08	11.16
V33:Narmada	10.69	10.79	10.74
V34:Ananda	11.78	11.15	11.46
V35:Ambpandhari	9.17	9.44	9.31
V36:Hira	8.15	8.10	8.12
V37:OR-1516-1-5-A	9.70	9.34	9.52
V38:China	9.22	8.92	9.07
V39:Sorati	11.72	11.65	11.68
V40:Mhadi	9.18	9.13	9.15
SE $\pm$	0.089	0.084	0.049
C.D. at 5%	0.248	0.233	0.136
Interaction Effect (S x V)			
SE $\pm$	0.179	0.168	0.098
C.D. at 5%	0.497	0.466	0.272
General Mean	9.463	9.445	9.447

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

Crop sown during S₁ -*kharif* season (24th MW) produced significantly maximum iron content (8.68ppm) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum iron content (10.27ppm) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in both year and pooled mean.

Effect of genotypes:

The iron content (ppm) of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 63). The rice genotype V₃₁-Laldodaki recorded significantly minimum iron content (5.17ppm). Rice genotype V₃-Karjat-4 recorded significantly maximum iron content (20.93ppm) which was followed by V₁₂ i.e. Ratnagiri-7 (15.56ppm) and V₃₈ i.e. Sorati (11.68ppm) during pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotype was significant in respect of iron content (ppm) (Table 64). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₃ i.e. Karjati-4 recorded significantly maximum iron content (18.94ppm) which was superior over other treatment combination during pooled mean.

In case of *rabi* season S₄V₁₂ i.e. crop sown in S₄ date of sowing (52th MW) with Ratnagiri-7 was recorded significantly higher iron content (17.02ppm) which was superior over all treatment combination during pooled mean. However, S₂V₃₁ with rice genotype Laldodki recorded significantly minimum iron content (4.71ppm) during pooled mean.

4.4.6.Zinc content (ppm):

Data regarding mean zinc content (ppm) of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 65 in graphically depicted in fig11. The general mean zinc content was 13.361, 14.444 and 13.902 ppm recorded during 2020-21, 2021-22 and pooled mean, respectively.

Table 64 Interaction effect of iron content (ppm) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	7.95	6.39	18.30	8.19	9.06	5.45	7.04	10.01	9.32	7.91
S2	10.65	8.55	21.69	6.26	10.61	6.34	8.68	9.11	10.66	8.43
S3	10.45	8.29	21.69	7.70	11.39	6.69	8.38	9.80	10.74	8.80
S4	10.80	9.13	21.88	8.89	12.22	8.01	8.99	9.76	11.51	9.89
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	8.62	13.91	9.25	8.17	9.86	7.02	6.58	7.26	6.35	8.22
S2	9.71	15.39	7.76	8.61	8.24	6.97	6.17	7.40	6.53	6.93
S3	10.29	15.97	8.30	9.20	8.46	7.79	7.07	9.24	7.88	7.29
S4	10.82	16.81	9.13	9.34	9.02	8.80	8.29	9.09	8.83	8.90
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	9.09	7.86	7.70	6.70	9.61	7.83	11.41	7.57	8.62	10.01
S2	9.38	8.44	6.69	7.11	10.27	5.66	11.31	8.08	10.92	10.99
S3	9.77	9.21	6.50	7.68	10.30	6.34	11.24	9.31	11.39	11.06
S4	9.70	10.41	7.05	7.59	10.80	6.57	11.80	9.64	11.49	12.11
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.11	10.30	8.80	12.16	8.39	5.62	10.31	8.74	10.51	8.27
S2	4.59	11.13	10.68	11.04	9.19	9.15	9.08	8.87	11.82	9.39
S3	4.91	11.74	11.38	11.51	9.41	8.65	9.88	9.67	11.98	9.57
S4	5.87	11.76	11.91	12.41	9.69	9.16	9.55	9.61	12.58	9.48
SE $\pm$		0.179								
C.D. at 5%		0.497								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	8.20	5.67	19.57	8.44	8.54	6.10	7.92	10.29	9.48	8.03
S2	10.20	8.22	20.97	6.48	10.72	6.51	8.43	9.32	10.51	8.50
S3	10.27	8.24	21.42	7.52	11.65	6.97	9.12	9.57	10.68	8.57
S4	10.37	9.24	21.94	9.31	12.33	7.62	9.42	10.68	11.43	9.63
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	9.23	13.28	9.29	8.31	10.80	6.69	5.51	7.10	6.42	6.99
S2	9.42	15.09	8.49	8.63	8.16	7.02	6.72	7.73	6.63	6.82
S3	9.65	16.77	8.72	8.89	8.67	7.80	6.79	8.87	7.50	8.12
S4	13.03	17.22	9.82	8.78	9.53	9.10	8.19	9.56	9.09	8.65
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	8.99	7.55	7.67	6.54	9.11	7.01	11.43	6.62	9.02	8.98
S2	9.93	8.79	6.12	6.87	10.18	5.03	10.96	8.79	9.82	11.09
S3	9.47	9.71	6.21	7.51	10.49	6.01	11.40	8.95	11.16	11.92
S4	9.87	9.91	7.01	7.74	10.80	6.96	11.62	9.18	11.99	12.56
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.13	10.03	9.12	10.27	9.03	6.09	10.00	8.11	9.89	8.54
S2	4.83	10.99	11.20	11.62	9.28	9.27	8.85	9.37	11.99	9.20
S3	5.30	11.56	11.22	10.98	10.23	8.00	9.39	9.06	12.29	8.85
S4	5.60	11.76	11.62	11.72	9.23	9.03	9.12	9.13	12.42	9.93
SE $\pm$		0.168								
C.D. at 5%		0.466								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	8.08	6.03	18.94	8.32	8.80	5.77	7.48	10.15	9.40	7.97
S2	10.43	8.38	21.33	6.37	10.66	6.42	8.56	9.22	10.58	8.46
S3	10.36	8.27	21.55	7.61	11.52	6.83	8.75	9.68	10.71	8.69
S4	10.59	9.19	21.91	9.10	12.28	7.82	9.21	10.22	11.47	9.76
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	8.92	13.60	9.27	8.24	10.33	6.86	6.04	7.18	6.38	7.61
S2	9.57	15.24	8.12	8.62	8.20	7.00	6.45	7.56	6.58	6.88
S3	9.97	16.37	8.51	9.04	8.57	7.80	6.93	9.06	7.69	7.70
S4	11.92	17.02	9.48	9.06	9.27	8.95	8.24	9.33	8.96	8.77
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	9.04	7.70	7.69	6.62	9.36	7.42	11.42	7.10	8.82	9.50
S2	9.66	8.61	6.40	6.99	10.23	5.35	11.13	8.43	10.37	11.04
S3	9.62	9.46	6.36	7.60	10.39	6.17	11.32	9.13	11.27	11.49
S4	9.79	10.16	7.03	7.67	10.80	6.77	11.71	9.41	11.74	12.34
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	5.12	10.17	8.96	11.22	8.71	5.85	10.16	8.43	10.20	8.41
S2	4.71	11.06	10.94	11.33	9.24	9.21	8.96	9.12	11.90	9.29
S3	5.10	11.65	11.30	11.25	9.82	8.32	9.63	9.37	12.13	9.21
S4	5.73	11.76	11.76	12.07	9.46	9.10	9.34	9.37	12.50	9.71
SE $\pm$		0.098								
C.D. at 5%		0.272								

Effect of sowing dates:

The data presented in Table 65 revealed that, the mean zinc content (ppm) of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during S₁-*kharif* season (24th MW) produced significantly maximum iron content (13.1ppm) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during pooled mean. The rice crop sown during *rabi* season, S₄(the 52th MW) date of sowing recorded significantly maximum zinc content (14.8 ppm) as compared to crop sown during S₂ (48thMW) and S₃ (50th MW) in pooled mean.

Table 65.Effect of different treatment on zinc content (ppm) of rice genotypes.

Treatments	Zinc content (ppm)		
	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)			
S1 : 24 th MW	12.56	13.6	13.1
S2 : 48 th MW	13.01	14.1	13.6
S3 : 50 th MW	13.60	14.7	14.1
S4 :52 th MW	14.28	15.4	14.8
SE $\pm$	0.011	0.014	0.006
C.D. at 5%	0.037	0.047	0.022
B)Sub plot (Varieties)			
V1:Karjat-1	17.12	18.3	17.7
V2:Karjat-3	9.67	10.6	10.2
V3:Karjat-4,	9.38	10.0	9.7
V4:Karjat-7	16.65	17.9	17.3
V5:Karjat-184	12.19	13.5	12.8
V6:Sahyadri-2	10.28	11.7	11.0
V7:Sahyadri-4	13.28	14.6	13.9
V8:Phondaghat -1	9.93	11.2	10.6
V9:Ratnagiri-1	10.47	11.8	11.2
V10:Ratnagiri-5	11.13	12.2	11.7
V11:Ratnagiri- 6	19.55	21.0	20.3
V12:Ratnagiri- 7	18.96	20.3	19.7
V13:Ratnagiri -24	16.76	18.2	17.5
V14:Ratnagiri-73	14.58	15.8	15.2
V15:Ratnagiri-711	15.82	17.2	16.5
V16:IRRI-14	11.10	12.2	11.6
V17:IRRI-15	10.57	11.5	11.0
V18:IRRI-20	12.06	12.9	12.5
V19:IRRI-21	10.97	11.9	11.4
V20:IRRI-22	11.42	12.2	11.8
V21:IRRI-27	10.33	11.2	10.7
V22:IRRI-28	12.37	13.7	13.0
V23:IRRI-34	10.32	11.4	10.9
V24:IRRI-36	11.00	11.9	11.4
V25:IRRI-47	7.29	8.5	7.9
V26:IRRI-52	10.15	10.7	10.4
V27:IRRI-53	13.70	14.9	14.3
V28:IRRI-55	15.04	16.1	15.6
V29:IRRI-62	17.15	18.1	17.6
V30:IR-35	17.59	18.7	18.2
V31:Laldodaki	11.55	12.8	12.2
V32:IR2289-6-22-5	12.71	13.7	13.2
V33:Narmada	17.34	18.3	17.8
V34:Ananda	18.55	19.3	18.9
V35:Ambpandhari	15.61	16.9	16.3
V36:Hira	13.34	14.5	13.9
V37:OR-1516-1-5-A	16.10	16.9	16.5
V38:China	15.72	16.5	16.1
V39:Sorati	9.60	10.5	10.1
V40:Mhadi	15.70	16.7	16.2
SE $\pm$	0.050	0.058	0.038
C.D. at 5%	0.139	0.161	0.106
Interaction Effect (S x V)			
SE $\pm$	0.100	0.116	0.076
C.D. at 5%	0.279	0.322	0.212
General Mean	13.361	14.444	13.902

S1 : 24th MW (11th-17th June)
S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)
S4 :52th MW (24th-31st December)

Effect of genotypes:

The zinc content (ppm) of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 65). The rice variety V₁₁ i.e. Ratnagiri-6 recorded significantly maximum zinc content (20.3 ppm) followed by variety V₁₂ i.e. Ratnagiri-7(19.7ppm) and V₃₄ i.e. Ananda(18.9) during pooled mean over others. The rice genotype V₂₅ i.e. IRRI-47 recorded significantly minimum zinc content (7.9ppm) followed by V₃ i.e. Karjat-4(9.7ppm).

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of zinc content (ppm) (Table 66). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₇ i.e. Sahyadri-4 recorded significantly higher zinc content (ppm) which was superior over other treatment combination during 2020-21, 2021-22 years and pooled mean.

In case of *rabi* season S₄V₁₁ i.e. crop sown in S₄ date of sowing (52th MW) with Ratnagiri-6 treatment combination was recorded significantly higher zinc content (22.11ppm) which was superior with other treatment combination pooled mean. However, S₂V₂₅ with rice genotype IRI-47 recorded significantly minimum zinc content (7.89ppm) which was superior over other.

4.5. Yield and yield attributes :

4.5.1. Number of tillers per plant :

Data regarding mean number of tillers per plant of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 67. The data clearly revealed that, the mean number of tillers per plant was maximum during both years and in pooled mean.

The mean number of tillers per plant was 9.82, 9.65 and 9.74 recorded during 2020-21, 2021-22 and pooled mean respectively at maturity.

Table 66. Interaction effect of zinc content (ppm) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	15.58	8.40	7.76	14.99	9.78	8.89	11.51	9.94	9.51	9.94
S2	17.21	9.80	9.56	16.52	11.98	9.83	13.31	9.34	10.27	11.04
S3	17.57	9.94	9.76	17.16	13.29	11.02	13.56	10.13	10.65	11.29
S4	18.11	10.54	10.43	17.92	13.72	11.38	14.73	10.30	11.45	12.25
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	18.37	16.39	18.51	13.94	16.70	10.26	10.02	10.42	10.09	11.91
S2	19.17	19.12	17.41	14.35	14.51	10.47	9.61	11.23	10.22	10.42
S3	20.04	19.66	17.96	14.99	14.98	11.43	10.71	12.61	11.32	10.92
S4	20.63	20.69	18.77	15.04	17.08	12.25	11.92	13.99	12.24	12.43
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	10.48	10.97	11.04	10.47	6.49	10.87	14.75	13.91	15.01	16.21
S2	9.94	12.13	10.12	10.62	7.18	9.63	11.61	14.54	17.54	17.54
S3	10.43	12.47	9.91	11.44	7.45	10.02	13.12	15.54	18.13	17.92
S4	10.49	13.89	10.22	11.46	8.05	10.07	15.31	16.18	17.93	18.69
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	11.56	11.72	15.12	18.21	15.00	12.42	16.52	14.72	9.13	14.85
S2	10.84	12.62	17.56	17.65	15.42	13.49	15.72	15.55	9.61	15.58
S3	11.42	12.98	18.23	18.31	15.74	13.57	16.21	16.31	9.71	16.01
S4	12.39	13.52	18.46	20.03	16.29	13.87	15.94	16.31	9.95	16.36
SE $\pm$		0.100								
C.D. at 5%		0.279								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	16.87	8.83	8.93	16.50	11.60	10.17	13.40	11.80	11.03	11.57
S2	18.40	10.80	9.50	17.57	13.17	11.50	13.77	10.50	11.67	12.00
S3	19.13	11.20	10.60	18.50	14.27	12.50	15.13	10.70	12.10	12.13
S4	18.73	11.73	10.83	19.20	14.83	12.80	15.90	11.93	12.53	13.10
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	19.60	18.30	20.03	14.63	18.47	11.33	10.23	11.60	10.93	11.60
S2	20.10	19.60	18.93	15.70	15.70	11.70	11.37	12.47	11.03	11.63
S3	20.53	21.30	19.50	15.87	16.43	12.27	11.60	13.57	11.87	12.70
S4	23.60	22.17	20.23	16.87	18.13	13.40	12.70	14.10	13.83	12.93
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	10.70	12.20	12.20	11.10	7.70	11.60	16.07	14.13	16.53	16.80
S2	11.13	13.50	10.80	11.63	8.60	9.23	13.47	16.50	17.60	18.50
S3	11.10	14.33	11.23	12.20	8.80	10.57	13.90	16.80	18.70	19.40
S4	11.67	14.63	11.53	12.63	9.00	11.50	16.20	16.80	19.50	20.20
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	12.90	12.67	16.57	18.00	16.60	13.60	17.27	15.60	9.60	16.60
S2	12.17	13.73	18.53	19.13	17.17	14.83	16.63	16.60	10.77	16.67
S3	12.83	14.03	19.00	18.90	17.50	14.37	17.03	16.63	11.10	16.47
S4	13.30	14.27	19.17	20.97	16.47	15.20	16.53	17.17	10.57	17.17
SE $\pm$		0.116								
C.D. at 5%		0.322								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	16.22	8.62	8.35	15.74	10.69	9.53	12.45	10.87	10.27	10.76
S2	17.81	10.30	9.53	17.04	12.58	10.66	13.54	9.92	10.97	11.52
S3	18.35	10.57	10.18	17.83	13.78	11.76	14.35	10.42	11.38	11.71
S4	18.42	11.14	10.63	18.56	14.28	12.09	15.31	11.12	11.99	12.68
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	18.98	17.34	19.27	14.29	17.58	10.80	10.13	11.01	10.51	11.75
S2	19.63	19.36	18.17	15.02	15.11	11.09	10.49	11.85	10.63	11.03
S3	20.29	20.48	18.73	15.43	15.71	11.85	11.16	13.09	11.59	11.81
S4	22.11	21.43	19.50	15.96	17.61	12.83	12.31	14.04	13.04	12.68
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	10.59	11.59	11.62	10.78	7.09	11.24	15.41	14.02	15.77	16.51
S2	10.54	12.82	10.46	11.13	7.89	9.43	12.54	15.52	17.57	18.02
S3	10.76	13.40	10.57	11.82	8.13	10.30	13.51	16.17	18.42	18.66
S4	11.08	14.26	10.88	12.05	8.52	10.79	15.75	16.49	18.72	19.45
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	12.23	12.20	15.84	18.11	15.80	13.01	16.89	15.16	9.36	15.72
S2	11.51	13.18	18.05	18.39	16.29	14.16	16.18	16.07	10.19	16.12
S3	12.13	13.51	18.61	18.60	16.62	13.97	16.62	16.47	10.40	16.24
S4	12.84	13.89	18.81	20.50	16.38	14.54	16.24	16.74	10.26	16.76
SE $\pm$		0.076								
C.D. at 5%		0.212								

Effect of sowing dates:

The data presented in Table 67 revealed that, the mean number of tillers per plant of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during S₁ -*kharif* season (24th MW) produced significantly minimum number of tillers per plant (8.04) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. General mean number of tillers per plant of both years and pooled mean were found to be 9.82, 9.65 and 9.74, respectively.

Table 67. Effect of different treatment on number of tillers per plant of rice genotypes

Treatments	Number of tillers per plant								
	At tillering			At flowering			At harvest		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)									
S1 : 24 th MW	7.10	6.98	7.04	9.10	8.98	9.04	8.10	7.98	8.04
S2 : 48 th MW	11.73	11.16	11.44	11.77	11.08	11.43	10.56	10.18	10.37
S3 : 50 th MW	11.05	11.26	11.16	11.07	11.29	11.18	10.55	10.17	10.36
S4 :52 th MW	11.99	11.70	11.85	12.03	11.68	11.85	10.07	10.29	10.18
SE $\pm$	0.11	0.10	0.08	0.11	0.12	0.09	0.09	0.10	0.07
C.D. at 5%	0.37	0.36	0.29	0.38	0.41	0.32	0.30	0.35	0.24
B)Sub plot (Varieties)									
V1:Karjat-1	10.83	10.50	10.67	10.83	10.50	10.67	9.92	9.67	9.79
V2:Karjat-3	11.00	11.00	11.00	11.00	11.00	11.00	9.75	9.83	9.79
V3:Karjat-4,	10.92	10.83	10.88	10.92	10.83	10.88	9.33	10.17	9.75
V4:Karjat-7	13.67	11.25	12.46	13.67	11.25	12.46	10.25	10.33	10.29
V5:Karjat-184	11.42	10.50	10.96	11.42	10.50	10.96	10.75	9.67	10.21
V6:Sahyadri-2	12.08	11.67	11.88	12.08	11.67	11.88	10.92	10.58	10.75
V7:Sahyadri-4	12.42	11.25	11.83	12.42	11.25	11.83	11.25	10.75	11.00
V8:Phondaghat -1	10.25	10.33	10.29	10.25	10.33	10.29	8.83	9.17	9.00
V9:Ratnagiri-1	10.92	10.83	10.88	10.92	10.83	10.88	9.58	9.50	9.54
V10:Ratnagiri-5	10.50	10.83	10.67	10.50	10.83	10.67	9.08	9.92	9.50
V11:Ratnagiri- 6	11.50	10.58	11.04	11.50	10.58	11.04	10.25	8.92	9.58
V12:Ratnagiri- 7	10.42	10.33	10.38	10.42	10.33	10.38	9.42	9.25	9.33
V13:Ratnagiri -24	10.85	10.46	10.65	10.85	10.46	10.65	9.69	9.62	9.65
V14:Ratnagiri-73	11.58	11.33	11.46	11.58	11.33	11.46	10.58	10.00	10.29
V15:Ratnagiri-711	11.08	10.75	10.92	11.08	10.75	10.92	9.75	9.33	9.54
V16:IRRI-14	10.92	11.25	11.08	10.92	11.25	11.08	9.92	9.92	9.92
V17:IRRI-15	10.75	10.50	10.63	10.75	10.50	10.63	9.67	9.17	9.42
V18:IRRI-20	10.83	10.75	10.79	10.83	10.75	10.79	9.50	9.33	9.42
V19:IRRI-21	13.67	10.92	12.29	13.67	10.92	12.29	10.92	9.92	10.42
V20:IRRI-22	11.00	10.58	10.79	11.00	10.58	10.79	10.33	10.25	10.29
V21:IRRI-27	10.50	11.00	10.75	10.50	11.00	10.75	9.08	9.42	9.25
V22:IRRI-28	10.58	10.50	10.54	10.58	10.50	10.54	9.25	9.25	9.25
V23:IRRI-34	11.25	10.75	11.00	11.25	10.75	11.00	10.00	9.25	9.63
V24:IRRI-36	10.67	10.75	10.71	10.67	10.75	10.71	9.17	10.00	9.58
V25:IRRI-47	11.17	10.67	10.92	11.17	10.67	10.92	10.08	9.42	9.75
V26:IRRI-52	10.92	10.83	10.88	10.92	10.83	10.88	9.83	10.33	10.08
V27:IRRI-53	10.67	10.75	10.71	10.67	10.75	10.71	10.17	9.75	9.96
V28:IRRI-55	10.83	11.00	10.92	10.83	11.00	10.92	10.17	9.92	10.04
V29:IRRI-62	11.50	10.33	10.92	11.50	10.33	10.92	10.83	9.17	10.00
V30:IR-35	9.33	9.67	9.50	9.33	9.67	9.50	8.17	8.42	8.29
V31:Laldodaki	10.42	10.58	10.50	10.42	10.58	10.50	9.33	9.33	9.33
V32:IR2289-6-22-5	10.58	10.50	10.54	10.58	10.50	10.54	9.50	9.08	9.29
V33:Narmada	10.75	10.83	10.79	10.75	10.83	10.79	9.92	9.83	9.88
V34:Ananda	11.17	11.08	11.13	11.17	11.08	11.13	10.67	9.58	10.13
V35:Ambpandhari	9.50	10.17	9.83	9.50	10.17	9.83	8.58	8.92	8.75
V36:Hira	9.42	10.33	9.88	9.42	10.33	9.88	8.42	8.83	8.63
V37:OR-1516-1-5-A	10.42	10.67	10.54	10.42	10.67	10.54	9.42	9.50	9.46
V38:China	10.83	11.00	10.92	10.83	11.00	10.92	9.75	9.92	9.83
V39:Sorati	10.33	10.67	10.50	10.33	10.67	10.50	9.50	9.75	9.63
V40:Mhadi	11.25	10.92	11.08	11.25	10.92	11.08	10.42	10.42	10.42
SE $\pm$	0.32	0.31	0.24	0.32	0.31	0.24	0.30	0.33	0.24
C.D. at 5%	0.89	0.88	0.68	0.89	0.88	0.68	0.83	0.92	0.66
Interaction Effect (S x M)									
SE $\pm$	0.64	0.63	0.49	0.64	0.63	0.49	0.59	0.66	0.47
C.D. at 5%	1.77	1.74	1.35	1.78	1.75	1.35	1.65	NS	1.32
General mean	10.47	10.27	10.37	10.99	10.76	10.87	9.82	9.65	9.74

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st January)

The rice crop sown during *rabi* season, S₂ (the 48th MW) date of sowing recorded significantly maximum number of tillers per plant (10.37) which was at par with S₃ and S₄ for pooled mean.

Effect of genotypes:

The number of tillers per plant of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 67). The rice genotype V₇ i.e. Sahyadri-4 recorded significantly maximum number of tillers per plant (11) which was at par with V₆ i.e. Sahyadri-2 (10.75), V₁₉ i.e. IRRI-21 (10.42) and V₄₀ i.e. Mhadi (10.42) over others. Rice genotype V₃₀ i.e. IR-35 recorded significantly minimum number of tillers per plant (8.29) which was at par with V₃₆ i.e. Hira (8.63) over others.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of number of tillers per plant (Table 68). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₂₃ i.e. IRRI 34 recorded significantly higher number of tillers per plant (9.8) which was at par with S₁V₃, S₁V₁₄, S₁V₁₅, S₁V₁₆, S₁V₂₀, S₁V₂₄, S₁V₂₅, S₁V₂₆, S₁V₂₉, S₁V₃₃, S₁V₃₄ and S₁V₃₈ over others.

In case of *rabi* season S₂V₇ and S₃V₇ was recorded significantly higher number of tillers per plant (12.3) which was at par with S₂V₁, S₂V₄, S₄V₄, S₂V₅, S₃V₅, S₄V₅, S₂V₆, S₃V₆, S₄V₆, S₄V₇, S₄V₉, S₂V₁₃, S₃V₁₃, S₄V₁₄, S₂V₁₉, S₃V₁₉, S₂V₂₀, S₃V₂₀, S₂V₂₇, S₃V₂₇, S₂V₂₈, S₃V₂₈, S₂V₃₄, S₃V₃₄, S₂V₄₀, S₃V₄₀ over others. However S₁S₃₀ with rice genotype IR-35 recorded significantly minimum number of tillers per plant (5.5) which was at par with S₁V₁ and S₁V₃₆ over others.

4.5 3. Total no. of panicles per plant:

Data regarding mean total number of panicles per plant of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 69. It was observed that the mean total number of panicles per plant was minimum during

Table 68 : Interaction effect of number of tillers per plant on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	6.7	8.3	9.3	8.3	8.0	8.3	8.3	8.3	7.3	7.7
S2	11.3	10.0	9.0	11.0	11.7	12.3	12.7	9.3	9.7	9.7
S3	11.3	10.0	9.0	10.7	11.7	12.3	12.7	9.3	9.7	9.7
S4	10.3	10.7	10.0	11.0	11.7	10.7	11.3	8.3	11.7	9.3
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	7.7	7.7	8.3	8.7	9.3	8.7	7.7	7.7	8.7	9.7
S2	11.3	10.7	11.7	11.3	10.0	10.7	10.7	10.3	12.3	11.3
S3	11.3	10.7	11.7	11.3	10.0	10.7	10.7	10.3	12.3	11.3
S4	10.7	8.7	10.3	11.0	9.7	9.7	9.7	9.7	10.3	9.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	7.7	6.3	10.7	8.7	10.3	9.3	7.0	8.0	8.3	5.0
S2	10.0	10.3	9.7	9.3	10.0	10.3	11.7	11.3	11.7	9.3
S3	10.0	10.3	9.7	9.3	10.0	10.3	11.7	11.3	11.7	9.3
S4	8.7	10.0	10.0	9.3	10.0	9.3	10.3	10.0	11.7	9.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	7.3	8.7	8.3	8.0	7.0	5.7	8.3	9.7	6.7	8.3
S2	10.0	10.0	10.7	12.3	9.3	9.0	8.7	9.7	10.7	11.3
S3	10.0	10.0	10.7	12.3	9.3	9.0	8.7	9.7	10.7	11.3
S4	10.0	9.3	10.0	10.0	8.7	10.0	12.0	10.0	10.0	10.7
SE $\pm$		0.59								
C.D. at 5%		1.65								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	6.7	8.0	8.7	8.3	7.3	7.3	8.0	7.7	7.3	7.7
S2	11.0	11.0	11.0	11.0	10.3	11.7	12.0	9.3	10.0	11.0
S3	10.3	11.0	11.0	11.0	10.3	11.7	12.0	9.3	10.0	11.0
S4	10.7	9.3	10.0	11.0	10.7	11.7	11.0	10.3	10.7	10.0
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	7.7	7.3	8.7	8.3	8.3	8.7	7.3	8.3	8.0	8.0
S2	9.3	10.3	11.3	10.3	9.7	10.0	9.3	9.3	10.7	11.0
S3	9.3	10.3	11.3	10.3	9.7	10.0	9.3	9.3	10.7	11.0
S4	9.3	9.0	10.3	11.0	9.7	11.0	10.7	10.3	10.3	11.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	7.3	7.7	9.0	8.7	9.0	8.3	7.7	8.7	8.7	6.0
S2	10.0	9.7	9.3	10.3	9.3	11.0	10.3	10.7	9.0	9.3
S3	10.0	9.7	9.3	10.3	9.3	11.0	10.3	10.7	9.0	9.3
S4	10.3	10.0	9.3	10.7	10.0	11.0	10.7	9.7	10.0	9.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	7.7	7.7	9.0	9.0	7.7	6.7	8.3	9.0	7.7	7.7
S2	9.0	9.3	9.7	9.7	8.7	9.3	10.0	10.3	10.7	12.0
S3	9.0	9.3	9.7	9.7	8.7	9.3	10.0	10.3	10.7	12.0
S4	11.7	10.0	11.0	10.0	10.7	10.0	9.7	10.0	10.0	10.0
SE $\pm$		0.66								
C.D. at 5%		1.85								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	6.7	8.2	9.0	8.3	7.7	7.8	8.2	8.0	7.3	7.7
S2	11.2	10.5	10.0	11.0	11.0	12.0	12.3	9.3	9.8	10.3
S3	10.8	10.5	10.0	10.8	11.0	12.0	12.3	9.3	9.8	10.3
S4	10.5	10.0	10.0	11.0	11.2	11.2	11.2	9.3	11.2	9.7
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	7.7	7.5	8.5	8.5	8.8	8.7	7.5	8.0	8.3	8.8
S2	10.3	10.5	11.5	10.8	9.8	10.3	10.0	9.8	11.5	11.2
S3	10.3	10.5	11.5	10.8	9.8	10.3	10.0	9.8	11.5	11.2
S4	10.0	8.8	10.3	11.0	9.7	10.3	10.2	10.0	10.3	10.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	7.5	7.0	9.8	8.7	9.7	8.8	7.3	8.3	8.5	5.5
S2	10.0	10.0	9.5	9.8	9.7	10.7	11.0	11.0	10.3	9.3
S3	10.0	10.0	9.5	9.8	9.7	10.7	11.0	11.0	10.3	9.3
S4	9.5	10.0	9.7	10.0	10.0	10.2	10.5	9.8	10.8	9.0
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	7.5	8.2	8.7	8.5	7.3	6.2	8.3	9.3	7.2	8.0
S2	9.5	9.7	10.2	11.0	9.0	9.2	9.3	10.0	10.7	11.7
S3	9.5	9.7	10.2	11.0	9.0	9.2	9.3	10.0	10.7	11.7
S4	10.8	9.7	10.5	10.0	9.7	10.0	10.8	10.0	10.0	10.3
SE $\pm$		0.47								
C.D. at 5%		1.32								

both years and in pooled mean. The mean total number of panicles per plant was 8.69, 8.79 and 8.75 recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 69 revealed that, the mean total number of panicles per plant of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during S₁-kharif season (24th MW) produced significantly minimum total number of panicles per plant as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

Table 69. Effect of different treatment on total no of panicles per plant of rice genotypes

Treatments	Total No. of panicles per plant		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	7.5	7.7	7.6
S2 : 48 th MW	9.0	9.0	9.0
S3 : 50 th MW	9.5	9.2	9.3
S4 :52 th MW	8.8	9.3	9.1
SE $\pm$	0.082	0.165	0.102
C.D. at 5%	0.290	0.583	0.309
B)Sub plot (Varieties)			
V1:Karjat-1	9.3	8.9	8.8
V2:Karjat-3	9.8	10.8	10.6
V3:Karjat-4,	8.5	8.8	8.8
V4:Karjat-7	8.6	8.9	8.4
V5:Karjat-184	8.4	8.3	8.5
V6:Sahyadri-2	8.5	7.9	8.2
V7:Sahyadri-4	9.4	7.9	8.5
V8:Phondaghat -1	8.8	8.9	9.2
V9:Ratnagiri-1	8.3	8.9	8.3
V10:Ratnagiri-5	8.8	9.3	9.1
V11:Ratnagiri- 6	8.4	8.3	8.1
V12:Ratnagiri- 7	9.0	8.4	8.9
V13:Ratnagiri -24	8.5	9.1	9.0
V14:Ratnagiri-73	8.8	8.0	8.3
V15:Ratnagiri-711	8.8	9.1	9.0
V16:IRRI-14	8.8	9.3	9.0
V17:IRRI-15	8.6	8.9	8.7
V18:IRRI-20	8.6	8.7	8.8
V19:IRRI-21	8.8	9.0	8.9
V20:IRRI-22	8.9	9.0	9.0
V21:IRRI-27	7.9	8.3	8.1
V22:IRRI-28	8.7	8.0	8.3
V23:IRRI-34	8.8	9.2	8.9
V24:IRRI-36	8.8	8.8	8.8
V25:IRRI-47	8.3	8.9	8.7
V26:IRRI-52	8.3	9.0	8.6
V27:IRRI-53	8.6	8.3	8.6
V28:IRRI-55	8.8	9.2	8.7
V29:IRRI-62	8.9	8.5	9.0
V30:IR-35	8.9	8.4	8.5
V31:Laldodaki	9.3	8.5	8.8
V32:IR2289-6-22-5	8.6	9.3	8.8
V33:Narmada	8.7	9.0	9.0
V34:Ananda	8.6	9.3	9.0
V35:Ambpandhari	8.6	8.7	8.5
V36:Hira	8.5	8.7	8.5
V37:OR-1516-1-5-A	8.5	8.8	8.8
V38:China	8.6	9.5	9.0
V39:Sorati	8.7	8.5	8.5
V40:Mhadi	8.1	8.7	8.7
SE $\pm$	0.415	0.399	0.280
C.D. at 5%	NS	1.112	0.777
Interaction Effect (S x V)			
SE $\pm$	0.824	0.806	0.559
C.D. at 5%	2.300	NS	NS
General Mean	8.69	8.79	8.75

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

The rice crop sown during *rabi* season, S₃ (the 50th MW) date of sowing recorded significantly maximum total number of panicles per plant (9.3) which was at par with S₂ and S₄ over others.

Effect of genotypes:

The total number of panicles per plant of rice was influenced significantly due to the different genotypes during both year and pooled mean. The rice genotype Karjat-3 recorded significantly maximum total number of panicles per plant (10.8) which was superior over all other genotypes during pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotypes was non significant in respect of total number of panicles per plant (Table 70). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₂ i.e. Karjat-3 recorded higher total number of panicles per plant (8.7) which was superior over other treatment combination during 2020-21, 2021-22 years and pooled mean.

In case of *rabi* season S₂V₂ i.e. crop sown in S₂ date of sowing (48th MW) with Karjat-3 was recorded higher total number of panicles per plant (11.7) which was superior over other treatment combination with crop sown in S₂ date of sowing (48th MW) and S₃ date of sowing (50th MW) during both years and pooled mean. However, S₄V₉, with rice genotype Ratnagiri-1 recorded minimum total number of panicles per plant which was superior over other treatment combination.

4.5.4. Panicle length (cm):

Data regarding mean panicle length of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 71. It was observed that, the data clearly revealed that, the mean panicle length was maximum during both years and in pooled mean.

The mean panicle length was 21.40cm, 21.57 cm and 21.48 cm recorded during 2020-21, 2021-22 and pooled mean respectively.

Table 70: Interaction effect of total no. of panicles per plant on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	7.0	8.3	7.7	7.3	6.7	7.7	8.0	8.0	5.3	7.3
S2	10.7	10.7	8.7	8.7	9.0	9.3	10.7	10.0	8.3	8.3
S3	8.0	10.0	8.7	9.3	10.0	9.0	9.3	10.0	10.0	9.0
S4	11.3	10.3	9.0	9.0	8.0	8.0	9.7	7.0	9.3	10.3
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	7.7	7.3	7.3	8.7	7.7	7.3	6.0	8.3	7.0	8.7
S2	7.7	8.0	10.0	10.0	11.0	9.3	8.7	8.3	8.7	8.7
S3	8.7	10.0	8.7	8.3	8.7	9.7	10.7	9.0	8.7	9.3
S4	9.7	10.7	8.0	8.3	8.0	9.0	9.0	8.7	10.7	9.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	6.3	7.3	7.7	8.0	8.0	8.0	6.3	7.3	8.0	9.3
S2	8.3	8.7	8.3	9.3	7.0	8.0	9.0	10.3	9.7	8.7
S3	10.0	9.7	10.0	9.3	9.3	10.0	9.3	8.3	8.3	9.3
S4	7.0	9.0	9.0	8.7	8.7	7.3	9.7	9.3	9.7	8.3
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	7.3	7.3	7.0	8.3	6.7	7.3	7.7	7.7	6.7	7.3
S2	10.3	9.7	8.7	7.7	9.0	9.0	8.3	8.7	7.7	9.3
S3	10.3	9.7	9.7	8.3	10.7	10.0	10.3	9.0	11.3	10.3
S4	9.0	7.7	9.3	10.0	8.0	7.7	7.7	9.0	9.0	5.3
SE $\pm$		0.824								
C.D. at 5%		2.300								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	7.0	9.0	8.0	9.3	7.0	8.0	6.3	7.3	8.0	9.3
S2	9.7	12.0	9.3	8.7	8.3	7.0	7.7	8.7	9.7	10.0
S3	10.0	11.3	8.7	7.7	9.7	8.3	8.0	10.0	10.7	9.0
S4	9.0	10.7	9.0	10.0	8.3	8.3	9.7	9.7	7.3	8.7
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	7.0	6.0	7.0	6.0	8.7	8.7	7.3	7.3	8.7	7.7
S2	8.7	9.7	9.3	8.0	9.7	8.3	7.3	8.7	9.3	9.3
S3	8.7	8.7	9.7	9.7	9.7	10.0	11.0	9.0	9.0	10.7
S4	8.7	9.3	10.3	8.3	8.3	10.3	10.0	9.7	9.0	8.3
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	7.0	6.7	9.3	8.0	8.3	7.3	7.7	8.0	7.0	6.7
S2	8.7	8.3	8.0	9.3	9.7	9.7	7.7	9.3	9.3	10.0
S3	8.7	8.7	9.0	8.3	8.3	9.0	9.3	9.3	8.0	7.7
S4	8.7	8.3	10.3	9.3	9.3	10.0	8.7	10.0	9.7	9.3
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	7.3	8.0	8.0	7.7	9.0	6.3	7.3	8.3	8.0	7.0
S2	8.0	9.7	8.3	10.7	8.0	9.0	9.3	9.3	8.3	9.0
S3	8.7	9.7	9.3	9.0	9.0	8.7	9.0	10.0	9.7	10.0
S4	10.0	9.7	10.3	10.0	8.7	10.7	9.3	10.3	8.0	8.7
SE $\pm$		0.806								
C.D. at 5%		NS								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	7.0	8.7	7.8	8.3	6.8	7.8	7.2	7.7	6.7	8.3
S2	9.5	11.7	9.3	8.3	9.0	8.0	8.7	9.7	9.0	9.3
S3	9.2	11.0	8.7	8.2	9.7	8.7	8.5	10.5	10.2	9.5
S4	9.7	11.2	9.3	8.8	8.3	8.3	9.5	9.0	7.5	9.3
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	7.3	6.7	7.2	7.3	8.2	8.0	6.7	7.8	7.8	8.2
S2	7.8	9.0	9.7	9.0	10.2	9.0	7.8	8.7	9.5	8.8
S3	8.0	9.7	9.5	8.7	9.5	9.7	10.3	9.5	8.7	10.2
S4	9.2	10.3	9.5	8.3	8.3	9.3	9.8	9.0	9.5	9.0
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	6.7	7.0	8.5	8.0	8.2	7.3	7.7	7.2	7.8	7.7
S2	8.5	8.2	8.3	9.2	8.8	8.7	8.2	9.7	9.7	9.0
S3	9.0	9.5	9.3	8.7	8.8	9.7	9.3	8.7	8.5	8.2
S4	8.2	8.3	9.3	9.3	8.8	8.8	9.2	9.2	9.8	9.2
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	7.7	7.2	8.0	7.7	7.8	6.8	7.7	7.8	7.3	7.3
S2	9.0	9.7	9.2	9.2	8.2	8.7	9.2	9.0	8.2	8.7
S3	9.5	9.8	9.5	8.8	9.5	9.5	9.5	9.7	9.8	10.7
S4	9.2	8.7	9.5	10.3	8.7	9.2	8.7	9.3	8.8	8.2
SE $\pm$		0.559								
C.D. at 5%		NS								

Effect of sowing dates:

The data presented in Table 71 revealed that, the mean panicle length of rice genotypes was non significantly influenced due to different sowing dates.

Crop sown during S₁ -*kharif* season (24th MW) showed maximum panicle length (21.62cm) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean. General mean panicle length of both years and pooled mean were found to be 21.40 cm, 21.57 cm and 21.48cm days respectively.

Table 71.Effect of different treatment on Panicle length (cm).of rice genotypes

Treatments	Panicle length (cm)		
	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)			
S1 : 24 th MW	21.45	21.79	21.62
S2 : 48 th MW	21.39	21.21	21.30
S3 : 50 th MW	21.16	21.93	21.55
S4 :52 th MW	21.60	21.36	21.48
SE $\pm$	0.07	0.27	0.15
C.D. at 5%	0.23	NS	NS
B)Sub plot (Varieties)			
V1:Karjat-1	19.17	19.53	19.35
V2:Karjat-3	21.44	21.00	21.22
V3:Karjat-4,	17.97	16.61	17.29
V4:Karjat-7	19.20	20.92	20.06
V5:Karjat-184	20.93	20.86	20.89
V6:Sahyadri-2	23.90	22.17	23.03
V7:Sahyadri-4	23.54	23.21	23.37
V8:Phondaghat -1	21.88	21.73	21.81
V9:Ratnagiri-1	19.12	20.74	19.93
V10:Ratnagiri-5	19.69	18.49	19.09
V11:Ratnagiri- 6	21.04	21.88	21.46
V12:Ratnagiri- 7	19.80	21.14	20.47
V13:Ratnagiri -24	19.69	20.57	20.13
V14:Ratnagiri-73	20.31	20.83	20.57
V15:Ratnagiri-711	20.18	21.80	20.99
V16:IRRI-14	21.16	21.16	21.16
V17:IRRI-15	22.02	22.31	22.17
V18:IRRI-20	21.47	21.76	21.61
V19:IRRI-21	23.28	22.02	22.65
V20:IRRI-22	23.19	23.44	23.31
V21:IRRI-27	22.24	23.57	22.90
V22:IRRI-28	21.33	22.78	22.05
V23:IRRI-34	24.76	23.54	24.15
V24:IRRI-36	20.95	21.56	21.25
V25:IRRI-47	21.54	23.08	22.31
V26:IRRI-52	22.61	23.30	22.95
V27:IRRI-53	22.41	22.92	22.66
V28:IRRI-55	21.59	22.08	21.84
V29:IRRI-62	22.08	24.00	23.04
V30:IR-35	22.96	23.10	23.03
V31:Laldodaki	23.80	22.69	23.25
V32:IR2289-6-22-5	21.54	21.18	21.36
V33:Narmada	22.46	22.00	22.23
V34:Ananda	23.31	22.88	23.10
V35:Ambpandhari	21.99	21.97	21.98
V36:Hira	20.06	19.51	19.78
V37:OR-1516-1-5-A	18.92	18.86	18.89
V38:China	20.58	19.76	20.17
V39:Sorati	20.76	20.58	20.67
V40:Mhadi	19.45	19.59	19.52
SE $\pm$	0.53	0.61	0.44
C.D. at 5%	1.49	1.70	1.22
Interaction Effect (S $\times$ V)			
SE $\pm$	1.07	1.22	0.87
C.D. at 5%	2.97	3.39	2.43
General Mean	21.40	21.57	21.48

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 :52th MW (24th-31st December)

The rice crop sown during *rabi* season, S₃ (the 50th MW) date of sowing recorded significantly maximum panicle length (21.55cm) as compared to crop sown during S₂ (48th MW) and S₄ (52th MW) in both year and pooled mean

Effect of genotypes:

The panicle length of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 71). The rice genotype V₂₃ i.e. IRRI-34 recorded significantly maximum panicle length (24.15cm) which was at par with V₆ i.e. Sahyadri-2, V₇ i.e. Sahyadri-4, V₂₀ i.e. IRRI-22, V₂₉ i.e. IRRI-62, V₃₀ i.e. IR-35, V₃₁ i.e. Laldadki and V₃₄ i.e. Anandaduring pooled mean over others.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of panicle length (Table 72). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₂₂ i.e. IRRI-28 recorded Significantly higher panicle length (26.65cm) which was superior over other treatment combination during 2020-21, 2021-22 years and pooled mean.

In case of *rabi* season S₃V₂₀ i.e. IRRI-22 crop sown in S₃ date of sowing (50th MW) with was recorded significantly higher panicle length (25.58cm) which was at par with S₄V₆, S₁V₇, S₃V₇, S₃V₇, S₄V₇, S₁V₁₇, S₃V₁₉, S₃V₂₀, S₁V₂₄, S₁V₂₅, S₂V₂₇, S₁V₂₆, S₃V₂₆, S₁V₂₇, S₂V₂₇, S₄V₃₀, S₁V₃₁, S₃V₃₁, S₄V₃₁, S₁V₃₄, S₂V₃₄ and S₁V₃₇ over others. However, S₁V₁ with rice genotype Karjat-1 i.e. crop sown in S₁ date of sowing (24th MW) recorded significantly minimum panicle length (17.12 cm) which was superior over other.

4.5.5. Total number of spikelet per panicle:

Data regarding mean total number of spikelet per panicle of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 73. It was observed that, the mean total number of spikelet per panicle was maximum during both years and in pooled mean.

