STUDIES ON EVALUATION OF DIFFERENT VARIETIES OF ONION FOR DEHYDRATION

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MASTER OF SCIENCE

IN

HORTICULTURE

(VEGETABLE SCIENCE)

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PARBHANI-431 402 (M.S.) INDIA

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BY

DETHE ROHINI GOVINDRAO

B.Sc. (Agriculture)

THESIS

submitted to the

Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani

In partial fulfillment of the requirement for the degree of

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PARBHANI – 431 402 (M.S.) INDIA

2021

DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled, "**STUDIES ON EVALUATION OF DIFFERENT VARIETIES OF ONION FOR DEHYDRATION**" submitted by me is based on the actual work carried out by me under the guidance and supervision of **Dr. V. S. Khandare**. The extent of information derived from the existing literature have been duly cited and referenced. The existing research work or its any part is not submitted anywhere else for the award of any degree or diploma.

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Khandare V. S.

Place : Parbhani

Date : 12/ 08/ 2021

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This is to certify that the thesis entitled, **"Studies on evaluation of different varieties of onion for dehydration"** submitted by **DETHE ROHINI GOVINDRAO Reg. No. 2019HT/12M** in partial fulfillment of the requirements for the award of the degree of **MASTER OF SCIENCE (Horticulture)** in the subject of **VEGETABLE SCIENCE** to the Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani has been approved by the Student's Advisory Committee after viva voce examination of the student in collaboration with the External Examiner.

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(Dr. V.S. Khandare)

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Dethe

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ABBREVIATIONS

%	:	Per cent
&	:	And
°B	:	Degree brix
°C	:	Degree Celcius
/	:	Per
@	:	At the rate
CD	:	Critical difference
cm	:	Centimeter
cv	:	Cultivars
CV	:	Coefficient of variance
DAP	:	Day after planting
DAS	:	Day after sowing
db	:	Dry basis
DR	:	Dehydration ratio
DR	:	Drying rate
dt	:	Drying time
et al.	:	And other
Etc.	:	And so forth (et cetera)
Fig.	:	Figures
FYM	:	Farm yard manures
g	;	Gram
ha.	:	Hectare
hrs	:	Hours
i.e.	:	That is
IW	:	Irrigation water
k	:	Potassium
Kg	:	Kilogram
Lit.	:	Litre
m	:	Meter
MC	:	Moisture content
mg	:	Milligram
mm	:	Milimeter
MR	:	Moisture ratio
N	:	Nitrogen
No.	:	Number
NS	:	Non-Significant
N-S	:	North-south
p	:	Phosphorous
pp.	:	Pages
RDF	:	Recommended dose of fertilizers
RR	:	Rehydration ratio
SE	:	Standard error
T	:	Treatment
TSS	:	Total soluble solids
Viz.,	:	Videlicet (Namely)
Wb	:	Wet basis

THESIS ABSTRACT

THESIS ABSTRACT

1	Title of the thesis	**:**	Studies on evaluation of different varieties of onion for dehydration.
2	Full name of the candidate	**:**	Dethe Rohini Govindrao
3	Full Name of the Research Guide	**:**	Khandare V. S.
4	Department	**:**	Horticulture (Vegetable Science)
5	College / University	**:**	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.
6	Degree to be awarded	**:**	M.Sc. (Horticulture)

ABSTRACT

An experiment entitled "Studies on evaluation of different varieties of onion for dehydration." was conducted during year 2020-21 at Horticulture Research Scheme (Vegetable), Department of Horticulture, VNMKV, Parbhani. The experiment was laid out in Randomized Block Design for field research experiment and Completely Randomized Design for laboratory experiment with three replications and twelve varieties viz. Bhima kiran, Bhima Super, Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, BhimaShubhra, Bhima Red, N-2-4-1, Phule Samarth.

Analysis of variance revealed significant differences among the varieties in all characters. In respect of growth and yield parameter Phule Samarth was recorded maximum number of leaves (12.8), maximum chlorophyll-a content (20.92) and chlorophyll-b (10.34). Highest yield of fresh onion per plot, length of bulb, diameter of bulb and average weight of bulb were maximum in Phule Samarth (21.99 kg), (6.70cm), (6.72cm) and (116.17g), respectively. The variety Phule Samarth showed best results for all yield parameters.

In respect of dehydration highest TSS was found in Bhima Shakti (15.80%) and Bhima Kiran (17.94%) of fresh and dried onion, respectively. Lowest browning index

was recorded in variety Bhima Shubhra (7.54 mg/g) while maximum browning index was found in variety Bhima Raj (12.38 mg/g). Moisture content on wet basis maximum was recorded in variety Bhima Shweta (98.27-82.00 %) however, minimum was recorded in variety Bhima Kiran (97.12-82.00 %) and moisture content on dry basis highest was recorded in variety Bhima Shweta (56.87-7.33 %) however, lowest was recorded in variety Bhima Kiran (33.72- -4.56 %). Minimum moisture ratio was recorded in variety Bhima Kiran (0.62 %), while maximum was observed in variety Bhima Shweta (0.72 %). Highest drying rate was observed in variety Bhima Dark Red (11.02 – 1.02 kg water /kg dry matter /hr) however, lowest was recorded in variety Bhima Kiran (4.17 - 0.56 kg water /kg dry matter /hr).

Hence, on account of drying ratio, rehydration ratio and browning index, , as compared to rest of the varieties of onion under studies the Bhima shubhra, Bhima Shweta and Bhima dark red varieties were more suitable for dehydration purposes.

(**Keywords**: Dehydration, Maxmum, Minimum, Onion, Recorded, Varieties.)

CHAPTER – I

INTRODUCTION

CHAPTER-I

INTRODUCTION

Onion (*Allium cepa* L.) is the most important underground bulbous vegetable crops grown in India. It is grows well in mild climate without extreme heat or cold or excessive rainfall. It is widely cultivated for internal consumption as well as for the export. Globally, the country occupies the second position after china in onion production with a share of around 14% (www.agriexchange.apeda.gov.in). Commercially cultivated in Maharashtra, Bihar, Gujrat, Karnataka, Orissa and Uttar Pradesh states in India. India is a traditional exporter of onions rank third after Netherland and spain (Singhal, 1996).

Onion is the rich source of amino acid, anthocyanin, flavonols and phenolics. Fresh onion contains around 86.8 per cent of moisture, 11.6 per cent of carbohydrates, 9mg/100g ascorbic acid, 1.2 per cent protein, 0.2-0.5 per cent of calcium, 0.05 per cent phosphorus and small amount of vitamin B1 (Thiamine), vitamin B2 (Riboflavine) and iron.

Onion possess excellent characteristics is pungency, which is due to a volatile oil known as allyl-propyl disulphide (Goudra, 2012). It contains good characteristics of taste and flavor to food and also significant therapeutic values. It has wide range of beneficial properties like antioxidant, anti-cholesterolaemic, anti-mutagenic for the human (Skerget *et al.*, 2009). Eating raw onions are useful to reduce the cholesterol levels because they increase levels of high density lipoproteins It also useful in control the coronary heart disease, cancer prevention, reduces high blood pressure and for skin and hair. Sulphur compounds present in onion will help to prevent the growth of cancer cells. Onions are also used in the treatment of anaemia, urinary disorders, bleeding piles and teeth disorders.

Processed and value added products are gaining importance in the worldwide markets. Dehydrated onions are considered as a potential product in world trade and India is the second largest producer of dehydrated onions in the world. There is a large demand of dehydrated onion in the European countries only (Murthy and Subramanyam, 1999).

The large quantity of onion is used as fresh, however, some of the surplus quantities of onion available in the market are processed by dehydration and are meant mainly for export and armed forces (Pawar *et al*., 1988). Onion dehydration is the best remedy for reducing storage waste and cost as well as transport. Dehydrated onion has lots of advantages like ease of transportation, storage, preparation and use. It also used for the flavouring supplement in many products in food industries for example sauces, soups, meat products, pickles, salad dressing and other snack items.

Dried onion products are more preferred than fresh onion bulbs due to its simplicity for use and greater shelf stability (Mazza and Lemaguer, 1980). Drying of onion bulb is performed by applying heat energy on onion slice does not only remove moisture content, it also influence the nutrient and may distract volatile and bioactive component. Major drying methods of agricultural products are open air and hot air drying techniques. Open air drying methods mainly practiced in rural areas while hot air drying techniques mainly used in urban areas. Both drying method have their own merits and demerits on nutritional values, bioactive component loss, colour, shrinkage and other organoleptic properties of the agricultural produces (Mazza and Lemaguer, 1980).

Dehydration is the best way to preserve various forms of onion for future use and to increase self life. This involves drying or removing moisture from the onions. Dehydrated onions not require refrigerated storage as do frozen onions and contents of a container can be used some time after opening provided they are not dehydrated. The main advantages of dehydrated onions are that they are easy to store, being lighter in weight and smaller in bulk than fresh or other processed onions. They are cheap to pack compared with canned goods. The newest dehydration process appears to be a variation on the air-drying process and is based on the principle of vapor pressure differentials, using air circulated around the onions at relatively low temperatures to ‘sweat’ the water from the food .

Generally, White onion varieties are preferred for dehydration due to higher TSS and higher dry matter content. Some essential characteristics that should be present in onion cultivars suitable prior to drying are white coloured flesh, TSS 15-

20%, high pungency, high insoluble solid, low ratio of reducing to non reducing sugar and lower browning during drying (Jones and Mann, 1963 and Saimbhi, 1970).

Keeping in view the need to identify suitable varieties, the study was conducted to investigate the drying behaviour of onion varieties and their suitability for dehydration. Hence, present study was undertaken with following objectives.

1. To assess the physicochemical profile of onion varieties.
2. To study the drying behavior on onion varieties.
3. To find out suitable variety of onion for dehydration.

CHAPTER – II

REVIEW OF LITERATURE

CHAPTER-II

REVIEW OF LITERATURE

The investigation entitled **"studies on evaluation of different varieties of onion for dehydration"** was carried out at Horticulture Research Scheme (Vegetable), Department of Horticulture, VNMKV, Parbhani. The findings of research workers regarding onion varieties are reviewed in this chapter under appropriate heading. Attempts have been made to put fourth here recently published review in respect of studies, confining as far as possible to the onion crops.

2.1 Growth parameters

2.1.1. Height of plant

Dwiwedi *et al*., (2012) evaluated onion varities for growth, yield and quality traits under agroclimatic condition of Kymore plateau region of MP, India. Result revealed that the variety pusa hybrid 102 significantly highest yield along with maximum plant height, number of leaves/plant, width of bulb weigth of bulb and dry matter content. The variety pusa white flat was produced bulb yield next to it with highest TSS content.

Neelam *et al*., (2014) studied the phenotypic diversity and genetic variation within a collection of onion (*Allium cepa* L.) germplasm from Peninsular India. The result showed that plant height of plant range between 43 cm (IC571913) to 61 cm (IC571927) with mean plant height of 53.31 cm. They also showed that the number of leaves per plant, range between 6.40 (IC564085) to 11.60 (IC571904) with phenotypic coefficient variation of 15.13.

2.1.2. Number of leaves

Sikdar *et al*., (2010) conducted on effect of spacing and depth of planting on growth and yield of onion. Result revealed that the plant spacing showed significant effects on most of the growth and yield characteristics. Wider spacing produced the maximum number of leaves per plant, longest plant height, maximum diameter and fresh weight of bulb while the closer spacing produced maximum yield of bulb (12.08 t/ha). Bulb yield was significantly higher at lesser depth of planting.