Table 72 : Interaction effect of Panicle length (cm).on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	17.00	21.30	18.00	20.00	17.33	23.67	25.00	25.00	17.33	19.00
S2	20.08	21.95	18.18	17.18	22.32	24.33	21.48	20.13	21.05	21.50
S3	20.33	20.73	20.33	17.47	22.07	22.93	24.93	19.50	15.80	19.63
S4	20.94	21.79	18.71	22.16	21.99	24.32	22.41	22.91	22.30	19.31
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	22.67	20.00	20.00	16.33	20.67	20.00	23.00	20.77	21.00	18.67
S2	19.39	21.64	22.13	21.22	20.40	21.91	21.10	21.68	23.57	22.29
S3	20.10	17.07	22.13	21.67	16.30	20.87	22.50	22.83	25.00	27.37
S4	22.33	20.49	21.06	21.00	23.36	21.88	21.49	21.70	23.56	23.42
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	21.67	27.50	22.43	22.83	22.90	23.80	23.00	17.83	22.50	22.77
S2	23.16	20.92	23.26	18.51	21.81	23.37	23.28	23.45	21.72	23.11
S3	21.37	18.67	21.87	21.87	20.53	23.03	22.63	22.23	20.50	22.53
S4	22.42	19.71	21.24	20.58	20.91	20.24	20.71	22.84	23.61	23.88
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	23.80	21.67	23.00	23.77	20.70	20.03	24.50	23.67	20.57	19.27
S2	23.02	21.72	21.77	24.35	22.69	21.00	18.19	20.85	22.36	20.74
S3	25.30	21.97	21.80	22.97	22.17	18.40	16.93	20.90	21.00	18.93
S4	24.88	20.79	23.28	23.27	22.39	20.79	17.38	17.89	19.44	19.44
SE $\pm$		1.07								
C.D. at 5%		2.97								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	17.23	21.33	18.43	19.23	18.50	21.33	21.73	21.00	18.53	17.77
S2	18.22	20.64	18.77	19.43	20.77	21.90	22.21	20.89	21.50	19.21
S3	21.51	20.23	18.67	22.77	19.96	21.23	22.66	21.93	21.44	18.79
S4	21.23	21.80	16.90	21.57	22.70	23.43	24.57	20.13	22.10	18.77
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	21.87	20.77	20.80	17.73	21.93	21.00	23.57	22.47	20.10	19.70
S2	21.36	19.78	21.55	21.50	21.43	21.11	21.22	21.68	22.45	22.22
S3	23.12	21.68	23.68	21.44	22.91	21.54	22.22	22.21	23.68	23.79
S4	21.77	22.10	23.23	20.33	21.43	21.00	22.23	21.23	22.43	19.77
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	21.33	25.80	22.33	24.20	24.07	22.53	24.23	21.00	21.53	23.20
S2	21.89	21.00	22.55	21.00	23.00	22.67	23.33	22.16	21.86	21.51
S3	23.01	21.86	22.97	20.68	23.34	24.56	22.01	22.21	23.21	21.57
S4	23.70	21.20	19.70	19.77	21.90	22.67	21.43	22.33	22.53	22.90
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	23.27	21.10	21.00	22.77	21.47	17.43	22.80	21.47	18.43	20.23
S2	22.47	20.68	22.43	24.00	22.22	20.12	19.18	19.67	21.01	19.90
S3	22.63	21.34	23.07	21.40	21.04	20.70	16.61	19.22	22.82	19.46
S4	22.53	21.27	20.67	22.53	22.63	20.90	18.00	18.50	19.67	19.43
SE $\pm$		1.22								
C.D. at 5%		3.39								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	17.12	21.32	18.22	19.62	17.92	22.50	23.37	23.00	17.93	18.38
S2	19.15	21.30	18.47	18.31	21.54	23.12	21.84	20.51	21.28	20.36
S3	20.92	20.48	19.50	20.12	21.01	22.08	23.80	20.72	18.62	19.21
S4	21.09	21.80	17.81	21.86	22.35	23.88	23.49	21.52	22.20	19.04
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	22.27	20.38	20.40	17.03	21.30	20.50	23.28	21.62	20.55	19.18
S2	20.37	20.71	21.84	21.36	20.92	21.51	21.16	21.68	23.01	22.26
S3	21.61	19.37	22.91	21.56	19.61	21.21	22.36	22.52	24.34	25.58
S4	22.05	21.30	22.15	20.67	22.40	21.44	21.86	21.47	23.00	21.60
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	21.50	26.65	22.38	23.52	23.48	23.17	23.62	19.42	22.02	22.98
S2	22.52	20.96	22.90	19.76	22.41	23.02	23.31	22.81	21.79	22.31
S3	22.19	20.26	22.42	21.27	21.94	23.80	22.32	22.22	21.86	22.05
S4	23.06	20.46	20.47	20.17	21.41	21.46	21.07	22.59	23.07	23.39
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	23.53	21.38	22.00	23.27	21.08	18.73	23.65	22.57	19.50	19.75
S2	22.74	21.20	22.10	24.18	22.46	20.56	18.68	20.26	21.68	20.32
S3	23.97	21.66	22.43	22.18	21.61	19.55	16.77	20.06	21.91	19.20
S4	23.71	21.03	21.97	22.90	22.51	20.85	17.69	18.20	19.56	19.44
SE $\pm$		0.87								
C.D. at 5%		2.43								

The mean total number of spikelet per panicle was 199.40, 197.77 and 198.58 recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 73 revealed that, the mean total number of spikelet per panicle of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during S₁-*kharif* season (24th MW) produced significantly minimum total number of spikelet per panicle (183.85) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

Table 73. Effect of different treatment on total number of spikelet per panicle of rice genotypes

Treatments	Total number of spikelet per panicle		
	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)			
S1 : 24 th MW	184.87	182.83	183.85
S2 : 48 th MW	198.91	205.93	202.42
S3 : 50 th MW	205.99	199.59	202.79
S4 : 52 th MW	207.82	202.72	205.27
SE $\pm$	2.35	1.16	1.39
C.D. at 5%	8.14	4.03	4.80
B) Sub plot (Varieties)			
V1: Karjat-1	198	192	195
V2: Karjat-3	221	258	239
V3: Karjat-4,	203	196	199
V4: Karjat-7	182	179	180
V5: Karjat-184	202	201	201
V6: Sahyadri-2	195	192	193
V7: Sahyadri-4	199	204	201
V8: Phondaghat -1	182	177	180
V9: Ratnagiri-1	180	169	175
V10: Ratnagiri-5	225	210	218
V11: Ratnagiri- 6	238	248	243
V12: Ratnagiri- 7	231	255	243
V13: Ratnagiri -24	207	208	208
V14: Ratnagiri-73	196	174	185
V15: Ratnagiri-711	179	189	184
V16: IRRI-14	234	236	235
V17: IRRI-15	231	214	223
V18: IRRI-20	200	213	207
V19: IRRI-21	212	205	209
V20: IRRI-22	210	201	205
V21: IRRI-27	182	198	190
V22: IRRI-28	201	199	200
V23: IRRI-34	207	211	209
V24: IRRI-36	197	187	192
V25: IRRI-47	193	191	192
V26: IRRI-52	199	179	189
V27: IRRI-53	203	199	201
V28: IRRI-55	216	207	212
V29: IRRI-62	216	219	217
V30: IR-35	206	194	200
V31: Laldodaki	162	181	172
V32: IR2289-6-22-5	156	166	161
V33: Narmada	172	177	175
V34: Ananda	168	178	173
V35: Ambpandhari	191	182	186
V36: Hira	170	161	165
V37: OR-1516-1-5-A	185	169	177
V38: China	195	186	190
V39: Sorati	209	190	199
V40: Mhadi	206	200	203
SE $\pm$	4.86	5.17	3.59
C.D. at 5%	13.53	14.39	9.98
Interaction Effect (S x V)			
SE $\pm$	9.72	10.34	7.17
C.D. at 5%	27.05	28.78	19.95
General Mean	199.40	197.77	198.58

S1 : 24th MW (11th-17th June)
 S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)
 S4 : 52th MW (24th-31st December)

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum total number of spikelet per panicle (205.27) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in both year and pooled mean. Significantly maximum total number of spikelet per panicle was recorded in S₄ (205.27) which was at par with S₂ (202.42) and S₃ (202.79) over others.

Effect of genotypes:

The total number of spikelet per panicle of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 73). The rice genotype V₁₁ i.e. Ratnagiri-6 and V₁₂ i.e. Ratnagiri-7, recorded significantly maximum total number of spikelet per panicle (243) which was at par with V₂ i.e. Karjat-3 (239) and V₁₆ i.e. IRRI-14 (235) for pooled mean over others.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of total number of spikelet per panicle. (Table 74). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₁₄ i.e. Ratnagiri-73 recorded significantly higher total number of spikelet per panicle (208) which was at par with V₂ i.e. Karjat-3, V₃ i.e. Karjat-4, V₄ i.e. Karjat-7, V₁₀ i.e. Ratnagiri-5, V₁₁ i.e. Ratnagiri-6, V₁₁ i.e. Ratnagiri-6, V₁₂ i.e. Ratnagiri-7, V₁₅ i.e. Ratnagiri-711, V₁₆ i.e. IRRI-14, V₁₇ i.e. IRRI-15, V₂₄ i.e. IRRI-36, V₂₆ i.e. IRRI-52, V₂₇ i.e. IRRI-53, V₂₈ i.e. IRRI-55, V₂₉ i.e. IRRI-62, V₃₀ i.e. IR-35, V₃₄ i.e. Ananda, V₃₆ i.e. Hira, V₃₇ i.e. OR-1516-1-5A, V₃₈ i.e. China, V₃₉ i.e. Sorati, V₄₀ i.e. Mhadi over others.

In case of *rabi* season S₂V₁₂ i.e. crop sown in S₂ date of sowing (48th MW) with Ratnagiri-7 was recorded significantly higher total number of spikelet per panicle (275) which was at par with S₃V₂, S₂V₁₁, S₃V₁₁, S₄V₁₁, S₁V₁₂, S₂V₁₆, S₂V₂₉ over others. However, S₁V₆ with rice genotype Sahyadri-2 recorded significantly minimum total number of spikelet per panicle (138) which was at par S₂V₉, S₃V₁₅, S₂V₃₈, S₂V₃₇, S₃V₃₂, S₃V₃₃, S₃V₃₄, S₃V₃₆, S₃V₃₇ and S₄V₃₈ over other.

Table 73. Effect of different treatment on total number of spikelet per panicle of rice genotypes

Treatments	Total number of spikelet per panicle		
	2020-21	2021-22	Pooled
A) Main plot (Date of sowing)			
S1 : 24 th MW	184.87	182.83	183.85
S2 : 48 th MW	198.91	205.93	202.42
S3 : 50 th MW	205.99	199.59	202.79
S4 : 52 th MW	207.82	202.72	205.27
SE $\pm$	2.35	1.16	1.39
C.D. at 5%	8.14	4.03	4.80
B) Sub plot (Varieties)			
V1: Karjat-1	198	192	195
V2: Karjat-3	221	258	239
V3: Karjat-4,	203	196	199
V4: Karjat-7	182	179	180
V5: Karjat-184	202	201	201
V6: Sahyadri-2	195	192	193
V7: Sahyadri-4	199	204	201
V8: Phondaghat -1	182	177	180
V9: Ratnagiri-1	180	169	175
V10: Ratnagiri-5	225	210	218
V11: Ratnagiri- 6	238	248	243
V12: Ratnagiri- 7	231	255	243
V13: Ratnagiri -24	207	208	208
V14: Ratnagiri-73	196	174	185
V15: Ratnagiri-711	179	189	184
V16: IRRI-14	234	236	235
V17: IRRI-15	231	214	223
V18: IRRI-20	200	213	207
V19: IRRI-21	212	205	209
V20: IRRI-22	210	201	205
V21: IRRI-27	182	198	190
V22: IRRI-28	201	199	200
V23: IRRI-34	207	211	209
V24: IRRI-36	197	187	192
V25: IRRI-47	193	191	192
V26: IRRI-52	199	179	189
V27: IRRI-53	203	199	201
V28: IRRI-55	216	207	212
V29: IRRI-62	216	219	217
V30: IR-35	206	194	200
V31: Laldodaki	162	181	172
V32: IR2289-6-22-5	156	166	161
V33: Narmada	172	177	175
V34: Ananda	168	178	173
V35: Ambpandhari	191	182	186
V36: Hira	170	161	165
V37: OR-1516-1-5-A	185	169	177
V38: China	195	186	190
V39: Sorati	209	190	199
V40: Mhadi	206	200	203
SE $\pm$	4.86	5.17	3.59
C.D. at 5%	13.53	14.39	9.98
Interaction Effect (S x V)			
SE $\pm$	9.72	10.34	7.17
C.D. at 5%	27.05	28.78	19.95
General Mean	199.40	197.77	198.58

S1 : 24th MW (11th-17th June)
S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)
S4 : 52th MW (24th-31st December)

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	164	203	197	194	177	138	169	176	165	204
S2	195	251	190	164	202	220	210	184	154	217
S3	210	257	204	200	209	212	212	171	176	236
S4	210	247	207	163	218	204	215	188	203	214
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	198	186	199	208	206	201	202	168	151	178
S2	255	275	238	173	186	267	240	212	212	223
S3	258	261	239	182	151	247	227	205	224	206
S4	261	251	223	178	193	223	221	243	249	214
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	174	182	183	188	177	191	185	189	193	194
S2	191	208	214	188	198	192	218	245	258	200
S3	180	200	234	193	185	216	195	211	211	198
S4	213	209	206	200	209	159	207	202	207	209
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	180	163	175	192	169	185	181	197	186	188
S2	173	157	201	171	177	144	148	152	193	203
S3	158	149	153	157	202	180	203	202	198	206
S4	176	176	170	172	197	154	175	212	221	215
SE $\pm$		7.17								
C.D. at 5%		19.95								

4.5.6. No. of filled spikelet per panicle :

Data regarding mean number of filled spikelet per panicle of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 75. The data clearly revealed that, the mean number of filled spikelet was maximum during both years and in pooled mean.

The mean number of filled spikelet per panicle was 173.39, 172.63 and 173.01 recorded during 2020-21, 2021-22 and pooled mean respectively.

Table 75. Effect of different treatment on number of filled spikelet per panicle of rice genotypes

Treatments	Number of filled spikelet per panicle		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	160.04	158.16	159.10
S2 : 48 th MW	174.11	180.27	177.19
S3 : 50 th MW	179.08	174.12	176.60
S4 : 52 th MW	180.32	177.98	179.15
SE $\pm$	1.99	1.05	0.93
C.D. at 5%	6.90	3.62	3.23
B) Sub plot (Varieties)			
V1: Karjat-1	168.72	166.14	167.43
V2: Karjat-3	202.80	249.44	226.12
V3: Karjat-4,	173.84	169.23	171.54
V4: Karjat-7	156.02	153.53	154.77
V5: Karjat-184	172.18	174.27	173.23
V6: Sahyadri-2	165.03	167.23	166.13
V7: Sahyadri-4	169.36	179.24	174.30
V8: Phondaghat -1	154.58	152.49	153.54
V9: Ratnagiri-1	152.83	143.57	148.20
V10: Ratnagiri-5	217.16	184.41	200.78
V11: Ratnagiri- 6	235.74	223.85	229.80
V12: Ratnagiri- 7	196.69	229.44	213.07
V13: Ratnagiri -24	201.57	179.95	190.76
V14: Ratnagiri-73	169.12	148.73	158.92
V15: Ratnagiri-711	154.11	163.16	158.63
V16: IRRI-14	201.99	209.40	205.70
V17: IRRI-15	200.11	189.08	194.60
V18: IRRI-20	170.83	187.89	179.36
V19: IRRI-21	180.61	179.63	180.12
V20: IRRI-22	180.25	175.24	177.75
V21: IRRI-27	156.48	172.06	164.27
V22: IRRI-28	172.58	173.67	173.12
V23: IRRI-34	175.73	184.88	180.30
V24: IRRI-36	168.22	162.21	165.21
V25: IRRI-47	165.06	166.21	165.63
V26: IRRI-52	170.50	153.66	162.08
V27: IRRI-53	174.33	172.81	173.57
V28: IRRI-55	187.62	182.93	185.27
V29: IRRI-62	190.68	193.28	191.98
V30: IR-35	179.45	167.71	173.58
V31: Laldodaki	137.59	155.92	146.75
V32: IR2289-6-22-5	132.97	140.69	136.83
V33: Narmada	146.93	151.83	149.38
V34: Ananda	143.88	151.84	147.86
V35: Ambpandhari	162.79	156.12	159.45
V36: Hira	146.59	135.48	141.04
V37: OR-1516-1-5-A	158.66	143.54	151.10
V38: China	165.72	159.78	162.75
V39: Sorati	180.86	165.37	173.11
V40: Mhadi	178.48	174.45	176.47
SE $\pm$	4.71	5.24	3.64
C.D. at 5%	13.10	14.58	10.13
Interaction Effect (S x V)			
SE $\pm$	9.42	10.48	7.28
C.D. at 5%	26.20	29.17	20.27
General Mean	173.39	172.63	173.01

S1 : 24th MW (11th-17th June)

S3 : 50th MW (10th-16th December)

S2 : 48th MW (26th November-2nd December)

S4 : 52th MW (24th-31st December)

Effect of sowing dates:

The data presented in Table 75 revealed that, the mean number of filled spikelet per panicle of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during *S₁-kharif* season (24th MW) produced significantly minimum number of filled spikelet per panicle (159.10) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

The rice crop sown during *rabi* season, *S₄* (the 52th MW) date of sowing recorded significantly maximum number of filled spikelet per panicle (179.15) which was at par with *S₂* and *S₃* over *S₁* over others.

Effect of genotypes:

The number of filled spikelet per panicle of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 75). The rice genotype *V₁₂* i.e. Ratnagiri-6 recorded significantly maximum number of filled spikelet per panicle (229.80) which was at par with *V₂* i.e. Karjat-3 over others for pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of number of filled spikelet per panicle (Table 76). The rice crop sown *S₁* i.e. *kharif* season (24th MW) with genotype *V₂* i.e. Karjat-3 recorded significantly higher number of filled spikelet per panicle (199.95) which was at par with *V₁₄* i.e. Ratnagiri-73 and *V₁₅* i.e. Ratnagiri-711 over others for pooled mean.

In case of *rabi* season *S₃V₁₁* i.e. crop sown in *S₃* date of sowing (48th MW) with Ratnagiri-6 was recorded significantly higher number of filled spikelet per panicle (270.82) which was superior over the other treatment combination during both years and pooled mean. However, *S₃V₃₂* with rice variety IR2289-6-22-5 recorded significantly minimum number of filled spikelet per panicle (124.30) which was superior over other.

Table 76: Interaction effect of number of filled spikelet per panicle on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	130.67	184.00	160.67	151.33	151.33	111.67	137.00	138.00	153.00	202.67
S2	172.77	194.07	176.83	151.07	175.37	191.03	181.87	176.50	122.47	209.77
S3	188.23	194.30	186.30	169.90	173.20	179.33	178.07	145.63	155.27	224.27
S4	183.20	238.83	171.57	151.77	188.83	178.10	180.50	158.20	180.57	231.93
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	177.33	141.00	171.00	186.33	175.33	185.33	182.33	145.33	121.33	159.00
S2	236.30	212.07	211.97	155.67	141.27	212.97	217.13	176.13	184.83	189.73
S3	278.57	224.87	226.87	166.23	128.07	228.10	197.37	172.03	200.93	187.83
S4	250.77	208.83	263.63	168.23	171.77	181.57	203.60	189.80	215.33	184.43
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	144.67	156.00	158.33	164.67	155.00	165.33	171.67	173.33	178.00	157.67
S2	172.07	181.37	167.70	163.03	180.57	166.23	173.40	202.27	212.33	202.10
S3	125.20	177.73	201.67	175.77	152.07	183.43	172.03	198.90	199.03	167.17
S4	183.97	175.20	175.20	169.40	172.60	167.00	180.23	175.97	173.37	190.87
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	156.67	125.00	166.33	171.33	158.67	156.33	160.67	162.33	175.00	180.00
S2	113.90	142.70	145.77	150.60	161.63	118.00	124.97	137.23	188.30	170.40
S3	140.17	133.13	133.10	138.33	167.77	175.50	183.93	184.83	173.33	174.60
S4	139.63	131.03	142.53	115.23	163.10	136.53	165.07	178.47	186.80	188.93
SE $\pm$		9.42								
C.D. at 5%		26.20								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	147.63	215.90	167.67	189.63	152.23	114.23	153.10	163.90	126.40	152.67
S2	168.33	257.20	167.67	126.87	170.37	191.60	183.53	135.40	135.63	208.70
S3	171.10	263.67	166.33	175.63	188.13	187.30	187.77	146.63	145.17	198.20
S4	177.50	261.00	175.27	121.97	186.33	175.80	192.57	164.03	167.07	178.07
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	167.47	179.77	177.00	177.73	184.83	167.70	172.93	138.27	129.37	143.40
S2	238.10	275.57	211.87	140.53	185.20	263.80	208.33	195.80	185.80	205.53
S3	263.07	232.03	218.93	143.33	123.67	198.97	196.57	179.90	186.80	165.93
S4	226.77	230.40	172.00	133.30	158.93	207.13	178.50	237.60	216.53	186.10
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	156.33	158.33	152.77	162.03	150.20	166.53	146.17	156.33	156.20	177.57
S2	161.30	188.70	207.60	164.43	159.17	163.17	208.27	230.87	247.50	141.17
S3	188.03	165.63	202.53	151.37	165.90	189.20	162.33	170.70	185.83	174.13
S4	182.57	182.00	176.63	171.00	189.57	95.73	174.47	173.80	183.57	177.97
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	156.63	148.30	133.37	163.63	128.03	163.27	152.70	178.10	148.40	149.67
S2	181.07	125.43	202.50	140.47	138.33	128.63	128.73	113.50	150.93	173.30
S3	126.50	115.47	123.77	122.33	182.60	126.13	162.50	160.80	167.90	181.97
S4	159.47	173.57	147.70	180.93	175.50	123.90	130.23	186.70	194.23	192.87
SE $\pm$		10.48								
C.D. at 5%		29.17								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	139.15	199.95	164.17	170.48	151.78	112.95	145.05	150.95	139.70	177.67
S2	170.55	225.63	172.25	138.97	172.87	191.32	182.70	155.95	129.05	209.23
S3	179.67	228.98	176.32	172.77	180.67	183.32	182.92	146.13	150.22	211.23
S4	180.35	249.92	173.42	136.87	187.58	176.95	186.53	161.12	173.82	205.00
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	172.40	160.38	174.00	182.03	180.08	176.52	177.63	141.80	125.35	151.20
S2	237.20	243.82	211.92	148.10	163.23	238.38	212.73	185.97	185.32	197.63
S3	270.82	228.45	222.90	154.78	125.87	213.53	196.97	175.97	193.87	176.88
S4	238.77	219.62	217.82	150.77	165.35	194.35	191.05	213.70	215.93	185.27
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	150.50	157.17	155.55	163.35	152.60	165.93	158.92	164.83	167.10	167.62
S2	166.68	185.03	187.65	163.73	169.87	164.70	190.83	216.57	229.92	171.63
S3	156.62	171.68	202.10	163.57	158.98	186.32	167.18	184.80	192.43	170.65
S4	183.27	178.60	175.92	170.20	181.08	131.37	177.35	174.88	178.47	184.42
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	156.65	136.65	149.85	167.48	143.35	159.80	156.68	170.22	161.70	164.83
S2	147.48	134.07	174.13	145.53	149.98	123.32	126.85	125.37	169.62	171.85
S3	133.33	124.30	128.43	130.33	175.18	150.82	173.22	172.82	170.62	178.28
S4	149.55	152.30	145.12	148.08	169.30	130.22	147.65	182.58	190.52	190.90
SE $\pm$		7.29								
C.D. at 5%		20.28								

4.5.7.1000 grain weight (gm):

Data regarding mean 1000 grain weight of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 77. The mean 1000 grain weight was 19.86, 19.50 and 19.68 g recorded during 2020-21, 2021-22 and pooled mean, respectively.

Effect of sowing dates:

The data presented in Table 77 revealed that, the mean 1000 grain weight of rice genotypes was significantly influenced due to different sowing dates.

Table 77.Effect of different treatment on 1000 grain weight (gm) of rice genotypes

Treatments	1000 grain weight (gm)		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	20.59	21.13	20.86
S2 : 48 th MW	19.65	18.15	18.90
S3 : 50 th MW	19.73	18.87	19.30
S4 :52 th MW	19.47	19.85	19.66
SE ±	0.40	0.18	0.25
C.D. at 5%	NS	0.61	0.87
B)Sub plot (Varieties)			
V1:Karjat-1	19.90	19.57	19.73
V2:Karjat-3	20.23	19.94	20.08
V3:Karjat-4,	10.05	10.08	10.06
V4:Karjat-7	23.35	21.86	22.61
V5:Karjat-184	16.41	16.58	16.49
V6:Sahyadri-2	22.74	21.83	22.28
V7:Sahyadri-4	23.53	23.16	23.35
V8:Phondaghat -1	21.75	22.79	22.27
V9:Ratnagiri-1	26.03	24.23	25.13
V10:Ratnagiri-5	12.09	12.60	12.35
V11:Ratnagiri- 6	14.00	14.41	14.21
V12:Ratnagiri- 7	20.81	20.61	20.71
V13:Ratnagiri -24	11.96	12.86	12.41
V14:Ratnagiri-73	22.10	20.85	21.47
V15:Ratnagiri-711	22.06	20.33	21.19
V16:IRRI-14	15.72	15.28	15.50
V17:IRRI-15	14.54	16.54	15.54
V18:IRRI-20	15.85	14.50	15.17
V19:IRRI-21	13.90	14.38	14.14
V20:IRRI-22	16.64	15.54	16.09
V21:IRRI-27	22.67	22.58	22.63
V22:IRRI-28	24.26	22.98	23.62
V23:IRRI-34	18.39	16.99	17.69
V24:IRRI-36	23.19	22.11	22.65
V25:IRRI-47	24.29	23.34	23.81
V26:IRRI-52	25.19	24.19	24.69
V27:IRRI-53	21.51	21.32	21.41
V28:IRRI-55	17.46	15.26	16.36
V29:IRRI-62	15.70	14.79	15.24
V30:IR-35	19.60	20.93	20.27
V31:Laldodaki	22.30	21.70	22.00
V32:IR2289-6-22-5	22.79	20.03	21.41
V33:Narmada	22.73	22.80	22.77
V34:Ananda	23.48	22.54	23.01
V35:Ambpandhari	15.23	16.87	16.05
V36:Hira	23.78	20.10	21.94
V37:OR-1516-1-5-A	22.00	23.84	22.92
V38:China	23.73	22.55	23.14
V39:Sorati	20.61	23.78	22.19
V40:Mhadi	20.83	22.29	21.56
SE ±	0.50	0.43	0.37
C.D. at 5%	1.40	1.19	1.02
Interaction Effect (S x V)			
SE±	1.00	0.86	0.73
C.D. at 5%	NS	2.39	2.04
General Mean	19.86	19.50	19.68

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

Crop sown during *S*₁-*kharif* season (24th MW) produced significantly maximum 1000 grain weight (20.86 gm) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

The rice crop sown during *rabi* season, *S*₄ (the 52th MW) date of sowing recorded significantly maximum 1000 grain weight (19.66 gm) as compared to crop sown during *S*₂ (48th MW) and *S*₃ (50th MW) in both year and pooled mean. Significantly maximum 1000 grain weight was recorded in *S*₁ (20.86 gm.) which was superior over the other treatment.

Effect of genotypes:

The 1000 grain weight of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 77). The rice variety *V*₉ i.e. Ratnagiri-1 recorded significantly maximum 1000 grain weight (25.13 gm) which was at par with *V*₂₆ i.e. IRRI-52. Rice genotype *V*₄ i.e. Karjat-4 recorded significantly minimum 1000 grain weight (10.06 gm) during pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of 1000 grain weight (Table 78). The rice crop sown *S*₁ i.e. *kharif* season (24th MW) with variety *V*₂₂ i.e. IRRI-28 recorded significantly higher 1000 grain weight (27.7 gm) which was at par with *V*₉ i.e. Ratnagiri-1 over others.

In case of *rabi* season *S*₃*V*₉ i.e. crop sown in *S*₃ date of sowing (50th MW) with Ratnagiri-1, was recorded significantly higher 1000 grain weight (25.69 gm) which was at par with *S*₂*V*₉, *S*₄*V*₂₅, *S*₄*V*₃₄, *S*₃*V*₃₇, *S*₂*V*₃₈, *S*₃*V*₃₈ over others. However, *S*₃*V*₃ with rice variety Karjat-4 recorded significantly minimum 1000 grain weight (9.83 gm) which was at par with *S*₂*V*₃, *S*₄*V*₃₀, *S*₂*V*₁₀, *S*₃*V*₁₀ over others.

Table 78 Interaction effect of 1000 grain weight (gm) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	19.89	19.07	10.1	23.13	16.45	23.11	23.7	21.74	26.45	12.54
S2	19.92	20.55	10.13	23.46	16.47	22.7	23.43	21.78	26.04	12.43
S3	19.89	20.74	9.88	23.43	16.45	22.57	23.49	21.78	26.05	11.75
S4	19.88	20.54	10.08	23.4	16.26	22.55	23.5	21.7	25.59	11.63
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	14.82	21.97	13.2	22.89	23.4	16.59	15.79	19.9	14.95	18.5
S2	12.85	20.48	12.88	22.03	21.68	15.43	14.24	15.13	13.49	16.01
S3	14.17	20.46	12.87	21.96	21.54	15.42	14.21	15.13	13.48	16.01
S4	14.17	20.33	12.87	21.5	21.61	15.44	13.93	13.23	13.69	16.02
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	23.51	27.13	19.72	23.59	25.69	26.57	23.19	18.67	17.84	19.74
S2	22.41	24.99	17.94	23.02	23.86	24.74	21	17.02	15.06	19.74
S3	22.4	24.99	17.96	22.99	23.85	24.71	20.97	17.01	15.05	19.47
S4	22.38	19.9	17.95	23.17	23.75	24.75	20.87	17.14	14.86	19.46
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	22.65	23.37	23.76	24.76	15.35	23.43	21.45	23.73	20.59	20.84
S2	22.21	22.52	22.41	22.99	14.49	23.87	21.4	23.73	20.66	20.83
S3	22.2	22.51	22.4	23.01	15.47	23.86	23.75	23.72	20.65	20.84
S4	22.13	22.77	22.36	23.16	15.62	23.94	21.4	23.73	20.54	20.82
SE $\pm$	1.00									
C.D. at 5%	NS									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	19.9	21.45	9.67	23.09	16.53	23.07	23.35	26.64	26.15	12.48
S2	19.67	19.13	10.37	21.53	16.27	20.13	23.6	22.33	24.13	10.43
S3	19.08	19.21	9.79	20.01	16.73	21.3	22.41	20.63	25.33	11.78
S4	19.64	19.98	10.49	22.82	16.78	22.82	23.29	21.55	21.31	15.72
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	14.83	21.81	13.28	22.4	23.36	18.54	26.45	18.59	18.73	15.3
S2	12.5	18.33	12.43	20.37	15.33	13.2	12.53	12.5	12.27	14.13
S3	13.27	20.53	13.34	21.48	19.51	13.48	13.15	13.83	12.72	13.71
S4	17.04	21.76	16.68	19.16	23.11	15.92	14.04	13.07	13.8	19.02
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	26.54	28.26	23.02	23.63	26.71	25.59	21.46	17.55	15.61	21.32
S2	19.7	22.30	14.00	20.50	20.50	22.40	20.20	12.60	13.13	25.83
S3	21.05	21.21	13.42	21.53	21.39	23.27	21.83	14.04	15.15	19.48
S4	23.04	22.49	17.54	22.78	24.75	25.48	21.77	16.84	15.26	17.10
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	22.35	23.38	23.78	25.2	15.41	11.61	28.02	17.54	26.79	25.77
S2	19.23	10.43	21.7	16.4	22.37	22.2	21.43	24.13	25.43	20.23
S3	22.63	23.32	22.67	24.08	14.88	23.32	24.08	23.98	21.07	21.13
S4	22.56	22.98	23.06	24.49	14.83	23.26	21.82	24.52	21.83	22.01
SE $\pm$	0.86									
C.D. at 5%	2.39									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	19.9	20.26	9.89	23.11	16.49	23.09	23.53	24.19	26.3	12.51
S2	19.8	19.84	10.25	22.5	16.37	21.42	23.52	22.06	25.09	11.43
S3	19.49	19.97	9.83	21.72	16.59	21.94	22.95	21.2	25.69	11.76
S4	19.76	20.26	10.28	23.11	16.52	22.69	23.39	21.63	23.45	13.68
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	14.83	21.89	13.24	22.65	23.38	17.56	21.12	19.25	16.84	16.9
S2	12.67	19.41	12.66	21.2	18.51	14.32	13.39	13.82	12.88	15.07
S3	13.72	20.49	13.11	21.72	20.53	14.45	13.68	14.48	13.1	14.86
S4	15.61	21.04	14.78	20.33	22.36	15.68	13.99	13.15	13.74	17.52
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	25.02	27.7	21.37	23.61	26.2	26.08	22.32	18.11	16.72	20.53
S2	21.05	23.65	15.97	21.76	22.18	23.57	20.6	14.81	14.1	22.79
S3	21.73	23.1	15.69	22.26	22.62	23.99	21.4	15.53	15.1	19.48
S4	22.71	20.03	17.74	22.97	24.25	25.12	21.32	16.99	15.06	18.28
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	22.5	23.38	23.77	24.98	15.38	17.52	24.74	20.64	23.69	23.31
S2	20.72	16.48	22.05	19.69	18.43	23.03	21.42	23.93	23.05	20.53
S3	22.42	22.91	22.54	23.55	15.17	23.59	23.91	23.85	20.86	20.99
S4	22.35	22.88	22.71	23.83	15.23	23.6	21.61	24.13	21.18	21.42
SE $\pm$		0.73								
C.D. at 5%		2.04								

4.5.8. Grain yield per plant (g):

Data regarding mean grain yield per plant (g) of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 79. In graphically depicted in fig. 12. The data clearly revealed that, the mean grain yield per plant (g) was maximum during both years and in pooled mean.

The mean grain yield per plant (g) was 16.63, 17.24 and 16.94g recorded during 2020-21, 2021-22 and pooled mean respectively.

Table 79. Effect of different treatment on grain yield per plant (g) of rice genotypes

Treatments	Grain yield per plant (g)		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	14.53	14.99	14.76
S2 : 48 th MW	16.80	17.83	17.31
S3 : 50 th MW	17.64	17.17	17.91
S4 : 52 th MW	17.56	18.00	17.78
SE $\pm$	0.041	0.054	0.022
C.D. at 5%	0.141	0.188	0.076
B) Sub plot (Varieties)			
V1: Karjat-1	13.65	13.63	13.64
V2: Karjat-3	23.78	24.08	23.93
V3: Karjat-4,	10.69	11.30	11.00
V4: Karjat-7	19.89	20.51	20.20
V5: Karjat-184	15.43	16.41	15.92
V6: Sahyadri-2	22.78	23.33	23.05
V7: Sahyadri-4	24.20	25.05	24.62
V8: Phondaghat -1	14.96	15.84	15.40
V9: Ratnagiri-1	17.35	18.80	18.08
V10: Ratnagiri-5	13.88	14.71	14.29
V11: Ratnagiri- 6	13.89	14.57	14.23
V12: Ratnagiri- 7	19.02	18.95	18.98
V13: Ratnagiri -24	18.74	17.66	18.20
V14: Ratnagiri-73	20.84	21.40	21.12
V15: Ratnagiri-711	18.32	19.10	18.71
V16: IRRI-14	15.13	16.47	15.80
V17: IRRI-15	15.20	14.90	15.05
V18: IRRI-20	16.89	17.16	17.03
V19: IRRI-21	15.33	16.26	15.80
V20: IRRI-22	16.11	14.55	15.33
V21: IRRI-27	15.24	17.54	16.39
V22: IRRI-28	15.30	17.66	16.48
V23: IRRI-34	15.89	16.71	16.30
V24: IRRI-36	15.33	16.26	15.80
V25: IRRI-47	16.56	17.26	16.91
V26: IRRI-52	17.29	18.09	17.69
V27: IRRI-53	16.97	17.77	17.37
V28: IRRI-55	15.46	16.00	15.73
V29: IRRI-62	15.21	16.07	15.64
V30: IR-35	15.33	15.73	15.53
V31: Laldodaki	13.81	14.19	14.00
V32: IR2289-6-22-5	13.75	14.49	14.12
V33: Narmada	14.74	15.50	15.12
V34: Ananda	14.62	15.21	14.92
V35: Ambpandhari	12.95	13.61	13.28
V36: Hira	14.19	15.15	14.67
V37: OR-1516-1-5-A	16.15	16.09	16.12
V38: China	19.51	20.17	19.84
V39: Sorati	19.62	20.05	19.83
V40: Mhadi	19.80	20.10	19.95
SE $\pm$	0.177	0.183	0.13
C.D. at 5%	0.493	0.510	0.36
Interaction Effect (S x V)			
SE $\pm$	0.354	0.366	0.256
C.D. at 5%	0.986	1.019	0.713
General Mean	16.634	17.244	16.939

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 : 52th MW (24th-31st December)

Effect of sowing dates:

The data presented in Table 79 revealed that, the mean grain yield per plant (g) of rice genotypes was significantly influenced due to different sowing dates.

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum grain yield (14.76 g) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

The rice crop sown during *rabi* season, S_3 (the 50th MW) date of sowing recorded significantly maximum grain yield per plant (17.91g) which was at par with S_2 and S_4 over others. Significantly maximum grain yield per plant (g) was recorded in S_3 (17.91g) which was superior over the other date of sowing.

Effect of genotypes:

The grain yield per plant (g) of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 79). The rice genotype V_7 i.e. Sahyadri-4 recorded significantly maximum grain yield per plant (24.62 g) which was at par with genotype V_2 i.e. Karjat-3 (23.93g) over other genotypes.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of grain yield per plant (g) (Table 80). The rice crop sown S_1 i.e. *kharif* season (24th MW) with genotype V_7 i.e. Sahyadri-4 recorded significantly higher grain yield per plant (22.86g) which was superior over other treatment combinations during pooled mean.

In case of *rabi* season S_4V_7 i.e. crop sown in S_4 date of sowing (52th MW) with Sahyadri-4 was recorded significantly higher grain yield per plant (25.32g) which was at par with S_2V_7 (25.14 g) i.e. crop sown in S_2 date of sowing (48th MW) and S_3V_7 (25.17 g) i.e. crop sown in S_3 date of sowing (50th MW) during pooled mean over others. However, S_4V_3 with rice genotype Karjat-4 recorded significantly minimum grain yield per plant (11.02g) over others.

Table 80 : Interaction effect of grain yield per plant (g) on sowing dates and varieties

Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	12.07	22.30	9.16	17.38	13.23	20.88	21.99	12.05	14.72	10.96
S2	14.17	23.77	10.64	20.28	16.04	23.26	24.84	15.96	16.80	13.39
S3	14.61	23.88	11.48	21.35	16.49	23.44	25.17	16.06	17.23	15.64
S4	13.73	25.17	11.49	20.54	15.97	23.53	24.78	15.77	20.65	15.52
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	12.60	15.25	16.98	17.10	16.87	12.81	12.99	14.76	14.46	13.67
S2	13.19	20.22	21.40	22.55	18.25	15.43	14.50	16.60	15.23	17.03
S3	15.41	20.28	21.67	22.56	19.66	16.64	15.82	17.56	16.27	16.49
S4	14.35	20.35	21.16	21.15	18.50	15.62	17.47	18.64	15.37	17.25
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	15.89	15.45	13.89	13.75	14.41	15.01	14.42	13.84	13.37	14.04
S2	14.34	14.92	15.61	14.98	16.82	17.07	17.35	15.86	15.35	15.49
S3	15.49	15.37	17.00	16.74	17.87	18.78	17.98	16.74	16.34	15.46
S4	15.25	15.46	17.08	15.84	17.13	18.32	18.15	15.41	15.80	16.34
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	12.41	12.44	12.72	12.50	10.33	12.77	14.42	16.09	15.06	16.25
S2	13.28	13.81	14.73	14.28	13.37	14.08	15.76	19.88	20.68	20.79
S3	14.59	14.75	15.75	16.28	13.83	14.98	16.96	20.86	21.59	20.75
S4	14.98	14.01	15.77	15.43	14.29	14.92	17.44	21.23	21.13	21.42
SE $\pm$		0.354								
C.D. at 5%		0.986								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	13.54	21.50	10.01	18.29	14.29	22.25	23.72	13.94	15.90	11.12
S2	13.17	24.83	11.40	21.57	17.03	23.67	25.43	16.77	19.20	15.30
S3	13.55	24.63	12.30	20.97	17.73	23.73	25.17	15.27	18.80	16.17
S4	14.27	25.36	11.49	21.22	16.58	23.65	25.86	17.40	21.31	16.25
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	13.55	14.60	15.82	16.89	17.41	13.66	12.39	15.30	15.15	12.61
S2	14.83	21.60	22.70	23.30	19.23	16.93	16.07	17.30	16.33	15.65
S3	14.48	21.45	17.08	23.10	20.67	18.97	15.27	18.07	17.55	14.57
S4	15.42	18.13	20.92	22.31	19.07	16.31	15.87	17.97	16.00	15.35
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	16.87	16.06	14.43	15.12	15.53	16.22	16.03	14.29	14.19	13.57
S2	18.63	18.33	16.17	16.17	17.37	18.27	18.50	16.47	16.37	15.83
S3	19.13	18.03	18.10	17.50	18.03	19.11	18.20	17.10	17.67	17.03
S4	15.53	18.22	18.14	16.27	18.09	18.74	18.34	16.13	16.05	16.50
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	11.58	11.92	13.93	13.69	11.23	13.81	13.51	15.53	14.64	15.42
S2	14.30	14.53	15.23	15.33	13.40	15.03	16.30	21.57	21.40	21.53
S3	15.17	15.87	16.57	15.63	14.63	15.70	17.80	21.77	22.25	21.83
S4	15.73	15.64	16.25	16.19	15.16	16.05	16.74	21.79	21.90	21.63
SE $\pm$		0.366								
C.D. at 5%		1.019								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	12.81	21.90	9.59	17.83	13.76	21.57	22.86	13.00	15.31	11.04
S2	13.67	24.30	11.02	20.92	16.54	23.46	25.14	16.37	18.00	14.34
S3	14.08	24.26	11.89	21.16	17.11	23.59	25.17	15.66	18.01	15.90
S4	14.00	25.26	11.49	20.88	16.27	23.59	25.32	16.58	20.98	15.88
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	13.08	14.92	16.40	17.00	17.14	13.24	12.69	15.03	14.80	13.14
S2	14.01	20.91	22.05	22.92	18.74	16.18	15.28	16.95	15.78	16.34
S3	14.95	20.86	19.37	22.83	20.17	17.80	15.54	17.81	16.91	15.53
S4	14.88	19.24	21.04	21.73	18.79	15.96	16.67	18.30	15.68	16.30
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	16.38	15.75	14.16	14.44	14.97	15.62	15.23	14.06	13.78	13.81
S2	16.49	16.63	15.89	15.58	17.10	17.67	17.92	16.16	15.86	15.66
S3	17.31	16.70	17.55	17.12	17.95	18.95	18.09	16.92	17.00	16.25
S4	15.39	16.84	17.61	16.06	17.61	18.53	18.25	15.77	15.93	16.42
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	11.99	12.18	13.33	13.09	10.78	13.29	13.97	15.81	14.85	15.84
S2	13.79	14.17	14.98	14.81	13.38	14.56	16.03	20.73	21.04	21.16
S3	14.88	15.31	16.16	15.96	14.23	15.34	17.38	21.31	21.92	21.29
S4	15.36	14.83	16.01	15.81	14.73	15.49	17.09	21.51	21.51	21.52
SE $\pm$		0.256								
C.D. at 5%		0.713								

4.5.8 Straw yield per plant (g):

Data regarding mean straw yield per plant (g) of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 81 in graphically depicted in fig12. The mean grain yield per plant (g) was 24.170 g, 24.796 g and 24.483g per plant recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 81 revealed that, the mean straw yield per plant (g) of rice genotypes was significantly influenced due to different sowing dates.

Table 81. Effect of different treatment on straw yield per plant (g) of rice genotypes

Treatments	Straw yield per plant (g)		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	22.18	22.60	22.39
S2 : 48 th MW	24.37	25.35	24.86
S3 : 50 th MW	24.99	25.61	25.30
S4 : 52 th MW	25.13	25.63	25.38
SE $\pm$	0.106	0.159	0.073
C.D. at 5%	0.367	0.550	0.254
B) Sub plot (Varieties)			
V1: Karjat-1	20.98	20.88	20.93
V2: Karjat-3	31.53	32.08	31.81
V3: Karjat-4,	18.36	19.63	19.00
V4: Karjat-7	27.39	28.34	27.87
V5: Karjat-184	23.10	23.83	23.46
V6: Sahyadri-2	29.94	30.49	30.22
V7: Sahyadri-4	32.61	33.13	32.87
V8: Phondaghat -1	22.21	22.76	22.49
V9: Ratnagiri-1	25.02	26.64	25.83
V10: Ratnagiri-5	21.79	22.71	22.25
V11: Ratnagiri- 6	21.47	22.15	21.81
V12: Ratnagiri- 7	25.77	26.20	25.98
V13: Ratnagiri -24	25.89	24.74	25.31
V14: Ratnagiri-73	28.67	28.82	28.74
V15: Ratnagiri-711	25.74	27.10	26.42
V16: IRRI-14	22.13	24.13	23.13
V17: IRRI-15	22.86	21.73	22.30
V18: IRRI-20	23.97	24.33	24.15
V19: IRRI-21	22.75	23.76	23.25
V20: IRRI-22	23.61	22.30	22.95
V21: IRRI-27	23.16	25.38	24.27
V22: IRRI-28	23.55	25.50	24.52
V23: IRRI-34	23.39	24.21	23.80
V24: IRRI-36	21.91	23.85	22.88
V25: IRRI-47	24.39	24.17	24.28
V26: IRRI-52	25.29	25.25	25.27
V27: IRRI-53	24.81	25.77	25.29
V28: IRRI-55	22.46	23.66	23.06
V29: IRRI-62	23.05	23.40	23.22
V30: IR-35	23.67	23.32	23.49
V31: Laldodaki	21.73	22.03	21.88
V32: IR2289-6-22-5	20.92	21.82	21.37
V33: Narmada	22.08	23.25	22.66
V34: Ananda	22.20	22.13	22.17
V35: Ambpandhari	20.45	21.11	20.78
V36: Hira	21.27	22.90	22.09
V37: OR-1516-1-5-A	23.73	23.75	23.74
V38: China	26.35	27.33	26.84
V39: Sorati	26.62	27.63	27.12
V40: Mhadi	27.80	27.60	27.70
SE $\pm$	0.444	0.405	0.297
C.D. at 5%	1.235	1.127	0.826
Interaction Effect (S x V)			
SE $\pm$	0.888	0.810	0.594
C.D. at 5%	2.469	2.253	1.652
General Mean	24.170	24.796	24.483

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 : 52th MW (24th-31st December)

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum grain yield per plant (22.39g) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during 2020-21, 2021-22 and pooled mean.

The rice crop sown during *rabi* season, S_4 (the 52th MW) date of sowing recorded significantly maximum straw yield per plant (25.38g plant⁻¹) as compared to crop sown during S_2 (48th MW) and S_3 (50th MW) in both year and pooled mean. Significantly maximum straw yield per plant (g) was recorded in S_2 (25.38g plant⁻¹) which was at par with date of sowing S_3 -*kharif* season (48th MW) over others.

Effect of genotypes:

The straw yield per plant (g) of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 81). The rice genotype Sahyadri-4 recorded significantly maximum straw yield per plant (32.87 g plant⁻¹) followed by genotype V_2 i.e. Karjat -3 (31.81 g plant⁻¹) and V_6 i.e. Sahyadri-2 (30.22 g plant⁻¹). Rice genotype V_3 i.e. Karjat -4 recorded significantly minimum straw yield per plant (19.00 g plant⁻¹) which was followed by V_{35} -Ambpandhari (20.78 g plant⁻¹) during pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotypes was significant in respect of straw yield per plant (g) (Table 82). The rice crop sown S_1 i.e. *kharif* season (24th MW) with genotype V_7 i.e. Sahyadri-4 recorded significantly higher straw yield per plant (32.19 g plant⁻¹) which was at par with V_2 i.e. Karjat-3 during pooled mean.

In case of *rabi* season S_4V_2 i.e. crop sown in S_4 date of sowing (52th MW) with Karjat -3 was recorded significantly higher straw yield per plant (33.43 g plant⁻¹) which was at par S_2V_7 , S_3V_7 , S_4V_7 over others. However, S_1V_3 with rice genotype Karjat-4 recorded significantly minimum straw yield per plant (9.59 g plant⁻¹) which was followed by S_2V_3 with rice genotype Karjat-4.

Table 82 : Interaction effect of straw yield per plant (g) on sowing dates and varieties
Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	19.07	31.96	18.49	25.71	21.23	29.22	32.33	19.72	22.72	18.96
S2	22.50	30.77	17.31	27.94	22.70	31.26	32.51	22.96	23.80	22.05
S3	21.61	29.55	18.48	28.35	24.49	29.77	33.50	23.06	24.56	23.97
S4	20.73	33.84	19.16	27.54	23.97	29.53	32.11	23.10	28.99	22.18
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	19.60	21.91	24.98	25.10	24.20	19.48	21.66	22.10	21.12	21.67
S2	21.19	26.56	28.73	30.88	25.25	22.43	21.83	24.93	23.57	23.70
S3	22.41	27.61	29.00	30.89	28.00	23.31	22.82	23.23	23.94	23.16
S4	22.68	27.02	29.49	27.81	25.50	23.29	25.13	25.64	22.37	25.92
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	24.56	25.11	20.55	19.42	21.74	22.34	21.42	21.17	20.70	21.71
S2	22.00	22.58	24.61	21.65	24.16	25.07	25.35	22.86	24.02	24.16
S3	22.16	23.04	24.00	23.74	26.54	27.44	25.98	23.41	24.34	24.12
S4	23.92	23.46	24.41	22.84	25.13	26.32	26.49	22.41	23.13	24.67
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	19.41	20.44	21.05	19.50	16.99	20.44	21.09	22.43	21.39	24.58
S2	20.28	21.15	21.73	21.28	21.37	20.41	24.10	26.88	28.35	29.79
S3	24.25	21.42	21.42	25.94	20.50	20.65	24.29	28.19	28.59	28.08
S4	22.98	20.68	24.10	22.09	22.96	23.58	25.44	27.89	28.13	28.75
SE $\pm$		0.888								
C.D. at 5%		2.469								

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	20.54	30.84	19.68	26.29	21.62	29.91	32.06	21.94	23.90	18.79
S2	20.83	31.83	18.73	28.57	25.70	32.00	34.43	24.10	26.87	23.63
S3	20.55	32.63	20.30	28.30	24.73	29.73	31.83	21.60	27.47	24.17
S4	21.61	33.02	19.82	30.22	23.24	30.32	34.19	23.40	28.31	24.25
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	20.21	23.27	23.82	23.56	25.41	20.99	19.39	21.97	22.48	20.28
S2	21.83	28.27	30.37	31.63	27.57	24.60	22.40	24.63	25.00	23.31
S3	22.14	28.45	23.08	30.43	29.67	26.30	21.93	26.40	23.88	22.57
S4	24.42	24.79	29.92	29.64	25.74	24.64	23.20	24.30	23.67	23.02
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	20.21	23.27	23.82	23.56	25.41	20.99	19.39	21.97	22.48	20.28
S2	21.83	28.27	30.37	31.63	27.57	24.60	22.40	24.63	25.00	23.31
S3	22.14	28.45	23.08	30.43	29.67	26.30	21.93	26.40	23.88	22.57
S4	24.42	24.79	29.92	29.64	25.74	24.64	23.20	24.30	23.67	23.02
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	24.20	23.06	21.77	23.79	23.20	22.56	24.03	21.95	22.19	21.57
S2	26.97	25.00	24.50	23.83	22.70	25.60	26.83	25.13	22.70	22.50
S3	27.47	26.70	24.43	24.17	25.70	26.45	27.20	25.10	24.00	24.70
S4	22.87	27.22	26.14	23.60	25.09	26.40	25.00	22.47	24.72	24.50
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	18.91	18.59	20.27	21.02	18.23	22.14	21.51	23.19	21.64	23.09
S2	22.63	23.20	22.57	22.00	21.07	22.70	22.63	27.57	28.73	28.87
S3	21.83	23.87	24.90	21.97	22.30	23.37	25.13	28.77	30.58	29.50
S4	24.73	21.64	25.25	23.53	22.83	23.39	25.74	29.79	29.57	28.96
SE $\pm$		0.810								
C.D. at 5%		2.253								

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	19.81	31.40	19.09	26.00	21.43	29.57	32.19	20.83	23.31	18.87
S2	21.67	31.30	18.02	28.26	24.20	31.63	33.47	23.53	25.33	22.84
S3	21.08	31.09	19.39	28.32	24.61	29.75	32.67	22.33	26.01	24.07
S4	21.17	33.43	19.49	28.88	23.61	29.92	33.15	23.25	28.65	23.22
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	19.91	22.59	24.40	24.33	24.81	20.24	20.52	22.03	21.80	20.98
S2	21.51	27.41	29.55	31.26	26.41	23.52	22.12	24.78	24.28	23.51
S3	22.28	28.03	26.04	30.66	28.83	24.80	22.38	24.81	23.91	22.86
S4	23.55	25.91	29.71	28.73	25.62	23.96	24.17	24.97	23.02	24.47
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	24.38	24.09	21.16	21.61	22.47	22.45	22.73	21.56	21.45	21.64
S2	24.49	23.79	24.56	22.74	23.43	25.33	26.09	24.00	23.36	23.33
S3	24.81	24.87	24.22	23.95	26.12	26.95	26.59	24.25	24.17	24.41
S4	23.39	25.34	25.28	23.22	25.11	26.36	25.75	22.44	23.93	24.59
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	19.16	19.51	20.66	20.26	17.61	21.29	21.30	22.81	21.52	23.84
S2	21.46	22.17	22.15	21.64	21.22	21.56	23.37	27.23	28.54	29.33
S3	23.04	22.64	23.16	23.96	21.40	22.01	24.71	28.48	29.59	28.79
S4	23.86	21.16	24.68	22.81	22.89	23.49	25.59	28.84	28.85	28.86
SE $\pm$		0.594								
C.D. at 5%		1.652								

4.5.10. Harvest index:

Data regarding mean harvest index of rice as influenced by different sowing dates and genotypes during both years and in the pooled, the data are presented in Table 83. The mean harvest index was 40.587, 40.839 and 40.713 recorded during 2020-21, 2021-22 and pooled mean respectively.

Effect of sowing dates:

The data presented in Table 83 revealed that, the mean harvest index of rice genotypes was significantly influence due to different sowing dates.

Table83.Effect of different treatment on harvest index of rice genotypes

Treatments	Harvest index		
	2020-21	2021-22	Pooled
A] Main plot (Date of sowing)			
S1 : 24 th MW	39.48	39.74	39.61
S2 : 48 th MW	40.63	41.13	40.88
S3 : 50 th MW	41.27	41.37	41.32
S4 :52 th MW	40.96	41.11	41.04
SE $\pm$	0.092	0.106	0.072
C.D. at 5%	0.317	0.366	0.249
B)Sub plot (Varieties)			
V1:Karjat-1	39.42	39.54	39.48
V2:Karjat-3	43.03	42.85	42.94
V3:Karjat-4,	36.78	36.54	36.66
V4:Karjat-7	42.03	41.98	42.01
V5:Karjat-184	40.04	40.78	40.41
V6:Sahyadri-2	43.19	43.35	43.27
V7:Sahyadri-4	42.57	43.06	42.82
V8:Phondaghat -1	40.18	41.02	40.60
V9:Ratnagiri-1	40.89	41.32	41.10
V10:Ratnagiri-5	38.78	39.21	39.00
V11:Ratnagiri- 6	39.30	39.74	39.52
V12:Ratnagiri- 7	42.41	41.78	42.09
V13:Ratnagiri -24	38.78	38.41	38.59
V14:Ratnagiri-73	42.05	42.57	42.31
V15:Ratnagiri-711	41.61	41.36	41.49
V16:IRRI-14	40.57	40.50	40.54
V17:IRRI-15	39.85	40.62	40.24
V18:IRRI-20	41.30	41.40	41.35
V19:IRRI-21	40.32	40.66	40.49
V20:IRRI-22	40.53	39.44	39.98
V21:IRRI-27	39.75	40.87	40.31
V22:IRRI-28	39.44	40.95	40.20
V23:IRRI-34	40.47	40.79	40.63
V24:IRRI-36	41.19	40.55	40.87
V25:IRRI-47	40.44	41.64	41.04
V26:IRRI-52	40.60	41.75	41.18
V27:IRRI-53	40.63	40.81	40.72
V28:IRRI-55	40.80	40.37	40.58
V29:IRRI-62	39.77	40.67	40.22
V30:IR-35	39.33	40.29	39.81
V31:Laldodaki	38.90	39.16	39.03
V32:IR2289-6-22-5	39.69	39.86	39.77
V33:Narmada	40.05	40.10	40.08
V34:Ananda	39.72	40.73	40.22
V35:Ambpandhari	38.80	39.14	38.97
V36:Hira	40.05	39.81	39.93
V37:OR-1516-1-5-A	40.51	40.35	40.43
V38:China	42.52	42.35	42.43
V39:Sorati	42.39	41.94	42.17
V40:Mhadi	41.56	42.07	41.81
SE $\pm$	0.434	0.380	0.268
C.D. at 5%	1.207	1.057	0.745
Interaction Effect (S x V)			
SE $\pm$	0.867	0.760	0.536
C.D. at 5%	NS	2.114	1.491
General Mean	40.587	40.839	40.713

S1 : 24th MW (11th-17th June)S3 : 50th MW (10th-16th December)S2 : 48th MW (26th November-2nd December)S4 :52th MW (24th-31st December)

Crop sown during S₁ -*kharif* season (24th MW) produced significantly minimum harvest index (39.61) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) during pooled mean.

The rice crop sown during *rabi* season, S₃ (the 50th MW) date of sowing recorded significantly maximum harvest index which was at par with S₄ over others.

Effect of genotypes:

The harvest index of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 83). The rice genotype V₆ i.e. Sahyadri-2 recorded significantly maximum harvest index (43.27) which was at par with genotype V₂ i.e. Karjat-3 (42.94) and V₇ i.e. Sahyadri-4 (42.82) over others. Rice genotype V₃ i.e. Karjat-4 recorded significantly minimum harvest index (36.66) which was followed by genotype V₁₃ i.e. Ratnagiri-24 (38.54) during pooled mean.

Interaction effect:

Interaction effect between sowing dates and genotypes was non significant in respect of harvest index (Table 84). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₆ i.e. Sahyadri-2 recorded higher harvest index (42.17 g) which was at par with S₁V₄, S₁V₇, S₁V₁₄, S₁V₁₅, S₁V₂₆, S₁V₃₈ and S₁V₃₉ over others during pooled mean.

In case of *rabi* season S₃V₆ i.e. crop sown in S₃ date of sowing (50th MW) with Sahyadri-2 was recorded significantly higher harvest index (44.25) which was at par with S₂V₂, S₃V₂, S₄V₂, S₃V₄, S₄V₆, S₂V₇, S₃V₇, S₄V₇, S₂V₁₂, S₄V₁₄, S₂V₃₈ and S₃V₃₈ during pooled mean. However, S₁V₃ with rice variety Karjat-4 recorded significantly minimum harvest index (33.45) which was followed by S₁V₁₀ with rice variety V₁₀ i.e. Ratnagiri-5.

Table 84: Interaction effect of harvest index on sowing dates and varieties
Year 2020-21

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	38.76	41.16	33.15	40.32	38.45	41.69	40.49	38.05	39.32	36.73
S2	38.70	43.58	38.13	42.09	41.43	42.65	43.35	41.03	41.41	37.77
S3	40.40	44.74	38.34	42.96	40.29	44.09	42.90	41.03	41.23	39.46
S4	39.83	42.66	37.50	42.75	39.98	44.35	43.55	40.61	41.60	41.18
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	39.24	41.04	40.74	40.61	41.10	39.70	37.50	40.04	40.71	38.70
S2	38.41	43.24	42.69	42.20	41.97	40.78	39.92	39.97	39.34	41.82
S3	40.81	42.38	42.77	42.20	41.32	41.64	40.95	43.06	40.50	41.62
S4	38.75	42.97	41.84	43.20	42.06	40.16	41.04	42.11	40.73	39.97
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	39.31	38.07	40.42	41.54	39.87	40.21	40.25	39.66	39.34	39.33
S2	39.46	39.84	38.81	40.92	41.11	40.50	40.64	40.99	38.97	39.08
S3	41.30	40.07	41.47	41.36	40.23	40.63	40.97	41.80	40.18	39.07
S4	38.94	39.78	41.20	40.96	40.56	41.06	40.67	40.75	40.58	39.85
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	38.99	37.93	37.73	39.09	37.89	38.47	40.64	41.79	41.39	39.80
S2	39.65	39.56	40.41	40.13	38.55	40.91	39.54	42.53	42.24	41.10
S3	37.56	40.89	42.44	38.54	40.37	42.07	41.14	42.52	43.04	42.61
S4	39.41	40.39	39.61	41.13	38.39	38.74	40.74	43.22	42.89	42.71
SE $\pm$	0.867									
C.D. at 5%	NS									

Year 2021-22

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	39.81	41.08	33.74	41.05	39.83	42.64	42.52	38.93	39.94	37.31
S2	38.78	43.85	37.88	43.03	39.86	42.53	42.48	41.05	41.73	39.30
S3	39.76	43.02	37.80	42.59	41.78	44.42	44.17	41.46	40.66	40.10
S4	39.81	43.43	36.73	41.25	41.66	43.83	43.06	42.65	42.95	40.12
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	40.18	38.55	39.96	41.79	40.68	39.46	39.02	41.17	40.37	38.32
S2	40.52	43.32	42.78	42.41	41.16	40.80	41.78	41.26	39.53	40.19
S3	39.58	43.02	42.54	43.15	41.06	41.89	41.05	40.67	42.40	39.23
S4	38.70	42.22	41.16	42.94	42.56	39.86	40.63	42.51	40.36	40.01
Sowing dates	Varieties									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	41.07	41.05	39.83	38.87	40.08	41.84	40.01	39.52	39.02	38.70
S2	40.87	42.32	39.83	40.47	43.36	41.64	40.82	39.59	41.90	41.40
S3	41.09	40.31	42.54	42.02	41.24	41.96	40.10	40.51	42.35	40.81
S4	40.46	40.11	40.97	40.83	41.89	41.55	42.33	41.85	39.40	40.26
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	38.01	39.09	40.88	39.50	38.15	38.43	38.59	40.14	40.37	40.07
S2	38.77	38.52	40.42	41.08	38.88	39.88	41.90	43.91	42.70	42.80
S3	41.00	39.86	39.95	41.56	39.63	40.22	41.49	43.09	42.11	42.61
S4	38.87	41.95	39.17	40.77	39.89	40.71	39.42	42.26	42.58	42.79
SE $\pm$	0.760									
C.D. at 5%	2.114									

Pooled

Sowing dates	Varieties									
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
S1	39.29	41.12	33.45	40.69	39.14	42.17	41.51	38.49	39.63	37.02
S2	38.74	43.72	38.00	42.56	40.64	42.59	42.92	41.04	41.57	38.53
S3	40.08	43.88	38.07	42.78	41.03	44.25	43.54	41.25	40.94	39.78
S4	39.82	43.05	37.12	42.00	40.82	44.09	43.31	41.63	42.27	40.65
Sowing dates	Varieties									
	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
S1	39.71	39.79	40.35	41.20	40.89	39.58	38.26	40.61	40.54	38.51
S2	39.46	43.28	42.74	42.31	41.57	40.79	40.85	40.62	39.43	41.01
S3	40.20	42.70	42.65	42.68	41.19	41.77	41.00	41.86	41.45	40.43
S4	38.73	42.59	41.50	43.07	42.31	40.01	40.84	42.31	40.54	39.99
Sowing dates	44.58									
	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30
S1	40.19	39.56	40.12	40.21	39.98	41.03	40.13	39.59	39.18	39.01
S2	40.16	41.08	39.32	40.69	42.23	41.07	40.73	40.29	40.44	40.24
S3	41.19	40.19	42.01	41.69	40.74	41.30	40.54	41.16	41.27	39.94
S4	39.70	39.95	41.08	40.90	41.22	41.31	41.50	41.30	39.99	40.06
Sowing dates	Varieties									
	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
S1	38.50	38.51	39.30	39.29	38.02	38.45	39.62	40.97	40.88	39.94
S2	39.21	39.04	40.41	40.60	38.72	40.39	40.72	43.22	42.47	41.95
S3	39.28	40.38	41.19	40.05	40.00	41.15	41.31	42.81	42.58	42.61
S4	39.14	41.17	39.39	40.95	39.14	39.72	40.08	42.74	42.74	42.75
SE $\pm$		0.536								
C.D. at 5%		1.491								

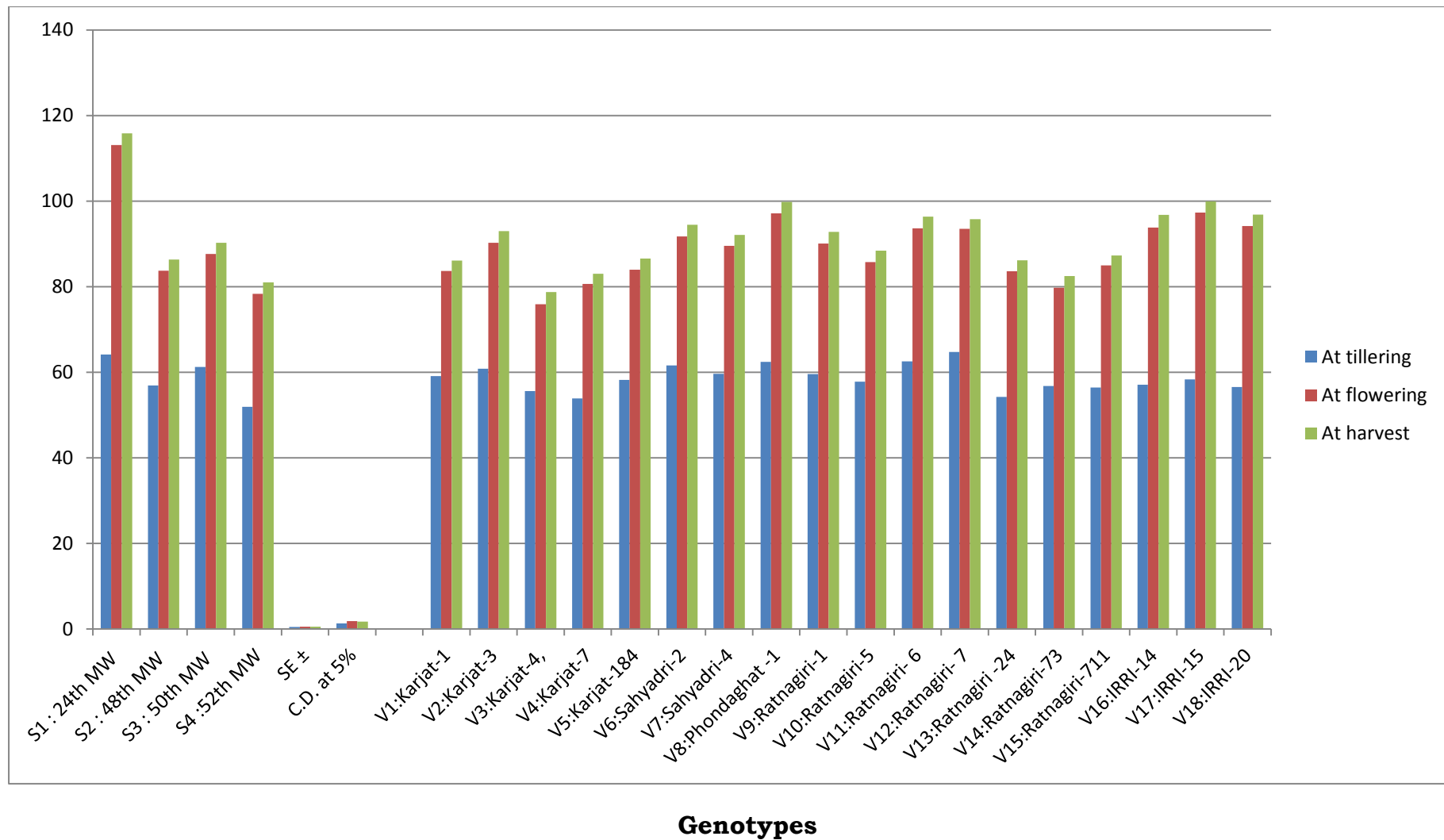
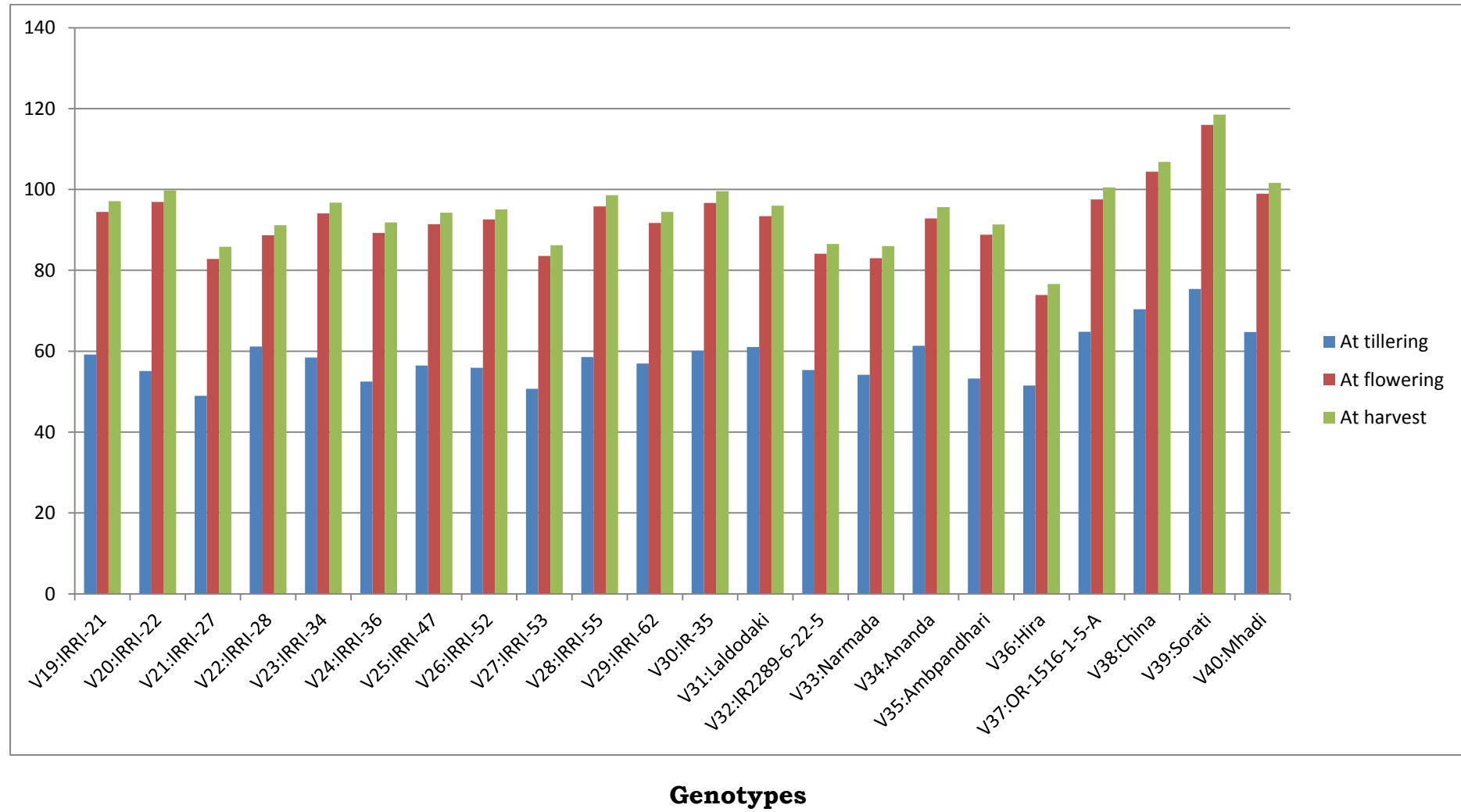


Fig. 1 : Effect of different treatment on plant height (cm) of rice genotypes

Continued ...



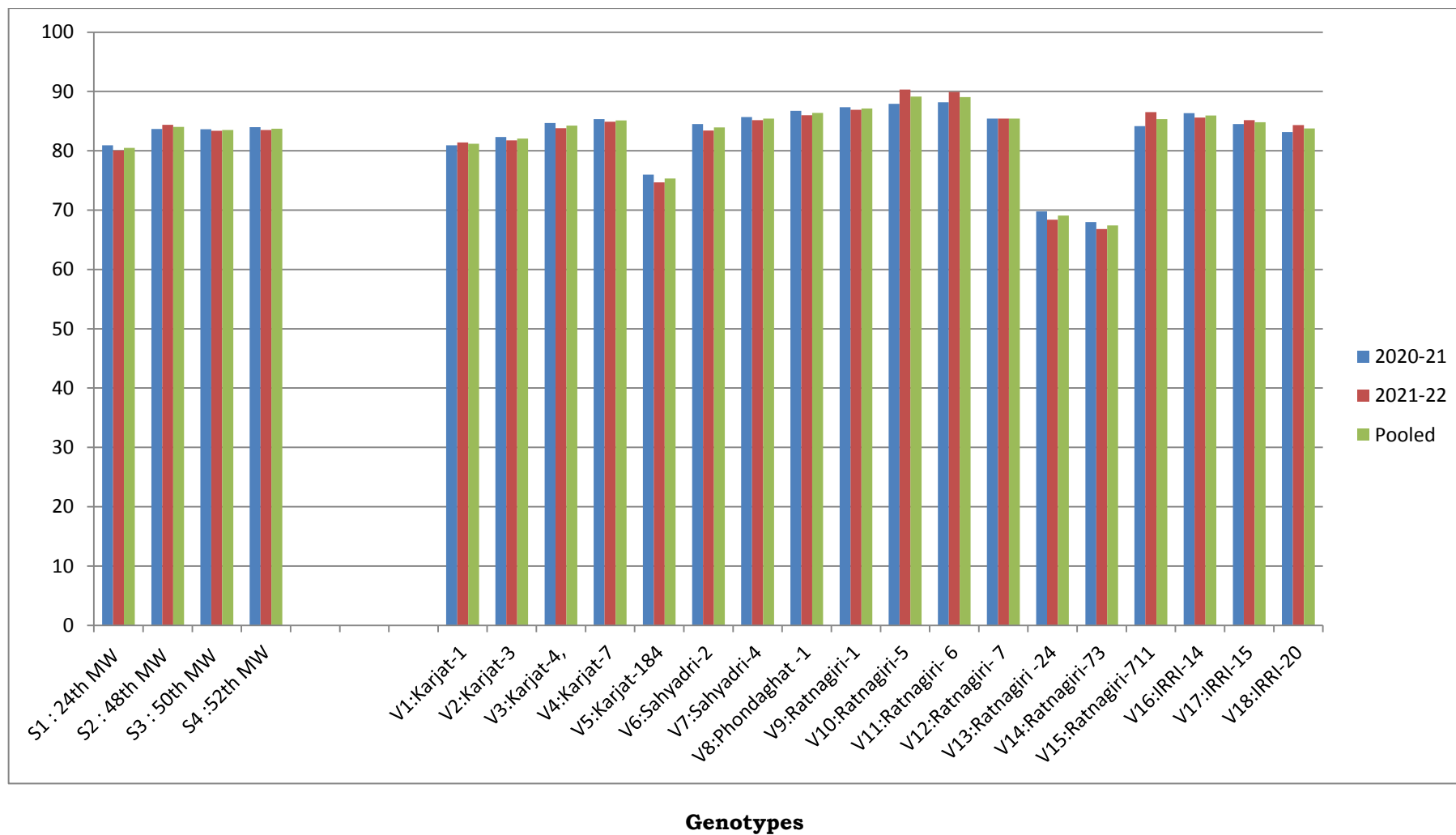
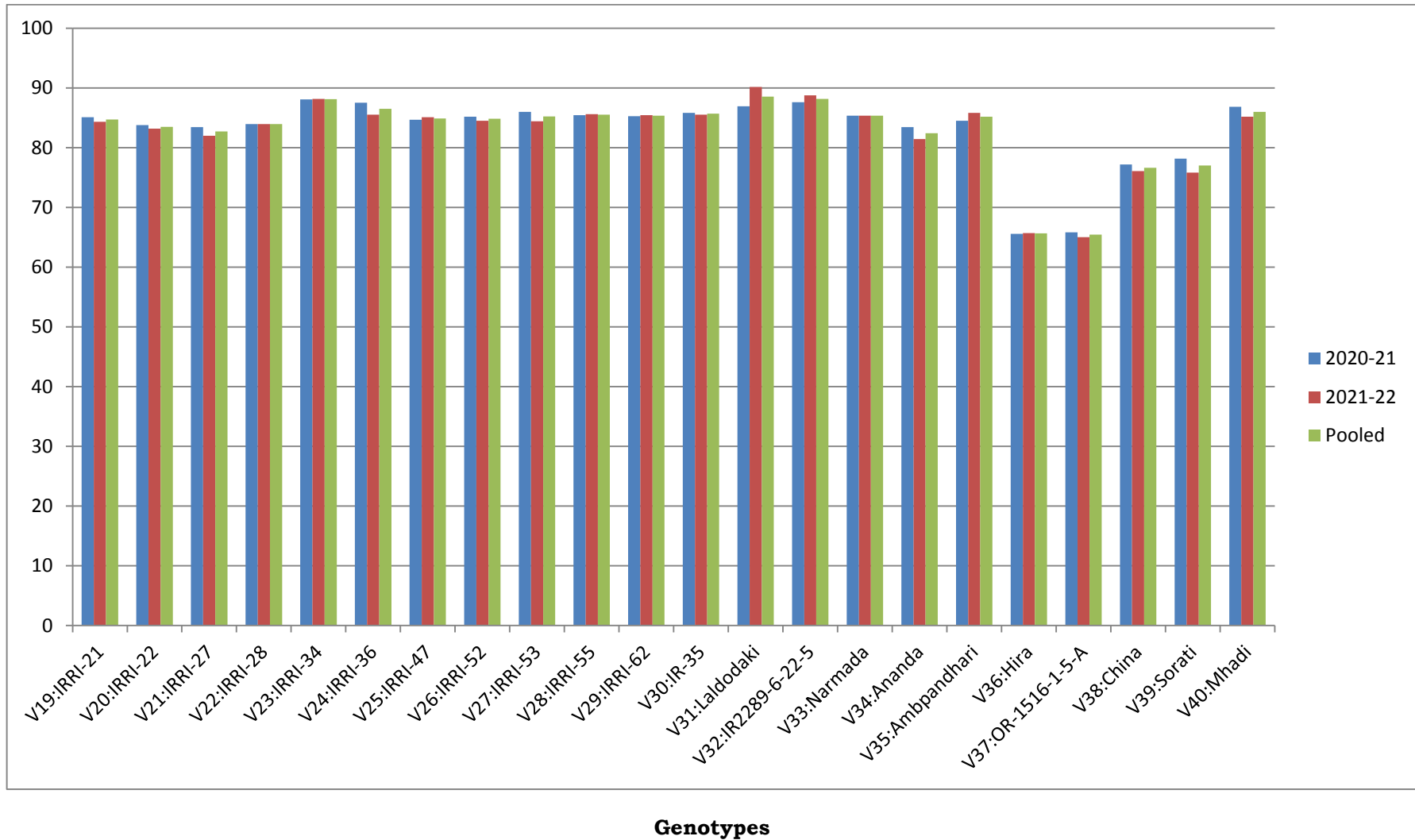


Fig. 2 : Effect of different treatment on days to first flowering of rice genotypes

Continued



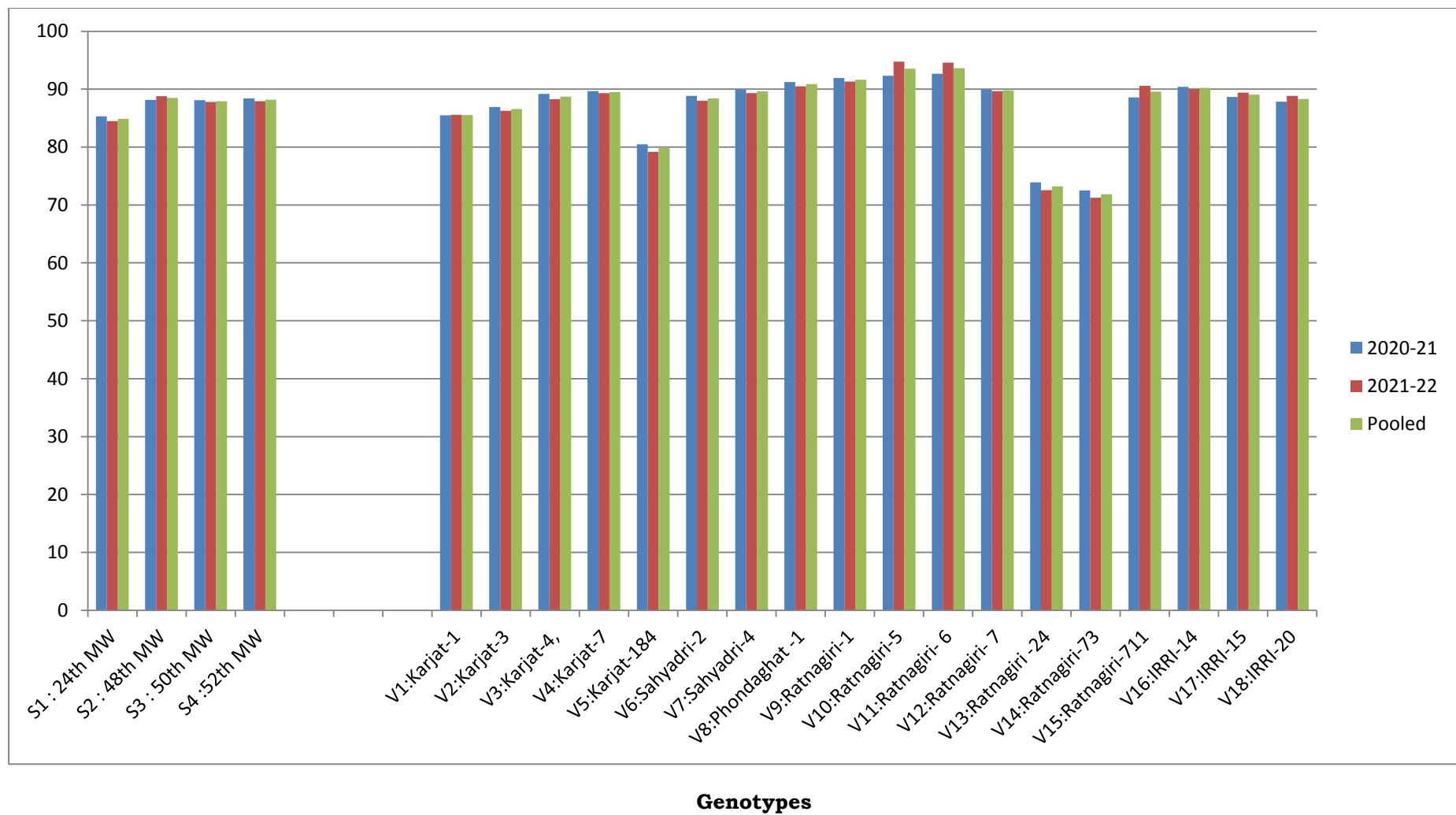
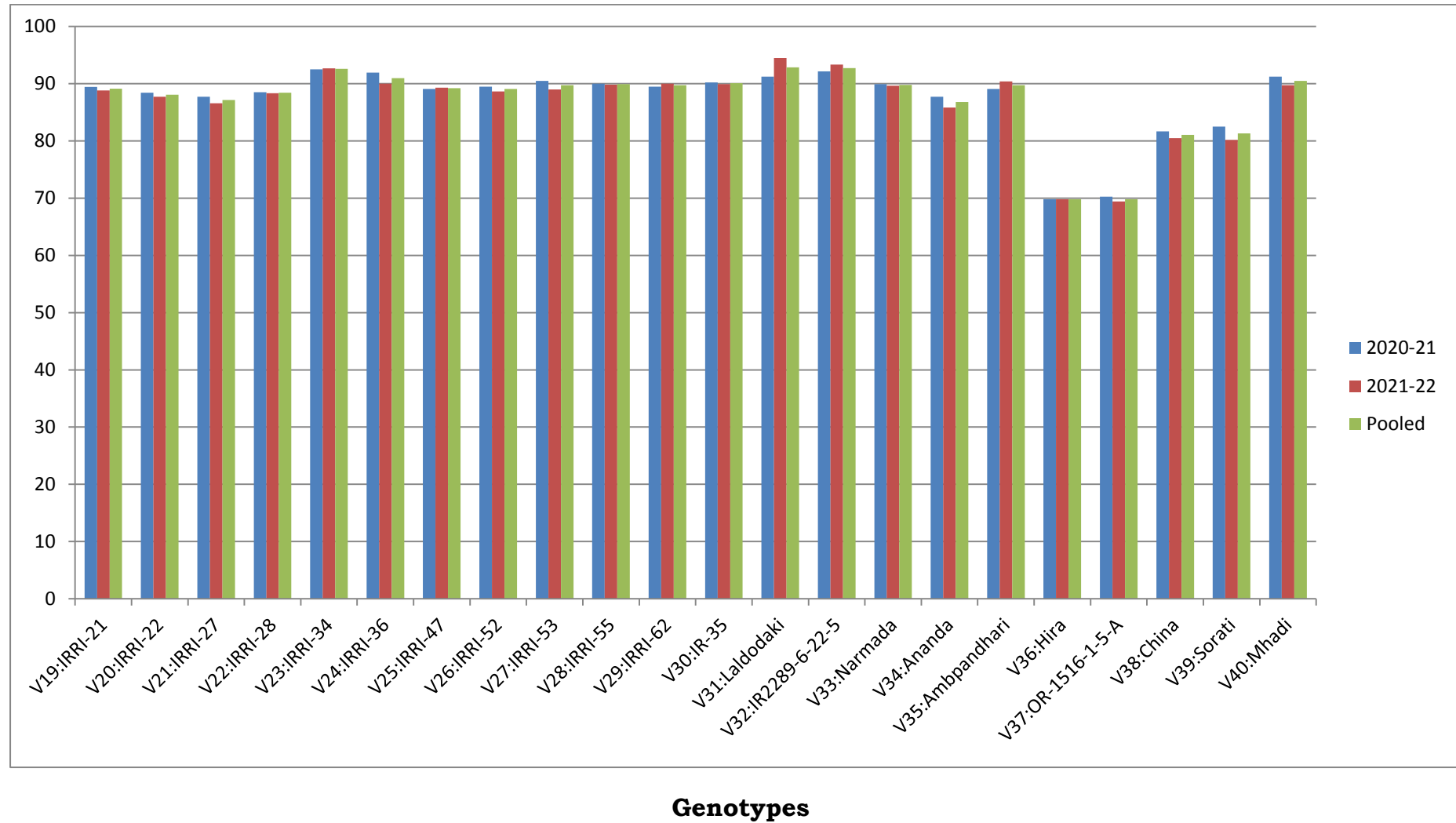


Fig. 3 : Effect of different treatment on day to 50% flowering of rice genotypes

Continued



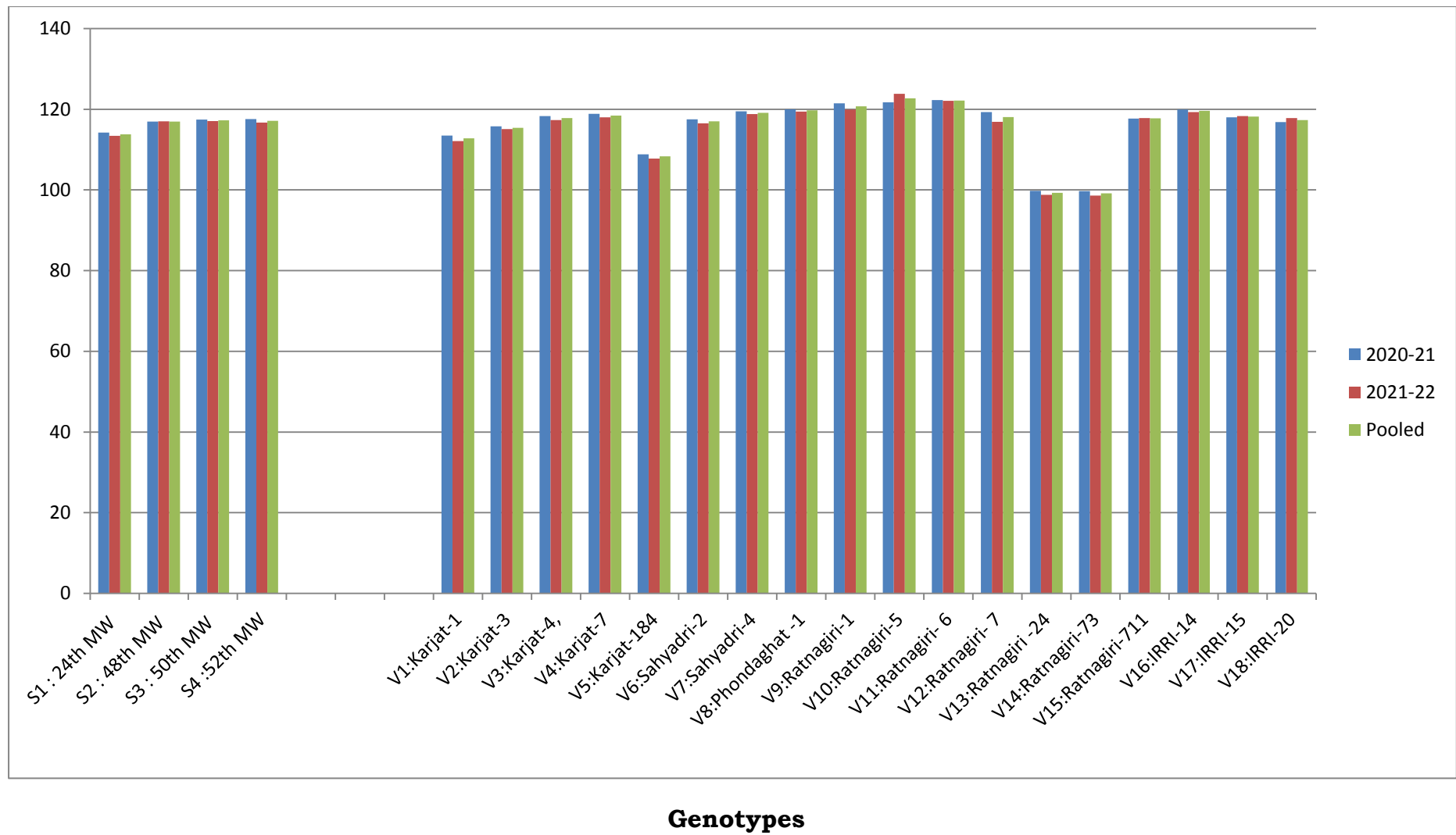
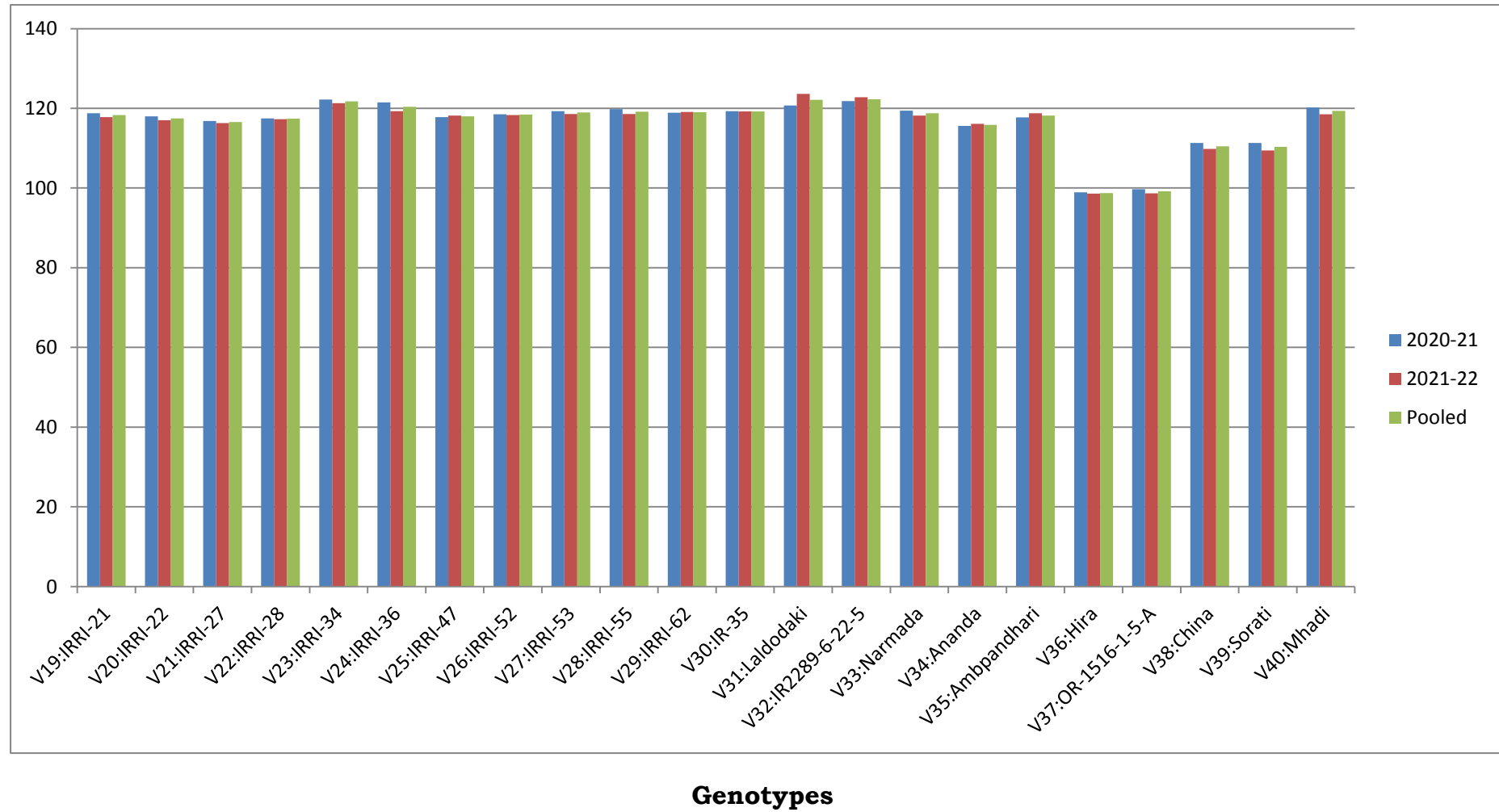


Fig. 4. Effect of different treatment on days to maturity of rice genotypes

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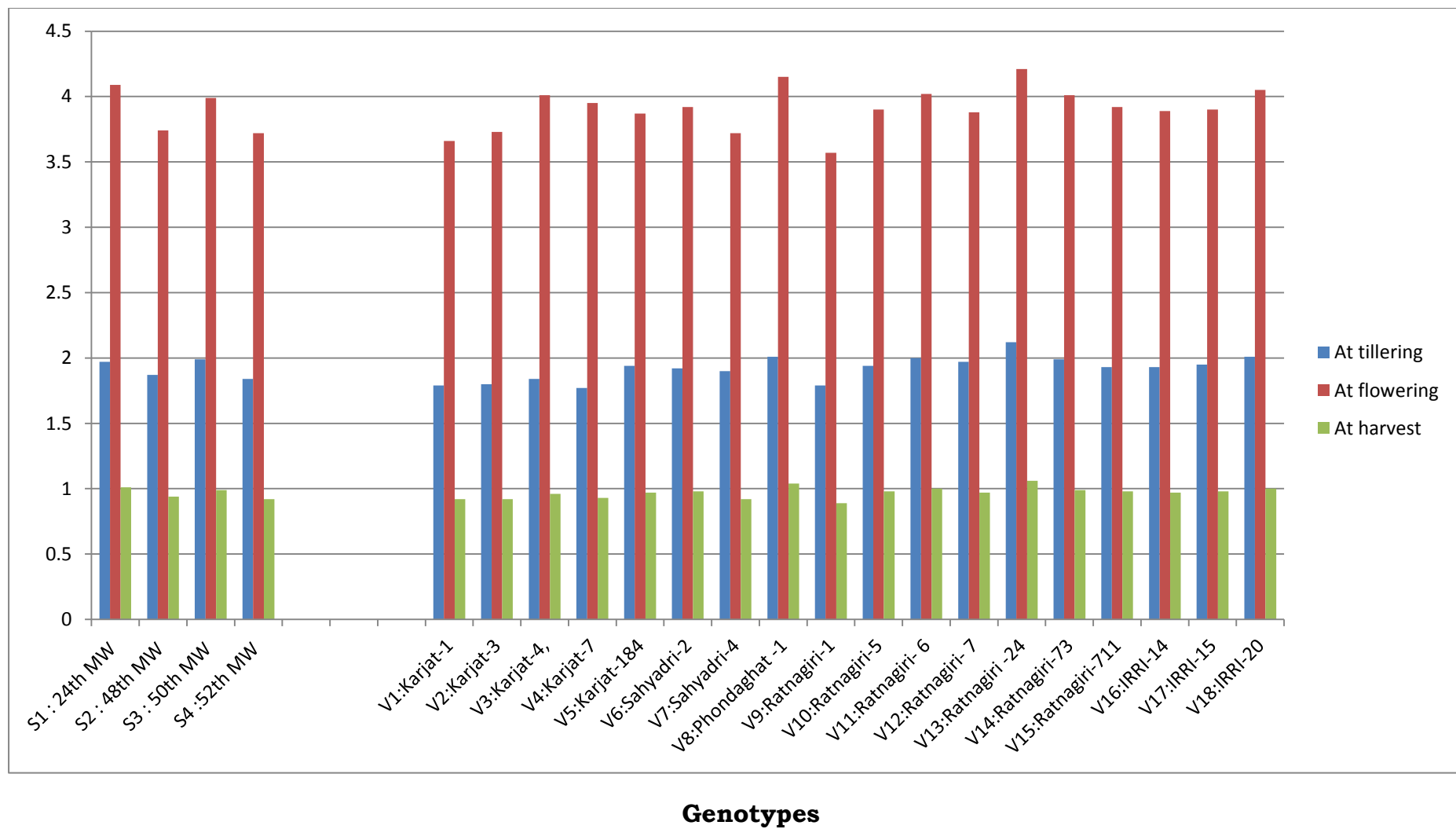
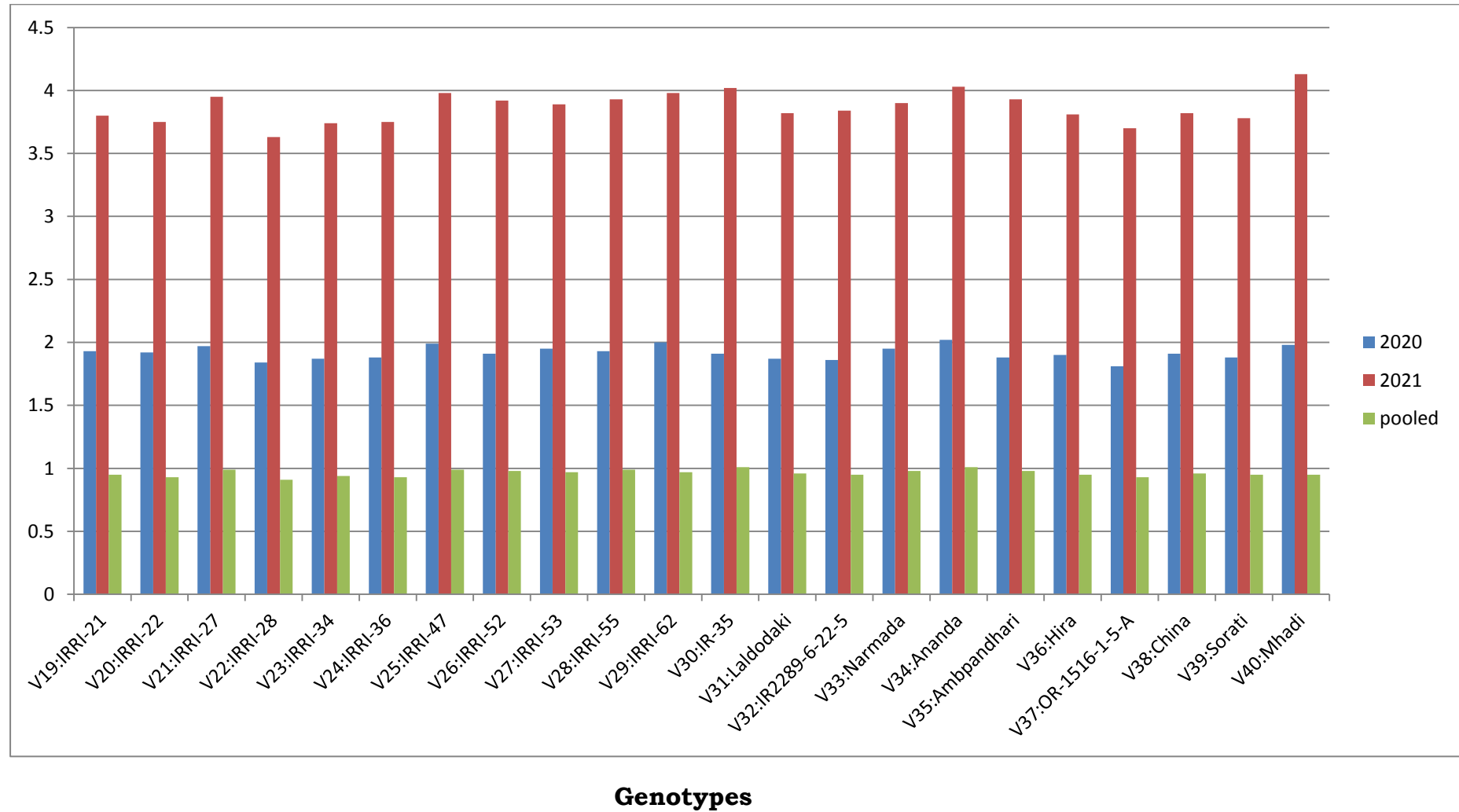


Fig. 5. Effect of different treatment on total chlorophyll (mg/g) of rice genotypes

Continued.....