The combined effect of spacing and depth of planting was found to be significant on most of the growth and yield parameters.

Bindu and Bindu (2015) studied the performance evaluation of onion (*Allium Cepa* L. *Var. Cepa*) varieties for their suitability in Kollam District. Result revealed that highest plant height (38.6 cm) was reported from onion variety N53 and the lowest by Agrifound Dark Red (35.2 cm). Similarly onion variety Arka Kalyan registered maximum number of leaves (15.4) and the lowest by N53 (10.4). The highest bulb yield of 8.2 t ha-1 was obtained from the cultivar Agrifound Dark Red and the lowest bulb yield was reported from N 53.

2.2. Yield Parameter

2.2.1 Length of bulb

Goudra (2012) studied on dehydration of selected onion (*Allium cepa* L.) varieties. Result revealed that the Arka pragati observed maximum length of bulb 5.83cm and minimum bulb length of Arka kalian 4.82cm. Shape of Arka Kalyan , Bijapur White And Arka Pragati was globe shape.

Gashua *et al*., (2014) reported that the refractometer analysis of some local varieties of onion (*Allium cepa* L.) bulbs for dehydration. Result showed that the different cultivars have different amount of soluble solid determined by their refractive index value which varies considerably and that medium and small size bulb have more dry matter content than larger bulbs. The local white cultivar is a better cultivar as compared with other because it had high soluble solid/ dry matter content indicated by higher mean refractive index.

Umamaheswarappa *et al.*, (2018) conducted studies on performance of onion (*Allium cepa* L.) varieties for growth and yield parameters under central dry zone of Karnataka. The results revealed that significantly the highest polar diameter of bulb (4.98 cm) was recorded in the genotype Bhima Super followed by Agri Found White (4.68 cm) as compared to rest of the genotypes. The equatorial diameter of bulb significantly superior in Bhima Super (5.46 cm) and which was at par with Arka Kalyan (5.27 cm) and lowest was in Prema-178 (4.69 cm). Significantly the highest per cent A grade bulb (20.76) was recorded in the genotype Agri Found Light Red followed by Bellary Red (18.73 cm) as compared to rest of the genotypes. The per

cent B grade bulb (54.26) and per cent C grade bulb (24.84) superior in the genotype NHRDF RED. The highest and significant average bulb weight was noted for Bhima Super (69.33 g) which was at par with Bellary Red (64.33 g) followed by NHRDF RED (63.33g) as compared to rest of the genotypes.

Singh and Singh S. (2020) conducted studies on assessment of growth, yield and quality of white onion and reported that maximum equatorial bulb diameter (5.95), polar bulb diameter (4.68 cm) and 20 bulbs weight (1.41 kg) were recorded in advance line-857 and were at par with check variety Agrifound white in respect of equatorial bulb diameter, diameter, advance lines-784 and check variety Agrifound white regarding polar bulb diameter. Higher gross yield (394.93 q/ha) and marketable yield (322.07q/ha) were recorded in advance line-798 and advance lines 629, respectively, and were at par with advance lines 629, 810, 878 and 886 in respect of gross yield.

2.2.2 Diameter

Mushtaq *et al*., (2013) conducted studies on productive and qualitative evaluation of onion cultivars under agro-climatic condition of Faisalabad. Result revealed that the maximum bolting percentage was recorded in Desi Red (46.67%) that indicates less vernalization requirement of this variety while it was the minimum in Faisal Red and VRIO-6 (13.33%). The cultivar Phulkara produced larger size bulbs (73.22 mm diameter) as well as highest yield (21.90 t ha-1) and bulb to neck diameter ratio (6.75). Similarly, minimum weight loss during curing was observed in Desi Red (4.64%), Pusa Red (4.76%) and Phulkara (4.83%), indicating higher dry matter contents while maximum weight loss (6%) was recorded in VRIO-6. Overall results revealed that both Phulkara and Desi Red are excellent for processing while Dark Red for cooking purpose under agro-climatic conditions of Faisalabad.

Abdelkader *et al*., (2014) studied performance of eight varieties of onion (*allium cepa* l.) cultivated under open field in Tunisia. The result revealed that the variety ‘Morada de Amposta’ recorded the highest leaf length (68.06 cm), pseudostem diameter (8.63 cm), number of leaves (8.71), plant height (76.95 cm), in addition to the greatest yields (32.88 t/ha) which were significantly increased respectively 66.2, 88.8, 2.1, 61.2, 63, 27.9 and 28.4% compared to those obtained

from the regular variety ‘Blanc Hâtif de Paris’. Variety ‘Blanc Hâtif de Paris’ was the earliest to maturity and recorded the most preferment bulb weight (155.02 g) and diameter (8.21 cm). ‘Keep Red’ variety had the highest height of the bulb (7.19 cm).

Hirave *et al.,* (2015) investigated performance of red onion varieties in *Kharif* season under Akola conditions. The result showed that the variety Bhima Red (V8) recorded significantly maximum diameter of bulb (6.61 cm), number of marketable bulbs (103.8), marketable yield per plot (6.9 kg) and marketable yield per hectare (328.57 quintal/ha).while the variety at par for diameter of bulb Phule Samarth (6.36 cm) and Bhima Raj (6.15 cm), for number of marketable bulbs Baswant-780 (93.13), Bhima Raj (90.24), Agrifound Dark Red (89.04) and Bhima Super (86.6), for marketable yield per plot Bhima Raj (6.27 kg) and Bhima Super (5.67 kg) and for marketable yield per hectare Bhima Raj (298.41 quintal/ha) and Bhima Super (269.83 quintal/ha) Whereas, minimum diameter of bulb recorded by Agrifound Dark Red (5.31 cm), while Phule Samarth recorded less number of marketable bulbs (64.76), marketable yield per plot (4.27 kg) and marketable yield per hectare (203.17 quintal/ha).

Kasera *et al.*, (2019) studied the yield and quality characters of different onion varieties for crop improvement purposes. Result showed that Agrifound white was observed best for growth (i.e. significantly maximum plant height, number of leaves per plant, leaf length, dry weight per plant, bulb and green top ratio and minimum neck thickness, bolting per cent, duration of the crop), yield parameters (fresh weight of bulb, polar diameter of bulb, equatorial diameter of bulb, bulb yield per hectare and long crop duration and lowest percentage of doubles bulb,) was recorded maximum in this genotypes.

2.2.3. Average weight of bulb

Raj (2000) studied on dehydration of red onion and reported that the Poona Red had better result with different physical parameters bulb diameter (5.90cm), skin color (Rosy pink), weight of bulb (87.0g), shape of bulb and Bellary Red with bulb diameter (4.96cm), skin color (light red), weight of bulb (59.0g), shape of bulb (round globe).

More *et al.*, (2018) evaluated response of *kharif* onion varieties to time of set planting. The result revealed that the plant height (53.83 cm), number of leaves per plant (7.80), leaf length (51.93 cm) at 90 DAT, weight of fresh bulb (87.7 g), average weight of bulb (80.6 g), Bulb diameter (6.36 cm), marketable bulb yield per plot (7.17 kg), total bulb yield per hectare (222.60 q), neck thickness (1.43 cm), bolting (0.00%), splitting (3.00 %) and Total Soluble Solids (11.61oBrix) at the time of harvesting than any other treatment combinations.

Suhas *et al.*, (2018) studied on evaluation of onion genotypes (*Allium cepa* L.) for yield and quality parameters during *Kharif* Season in Eastern dry zone of Karnataka. Result revealed that the genotype Super Flare were noticed maximum average bulb weight (135.00 g) and ten bulb weight (1380.00 g). However, Maximum bulb yield was documented in Super Flare (38.16 t/ha). On the basis of yield and quality parameters Super Flare, S-780, Arka Bindu and Rampur Local were found best suited for *Kharif* season cultivation in Eastern Dry Zone of Karnataka.

2.2.4 Yield of bulb per plot

Pardeshi and Waskar (2012) conducted studies on performance of improved onion (*Allium cepa* L.) varieties under Marathwada region in respect of growth and yield parameters. Result revealed that variety Arka Niketan (Check) was early in maturity, while variety PKV Selection White was best for low twin bulb per cent. The neck thickness was lowest in variety Sel-383. Yield of bulb was found to be highest in variety JNDWD-207.

Galeev *et al.*, (2018) studied that the yield and quality of varieties of garden onion cultivated in a one-year cycle, depending on growth regulators. Result showed that the yield of garden onion depended on the genotype by 28.6%, on growth regulators - by 35.4%, on the order of the year - by 21.8% and on association of the factors - by 10%.

Gosai *et al.*, (2018) studied on evaluation of different varieties of onion (*Allium cepa* L.) under North Gujarat condition. Result revealed that the maximum weight of bulb (82.99 g), marketable yield of bulb per plot (19.41 kg), marketable yield of bulb per hectare (553.17 q/ha) and total yield of bulb per hectare (589.82

q/ha) were obtained with treatment V9 (Bhima Shakti). The treatment V9 (Bhima Shakti) was found statistically at par with treatment V8 (Bhima Kiran) (77.38 g) (18.10 kg) (515.76 q/ha) and (556.59 q/ha) and V1 (Agrifound Light Red) (76.83 g) (17.97 kg) (512.15 q/ha) (548.42 q/ha) and minimum unmarketable yield of bulb per plot (1.20 kg).

Hiremath *et al*., (2018) studied on the assessment of onion varieties for late *Kharif*. Result revealed that onion variety Bhima Super performed better in both growth and yield parameter compared to Bhima Red, Arka Kalyan and Bellary Red variety. The market preference was more in Bhima Super variety and fetches higher price in the market. Bhima Super variety registered 34.01 per cent increased yield over Bellary Red variety.

Kindeya *et al*., (2020) studied performance evaluation and shelf life of onion varieties in western tigry, Ethopia. Result showed that the highest yield was obtained from Bombey red (440.3kg/ha) followed by Nafis (395 kg/ha), Shendi (391kg/ha), Nasik red (373kg/ha) and Adama red (387kg/ha), respectively.

2.3 Quality Parameters

2.3.1. Total soluble solids (TSS)

Verma *et al*., (1999) studied on quality evaluation of different onion varieties for dehydration. Result revealed that the Punjab-48 was superior than other varities based on the yield, dry matter, drying ratio, TSS, pungency value, sugar etc., for dehydration.

Pardeshi and Waskar (2012) conducted studies on performance of improved onion varieties under Marathwada region in respect of yield parameters and total soluble solids. Result showed that maximum TSS was recorded in variety Arka Niketan (13.00 per cent) followed by variety Sel-402 (11.30 per cent) which was at par with varieties viz., SYN-3, PRO-6, JNDWD-207 and L-28. Significantly, lowest TSS (10.15 per cent) was recorded in the variety Sel.-383. Flavour intensity of onion is influenced by genetic potential of a cultivar and the environment in which the cultivar grows.

Kotecha (2015) studied on preparation of dehydrated flakes from onion. He result showed that the better quality of dehydrated onion flakes can be prepared from Phule safed cultivar by giving pretreatment of 0.2% KMS solution. The TSS content of Phule safed was highest i.e. 12.8 ° brix among the all varieties. Drying ratio of Phule Samarth was observed very high 8.19:1 as compared to other cultivars.