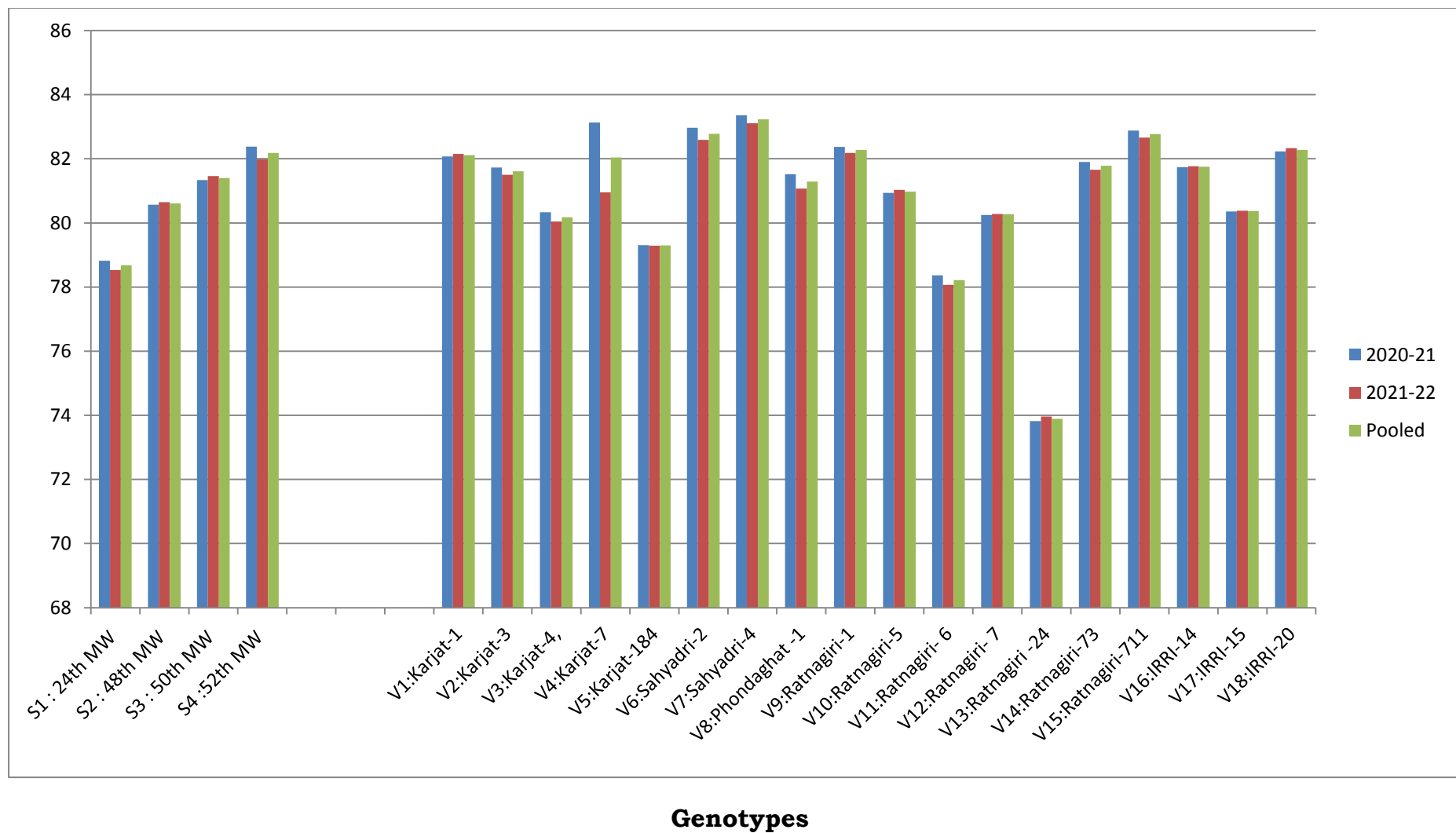
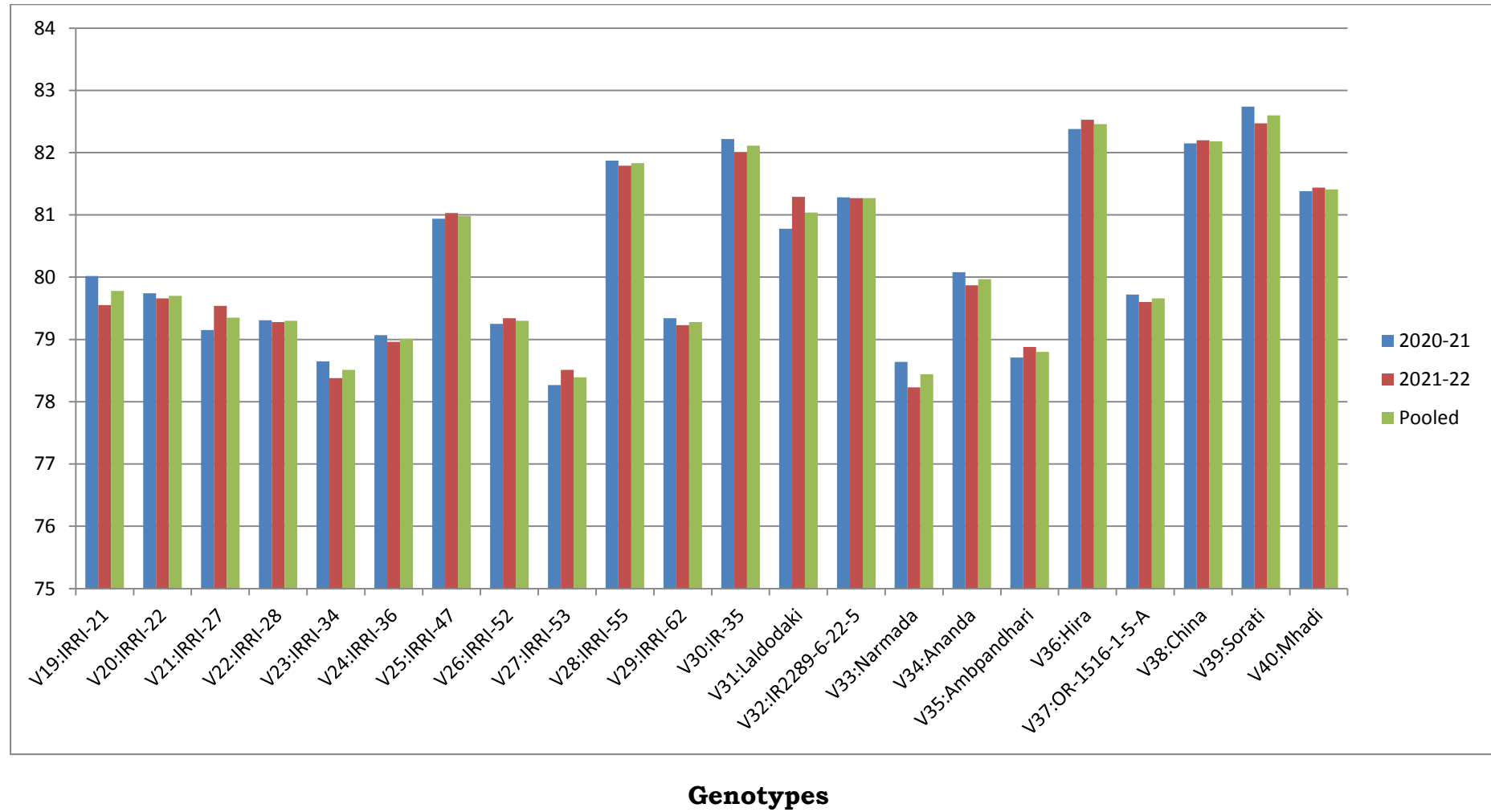


Fig. 6 : Effect of different treatment on carbohydrate (%) of rice genotypes

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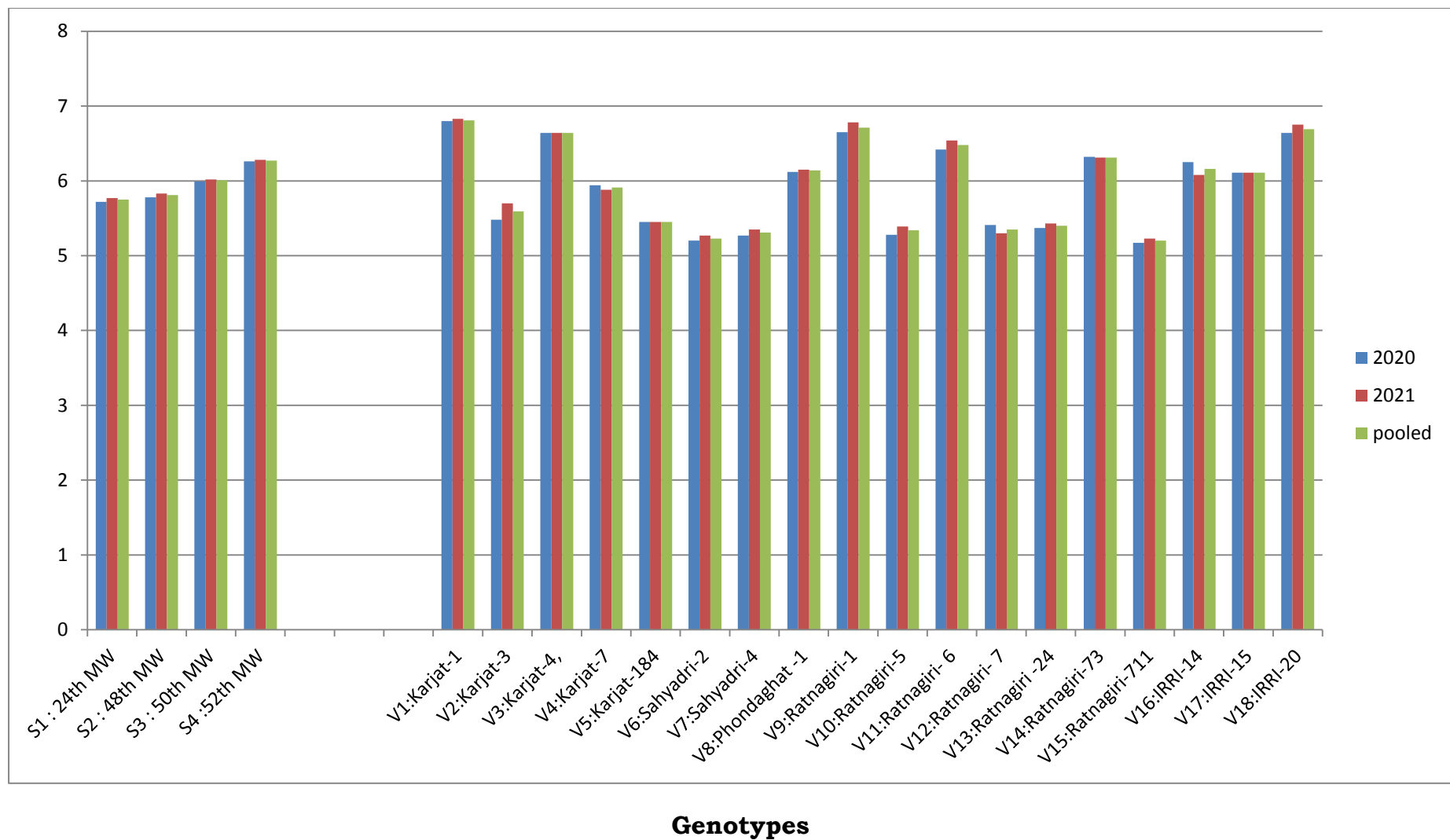
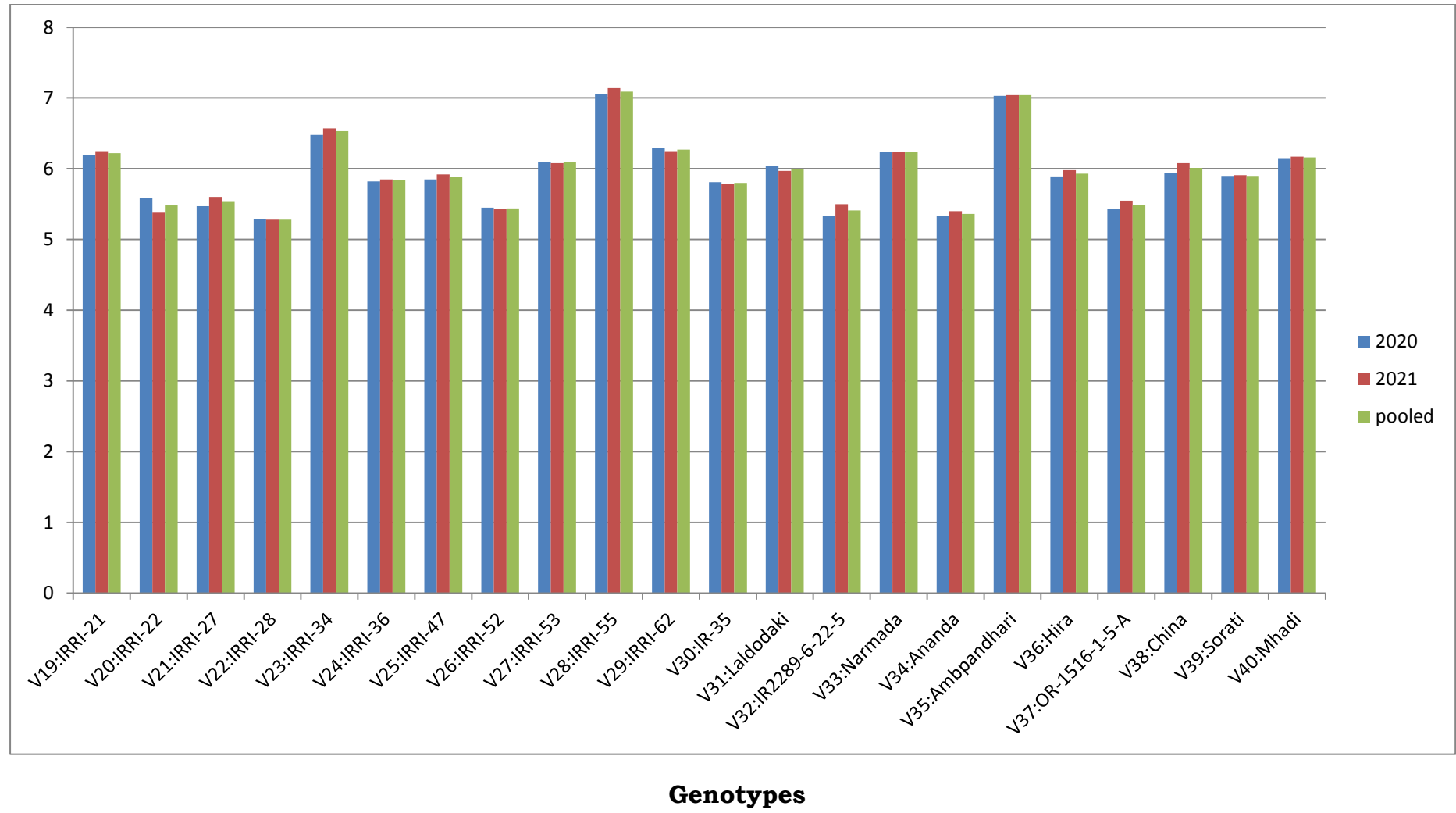


Fig. 7 : Effect of different treatment on protein (%)of rice genotypes

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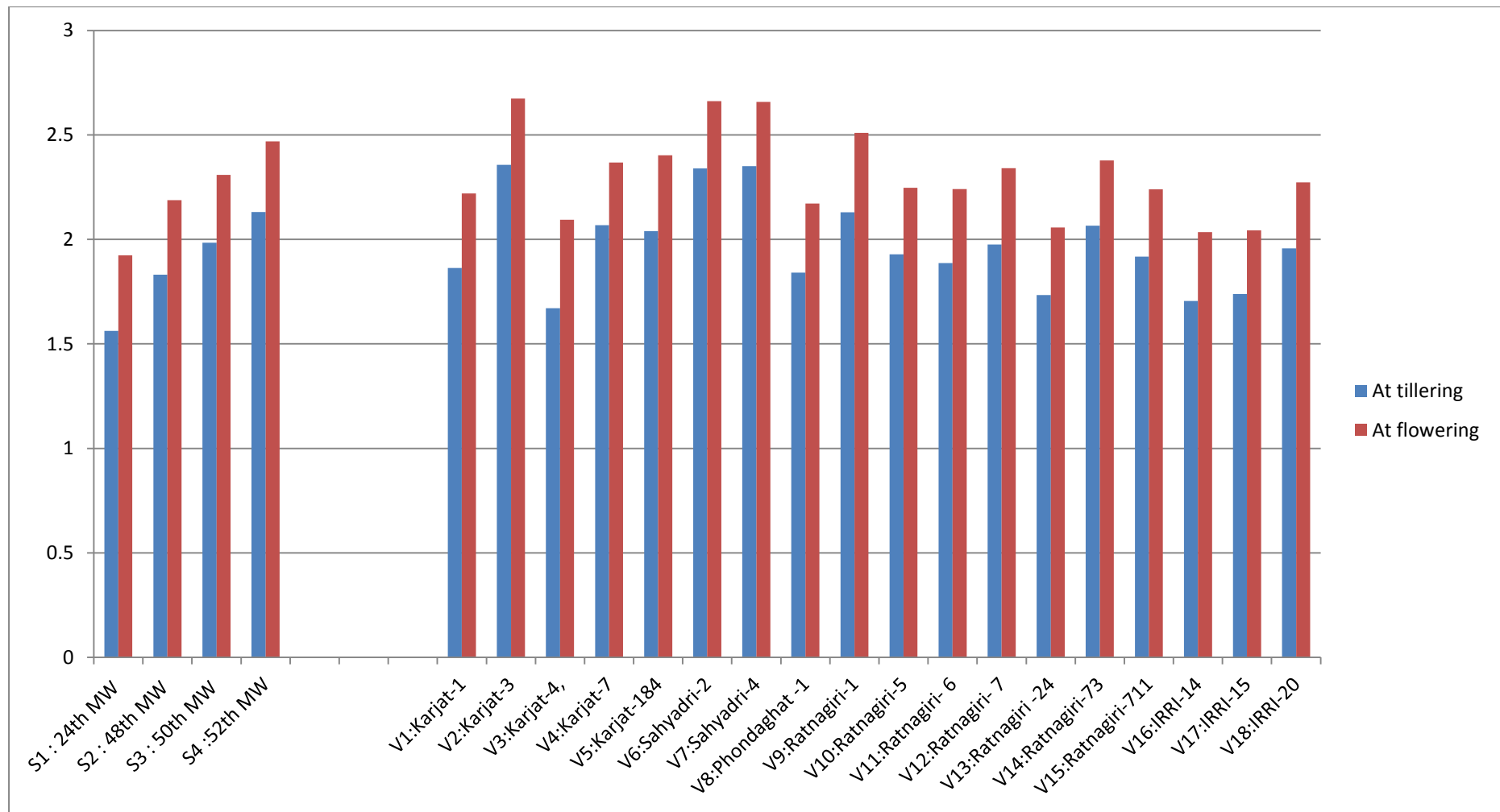
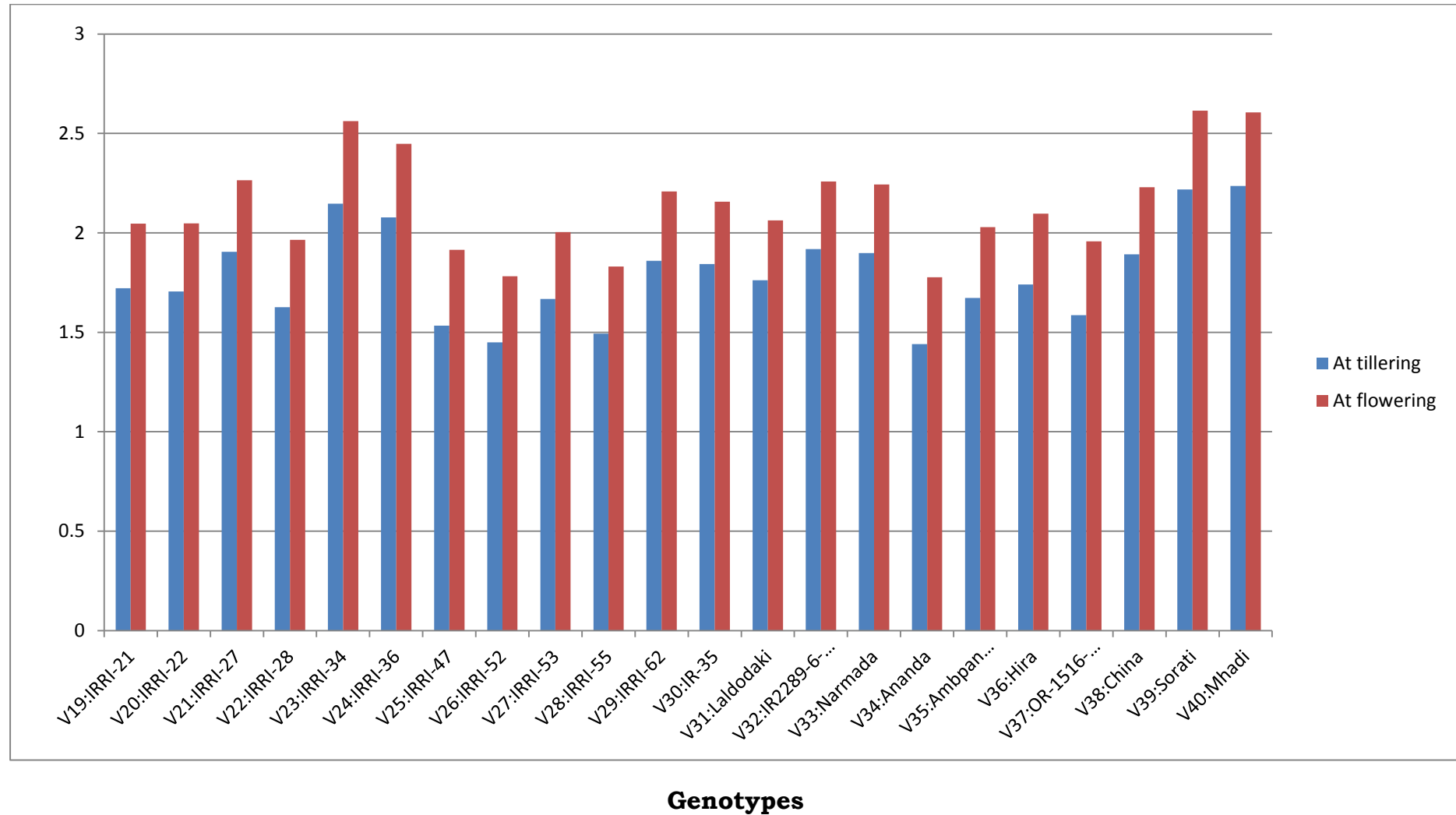


Fig. 8 : Effect of different treatment on nitrate reductase activity ($\mu\text{mol g}^{-1}$) of rice genotypes.

Continued



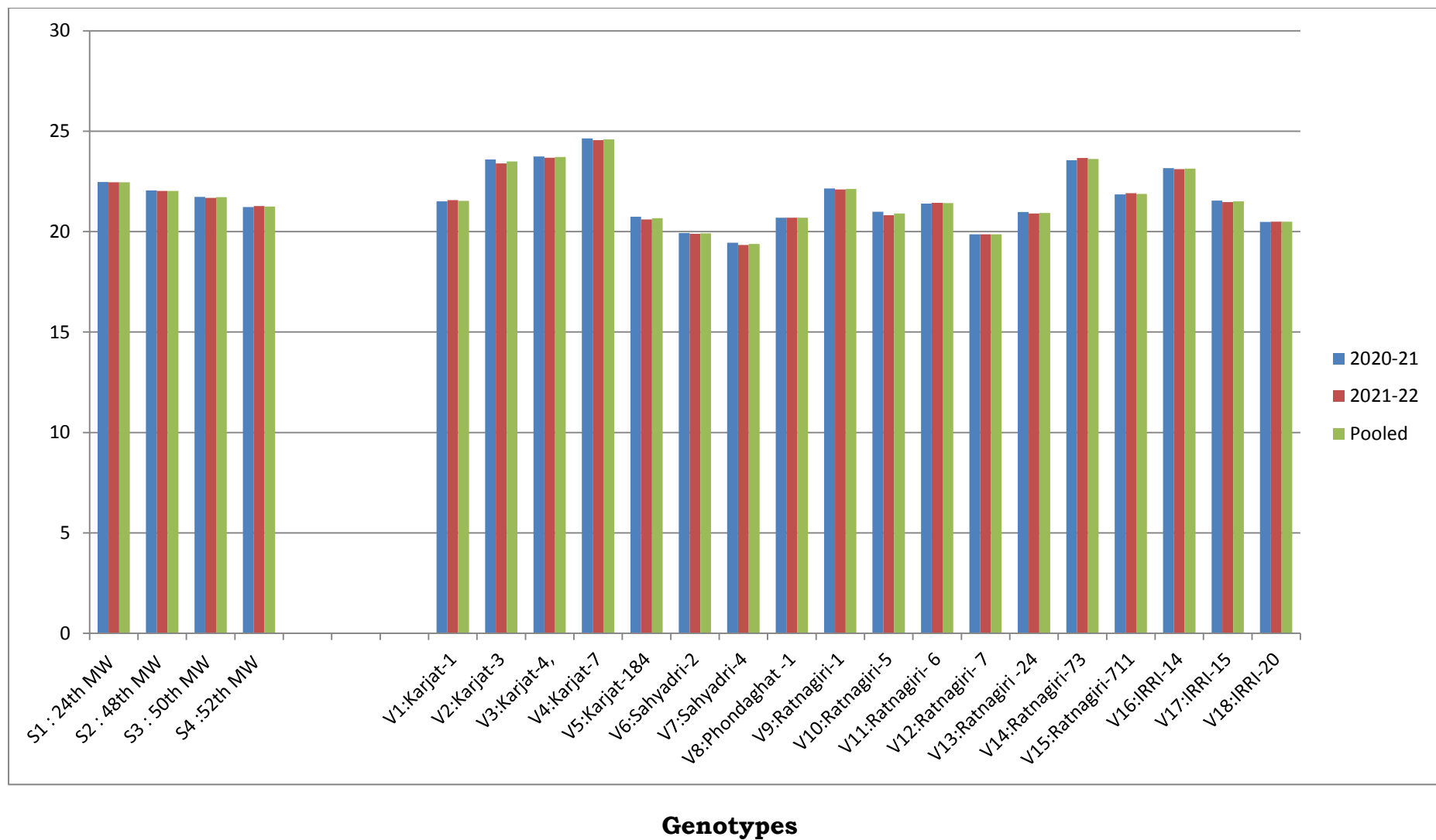
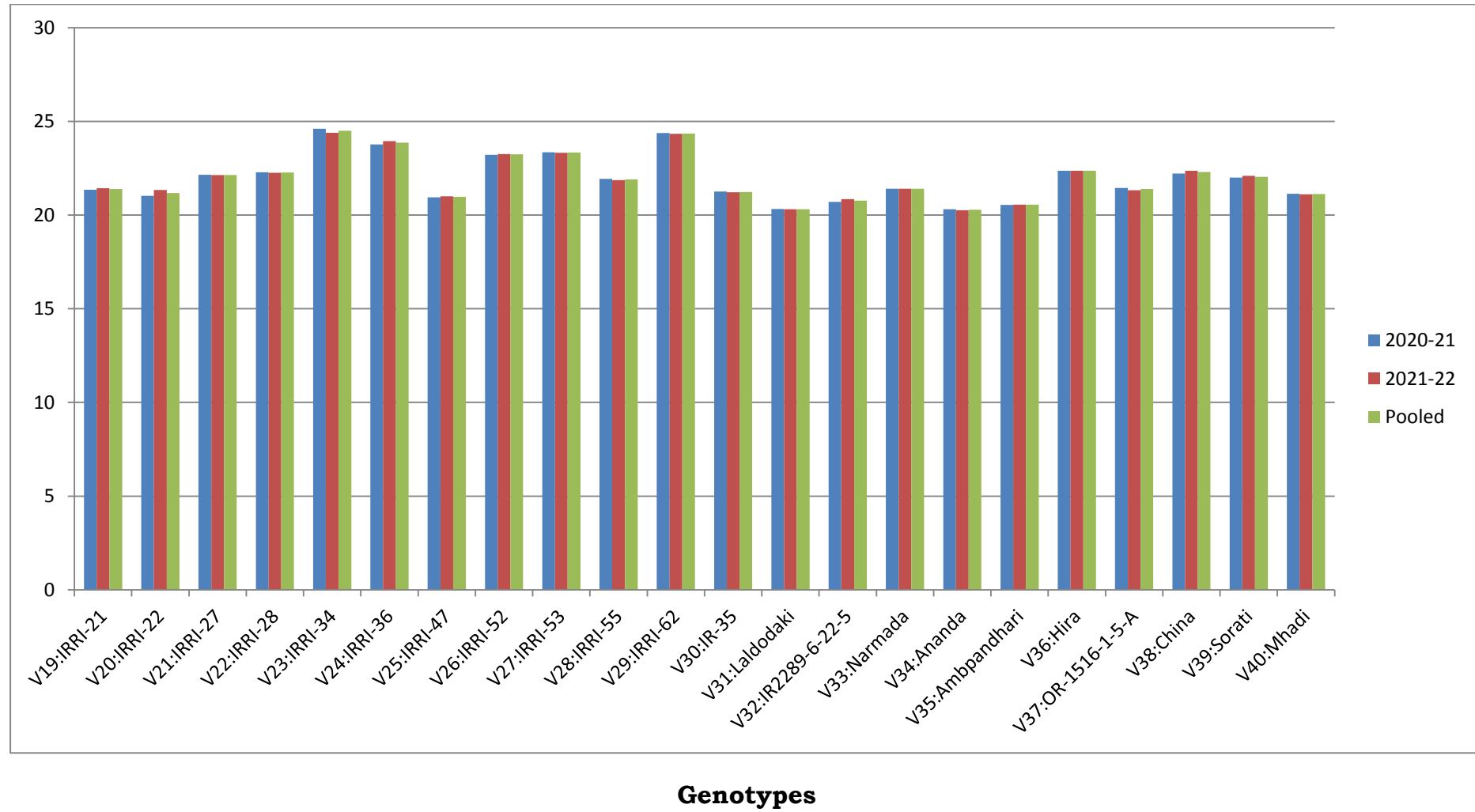


Fig. 9 : Effect of different treatment on amylose (%)of rice genotypes.

Continued



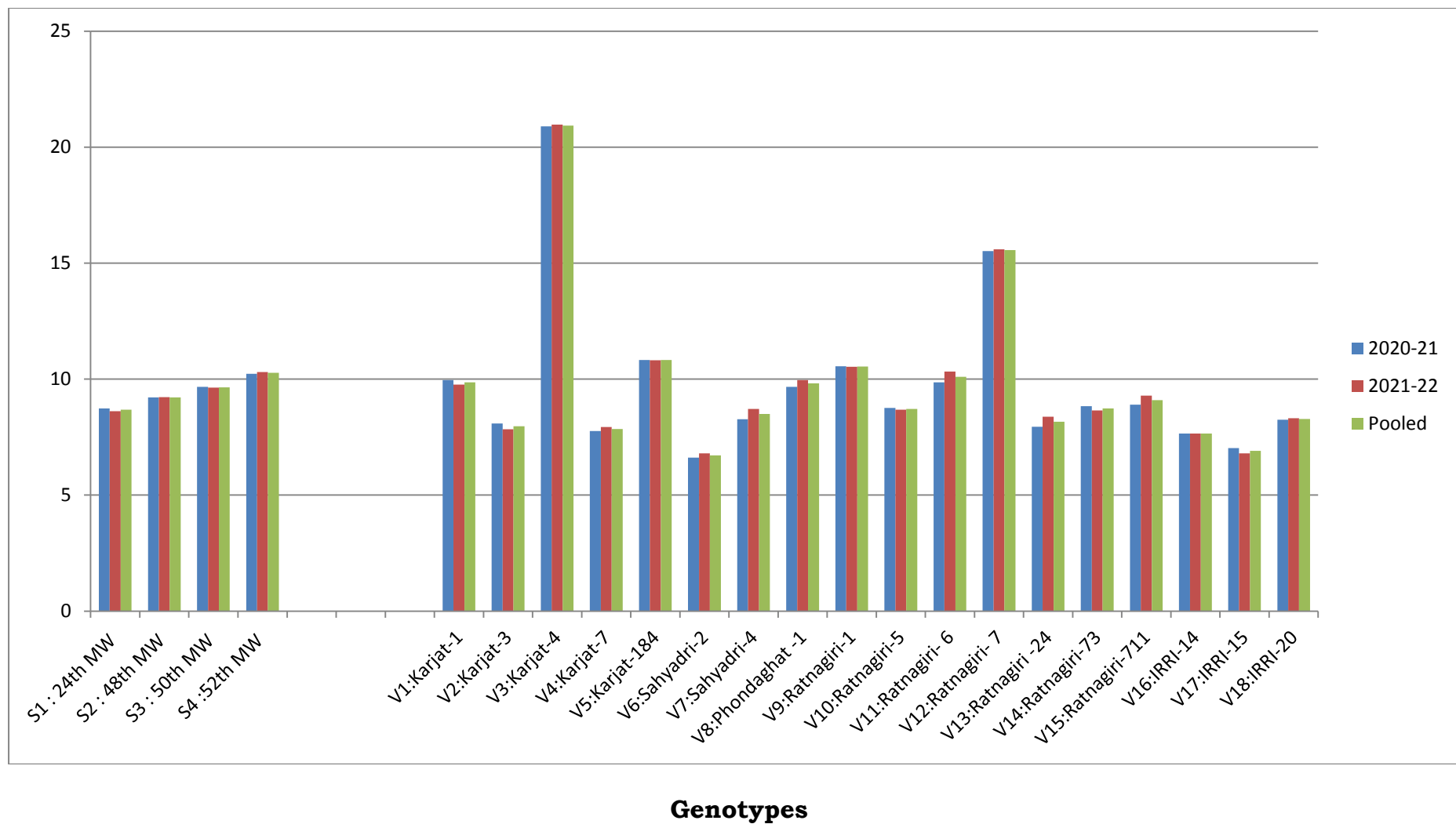
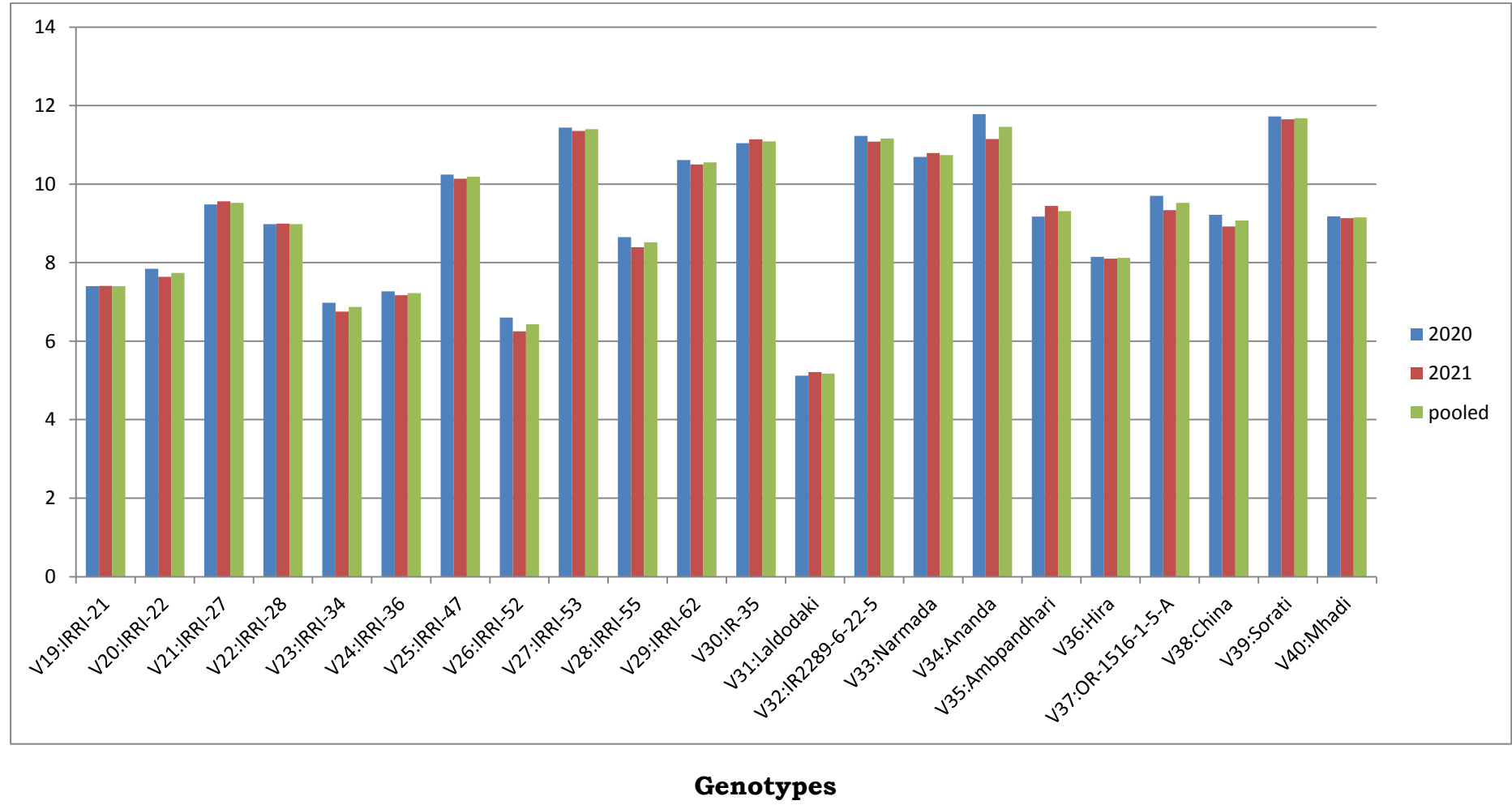


Fig.10 : Effect of different treatment on iron (ppm) of rice genotypes.

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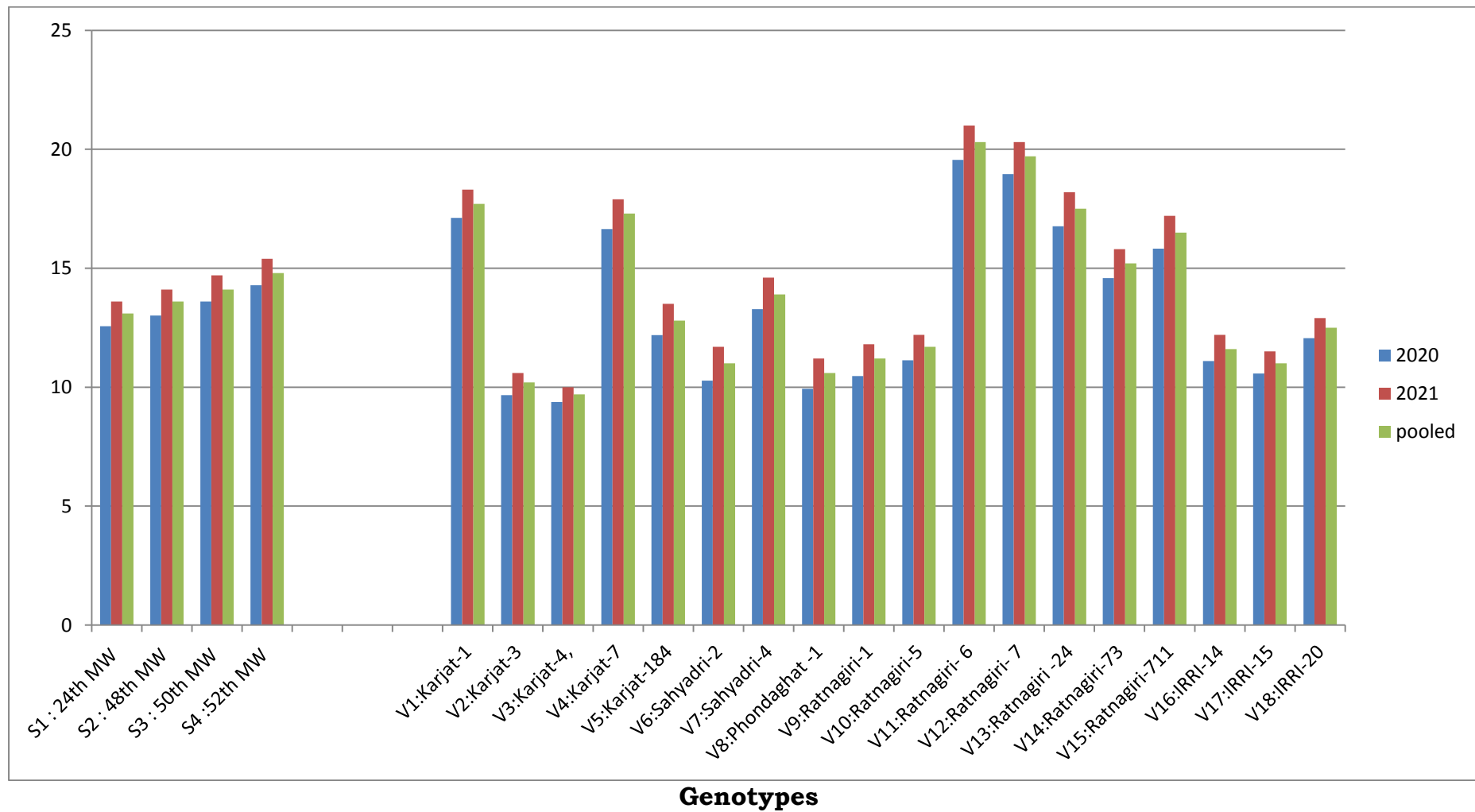
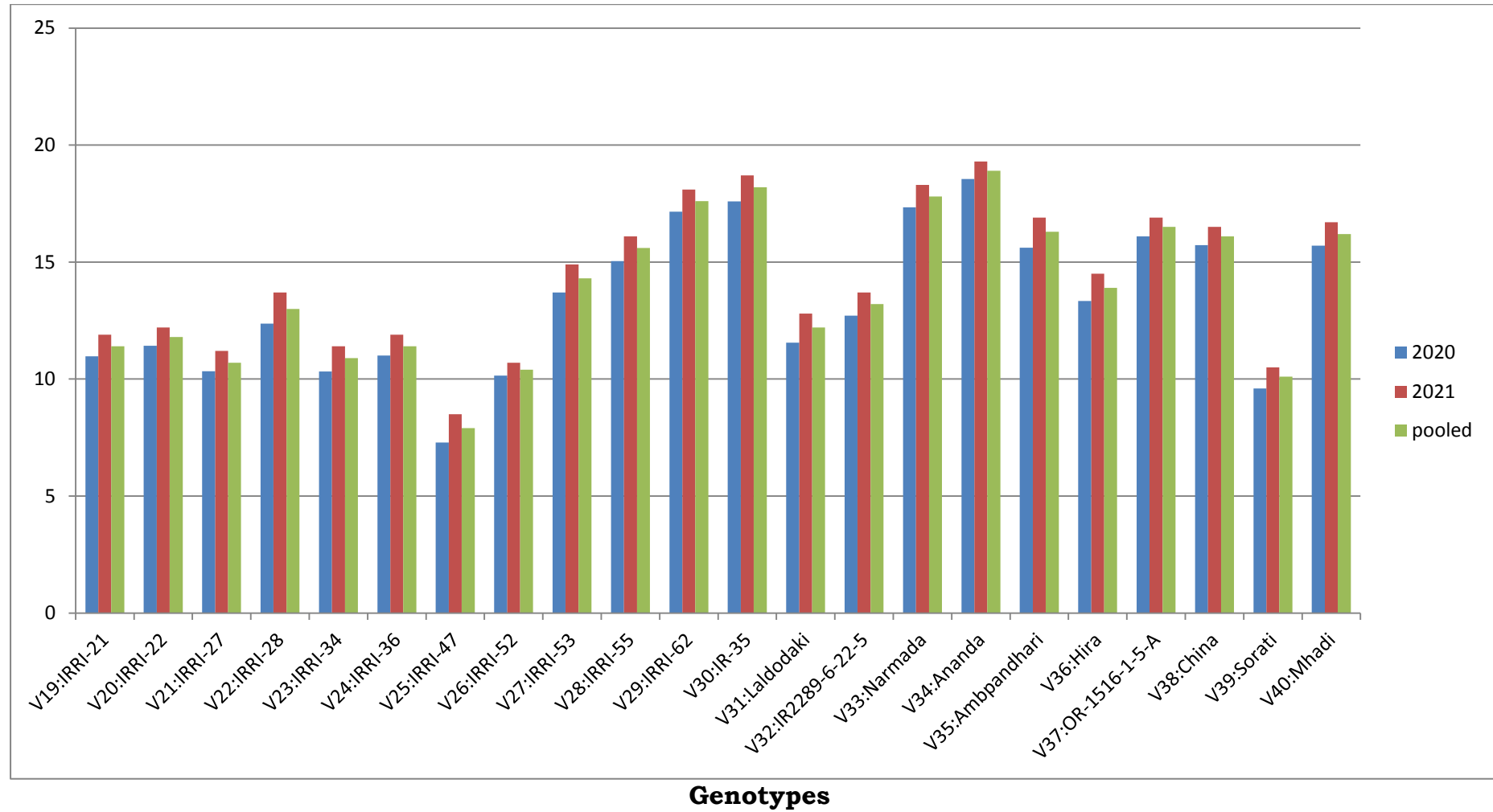


Fig.11 Effect of different treatment on zinc (ppm) of rice genotypes.