2.3.2. Titrable acidity

Patil *et al.,* (2012) studied the physic-chemical constituents in onion (*Allium cepa* L.) during storage. Result showed that the onion cultivars, Pusa white round and pusa red were stored under ambient conditions. Pungency and ascorbic acid content decreased, while total antioxidant capacity increased during storage. Pusa white round was suitable for dehydration with minimum browning.

Jethawa *et al*., (2018) conducted studies on Gujarat Junagadh Red Onion-11 (GJRO-11) a new high yielding red onion variety. Result revealed that GJRO-11 contains higher TSS (12.94%), total carbohydrates (9.3%), total protein (1.16%), ascorbic acid (3.89 mg/g), total phenol (13.66 mg/100 g), pyruvic acid (1.22) and total soluble sugar (1.22%) as compared to check varieties. This variety also recorded less jointed bulb percent (2.04%) as compared to check varieties.

Mitra *et al*., (2012) studied on onion dehydration. Result revealed that several analytical and numerical methods are available for analyzing the drying behaviour as well as quality parameters. However, there are some other methods of drying such as vacuum drying, dehumidified air drying etc. which can be explored in order to assess the effect of different operating parameters on quality of onion as it contains several essential nutrients and has enormous medicinal value as well. Combination of two or more drying methods or multimode drying techniques can also be adopted for drying of onion. Most of the modeling of drying kinetics has been done for hot air drying method. These models can be tested for other drying methods also.

2.3.3. Ascorbic acid

Raj (2000) studied on dehydration of red onion (*Allium cepa* L.). Result showed that Bellary Red variety of onion was higher in dehydration ratio (9.11:1) as compared with Poona Red (8.87:1). The Poona Red was higher in ascorbic

acid (32.66mg/100g) and total sugar (54.52%) compared with Bellary Red ascorbic acid (26.71mg/100g) and total sugar (48.46%).

Goudra (2012) studied on dehydration of selected onion (*Allium cepa* L.) varieties. Rehydration ratio of bijapur white was observed highest during dehumified air drying rehydrated at 65°C compared with other two temperature. Lower water activity and greater ascorbic acid were observed 0.344 and 37.20 mg/100g respectively in 0.2% KMS pretreatment in Bijapur white onion cultivar when dried in dehumified air drying.

Rayar (2014) emphasized on effect of pretreatments and varieties on dehydration of red onion. Result showed that time taken by Agrifound Light Red for drying was 19.10 hrs less as compared to other variety and highest TSS, recovery and minimum dehydration ratio 15.00%, 13.97% and 7.60, respectively. The higher ascorbic acid retention was observed (14.40mg/100g) and greater texture score was in Arka Pragati at 3MAT.

Patil *et al.*, (2015) studied effect of two stage drying mode on the quality attributes of dried onion slices. Result showed that ascorbic acid decreases with increase in temperature. There was increase in rehydration ratio by decreasing temperature and cut-off time. The full second order model was found inadequate in describing the reducing sugar, total sugar, dehydration ratio.

Loredana *et al.*, (2017) studied on chemical composition and antioxidant properties of five white onion landraces. Result revealed that the total content of volatile compounds as well as the sulfur containing compounds in Aprilatica was significantly ($p \leq 0.05$) higher than the other landraces. The nutraceutical feature investigated through the total phenols, phenols profile, and antioxidant activity showed higher values for the samples harvested in spring months. High pungency values ranging from 9 to 14μmol/g FW were found in all onion landraces investigated as enzymatically (alliinase) produced pyruvate (EPY). The organic acids profile (malic, citric, succinic, pyruvic, oxalic, ascorbic, and tartaric acids) highlighted malic and citric acids in higher amounts in all landraces. Fructose,

glucose, and sucrose were found as soluble sugars and fructose was the most abundant.

2.3.4. Total sugars

Bajaj *et al.*, (1980) analyzed the chemical evaluation of some important varieties of onion (Allium cepa L.). Result showed that the five white and seven red cultivers of onion were studied for the dry matter, carbohydrates, total phenols, coloring matter. Total water soluble sugar were reducing sugar ranged from 41.50 to 74.00 %, 12.00 to 22.25 %, respectively.

Varina and Smittle (1993) evaluated sweet onion cultivars for Sugar concentrations and pungency. Result showed that total bulb sugar concentration and pungency varied among cultivars and years. pungency ratio was lower in 'Texas 1015Y' and 'Sweet Georgia' than in 'Dessex', 'Rio Bravo','Hybrid Yellow Granex', and 'Granex 33'. Under low S nutrition, market acceptance of "sweet" onion cultivars that vary slightly in nonstructural water-soluble carbohydrates may be assessed more precisely by the sugar: pungency ratio than by sugar or pungency assessments.

Male (2009) studied the evaluation of white onion cultivars for dehydrator powder. Result revealed that the G.J.White onion No.1 was observed superior by the higher amount of total soluble solid, higher amount of ascorbic acid, minimum moisture content, higher amount of total sugar and reducing sugar at 3 and 6 months of storage as compared to other varieties viz. Phule safed , Agrifound white, G. J. White onion No.98-206 and local varities.

Kandoliya *et al*., (2015) reported determination of nutritional value and antioxidant from bulbs of different onion (*Allium cepa*) variety. Results revealed that JDRO-07-13 of red variety and GWO-1 of white nutritionally found better due to its higher antioxidant property, proteins, carbohydrates, reducing sugar.

Sekara *et al*., (2017) reported interactions among genotype, environment and agronomic practices on production and quality of storage onion (*Allium cepa* L.). Result showed that the shelf-life of onion bulbs is a genetic trait, improvable by efficient crop and post-harvest management, and adequate conditions of bulb storage. The quality of storage onion bulbs is ascribed to several indicators,

such as thiosulfonates, pyruvic acid, soluble solids, sugars, and many other biological compounds.

Priyadarshani *et al.,* (2020) studied on identification of suitable onion genotypes for processing. Result showed that the percentage of dry matter content was registered maximum in Arka Sona (21.34%) and Arka Swadista (19.15%). Among the genotypes, maximum reducing sugar was noticed in the genotype GWO-1 and ON-15-29 (3.67% each) of different genotypes, maximum non-reducing sugar and total sugars were recorded in the genotype Rose Onion (4.12 and 6.34% respectively). However, maximum pungency (pyruvic acid) was documented in case of Rose Onion (6.55µmol./gram of FW) followed by Arka Sona (6.54 µmol./gram of FW) and Arka Swadista (5.95µmol./gram of FW). Therefore, it was noticed that genotypes Arka Sona, Arka Swadista and Rose Onion were found suitable for processing with good quality characters.

2.3.5 Chlorophyll

Moldovan *et al.,* (2009) studied on influence of chlorophyll content from onion after selenium and zinc adding. Result revealed that in case of adding selenium, were total chlorophyll content was increase significant in comparison to control plants. The level of chlorophyll-a was 37.10 respective 37.38 and chlorophyll-b 21.45 respective 30.10 mg/L while Zinc adding leaded to increase content also. Thus chlorophyll-a was 20.11 respective 36.58 and chlorophyll-b 7.6 respective 21.45 mg/L.

Hansi and cebeci (2014) investigated on proline chlorophyll and carotinoids under drought stress in some onion cultivars. Result revealed that the total chlorophyll was change with cultivar and drought. Total chlorophyll was observed decreased with drought level. The change in chlorophyll a and b was significant for three factor such as cultivar, drought and their interaction ($p< 0.01$). chlorophyll b increased under drought stress in comparison with control in kantartopu-3.

Ghodke *et al.,* (2018) studied on physiological and biochemical responses in onion crop to drought stress. Result showed that the chlorophyll contents for the determining the drought tolerance ability was best physiological approach. Higher chlorophyll content of leaf tissue observed in onion variety Bhima kiran.

2.3.6. Moisture

Gabel *et al*., (2006) studied on catalytic infrared dehydration of onion. Result indicated that CIR heating is an effective method for onion drying. Greater drying rates and shorter drying times were seen in CIR drying compared to FAC drying but only at MC greater than 50%. For achieving high quality product and drying rate, a recommended combination of CIR and convection drying is to use CIR to achieve 75% MC and then use convection for later stages of drying. This type of processing would be beneficial for commercial dehydrators who would not have to replace existing equipment to incorporate a CIR unit. The recommended product temperature for CIR drying is 70 and 80 °C. The higher temperature (80 °C) should be used at the beginning of drying to achieve maximum drying rates while product degradation is minimal.

Gupta *et al*., (2010) studied varietal effect on drying behavior and quality characterics of onion. Result showed that the variety PBW-1was found more suitable for commercial dehydration on account of lower drying ratio of 6.49 as compared to 7.26 for pb Naroya and 7.90 for PRO-6, respectively.

Gupta *et al*., (2010) studied on preparation and quality evaluation of dehydrated carrot and onion slices. It was observed that moisture content and rehydration ratio increased during storage period but moisture content showed decreasing trend with increasing temperatures. There was decrease in β-carotene, Vitamin A content and organoleptic properties. However, no significant effect on ash content was observed during storage.

Goudra *et al.*, (2014) studied on dehydration of onions with different drying methods. Result showed that the reduction of moisture content of Arka kalyan, Bijapur white and Arka pragati onion took less drying time of 12 h in dehumidified air drying to dry the samples from an initial content in range of 774.13-891.08% (d.b.).h-1 to final moisture content range of 4.34-5.10% (d.b.).h-1, respectively as compared to open yard sun drying and solar tunnel drying methods. The drying rate was higher in the beginning of the drying processes and gradually reduced through the end of the drying process.

Revaskar *et al.,* (2014) studied on dehydration kinetics of onion slices in osmotic and air convective drying process. Result revealed that the entire drying process occurred in falling rate period and constant rate period was not observed. Five thin layer drying equations were investigated for their suitability to describe the drying behavior of onion slices. The effect of temperature and pre-treatment on drying behavior of onion slices in tray dryer was investigated.

Olalusi (2014) evaluated hot air drying and quality of red and white varieties of onion (Allium cepa L.). Result showed significant difference in mineral content at the three air temperatures for the red and white varieties but the red variety observed highest mineral contents although dehydrated samples showed decrease in mineral content with respect to fresh sample.

Djaeni *et al*., (2017) evaluated the physical-chemical quality of onion analyzed under drying temperature. Result revealed that the moisture content removal increased with increasing of air temperature and extending drying time. On the other hand, the quality of onion degraded as shown in colour change and lower thiamine retention.

Anamaria *et al*., (2018) studies on hot air drying and quality powder of three, red-skinned, white-skinned and yellow-skinned, onion varieties (*Alium cepa* L.). Result showed that one of the powder onion variety richest in phenolic compounds with antioxidant capacity is red-skinned variety (RO), followed by yellow-skinned varietiy (YO) and white-skinned varietiy (WO). The hot drying process dehydrated at 70–60 °C in a hot air dryer machine for 6 hours, the temperature being reduced as the moisture content decreases has highlighted the quality of the powder.

Goudra *et al.,* (2018) studied on drying characteristics of onion (variety- Arka kalian) slices using different drying methods. Result revealed that the sample of Arka kalyan onion required 17 to 21 h to dry under open yard sun drying and 15-17 h in solar tunnel drier to bring down initial moisture content ranging from 545.16- 992.905% (db) to final moisture content of 4.95-5.21% (db).