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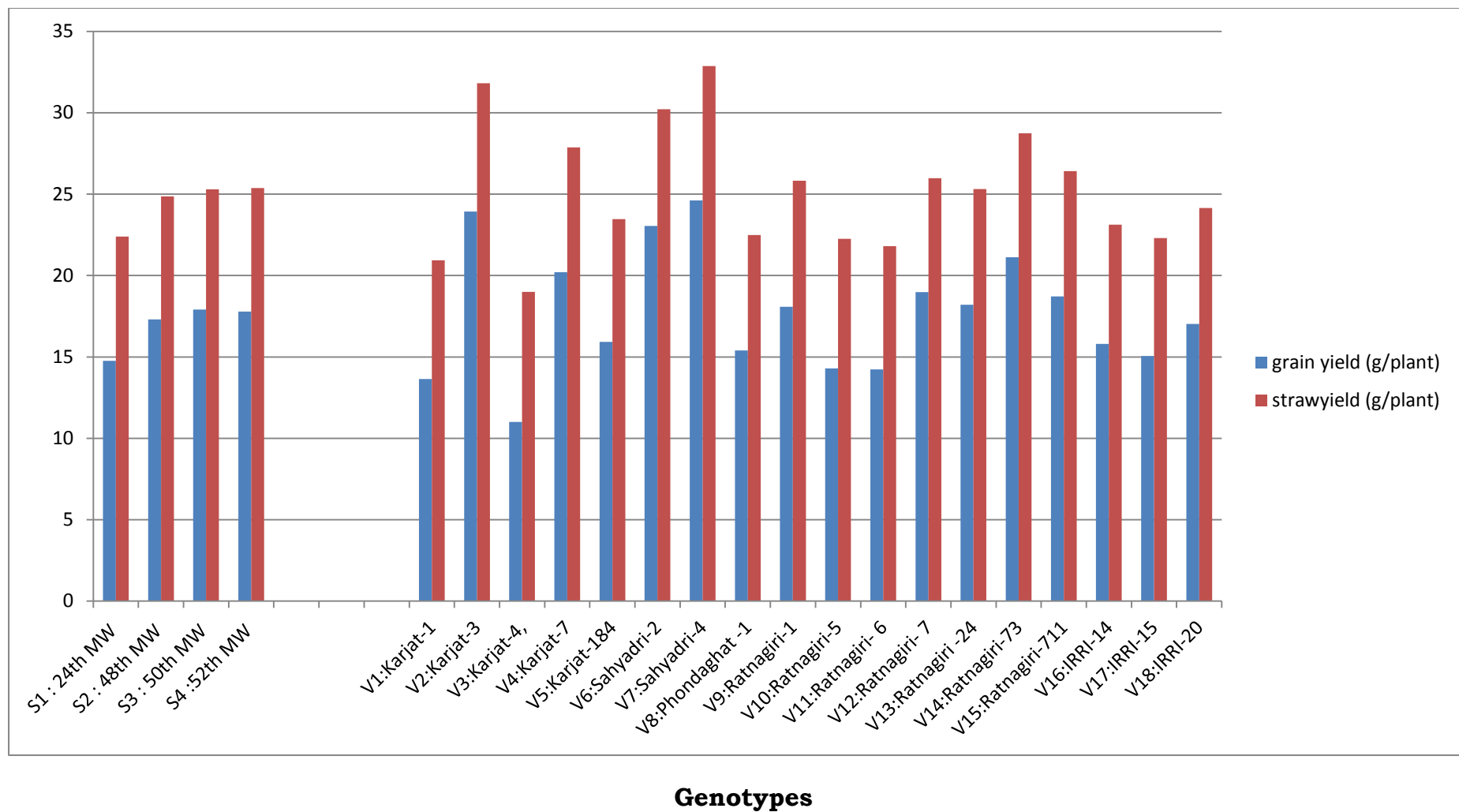
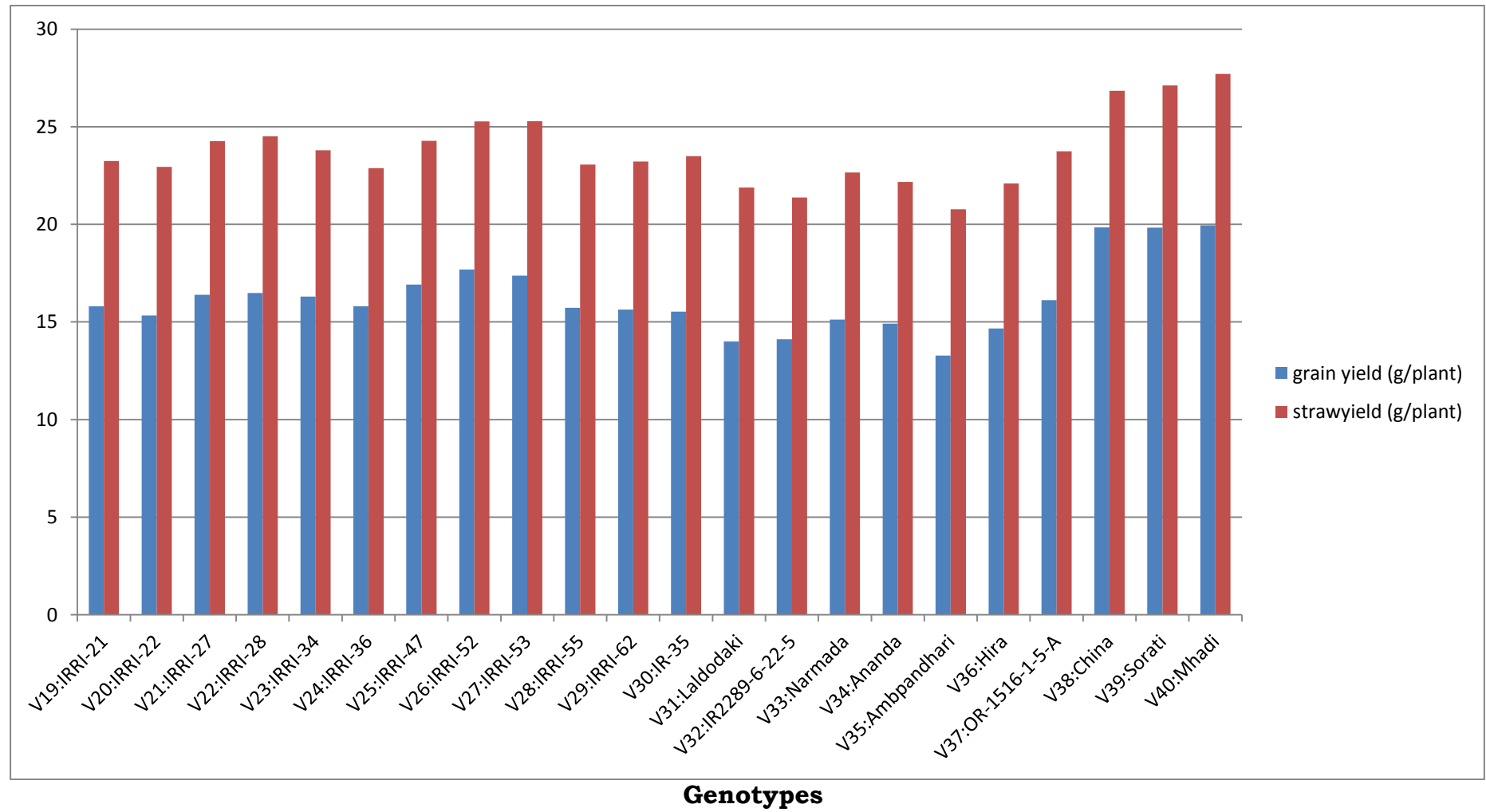


Fig. 12 : Effect of different treatment on grain yield and straw yield (g/plant)of rice genotypes

Continued....





Kharif 2020



Kharif 2021



Rabi 2020-21



Rabi 2021-22

Plate I : General view of experimental plot at Regional Agriculture Research Station Karjat Dist –Raigad



Plate II : Nursery view of experiment



Plate III : General view of experimental plot after transplanting



Plate IV : Measurement of leaf observations by portable pressure chamber (Arimad-3000) in experimental field



Plate V: Measurement of leaf observations by Infrared Red Gas Analyzer (IRGA)



Analysis of NR activity of leaf



Analysis of amylose content of seed grain



Analysis of carbohydrate of seed grain



Analysis of Iron and zinc of seed grain

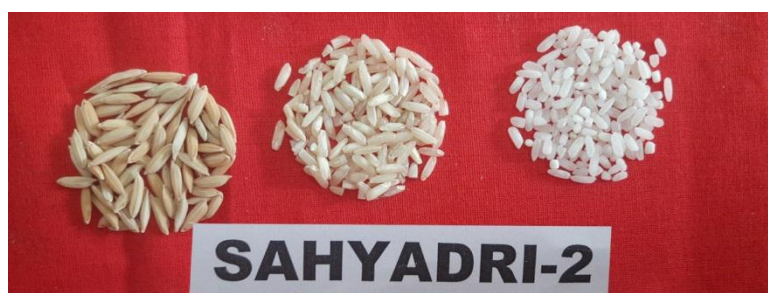


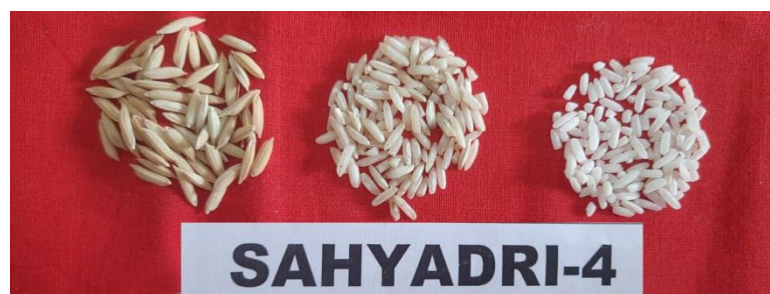
Analysis of Chlorophyll of leaf



Plate VI : Photographs of laboratory analysis

Plate VII : Photographs of seed grains of different varieties













LALDODKI



IR2289-6-22-5



NARMADA



ANANDA



HIRA



AMBEPANDHARI



CHAPTER -V

DISCUSSION

The present investigation entitled, **“Morpho-physiological and biochemical characterization of rice (*Oryza sativa* L.) genotypes for their suitability under *rabi* environment of Konkan”** was carried out with the objectives to study morphological, physiological, biochemical characterization, thermo and photo sensitivity response of 40 early duration rice genotypes under *kharif* and different sowing windows during *rabi* season in Konkan, to assess correlation of weather parameters with grain yield and to find out physiologically efficient, high yielding and stable genotype for growing under *rabi* season. Information on morphological and physiological characters plays a vital role in rice breeding. It essential to know the physiological behaviour of rice genotypes or definite breeding objectives to improve those genotypes. Identifying promising physiologically efficient, high yielding and stable genotype for growing under *rabi* season plays an important role in varietal development programmes. Development of rice varieties with high yielding ability is one of the most fundamental approaches for dealing with the expected increase in world demand.

In view of above, a field experiment was carried out during *kharif* - 2020, *kharif*-2021, *rabi*-20-21 and *rabi*-21-22, Regional Agricultural Research Station, Karjat, Dist–Raigad (MH).The results presented in previous chapter are discussed briefly here.

5.1 Morphological and phenological parameters:

Morphological parameters *viz.*, plant height were recorded at tillering, flowering and harvesting stage and phenological parameters *viz.*, days to first flowering, days to 50% flowering and days to physiological maturity were presented Table 85.

Table 85. Effect of different treatments on morphological and phenological parameters.

Sr No	Genotypes	Plant height (cm)			Days to first flowering	Days to 50% first flowering	Days to physiological maturity
A] Main plot (Date of sowing)		Tillering	Flowering	Harvesting			
1	S ₁ : 24 th MW	64.11	113.06	115.81	80.50	84.89	113.81
2	S ₂ : 48 th MW	56.91	83.71	86.30	84.02	88.48	116.96
3	S ₃ : 50 th MW	61.20	87.60	90.27	83.51	87.94	117.27
4	S ₄ : 52 th MW	51.90	78.33	80.99	83.73	88.17	117.13
	SE $\pm$	0.43	0.52	0.49	0.100	0.093	0.103
	C.D. at 5%	1.30	1.80	1.71	0.345	0.322	0.357
B) Sub plot (Varieties)							
1	V1: Karjat-1	59.07	83.65	86.08	81.17	85.54	112.79
2	V2: Karjat-3	60.80	90.22	92.99	82.04	86.58	115.42
3	V3: Karjat-4,	55.60	75.89	78.74	84.25	88.71	117.83
4	V4: Karjat-7	53.86	80.61	82.98	85.13	89.50	118.46
5	V5: Karjat-184	58.22	83.97	86.58	75.33	79.83	108.33
6	V6: Sahyadri-2	61.59	91.75	94.43	83.96	88.42	117.00
7	V7: Sahyadri-4	59.63	89.55	92.07	85.42	89.63	119.13
8	V8: Phondaghat -1	62.40	97.15	99.79	86.38	90.88	119.71
9	V9: Ratnagiri-1	59.58	90.04	92.82	87.13	91.63	120.71
10	V10: Ratnagiri-5	57.80	85.71	88.41	89.13	93.54	122.71
11	V11: Ratnagiri- 6	62.55	93.63	96.33	89.04	93.63	122.17
12	V12: Ratnagiri- 7	64.73	93.48	95.78	85.42	89.79	118.08
13	V13: Ratnagiri -24	54.24	83.57	86.15	69.08	73.23	99.31
14	V14: Ratnagiri-73	56.75	79.75	82.47	67.42	71.88	99.13
15	V15: Ratnagiri-711	56.43	84.97	87.28	85.33	89.58	117.75
16	V16: IRR1-14	57.07	93.78	96.78	85.96	90.21	119.63
17	V17: IRR1-15	58.34	97.33	99.94	84.83	89.04	118.17
18	V18: IRR1-20	56.55	94.17	96.85	83.75	88.33	117.29
19	V19: IRR1-21	59.18	94.47	97.08	84.71	89.13	118.29
20	V20: IRR1-22	55.10	96.89	99.79	83.46	88.08	117.50
21	V21: IRR1-27	48.96	82.84	85.82	82.71	87.17	116.54
22	V22: IRR1-28	61.13	88.68	91.18	83.92	88.42	117.38
23	V23: IRR1-34	58.43	94.06	96.71	88.13	92.58	121.75
24	V24: IRR1-36	52.51	89.22	91.82	86.50	90.96	120.38
25	V25: IRR1-47	56.44	91.40	94.26	84.88	89.21	118.00
26	V26: IRR1-52	55.91	92.58	95.03	84.83	89.08	118.42
27	V27: IRR1-53	50.70	83.57	86.23	85.21	89.75	118.96
28	V28: IRR1-55	58.58	95.83	98.60	85.50	89.92	119.17
29	V29: IRR1-62	56.95	91.74	94.46	85.33	89.75	119.00
30	V30: IR-35	60.08	96.67	99.59	85.67	90.08	119.21
31	V31: Laldodaki	61.04	93.37	96.00	88.54	92.88	122.13
32	V32: IR2289-6-22-5	55.37	84.08	86.55	88.17	92.75	122.29
33	V33: Narmada	54.16	82.99	85.97	85.33	89.79	118.79
34	V34: Ananda	61.35	92.85	95.62	82.42	86.79	115.83
35	V35: Ambpandhari	53.27	88.81	91.35	85.17	89.75	118.21
36	V36: Hira	51.52	73.89	76.60	65.63	69.83	98.75
37	V37: OR-1516-1-5-A	64.81	97.52	100.49	65.42	69.83	99.17
38	V38: China	70.38	104.38	106.81	76.63	81.08	110.50
39	V39: Sorati	75.36	115.94	118.51	77.00	81.33	110.33
40	V40: Mhadi	64.76	98.93	101.61	86.00	90.50	119.33
	SE	1.27	0.96	0.94	0.305	0.296	0.223
	C.D. at 5%	3.54	2.67	2.63	0.850	0.823	0.621
Interaction Effect (S x M)							
	SE $\pm$	2.55	1.92	1.89	0.611	0.592	0.446
	C.D. at 5%	7.07	5.35	5.25	1.700	1.646	1.241
	General Mean	58.53	90.67	93.34	82.941	87.368	116.295

S₁ : 24th MW (11th-17th June)S₃ : 50th MW (10th-16th December)S₂ : 48th MW (26th November-2nd December)S₄ : 52th MW (24th-31st December)

5.1.1 Plant height:

Plant height is an important morphological character. Taller plant with better canopy produces higher dry matter and characterized by high photosynthetic efficiency than short stature plant (Nimje, 2010). However, taller plants lodge at maturity because of top heaviness due to panicle weight and weaker lower stem, which ultimately reduces the yield. Therefore, non-lodging and medium tall plants would be preferable.

In present investigation, plant height increased up to harvest in all the rice genotypes. The rapid increase in height was observed during the period of tillering and flowering and thereafter rate of increase was slow up to harvest. The rice genotype V₃₉ (Sorati) recorded significantly higher plant height at tillering, flowering and harvesting stages followed by genotype China, Mhadi and rest of all other genotypes (Table 85). Significantly lower plant height was recorded V₃₆ i.e. Hira (76.60cm) which was at par with V₃ i.e. Karjat -4 (78.74 cm) over other genotype.

Such trend in plant height was also reported by Yadava *et al.* (1988) showed that canopy height increased with crop age in rice. Singh and Jain (2000) found that the plant height increased gradually from tillering to flowering and remained almost constant thereafter till maturity. Golam (2001) studied the physiological basis for yield of 11 hybrids and two varieties of rice. Significant differences were recorded in plant height in all 13 genotypes. Plant height increased continuously up to harvest in all 13 genotypes.

Chandrasekhar *et al.* (2001) studied physiological analysis of growth and productivity in hybrid rice. The growth in terms of plant height increased rapidly at 60 DAT and later the increase was not much in all the cultivars. Poonam *et al.* (2009) studied agro-physiological parameters of rice hybrid with 32 treatments combination of 8 hybrids and 4 dates of planting during each rainy and winter season. Plant grew taller (120 cm) during rainy season and highest plant height (110.0 cm)

observed in February. Hussain *et al.* (2014) and Kardile *et al* (2018) observed that plant length increased in all varieties steadily from transplanting to full heading stage

Crop sown during *kharif* season i.e. S₁(24th MW) produced 30 % more height significantly taller plant (115.81 cm) as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃(50th MW), S₄ (52th MW)for all growth stages of rice i.e. tillering, flowering and harvesting stages. Padmaja (2001) conducted an experiment with ten genotypes during *kharif*, 1998 and 1999. The plant height measured at maximum tillering stage ranged from 45 cm (Swara) to 85 cm (SLO-13). The rice crop sown during *rabi* season, the S₃ i.e. 50th MW date of sowing recorded significantly higher plant height as compared to crop sown during S₂ i.e. 48th MW and S₄ i.e. 52th MW for all growth stages. The rice genotype V₃₉(Sorati) recorded significantly higher plant height at tillering, flowering and harvesting stages during both season i.e. *kharif* and *rabi*. Interaction S₃V₃₉ i.e. 50th MW sowing with genotype Sorati recorded significantly higher height over other genotypes (Table 3). Significantly lower plant height was recorded V₃₆ i.e. Hira (76.60cm) which was at par with V₃ i.e. Karjat-4 (78.74 cm) over other genotypes. Interaction S₄V₃ i.e. 52th MW sowing with genotype Karjat-4 recorded significantly lower height (Table 3).

Significant variation in plant height among the genotypes was earlier reported by many scientists (Padmaja (2001); Lohidas (2003); Akram *et al.*, 2007; Sabouri *et al*; 2008, Courtney *et al.*,2011, Muhammad *et al.* (2012); Dutta *et al.* (2013) evaluated sixty eight genotypes of rice and in their experiment they recorded 132.70 cm as mean height of genotypes. Maximum height was recorded in the Dolbao (200 cm) and minimum height recorded in Ijong (78.80 cm) and Dhakal (2014) conducted a study with fifty rice genotypes during *kharif* 2013. The range for plant height was from 50.63 to 111.56 cm with an average plant height 89.17 cm.

5.1.2 Days to first flowering:

The reproductive phases start with flowering and ends with maturity. In present investigation, crop sown during *S*₁-*kharif* season (24th MW) produced significantly maximum days to first flowering (80.50 days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) (Table 85). The rice crop sown during *rabi* season, *S*₂ (48th MW) date of sowing recorded significantly maximum days to first flowering which was at par with *S*₃ (50th MW) and *S*₄ (52th MW). The rice genotype OR-1516-1-5-A recorded significantly minimum (Early) days to first flowering followed by genotype Hira. Rice genotype *V*₁₀ recorded significantly maximum days to first flowering which was at par with *V*₁₁ over others. Interaction *S*₁*V*₁₁ i.e. *kharif* season with genotype Ratnagiri-6 recorded significantly maximum days to first flowering followed by *V*₉ i.e. genotype Ratnagiri-1, *V*₁₀ i.e. genotype Ratnagiri-5 over others. In case of *rabi* season *S*₂*V*₁₀ i.e. sowing 48th MW genotype Ratnagiri-5 recorded significantly higher days to first flowering followed by *S*₂*V*₁₁ i.e. 48th MW genotype Ratnagiri-6 (Table 5).

5.1.1 Days to 50% flowering:

Crop sown during *S*₂-*rabi* season (48th MW) produced significantly maximum days to 50 % flowering (88.48 days) as compared to other sowing dates of *rabi* season as well as *S*₁-*kharif* season (24th MW) (Table 85). Significantly maximum days of 50% flowering was recorded in *S*₂ (88.48 days) which was at par with *S*₄ (88.17 days). The rice genotype Hira and OR-1516-1-5-A recorded significantly minimum (Early) 69.83 days to 50% flowering. Rice genotype *V*₁₁ i.e. Ratnagiri-6 (93.63 days) recorded significantly maximum (late) days to 50% flowering which was at par with *V*₁₀ i.e. Ratnagiri-5 (93.54 days). Interaction *S*₁*V*₁₀ (*kharif* with Ratnagiri-5) and *S*₂*V*₁₀ (*Rabi* i.e. 48th MW sowing) with genotype Ratnagiri-5 (95.33 days) showed maximum days to 50% flowering. Similarly *S*₃*V*₃₆ (50th MW with Hira) recorded minimum days to 50% flowering over others. Similar work was done and reported by many scientists (Sadeghi 2011, Shet *et al* (2012), Augustina *et. al.* (2013) and Sharma *et.al.* 2014)

and Dhakal (2014). These scientists reported that days to 50 % flowering is an important phenological observation which influences the crop growth performance

5.1.1 Days to physiological maturity:

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum days to physiological maturity (113.81 days) as compared to other sowing dates of *rabi* season (Table 85). The rice crop sown during *rabi* season, S_3 (the 50th MW) date of sowing recorded significantly maximum days to physiological maturity (117.27 days) as compared to crop sown during S_2 (48th MW) and S_4 (52th MW). Significantly higher days to maturity was recorded in V_{10} (Ratnagiri-5) followed by V_{11} (Ratnagiri-6), V_{31} and V_{32} . Significantly minimum days to maturity was recorded in V_{36} (Hira). Interaction S_1V_{10} (*kharif* with genotype Ratnagiri-5) and S_3V_{10} (*Rabi* sowing 50th MW) with genotype Ratnagiri-5 showed significantly higher days to maturity. Similarly S_1V_{36} (*Kharif* with genotype Hira) recorded less days to maturity (Table 9).

Similar results also reported by Dhakal (2014), conducted a study with fifty rice genotypes during *kharif* 2013. Maturity duration ranged from 108 to 142 days with an average of 124 days. Muhammad *et al.* (2012) evaluated ten rice genotypes during their experiment. Days to maturity showed same trend as observed in case of days to heading. The early heading lines matured early and late heading lines matured late. The maturity period ranged from 137 to 148 days. Zia-Ul *et al.* (2005), Ashrafuzzaman *et al.* (2009) and Shahidullah *et al.* (2009).

5.2. Physiological Parameters:

Data on physiological parameters of rice genotypes are presented in table 86.

Table 86 : Effect of different treatment on physiological parameters of rice genotypes at harvest stage..

Sr No	Genotypes	Total chlorophyll content (mg/g)			Chlorophyll stability index			Leaf water potential (bar)	Absolute growth rate { AGR } (g/day)			Relative growth rate.(RGR) (g/g/day) at harvest	Net assimilation rate.(NAR) (g/dm2/day) at harvest	Leaf area index .{LAI} at harvest
A] Main plot (Date of sowing)														
		Tillering	Flowering	Harvesting	Tillering	Flowering	Harvesting	Flowering	Tillering	Flowering	Harvesting			
1	S ₁ : 24 th MW	1.97	4.09	1.01	0.654	1.091	0.440	5.31	0.1281	0.3925	1.0354	0.0184	0.0377	3.568
2	S ₂ : 48 th MW	1.87	3.74	0.94	0.640	1.084	0.432	5.88	0.1311	0.3904	1.0332	0.0179	0.0390	4.145
3	S ₃ : 50 th MW	1.99	3.99	0.99	0.648	1.093	0.438	6.10	0.1304	0.3883	1.0275	0.0180	0.0923	4.281
4	S ₄ :52 th MW	1.84	3.72	0.92	0.645	1.014	1.444	5.93	0.1304	0.3934	1.0397	0.0182	0.0368	4.194
	SE ±	0.023	0.03	0.01	0.008	0.033	0.006	0.19	0.0011	0.0020	0.0053	0.0009	0.0073	0.077
	C.D. at 5%	0.070	NS	0.038	NS	NS	NS	0.64	NS	NS	NS	NS	0.0251	0.232
B)Sub plot (Varieties)														
1	V1:Karjat-1	1.79	3.66	0.92	0.626	1.075	0.434	5.60	0.1302	0.3878	1.0246	0.0165	0.0663	3.829
2	V2:Karjat-3	1.80	3.73	0.92	0.645	1.061	0.448	6.03	0.1465	0.4585	1.2373	0.0201	0.0596	4.024
3	V3:Karjat-4,	1.84	4.01	0.96	0.633	1.061	0.441	6.02	0.1250	0.3752	0.9675	0.0168	0.0613	4.000
4	V4:Karjat-7	1.77	3.95	0.93	0.634	1.063	0.462	5.83	0.1383	0.4112	1.0618	0.0155	0.0573	3.602
5	V5:Karjat-184	1.94	3.87	0.97	0.638	1.055	0.439	5.93	0.1288	0.3806	1.0104	0.0165	0.0565	3.956
6	V6:Sahyadri-2	1.92	3.92	0.98	0.628	1.068	0.452	5.81	0.1249	0.3755	1.0068	0.0237	0.0615	4.058
7	V7:Sahyadri-4	1.90	3.72	0.92	0.618	1.043	0.451	4.73	0.1305	0.3981	1.0192	0.0173	0.0588	4.008
8	V8:Phondaghat -1	2.01	4.15	1.04	0.652	1.095	0.453	5.60	0.1452	0.4168	1.1292	0.0161	0.0790	4.043
9	V9:Ratnagiri-1	1.79	3.57	0.89	0.644	1.082	0.435	6.66	0.1272	0.3839	1.0261	0.0206	0.0541	4.156
10	V10:Ratnagiri-5	1.94	3.90	0.98	0.660	1.078	0.433	6.09	0.1362	0.3883	1.0024	0.0175	0.0635	4.307
11	V11:Ratnagiri- 6	2.00	4.02	1.00	0.679	1.088	0.445	6.17	0.1264	0.3776	0.9902	0.0168	0.0542	3.625
12	V12:Ratnagiri- 7	1.97	3.88	0.97	0.640	1.055	0.448	5.73	0.1285	0.3847	1.0558	0.0216	0.0596	4.050
13	V13:Ratnagiri -24	2.12	4.21	1.06	0.641	0.983	0.415	5.70	0.1166	0.3488	0.9464	0.0156	0.0588	3.995
14	V14:Ratnagiri-73	1.99	4.01	0.99	0.646	1.063	0.418	6.20	0.1348	0.4103	1.0902	0.0167	0.0686	4.134
15	V15:Ratnagiri-711	1.93	3.92	0.98	0.638	1.041	0.436	5.94	0.1277	0.3724	0.9915	0.0202	0.0621	3.858
16	V16:IRRI-14	1.93	3.89	0.97	0.633	1.066	0.405	5.50	0.1335	0.4089	1.0589	0.0158	0.0560	4.282
17	V17:IRRI-15	1.95	3.90	0.98	0.660	1.087	0.432	5.09	0.1285	0.3893	1.0179	0.0171	0.0600	4.503
18	V18:IRRI-20	2.01	4.05	1.00	0.634	1.054	0.436	5.38	0.1292	0.4000	1.0648	0.0212	0.0613	4.021
19	V19:IRRI-21	1.93	3.80	0.95	0.639	1.080	0.422	5.67	0.1188	0.3678	0.9820	0.0164	0.0432	4.395
20	V20:IRRI-22	1.92	3.75	0.93	0.642	1.055	0.405	5.48	0.1311	0.4007	1.0630	0.0154	0.0503	4.263
21	V21:IRRI-27	1.97	3.95	0.99	0.647	1.092	0.430	5.75	0.1363	0.4012	1.0817	0.0214	0.0380	4.619

Sr No	Genotypes	Total chlorophyll content (mg/g)			Chlorophyll stability index			Leaf water potential (bar)	Absolute growth rate { AGR } (g/day)			Relative growth rate.(RGR) (g/g/day) at harvest	Net assimilation rate.(NAR) (g/dm ² /day) at harvest	Leaf area index .{LAI} at harvest
22	V22:IRRI-28	1.84	3.63	0.91	0.646	1.060	0.435	6.37	0.1370	0.4185	1.1305	0.0206	0.0354	4.263
23	V23:IRRI-34	1.87	3.74	0.94	0.655	1.086	0.418	5.87	0.1391	0.4265	1.1407	0.0208	0.0371	3.947
24	V24:IRRI-36	1.88	3.75	0.93	0.672	1.083	0.443	5.75	0.1276	0.3904	1.0349	0.0168	0.0373	3.975
25	V25:IRRI-47	1.99	3.98	0.99	0.645	1.085	0.440	6.22	0.1201	0.3607	0.9538	0.0239	0.0370	4.119
26	V26:IRRI-52	1.91	3.92	0.98	0.647	1.089	0.437	6.07	0.1272	0.3663	0.9596	0.0177	0.0539	4.165
27	V27:IRRI-53	1.95	3.89	0.97	0.647	1.045	0.447	6.02	0.1290	0.3776	0.9989	0.0170	0.0324	3.860
28	V28:IRRI-55	1.93	3.93	0.99	0.640	1.093	0.432	5.95	0.1175	0.3422	0.8945	0.0158	0.0406	3.940
29	V29:IRRI-62	2.00	3.98	0.97	0.670	1.102	0.442	6.14	0.1298	0.3916	1.0258	0.0163	0.0380	3.665
30	V30:IR-35	1.91	4.02	1.01	0.638	1.065	0.451	5.79	0.1224	0.3905	1.0130	0.0201	0.0344	4.000
31	V31:Laldodaki	1.87	3.82	0.96	0.655	1.054	0.448	6.15	0.1343	0.4033	1.0300	0.0158	0.0373	3.888
32	V32:IR2289-6-22-5	1.86	3.84	0.95	0.672	1.093	0.453	6.20	0.1286	0.3647	0.9896	0.0163	0.0589	4.353
33	V33:Narmada	1.95	3.90	0.98	0.668	1.085	0.441	5.73	0.1221	0.3633	0.9391	0.0157	0.0624	4.058
34	V34:Ananda	2.02	4.03	1.01	0.625	1.042	0.435	5.85	0.1315	0.4087	1.0682	0.0172	0.0389	3.647
35	V35:Ambpandhari	1.88	3.93	0.98	0.640	1.055	0.440	5.47	0.1334	0.3910	1.0301	0.0201	0.0358	4.034
36	V36:Hira	1.90	3.81	0.95	0.650	1.073	0.443	5.54	0.1354	0.4527	1.1927	0.0195	0.0342	4.148
37	V37:OR-1516-1-5-A	1.81	3.70	0.93	0.672	1.083	0.443	5.21	0.1241	0.3741	0.9796	0.0194	0.0614	4.363
38	V38:China	1.91	3.82	0.96	0.660	1.084	0.453	5.39	0.1255	0.3774	1.0215	0.0163	0.0582	3.988
39	V39:Sorati	1.88	3.78	0.95	0.638	1.035	0.433	5.62	0.1370	0.4088	1.0805	0.0175	0.0691	4.014
40	V40:Mhadi	1.98	4.13	0.95	0.650	1.079	0.434	5.45	0.1235	0.3709	0.9689	0.0170	0.0214	3.731
	SE	0.052	0.05	0.03	0.014	0.018	0.011	0.29	0.0049	0.0184	0.0512	0.0026	0.0045	0.168
	C.D. at 5%	0.15	0.14	0.07	NS	NS	NS	0.80	0.0136	0.0513	0.1426	0.0074	0.0125	0.467
Interaction Effect (S x M)														
	SE ±	0.104	0.07	0.05	0.027	0.035	0.022	0.58	0.0098	0.0369	0.1025	0.0053	0.0090	0.336
	C.D. at 5%	0.29	NS	0.14	0.076	NS	NS	1.60	0.0272	0.1025	0.2851	0.0147	0.0251	0.933
	General mean	1.92	3.89	0.96	0.647	1.070	0.438	5.80	0.1300	0.3911	1.0340	0.0181	0.0515	4.047

S1 : 24th MW (11th-17th June)

S2 : 48th MW (26th November-2nd December)S3 : 50th MW (10th-16th December)

S4 :52th MW (24th-31st December)

5.2.1.Total chlorophyll content(mg/g) :

Chlorophyll content plays vital role in the process of photosynthesis thus has direct influence on grain production. Miah *et al* (2012) reported that a chlorophyll pigment plays an important role in the photosynthesis process as well as biomass production. The total chlorophyll content (mg/g) as influenced periodically by the different treatments at various crop growth stages. It was observed that the chlorophyll content increased with advancing age of the crop up to 80 DAT, after that it decreased. Similar trends were reported by Abdul Baset Mia *et al.* (2012) and Hussain *et al.* (2014).

In the present investigation, at flowering stage, the date of sowing during *kharif* season recorded higher total chlorophyll content (4.09mg/g) than rest of the date of sowing in *rabi* season (Table 86). The sowing dates S₃ recorded maximum total chlorophyll content (3.99 mg/g) over S₂ and S₄. At harvesting stage, S₁ date of sowing during *kharif* season recorded significantly higher total chlorophyll content (1.01mg/g) than rest of the date of sowing in *rabi* season. The sowing dates S₃ recorded significantly maximum total chlorophyll content (0.99 mg/g) over S₂. At flowering stage, maximum chlorophyll content was recorded in V₁₃ i.e. Ratnagiri-24 (4.21 mg/g) which was followed by V₈ i.e. Phondaghat-1 (4.15 mg/g). Interaction S₁V₈ (*kharif* sowing) with genotype Phondaghat-1 and *rabi* season S₂V₁₃ (sowing 50th MW with genotype Ratnagiri-24 recorded significantly higher chlorophyll content over others (Table 88). Such variation in photosynthesis pigment was reported by Munshi (2005), Hossain *et al* (2008) and Kiran *et al* (2013). Abdul Baset Mia *et al.* (2012) reported that total chlorophyll content decreased gradually from tillering to flowering stages.

5.2.2. Chlorophyll stability index:

Chlorophyll stability is a function of temperature and it is found to correlate with drought tolerance. Chlorophyll stability index is a measure of intensity of membrane or heat stability of the pigments under stress condition (Kaloyereas, 1958).

In the present investigation, the Chlorophyll stability index was influenced periodically by the different treatments at various crop growth stages. It was observed that the Chlorophyll stability index increased with advancing age of the crop up to flowering after that it decreased (Table 86).

At tillering stage, S₁ sowing during *kharif* season recorded maximum chlorophyll stability index than rest of the date of sowing in *rabi* season. Among the *rabi* season, S₃ recorded maximum chlorophyll stability index over S₂ and S₄. At flowering stage, sowing during *kharif* season recorded maximum chlorophyll stability index than rest of the date of sowing in *rabi* season. S₄ recorded maximum chlorophyll stability index over S₂ and S₃ at harvesting stage. At tillering stage, maximum chlorophyll stability index was recorded in V₁₁ i.e. Ratnagiri-6 (0.679 mg/g) which was followed by IR2289-6-22-5 (0.672 mg/g), OR-1516-1-5-A (0.672 mg/g) and IRRI-36 (0.672 mg/g). At harvesting stage, maximum chlorophyll stability index was recorded in V₄ i.e. Karjat-7 (0.462 mg/g) which was followed by IR2289-6-22-5 (0.653 mg/g), Phondaghat-1 (0.653 mg/g), Phondaghat -1 (0.653 mg/g). Interaction S₁V₁ *kharif* sowing with genotype Karjat-1, S₁V₂, S₁V₂, S₁V₁₅, S₁V₃₄ and S₁V₁₅ recorded higher CSI over others (Table 88). Patel *et al.* (2006) studied performance of *kharif* rice under raised and sunken beds system. Chlorophyll stability index was found significantly higher in RCPL-29 followed by Vivek Dhan 82 as compared to other varieties both at vegetative and heading stages. Kardile *et al.* (2018) reported that at 60 DAT, RTN-13-4-3-1 (2.0662 mg/g) recorded highest total chlorophyll content followed by KJTRH-21. At 90 DAS, RTNRH-10 (1.572 mg/g) recorded maximum total chlorophyll content followed by RTN-84-2-1-2.

5.2.3. Leaf water potential:

Leaf water potential is highly variable depending on several soil, plant and environmental factors, soil water content, wind speed, vapour pressure deficit, solar radiation, temperature and relative humidity may contribute to changes in plant water potential. These factors acting alone or jointly with soil water deficit could intensify plant water stress

causing stomatal closure and thus influencing the potential values. Gaosegelwe and Kirkham (1990) have suggested that LWP might be used as an easy and fast way to screening genotypes for drought avoidance. It is the key input factor for photosynthesis. It is well established that there will be 50 per cent reduction in the rate of photosynthesis if water content in the leaf tissue drops down even by 10 per cent below the optimum relative water content.

At tillering stage S₁(*kharif* sowing) recorded maximum leaf water potential and S₄ recorded minimum leaf potential. Among genotype V₁₃ recorded maximum leaf water potential and V₃₇ recorded minimum leaf water potential. Interaction S₁V₁₃(*kharif* with genotype Ratnagiri-24) maximum and S₄V₃₃(*Rabi* sowing MW 52th and genotypes Narmada recorded minimum leaf water potential .

This decreasing trend in leaf water potential at later stage of growth at all three locations and soil types could be attributed to decreasing soil moisture content with advancement of growth stages in mango also reported by Hailmichael *et al* 2016.

5.2.4. Absolute growth rate (AGR)g/day:

Data on absolute growth rate, relative growth rate, net assimilation rate and leaf area index of rice genotypes are presented in Table 86. Amongst various growth parameters an absolute growth rate (AGR) is a plain and simple measure of rate of increase in weight. The mean AGR was maximum, irrespective of their groups to complete life cycle. This could be due to the rapid rate of increase in total dry matter during this period as the AGR mainly depends on the accumulation of dry matter (Nimje, 2010). After reaching the maximum AGR it decrease till maturity due to aging of leaf shedding (Nicknejad *et al.*, 2009).

In the present investigation, at flowering and harvesting stage, date of sowing during *kharif* season recorded minimum absolute growth rate (AGR) g/day than rest of the date of sowing in *rabi* season.(Table 86). The sowing dates in *rabi* season, S₂ recorded maximum absolute growth rate (AGR)g/day over S₃ and S₄ at tilleringstage.S₄ recorded maximum

absolute growth rate (AGR)g/day over S₂ and S₃ at flowering stage and at harvesting stage. At harvesting stage, the rice variety V₂ i.e. Karjat-3 recorded maximum absolute growth rate (AGR) 1.2373 g/day which was at par with V₄ i.e. V₈-Karjat-184, V₂₃- Ratnagiri-73, V₃₆-Hira. Interaction S₁V₄(*kharif* with genotype Karjat-7) and among *rabi* season S₂V₃₆ (sowing 48th MW with genotype Hira) recorded significantly maximum absolute growth rate (AGR) than other combinations. (Table18) Similar finding were also reported by Erfani and Nasiri (2000) reported that CGR, NAR and leaf area index (LAI) were higher throughout growth stages in improved genotypes than traditional genotypes and Chandrasekhar *et al.* (2001) for rice hybrids. AGR was observed highly significant and positively correlated with grain yield. Horie (2003) reported that in early maturity lines, the CGR increase before flowering had significant correlation with grain yield, while in the late maturity lines CGR increase after flowering had significant correlation with yield. Mondalet *al.* (2010) also reported that higher AGR had significant correlation with yield.

5.2.5. Relative growth rate (RGR):

The concept of growth of the plant in terms of compound interest law was given by Blackman (1919). The RGR is the rate of increase in dry weight per unit dry weight per unit time. The fall in RGR at the time maturity of crop might be because of respiratory activity of plants, thus higher amount of photosynthesis might have been used for maintenance of developing organs. Relative growth rate (RGR) decreased with the age of crop (Golam, 2001).

In the present investigation, date of sowing (24thMW) in *kharif* season recorded maximum relative growth rate (RGR) 0.0138g/g/day and 0.0184g/g/day than rest of the date of sowing in *rabi* season at flowering and harvesting stage. S₃ recorded maximum relative growth rate (RGR) 0.400 g/g/day over S₂ and S₄ at tillering stage. S₄ recorded maximum relative growth rate (RGR) 0.0136 g/g/day and 0.0182 g/g/day over S₂ and S₄ at flowering and harvesting stage.

At harvesting stage, the rice variety V₆ i.e. Sahyadri-2 recorded maximum relative growth rate (RGR) 0.0237 g/g/day which was at par with V₁-Karjat-1, V₂-Karjat-3, V₃-Karjat-4, V₅-Karjat-184, V₆-Sahyadri-2, V₇-Sahyadri-4, V₉-Ratnagiri-1, V₁₀-Ratnagiri-5, V₁₁-Ratnagiri-6, V₁₂-Ratnagiri- 7, V₁₄-Ratnagiri-73, V₁₅-Ratnagiri-711,V₁₇ - IRRI-15 ,V₁₈-IRRI-20, V₁₉-IRRI-21 ,V₂₁-IRRI-27, V₂₂-IRRI-28, V₂₃-IRRI-34, V₂₄-IRRI-36, V₂₅ - IRRI-47,V₂₆-IRRI-52, V₂₉-IRRI-62, V₃₀-IR-35, V₃₂-IR-2289-6-22-5,V₃₄-Ananda, V₃₅-Ambpandhari, V₃₆-Hira,V₃₇-OR V₃₈-China, V₃₉-Sorati,V₄₀-Mhadi. Interaction S₁V₂₅(*kharif* sowing) genotype IRRI-47 recorded significantly higher relative growth rate (RGR) at harvesting stage at par with S₁V₂ and S₁V₂₂, over others. Similarly S₄V₁₂(sowing 52 MW)with genotype Ratnagiri-7 recorded significantly higher relative growth rate(RGR) than other combination (Table 86). Similar decrease of RGR with the age of crop was reported by Chandrasekhar *et al.*(2001) reported that CGR, LAI, LAD and SLW had direct effect on dry matter production and yield whereas RGR had negative and significant correlation with grain yield (Kulmi, 1992) and Chandrika *et al.* (2015) studied physiological attributes and yield of developed rice varieties. Results showed that maximum LAI, CGR, RGR, NAR, LAD and LAR were recorded in the variety RNR-15038.

5.2.6. Net assimilation rate.(NAR):

NAR is the rate of increase in dry weight per unit leaf area. NAR measures, the efficiency of leaf area and hence, it can be used as a measure of source activity (Nimje, 2010).The increase in the NAR can be attributed to the high chlorophyll values during this period. Shahidullah *et al.* (2009) were also reported by such significant variation in NAR among the developed rice genotypes.

In the present investigation, date of sowing during *kharif* season - S₁ recorded minimum net assimilation rate. (NAR) g⁻¹dm⁻²day⁻¹ than rest of the date of sowing in *rabi* season at flowering and harvesting stage (Table 86). S₃ recorded maximum net assimilation rate.(NAR) g⁻¹dm⁻²day⁻¹ over S₂ and S₄ at flowering stage and harvesting stage. The rice variety V₈ i.e. Phondaghat-1 recorded maximum net assimilation rate.(NAR) 0.0790

$\text{g}^{-1}\text{dm}^{-2}\text{day}^{-1}$ which was at par with V_{14} i.e. Ratnagiri -73 at harvesting stage. The rice crop sown S_1 i.e. *kharif* season with V_8 i.e. Phondaghat -1 recorded significantly higher net assimilation rate (NAR) $0.1104 \text{ g}^{-1}\text{dm}^{-2}\text{day}^{-1}$ which were followed by S_1V_{14} at harvesting stage. Interaction S_1V_8 (*kharif* sowing) with genotype Phondaghat-1 and *rabi* season S_3V_1 (sowing 50th MW) with genotype Karjat-1 recorded significantly higher net assimilation rate (NAR) over others. (Table 88). Similar increasing trend of NAR with the age of crop was also reported by Chandrasekhar *et al.* (2001) reported that CGR, LAI, LAD and SLW had direct effect on dry matter production and yield whereas RGR had negative and significant correlation with grain yield (Kulmi, 1992). Chandrika *et al.* (2015) studied physiological attributes and yield of developed rice varieties. Results showed that maximum LAI, CGR, RGR, NAR, LAD and LAR were recorded in the variety RNR-15038. The varietal differences for NAR have also been reported by Mondal *et al.* (2010) reported that the physiological and yield parameters differed significantly among the genotypes. The mutant RM 100-24 performed well with respect to physiological parameters like AGR, RGR and NAR.

5.2.7. Leaf area index. (LAI:)

The LAI is one of the most important growth parameters having influenced on plant growth. Watson (1947) defined the LAI as the total area of leaves present per unit area of land. It gives an idea about the size of the photosynthetic system. The sowing dates S_3 recorded maximum LAI over rest of the date of sowing in *rabi* season (Table 86). However the sowing dates in *rabi* season, S_4 recorded maximum LAI at tillering stage. S_3 recorded maximum LAI at flowering and harvesting stage. At harvesting stage, maximum LAI was recorded in V_{21} i.e. IRRI-27 (4.619) which was at par with V_9 i.e. V_9 i.e. Ratnagiri -1, V_5 i.e. Ratnagiri -5, V_9 i.e. Ratnagiri -73, V_{17} i.e. IRRI-15, V_{18} i.e. IRRI-20, V_{19} i.e. IRRI-21, V_{20} i.e. IRRI-22, V_{21} i.e. IRRI-27, V_{22} i.e. IRRI-28, V_{25} i.e. IRRI-47, V_{26} i.e. IRRI-52, V_{32} i.e. IR2289-6-22-5, V_{36} i.e. Hira, V_{37} i.e. OR-1516-1-5-A). Interaction S_1V_{21} (*kharif* sowing) with genotypes (IRRI-27) recorded significantly higher leaf area index. (LAI) and among *rabi*- S_3V_{30} recorded maximum

leaf area index.(LAI) than other combinations (Table 88). Similar results were also reported by Park *et al.* (2004), Kumar *et al.* (2006) and Chandrika *et al.* (2015).

5.2.8. Growing degree days (° days):

The growing degree day is a weather based indicator for assessing crop development. It can be used to predict when crop will reach maturity. Data on growing degree days (GDD) at 50% flowering for aromatic and non-aromatic rice genotypes are presented in Table 87.

In the present investigation, Crop sown during S₁-*kharif* season (24th MW) produced significantly maximum growing degree days (1268 ° days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). (Table 87). The rice crop sown during *rabi* season, S₃ (the 50th MW) date of sowing recorded significantly maximum growing degree days (° days) at first flowering stage (1234.8 ° days) as compared to crop sown during S₂ (48th MW) and S₄ (52th MW). The rice variety V₁₉ i.e. IRRI-21 and V₃₅ i.e. Ambepandhari recorded significantly maximum growing degree days (1470.6 ° days) at first flowering stage which at par with variety V₁₅ i.e. Ratnagiri-711 (1465 ° days). Rice variety V₃₆ i.e. Hira (927.6 ° days) recorded significantly minimum growing degree days (° days) at first flowering stage

Crop sown during S₁-*kharif* season (24th MW) produced significantly maximum growing degree days (1435.5 ° days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) at 50% flowering stage of rice varieties. The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum growing degree days (° days) at 50% flowering stage (1470.2 ° days) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW). Significantly maximum growing degree days (° days) were recorded in S₁ (1470.2° days) which was superior over the other dates of sowing. The rice variety V₂₃ i.e. IRRI-34 recorded significantly maximum growing degree days (1560.2 ° days) at 50% flowering stage over the other variety. Rice variety V₃₆ i.e. Hira (1048.8 ° days), (1055.7 ° days) and (1052.2 ° days) recorded significantly minimum growing degree days (° days) at 50% flowering stage.

Table 87 Effect of different treatment for meteorological parameter of rice genotypes

Sr No	Genotypes	Growing degree days (° days)			Photo-thermal units(o hr)			Helio thermal unit(0 hr)			Phenothermal index	
		First flowering	50% flowering	Maturity	First flowering	50% flowering	Maturity	First flowering	50% flowering	Maturity	Sowing to 50% flowering	50% flowering to maturity
A) Main plot (Date of sowing):												
1	S ₁ : 24 th MW	1,268.0	1,435.5	2,005.3	15,956.4	18,105.4	25,157.4	2,162.9	2,927.0	4,266.1	17.409	17.205
2	S ₂ : 48 th MW	1,228.3	1,416.2	1,791.9	11,183.0	14,162.7	20,405.4	5,707.9	8,470.3	13,550.2	17.271	15.384
3	S ₃ : 50 th MW	1,234.8	1,431.4	1,788.8	11,237.9	13,430.2	21,282.4	7,145.1	8,677.2	12,816.3	17.328	15.328
4	S ₄ :52 th MW	1,234.6	1,470.2	1,789.8	11,853.0	15,112.6	23,141.2	7,600.9	9,461.4	14,426.7	17.414	15.350
	SE ±	9.892	10.161	2.943	24.773	58.599	10.262	29.828	38.739	9.583	0.068	0.026
	C.D. at 5%	27.474	30.821	8.927	75.140	177.742	31.127	90.476	117.503	29.069	NS	0.079
B)Sub plot (Varieties):												
1	V1:Karjat-1	1,185.2	1,562.3	1,788.3	11,853.5	16,087.1	21,970.4	5,047.6	7,756.2	10,932.9	18.022	15.715
2	V2:Karjat-3	1,160.9	1,535.9	1,852.1	11,580.7	16,041.4	22,858.5	4,863.9	7,734.7	11,357.2	17.759	15.753
3	V3:Karjat-4,	1,236.0	1,472.3	1,843.0	12,432.6	14,463.8	22,687.5	5,262.1	7,118.1	11,326.7	18.192	15.747
4	V4:Karjat-7	1,236.7	1,491.7	1,815.4	12,389.4	16,005.1	22,164.9	5,263.7	7,735.0	11,062.2	17.261	15.725
5	V5:Karjat-184	1,156.9	1,381.8	1,645.9	11,539.9	14,207.5	19,718.7	5,226.8	6,914.3	9,871.8	17.414	15.567
6	V6:Sahyadri-2	1,444.2	1,530.1	1,859.6	14,805.1	16,239.7	22,804.4	7,354.3	7,938.3	11,395.2	17.452	15.758
7	V7:Sahyadri-4	1,444.2	1,466.9	1,869.1	14,805.1	15,567.3	22,971.3	7,354.3	7,469.7	11,508.7	17.333	15.768
8	V8:Phondaghat -1	1,153.0	1,482.2	1,874.2	11,482.5	15,676.6	23,061.5	4,879.0	7,493.3	11,559.9	17.413	15.775
9	V9:Ratnagiri-1	1,379.6	1,473.6	1,896.4	14,449.5	15,670.8	23,449.9	6,955.0	7,515.4	11,669.0	17.318	15.784
10	V10:Ratnagiri-5	1,153.0	1,464.3	1,938.4	11,482.5	15,492.0	24,061.3	4,879.0	7,423.4	12,051.3	17.381	15.823
11	V11:Ratnagiri- 6	1,274.3	1,549.5	1,928.0	12,868.0	16,613.5	23,901.4	5,476.2	8,155.6	11,956.0	17.346	15.819
12	V12:Ratnagiri- 7	1,161.7	1,471.0	1,818.3	11,585.4	15,755.2	23,297.5	4,881.3	7,682.7	11,596.9	17.368	15.214
13	V13:Ratnagiri -24	1,415.0	1,515.2	1,875.0	14,711.9	16,120.1	23,176.7	7,207.3	9,263.8	11,554.5	17.349	15.774
14	V14:Ratnagiri-73	1,167.5	1,465.3	1,539.5	11,281.0	15,500.8	17,375.9	4,850.8	7,627.5	8,946.0	17.455	15.650
15	V15:Ratnagiri-711	1,471.3	1,532.9	2,078.5	14,959.3	16,641.2	25,889.6	7,398.2	8,146.7	12,952.6	17.240	16.042
16	V16:IRRI-14	1,210.4	1,408.0	1,835.5	12,192.6	14,793.1	22,729.3	5,198.1	7,123.3	11,247.3	17.352	15.739
17	V17:IRRI-15	1,241.1	1,399.4	1,864.7	12,569.4	14,645.0	23,015.7	5,288.4	7,069.7	11,449.6	17.403	15.764
18	V18:IRRI-20	1,153.0	1,436.8	1,864.8	11,405.3	15,088.7	23,034.5	4,879.0	7,286.9	11,449.0	17.434	15.764

Sr No	Genotypes	Growing degree days (° days)			Photo-thermal units(o hr)			Helio thermal unit(0 hr)			Phenothermal index	
		First flowering	50% flowering	Maturity	First flowering	50% flowering	Maturity	First flowering	50% flowering	Maturity	Sowing to 50% flowering	50% flowering to maturity
19	V19:IRRI-21	1,409.3	1,395.0	1,845.4	15,334.5	14,579.1	22,754.5	7,606.7	7,070.7	11,313.2	17.374	15.746
20	V20:IRRI-22	1,200.5	1,483.6	1,817.2	12,027.3	15,970.8	22,355.2	5,135.3	7,688.9	11,108.7	17.250	15.722
21	V21:IRRI-27	1,163.9	1,467.9	1,881.9	11,525.8	15,672.3	23,270.3	4,935.3	7,585.7	11,586.6	17.240	15.779
22	V22:IRRI-28	1,195.9	1,484.3	1,884.0	11,988.4	15,962.4	23,318.6	5,103.9	7,678.4	11,636.7	17.266	15.783
23	V23:IRRI-34	1,238.7	1,562.3	1,902.2	12,647.2	16,682.6	23,560.0	5,750.5	8,071.8	11,770.4	17.359	15.798
24	V24:IRRI-36	1,233.2	1,526.5	1,887.8	12,430.9	16,378.0	23,364.8	5,512.2	7,914.2	11,670.9	17.283	15.787
25	V25:IRRI-47	1,227.2	1,535.7	1,881.2	12,423.6	16,467.4	23,262.5	5,483.8	7,954.0	11,605.7	17.313	15.779
26	V26:IRRI-52	1,245.6	1,481.8	1,855.7	12,590.6	15,848.0	22,892.8	5,279.1	7,673.6	11,416.5	17.244	15.758
27	V27:IRRI-53	1,163.9	1,465.7	1,861.5	11,626.9	15,655.8	22,986.0	4,935.3	7,584.9	11,435.5	17.231	15.762
28	V28:IRRI-55	1,201.2	1,486.6	1,878.2	12,056.5	15,987.5	23,221.0	5,135.3	7,686.9	11,569.2	17.268	15.777
29	V29:IRRI-62	1,214.8	1,485.8	1,884.1	12,220.5	15,978.7	23,298.7	5,112.5	7,684.6	11,625.8	17.267	15.788
30	V30:IR-35	1,228.5	1,485.0	1,866.8	12,423.2	15,970.2	23,041.8	5,496.8	7,682.7	11,453.9	17.267	15.771
31	V31:Laldodaki	1,174.6	1,335.9	1,937.9	11,732.4	13,495.1	24,041.5	4,991.5	6,435.9	11,986.0	17.670	15.817
32	V32:IR2289-6-22-5	1,261.2	1,342.7	1,966.0	12,843.6	13,573.1	24,477.8	5,816.1	6,469.5	12,280.4	17.666	15.853
33	V33:Narmada	1,385.0	1,337.0	1,877.7	14,519.9	13,533.1	23,151.4	7,001.4	6,468.8	11,615.6	17.635	15.779
34	V34:Ananda	1,349.9	1,513.0	1,876.1	13,808.3	16,198.8	23,184.7	6,977.5	7,826.9	11,552.1	17.284	15.773
35	V35:Ambpandhari	1,466.8	1,299.5	1,871.5	15,326.3	12,930.8	23,095.8	7,600.8	6,230.8	11,516.0	17.694	15.780
36	V36:Hira	928.4	1,052.2	1,513.2	9,025.5	10,379.4	16,966.5	4,312.7	5,036.8	8,730.0	17.823	15.686
37	V37:OR-1516-1-5-A	1,017.8	1,197.2	1,521.4	10,127.8	11,995.3	17,100.5	4,493.9	5,709.4	8,786.3	17.598	15.679
38	V38:China	1,174.5	1,216.3	1,827.4	11,716.7	12,026.2	19,562.6	4,984.4	5,732.7	10,247.3	17.843	16.878
39	V39:Sorati	1,150.1	1,212.4	1,861.0	11,416.8	16,016.2	19,717.4	5,244.5	7,805.0	10,318.8	13.855	17.225
40	V40:Mhadi	1,382.9	1,526.4	1,873.5	14,095.0	16,198.3	23,071.1	6,993.7	7,912.3	11,480.7	17.290	15.774
	SE	1,185.2	6.117	5.886	65.339	91.287	69.304	83.246	114.910	41.414	0.073	0.094
	C.D. at 5%	1,160.9	16.989	17.853	181.466	253.532	192.480	231.201	319.140	115.018	0.203	0.260
	Interaction Effect (S × M)											
	SE ±	19.785	12.234	16.651	130.678	182.574	138.609	166.493	229.819	82.827	0.146	0.188
	C.D. at 5%	54.946	33.977	NS	362.933	507.065	384.960	462.402	638.280	230.037	0.406	0.521
	General Mean	1241.4	1,438.3	1,844.0	12,557.5	15,202.7	22,496.6	5654.2	7,384.0	11,264.8	17.356	15.817

Crop sown during S_1 -*kharif* season (24th MW) produced significantly maximum growing degree days (2005.3°days) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S_2 (the 48th MW) date of sowing recorded significantly maximum growing degree days (° days) at maturity stage (1791.9° days) as compared to crop sown during S_3 (50th MW) and S_4 (52th MW).

Interaction S_1V_{15} (*kharif* sowing 24th MW) of genotype V_{15} i.e. Ratnagiri-711 recorded higher growing degree days (GDD) at maturity stage. Similarly in *rabi* S_2V_{36} (sowing 48th MW) with genotype Hira recorded higher GDD than others (Table 87)

These were also highly significant and positively correlate with grain yield and total biomass (Mohammad *et al.*, 2013). Varietal differences for GDD were also reported by Amandeep Kaur and L.K. Dhaliwal (2014) reported that the highest growing degree days, helio-thermal units, photo thermal units and pheno-thermal index to reach the physiological maturity. Pheno-thermal index gradually increases from tillering to physiological maturity in all three transplanting dates in both the years being the lowest at emergence and highest during grain filling and physiological maturity. Mote *et al.* (2015) observed that agro-meteorological indices *viz.*, photo thermal units (PTU), heliothermal units (HTU), photo thermal index (PTI), energy degree unit (EDU) were work out for different phenological stages of the rice cultivars under different environment.

5.2.9. Photo-thermal units(°hr):

Data on photo-thermal units (PTU) at first flowering and 50% flowering stage for rice genotypes are presented in Table 87. In the present investigation, Crop sown during S_1 -*kharif* season (24th MW) produced significantly maximum photo-thermal units (15956.4° hr) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S_4 (the 52th MW) date of sowing recorded significantly maximum photo-thermal units (°hr) at first

flowering stage (11853 °hr) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW). The rice variety V₁₉ i.e. IRRI-21 recorded significantly maximum photo-thermal units (15334.5 °hr) at first flowering stage which at par with variety V₃₅ i.e. Ambephandhari (15326.3 °hr). Rice variety V₃₆ i.e. Hira (9025.5 °hr) recorded significantly minimum photo-thermal units (°hr) at first flowering stage. The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum photo-thermal units (°hr) at 50% flowering stage (15112.6 °hr) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in both year and pooled mean. Significantly maximum photo-thermal units (°hr) were recorded in S₁ (18105.4 °hr) which was superior over the other date of sowing. The rice variety V₂₅ i.e. IRRI-47 recorded significantly maximum photo-thermal units (17432.6 °hr), V₁₁ i.e. Ratnagiri-6 (15977.5 °hr), V₂₃ i.e. IRRI-34 (16682.6 °hr) at 50% flowering stage over the other variety. Crop sown during S₁–*kharif* season (24th MW) produced significantly maximum photo-thermal units (25157.4 °hr) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum photo-thermal units (°hr) at maturity stage (23141.2 hr) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW) in both year and pooled mean. Significantly maximum photo-thermal units (°hr) was recorded in S₁ (25157.4 °hr) which was superior over the other date of sowing. The rice variety V₁₅ i.e. Ratnagiri-711 recorded significantly maximum photo-thermal units (25889.6 °hr) at maturity stage over the other variety. Rice variety V₃₆ i.e. Hira (16966.5 °hr) recorded significantly minimum photo-thermal units (°hr) at maturity stage.

Interaction S₁V₁₅ (*kharif* sowing 24th MW) with genotype V₁₅ i.e. Ratnagiri-711 recorded significantly higher Photo-thermal units (PTU) at maturity stage (Table 89). Similarly in *rabi* S₂V₃₆ (sowing 48th MW) with genotype Hira recorded higher GDD than others (Table 89).

Photo-thermal units for 50% flowering and physiological maturity were directly and significantly associated with grain yield (Mohammad *et al.*, 2013). Varietal differences for GDD were also reported by Amandeep Kaur and L.K. Dhaliwal (2014) reported that the highest growing degree days, helio-thermal units, photo thermal units and pheno-thermal index to reach the physiological maturity. Pheno-thermal index gradually increases from tillering to physiological maturity in all three transplanting dates in both the years being the lowest at emergence and highest during grain filling and physiological maturity. Mote *et al.* (2015) observed that agro-meteorological indices *viz.*, photo thermal units (PTU), helio thermal units (HTU), photo thermal index (PTI), energy degree unit (EDU) were work out for different phenological stages of the rice cultivars under different environment.

5.2.10. Helio thermal unit (°hr):

Data on helio-thermal units (HTU) at 50% flowering for rice genotypes are presented in Table 87. In the present investigation, crop sown during *S₁-kharif* season (24th MW) produced significantly minimum helio thermal unit (°hr) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, *S₄* (the 52th MW) date of sowing recorded significantly maximum helio thermal unit (°hr) at first flowering stage (7600.9 °hr) as compared to crop sown during *S₃* (50th MW) and *S₄* (52th MW). The rice variety *V₁₉* i.e. IRRI-21 recorded significantly maximum helio thermal unit (7606.7 °hr) at first flowering stage which at par with variety *V₃₅* i.e. Ambepandhari (7600.8°hr). Rice variety *V₃₆* i.e. Hira recorded significantly minimum helio thermal unit (4312 °hr) at first flowering stage.

Crop sown during *S₁-kharif* season (24th MW) produced significantly minimum helio thermal unit (2927 °hr) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW) at 50% flowering stage. The rice crop sown during *rabi* season, *S₄* (the 52th MW) date of sowing recorded significantly maximum helio thermal unit (9461.4 °hr) at 50% flowering stage (1470.2 °days) as compared to crop

sown during S₂ (48th MW) and S₃ (50th MW). The rice variety V₁₃ i.e. Ratnagiri-24 recorded significantly maximum helio thermal unit (9263.8 °hr) at 50% flowering stage. Crop sown during S₁-kharif season (24th MW) produces significantly minimum Helio thermal unit (4266.1 °hr). S₂-*rabi* season (48th MW) produced significantly maximum Helio thermal unit (13550.2 °hr) as compared to other sowing dates of *kharif* season (24th MW) and *rabi* season (50th MW and 52th MW). The rice variety V₁₅ i.e. Ratnagiri-711 recorded significantly maximum helio thermal unit (12952.6 °hr) at maturity stage over the other variety. Rice variety V₃₆ i.e. Hira (8730°hr) recorded significantly minimum helio thermal unit (°hr) at maturity stage. In case of *Rabi* season S₄V₁₅ i.e. crop sown in S₄ date of sowing (52th MW) was recorded significantly higher Helio thermal unit (°hr) at maturity stage (16728.8 °hr) which was superior over other treatment combination.

HTU at two stages was highly associated with grain yield. This finding thus describes the effect of sunny day on the partitioning of the total biomass in to grain yield. This may be due to transportation of the photosynthates towards grain formation (Mohammad *et al.*, 2013). Varietal differences for GDD were also reported by Amandeep Kaur and L.K. Dhaliwal (2014) reported that the highest growing degree days, helio-thermal units, photo thermal units and pheno-thermal index to reach the physiological maturity. Pheno-thermal index gradually increases from tillering to physiological maturity in all three transplanting dates in both the years being the lowest at emergence and highest during grain filling and physiological maturity. Mote *et al.* (2015) observed that agro-meteorological indices viz., photothermal units (PTU), heliothermal units (HTU), photothermal index (PTI), energy degree unit (EDU) were work out for different phenological stages of the rice cultivars under different environment.

5.2.11. Phenothermal index:

Data on phenothermal index from sowing to 50% flowering for rice genotypes are presented in Table. 87. Crop sown during S₁-*kharif* season (24th MW) produced significantly minimum phenothermal index from sowing to 50% flowering stage as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW).

The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum phenothermal index from sowing to 50% flowering stage (17.414) as compared to other sowing date. The rice variety V₃ i.e. Karjat-4 recorded significantly maximum phenothermal index from sowing to 50% flowering stage which was superior over the other variety. Rice variety V₃₉ i.e. Sorati (13.855) recorded significantly minimum phenothermal index from sowing to 50% flowering stage. Crop sown during S₁-*kharif* season (24th MW) produced significantly maximum phenothermal index as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW).

The rice crop sown during *rabi* season, S₂ (the 48th MW) date of sowing recorded significantly maximum phenothermal index from 50% flowering to maturity stage (15.384) as compared to crop sown during S₃ (50th MW) and S₄ (52th MW). Significantly maximum phenothermal index were recorded in S₁ (17.126) which was superior over the other date of sowing. The rice variety V₃₉ i.e. Sorati recorded significantly maximum phenothermal index (17.225) from 50% flowering to maturity stage which was at par with China (16.878). Rice variety V₁₂ i.e. Ratnagiri-6 (15.214) recorded significantly minimum phenothermal index from 50% flowering to maturity stage. The rice crop sown S₁ i.e. *kharif* season (24th MW) with variety V₃₈ i.e. Sorati significantly higher phenothermal index (18.882) recorded from 50% flowering to maturity stage which was at par with V₃₉, i.e. Sorati with treatment combination (Table. 89). In case of *rabi* season S₃V₃₉ i.e. crop sown in S₃ date of sowing with Sorati (50th MW) was recorded significantly higher phenothermal index from 50% flowering to maturity stage (16.918) which was at par with S₂V₃₈ (16.888) and

S₂V₃₉(16.715) i.e. crop sown in S₂ date of sowing (48th MW) , S₃V₃₈ (16.547) and S₃V₃₈ (16.547) i.e. crop sown in S₃ date of sowing (50th MW) and S₄V₃₉ (16.747) i.e. crop sown in S₄ date of sowing (52th MW) during both years and pooled mean. However, S₃V₁₂ with rice genotype Ratnagiri-24 recorded significantly minimum. Similar results were also reported by Varietal differences for GDD were also reported by Amandeep Kaur and L.K. Dhaliwal (2014) reported that the highest growing degree days, helio-thermal units, photo thermal units and pheno-thermal index to reach the physiological maturity. Pheno-thermal index gradually increases from tillering to physiological maturity in all three transplanting dates in both the years being the lowest at emergence and highest during grain filling and physiological maturity. Mote *et al.* (2015) observed that agro-meteorological indices *viz.*, photothermal units (PTU), heliothermal units (HTU), photothermal index (PTI), energy degree unit (EDU) were work out for different phenological stages of the rice cultivars under different environment.

5.3 Leaf Gas Exchange observations:

5.3.1. Rate of photosynthesis ($\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$):

Different leaf gas exchange parameters *viz.* Dry matter production and grain yield formation mainly depends on photosynthetic production in rice. Further it is known that current photosynthesis during the grain-filling stage is an important physiological factor affecting grain yield in rice. Photosynthesis rate was measured with the help of infrared gas analyser (LICOR-6400) at different growth stages.

In the present investigation, the rice crop sown during *rabi* season, the S₃ i.e. 50th MW date of sowing recorded significantly higher rate of photosynthesis $16.29 \mu\text{mol CO}_2\text{m}^{-2}\text{sec}^{-1}$ as compared to crop sown during S₂ i.e. 48th MW and S₄ i.e. 52nd MW at tillering stage. The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher rate of photosynthesis $19.54 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$ which was at par with S₃ i.e. 50nd MW date of sowing $19.53 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$ during pooled mean at flowering stage. At harvesting stage, rice variety

V₆ i.e. Sahyadri-2 recorded significantly higher rate of photosynthesis (19.25 $\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) which was at par with V₇ i.e. Sahyadri-4 (18.35 $\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) and V₁₄ i.e. Ratnagiri-73 (18.32 $\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$). Interaction S₁V₆ *kharif* sowing with Sahyadri-2 and in *rabi* S₃V₆ (sowing 50th MW) with genotype Sahyadri-2 recorded significantly rate of photosynthesis (Table 88). Thus, genotypes also differed in present study.

Varietal difference for photosynthesis rate was also reported by Sharma *et al.* (1997). Photosynthesis rate varied significantly from 26.4-38.6 mg Co₂ dm⁻² h⁻¹ among the 22 rice genotypes at flowering stage.

Pramodkumar *et al.* (2000) conducted a field experiment with 12 genotypes of barnyard millet during 1997-1998 under rainfed condition in hills the understood the photosynthesis basis of yield. The rate of photosynthesis recorded during vegetative phase and reproductive phase ranged between 18.20 to 24.91 and 14.15 to 25.06 $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$ respectively. Pramod kumar *et al.* (2002) studied photosynthetic and yield performance of rice genotypes under low temperature condition in hills. Rate of canopy photosynthesis recorded at seedlings, vegetative and booting stages were found almost similar under both normal and late plantings. Photosynthesis rate was observed positive and highly significant association with grain yield. Similar trends in rate of photosynthesis in rice were also reported by Kardile *et al.* (2018). In present study it has been observed that there is direct associate between rate of photosynthesis and grain yield particularly in *rabi* conditions. Hence it is quite evident that if by any means the increase the photosynthesis would certainly increase the rice yield. He conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. They found that RTNRH-10 (18.557 $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$) and RTN-13-4-2-3-1 (23.446 $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$) recorded significantly highest rate of photosynthesis at 60 DAT and 90 DAS, respectively.

Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield

under timely sown irrigated condition of upper IGPs. They stated significantly lower rate of photosynthesis ($\mu \text{ mole CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) was reported in Pusa Sugandha 15, Basmati 370 and Taroari Basmati in comparison to Pusa Sugandha 5, Vallabh 21 and Pusa Basmati1.

5.3.2. Leaf transpiration rate ($\mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$):

Transpiration occurs through the stomatal action, through which the gaseous exchange takes place. Hence, it is indirectly related to photosynthesis and thus, influences the production (Nimje,2010). Transpiration rate was measured with the help of infrared gas analyser (LICOR-6400) at different growth stages.

In the present investigation, crop sown during *kharif* season i.e. S₁(24th MW) has shown significantly minimum rate of leaf transpiration $3.78 \mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂(48th MW), S₃ (50th MW) and S₄ (52th MW). The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf transpiration rate $4.71 (\mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1})$ at tillering stage. At flowering stage, crop sown during *Kharif* season i.e. S₁(24th MW) produced significantly minimum rate of leaf transpiration $5.61 \mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$. The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf transpiration rate $6.51 (\mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1})$ at flowering stage. At harvesting stage, crop sown during *Kharif* season i.e. S₁(24th MW) produced significantly minimum rate of leaf transpiration $5.48 \mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$. The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf transpiration rate $6.50 \mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ at harvesting stage. The rice variety V₉ i.e. Ratnagiri-1 recorded significantly higher leaf transpiration rate $6.19 \mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$ at harvesting stage. Significantly lower leaf transpiration rate was recorded V₁ i.e. Karjat-1 ($2.40 \mu \text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$). Interaction S₁V₉ (*kharif* sowing) with Ratnagiri -1 and *rabi* S₂V₁₁ (sowing 48th MW) with genotype Ratnagiri-6 recorded significantly higher transpiration than other combination. (Table 90).

It was observed that transpiration rate increased at flowering and decrease at harvest of the crop. Transpiration rate was observed highly significant and negatively correlated with grain yield. Varietal difference for transpiration rate was also reported by Pramod kumar *et al.* (2000) evaluated 12 genotypes of barnyard millet under rainfed conditions to understand the photosynthetic basis of yield. The study revealed that transpiration rate during vegetative phase, ranged between 6.83 to 8.86 m mole per m² per sec.

Selvi *et al.* (2001) tested forty two hybrids and seven parents of rice for combining ability of grain yield and physiological characters including transpiration rate. The hybrid IR- 20/ ACM- 44 was the best specific combiner for transpiration rate.

Pramod kumar (2003) studied the six wheat varieties viz., Sonalika, Kalyansona, VL-616, Opal, Bezostaya and Blue boy to understand the photosynthetic basis of yield in wheat under irrigated and rainfed conditions. The wheat varieties varied considerably in transpiration rate. Rate of transpiration exhibited the significant reduction under rainfed conditions, as compared to irrigated conditions. Reduction in stomatal conductance controlled the gaseous exchange, which in turn decreased the rate of photosynthesis and transpiration, under rainfed conditions.

Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. They stated that Vallabh 21 recorded the highest rate of transpiration (m mole H₂O m⁻² s⁻¹) in comparison to others. Phule *et al.* (2018) indicated that, transpiration rate was significantly ($P \leq 0.05$) higher under aerobic condition as compared to that under anaerobic condition. Under the aerobic condition, transpiration rate was significantly ($P \leq 0.05$) higher in CR Dhan 202 (10.31 mmol H₂O m⁻² s⁻¹) compared to BPT 5204 (6.76 mmol H₂O m⁻² s⁻¹).

5.3.4. Stomatal conductance ($\mu\text{mol H}_2\text{O m}^{-2}\text{sec}^{-1}$) :

Stomatal conductance directly modifies plant water relations and photosynthesis (Urban *et al.*, 2017). Stomatal conductance was measured with the help of infrared gas analyser (LICOR-6400) at different growth stages. (Table-88).

At tillering stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum stomatal conductance 0.161 mmol m⁻²Sec⁻¹ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW). The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher stomatal conductance 0.256 mmol m⁻²Sec⁻¹ as compared to crop sown during S₂ i.e. 48th MW and S₃ i.e. 50th MW. At flowering stage, crop sown during *Kharif* season i.e. S₁ (24th MW) produced significantly minimum stomatal conductance 0.293 mmol m⁻²Sec⁻¹ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW). At harvesting stage, crop sown during *Kharif* season i.e. S₁ (24th MW) produced significantly minimum stomatal conductance 0.269 mmol m⁻²Sec⁻¹ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW). Likewise the rate of photosynthesis also increased whereas stomatal conductance increased thus showing direct relations between photosynthesis, stomatal conductance and transpirations.

At tillering stage, the rice variety V₃ i.e. Karjat-4 recorded significantly higher stomatal conductance (0.244 mmol m⁻²Sec⁻¹). Significantly lower stomatal conductance was recorded V₁₃ i.e. Ratnagiri - 24 (0.197 mmol m⁻²Sec⁻¹). At flowering stage, the rice variety V₃₅ i.e. Ambepandhari recorded significantly higher stomatal conductance (0.363 mmol m⁻²Sec⁻¹). Significantly lower stomatal conductance was recorded V₁₃ i.e. Ratnagiri - 24 (0.318 mmol m⁻²Sec⁻¹). At harvesting stage, the rice variety V₃₇ i.e. OR-1516-1-5 A recorded significantly higher stomatal conductance (0.345 mmol m⁻²Sec⁻¹). Significantly lower stomatal conductance was recorded V₁₃-Ratnagiri - 24 (0.294 mmol m⁻²Sec⁻¹).

Table 88 Effect of different treatment on leaf gas exchange observations of rice genotypes

Sr	Genotypes	Rate of photosynthesis ($\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$)			Leaf transpiration rate ($\mu\text{gm}^{-2}\text{sec}^{-1}$)			Leaf canopy temperature ($^{\circ}\text{C}$)			Stomatal conductance ($\text{molH}_2\text{O}/\text{m}^2/\text{sec}$)		
A) Main plot (Date of sowing)													
		Tillering	Flowering	Harvesting	Tillering	Flowering	Harvesting	Tillering	Flowering	Harvesting	Tillering	Flowering	Harvesting
	S ₁ : 24 th MW	13.34	16.69	14.46	3.78	5.61	5.48	34.368	36.806	36.795	0.161	0.293	0.269
	S ₂ : 48 th MW	15.65	18.77	16.56	4.38	6.20	6.17	35.883	37.641	38.146	0.232	0.359	0.337
	S ₃ : 50 th MW	16.29	19.53	17.30	4.51	6.27	6.24	36.250	38.041	37.490	0.234	0.356	0.335
	S ₄ :52 th MW	16.09	19.54	17.32	4.71	6.51	6.50	36.676	38.259	38.254	0.256	0.382	0.362
	SE $\pm$	0.136	0.130	0.135	0.045	0.054	0.047	0.134	0.151	0.110	0.0023	0.002	0.001
	C.D. at 5%	0.472	0.449	0.466	0.154	0.187	0.162	0.464	0.522	0.382	0.0078	0.005	0.005
B)Sub plot (Varieties)													
1	V1:Karjat-1	14.05	17.91	15.71	3.90	5.76	5.67	36.635	38.385	37.368	0.214	0.346	0.323
2	V2:Karjat-3	14.05	18.81	16.61	4.38	6.24	6.18	36.239	37.864	37.973	0.220	0.345	0.325
3	V3:Karjat-4,	14.18	16.69	14.53	4.78	6.62	6.57	35.986	37.694	37.753	0.244	0.362	0.336
4	V4:Karjat-7	15.08	17.92	15.69	4.43	6.01	5.98	35.513	37.263	37.915	0.203	0.329	0.316
5	V5:Karjat-184	15.19	18.70	16.52	4.13	5.98	5.95	35.990	37.907	37.351	0.215	0.348	0.322
6	V6:Sahyadri-2	16.23	21.49	19.25	4.22	6.01	5.97	36.457	38.165	37.585	0.214	0.339	0.320
7	V7:Sahyadri-4	15.88	20.69	18.35	3.92	5.70	5.67	36.027	37.777	37.286	0.229	0.353	0.328
8	V8:Phondaghat -1	16.04	18.90	16.66	4.32	6.15	6.12	36.032	38.157	37.170	0.208	0.343	0.319
9	V9:Ratnagiri-1	15.75	18.78	16.60	4.21	6.01	5.98	36.304	38.346	37.587	0.221	0.346	0.321
10	V10:Ratnagiri-5	13.99	16.82	14.55	4.43	6.36	6.31	35.550	37.384	37.544	0.199	0.330	0.310
11	V11:Ratnagiri- 6	15.15	18.33	16.10	4.45	6.18	6.13	36.247	37.997	37.253	0.219	0.342	0.319
12	V12:Ratnagiri- 7	16.53	19.89	17.64	4.23	6.05	6.02	36.597	38.680	37.197	0.228	0.362	0.337
13	V13:Ratnagiri -24	14.22	17.20	15.16	4.00	5.68	5.66	33.577	35.423	34.885	0.197	0.318	0.294
14	V14:Ratnagiri-73	15.57	20.54	18.32	4.35	6.15	6.13	36.256	38.048	38.117	0.216	0.344	0.324
15	V15:Ratnagiri-711	15.08	18.41	16.18	4.26	6.12	6.05	35.994	37.828	38.487	0.220	0.345	0.325
16	V16:IRRI-14	14.14	17.19	14.90	4.06	5.86	5.81	35.836	37.919	37.971	0.219	0.344	0.323
17	V17:IRRI-15	15.45	18.60	16.43	4.58	6.49	6.43	35.943	37.943	38.187	0.226	0.355	0.333
18	V18:IRRI-20	15.69	19.00	16.80	4.21	6.13	6.08	35.634	37.509	37.945	0.232	0.358	0.338

Sr	Genotypes	Rate of photosynthesis ($\mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$)			Leaf transpiration rate ($\mu\text{gm}^{-2}\text{sec}^{-1}$)			Leaf canopy temperature ($^{\circ}\text{C}$)			Stomatal conductance ($\text{molH}_2\text{O}/\text{m}^2/\text{sec}$)		
19	V19:IRRI-21	15.35	18.17	15.94	3.72	5.57	5.51	36.046	38.296	38.322	0.226	0.355	0.331
20	V20:IRRI-22	15.44	18.33	16.10	4.12	5.95	5.89	35.483	37.442	38.384	0.228	0.346	0.327
21	V21:IRRI-27	15.45	18.93	16.72	3.95	5.79	5.76	35.618	37.576	37.675	0.221	0.346	0.324
22	V22:IRRI-28	14.28	17.23	15.02	4.37	6.17	6.13	36.170	38.212	37.951	0.223	0.344	0.322
23	V23:IRRI-34	14.80	17.92	15.74	4.24	6.04	6.01	35.329	37.370	37.123	0.210	0.332	0.317
24	V24:IRRI-36	15.44	18.24	16.08	4.65	6.35	6.32	35.693	37.443	37.149	0.230	0.355	0.342
25	V25:IRRI-47	16.39	19.58	17.41	4.38	6.20	6.13	35.100	37.100	37.214	0.206	0.329	0.307
26	V26:IRRI-52	15.76	19.13	16.95	4.34	6.21	6.14	35.238	37.238	37.273	0.223	0.352	0.331
27	V27:IRRI-53	14.93	17.64	15.47	4.49	6.27	6.24	34.379	36.338	37.184	0.216	0.347	0.326
28	V28:IRRI-55	15.27	18.24	16.04	4.23	5.51	5.45	34.556	36.389	37.488	0.218	0.333	0.307
29	V29:IRRI-62	14.98	18.36	16.13	4.23	5.81	5.77	35.203	37.244	36.986	0.213	0.342	0.315
30	V30:IR-35	16.45	19.21	16.99	4.55	6.42	6.35	36.073	37.990	37.671	0.233	0.360	0.340
31	V31:Laldodaki	15.82	18.84	16.59	4.74	6.61	6.53	35.608	37.442	37.963	0.221	0.354	0.325
32	V32:IR2289-6-22-5	16.20	19.31	17.10	4.50	6.34	6.30	36.209	38.167	37.570	0.213	0.341	0.318
33	V33:Narmada	15.10	18.13	15.92	4.61	6.47	6.36	35.968	37.885	37.541	0.230	0.356	0.334
34	V34:Ananda	15.31	18.31	16.06	4.71	6.57	6.43	35.389	37.306	37.873	0.217	0.341	0.319
35	V35:Ambpandhari	15.59	18.62	16.38	4.52	6.32	6.29	35.276	37.193	38.197	0.233	0.363	0.341
36	V36:Hira	14.83	17.44	15.31	4.53	6.35	6.29	35.800	37.758	37.645	0.216	0.343	0.323
37	V37:OR-1516-1-5-A	15.50	18.92	16.58	4.41	6.38	6.33	34.900	36.650	37.856	0.229	0.359	0.345
38	V38:China	15.83	18.75	16.56	4.28	5.92	5.86	35.746	37.538	37.440	0.229	0.350	0.333
39	V39:Sorati	15.50	19.26	16.96	4.64	6.43	6.38	35.613	37.363	37.654	0.233	0.357	0.332
40	V40:Mhadi	16.00	19.40	17.07	4.41	6.32	6.28	36.754	38.296	38.220	0.232	0.358	0.340
	SE	0.404	0.415	0.414	0.127	0.145	0.148	0.323	0.346	0.250	0.006	0.007	0.007
	CD at 5%	1.125	1.154	1.151	0.353	0.403	0.412	0.898	0.961	0.695	0.018	0.020	0.020
Interaction Effect (S x M)													
	SE+	0.809	0.830	0.827	0.254	0.290	0.296	0.646	0.691	0.500	0.013	0.014	0.016
	CD at 5%	2.250	2.309	2.302	0.706	0.806	0.823	1.797	1.923	1.391	0.036	0.040	0.047
	General mean	15.342	18.632	16.409	4.344	6.149	6.098	35.794	37.687	37.671	0.221	0.347	0.326

Grain yield was observed highly significant and positively associated with stomatal conductance. Varietal difference for stomatal conductance was also reported by Pramod kumar *et al.* (2000) studied genotypic differences in photosynthesis and its associated parameters in barnyard millet. During vegetative stage stomatal conductance ranged between 371.66 to 778.237 mmolm⁻²s⁻¹ and in reproductive stage it was 308.00 to 746.25 was measured. Selvi *et al.* (2001) tested forty-two hybrid and seven parents of rice for combining ability of grain yield and physiological characters including stomatal conductance. The hybrid IR-20/ ACM-44 was found to be best specific combiner for stomatal conductance. Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. They found that RTN-13-4-2-3-1 (0.0497 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) and RTNRH-10 (0.0603 $\mu\text{mol H}_2\text{O m}^{-2} \text{ sec}^{-1}$) recorded significantly highest stomatal conductance at 60 and 90 DAS respectively. Phule *et al.* (2018) indicated that, stomatal conductance was significantly ($P \leq 0.05$) higher under aerobic condition as compared to that under anaerobic condition. Under the aerobic condition, stomatal conductance was significantly ($P \leq 0.05$) higher in CR Dhan 202 (0.16 mol H₂O m⁻² s⁻¹) compared to BPT 5204 (0.10 mol H₂O m⁻² s⁻¹).

5.3.3. Leaf canopy temperature:

At tillering stage, crop sown during *Kharif* season i.e. S₁(24th MW) recorded significantly minimum leaf canopy temperature (34.368°C) where as the S₂ i.e. 48th MW, S₃ i.e. 50th MW, S₄ i.e. 52th MW date of sowing recorded significantly higher leaf canopy temperature 35.88°C, 36.25°C, 36.67°C respectively. At flowering stage, crop sown during *Kharif* season i.e. S₁(24th MW) produced significantly minimum leaf canopy temperature (36.806°C). The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded significantly higher leaf canopy temperature (38.259°C) at flowering stage. At harvesting stage, crop sown during *Kharif* season i.e. S₁(24th MW) produced significantly minimum leaf canopy temperature (36.795°C). The rice crop sown during *rabi* season, the S₄ i.e. 52th MW date of sowing recorded

significantly higher leaf canopy temperature (38.254 °C) at harvesting stage. Same trend has been confirmed at flowering and harvest stage .So increase in canopy temperature has increased the transpiration rate during *rabi* seasons than *kharif*. So also the rate of photosynthesis during *rabi* seasons. The rice variety V₄₀ i.e. Mhadi recorded significantly higher leaf canopy temperature (38.680°C) at tillering stage. Significantly lower leaf canopy temperature was recorded V₁₆ i.e. Ratnagiri-24(33.577°C). At flowering stage, the rice variety V₁₂ i.e. Ratnagiri-7 recorded significantly higher leaf canopy temperature (36.754°C). Significantly lower leaf canopy temperature was recorded V₁₆ i.e. Ratnagiri-24(35.423°C). At harvesting stage, the rice variety V₁₅ i.e. Ratnagiri-711 recorded significantly higher leaf canopy temperature (38.487°). Significantly lower leaf canopy temperature was recorded V₂₉ i.e. IRRI-62 (36.986°C).

Similar findings by Chuan Yan *et al.* (2012) in rice flag leaf physiology, organ and canopy temperature in response to water stress. Canopy temperature in rice plots under different water stresses were recorded thermo graphically, and we obtained a different infrared image of canopy, which showed the effect of water stress on the canopy temperature. The blue and red colors indicate the lower and higher temperatures respectively. Canopy temperature increased with the increase in water stress, namely W3>W2>W1. The temperature difference was up to 3°C. 2401(*japonica* rice), Ilyou107(*indica* rice), Ilyou7954(*indica* rice) and Zhejing22 recorded leaf canopy temperatures from 28.73 to 31.69°C, 30.74 to 32.62°C, 28.30 to 30.59°C and 28.73 to 31.69°C, respectively.

5.4.Biochemical analysis:

Data on Carbohydrate content and protein content for rice genotypes are presented in Table 89.

5.4.1 Carbohydrate content:

In the present investigation, significant differences were observed within rice genotypes for grain carbohydrate content. Crop sown during

S₁-*kharif* season (24th MW) produced significantly minimum carbohydrate content (78.68 %) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₄ (the 50th MW) date of sowing recorded significantly maximum carbohydrate content (82.18 %) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW). Rice variety V₇ i.e. Sahyadri-4 recorded significantly maximum carbohydrate content (83.23 %). The rice genotype Ratnagiri -24 recorded significantly minimum carbohydrate content (73.89 %) which was followed by V₁₁ i.e. Ratnagiri-6 (78.22 %).

Varietal difference for carbohydrate content was also reported by Juliano (1972) reported that brown rice and milled rice contain 0.83-1.36% and 0.25-0.53% total sugars; 0.09-0.13% and 0.05-0.08% reducing sugars respectively. Asaduzzaman *et al.* (2013) determined the starch content of different aromatic rice varied between 63.193 to 72.60/100 g. Chingakham *et al.* (2016) observed that Carbohydrate content of the black rice varieties were more than 70 per cent. Therefore, the black rice varieties are good source of carbohydrate. Gimhavanekar *et al.* (2020) observed that rice varieties *vizly.*, Karjat -3 and Karjat -7 recorded 73.23 % and 74.06 % carbohydrate respectively.

5.4.2 Protein content (%) :

Despite the negative influence on the texture of cooked rice, high protein content rice is considered to be nutritious in grains and thus rice grains with high protein content possess high nutritive value while rice cultivars with low protein content could prove to have desired cooking qualities (Harsimrandeep, 2016).

In the present investigation, crop sown during S₁-*kharif* season (24th MW) produced significantly minimum protein content (5.75%) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum protein content (6.27 %) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW). Rice genotype V₂₈ i.e. IRRI-53 recorded significantly maximum protein content (7.09%) which was at par with V₃₅ i.e. Ambpandhari (7.04%). The rice genotype Ratnagiri-711 recorded significantly minimum protein

content (5.20%) which was at par with Sahyadri-2(5.23%). The rice crop sown S₁i.e. *kharif* season (24th MW) with genotype V₃₅ i.e. Ambepandhari recorded significantly higher protein content (6.84 %). In case of *rabi* season S₄V₂₈ i.e. crop sown in S₄ date of sowing (52th MW) with IRRI-55 was recorded significantly higher protein content(7.67%). However, S₂V₆ with rice genotype Ratnagiri-711 recorded significantly minimum protein content (5.03%) which was at par with S₂V₆ (5.03%) and S₂V₃₄ (5.10%).

Varietal difference for protein content was also reported by Pederson and Eggum (1983) observed the variation in protein content between brown and white rice is because of bran portion, which is higher in protein and significantly increase the protein content of brown rice as reported earlier. Ahmed *et al.* (1998) reported that the crude protein content of nine aromatic rice cultivars ranged from 9.17 to 11.77%. Buresova *et al.* (2010) studied the variation in protein value in different aromatic rice varieties could be due to the application of fertilizer (nitrogen content), growing conditions and time and also location of growing areas. The highest protein content (12.4%) was assessed in cv. Kitaro. The lowest protein content (8.0%) was found in a sample of cv. Lupus. Abdul Baset Mia *et al.* (1994) results showed that highest protein content was recorded in Binasil (10.53%). Other cultivars showed similar protein content and they were statistically identical. Gimhavanekar *et al.* (2020) observed that rice varieties Karjat - 3 and Karjat-7 recorded 6.70 % and 5.40% protein content. Qian Zang *et.al.* (2022) observed that protein content of NJ46 showed TP>DS. The amylose content was lower at EH than MH, but protein content was opposite i.e. higher trend. Rikako Shimoyangi conducted experiment with different transplanting dates (20 May, 3June, 17June) and observed that high temperature during grain filling decreased amylose but increased protein content.

5.4.3. Leaf Nitrate reductase activity (umol/g):

Data on leaf nitrate reductase activity and grain amylose content of rice genotypes are presented in Table 89. Reduced nitrate reductase (NRase) activity which indicated disruption in nitrogen metabolism under water deficit condition (Parthasarathi *et al.*, 2012). It plays a central role in plant primary metabolism and exhibits complex

regulation mechanism for its catalytic activity (Dehghanpour *et al.*, 2011).

In the present investigation, crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum nitrate reductase activity 1.562 $\mu\text{mol g}^{-1}$ and 1.923 $\mu\text{mol g}^{-1}$ at tillering and flowering stage respectively compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S_4 (the 52th MW) date of sowing recorded significantly maximum nitrate reductase activity 2.131 $\mu\text{mol g}^{-1}$ and 2.469 $\mu\text{mol g}^{-1}$ at tillering and flowering stage. The rice genotype Ananda recorded significantly minimum nitrate reductase activity (1.440 $\mu\text{mol g}^{-1}$). Rice genotype V_2 i.e. Karjat-3 recorded significantly maximum nitrate reductase activity (2.357 $\mu\text{mol g}^{-1}$). At flowering stage, rice genotype V_2 -Karjat-3 recorded significantly maximum nitrate reductase activity (2.674 $\mu\text{mol g}^{-1}$) which was followed by genotype V_6 i.e. Sahyadri-2 (2.661 $\mu\text{mol g}^{-1}$), V_7 -Sahyadri-4 (2.658 $\mu\text{mol g}^{-1}$), V_{39} -Sorati (2.614 $\mu\text{mol g}^{-1}$), V_{40} -Mhadi (2.606 $\mu\text{mol g}^{-1}$). The rice crop sown S_1 i.e. *kharif* season (24th MW) with genotype V_{39} i.e. Sorati recorded significantly higher nitrate reductase activity (2.400 $\mu\text{mol g}^{-1}$). *Rabi* season S_4V_{40} i.e. crop sown in S_4 date of sowing (52th MW) with Mhadi was recorded significantly higher nitrate reductase activity (2.400 $\mu\text{mol g}^{-1}$). However, S_2V_{34} with rice genotype Ananda recorded significantly minimum nitrate reductase activity (1.672 $\mu\text{mol g}^{-1}$).

NRA was gradually increased at tillering to flowering stages. Similar result obtained by Abdul *et al.* (2012) studied the maximum NRA was attained at flowering stage as compared to panicle initiation and tillering stages and NRA was gradually increased at tillering to flowering stages. At tillering stage, BRRIdhan32 showed the highest amount of NRA and Binasail recorded the lowest amount of NRA Vinait *et al.* (2017) reported the leaf nitrate reductase activity declined under heat stress. The per cent reduction in NR activity was observed maximum in genotype IET 20924 (36%) and minimum in IET 20734 (3.00%). Gimhavanekar *et al.* (2020) observed that maximum nitrate reductase activity was recorded in aromatic rice genotypes, Basmati-63 (4.62 $\mu\text{mol g}^{-1}$). which was at par with phule radha (3.88 $\mu\text{mol g}^{-1}$) over other rice

genotypes. The minimum nitrate reductase activity was recorded in katechinoor ($1.16 \text{ } \mu\text{mol g}^{-1}$). NRA was gradually increased at tillering to flowering stages.

5.4.4. Amylose content (%) :

Hardness and stickiness of cooked rice is determined by Amylose content (Srivastava and Jaiswal, 2013). Rice with high amylose content show high volume expansion during cooking and cook dry, less tender and become hard upon cooling, while low amylose varieties cook moist and sticky (Juliano, 1985).