Islam *et al.,* (2019) studied that the model of dehydration and assessment of moisture content on onion using EIS. Result revealed that the onion is perishable and thus subject to drying during unrefrigerated storage. Moisture content is important to ensure optimum quality in storage. To track and examine the dynamics of natural dehydration in onion and also to assess its moisture content, noninvasive and non destructive methods are preferred.

2.3.7. Moisture Ratio

Revaskar *et al.,* (2014) studied on dehydration kinetics of onion slices in osmotic and air convective drying process. Result revealed that the entire drying process occurred in falling rate period and constant rate period was not observed. Five thin layer drying equations were investigated for their suitability to describe the drying behavior of onion slices. The effect of temperature and pre-treatment on drying behavior of onion slices in tray dryer was investigated.

2.3.8. Drying rate

Bajaj *et al*., (1979) conducted studies on the lychroymatory factor and other chemical constituents of some cultivars of onion. Result revealed that the coloring matter of dehydrated onion was maximum in the Punjab selection and minimum in S-72 and l-106. The Punjab-48 variety of onion was considered to be more suitable for dehydration purpose.

Lewicki *et al.,* (1998) studied rehydration properties of dried onion. result showed that the effect of pre-drying treatment on the reconstitution properties of dried onion was much more evident than that caused by the drying mode. Increase in hot air temperature as well as drying by infrared heating or by convection assisted with microwave power seemed to improve reconstitution properties of the onion in comparison with onion dried only by convection.

Hatamipour *et al.,* (2007) analyzed drying characteristics of six cultivars of sweet potatoes in different dryer. Result revealed that the temperature did not show significant effect on shrinkage, but blanching time and air circulation had significant effect on shrinkage as well as on the appearance of dried product. Less

shrinkage observed in Renjer and Diamant varieties at 80°C in comparison with other varieties.

Kadri (2008) conducted studies on process development for onion (*Allium cepa* L.) dehydration. Result showed that the drying behavior of Phule Samarth slices took 20 and 16 hr while shreds took about 15 and 12hr by using continuous tray and intermittent tray drying method.

Gupta *et al.*, (2010) studied on preparation and quality evaluation of dehydrated carrot and onion slices. It was observed that moisture content and rehydration ratio increased during storage period but moisture content showed decreasing trend with increasing temperatures. There was decrease in β-carotene, Vitamin A content and organoleptic properties. However, no significant effect on ash content was observed during storage.

Mitra *et al.*, (2012) studied on onion dehydration. Result revealed that several analytical and numerical methods are available for analyzing the drying behaviour as well as quality parameters. However, there are some other methods of drying such as vacuum drying, dehumidified air drying etc. which can be explored in order to assess the effect of different operating parameters on quality of onion as it contains several essential nutrients and has enormous medicinal value as well. Combination of two or more drying methods or multimode drying techniques can also be adopted for drying of onion. Most of the modeling of drying kinetics has been done for hot air drying method. These models can be tested for other drying methods also.

Vintila *et al.*, (2012) studied on onion dehydration. Result showed that the biochemical analysis observed dehydrated onion had high content in carbohydrate, protein and minerals. Graph shows that values started from 70% at the beginning of dehydration and then suddenly decreased to 12- 15% during first 120 min, to values of 7-8%.

Alam *et al.*, (2014) investigated on rehydration characteristics of dried summer onion. Result showed that, different reconstitutional properties of summer onion. During rehydration quality test for both samples (mechanical and solar dried) it was observed that the rehydration ratio (RR) was higher for mechanical dried onion

than that of solar dried counterparts and RR was also higher for blanched sample rather than unblanched sample for both the drying method. The coefficient of reconstitution (CR) is found to be highest for mechanical dried blanched onion and was followed by mechanical unblanched, solar blanched and unblanched dried onion.

Revaskar *et al.,* (2014) studied on dehydration kinetics of onion slices in osmotic and air convective drying process. Result revealed that the entire drying process occurred in falling rate period and constant rate period was not observed. Five thin layer drying equations were investigated for their suitability to describe the drying behavior of onion slices. The effect of temperature and pre-treatment on drying behavior of onion slices in tray dryer was investigated.

Olalusi (2014) evaluated hot air drying and quality of red and white varieties of onion (Allium cepa L.). Result showed significant difference in mineral content at the three air temperatures for the red and white varieties but the red variety observed highest mineral contents although dehydrated samples showed decrease in mineral content with respect to fresh sample.

Hussein *et al.,* (2018) studied on drying characteristics of osmotically pretreated red onion slices via hot air oven. The drying characteristic of osmotically pretreated red onion slices via hot air oven at 40°C to 80°C drying temperature and 1.5 m/s air velocity was investigated. The initial osmotic dehydration resulted into removal of substantial amount of moisture from the onion slices thereby shorten the drying time. The entire drying process occurred in falling rate period and constant rate period was not observed.

Pooja *et al.*, (2018) studies on effect of different pre-treating chemicals on physico-chemical qualities of onion dried using solar tunnel dryer. Water activity plays an important role in physical properties such as texture and in the shelf life of foods. Result showed that water activity of dehydrated onion found non-significant with respect to effect of different shape/sizes and interactions but significant differences were found among the pre-treatments.

Seifu *et al.*, (2018) analyzed effect of variety and drying temperature on physicochemical quality, functional property, and sensory acceptability of dried

onion powder. The result indicated that the total color change of Bombay red was not affected by temperature, but Qellafo and Sweet Carolin varieties showed an increased with increasing temperature for all three varieties.

2.4 Drying Kinetics

2.4.1 Dehydration Ratio

Kulkarni (2011) emphasized on standardization of pretreatments and drying methods in dehydration of onion. Result showed that the onion slices prepared by using 1 per cent $NaHSO_3$ observed the lower dehydration ratio, higher rehydration and good retention of bio-chemiacal parameter like greater ascorbic acid, sugar retention and lesser non-enzymatic browning.

Priyanka (2014) studied on dehydration of onion (*Allium cepa* linn.), nutritional composition and development of value added products. Result revealed that the moisture content of dried onion sample increased throughout storage period 30 days and dehydration ratio of slices was observed high in onion sample dried in cabinet and microwave drying.

2.4.2. Rehydration Ratio

Gupta *et al.*, (2010) studied on preparation and quality evaluation of dehydrated carrot and onion slices. It was observed that moisture content and rehydration ratio increased during storage period but moisture content showed decreasing trend with increasing temperatures. There was decrease in β-carotene, Vitamin A content and organoleptic properties. However, no significant effect on ash content was observed during storage.

Goudra *et al.*, (2017) investigated rehydration characteristics of dehydrated different onion slices. Result showed that the dehumidified air dried, untreated Bijapur white onion had higher rehydration ratio of 4.99 followed by dehumidified air dried, untreated Arka pragati and Arka kalyan onion as 4.97. The data indicated that in open yard sun drying, pre-treated with 10% NaCl for Arka pragati and Arka kalyan onion had lowest rehydration ratio of 2.89 compared with all other treatments. This is because, during rehydration, the absorbed salt may be

dissolved in water, which decreases the weight of the sample and hence reduces the rehydration ratio.

Demissew *et al*., (2018) conducted studies on evaluation of drying methods on some nutritional and volatile components of Bombay red onion. Result revealed that the effect of different drying method on protein, carbohydrate, total sugar, fat, pyurvic acid, ascorbic acid, total phenol, total flavonol, rehydration ratio, colour and sensory properties of onion slice were found insignificant at ($P < 0.05$) for microwave and modified direct solar dryer. But oven drying method had significant effect on onion bulb quality attributes at ($P < 0.05$) than other two drying methods.

2.4.3. Browning index

Rosendo (1995) reported that the optimising a multistage onion dryer using mathematical modeling. Result showed that the Non-enzymic browning of onion slices was modelled as a zero order reaction. Browning kinetic model was developed as a function of time, water activity and temperature of the product. The predictions of the computerised drying model showed better agreement with the results of the thick bed drying experiments.

Patil (2011) revealed that the dehydration of onion (*Allium cepa* L.): cultivar suitability and technological conditions for retaining fuctional quaity. Result showed that pusa white red cultivar of onion more suitable for dehydration , this cultivar observed with low reducing/non-reducing ratio, less browning, greater rehydration ratio, total solid /ha as compared with Pusa Red cultivar of onion.

Rathod (2013) analyzed effect of pre-treatment and drying methods in dehydration of onion. Result revealed that the onion slices of Pusa White flat showed the greater results for the physicochemical parameters and organoleptic characters. The higher dry matter content was observed in Bhima Shweta (13.80%) in sun dried onion slices and highest browning rate for Bhima Shweta and lowest in Pusa White flat.

CHAPTER – III

MATERIALS AND METHODS

CHAPTER-III

MATERIAL AND METHODS

An experiment entitled **"studies on evaluation of different varieties of onion for dehydration"** was conducted at experimental Farm, Horticulture Research Scheme (vegetable), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.(M.S.) This chapter outlines are specifics of the material used and procedures to be followed during the process of the investigations.

3.1 GENERAL

3.1.1 Location

The present investigation was conducted at Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Geographically Parbhani is situated at 409-meter altitude above mean sea level and falls on 19°16' N latitude and 76°47' E longitude and has a sub-tropical climate.

3.1.2 Climatic conditions

The area falls under the semi-arid tropics. The average annual precipitation (worked on the basis of last 33 years) in Parbhani is about 900 mm, mostly concentrated during the South West monsoon months from June to September. Summer is hot and dry, while winter is cool. The weather data pertaining to various weather parameters recorded during the course of investigation (January 2020 to March 2020) are given in Appendix-I.

In order to get idea about climatic conditions during the periods of investigation 2020, the weekly average weather condition i.e. maximum and minimum temperature, relative humidity and rainfall data was obtained from Agricultural Meteorological Observatory, VNMKV, Parbhani.

3.2 EXPERIMENTAL MATERIAL

3.2.1 Experimental Site

The field experiment on onion was carried out at experimental Farm, Horticulture Research Scheme (vegetable) and laboratory work carried out at laboratory of Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.(M.S.) during *(Rabi)* season of 2020-2021.

3.2.2 Experimental Design

Experiment I: Evaluation of different varieties of onion for dehydration

The field experiment was carried out in Randomized Block Design with three replications.

1.	Crop	:	Onion
2.	Family	:	Amarlidaceae
3.	Year of study	:	2020-21
4.	Experimental design	:	RBD
5.	Number of replication	:	03
6.	Plot size	:	3×3m
7.	Number of variety	:	12
8.	Number of plots	:	36
9.	Spacing	:	30×10cm

3.2.3 Experiments details:

Table 3.1 List of onion varieties evaluated.

Treatments	Name of onion variety	source
T_1	Bhima kiran	DOGR, Rajgurunagar
T_2	Bhima super	DOGR, Rajgurunagar
T_3	Bhima Dark Red	DOGR, Rajgurunagar
T_4	Bhima Light Red	DOGR, Rajgurunagar
T_5	Bhima Safed	DOGR, Rajgurunagar
T_6	Bhima Raj	DOGR, Rajgurunagar
T_7	Bhima Shakti	DOGR, Rajgurunagar
T_8	Bhima Shweta	DOGR, Rajgurunagar
T_9	Bhima Shubra	DOGR, Rajgurunagar
T_{10}	Bhima Red	DOGR, Rajgurunagar
T_{11}	N-2-4-1	M.P.K.V. Rahuri
T_{12}	Phule Samarth	M.P.K.V. Rahuri

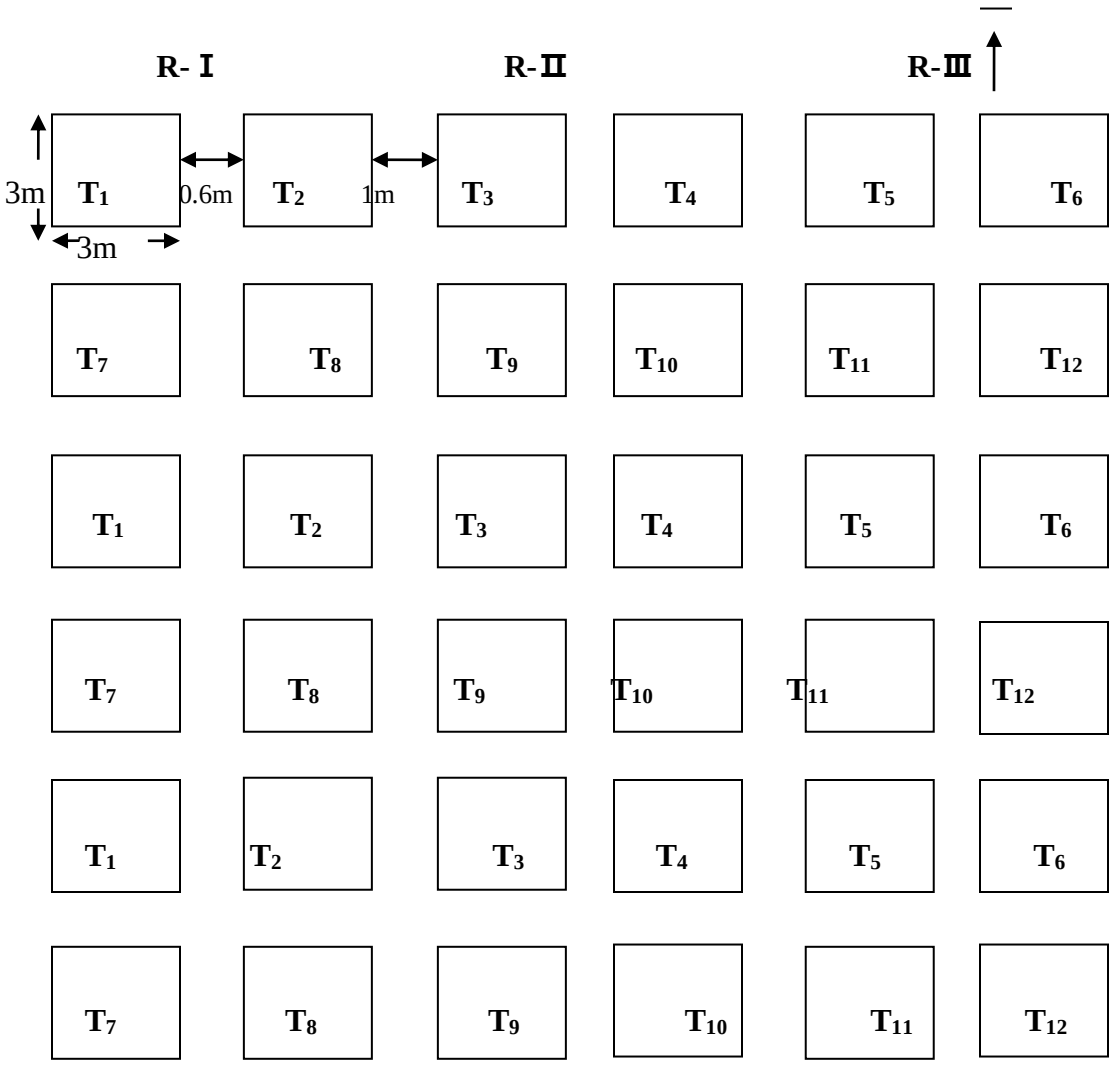

Fig. No. 3.1: Plan of Layout

Design : Randomized Block Design
Replication : Three
Net : 3.00 × 3.00 m

3.3 EXPERIMENTAL METHOD

3.3.1 Cultural Practices

3.3.1.1 Soil and climate

Onion can be grown all types of soil but sandy loam to clay loam is recommended for cultivation. Good drainage is essential and water logging leads to serious loss to onion crop. Climate – onion is a cool season vegetable and grows well under mild climate without extreme heat or cold or excessive rainfall. The ideal temperature for vegetative growth is 12.8 – 23.0°C. For the bulb formation it requires long days and still higher temperature (20-25°C).

3.3.1.2. Nursery Management and transplanting

Seed treatment: seeds treatments with thiram + carbendazim(2:1) @ 3g/kg should be done to diseases and damping off.

Nursery sowing: The size of the nursery bed was 3 m length, 1 m width, and 15 cm height. The nursery beds were prepared by combining FYM @ 20 kg and the NPK mixture @ 20 g of bed. After levelling, the seeds were sown in a line with a distance of 5 cm. After levelling, the seeds were sown in lines at a distance of 5 cm. at a depth of 2cm; the beds are then watered with rose cane. Germination of the seeds was done within 5-7 days after sowing, and the seedlings were then thinned to 1 cm in the line. Irrigation and weeding operations were taken out as and when necessary to raise strong seedlings free from disease. The seedlings treated with systemic fungicide Thiophanate Methyl 70%WP (ROKO 70%WP) to control diseases. Healthy seedlings were transplanted at a spacing of 30 X 10 cm after 8-10 weeks.

3.3. 1.3. Manure and fertilizer application

Farm yard manure was applied at the rate of 25 ton/ ha at the time of land preparation. 100:50:50 kg N: P: K, 15kg Mg and 20kg sulphur. One third nitrogen and full dose phosphorous and potash should be applied at the time transplanting whereas rest of nitrogen should be applied in two doses i.e., 30 and 45 days after transplanting.

3.3.1.4. Irrigation

Onion is mainly grown as an irrigated crop in India. Frequently of

irrigation depends on soil and climatic conditions. It require less water immediately after establishment of seedlings and consumption goes on increasing with maximum requirements before maturity, around 3 MAT, there after it is reduced. So irrigate the crop at 12-15 days interval during early stage followed by subsequent irrigations at 7-10 days interval.

3.3.1.5 Weeding and inter-culture

During early stage of the crop, plants grow slowly and it is essential to remove weeds. Pre-plant incorporation of Basalin (2kg a.i./ha) and Pendimethalin @3-4ml/l along with one hand weeding at 45 DAT is recommended to control weeds. Being a shallow rooted crop, deep inter-culture operation is likely to injure roots and reduce yield. Generally two hoing are essential for making soil loose and cover bulbs.

3.3.1.6 Harvesting

When the tops leaves turned brownish yellow and displayed the sign of drying leaves and bending over the ground, onion crops were harvested. There was harvesting done.

3.3.1.7 Storage Condition

Freshly harvested, healthy onion bulbs of average size were selected for storage experiment. The bulbs were grouped in sets of 12 for each replication (n=3) in each treatment set, and stored under ambient conditions (25°C). The bulbs were analyzed at monthly intervals for 05 months from the harvest for physicochemical and quality characteristics, with initial post-harvest analysis at the beginning of experiment was considered the reference.

3.4. OBSERVATION RECORDED

3.4.1. Growth parameter

3.4.1.1 Height of plant (cm)

Height of plant from the base of the plant to tip of the main stem was measured with scale. Plant height was measured at 30 and 60 days after transplanting and mean values were expressed in centimeter.

3.4.1.2 Number of leaves per plant

Number of leaves was counted at 30 DAT and 60 DAT at from selected plants. The mean was calculated.

Plate. No. 3.1 General view of experimental plot

Plate No. 3.2 Different varieties of onion

3.4.2 Yield parameter

3.4.2.1. Length of bulb (cm)

The length of each selected bulbs was measured by using digital vernier caliper from the base to tip of the bulbs and average of five fruits was computed and expressed in centimeters.

3.4.2.2 Diameter of bulb (cm)

The diameter of the selected bulbs was measured at the centre of fruits by using Digital Vernier caliper and average of ten fruits was recorded.

3.4.2.3. Average weight of bulb (gm)

The weight of each selected bulbs measured by using weighing balance and average weight of five bulb weight was calculated.

3.4.2.4. Yield per plot

Fruit yield per plot was recorded as the weight of whole fruits per plot and was expressed in kilograms.

3.4.3 Quality parameters

3.4.3.1 Total soluble solids (TSS)

Total soluble solids were measured by digital hand refractometer (0-32 %) by taking a drop of juice on prism of refractometer and the reading was recorded as total soluble solid in per cent and after computing the mean value it was recorded as a TSS value of bulb for each treatment.

3.4.3.2 Titratable Acidity

Titratable acidity was determined according to the AOAC official method 942.15 (AOAC 2000). Five gram of onion juice diluted in 25 ml of distilled water and titrated by 0.1N sodium hydroxide (NaOH) to pH 8.1. The titratable acidity was expressed as g citric acid/kg tomato, according to the following equation:

Titratable acidity (g citric acid/kg tomato) = (V×0.1×1000×0.064)/m
Where: 0.1 is normality of NaOH (N), 0.064 is conversion factor of citric acid, V is the volume of NaOH required (ml) and m is mass of tomato juice sample used (g).

3.4.3.3 Ascorbic acid

Determination of ascorbic acid was done by 2,6 dichlorophenol indophenols dye method as described by Ranganna (1977). A known quantity of onion juice or powder with 3% metaphosphoric acid (HPO_3) to make the final volume

of 100 ml and then filtered. A known quantity of aliquot was titrated against 0.025%. 2,6 dichlorophenol indophenols dye to a pink colour end point. The ascorbic acid content of the sample was calculated taking into consideration the dye factor and expressed as mg ascorbic acid per 100 g juice extract.

$$\text{Dye factor} = \frac{0.5}{\text{Titrate reading}}$$

$$\text{Ascorbic acid (mg/100 gm)} = \frac{\text{Titrate} \times \text{Dye factor} \times \text{Vol. made up reading}}{\text{Aliquot extract} \times \text{weight of sample taken for estimation}} \times 100$$

3.4.3.4 Total Sugars (%)

Total sugars were determined by adding the value of reducing and non reducing sugars. It was expressed in per cent.

a) Reducing sugar

Reducing sugar of juice were determined by method described by Ranganna (1986). A known quantity of sample was taken in a volumetric flask, some distilled water added and dissolved. Thereafter, 2 ml of 45% basis lead acetate solution was added for clarification. After 10 minute, the solution delayed by adding potassium oxalate crystals remained undisclosed and volume made up to level with distilled water and filtrate was titrated against boiling standard Fehling's mixtures till the blue coloured appeared. Then 1-2 drops of methylene blue indicator was added and the titration was continued till the content attained a brick red colour and titrate value was noted. The percentage of reducing sugar was calculated according to following formula.

$$\text{Reducing Sugar} = \frac{\text{Glucose equivalent} \times \text{Total volume made up}}{\text{Titrate value} \times \text{weight of sample}} \times 100$$

b) Non-Reducing Sugars

Non Reducing sugars content was determined by using Benedict's method. It was expressed in percent. In this method the juice powder of onion was taken for analysis. In this method the juice extracted from bulb is inverted by boiling

with mineral acid to obtain invert sugar solution. It is titrated against Benedict's reagent.