In the present investigation, crop sown during S_1 -*kharif* season (24th MW) produced significantly maximum amylose content (22.46 %) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S_2 (the 48th MW) date of sowing recorded significantly maximum amylose content (22.03%) which was superior over others crop sown during S_3 (50th MW) and S_4 (52th MW). The rice variety Karjat-7 recorded significantly maximum amylose content (24.59%) followed by variety IRRI-34 (24.50%) and IRRI-62 (24.35%). Rice variety V_7 i.e. Sahyadri-4 (19.) recorded significantly minimum amylose content (19.38%) which was followed by V_6 i.e. Sahyadri-2 (19.91%). The rice crop sown S_1 i.e. *kharif* season (24th MW) with genotype V_4 i.e. Karjat -7 recorded significantly higher amylose content (24.92%). In case of *rabi* season S_2V_4 i.e. crop sown in S_2 date of sowing (48th MW) with Karjat-7 was recorded significantly maximum amylose content (%) (24.65 %) which was at par with S_2V_{23} (24.60%) i.e. crop sown in S_2 date of sowing (48th MW) and S_3V_4 (24.55%) i.e. crop sown in S_3 date of sowing (50th MW).

The varietal difference for amylose content was also reported by Sagar *et al.* (1988) observed that the amylose content ranged from 20.00-27.70% with a mean of 22.10% in aromatic rice grains. Asaduzzaman *et al.* (2013) observed the variation of amylose content among different aromatic rice varieties was 15.69 to 23.01/100 g. Gimhavanekar *et al.* (2020) observed that rice varieties vizly; Karjat -3 and Karjat -7 recorded 24.07 % and 23.36 % amylose.

Table 89 :Effect of different treatments on biochemical analysis of rice genotypes

Sr No	Genotypes	Grain Carbohydrate content(%)	Grain Protein (%)	Leaf Nitrate reductase activity(μ mol/g)		Grain Amylose content(%)	Grain Iron (ppm)	Grain Zinc (ppm)
A) Main plot (Date of sowing)				Tillering	Harvesting			
	S ₁ : 24 th MW	78.68	5.75	1.562	1.923	22.46	8.68	13.1
	S ₂ : 48 th MW	80.61	5.81	1.831	2.187	22.03	9.21	13.6
	S ₃ : 50 th MW	81.40	6.01	1.984	2.308	21.71	9.65	14.1
	S ₄ : 52 th MW	82.18	6.27	2.131	2.469	21.25	10.27	14.8
	SE $\pm$	0.028	0.008	0.017	0.013	0.012	0.016	0.006
	C.D. at 5%	0.099	0.028	0.060	0.046	0.043	0.055	0.022
B) Sub plot (Varieties)								
1	V1:Karjat-1	82.11	6.81	1.863	2.220	21.53	9.86	17.7
2	V2:Karjat-3	81.61	5.59	2.357	2.674	23.49	7.97	10.2
3	V3:Karjat-4,	80.18	6.64	1.671	2.094	23.71	20.93	9.7
4	V4:Karjat-7	82.04	5.91	2.068	2.368	24.59	7.85	17.3
5	V5:Karjat-184	79.30	5.45	2.040	2.402	20.67	10.82	12.8
6	V6:Sahyadri-2	82.78	5.23	2.339	2.661	19.91	6.71	11.0
7	V7:Sahyadri-4	83.23	5.31	2.350	2.658	19.38	8.50	13.9
8	V8:Phondaghat -1	81.29	6.14	1.841	2.172	20.69	9.82	10.6
9	V9:Ratnagiri-1	82.28	6.71	2.129	2.510	22.12	10.54	11.2
10	V10:Ratnagiri-5	80.98	5.34	1.929	2.247	20.90	8.72	11.7
11	V11:Ratnagiri- 6	78.22	6.48	1.886	2.241	21.42	10.10	20.3
12	V12:Ratnagiri- 7	80.27	5.35	1.975	2.341	19.86	15.56	19.7
13	V13:Ratnagiri -24	73.89	5.40	1.733	2.057	20.93	8.16	17.5
14	V14:Ratnagiri-73	81.78	6.31	2.066	2.377	23.61	8.74	15.2
15	V15:Ratnagiri-711	82.77	5.20	1.918	2.240	21.88	9.09	16.5
16	V16:IRRI-14	81.75	6.16	1.705	2.034	23.13	7.65	11.6
17	V17:IRRI-15	80.37	6.11	1.738	2.043	21.50	6.91	11.0
18	V18:IRRI-20	82.28	6.69	1.957	2.273	20.49	8.28	12.5
19	V19:IRRI-21	79.78	6.22	1.721	2.046	21.39	7.40	11.4
20	V20:IRRI-22	79.70	5.48	1.705	2.047	21.18	7.74	11.8
21	V21:IRRI-27	79.35	5.53	1.905	2.264	22.14	9.52	10.7

Sr No	Genotypes	Grain Carbohydrate content(%)	Grain Protein (%)	Leaf Nitrate reductase activity(μ mol/g)		Grain Amylose content(%)	Grain Iron (ppm)	Grain Zinc (ppm)
22	V22:IRRI-28	79.30	5.28	1.626	1.965	22.27	8.98	13.0
23	V23:IRRI-34	78.51	6.53	2.147	2.562	24.50	6.87	10.9
24	V24:IRRI-36	79.01	5.84	2.078	2.448	23.86	7.22	11.4
25	V25:IRRI-47	80.98	5.88	1.533	1.914	20.97	10.19	7.9
26	V26:IRRI-52	79.30	5.44	1.449	1.782	23.24	6.43	10.4
27	V27:IRRI-53	78.39	6.09	1.667	2.003	23.34	11.40	14.3
28	V28:IRRI-55	81.83	7.09	1.493	1.830	21.90	8.52	15.6
29	V29:IRRI-62	79.28	6.27	1.859	2.208	24.35	10.55	17.6
30	V30:IR-35	82.11	5.80	1.843	2.157	21.23	11.09	18.2
31	V31:Laldodaki	81.04	6.00	1.761	2.062	20.31	5.17	12.2
32	V32:IR2289-6-22-5	81.27	5.41	1.918	2.258	20.77	11.16	13.2
33	V33:Narmada	78.44	6.24	1.898	2.243	21.41	10.74	17.8
34	V34:Ananda	79.97	5.36	1.440	1.777	20.29	11.46	18.9
35	V35:Ambpandhari	78.80	7.04	1.672	2.029	20.55	9.31	16.3
36	V36:Hira	82.46	5.93	1.740	2.096	22.37	8.12	13.9
37	V37:OR-1516-1-5-A	79.66	5.49	1.586	1.957	21.39	9.52	16.5
38	V38:China	82.18	6.01	1.892	2.229	22.29	9.07	16.1
39	V39:Sorati	82.60	5.90	2.218	2.614	22.04	11.68	10.1
40	V40:Mhadi	81.41	6.16	2.235	2.606	21.12	9.15	16.2
	SE	0.042	0.023	0.032	0.011	0.026	0.049	0.038
	CD at 5%	0.116	0.063	0.088	0.031	0.072	0.136	0.106
Interaction Effect (S x M)								
	SE	0.083	0.045	0.063	0.022	0.052	0.098	0.076
	CD at 5%	0.231	0.126	0.175	0.062	0.144	0.272	0.212
	General mean	80.716	5.957	1.877	2.222	21.862	9.447	13.902

5.4.5 Iron content ppm(Fe):

In the present investigation, Crop sown during S₁-*kharif* season (24th MW) produced significantly maximum iron content (8.68ppm) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₄(the 52th MW) date of sowing recorded significantly maximum iron content (10.27ppm) as compared to crop sown during S₂ (48th MW) and S₃ (50thMW). The rice genotype V₃₁-Laldodaki recorded significantly minimum iron content (5.17ppm). Rice genotype V₃-Karjat-4 recorded significantly maximum iron content (20.93ppm) which was followed by V₁₂ i.e. Ratnagiri-7 (15.56ppm) and V₃₈ i.e. Sorati(11.68ppm). The rice crop sown S₁i.e.*kharif* season(24th MW) with genotype V₃ i.e. Karjati-4 recorded significantly maximum iron content (18.94 ppm) . In case of *rabi* season S₄V₁₂ i.e. crop sown in S₄ date of sowing (52th MW) with Karjati-4 was recorded significantly higher iron content (17.02ppm). However, S₂V₃₁ with rice genotype Laldodki recorded significantly minimum iron content (4.71ppm). Lawanya *et al.* (2021) and Kushwaha *et al.* (2022) reported similar finding. Dutta and Barua (1978) conducted field experiment at Jorhat for evaluation of nutritional quality of some rice varieties grown in Assam and found that iron content in different in different rice varieties varied from 1.66 to 1.92 mg per 100 g rice and observed highest in Chinese-63 and lowest in Ghee bora.

Kumar and Kapoor (1984)studied mineral composition of different varieties of cereals and legumes at Hissar and observed 4.16,4.16 and 4.15 mg iron per 100 g rice in Pusa-221, Jhona -349 and Basmatti-370 respectively.

Patil (1985) conducted field experiment at Dapoli for evaluation of quality characteristics of promising rice varieties grown in Konkan and revealed that iron content in rice varieties varied from 2.26 to 9.54 mg per 100 g rice.

Singh *et al* (1998) studied quality characteristics of six rice varieties grown in Himachal Pradesh and observed that iron content of

brown rice varied from 2.41 to 4.50 mg per 100 g rice while that of milled rice varied from 1.21 to 3.06 mg per 100 g rice.

Ghadi (2001) during quality evaluation of promising rice varieties grown in Konkan region at Dapoli found that the content of iron in twelve rice varieties ranged from 6.34 to 13.81 mg per 100 g rice respectively.

Amudha *et al.* (2007) while studying nutritional aspects of rice observed that the iron content in all the six genotypes ranged between 10.85 to 16.42 mg per 100 g in brown rice samples and between 8.95 to 14.72 mg per kg in polished rice samples.

5.4.6 Zinc content:

Results were in accordance with the finding of Lawanya *et al.* (2021) and Kushwaha *et al.* (2022). Sanjeev Roa *et al.* (2007) studied zinc content of the popular varieties of rice as 13 mg/kg and RDA of zinc as 12 mg/kg for male and 10 mg/kg for female, the zinc intake through rice consumption is 2.9 g/day per person.

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum zinc content (13.1 ppm) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S_4 (the 52th MW) date of sowing recorded significantly maximum zinc content (14.8 ppm) as compared to crop sown during S_2 (48th MW) and S_3 (50th MW). The rice genotype V_{11} i.e. Ratnagiri-6 recorded significantly maximum zinc content (20.3 ppm) followed by genotype V_{34} i.e. Ananda (18.9) and V_{12} i.e. Ratnagiri-7 (17.3 ppm). The rice crop sown S_1 i.e. *kharif* season (24th MW) with genotype V_7 i.e. Sahyadri-4 recorded significantly higher zinc content (%). In case of *Rabi* season S_4V_{11} i.e. crop sown in S_4 date of sowing (52th MW) with Ratnagiri-6 treatment combination was recorded significantly higher zinc content (22.11 ppm). However, S_2V_{25} with rice variety IRI-47 recorded significantly minimum zinc content (7.89 ppm).

5.5. Yield and yield attributes:

Data on number of tillers per plant, total no. of panicles per plant, panicle length, total number of spikelet per panicle, no. of filled spikelet per panicle, 1000 grain weight, grain yield per plant, straw yield per plant, and harvest index for rice genotypes are presented in Table 90.

5.5.1. Number of tillers per plant:

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum number of tillers per plant (8.04) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S_2 (the 48th MW) date of sowing recorded significantly maximum number of tillers per plant (10.37) as compared to crop sown during S_3 (50th MW) and S_4 (52th MW). Significantly maximum number of tillers per plant was recorded in S_2 (10.37) which was at par with the other sowing date S_3 (50th MW) and S_4 (52th MW).

The rice genotype V_7 i.e. Sahyadri-4 recorded significantly maximum number of tillers per plant (11) which was at par with V_{19} i.e. IRRI-21 (10.42) and V_{40} i.e. Mhadi (10.42). Rice genotype V_{36} i.e. Hira recorded significantly minimum number of tillers per plant (8.63) which was at par with V_8 i.e. Phondaghat-1 (9) and V_{32} i.e. IR2289-6-2-5 (8.29). S_2V_6 i.e. crop sown in S_2 date of sowing (48th MW) and S_3V_6 i.e. crop sown in S_3 date of sowing (50th MW) with Sahyadri-2 was recorded significantly higher number of tillers per plant (12) which was at par with S_2V_{40} i.e. crop sown in S_2 date of sowing (48th MW) (11.7) and S_3V_{40} (11.7) i.e. crop sown in S_3 date of sowing (50th MW). Yoshida *et al.* (1972) studied the physiological aspect of high yields in rice and reported that number of panicles per unit area is the most important component of rice yield. It accounts for 89% of the variation in grain yield. Similar results by Gallagher and Biscoe (1978) found that tiller number directly affects the number of panicle and as a consequence affects the total yield. Miller *et al.* (1991) found that tiller number directly affects the number of panicle and as a consequence affects the total yield. Chandrasekhar *et al.* (2001) studied physiological analysis of growth and productivity in hybrid rice.

The tiller number increased up to 60 DAT and remained almost constant during later growth stages. Maximum tillers (12.7/plant) were produced by APHR-2 than other cultivars. Zahid *et al.* (2005) also reported a highly significant variation for different traits including the number of productive tillers per plant which was correlated with total yield. Sinha *et al.* (2009) found that the number of tillers increased continuously and attained maximum values at 60 day after transplanting. Mehta *et al.* (2013) observed that number of tillers per square meter was found up to 60 DAT after that declined up to the maturity because of drying of unproductive tillers. Maximum number of effective tillers per square meter (308) was produced by the genotype RNR 2354 and whereas minimum of 264 were produced in Pusa1121 and Chittimuthyalu (264) at harvest.

Lavanya *et al.* (2018) studied various rice genotypes for grain yield by physiological approaches. They found that maximum productive tiller number was observed in the genotypes DRRH2 and RPHR1005 (15.7) followed by KRH2 (15.3) and minimum productive tiller number was observed in PUSA5A X BR827-35 (8.7).

5.5 .2.Total no. of panicles per plant:

Crop sown during S₁-kharif season (24th MW) produced significantly minimum total number of panicles per plant as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₃ (the 50th MW) date of sowing recorded significantly maximum total number of panicles per plant as compared to crop sown during S₂ (48th MW) and S₄ (52th MW). Significantly maximum total number of panicles per plant (9.3) was recorded in S₃ i.e. crop sown in S₃ date of sowing (50th MW) which was at par with S₂ i.e. crop sown in S₂ date of sowing (48th MW) (9) and S₄ i.e. crop sown in S₄ date of sowing (52th MW) (9.1). The rice genotype Karjat-3 recorded significantly maximum total number of panicles per plant (10.8) which was superior over the other genotype. S₂V₂ i.e. crop sown in S₂ date of sowing (48th MW) with Karjat-3 was recorded significantly higher total number of panicles per plant (11.7) which was superior over other

treatment combination with crop sown in S₂ date of sowing (48th MW) and S₃ date of sowing (50th MW). Padmaja (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes which were released during 1960's, 1970's, 1980's and 1990's. There was significant difference among the genotypes for number of panicles per m². Lohidas (2003) studied five hybrids during the season *kharif*, 2001 and 2002. On average rice hybrids produced a maximum number of 9-12 panicles per plant. Katsura *et al*, (2007) conducted an experiment during the years 2003 and 2004 with three rice varieties. They recorded the number of panicles/m during both the years for Liangyoupeijiu, Takanari, and Nipponbare were (223, 239 and 326) and (217, 274 and 304) respectively. Dutta *et al*. (2013) evaluated sixty eight genotypes of rice. Among genotypes minimum panicles per plant were noted in Adoliabao (7) and maximum (29) panicles per plant

5.5.3. Panicle length (cm):

Crop sown during S₁-*kharif* season (24th MW) produced maximum panicle length (21.62cm) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₃ (the 50th MW) date of sowing recorded maximum panicle length (21.55cm) as compared to crop sown during S₂ (48th MW) and S₄ (52th MW). The rice variety laldodki recorded significantly maximum panicle length (24.15) which was at par with V₆ i.e. Sahyadri-2, V₇ i.e. Sahyadri-4, V₂₀ i.e. IRRI-22, V₂₉ i.e. IRRI-62, V₃₀ i.e. IR-35 and V₃₄ i.e. Ananda. In case of *Rabi* season S₃V₂₀ i.e. IRRI-22 crop sown in S₃ date of sowing (50th MW) with was recorded significantly higher panicle length (25.58cm) which was at par with S₁V₇, S₁V₁₇, S₁V₂₄, S₁V₂₅, S₁V₂₆, S₁V₂₇, S₂V₃₁ and S₁V₃₇ i.e. crop sown in S₁ date of sowing (24th MW), S₂V₇, S₂V₂₆ and S₂V₃₄ i.e. crop sown in S₂ date of sowing (48th MW), S₃V₇, S₃V₁₉, S₃V₂₆, S₃V₃₁ i.e. crop sown in S₃ date of sowing (50th MW) and S₄V₆, S₄V₇, S₄V₃₀, S₄V₃₁ i.e. crop sown in S₄ date of sowing (52th MW). Similar results reported by Fageria and Baligar (2001) reported that panicle length and spikelet number had the highest correlation with grain yield. Panicle length had the high positive and

Table 90: Effect of different treatment on yield and yield attributes character s of rice genotypes

Sr No	Genotypes	Number of tillers per plant	Total No. of panicles per plant	Panicle length (cm).	Total number of spikelet per panicle	Number of filled spikelet per panicle	1000 grain weight (gm)	Grain yield per plant (g)	Straw yield per plant (g)	Harvest index
A) Main plot (Date of sowing)										
1	S ₁ : 24 th MW	8.04	7.6	21.62	183.85	159.10	20.86	14.76	22.39	39.61
	S ₂ : 48 th MW	10.37	9.0	21.30	202.42	177.19	18.90	17.31	24.86	40.88
	S ₃ : 50 th MW	10.36	9.3	21.55	202.79	176.60	19.30	17.91	25.30	41.32
	S ₄ :52 th MW	10.18	9.1	21.48	205.27	179.15	19.66	17.78	25.38	41.04
	SE ±	0.07	0.102	0.15	1.39	0.93	0.25	0.022	0.073	0.072
	C.D. at 5%	0.24	0.309	NS	4.80	3.23	0.87	0.076	0.254	0.249
B) Sub plot (Varieties)										
1	V1:Karjat-1	9.79	8.8	19.35	195	167.43	19.73	13.64	20.93	39.48
2	V2:Karjat-3	9.79	10.6	21.22	239	226.12	20.08	23.93	31.81	42.94
3	V3:Karjat-4,	9.75	8.8	17.29	199	171.54	10.06	11.00	19.00	36.66
4	V4:Karjat-7	10.29	8.4	20.06	180	154.77	22.61	20.20	27.87	42.01
5	V5:Karjat-184	10.21	8.5	20.89	201	173.23	16.49	15.92	23.46	40.41
6	V6:Sahyadri-2	10.75	8.2	23.03	193	166.13	22.28	23.05	30.22	43.27
7	V7:Sahyadri-4	11.00	8.5	23.37	201	174.30	23.35	24.62	32.87	42.82
8	V8:Phondaghat -1	9.00	9.2	21.81	180	153.54	22.27	15.40	22.49	40.60
9	V9:Ratnagiri-1	9.54	8.3	19.93	175	148.20	25.13	18.08	25.83	41.10
10	V10:Ratnagiri-5	9.50	9.1	19.09	218	200.78	12.35	14.29	22.25	39.00
11	V11:Ratnagiri- 6	9.58	8.1	21.46	243	229.80	14.21	14.23	21.81	39.52
12	V12:Ratnagiri- 7	9.33	8.9	20.47	243	213.07	20.71	18.98	25.98	42.09
13	V13:Ratnagiri -24	9.65	9.0	20.13	208	190.76	12.41	18.20	25.31	38.59
14	V14:Ratnagiri-73	10.29	8.3	20.57	185	158.92	21.47	21.12	28.74	42.31
15	V15:Ratnagiri-711	9.54	9.0	20.99	184	158.63	21.19	18.71	26.42	41.49
16	V16:IRRI-14	9.92	9.0	21.16	235	205.70	15.50	15.80	23.13	40.54
17	V17:IRRI-15	9.42	8.7	22.17	223	194.60	15.54	15.05	22.30	40.24
18	V18:IRRI-20	9.42	8.8	21.61	207	179.36	15.17	17.03	24.15	41.35
19	V19:IRRI-21	10.42	8.9	22.65	209	180.12	14.14	15.80	23.25	40.49

Sr No	Genotypes	Number of tillers per plant	Total No. of panicles per plant	Panicle length (cm).	Total number of spikelet per panicle	Number of filled spikelet per panicle	1000 grain weight (gm)	Grain yield per plant (g)	Straw yield per plant (g)	Harvest index
20	V20:IRRI-22	10.29	9.0	23.31	205	177.75	16.09	15.33	22.95	39.98
21	V21:IRRI-27	9.25	8.1	22.90	190	164.27	22.63	16.39	24.27	40.31
22	V22:IRRI-28	9.25	8.3	22.05	200	173.12	23.62	16.48	24.52	40.20
23	V23:IRRI-34	9.63	8.9	24.15	209	180.30	17.69	16.30	23.80	40.63
24	V24:IRRI-36	9.58	8.8	21.25	192	165.21	22.65	15.80	22.88	40.87
25	V25:IRRI-47	9.75	8.7	22.31	192	165.63	23.81	16.91	24.28	41.04
26	V26:IRRI-52	10.08	8.6	22.95	189	162.08	24.69	17.69	25.27	41.18
27	V27:IRRI-53	9.96	8.6	22.66	201	173.57	21.41	17.37	25.29	40.72
28	V28:IRRI-55	10.04	8.7	21.84	212	185.27	16.36	15.73	23.06	40.58
29	V29:IRRI-62	10.00	9.0	23.04	217	191.98	15.24	15.64	23.22	40.22
30	V30:IR-35	8.29	8.5	23.03	200	173.58	20.27	15.53	23.49	39.81
31	V31:Laldodaki	9.33	8.8	23.25	172	146.75	22.00	14.00	21.88	39.03
32	V32:IR2289-6-22-5	9.29	8.8	21.36	161	136.83	21.41	14.12	21.37	39.77
33	V33:Narmada	9.88	9.0	22.23	175	149.38	22.77	15.12	22.66	40.08
34	V34:Ananda	10.13	9.0	23.10	173	147.86	23.01	14.92	22.17	40.22
35	V35:Ambpandhari	8.75	8.5	21.98	186	159.45	16.05	13.28	20.78	38.97
36	V36:Hira	8.63	8.5	19.78	165	141.04	21.94	14.67	22.09	39.93
37	V37:OR-1516-1-5-A	9.46	8.8	18.89	177	151.10	22.92	16.12	23.74	40.43
38	V38:China	9.83	9.0	20.17	190	162.75	23.14	19.84	26.84	42.43
39	V39:Sorati	9.63	8.5	20.67	199	173.11	22.19	19.83	27.12	42.17
40	V40:Mhadi	10.42	8.7	19.52	203	176.47	21.56	19.95	27.70	41.81
	SE	0.24	0.280	0.44	3.59	3.64	0.37	0.13	0.297	0.268
	CD at 5%	0.66	0.777	1.22	9.98	10.13	1.02	0.36	0.826	0.745
	Interaction Effect (S x M)					19.35				
	SE+	0.47	0.559	0.87	7.17	7.28	0.73	0.256	0.594	0.536
	CD at 5%	1.32	NS	2.43	19.95	20.27	2.04	0.713	1.652	1.491
	General mean	9.74	8.75	21.48	198.58	173.01	19.68	16.939	24.483	40.713

significant correlation to number of grains per panicle and significant and negative correlation to grain yield. Sharma (2002) reported that there had been significant variation in panicle length in aromatic rice varieties. Ashrafuzzaman *et al.* (2009) working on yield and yield contributing characters in aromatic rice reported that BR34 possessed the longest panicle (19.73 cm) and Kataribhog had the shortest panicle (16.20 cm). Faruq Golam *et al.* (2011) observed that significant variation was observed in length of panicle among the genotypes at 5% levels. The data for panicle length ranged from 19.30 to 26.77. Abdul Baset Mia *et al.* (2012) reported that Binasail recorded the longest and BRRIdhan32 showed the shortest panicle length. Arooj *et al.* (2015) evaluated agronomic traits for yield and yield components in advance breeding lines of rice. Chandrika *et al.* (2015) observed that maximum panicle length of 28.4 cm was recorded in genotype RNR 15038 and minimum panicle length of 22.4 cm of was recorded in genotype Rajendra. Chandrashekhar *et al.* (2017) reported that significantly more panicle length in SRI compared to NTP. Higher mean panicle length was recorded in SRI (25.6 cm) compared to NTP (24.8 cm). Mohammad Shamim *et al.* (2018) studied morpho-physiological characterization of aromatic rice (*Oryza sativa*) genotypes for grain yield under timely sown irrigated condition of upper IGPs. Stated that the highest panicle length was reported in Pusa Basmati 1460 (35.7 cm) whereas, it was shortest in Taroari Basmati (45.4 cm).

5.5.4. Total number of spikelet per panicle:

Number of spikelets and filled spikelets per panicle is considered as one of the principle indices of sink size in rice (Nimje, 2010). The significant differences were observed within the rice genotypes under study.

In the present investigation, Crop sown during S₁-*kharif* season (24th MW) produced significantly minimum total number of spikelet per panicle (183.85) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum total number of

spikelet per panicle (205.66) as compared to crop sown during S₂ (48thMW) and S₃ (50thMW). Significantly maximum total number of spikelet per panicle was recorded in S₄ (205.27) which was at par with S₂ (202.42) and S₃(202.79).

The rice varieties Ratnagiri-6 and Ratnagiri-7 recorded significantly maximum total number of spikelets per panicle (243) which was at par with Karjat-3 (239).

Total number of spikelets and filled spikelets per panicle were observed positively correlated with grain yield. Similar results were reported by Chandrika *et al.* (2015) reported that maximum number of spikelets per panicle (165) was found in the genotype and minimum number of spikelets per panicle (109) was found in the rice genotype. Fageria and Baligar (2001) reported that grain number per panicle had a positive and significant correlation with grain yield and Patel *et al.* (2010) found that among the yield components assessed, sink size (spikelets per panicle) contributed more to the yield and is considered to be most important factor responsible for yield gap between aerobic and flooded rice. The varietal difference for total number of spikelets was also reported by Kusutani *et al.* (2000) reported that the variety which produced highest number of effective tillers per hill and highest number of grains per panicle also showed highest grain yield in rice and Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*.

5.5.5. No. of filled spikelet per panicle :

Number of spikelets per panicle, is considered as one of the principle indices of sink size in rice (Nimje, 2010). The significant differences were observed within rice genotypes under study.

In the present investigation, Crop sown during S₁–*kharif* season (24th MW) produced significantly minimum number of filled spikelet per panicle (159.10)as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₄ (the

52th MW) date of sowing recorded significantly maximum number of filled spikelet per panicle (179.15) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW). The rice variety V₁₂ i.e. Ratnagiri- 6 recorded significantly maximum number of filled spikelet per panicle (229.80) which was at par with V₂ i.e. Karjat-3.

Total number of spikelets and filled spikelets per panicle were observed positively correlated with grain yield. Similar results were reported by Samonte *et al.* (1998) also found that number of filled grains per panicle had significant positive effect on rice grain yield. Padmaja (2001) conducted an experiment during *kharif*, 1998 and 1999 with ten genotypes of rice. Decade wise data of mean values for filled grains varied from 83.50 to 87.49 per cent. Rasheed *et al.* (2002) reported that fertility percentage showed positive but non-significant correlation with grain yield per plant. Lohidas (2003) evaluated five hybrids during the season *kharif*, 2001 and 2002 for different parameters. The filled grain percentage% as significantly higher in PHB-71 during *kharif*, 2001 (82.40 %) and 2002 (82.80 %). APHR-1 recorded significantly the lower (59 %) grain filling percentage during *kharif*, 2001 and 2002. Hussain *et al.* (2014) found that NERICA-4 produced the highest number of spikelets/panicle but it was at par with IR-28 and significantly higher than japonica varieties, Fageria and Baligar (2001) and Patel *et al.* (2010). The varietal difference for total number of spikelet was also reported by Chandrashekhar *et al.* (2017) reported that significantly more number of spikelet's per panicle compared to NTP. Maximum mean number of spikelet per panicle were recorded in SRI (12) and NTP (10).and Kardile *et al.* (2018).

5.5.6.1000 grain weight (cm):

Grains are the actual sites where the accumulation of photosynthates take place in panicles and hence constitute the real sink. The size of the grains has a direct bearing on yield (Nimje, 2010).

In the present investigation, Crop sown during S₁–*kharif* season (24th MW) produced significantly maximum 1000 grain weight (20.86 gm)

as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum 1000 grain weight (19.72 gm) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW). The rice genotype Ratnagiri-1 recorded significantly maximum 1000 grain weight (25.13 gm) which was at par with V₇ i.e. Sahyadri-4, V₂₂ i.e. IRRI-28, V₂₄ i.e. IRRI-36 V₂₅ i.e. IRRI-47, V₂₆ i.e. IRRI-52, V₃₃ i.e. Narmada, V₃₄ i.e. Ananda, V₃₇ i.e. OR-1516-1-5-A, V₃₈ i.e. China. Rice variety V₄ i.e. Karjat-4 recorded significantly minimum 1000 grain weight (10.06 gm).

Similar significant variation among the rice genotypes were recorded significant correlation between 1000 grain weight and yield. Similar findings supported by Sidhu *et al.* (1992) recorded 1000 grain weight of 15.80 g with Basmati 385 variety, 15.70 g with Basmati 370 and 16.50 g with Pusa Basmati-1. Cheema *et al.* (1998) found positive and significant correlation between 1000-grain weight and grain yield per plant Mondal *et al.* (2005) reported the significant difference among the cultivars studied for 1000- grain weight and Ashrafuzzaman *et al.* (2009) revealed that there was significant difference of 1000- grain weight among the varieties. The highest 1000-grain weight was recorded in BR38 (20.13 g) and the lowest was recorded in BR34 (12.17 g). Dhakal (2014) evaluated fifty rice genotypes during khari/2013. The 1000 grain weight ranged from 12.46 to 28.53 g with average value of 20.05 g. Among all the genotypes, RP Bio 4918-166-9 (12.46 g) had recorded lowest 1000 grain weight followed by RP 5216-13-7-2-1-1-1 (13.20 g) and RP 5214-18-6-2-1-1-1-B (13.53 g). Hussain *et al.* (2014) observed that non-significant difference in 1000 grain weight of all varieties, however, it varied between 28.5 to 29.9 g. Chandrika *et al.* (2015) observed that the highest 1000 grains weight was recorded in (22.5 g) due to the bold grain while lowest 1000 grain weight was recorded for the genotype HR-12 (11.10 g) due to fine grain nature.

5.5.7. Grain yield per plant (g):

Grain yield is the economic part of the total dry matter. This is the end product of the plants life cycle and it is of much interest to mankind. Yield is a compound character and is a sum total of the contribution made by a number of physiological characters. It is an ultimate product of the action and interaction of a number of component plant characters. To the plant physiologist, it is net economic gain from the source and sinks capacity (Nimje, 2010).

In the present investigation, crop sown during S₁-*kharif* season (24th MW) produced significantly minimum grain yield (14.76 g) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₃ (the 50th MW) date of sowing recorded significantly maximum grain yield per plant (17.91g) which was at par with S₂ and S₄ over others. Significantly maximum grain yield per plant (g) was recorded in S₃ (17.91g) which was superior over the other date of sowing.

The rice variety V₇ i.e. Sahyadri-4 recorded significantly maximum grain yield per plant (24.62 g) which was at par with variety V₂ i.e. Karjat-3 (23.93 g).

The rice crop sown S₁ i.e. *kharif* season (24th MW) with variety V₇ i.e. Sahyadri-4 recorded significantly higher grain yield per plant (22.86 g).

In case of *rabi* season S₄V₇ i.e. crop sown in S₄ date of sowing (52th MW) with Sahyadri-4 was recorded significantly higher grain yield per plant (25.32 g) which was at par with S₂V₇ (25.14 g) i.e. crop sown in S₂ date of sowing (48th MW) and S₃V₇ (25.17 g) i.e. crop sown in S₃ date of sowing (50th MW). However, S₄V₃ with rice genotype Karjat-4 recorded significantly minimum grain yield per plant (11.02g).

Similar results were reported by Muhammad et al. (2012) evaluated ten rice genotypes during the experiment. All genotypes produced variable grain yield ranging from 1.64 to 3.43 tons per hectare. Higher

paddy yield was harvested from cultivar KS-133. It was noted that the lowest paddy yields were produced by well adopted cultivars IR 6.

Chandrika *et al.* (2015) observed that rice genotypes exhibited significant differences in grain yield. Among the genotypes RNR 15038 recorded highest grain yield of 6142 kg ha⁻¹ followed by RNR 15048 with (5788kg ha⁻¹). The lowest grain yield was recorded in Rajendra (3597 kg ha⁻¹) followed by HR-12 (3733 kg ha⁻¹). Chandrashekhar *et al.* (2017) reported that significantly higher grain yield of 5.76 tons ha⁻¹ in SRI as compared to NTP (5.09 tons ha⁻¹). The SRI obtained 11% higher grain yield than NTP. Among the nutrient management practices, T₃ recorded higher grain yield (6.01 tons ha⁻¹) followed by T₄ (5.87 tons ha⁻¹). Lower grain yield was recorded by T₂ (4.14 tons ha⁻¹) over other treatments. Kardile *et al.* (2018) conducted field experiment with 6 pre-release cultures, 5 pre-release rice hybrids and 2 checks genotypes to study the yield variation during *kharif*. They found that the RTNRH-10 (31.76g/plant) recorded highest grain yield per plant followed by RTNRH- 17 (30.40g /plant) as compared to other genotypes. Sidhu *et al.* (1992), Fageria and Baligar (2001), Patel *et al.* (2010), Islam *et al.* (2016) and Mohhamd Shmim *et al.* (2018). Variation in grain yield in rice has been also reported by Hari *et al.* (1997), Golam *et al.*, (2001), Ramrao (2004).

5.5.8. Straw yield per plant (g):

Production of straw yield is total biomass production efficiency of any crop (Nimje, 2010). In the present investigation, crop sown during S₁-*kharif* season (24th MW) produced significantly minimum grain yield per plant (22.39g) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S₄ (the 52th MW) date of sowing recorded significantly maximum straw yield per plant (25.38g plant⁻¹) as compared to crop sown during S₂ (48th MW) and S₃ (50th MW). Significantly maximum straw yield per plant (g) was recorded in S₂ (25.38g plant⁻¹) which was at par with date of sowing S₃-*kharif* season (48th MW).

The rice genotype Sahyadri-4 recorded significantly maximum straw yield per plant (32.87 g plant⁻¹) followed by genotype V₂ i.e. Karjat -3 (31.81 g plant⁻¹). Rice genotype V₃ i.e. Karjat -4 recorded significantly minimum straw yield per plant (19.00 g plant⁻¹) which was followed by V₃₅-Ambpandhari (20.78 g plant⁻¹). The rice crop sown S₁ i.e. *kharif* season (24th MW) with genotype V₇ i.e. Sahyadri-4 recorded significantly higher straw yield per plant (32.19 g plant⁻¹) which was at par with V₂ i.e. Karjat-3. In case of *rabi* season S₄V₂ i.e. crop sown in S₄ date of sowing (52th MW) with Karjat -3 was recorded significantly higher straw yield per plant (33.43 g plant⁻¹) which was at par with S₂V₂ i.e. crop sown in S₂ date of sowing (48th MW) and S₃V₂ i.e. crop sown in S₃ date of sowing (50th MW). Variation in straw yield in rice genotypes has also been reported by Nimje *et al.* (2010) reported production of straw yield is total biomass production efficiency of any crop. Gimhavanekar *et al.* (2020) reported variation in straw yield in different rice genotype. Significantly maximum straw yield was recorded in kalakrishna (29.92 g per plant) which was at par with Pusasugandha (29.79 g per plant) Ghansal regional (29.65 g per plant). Basmati-107 (29.53 g per plant), Kala Jeera (28.73 g per plant) Shrabanmasi (28.72 g per plant) and Parag (28.71 g per plant). Ral *et al.* (2008) reported variation in straw yield in rice genotypes. Significantly maximum straw yield was recorded in D₂-1 July Planting (5671 Kg/ha) which was at par with D₁-15 June Planting (5629 Kg/ha). Similar results reported by Hari *et al.* (1997), Singh and Jain (2000) and Golam (2001).

5.5.9. Harvest index:

Although, both the grain and straw yield are more important, grain yield is more important than straw yield and hence, it is necessary to study relationship of grain to straw. This is effectively done by computing harvest index (Nimje, 2010). Harvest index is the percentage of biological yield, represented by economic yield. Donald (1962) defined the harvest index as, “the ratio of grain weight to total dry weight of above ground parts at maturity of the crop. Partitioning of the dry matter into economic and non-economic part is interest to plant scientist,

because yield in any crop depends upon its capacity to produce dry matter and its efficient partitioning between economic and non-economic parts. Harvest index helps in knowing how much of the total dry matter is converted in to economic part. Higher this conversion, higher will be harvest index and hence, this would help in designing an ideal plant type where more portion of the total dry matter is converted in to economic parts (Nimje, 2010).

In the present investigation, crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum harvest index (39.61) as compared to other sowing dates of *rabi* season (48th MW, 50th MW, 52th MW). The rice crop sown during *rabi* season, S_3 (the 50th MW) date of sowing recorded significantly maximum harvest index which was at par with S_4 . The rice genotype V_6 i.e. Sahyadri-2 recorded significantly maximum harvest index (43.27) which was at par with variety V_2 i.e. Karjat-3 (42.94) and V_7 i.e. Sahyadri-4 (42.82). Rice genotype V_3 i.e. Karjat-4 recorded significantly minimum harvest index (36.66) which was followed by genotype V_{13} i.e. Ratnagiri-24 (38.54). The rice crop sown S_1 i.e. *kharif* season (24th MW) with genotype V_6 i.e. Sahyadri-2 recorded higher harvest index (42.17). In case of *rabi* season S_3V_6 i.e. crop sown in S_3 date of sowing (50th MW) with Sahyadri-2 was recorded significantly higher harvest index (44.25).

The varietal difference for harvest index was also reported by Kusutani *et al.* (2000) conducted the studies on the varietal differences in harvest index and morphological characteristics of rice and highlighted the contribution of high harvest index to yields and Chandrasekhar *et al.* (2001) conducted experiment on 5 rice hybrid along with a local check. Harvest index was maximum in MGR1 (57.72%) followed by KHR1 (51.09%) and lowest in NLR33358 (42.94%).

5.5.10 Correlation studies:

Correlations analysis can be used to find out mutual association between weather and its impact on grain yield of different rice genotypes.

Table91:Correlation analysis between weather parameters and grain yield of different rice genotypes

Code	Varieties	Rainfall	Rainy days	Temperature maximum	Temperature minimum	Relative humidity -1	Relative humidity -2	Wind speed	Sunshine hours
V1	Karjat-1	-0.564	-0.628	0.507	-0.638	-0.620	-0.650	-0.636	0.650
V2	Karjat-3	-0.916 **	-0.911**	0.855**	-0.848**	-0.944**	-0.917**	-0.464	0.911**
V3	Karjat-4,	-0.821*	-0.858**	0.699	-0.842*	-0.855*	-0.872*	-0.651**	0.869*
V4	Karjat-7	-0.912*	-0.940**	0.866*	-0.947*	-0.921*	-0.945*	-0.781*	0.946*
V5	Karjat-184	-0.862*	-0.894**	0.798*	-0.915*	-0.864*	-0.898*	-0.792*	0.899*
V6	Sahyadri-2	-0.849*	-0.899**	0.823*	-0.909*	-0.876*	-0.913*	-0.818*	0.916*
V7	Sahyadri-4	-0.813*	-0.865**	0.796*	-0.879*	-0.849*	-0.880*	-0.808*	0.880*
V8	Phondaghat -1	-0.817*	-0.859**	0.841*	-0.866*	-0.849*	-0.871*	-0.771**	0.872*
V9	Ratnagiri-1	-0.709*	-0.735*	0.662**	-0.657*	-0.788*	-0.759*	-0.365**	0.752*
V10	Ratnagiri-5	-0.901*	-0.916**	0.771*	-0.872*	-0.939*	-0.928*	-0.553**	0.921*
V11	Ratnagiri- 6	-0.644	-0.681	0.513	-0.653	-0.709*	-0.702	-0.476	0.693
V12	Ratnagiri- 7	-0.918*	-0.921**	0.893*	-0.939*	-0.871*	-0.909*	-0.749**	0.916*
V13	Ratnagiri -24,	-0.784*	-0.778*	0.861*	-0.777*	-0.756*	-0.769*	-0.588**	0.774*
V14	Ratnagiri-73	-0.960	-0.968**	0.928*	-0.988*	-0.935*	-0.961*	-0.796**	0.963*
V15	Ratnagiri-711	-0.763*	-0.787*	0.608**	-0.798*	-0.770*	-0.791*	-0.635**	0.788*
V16	IRRI-14	-0.792*	-0.815*	0.675**	-0.831*	-0.791*	-0.817*	-0.683**	0.816*
V17	IRRI-15	-0.869*	-0.870**	0.798*	-0.797*	-0.898*	-0.879*	-0.418**	0.877*
V18	IRRI-20	-0.868*	-0.892**	0.753*	-0.829*	-0.920*	-0.910*	-0.509	0.905*
V19	IRRI-21	-0.605	-0.635	0.462	-0.663	-0.611	-0.640	-0.591	0.637
V20	IRRI-22	-0.841*	-0.831*	0.854*	-0.799*	-0.819*	-0.824*	-0.511**	0.829*
V21	IRRI-27	0.020	0.004	-0.050	-0.053	0.046	0.008	-0.198	0.005

Code	Varieties	Rainfall	Rainy days	Temperature maximum	Temperature minimum	Relative humidity -1	Relative humidity -2	Wind speed	Sunshine hours
V22	IRRI-28	-0.287	-0.303	0.263	-0.314	-0.317	-0.311	-0.282	0.304
V23	IRRI-34	-0.811*	-0.835**	0.643	-0.777*	-0.876*	-0.854*	-0.461**	0.843*
V24	IRRI-36	-0.663	-0.709*	0.502	-0.710*	-0.702**	-0.725*	-0.601**	0.721*
V25	IRRI-47	-0.865*	-0.902**	0.761*	-0.894*	-0.902*	-0.916*	-0.712**	0.912*
V26	IRRI-52	-0.835*	-0.872**	0.706**	-0.849*	-0.878*	-0.888*	-0.640**	0.883*
V27	IRRI-53	-0.864*	-0.908**	0.831*	-0.907*	-0.893*	-0.921*	-0.774**	0.923*
V28	IRRI-55	-0.861*	-0.883**	0.763*	-0.912*	-0.850*	-0.882*	-0.774**	0.881*
V29	IRRI-62	-0.818*	-0.847**	0.700	-0.854*	-0.827*	-0.853*	-0.695**	0.852*
V30	IR-35	-0.898*	-0.898**	0.785*	-0.847*	-0.923*	-0.904*	-0.488**	0.898*
V31	Laldodaki	-0.872*	-0.868**	0.717*	-0.790*	-0.921*	-0.880*	-0.363**	0.867*
V32	IR2289-6-22-5	-0.862*	-0.864**	0.714*	-0.834*	-0.887*	-0.869*	-0.516**	0.858*
V33	Narmada	-0.812*	-0.852**	0.678	-0.820*	-0.869*	-0.872*	-0.603**	0.867*
V34	Ananda	-0.804*	-0.843**	0.674	-0.814*	-0.860*	-0.862*	-0.601**	0.856*
V35	Ambpandhari	-0.887*	-0.916**	0.786	-0.874*	-0.940*	-0.933*	-0.599**	0.927*
V36	Hira	-0.746*	-0.787*	0.630	-0.755*	-0.814*	-0.809*	-0.556**	0.800*
V37	OR-1516-1-5-A	-0.908*	-0.903**	0.747*	-0.841*	-0.927*	-0.908*	-0.437**	0.901*
V38	China	-0.966*	-0.972**	0.888*	-0.942*	-0.977*	-0.974*	-0.630**	0.971*
V39	Sorati	-0.981*	-0.989**	0.901*	-0.971*	-0.986*	-0.991*	-0.684**	0.988*
V40	Mhadi	-0.986*	-0.989**	0.929*	-0.965*	-0.987*	-0.988*	-0.659**	0.987*

The data presented in table 91 revealed that correlation between weather parameter and yield of different rice genotypes as below :

- The weather parameter maximum temperature showed significantly positive correlation with yield of 27 rice genotypes *viz*; Karjat-3, Karjat-7 Karjat-184, Sahyadri-2, Sahyadri-4, Phondaghat-1, Ratnagiri-1, Ratnagiri-5, Ratnagiri-7, Ratnagiri-24, Ratnagiri-73 , Ratnagiri-711,IRRI-14, IRRI-15, IRRI-20, IRRI-21, IRRI-22,IRRI-47, IRRI-52,IRRI-53 IR-35, IR2289-6-22-5,OR-1516-1-5A,China,Sorati and Mhadi.
- The weather parameters minimum temperature showed significantly negative correlation with yield of rice cultivars *viz*; Karjat-3, Karjat-7 Karjat-184, Sahyadri-2, Sahyadri-4, Phondaghat-1, Ratnagiri-1,Ratnagiri-5, Ratnagiri-7, Ratnagiri-24, Ratnagiri-73 , Ratnagiri-711, IRRI-14, IRRI-15, IRRI-20, IRRI-21, IRRI-22,IRRI-47, IRRI-52,IRRI-53 IR-35, IR2289-6-22-5, OR-1516-1-5A,Ananda Narmada, Ambepandhari, Hira, China, Sorati and Mhadi.
- The weather parameter morning and evening relativity humidity showed significantly negative correlation with yield of rice cultivar *viz*; Karjat-3 Karjat-4,Karjat-7 Karjat-184,Sahyadri-2, Sahyadri-4 ,Phondaghat-1,Ratnagiri-1,Ratnagiri-5, Ratnagiri-6, Ratnagiri-7, Ratnagiri-24, Ratnagiri-73, Ratnagiri-711,IRRI-14, IRRI-15, IRRI-20, IRRI-22,IRRI-34,IRRI-36,IRRI-47, IRRI-52,IRRI-53, IRRI-62, IR-35, IR2289-6-22-5,OR-1516-1-5A,China,Sorati and Mhadi.
- The weather parameter wind velocity showed significantly negative correlation with yield of rice cultivar *viz*; Karjat-184, Sahyadri-2, Sahyadri-4, Phondaghat-1, Ratnagiri-24, Ratnagiri-73IRRI-47, IRRI-53, IRRI-55.
- The weather parameter sun shine hours showed significantly positive correlation with yield of rice cultivar *viz*; Karjat-3 Karjat-4, Karjat-7 Karjat-184, Sahyadri-2, Sahyadri-4, Phondaghat-1,Ratnagiri-1, Ratnagiri-5, Ratnagiri-7, Ratnagiri-24, Ratnagiri-

73, Ratnagiri-711, IRRI-14, IRRI-15, IRRI-20, IRRI-22, IRRI-34, IRRI-36, IRRI-47, IRRI-52, IRRI-53, IRRI-62, IR-35, Laldodk, IR2289-6-22-5, OR-1516-1-5A, China, Sorati and Mhadi.

5.5.11 Stability analysis studies:

- Stability analysis data (Table 92) revealed that the varieties *vizly*; Karjat-3 and Karjat-7 which have high average grain yield across all sowing and b_i value near 1, non significant and S^2_{di} non significant are stable in all environment which exhibited b_i value more than one and non significant deviation from regression.
- The varieties *vizly*; China, Sorati and Mhadi which have high average grain yield b_i value near 1, significant and S^2_{di} non significant are stable under favourable environment
- The varieties *vizly*; Sahyadri-2 and Sahyadri-4 which have high average grain yield b_i value less than 1 and significant and S^2_{di} non significant are stable under poor environment.

Table 92 Stability parameters of different genotypes for grain yield.