3.4.3.5. Chlorophyll

a) Chlorophyll- a

Chlorophyll-a contain of onion bulb were determined by using spectrophotometer. In this method fresh leaf samples were weighted, 0.1 g for every individual sample. Refrigerated 80% cc. acetone was used in order to drive the protein-chlorophyll complex and to extract the chlorophyll.

b) Chlorophyll -b

Chlorophyll-b contain of onion bulb were determined by using spectrophotometer. In this method fresh leaf samples were weighted, 0.1 g for every individual sample. Refrigerated 80% cc. acetone was used in order to drive the protein-chlorophyll complex and to extract the chlorophyll.

Experiment II : **Dehydration in onion**

The laboratory experiment was carried out in Completely Randomized Design with three replications.

Table 3.2: Treatment details:

Treatments	**Name of onion variety**
T_1	Bhima kiran
T_2	Bhima super
T_3	Bhima Dark Red
T_4	Bhima Light Red
T_5	Bhima Safed
T_6	Bhima Raj
T_7	Bhima Shakti
T_8	Bhima Shweta
T_9	Bhima Shubra
T_{10}	Bhima Red
T_{11}	N-2-4-1
T_{12}	Phule Samarth

Methods:

Harvested Fresh onions were procured from the vegetable farm of the Horticulture Research Scheme (Vegetable), VNMKV, Parbhani for experimentation. Tweleve varieties (Bhima kiran, Bhima super, Bhima Dark Red, Bhima Light Red, Bhima Safed , Bhima Raj , Bhima Shakti , Bhima Shweta , Bhima Shubra , Bhima Red, N-2-4-1 and Phule Samarth) were selected for the experiments. Preliminary sorting and grading of the procured onions was done and the odd sized onions were separated and discarded. Thereafter, uniform sized onions were kept for further experiments. The sorted onions of uniform size, appearance and hardness were manually trimmed, peeled and washed with running tap water. The onions were then sliced transversally in the longitudinal axis of the onion, in pieces of approximately 3 mm thickness for the dehydration studies. The onion slices were prepared manually with a steel knife. The onions slices were subsequently dried by using Cabinet dryer employing hot air stream at constant temperature of 60°C. Drying was continued till two consecutive readings of weight showed no change.

3.4.5 Observation Recorded

3.4.5.1 Moisture (%)

The reduction in moisture content of onion slices was recorded at an interval of one hour during drying process. The moisture content was calculated by using the following equation.

$$\text{Moisture content (\%)} = \frac{W1 - W2}{W1} \times 100$$

Where,

W1 = Initial weight of sample (gm)

W2 = Final weight of sample (gm)

3.4.5.2 Moisture ratio

The moisture ratio or dimensionless mass loss of samples during the drying process was calculated from the Lewis equation (Jayas *et al*., 1991).

$$\text{Dimensionless mass loss} = \frac{M_t - M_e}{M_i - M_e}$$

Where M_t is the sample moisture content at time t, % wb (wet basis), m_e is the equilibrium moisture content, % wb and M_i initial moisture content, % wb.

3.4.5.3 Drying rate

The drying rate of sample was determined using the equation

$$\text{Drying rate} = \frac{W_{t+dt} - W_t}{dt}$$

Where W_t is the sample weight at time t, % wb (wet basis), dt is the time interval between two consecutive measurements.

3.4.5.4 Dehydration ratio

Dehydration ratio was calculated by taking the weights of sample before drying and the weight of sample after drying.

$$\text{Dehydration ratio} = \frac{W2}{W1} \times 100$$

Where, W2 =Weight of sample after drying

W1 =Weight of sample before drying

3.4.5.5 Rehydration ratio

Dehydrated slices were evaluated for rehydration ratio to find the reconstitution of dried sample using the following formula

$$\text{Rehydration ratio} = \frac{W2}{W1} \times 100$$

Where, W2 =Weight of rehydrated sample, g

W1 =Weight of the dehydrated sample, g

3.4.5.3 Browning

Browning index of dehydrated onion was determined by the hunter lab calorimeter. Instrument was initially calibrated with a black as well as with standard ceramic plate. The 3-dimentional scale L*, a* and b* was used. The L* is the lightness coefficient, ranging between 0 (black) to 100 (white), a* represents

greenness and redness while b* represents yellowness and blueness, C represents croma value h represents hue angle.

$$\text{Browning index} = \frac{100\,(X - 0.31)}{0.17}$$

Where

$$X = \frac{a + 1.75\,L}{5.645\,L + a - 0.3012\,b}$$

3.5 Statistical analysis

The data on various observations during the course of investigation were statistically analyzed as suggested by Panse and Sukhatme (1967).

CHAPTER – IV

RESULTS AND DISCUSSION

CHAPTER – IV

RESULT AND DISCUSSION

The present experiment was carried out to investigate the "Studies on evaluation of different varieties of onion for dehydration'' was conducted at experimental Farm, Horticulture Research Scheme (vegetable) and laboratory work carried out at Laboratory of Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.) with objectives, to assess the physicochemical profile of onion varieties, to study the drying behavior of onion varieties and to find out suitable variety of onion for dehydration. The observations were recorded on various parameters governing to growth, yield and quality and drying kinetics. The results obtained are presented under appropriate headings.

4.1 Growth parameter

4.2 Yield parameter

4.3 Quality parameter

4.4 Drying kinetics

4.1 Growth parameter

4.1.1. Height of plant

Height of plant was recorded at 30 and 60 days after planting are presented in Table No. 4.1. The data in respect of height of plant showed significant differences at all stages of growth.

At 30 days after planting, significantly maximum height was recorded in variety Bhima Shubhra (29.21 cm) which was at par with the variety Bhima super (28.90 cm), Bhima Raj (28.28cm) and Bhima Kiran (28.04). However, minimum plant height was observed in variety N-2-4-1 (25.41 cm), Bhima Red (26.04cm), Bhima Light Red and Phule Samarth (26.74cm) at par with each other.

At 60 DAP, non-significant plant height was observed in different onion varieties.

Table 4.1: Height of plant in different onion varieties

Treatment Symbol	variety	Height of plant (cm)	
		30 DAS	60 DAS
T_1	Bhima kiran	28.04	53.06
T_2	Bhima super	28.90	52.21
T_3	Bhima Dark Red	26.96	55.45
T_4	Bhima Light Red	26.67	56.74
T_5	Bhima Safed	27.33	56.29
T_6	Bhima Raj	28.28	53.62
T_7	Bhima Shakti	27.57	55.32
T_8	Bhima Shweta	27.73	55.41
T_9	Bhima Shubhra	29.21	54.56
T_{10}	Bhima Red	26.41	52.82
T_{11}	N-2-4-1	25.74	53.70
T_{12}	Phule Samarth	26.44	50.63
SE ±		**0.41**	**1.25**
CD @ 5%		**1.21**	**N/A**

The results are in agreement with the findings of Gosai *et al.,* (2018) revealed that the highest plant height at 45 DAP was observed in NHRDF Red (30.00cm) and lowest plant height in Brown Spanish (21.02cm). This type of differences in plant height might due to their genetical behavior and also due to the suitability of environmental conditions.

Sikdar *et al.,* (2010) observed that the highest plant height (46.74cm) at 60DAP. The plant height affected by the depth of planting. Shallow depth of planting affected to plant height.

4.1.2. Number of leaves per plant

The data regarding the number of leaves per plant were recorded at 30 and 60 days after planting and presented in Table No. 4.2. The number of leaves per plant was significantly influenced by onion varieties at all stages of observations.

The data regarding the number of leaves per plant was recorded at 30 days after planting revealed that, significantly maximum number of leaves per plant

was recorded in variety Phule Samarth (6.8) which was at par with N-2-4-1 (5.6). However, minimum number of leaves per plant was recorded in variety Bhima Super (4.40) and Bhima Shakti (4.46), Bhima Light Red (4.56) and Bhima Dark Red (4.66) at par with each other.

The data pertaining the number of leaves per plant was recorded at 60 days after planting revealed that, significantly greater number of leaves per plant was recorded in variety Phule Samarth (12.8) followed by Bhima super (9.70), Bhima Safed (9.64) and Bhima Dark Red (9.47). However, least number of leaves was observed in variety Bhima Red (8.33).

Table 4.2: Number of leaves per plant in different onion varieties

Treatment Symbol	Variety	Number of leaves per plant	
		30 DAS	60 DAS
T_1	Bhima kiran	5.23	8.63
T_2	Bhima super	4.40	9.70
T_3	Bhima Dark Red	4.66	9.47
T_4	Bhima Light Red	4.56	9.26
T_5	Bhima Safed	4.73	9.64
T_6	Bhima Raj	4.73	8.63
T_7	Bhima Shakti	4.46	9.40
T_8	Bhima Shweta	5.26	8.73
T_9	Bhima Shubhra	5.00	8.93
T_{10}	Bhima Red	5.36	8.33
T_{11}	N-2-4-1	5.60	8.56
T_{12}	Phule Samarth	6.80	12.80
SE ±		**0.41**	**0.42**
CD @ 5%		**1.22**	**1.26**

Similar variation in number of leaves among different varieties were reported by Sikdar *et al*., (1986) plant spacing showed significant effects on most of the growth and yield characteristics. Wider spacing produced the maximum number of leaves per plant.

Gosai *et al.,* (2018) revealed that the highest number of leaves at 45 DAP was observed in NHRDF Red (5.86) and at 90 DAP in variety NHRDF Red-3

(10.73). Number of leaves differences observed in variety due to the genetic makeup of different variety and adoptability of environmental conditions.

4.2. Yield parameter

4.2.1. Length of bulb (cm)

Data in respect of length of bulb was recorded after harvesting and presented in Table No.4.3.

From the data presented in Table 4.3 observed that significantly maximum length of bulb was recorded in variety Phule Samarth (6.70 cm) followed by in variety Bhima Red (5.04), Bhima super (4.90 cm) and Bhima Shubhra (4.87) which were at par with each other. However, minimum length of bulb was found in variety Bhima Light Red (4.3 cm).

Table 4.3: Length of bulb in different onion varieties

Treatment Symbol	Variety	Length of bulb (cm)
T_1	Bhima kiran	4.75
T_2	Bhima super	4.90
T_3	Bhima Dark Red	4.49
T_4	Bhima Light Red	4.3
T_5	Bhima Safed	4.67
T_6	Bhima Raj	5.04
T_7	Bhima Shakti	4.73
T_8	Bhima Shweta	4.70
T_9	Bhima Shubhra	4.87
T_{10}	Bhima Red	4.58
T_{11}	N-2-4-1	4.57
T_{12}	Phule Samarth	6.70
SE ±		**0.34**
CD @ 5%		**1.00**

These results are in close conformity with the results obtained by Goudra (2012) reported that the Arka Pragati observed maximum length of bulb 5.83cm and minimum bulb length of Arka Kalian 4.82cm. Also Umamaheswarappa *et al.,* (2018) revealed that significantly the highest polar diameter of bulb (4.98 cm) was

recorded in the genotype Bhima Super followed by Agri found White (4.68 cm) as compared to other of the genotypes.