Varieties	Mean	S ² Di	bi
V1-Karjat-1	13.6325	0.1799	0.049*
V2-Karjat-3	24.0817	0.0815	1.128
V3-Karjat-4,	11.3000	0.0342	0.588
V4-Karjat-7	20.5108	0.0835	0.963
V5-Karjat-184	16.4083	0.1194	0.949
V6-Sahyadri-2	23.3250	-0.1306	0.476*
V7-Sahyadri-4	25.0450	0.0234	0.574
V8-Phondaghat -1	15.8433	1.2918 ***	0.798
V9-Ratnagiri-1	18.8033	1.8184 ***	1.265
V10-Ratnagiri-5	14.7083	-0.0193	1.599*
V11-Ratnagiri- 6	14.5692	0.1261	0.441
V12-Ratnagiri- 7	18.9450	3.8811 ***	1.906
V13-Ratnagiri -24,	19.1317	9.5000 ***	0.315
V14-Ratnagiri-73	21.3992	0.3235 *	1.977
V15-Ratnagiri-711	19.0958	0.4676 *	0.777
V16-IRRI-14	16.4667	1.4101 ***	1.284
V17-IRRI-15	14.8975	0.2240	1.084
V18-IRRI-20	17.1600	-0.0473	0.835
V19-IRRI-21	16.2575	0.4351 *	0.518
V20-IRRI-22	14.5450	0.3524 *	0.822
V21-IRRI-27	17.5425	3.6467 ***	0.308
V22-IRRI-28	17.6617	-0.0604	0.698
V23-IRRI-34	16.7108	0.8337 ***	1.049
V24-IRRI-36	16.2642	0.3081 *	0.535
V25-IRRI-47	17.2558	-0.0417	0.774
V26-IRRI-52	18.0850	-0.0533	0.839
V27-IRRI-53	17.7667	-0.0554	0.756
V28-IRRI-55	15.9967	0.0423	0.767
V29-IRRI-62	16.0692	0.4323 *	0.858
V30-IR-35	15.2125	0.0574	0.983
V31-Laldodaki	14.1942	0.2552	1.172
V32-IR2289-6-22-5	14.4908	0.1533	1.162
V33-Narmada	15.4958	0.2063	0.720
V34-Ananda	15.2125	0.0357	0.677
V35-Ambpandhari	13.6067	0.4949 **	1.075
V36-Hira	15.4958	0.0773	0.605
V37-OR-1516-1-5-A	15.2125	0.2051	1.170
V38-China	20.1650	-0.0656	2.044*
V39-Sorati	20.0475	-0.1315	2.397*
V40-Mhadi	20.1042	-0.0922	2.065*

CHAPTER –VI

SUMMARY AND CONCLUSION

The field experiment entitled, “Morpho-physiological and biochemical characterization of rice (*Oryza sativa* L.) genotypes for their suitability under *rabi* environment of Konkan” was carried out at Regional Agricultural Research Station, Karjat, Dist. : Raigad with the following objectives:

1. Morphological characterization of 40 early duration rice genotypes under *kharif* and different sowing windows during *rabi* season in Konkan.
2. Physiological and biochemical characterization of 40 early duration rice genotypes under *kharif* and different sowing windows during *rabi* season.
3. Thermo and photo sensitivity response of 40 rice genotypes grown under *kharif* and different sowing windows during *rabi* season to assess correlation of weather parameters.
4. To find out physiologically efficient, high yielding and stable genotype for growing under *rabi* season.

Observations were recorded in context with morphological and phenological parameters, physiological parameters, leaf gas exchange observations, biochemical analysis, yield and yield attributes. For investigation forty rice genotypes were studied and according the finding emerged from investigation are summarized below;

1. Morphological and phenological parameters:

1. Plant height:

The rapid increase in height was observed during the period of tillering and flowering and thereafter rate of increase was slow up to

harvest. The rice genotype V₃₉ (Sorati) recorded significantly higher plant height at tillering, flowering and harvesting stages followed by variety China, Mhadi and rest of all other genotypes. Significantly lower plant height was recorded V₃₆ i.e. Hira (76.60cm) which was at par with V₃ i.e. Karjat -4 (78.74 cm) over other genotype. Interaction S₁V₃₉ (*kharif* sowing with genotype Sorati and S₃V₃₉ (50th MW sowing with genotype sorati recorded significantly higher height. Interaction S₄V₃ (sowing 52th MW with genotype Karjat-4 recorded significant less height.

2. Days to first Flowering:

Crop sown during S₁ –*kharif* season (24th MW) produced significantly maximum days to first flowering (69.98days)as compared to other sowing dates. The rice genotype Hira recorded significantly minimum (Early) days to first flowering followed by variety OR-1516-1-5-A. Rice genotype V₇ i.e. Sahyadri-4 (78.63) recorded significantly maximum (late) days to first flowering which was at par with V₁₅ i.e. Ratnagiri-711 (76.46 days) and V₆ i.e. Sahyadri-2 (76.17days).

3. Days to 50% flowering :

Crop sown during S₄ –*rabi* season (52th MW) produced significantly maximum days to 50 % flowering (83.71 days) as compared to other sowing dates. The rice genotype Hira recorded significantly minimum (Early) 59.42 days to 50% flowering followed by genotype China (67.71days). Rice genotype V₂₃ i.e. IRRI-34 (88.79 days) recorded significantly maximum (late) days to 50% flowering which was at par with V₂₅ i.e. IRRI-47 (88.29days) and V₄₀ i.e. Mhadi (87.72 days).

4. Days to physiological maturity:

Crop sown during S₁–*kharif* season (24th MW) produced significantly minimum days to physiological maturity (115.81 days)as compared to other sowing dates of *rabi* season. The rice genotype Hira and OR-1516-1-5-A recorded significantly minimum (Early) days to maturity (98.75 days) and (99.17days) followed by genotype V₁₄

i.e. Ratnagiri-73 (99.13 days) and V_{13} i.e. Ratnagiri-24 (99.31 days). Rice genotype V_{11} i.e. Ratnagiri-6 recorded significantly maximum days to maturity (122.17 days) which was at par with V_{10} i.e. Ratnagiri-5 (122.71 days), V_9 i.e. Ratnagiri-1 (120.71 days), V_{31} i.e. Laldodki (122.13 days) and V_{32} i.e. IR2289-6-22-5 (122.29 days). Interaction S_1V_{10} (*kharif* sowing) with genotype Ratnagiri -5 and *rabi* S_3V_{10} (sowing 50th MW) with genotype Ratnagiri-5 recorded significantly higher days to maturity over others. Similarly S_1V_{36} (*kharif* sowing) with genotype Hira recorded significantly less days maturity.

2. Physiological Parameters:

1. Total chlorophyll content (mg/g) :

The data indicated that, the total chlorophyll content (mg/g) increased with increase in age of the crop up to flowering stage, thereafter, it decreased. At flowering stage, significantly maximum chlorophyll content was recorded in V_{13} (4.21 mg/g) which was followed by V_8 (4.15 mg/g) and V_{40} (4.13 mg/g). However the sowing dates S_3 recorded maximum total chlorophyll content (3.99 mg/g) over S_2 and S_4 . Interaction S_1V_{13} (*kharif* sowing) genotype Phondaghat-1 for *rabi* S_2V_{13} (sowing 50th MW) with genotype Ratnagiri-24 showed significantly higher chlorophyll content.

2. Chlorophyll stability index:

The chlorophyll stability index progressively increased with the advancing age of the crop, up to flowering stage, there after decreased. There was non significant difference in the chlorophyll stability index at tillering, flowering and harvesting stage. At flowering stage, maximum chlorophyll stability index was recorded maximum chlorophyll stability index was recorded in V_8 i.e. Phondaghat- 1 (1.095 mg/g) which was followed by V_{28} i.e. IRRI-55 (1.093 mg/g), V_{32} i.e. IR2289-6-22-5 (1.093 mg/g), V_{21} i.e. IRRI-27 (1.092 mg/g). Interaction S_1V_1 , S_1V_2 , S_1V_{15} , S_2V_{15} recorded significantly higher chlorophyll stability index (CSI) over others.

3. Leaf water potential(bar):

At tillering stage, maximum leaf water potential (bar) was recorded in V₁₄ i.e. Ratnagiri- 73 (1.40 bar) which was at par with V₉-Ratnagiri-1(1.18 bar), V₁₀-Ratnagiri-5(1.20 bar), V₂₄-Ratnagiri-24(1.32bar). At flowering stage, maximum leaf water potential (bar) was recorded in V₉ i.e. Ratnagiri-1(6.66 bar), which was at par with V₂ i.e.Karjat-3, V₃ i.e. Karjat-4V₅ i.e.Karjat-184, V₁₀ i.e.Ratnagiri-5, V₁₁i.e. Ratnagiri-6, V₁₄ i.e.Ratnagiri-73 and over other. At harvesting stage, maximum leaf water potential was recorded in V₁₉ i.e. IRRI-21 (-1.68 bar) and V₂₄ i.e. IRRI-36 (-1.68 bar) which was at par with all genotypes.

4.Absolute growth rate (AGR)g/day):

There was significant difference in the absolute growth rate (AGR) g/day at tillering, flowering and harvesting stage .There was continuous increased in AGR from tillering to harvesting stage. At harvesting stage, the rice variety V₂ i.e. Karjat-3 recorded maximum absolute growth rate (AGR) 1.2373 g/day which was at par with V₄ i.e. V₈-Karjat-184,V₁₄-Ratnagiri -73, V₂₂-IRRI-28, V₂₃- IRRI -34, V₃₆- Hira over others varieties. Interaction S₁V₄ (*kharif* sowing with genotype Karjat-7) and for *rabi* S₂V₃₆(*kharif* sowing 48th MW with genotype Hira) recorded significantly higher absolute growth rate (AGR) over other.

5. Relative growth rate (RGR):

There was non significant difference in the relative growth rate (RGR)g/g/day at tillering, flowering and harvesting stage. At harvesting stage, the rice variety V₆ i.e. Sahyadri-2 recorded maximum relative growth rate (RGR) 0.0237 g/g/day which was at par with with V₁-Karjat-1, V₂-Karjat-3, V₃-Karjat-4, V₅-Karjat-184, V₆-Sahyadri-2, V₇-Sahyadri-4, V₉-Ratnagiri-1, V₁₀-Ratnagiri-5, V₁₁-Ratnagiri-6, V₁₂-Ratnagiri-7, V₁₄-Ratnagiri-73, V₁₅-Ratnagiri-711,V₁₇ - IRRI-15, V₁₈-IRRI-20, V₁₉-IRRI-21, V₂₁-IRRI-27, V₂₂-IRRI-28, V₂₃-IRRI-34, V₂₄-IRRI-36, V₂₅ - IRRI-47, V₂₆-IRRI-52, V₂₉-IRRI-62, V₃₀-IR-35, V₃₂-IR-2289-6-22-5, V₃₄-Ananda, V₃₅-Ambpandhari, V₃₆-Hira,V₃₇-OR-15-15-1-5-A, V₃₈-China,

V₃₉-Sorati, V₄₀-Mhadi. Interaction S₁V₂₅ and for *rabi* S₄V₁₂ (sowing 52th MW with genotype Ratnagiri-7) recorded significantly higher relative growth rate (RGR) over others.

6. Net assimilation rate (NAR) (g⁻¹dm⁻²day):

There was significant difference in the net assimilation rate (NAR) g⁻¹dm⁻²day at tillering, flowering and harvesting stage. At flowering stage, the rice genotype V₁₄ i.e. Ratnagiri -73 recorded maximum net assimilation rate. (NAR) 0.0322 g⁻¹dm⁻²day which was at par with V₁₆ i.e. IRRI-14, V₂₈ i.e. IRRI-55 and over others varieties. At harvesting stage, the rice genotype V₈ i.e. Phondaghat-1 recorded maximum net assimilation rate. (NAR) 0.0790 g⁻¹dm⁻²day which was at par with V₁₄ i.e. Ratnagiri -73 and V₃₉ i.e. Sorati over others varieties. Interaction S₁V₈ (*kharif* sowing) with genotype Phondaghat-1 and for *rabi* S₃V₁ (*kharif* sowing 50th MW with genotype Karjat-1) recorded significantly higher net assimilation rate. (NAR) over others.

7. Leaf area index. (LAI):

There was significant difference in LAI during 2020 year and pooled mean at harvesting stage. At harvesting stage, maximum LAI was recorded in V₂₁ i.e. IRRI-27 (4.619) which was at par with V₉ i.e. Ratnagiri -1, V₁₀ i.e. Ratnagiri -5, V₁₆ i.e. IRRI-14, V₁₇ i.e. IRRI-15, V₁₉ i.e. IRRI-21, V₂₀ i.e. IRRI-22, V₂₁ i.e. IRRI-27, V₂₂ i.e. IRRI-28, V₂₆ i.e. V₃₂ i.e. IRRI-52, V₃₆ i.e. Hira and over others at pooled mean.

8. Growing degree days (° days):

Crop sown during S₁ -*kharif* season (24th MW) produced significantly maximum growing degree days (1268 °days) as compared to other sowing dates of *rabi* season. The rice genotype V₁₅ i.e. Ratnagiri-711 recorded significantly maximum growing degree days (1471.3 ° days) at first flowering stage which was at par with variety V₆ i.e. Sahyadri-2, V₇ i.e. Sahyadri-4 and V₃₅ i.e. Ambepandhari over rest genotypes. Rice

genotype V₃₆ i.e. Hira (928.4 °days) recorded significantly minimum growing degree days (° days) at first flowering stage during pooled mean

9. Photo-thermal units (°hr):

Crop sown during S₁ –*kharif* season (24th MW) produced significantly maximum photo-thermal units (15956.4 °hr) as compared to other sowing dates of *rabi* season. The rice genotype V₁₉ i.e. IRRI-21 recorded significantly maximum photo-thermal units (15334.5 °hr) at first flowering stage which at par with genotype V₃₅ i.e. Ambepandhari (15326.3 °hr) over others. Rice genotype V₃₆ i.e. Hira (9025.5 °hr) recorded significantly minimum photo-thermal units (°hr) at first flowering stage.

10. Helio thermal unit(°hr):

Crop sown during S₁ –*kharif* season (24th MW) produced significantly minimum helio thermal unit (°hr) as compared to other sowing dates of *rabi* season. The rice genotype V₁₉ i.e. IRRI-21 recorded significantly maximum helio thermal unit (7606.7° hr) at first flowering stage which was at par with genotype V₆ i.e. Sahyadri-2, V₇ i.e. Sahyadri-4, V₁₃ i.e. Ratnagiri-24, V₁₅ i.e. Ratnagiri-711, V₃₅ i.e. Ambepandhari over others genotypes. Rice genotype V₃₆ i.e. Hira recorded significantly minimum helio thermal unit (4312.7°hr) at first flowering stage.

11. Phenothermal index:

Crop sown during S₁ –*kharif* season (24th MW) produced 17.409 phenothermal index from sowing to 50% flowering stage as compared to other sowing dates of *rabi* season. The rice genotype V₃ i.e. Karjat-4 recorded significantly maximum phenothermal index (18.192) from sowing to 50% flowering stage which was at par with V₁ superior over the other genotypes. Rice genotype V₃₉ i.e. Sorati (13.855) recorded significantly minimum phenothermal index from sowing to 50% flowering stage during pooled mean.

3. Leaf gas exchange observations:

1. Rate of photosynthesis ($\mu\text{mol CO}_2\text{m}^{-2}\text{sec}^{-1}$):

At tillering stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum rate of photosynthesis ($13.34 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) as compared to other sowing dates of *rabi* season. At harvesting stage, the rice genotype V₆ i.e. Sahyadri-2 recorded significantly higher rate of photosynthesis ($19.25 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) which was at par with V₇ i.e. Sahyadri-4 ($18.35 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) and V₁₄ i.e. Ratnagiri-73 ($18.32 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) and over others. Significantly lower rate of photosynthesis was recorded V₁ i.e. Karjat-1 and V₁₆ i.e. IRRI-14 ($14.90 \mu\text{molCO}_2\text{m}^{-2}\text{sec}^{-1}$) which was at par with V₁, V₄, V₁₀, V₁₃, V₁₆, V₁₉, V₂₂, V₂₃, V₂₄, V₂₇, V₂₈, V₃₆ and over others. Interaction S₁V₆ (*kharif* sowing with genotype Sahyadri-2) and *rabi*S₃V₆ (sowing 50th MW with genotype Sahyadri-2) showed higher rate of photosynthesis over others.

2. Leaf transpiration rate ($\mu\text{mol H}_2\text{O m}^{-2} \text{sec}^{-1}$):

Crop sown during *kharif* season i.e. S₁(24th MW) produced significantly minimum rate of leaf transpiration $3.78 \mu\text{mol H}_2\text{O m}^{-2} \text{sec}^{-1}$ as compared to other sowing dates of *rabi* season. The rice genotype V₉ i.e. Ratnagiri-1 recorded significantly higher leaf transpiration rate $6.19 \mu\text{mol H}_2\text{O m}^{-2} \text{sec}^{-1}$ at harvesting stage which was superior over other treatment combination. Significantly lower leaf transpiration rate was recorded V₁ i.e. Karjat-1 ($2.40 \mu\text{mol H}_2\text{O m}^{-2} \text{sec}^{-1}$). Interaction S₄V₄ (sowing 52th MW with genotype Karjat-7) recorded lowest transpiration over others.

3. Stomatal conductance ($\text{molH}_2\text{Om}^{-2}\text{s}^{-1}$):

At tillering stage, crop sown during *kharif* season i.e. S₁ (24th MW) produced significantly minimum stomatal conductance $0.161 \text{molH}_2\text{Om}^{-2} \text{s}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW) during pooled mean. At harvesting stage, crop sown during *Kharif* season i.e. S₁ (24th MW) produced significantly

minimum stomatal conductance $0.269 \text{ molH}_2\text{O m}^{-2}\text{s}^{-1}$ as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW), S₄ (52th MW) during pooled mean. At harvesting stage, the rice genotype V₃₇ i.e. OR-1516-1-5 A recorded significantly higher stomatal conductance ($0.345 \text{ molH}_2\text{O m}^{-2}\text{s}^{-1}$) which was at par with V₂, V₃, V₄, V₁₁, V₁₇, V₁₈, V₁₉, V₂₀, V₂₅, V₂₆, V₃₀, V₃₁, V₃₃, V₃₅, V₃₇, V₃₈, V₃₉, V₄₀ and over others. Interaction S₁V₂₄ and for *rabi* S₄V₃₇ recorded higher stomatal conductance.

4. Leaf canopy temperature :

At tillering stage, crop sown during *Kharif* season i.e. S₁ (24th MW) produced significantly minimum leaf canopy temperature (34.368 °C) as compared to other sowing dates of *rabi* season. At harvesting stage, crop sown during *Kharif* season i.e. S₁ (24th MW) produced significantly minimum leaf canopy temperature (36.795 °C) as compared to other sowing dates of *rabi* season i.e. S₂ (48th MW), S₃ (50th MW) and S₄ (52th MW) during pooled mean. At harvesting stage, the rice variety V₁₅ i.e. Ratnagiri-711 recorded significantly higher leaf canopy temperature (38.487 °C) which was superior over others. Significantly lower leaf canopy temperature was recorded V₂₉ i.e. IRRI-62 (36.986 °C). Interaction S₂V₃₃ (sowing 48th MW with genotype Narmada recorded lowest leaf canopy temperature over others).

4. Biochemical Analysis:

1. Carbohydrate content:

Crop sown during S₁ -*kharif* season (24th MW) produced significantly minimum carbohydrate content (78.68 %) as compared to other sowing dates of *rabi* season. Rice genotype V₇ i.e. Sahyadri-4 recorded significantly maximum carbohydrate content (83.23 %) which was superior over other varieties during pooled mean. The rice variety Ratnagiri -24 recorded significantly minimum carbohydrate content (73.89 %) which was followed by V₁₁ i.e. Ratnagiri-6 (78.22 %).

2. Protein content (%):

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum protein content (5.75 %)as compared to other sowing dates of *rabi* season. Rice genotype V_{28} i.e. IRRI-53 recorded significantly maximum protein content (7.09%) which was at par with V_{35} i.e. Ambpandhari (7.04%) pooled mean and over others. The rice genotype Ratnagiri-711 recorded significantly minimum protein content (5.20%) which was at par with Sahyadri-2(5.23%).

3. Nitrate reductase activity (μmolg^{-1}):

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum nitrate reductase activity 1.562 $\mu\text{mol g}^{-1}$ and 1.923 $\mu\text{mol g}^{-1}$ at tillering and flowering stage respectively compared to other sowing dates of *rabi* season. At flowering stage, rice variety V_2 -Karjat-3 recorded significantly maximum nitrate reductase activity (2.674 μmolg^{-1}) which was followed by variety V_6 i.e. Sahyadri-2 (2.661 μmolg^{-1}), V_7 -Sahyadri-4 (2.658 μmolg^{-1}), V_{39} —Sorati (2.614 μmolg^{-1}), V_{40} -Mhadi (2.606 μmolg^{-1}) during pooled mean and over others.

4. Amylose content (%) :

Crop sown during S_1 -*kharif* season (24th MW) produced significantly maximum amylose content (22.46 %) as compared to other sowing dates of *rabi* season. The rice genotype Karjat -7 recorded significantly maximum amylose content (24.59%) followed by variety IRRI-34 (24.50%) and IRRI-62 (24.35 %). Rice genotype V_7 i.e. Sahyadri-4 (19.) recorded significantly minimum amylose content (19.38.%) which was followed by V_6 i.e. Sahyadri-2 (19.91 %.) during pooled mean

5. Iron content (ppm):

Crop sown during S_1 -*kharif* season (24th MW) produced significantly maximum iron content (8.68ppm) as compared to other sowing dates of *rabi* season. The rice genotype V_{31} -Laldodaki recorded significantly minimum iron content (5.17ppm). Rice genotype V_3 -Karjat-

4 recorded significantly maximum iron content (20.93ppm) which was followed by V₁₂ i.e. Ratnagiri-7 (15.56ppm) and V₃₈ i.e. Sorati (11.68ppm) during pooled mean

6. Zinc content (ppm):

Crop sown during S₁ -*kharif* season (24th MW) produced significantly maximum iron content (13.1ppm) as compared to other sowing dates of *rabi* season. The rice genotype V₁₁ i.e. Ratnagiri-6 recorded significantly maximum zinc content (20.3 ppm) followed by variety V₃₄ i.e. Ananda (18.9) and V₁₂ i.e. Ratnagiri-7(17.3ppm) during pooled mean and over others. The rice genotype V₂₅ i.e. IRRI-47 recorded significantly minimum zinc content (7.9ppm) followed by V₃ i.e. Karjat-4(9.7ppm).

5. Yield and yield attributes:

1. Number of tillers per plant:

Crop sown during S₁ -*kharif* season (24th MW) produced significantly minimum number of tillers per plant (8.04)as compared to other sowing dates of *rabi* season. The rice genotype V₇ i.e. Sahyadri-4 recorded significantly maximum number of tillers per plant (11) which was at par with V₆ i.e.Sahyadri-2 (10.75), V₁₉ i.e.IRRI-21 (10.42) and V₄₀ i.e. Mhadi (10.42) over others. Rice genotype V₃₀ i.e. IR-35 recorded significantly minimum number of tillers per plant (8.29) which was at par with V₃₆ i.e. Hira (8.63) over others. In *kharif* interaction S₁V₂₃ and *rabi* S₂V₇ and S₃V₇ recorded higher number of tillers per plant.

2. Total no. of panicles per plant:

Crop sown during S₁-*kharif* season (24th MW) produced significantly minimum total number of panicles per plant as compared to other sowing dates of *rabi* season. The total number of panicles per plant of rice was influenced significantly due to the different genotypes during both year and pooled mean. The rice genotype Karjat-3 recorded significantly maximum total number of panicles per plant (10.8) which

was superior over all other genotypes during pooled mean. For *kharif* S₁V₂ (*kharif* sowing with genotype Karjat-3) and for *rabi* S₂V₂ (sowing 48th MW with genotype Karjat-7) recorded higher panicles per plant.

3. Panicle length (cm):

Crop sown during S₁ –*kharif* season (24th MW) showed maximum panicle length (21.62cm) as compared to other sowing dates of *rabi* season. The rice genotype V₂₃ i.e. IRRI-34 recorded significantly maximum panicle length (24.15 cm) which was at par with V₆ i.e. Sahyadri-2, V₇ i.e. Sahyadri-4, V₂₀ i.e. IRRI-22, V₂₉ i.e. IRRI-62, V₃₀ i.e. IR-35, V₃₁ i.e. Laldadki and V₃₄ i.e. Ananda during pooled mean. For *kharif* interaction S₁V₂₂ and for *rabi* S₃V₂₀ recorded significantly higher panicle length over others.

4. Total number of spikelet per panicle:

Crop sown during S₁ –*kharif* season (24th MW) produced significantly minimum total number of spikelet per panicle (183.85) as compared to other sowing dates. The total number of spikelet per panicle of rice was influenced significantly due to the different varieties during both year and pooled mean (Table 75). The rice variety V₁₁ i.e. Ratnagiri-6 and V₁₂ i.e. Ratnagiri-7, recorded significantly maximum total number of spikelet per panicle (243) which was at par with V₂ i.e. Karjat-3 (239) and V₁₆ i.e. IRRI-14(235) for pooled mean. For *kharif* interaction S₁V₁₄ and *rabi* S₂V₁₂ (Sowing 48th MW with genotype Ratnagiri -7 recorded significantly higher spikelet per panicle over others

5. No. of filled spikelet per panicle:

Crop sown during S₁ –*kharif* season (24th MW) produced significantly minimum total number of filled spikelet per panicle (159.10) as compared to other sowing dates of *rabi* season. The number of filled spikelet per panicle of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 77). The rice genotype V₁₂ i.e. Ratnagiri-6 recorded significantly maximum

number of filled spikelet per panicle (229.80) which was at par with V₂ i.e. Karjat-3 over others for pooled mean. For interaction S₁V₁₂ (*kharif* sowing genotype Karjat-3 and *rabi* S₃V₁₁ (Sowing 50th MW with genotype Ratnagiri -7 recorded significantly higher filled spikelet per panicle over others.

6. 1000 grain weight (g):

Crop sown during S₁ -*kharif* season (24th MW) produced significantly maximum 1000 grain weight (20.86 gm) as compared to other sowing dates. The 1000 grain weight of rice was influenced significantly due to the different genotypes during both year and pooled mean (Table 77). The rice genotype V₉ i.e. Ratnagiri-1 recorded significantly maximum 1000 grain weight (25.13 gm) which was at par with V₂₆ i.e. IRRI-52. Rice genotype V₄ i.e. Karjat-4 recorded significantly minimum 1000 grain weight (10.06 gm) during pooled mean. Interaction S₁V₂₂ *kharif* sowing with genotype IRRI-28 and *rabi* S₃V₉ (sowing 50th MW with genotype Ratnagiri-1) recorded significantly test weight over others.

7. Grain yield per plant (g):

Crop sown during S₁-*kharif* season (24th MW) produced significantly minimum grain yield (14.76 g) as compared to other sowing dates. The rice crop sown during *rabi* season, S₃ (the 50th MW) date of sowing recorded significantly maximum grain yield per plant (17.91g) which was at par with S₂ and S₄ over others. The grain yield per plant (g) of rice was influenced significantly due to the different genotypes during both year and pooled mean. The rice genotype V₇ i.e. Sahyadri-4 recorded significantly maximum grain yield per plant (24.62 g) which was at par with genotype V₂ i.e. Karjat-3 (23.93 g) over other varieties. Interaction S₁V₇ (*kharif* sowing with genotype Sahyadri-4 and for *rabi* S₄V₇ at par with S₂V₇ recorded significantly higher yield per plant.

8. Straw yield per plant (g)

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum straw yield per plant (22.39g) as compared to other sowing dates. The straw yield per plant (g) of rice was influenced significantly due to the different varieties during both year and pooled mean. The rice genotype Sahyadri-4 recorded significantly maximum straw yield per plant (32.87 g plant⁻¹) followed by variety V_2 i.e. Karjat - 3 (31.81 g plant⁻¹) and V_6 i.e. Sahyadri-2 (30.22 g plant⁻¹). Rice genotype V_3 i.e. Karjat -4 recorded significantly minimum straw yield per plant (19.00 g plant⁻¹) which was followed by V_{35} -Ambpandhari (20.78 g plant⁻¹) during pooled mean. Interaction S_1V_7 (*kharif* sowing with genotype Sahyadri-4) and for *rabi* S_4V_2 (sowing 52th MW with genotype Karjat-3) recorded significantly higher straw yield per plant which was at par with S_2V_7 , S_3V_7 , S_4V_7 .

9. Harvest index:

Crop sown during S_1 -*kharif* season (24th MW) produced significantly minimum harvest index (39.61) as compared to other sowing dates. The rice crop sown during *rabi* season, S_3 (the 50th MW) date of sowing recorded significantly maximum harvest index which was at par with S_4 over others. The rice variety V_6 i.e. Sahyadri-2 recorded significantly maximum harvest index (43.27) which was at par with variety V_2 i.e. Karjat-3 (42.94) and V_7 i.e. Sahyadri-4 (42.82). Rice variety V_3 i.e. Karjat-4 recorded significantly minimum harvest index (36.66) which was followed by genotype V_{13} i.e. Ratnagiri-24 (38.54) during pooled mean. Interaction S_1V_6 (*kharif* sowing with genotype Sahyadri -2) and for *rabi* S_3V_6 (sowing 50th MW with genotype Sahyadri-2) recorded significantly higher harvest index over others.

CONCLUSION:

On the basis of the results obtained in the present investigation, the following broad conclusions can be drawn.

- The rice genotype Sorati recorded higher plant height where as variety Hira and Karjat-4 recorded lower plant height. Sowing 50th meteorological week with genotype Sorati recorded higher height whereas sowing 52th meteorological week with genotype Karjat-4 recorded less height. Rice genotype Hira and OR-1516-1-5-A showed significantly minimum day to maturity whereas Ratnagiri-6 and Ratnagiri-1 recorded maximum days to maturity. Sowing 50th meteorological week with genotype Ratnagiri-5 recorded higher days to maturity where as *kharif* sowing with genotype Hira recorded less days to maturity. Ratnagiri-5 and Ratgiri-1 recorded maximum days to maturity.
- Rice genotype Ratnagiri-24 recorded higher total chlorophyll followed by Phondaghat-1. Sowing 50th meteorological week with genotype Ratnagiri-24 showed higher chlorophyll. The CSI was higher in Phondaghat-1.
- Genotype Karjat -3 recorded higher AGR whereas Sahyadri-2 recorded higher RGR and Phondaghat-1 recorded higher NAR. Sowing 48th meteorological week with variety Hira recorded higher AGR and sowing 52th meteorological week with genotype Ratnagiri-7 recorded higher RGR and sowing 50th meteorological week with genotype Karjat-1 recorded higher NAR than other varieties.
- Higher GDD were recorded in Ratnagiri-711, heliothermal units in IRRI-21 and photothermal units in Karjat-4.
- Rice genotype Sahyadri-2 recorded higher rate of photosynthesis followed by Sahyadri-4. Sowing 50th meteorological week with genotype Sahyadri-2 showed higher rate of photosynthesis. Higher rate of transpiration was recorded in Ratnagiri-1 and lower in Karjat-1. Sowing 52th meteorological week with genotype Karjat-7 recorded lower rate of transpiration. Higher stomatal conductance was recorded in genotype OR-1516-1-5-A.

- Rice genotype Sahyadri-4 recorded maximum number of tillers followed by Sahyadri-2 IRRI-21, Mhadi. Sowing 48th or 50th meteorological week with genotype Sahyadri-4 exhibited higher number of tillers. Higher panicle length was recorded in genotype IRRI-34 followed by Sahyadri-2, Sahyadri-4 over others. Rice genotype Ratnagiri-6 recorded higher number of filled spikelet/panicle followed by Karjat-3. Rice genotype Sahyadri-4 recorded higher yield / plant followed by Karjat-3. Sowing 52th meteorological week with genotype Sahyadri-4 produced higher yield followed by sowing 48th meteorological week sowing and 50th meteorological week sowing of above genotypes. Rice genotypes Sahyadri-2, Sahyadri-4 and Karjat-3 recorded higher harvest index than others.
- The weather parameters maximum temperature and sunshine hours showed significantly positive and minimum temperature humidity and wind velocity showed significantly negative correlation with yield of rice genotype *viz*; Karjat-3, Karjat-7, Sahyadri-2, Sahyadri-4, Ratnagiri-5, Ratnagiri-7, Ratnagiri-24, IRRI-25, Sorati and Mhadi.
- Rice genotype Karjat-3 and Karjat-7 was found stable for yield in all environment whereas Sorati, Mhadi and China was found stable under favourable environment and Sahyadri-2 and Sahyadri-4 was found stable under poor environment.

Future prospects:

Based on the outcome of present investigation, the following future strategies would be decided.

- For breeding programme, the stable rice genotypes *vizly.*, Karjat-3 and Karjat-7 should be taken on the basis of yield and quality characters for hybridization programme.
- Stable rice genotypes can be used as a potential breeding material in the future rice programme.

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DEPARTMENT OF AGRIL BOTANY
COLLEGE OF AGRICULTURE,DAPOLI
DR. BALASAHEB SAWANT KONKAN KRISHI VIDIYAPEETH DAPOLI
DIST. RATNAGIRI (M.S.) – 415712

Name of the student : **Mrs. Minakshi Hemchandra Keluskar**

Registration number : ADPD/19/0314

Discipline : Plant Physiology

Degree : Ph.D. (Ag) Scholar

Research guide : Dr. A. V. Mane
Deputy Director of Research (Seed) ,
Dr.Balasaheb Sawant Konkan Krishi
Vidhyapeeth, Dapoli, Dist-Ratnagiri -415712

Title of research work : Morpho-physiological and biochemical
characterization of rice (*Oryza sativa* L.)
genotypes for their suitability under *rabi*
environment of Konkan

ABSTRACT

The present investigation entitled, “Morpho-physiological and biochemical characterization of rice (*Oryza sativa* L.) genotypes for their suitability under *rabi* environment of Konkan” was carried at Regional Agricultural Research Station, Karjat, Dist-Raigad (MH) during *kharif* - 2020,*kharif*-2021, *rabi*-20-21and *rabi*-21-22. The experiment was laid out with early duration rice germplasms in Split Plot Design with three replications to study morphological, physiological, biochemical characterization, thermo and photo sensitivity response of 40 early duration rice genotypes under *kharif* and different sowing windows during *rabi* season in Konkan and also to assess correlation of weather parameters with grain yield and to find out physiologically efficient, high yielding and stable genotypes for *rabi* season

The results revealed that Hira and OR-1516-1-5-A showed the shortest days to maturity, while Ratnagiri-6 and Ratnagiri-1 required the longest time. Sowing in the 50th meteorological week with Ratnagiri-5 resulted in a longer maturity period, whereas *kharif* sowing with Hira

resulted in a shorter duration. Ratnagiri-5 and Ratnagiri-1 required the most extended time to mature

Karjat-3 had a higher average growth rate, Sahyadri-2 displayed a higher relative growth rate, and Phondaghat-1 demonstrated a higher net assimilation rate. Sowing in the 48th meteorological week with Hira resulted in a higher average growth rate, sowing in the 52th meteorological week with Ratnagiri-7 led to a higher relative growth rate, and sowing in the 50th meteorological week with Karjat-1 yielded a higher net assimilation rate

Ratnagiri-711 recorded the highest growing degree days. Ratnagiri-711 recorded significantly maximum growing degree days (1471.3° days) at first flowering stage which was at par with genotype Sahyadri-2, Sahyadri-4 and Ambepandhari over rest genotypes. Karjat-4 recorded significantly maximum phenothermal index (18.192) from sowing to 50% flowering stage which was at par with Karjat-1 superior over the other genotype. IRRI-21 recorded the highest heliothermal units, and Karjat-4 recorded the highest photothermal units. Sahyadri-2 exhibited the highest rate of photosynthesis, followed by Sahyadri-4. At harvesting stage, the rice genotype Sahyadri-2 recorded significantly higher rate of photosynthesis (19.25 $\mu\text{molCO}_2/\text{m}^2/\text{sec}$) which was at par with Sahyadri-4 (18.35 $\mu\text{molCO}_2/\text{m}^2/\text{sec}$) and Ratnagiri-73 (18.32 $\mu\text{molCO}_2/\text{m}^2/\text{sec}$) over others. Sowing in the 50th meteorological week with Sahyadri-2 showed the highest photosynthetic rate. Ratnagiri-1 had the highest rate of transpiration, while Karjat-1 had the lowest. Sowing in the 52nd meteorological week with Karjat-7 resulted in a lower rate of transpiration. OR-1516-1-5-A exhibited higher stomatal conductance

Sahyadri-4 had the highest number of tillers, followed by Sahyadri-2, IRRI-21, and Mhadi. Sowing in the 48th or 50th meteorological week with Sahyadri-4 resulted in a higher number of tillers. IRRI-34 exhibited the longest panicle length, followed by Sahyadri-2 and Sahyadri-4. Ratnagiri-6 had the highest number of filled spikelets per panicle, followed by Karjat-3. Sahyadri-4 had the highest yield per plant, followed by Karjat-3. Sowing in the 52th meteorological week with Sahyadri-4 resulted in the highest yield, followed by sowing in the 48th and 50th meteorological weeks. Sahyadri-4 recorded significantly maximum grain yield per plant (24.62 g) which was at par with genotype Karjat-3 (23.93g) over other genotypes. *Kharif* season

(24th MW) with Sahyadri-4 recorded significantly higher grain yield per plant (22.86 g) which was superior over other treatment combinations during pooled mean. The weather parameters maximum temperature and sunshine hours showed significantly positive and minimum temperature humidity and wind velocity showed significantly negative correlation with yield of rice genotype *viz*; Karjat-3, Karjat-7, Sahyadri-2, Sahyadri-4, Ratnagiri-5, Ratnagiri-7, Ratnagiri-24, IRRI-25, Sorati and Mhadi. Karjat-3 and Karjat-7 was found stable for yield in all environment whereas Sorati, Mhadi and China was found stable under favourable environment and Sahyadri-2 and Sahyadri-4 was found stable under unfavourable environment.

APPENDIX-I

The meteorological observation during experimental during experimental period were recorded at observatory of the RARS,Karjat (*Kharif- 2020*).

Week No.	Period	Rainfall (mm)	Rain y Days	Temperature (° C)		Humidity (%)		Wind velocity (km/h)	Sun shine (Hrs)
				Max.	Min.	I	II		
24	11 June - 17 June	202	7	32.4	24.55	88.1	73.7	3.3	1
25	18 June - 24 June	42.2	3	32.35	24.9	88.6	74.4	5.2	2.2
26	25 June - 1 July	25.8	3	33.6	25.7	86.7	67.4	4.2	3.4
27	2 July - 8 July	336.8	7	30.35	23.95	86.6	85.9	6.8	0.7
28	9 July - 15 July	123.2	7	30.7	24.4	91.4	88.7	4.8	0.7
29	16 July - 22 July	120.5	5	30.75	24.5	88.1	82.1	3	2.4
30	23 July - 29 July	67.8	5	30.2	24.7	92.1	78.3	3.2	1.8
31	30 July - 5 Aug.	149.8	3	30.7	24.45	91.4	76	5.1	4.3
32	6 Aug. - 12 Aug.	346.8	7	29	24.1	91	88.9	6.1	0.5
33	13 Aug. - 20 Aug.	452.4	7	27.9	23.9	95.4	90	5.2	0
34	20 Aug. - 26 Aug.	213	7	28.95	24	91.1	83.4	4.7	1.2
35	27 Aug. - 2 Sept.	312	6	29.2	23	93.7	84.6	3.1	2.6
36	3 Sept. - 9 Sept.	48.9	5	33.95	23.5	93	69.4	1.7	5.4
37	10 Sept. - 16 Sept.	83.4	5	31.5	23.3	92.1	80.6	2.5	2.2
38	17 Sept. - 23 Sept.	156	5	29.75	23.1	93.4	86.4	2	0.3
39	24 Sept. - 30 Sept.	33.4	2	31	22.75	91	72.3	1.9	5
40	1 Oct. - 7 Oct.	5.2	1	32.1	22.9	93.6	69.1	1.8	4.6
41	8 Oct. - 14 Oct.	20	2	32.45	23.55	93.6	70.9	1.8	2
42	15 Oct. - 21 Oct.	132.2	2	31.9	23.7	88.3	72.3	2.1	4.3
43	22 Oct. - 28 Oct.	67.8	1	33.9	21.9	91.7	54.3	1.9	6.9
44	29 Oct. - 4 Nov..	0	0	35.05	18.9	91.1	38.6	1.2	8.1

APPENDIX-II

The meteorological observation during experimental during experimental period were recorded at observatory of the RARS, Karjat (*Kharif- 2021*).

Week No.	Period	Rainfall (mm)	Rainy Days	Temperature (° c)		Humidity (%)		Sun shine (Hrs)	Wind Speed (km/h)
				Max.	Min.	I	II		
24	11 June - 17 June	185.2	7	29.15	24.45	93	84	3.3	0.7
25	18 June - 24 June	319.9	7	29.65	23.5	89.6	82.3	3.4	0.5
26	25 June - 1 July	93.3	5	30.65	24.55	90.4	77.9	2.7	1.7
27	2 July - 8 July	15.2	2	31.7	25.15	88.6	73.1	3.2	4.9
28	9 July - 15 July	229.4	5	29.45	23.45	90.9	83.7	2.6	0.3
29	16 July - 22 July	914.2	7	28.35	22.9	93.3	95.1	3.8	0.2
30	23 July - 29 July	422.5	7	28.45	24.3	93.1	86.4	5.2	0.3
31	30 July - 5 Aug.	168.2	7	29.55	24.1	91.1	82.1	5	2.2
32	6 Aug. - 12 Aug.	28.6	4	31.05	23.85	89.7	75	2.2	2.8
33	13 Aug. - 20 Aug.	117.6	6	28.4	22.9	95.3	82	1.2	0.6
34	20 Aug. - 26 Aug.	73.8	3	30.1	23.4	92.1	78.1	1.2	3.4
35	27 Aug. - 2 Sept.	128.2	4	29.5	23.2	93.6	80.3	2	3
36	3 Sept. - 9 Sept.	200	7	29.95	23.9	90.6	83.7	2.7	1.4
37	10 Sept. - 16 Sept.	242.6	7	29.65	24	91.3	86.9	4.4	1.1
38	17 Sept. - 23 Sept.	158.2	6	30.6	23.6	94.7	82.4	2.2	2.3
39	24 Sept. - 30 Sept.	123.6	4	30.3	23.6	90.6	79.3	1.8	1.9
40	1 Oct. - 7 Oct.	84.6	2	32.4	23.6	92.4	70.9	1.2	5.9
41	8 Oct. - 14 Oct.	123	5	32.55	23	94.7	68.7	1.2	5.9
42	15 Oct. - 21 Oct.	0	0	32.6	22.3	92.6	61.4	1.1	6.9
43	22 Oct. - 28 Oct.	0	0	34	20.7	89.4	42.3	0.8	8.3
44	29 Oct. - 4 Nov..	0	0	34.9	20.15	88	37.7	0.8	6.7

APPENDIX-III

The meteorological observation during experimental during experimental period were recorded at observatory of the RARS, Karjat (*Rabi*- 2020-21).

Week No.	Period	Rainfall (mm)	Rainy Days	Temperature (o C)		Humidity (%)		Sun shine (Hrs)	Wind Speed (km/h)
				MAX	MIN	I	II		
47	26 Nov. - 2 Dec.	0	0	34.4	18.7	87	40.1	2.1	8
48	3 Dec. - 9 Dec.	9.2	1	61.6	17.9	91.4	52.1	0.7	6.8
49	10 Dec. - 16 Dec.	0	0	62.15	16.7	90.1	41	1.1	4.1
50	17 Dec. - 23 Dec.	0	0	32.7	14.6	93.9	41.1	0.4	7.1
51	24 Dec. - 31 Dec.	0	0	31.15	14.65	95.1	43.6	1.1	6.5
52	1 Jan. - 7 Jan.	0	0	32.25	17.1	90	42.1	1.1	6.8
1	8 Jan. - 14 Jan.	21	1	28.95	14.2	94.4	47.1	1.8	7
2	15 Jan. - 21 Jan.	0	0	31.4	15	89.7	40.9	1.4	7.8
3	22 Jan. - 28 Jan.	0	0	30.05	13.4	93.9	37.3	2.2	6.6
4	29 Jan. - 4 Feb.	0	0	32.65	13	92.7	29.7	2	8.3
5	5 Feb. - 11 Feb.	0	0	31.15	14.55	91.6	30.1	2.6	8
6	12 Feb. - 18 Feb.	0	0	32.95	14.5	87.9	24.9	2.1	8.8
7	19 Feb. - 25 Feb.	0	0	36.45	15.2	89.3	22	2.2	8.3
8	26 Feb. - 4 march	0	0	37.9	16.2	77.3	20.6	1.8	7.1
9	5 mar - 11 mar	0.8	0	37.4	17.9	79	26.6	1.9	4.1
10	12 mar- 18 mar	0	0	40.6	17.3	75.3	16.4	1.8	8.6
11	19 mar - 25 mar	0	0	38.1	19.4	82.4	28.9	2.9	4.9
12	26 mar - 1 April	0	0	40	19.9	78.7	23.7	3.7	8
13	2 April - 8 April	0	0	39.45	20.7	81.3	33.4	4.4	7.1
14	9 April - 15 April	0	0	40.65	21.25	84.7	32.1	4.5	6.9
15	16 April - 22 April	0	0	40.55	21.8	90.1	31.6	4	5.2
16	23 April - 29 April	0	0	41.9	23.4	92.6	30.1	4.3	7.3
17	30 April - 6 may	0	0	40.3	23.8	90.9	35.6	5.1	8.9

APPENDIX-IV

The meteorological observation during experimental during experimental period were recorded at observatory of the RARS, Karjat (Rabi- 2021-22).

Week No	Period	Rainfall (mm)	Rainy Days	Temperature (o C)		Humidity (%)		Wind velocity (km/h)	Sun shine (Hrs)
				MAX	MIN	I	II		
45	5 Nov. - 11 Nov.	31.2	0	33.55	17.9	87.3	41.3	0.6	6.1
46	12 Nov. - 18 Nov.	0	0	34.7	19.3	85.9	42.1	0.9	5.7
47	20 Nov. - 25 Nov.	38.6	2	33.8	23.1	92.4	56.9	1.5	5.9
48	26 Nov. - 2 Dec.	65	1	32.35	19.3	85.9	57.3	1.4	5
49	3 Dec. - 9 Dec.	9.2	1	61.6	17.9	91.4	52.1	0.7	6.8
50	10 Dec. - 16 Dec.	0	0	62.15	16.7	90.1	41	1.1	4.1
51	17 Dec. - 23 Dec.	0	0	32.7	14.6	93.9	41.1	0.4	7.1
52	24 Dec. - 31 Dec.	0	0	31.15	14.65	95.1	43.6	1.1	6.5
1	1 Jan. - 7 Jan.	0	0	32.25	17.1	90	42.1	1.1	6.8
2	8 Jan. - 14 Jan.	21	1	28.95	14.2	94.4	47.1	1.8	7
3	15 Jan. - 21 Jan.	0	0	31.4	15	89.7	40.9	1.4	7.8
4	22 Jan. - 28 Jan.	0	0	30.05	13.4	93.9	37.3	2.2	6.6
5	29 Jan. - 4 Feb.	0	0	32.65	13	92.7	29.7	2	8.3
6	5 Feb. - 11 Feb.	0	0	31.15	14.55	91.6	30.1	2.6	8
7	12 Feb. - 18 Feb.	0	0	32.95	14.5	87.9	24.9	2.1	8.8
8	19 Feb. - 25 Feb.	0	0	36.45	15.2	89.3	22	2.2	8.3
9	26 Feb. - 4 March	0	0	37.9	16.2	77.3	20.6	1.8	7.1
10	5 mar - 11 mar	0.8	0	37.4	17.9	79	26.6	1.9	4.1
11	12 mar- 18 mar	0	0	40.6	17.3	75.3	16.4	1.8	8.6
12	19 mar - 25 mar	0	0	38.1	19.4	82.4	28.9	2.9	4.9
13	26 mar - 1 April	0	0	40	19.9	78.7	23.7	3.7	8
14	2 April - 8 April	0	0	39.45	20.7	81.3	33.4	4.4	7.1
15	9 April - 15 April	0	0	40.65	21.25	84.7	32.1	4.5	6.9
16	16 April - 22 April	0	0	40.55	21.8	90.1	31.6	4	5.2
17	23 April - 29 April	0	0	41.9	23.4	92.6	30.1	4.3	7.3
18	30 April - 6 may	0	0	40.3	23.8	90.9	35.6	5.1	8.9

List of Symbols and Abbreviations

MH	Maharashtra
cm	Centimetre
MW	Meteorological week
mg/g	milligram per gram
AGR	Absolute growth rate
RGR	relative growth rate
NAR	net assimilation rate
LAI	Leaf area index
°C	degree celcius
CD	critical difference
Fig.	figure
g	gm
mg	milligram
ha	hectare
kg	kilogram
Max	maximum
Min	minimum
No.	number