4.2.2. Diameter of bulb (cm)

Data in respect of weight of bulb was recorded after harvesting and presented in Table No.4.4.

The data presented in Table 4.4 found non-significant results of diameter of bulb in onion varieties studied.

These results are in close conformity with results obtained by Abdelkader *et al*., (2014), Kasera *et al.,* (2019) and Mushtaq *et al*., (2013). Hirave *et al.,* (2015) showed that the variety Bhima Red (V8) recorded significantly higher diameter of bulb (6.61 cm) and lower diameter of bulb was recorded by Agri found Dark Red (5.31 cm).

Table 4.4 : Diameter of bulb in different onion varieties

Treatment Symbol	Variety	Diameter of bulb (cm)
T_1	Bhima kiran	6.04
T_2	Bhima super	5.83
T_3	Bhima Dark Red	6.13
T_4	Bhima Light Red	5.88
T_5	Bhima Safed	6.20
T_6	Bhima Raj	5.32
T_7	Bhima Shakti	5.98
T_8	Bhima Shweta	6.05
T_9	Bhima Shubhra	5.95
T_{10}	Bhima Red	5.47
T_{11}	N-2-4-1	6.33
T_{12}	Phule Samarth	6.72
SE ±		**0.39**
CD @ 5%		**N/A**

These results are in close conformity with results obtained by Abdelkader *et al*., (2014), Kasera *et al.*, (2019) and Mushtaq *et al*., (2013). Hirave *et al.*, (2015) showed that the variety Bhima Red (V8) recorded significantly higher diameter of bulb (6.61 cm) and lower diameter of bulb was recorded by Agri found Dark Red (5.31 cm).

4.2.3. Average weight of bulb (gm)

Data in respect of average weight of bulb was recorded after harvesting and presented in Table No.4.5.

From the data presented in Table 4.5 showed significantly maximum average weight of bulb was recorded in variety Phule Samarth (116.17 g) followed by in Bhima Kiran (99.20 g) and Bhima Shubhra (97.25g) which were at par with each other. However, minimum average weight of bulb was recorded in variety Bhima Red (71.14g).

Table 4.5: Average weight of bulb in different onion varieties

Treatment Symbol	**variety**	**Average weight of bulb (g)**
T_1	Bhima kiran	99.20
T_2	Bhima super	95.87
T_3	Bhima Dark Red	85.38
T_4	Bhima Light Red	76.84
T_5	Bhima Safed	81.64
T_6	Bhima Raj	79.97
T_7	Bhima Shakti	86.24
T_8	Bhima Shweta	94.37
T_9	Bhima Shubhra	97.25
T_{10}	Bhima Red	71.14
T_{11}	N-2-4-1	78.98
T_{12}	Phule Samarth	116.71
SE ±		**4.81**
CD @ 5%		**14.21**

Average weight of bulb was significantly differed in onion varieties. These results are in close conformity with the results obtained by Gosai *et al.*, (2018)

revealed that the highest in Bhima Shakti (86.99g) and lowest in Brown Spanish (52.48g).Weight of bulb influenced by genetic makeup of different variety and adaptability of environmental conditions.

4.2.4. Yield per plot

Data in respect of yield of bulb per plot different turmeric varieties are presented in Table No.4. 6.

The significantly highest yield of bulb per plot was recorded in variety Phule Samarth (21.99 kg) followed by in Bhima Shakti (17.00 kg) and Bhima super (16.69 kg) which were at par with each other. However, minimum yield of bulb per plot was recorded in variety Bhima kiran (12.81 kg).

Table 4.6: Yield per plot in different onion varieties

Treatment Symbol	Variety	Yield per plot (Kg)
T_1	Bhima kiran	12.81
T_2	Bhima super	16.69
T_3	Bhima Dark Red	14.55
T_4	Bhima Light Red	12.89
T_5	Bhima Safed	15.24
T_6	Bhima Raj	15.69
T_7	Bhima Shakti	17.00
T_8	Bhima Shweta	15.17
T_9	Bhima Shubhra	14.42
T_{10}	Bhima Red	14.08
T_{11}	N-2-4-1	13.94
T_{12}	Phule Samarth	21.91
SE ±		**1.35**
CD @ 5%		**3.99**

These results are in close conformity with results obtained by Sikdar *et al.,* (2010) showed that the highest yield per plot (1.54kg) with spacing (20×10cm). Yield of bulb influenced by effect of spacing and depth of planting. Spacing between row to row and plant to plant results into maximum bulb yield.

Galeev *et al.*, (2018) Noticed that the maximum yield in Bennito F1 (43 t/ha) and lowest yield was observed in variant Yermak (21 t/ha). Commercial yield increased when the onion seed soaked in growth regulators like Argon, Albite, Novosil and Zicron by 36-47%, 15-21%, 48-56% and 30-52%, respectively.

Pardeshi and Waskar (2012) observed that JNDWD-207 was higher in yield per plot (22.5kg) and variety Sel-383 had minimum yield (13.33kg). Highest yield observed due to the increased growth of plant regarding with height of plant and number of leaves per plant.

4.3. Quality parameter

4.3.1. Total soluble solids (TSS), Titrable acidity and Ascorbic acid content in fresh harvested different varieties of onion

Data presented in Table No.4.7 showed that the Total soluble solids (TSS), Titrable acidity and Ascorbic acid content in fresh harvested different varieties of onion.

Data in respect of Total soluble solids (TSS) showed significant differences in different onion varieties. Significantly highest TSS of fresh onion observed in variety Bhima Shakti (15.80 %) which were at par with variety Bhima Kiran (14.59 %) while the lowest TSS was recorded in variety Phule Samarth (11.25 %), Bhima Drak Red (11.29%), Bhima Shubhra (12.29%), Bhima Safed (12.37%), Bhima Light Red (12.45%) which are at par with each other.

Data on Ascorbic Acid of fresh onion observeded significantly maximum in variety Bhima Kiran (20.21 %) which were at par with variety Bhima Shubhra (19.84 %) while the minimum ascorbic acid was recorded in variety Bhima Super (10.60%), Bhima Light Red (10.97%), N-2-4-1 which are at par with each other.

Table 4.7: Total soluble solids (TSS), Titrable acidity and Ascorbic acid content in fresh harvested different varieties of onion

Treatment Symbol	Variety	TSS (%)	Titrable acidity (%)	Ascorbic acid (mg/100g)
T_1	Bhima Kiran	14.59	1.42	20.21
T_2	Bhima Super	12.86	1.97	10.60
T_3	Bhima Drak Red	11.29	1.69	13.20
T_4	Bhima Light Red	12.45	1.56	10.97
T_5	Bhima Safed	12.37	1.62	17.08
T_6	Bhima Raj	13.25	1.42	15.92
T_7	Bhima Shakti	15.80	1.31	15.51
T_8	Bhima Shweta	13.63	1.01	16.22
T_9	Bhima Shubhra	12.29	1.40	19.84
T_{10}	Bhima Red	13.66	1.34	15.51
T_{11}	N-2-4-1	13.23	1.27	11.55
T_{12}	Phule Samarth	11.25	1.57	16.22
SE ±		**0.54**	**0.19**	**0.53**
CD @ 5%		**1.61**	**N/A**	**1.55**

These results of TSS are in close conformity with the results obtained by Pardeshi and Waskar (2012) showed that the maximum TSS observed in variety Arka Niketan (13.00%) and minimum TSS in Sel.-383 (10.15%) variety of onion. Genetic potential and climatic condition adopted by the variety during its growth impacton TSS of onion.

This result closely confirm with result finding by Vitila *et al*., (2012) revealed that the acidity of fresh onion was noticed (0.20%). Titrable acidity influencing by the dehydration, increased after dehydration. Results regarding ascorbic acid content are in closely confirmation with the finding of Goudra (2012), Rayar (2014), Patil *et al*., (2015) and Loredana *et al.*, (2017).

4.3.2. Sugars (%)

The data regarding to the total Sugars, Reducing sugar and Non reducing sugars of Fresh harvested different varieties of onion are presented in Table No.4.8.

The data showed that significantly maximum total sugars of fresh onion was recorded in variety Bhima Shewata (6.41 %) followed by in Bhima Kiran (6.34%) and Bhima Safed (6.20%) which were at par with each other. However, minimum was recorded in variety Phule Samarth (5.32%).

The data in respect to the reducing sugar of fresh harvested different varieties of onion showed that significantly maximum reducing sugar of fresh onion was recorded in variety Bhima Red (1.42 %) followed by in Bhima Safed (1.35%) and Bhima Kiran (1.35%) which were at par with each other. However, minimum was recorded in variety Phule Samarth (1.06%).

The data in respect to the non reducing sugars of fresh harvested different varieties of onion showed that significantly highest non-reducing sugars of fresh onion was recorded in variety Bhima Kiran (5.13 %) which was at par with Bhima Shweta (5.01%). However, lowest non-reducing sugars was recorded in variety Phule Samarth (5.04%).

Table 4.8: Sugars in fresh harvested different onion varieties.

Treatment Symbol	**Variety**	**Total sugars** (%)	**Reducing sugar (%)**	**Non reducing sugars (%)**
T_1	Bhima kiran	6.34	1.35	5.13
T_2	Bhima super	5.44	1.23	4.44
T_3	Bhima Dark Red	5.33	1.06	4.05
T_4	Bhima Light Red	5.70	1.23	4.41
T_5	Bhima Safed	6.20	1.35	4.90
T_6	Bhima Raj	5.97	1.20	4.76
T_7	Bhima Shakti	5.88	1.30	4.64
T_8	Bhima Shweta	6.41	1.22	5.01
T_9	Bhima Shubhra	5.56	1.33	4.23
T_{10}	Bhima Red	6.09	1.42	4.60
T_{11}	N-2-4-1	5.47	1.19	4.23
T_{12}	Phule Samarth	5.32	1.06	4.05
SE ±		**0.13**	**0.02**	**0.05**
CD @ 5%		**0.38**	**0.06**	**0.15**

These results are in close conformity with results obtained by Galeev *et al.,* (2018). Mention that the highest total sugar in Bennito F1 (10.3%) and lowest total sugar was observed in variant Borodkovsky (10%). Total sugar increased due to effect of growth regulators like Argon, Albite, Novosil and Zicron.

Kandoliya *et al*., (2015) revealed that JDRO-07-13 of red variety and GWO-1 of white nutritionally found better due to its lower reducing sugar (2.21mg/g). Also Priyadarshani *et al.,* (2020) showed that the among the genotypes, maximum reducing sugar was noticed in the genotype GWO-1 and ON-15-29 (3.67% each) of different genotypes, maximum non-reducing sugars and total sugars were recorded in the genotype Rose onion 4.12 and 6.34%, respectively.

4.3.3. Chlorophyll content

The data in respect to the Chlorophyll a and Chlorophyll b of fresh harvested different varieties of onion are presented in Table No.4.9.

The data showed that significantly maximum Chlorophyll a and Chlorophyll b of fresh onion was recorded in variety Phule Samarth (20.92) and (10.34), respectively followed by in Bhima Shkti (19.94) and (10.9), respectively. The minimum Chlorophyll a and Chlorophyll b were recorded in variety Bhima Dark Red (16.28) and (6.36), respectively.

Table 4.9: Chlorophyll-a and b in different onion varieties

Treatment Symbol	Variety	Chlorophyll	
		Chlorophyll-a	Chlorophyll-b
T_1	Bhima Kiran	16.40	6.43
T_2	Bhima Super	18.02	7.69
T_3	Bhima Drak Red	16.28	6.36
T_4	Bhima Light Red	19.60	8.62
T_5	Bhima Safed	18.69	8.19
T_6	Bhima Raj	16.80	6.86
T_7	Bhima Shakti	19.94	10.09
T_8	Bhima Shweta	18.45	7.96
T_9	Bhima Shubhra	19.31	8.27
T_{10}	Bhima Red	16.77	6.52
T_{11}	N-2-4-1	18.05	7.35
T_{12}	Phule Samarth	20.92	10.34
SE ±		**0.31**	**0.19**
CD @ 5%		**0.92**	**0.57**

These results were in agreement with findings of Hansi and Cebeci (2014). Total chlorophyll-a was decreased with drought level. The change in chlorophyll a content decreased as 37% at S_2 irrigation level in Akgun-12 and 28% at same condition in Kantartopu-3. Chlorophyll-b decreased Texas Early Grano and Akgun-12 at S_2 treatment. Total chlorophyll content affected by the cultivar and drought. Total chlorophyll-a was decreased with drought level.

Ghodke *et al*., (2018) reported that the higher chlorophyll content was observed in leaf tissue of onion variety Bhima kiran chlorophyll contents increased in irrigated condition and decreased in drought condition.

4.3. Dehydration of different onion varieties

4.3.1. Effect of drying on Total soluble solids (TSS), Titrable acidity and Ascorbic acid content in different varieties of onion

Data presented in Table No. 4.10 showed that the effect of drying on Total soluble solids (TSS), Titrable acidity and Ascorbic acid content in different varieties of onion.

The data showed that significantly maximum TSS of dehydrated onion was observed in variety Bhima Kiran (17.94 %) which was at par with variety Bhima Shakti (17.82 %) while the minimum TSS was recorded in variety Bhima Raj (13.11 %).

Data in respect of titrable acidity of dehydrated onion showed significant difference among varieties. Maximum acidity was recorded in variety N-2-4-1 (25.03) followed by Bhima Shubhra (21.80%). However, minimum acidity was found in variety Bhima Kiran (14.57%).

The data in respect of ascorbic acid content showed significantly maximum ascorbic acid of dehydrated onion in variety Bhima Kiran (17.93 mg/100g) which was at par with the variety Bhima Safed (17.75 mg/100g) and Bhima Shubhra (16.74 mg/100g). The minimum ascorbic acid content was found in variety Bhima Light Red (11.49 mg/100g).

Table 4.10: Effect of drying on Total soluble solids (TSS), Titrable acidity and Ascorbic acid content in different varieties of onion

Treatment Symbol	Variety	TSS (%)	Titrable acidity (%)	Ascorbic acid (mg/100g)
T_1	Bhima Kiran	17.94	14.57	17.93
T_2	Bhima Super	15.07	15.82	11.57
T_3	Bhima Drak Red	16.02	15.61	12.14
T_4	Bhima Light Red	14.82	19.51	11.49
T_5	Bhima Safed	13.93	15.22	17.75
T_6	Bhima Raj	13.11	17.53	14.91
T_7	Bhima Shakti	17.82	18.44	14.61
T_8	Bhima Shweta	13.85	20.68	14.88
T_9	Bhima Shubhra	15.49	21.80	16.74
T_{10}	Bhima Red	16.08	16.66	15.70
T_{11}	N-2-4-1	15.74	25.03	13.06
T_{12}	Phule Samarth	13.36	20.36	15.70
SE ±		**0.33**	**0.73**	**0.49**
CD @ 5%		**0.96**	**2.15**	**1.44**

This result are closely confirm with result finding by Mitra *et al*., (2012), Vitila *et al*., (2012) revealed that the acidity of fresh onion was noticed (0.20%). Titrable acidity in affected by the dehydration. Titrable acidity increased after dehydration. Lewicki *et al*., (1998) revealed that the pre-drying treatments affect chemical composition of onion.

Patil *et al*., (2015) result showed that ascorbic acid was observed 5.1 to 9.3 (mg/100g). Highest ascorbic acid was noticed at 70°C temperature, 50 min cut-off time and tempering period 40 min. Ascorbic acid of onion decreased with increasing drying temperature, this is due the effect of different drying condition like temperature, cut-off time and temperature period on nutritional quality of onion.

4.3.2. Effect of drying on sugars in different varieties of onion

Data presented in Table No.4.11 showed that the effect of drying on total Sugars, reducing sugar and non-reducing sugars in different varieties of onion.

Data in respect of total sugars of dehydrated onion showed significant difference among varieties. Significantly highest total sugars of dehydrated onion was recorded in variety Bhima Kiran (27.76%) which was at par with Bhima Raj (25.87%), Bhima Safed (25.83%), Bhima Shubhra (25.50%), and Bhima Light Red (25.14%). However, lowest total sugars were recorded in variety Bhima Dark Red (19.09%).

Data on reducing sugar of dehydrated onion showed significant difference among varieties. Significantly maximum reducing sugar of dehydrated onion was recorded in variety Bhima Kiran (21.27 %) which was at par with Bhima Raj (19.46%). However, minimum reducing sugar was recorded in variety Phule Samarth (9.77%).

Data pertaining to the non reducing sugars of dehydrated onion found significant difference among varieties. Significantly maximum Non reducing sugars of dehydrated onion was recorded in variety Bhima Shubhra (12.73 %) followed by Bhima Light Red (11.24 %). However, minimum non reducing sugars were recorded in variety Bhima Kiran (6.65%).

Table 4.11: Effect of drying on sugars in different varieties of onion

Treatment Symbol	Variety	Total sugars (%)	Reducing sugar (%)	Non reducing sugars (%)
T_1	Bhima kiran	27.76	21.27	6.65
T_2	Bhima super	23.30	15.41	7.33
T_3	Bhima Dark Red	19.09	10.99	8.02
T_4	Bhima Light Red	25.14	13.62	11.24
T_5	Bhima Safed	25.83	16.83	8.51
T_6	Bhima Raj	25.87	19.46	6.69
T_7	Bhima Shakti	23.03	15.54	7.15
T_8	Bhima Shweta	24.90	12.09	12.42
T_9	Bhima Shubhra	25.50	13.48	12.73
T_{10}	Bhima Red	23.11	16.03	6.74
T_{11}	N-2-4-1	20.16	11.92	8.43
T_{12}	Phule Samarth	19.59	9.77	9.64
SE ±		**0.68**	**0.64**	**0.17**
CD @ 5%		**2.00**	**1.88**	**0. 52**

These results are in close conformity with results obtained by Patil *et al*., (2015). Result showed that total sugar ranged between 33.60.to 44.97% and reducing sugar ranging between 12.20 to 24.51%. This is because of effect of drying method, sugar percentage affected by drying parameters.

4.3.3. Moisture (%)

The data on moisture content of different varieties of onion are presented in Table No. 4.12.

The data regarding to the moisture content on wet basis maximum was recorded in variety Bhima Shweta (98.27-82.00 %) followed by Bhima Safed (98.08-87.00 %) and Bhima Dark Red (98.04-86.00%). However, minimum was recorded in variety Bhima Kiran (97.12-82.00 %).

The data pertaining to the moisture content on dry basis highest was recorded in variety Bhima Shweta (56.87-7.33 %) followed by Bhima Safed (50.98-

6.69 %) and Bhima Dark Red (50.02-6.14%). However, lowest was recorded in variety Bhima Kiran (33.72- -4.56 %).

Table 4.12: Moisture content on wet basis and dry basis in different varieties of onion.

Treatment Symbol	Variety	Moisture (% wb)	Moisture (% db)
T_1	Bhima kiran	97.12 - 82.00	33.72 - -4.56
T_2	Bhima super	97.42 - 83.00	37.70 - -4.88
T_3	Bhima Dark Red	98.04 - 86.00	50.02 – 6.14
T_4	Bhima Light Red	97.70 - 84.00	42.40 – 5.25
T_5	Bhima Safed	98.08 - 87.00	50.98 – 6.69
T_6	Bhima Raj	97.35 - 83.00	36.71 – 4.88
T_7	Bhima Shakti	97.26 - 82.00	35.55 – 4.56
T_8	Bhima Shweta	98.27 - 88.80	56.87 – 7.33
T_9	Bhima Shubhra	97.90 - 85.00	46.62 – 5.67
T_{10}	Bhima Red	97.84 - 85.00	45.30 – 5.67
T_{11}	N-2-4-1	97.50 - 84.00	39.06 – 5.25
T_{12}	Phule Samarth	97.87 - 86.00	45.99 – 6.14

These results are in close conformity with results obtained by Djaeni *et al*., (2017) showed that the initial moisture content was observed (89.97%) wet basis and moisture ratio of 9 on dry basis. moisture contents removal increasing with increasing air temperature and drying time also.

Gupta *et al*., (2010) observed that moisture content and rehydration ratio increased during storage period but moisture content showed decreasing trend with increasing temperatures.

4.3.4. Moisture ratio

The data on moisture ratio of different varieties of onion as presented in Table No.4.13.

The data regarding to the moisture ratio significantly minimum moisture ratio was recorded in variety Bhima Shakti and Bhima Kiran (0.62 %),

followed by in Bhima super and Bhima Raj (0.63%) while, maximum was observed in variety Bhima Shweta (0.72 %).

Table 4.13: Effect of drying on moisture ratio in different varieties of onion

Treatment Symbol	variety	Moisture Ratio
T_1	Bhima kiran	0.62
T_2	Bhima super	0.63
T_3	Bhima Dark Red	0.68
T_4	Bhima Light Red	0.65
T_5	Bhima Safed	0.70
T_6	Bhima Raj	0.63
T_7	Bhima Shakti	0.62
T_8	Bhima Shweta	0.72
T_9	Bhima Shubhra	0.66
T_{10}	Bhima Red	0.67
T_{11}	N-2-4-1	0.65
T_{12}	Phule Samarth	0.68
SE ±		**0.24**
CD @ 5%		**0.73**

These results are in close conformity with results obtained by Revaskar *et al*., (2014) moisture diffusivity is affected due to the shrinkage, moisture contents and temperature of material. Moisture ratio decreasing continuously showed that diffusion has internal mass transfer.

Gupta *et al*., (2010) studied varietal effect on drying behavior and quality characterics of onion. Result showed that the variety PBW-1was found more suitable for commercial dehydration on account of lower drying ratio of 6.49 as compared to 7.26 for pb Naroya and 7.90 for PRO-6, respectively.

4.3.5 Drying rate

The data in respect to the drying rate of different varieties of onion as presented in Table No. 4.14.

The data in respect to the drying rate significantly highest was observed in variety Bhima Dark Red (11.02 – 1.02 kg water /kg dry matter /hr) followed by Phule Samarth (910.34 - 0.38 kg water /kg dry matter /hr) and Bhima Safed (9.98 - 0.42 kg water /kg dry matter /hr). However, lowest was recorded in variety Bhima Kiran (4.17 - 0.56 kg water /kg dry matter /hr).

Table 4.14: Drying rate in different varieties of onion.

Treatment Symbol	Variety	Drying rate (kg water /kg dry matter /hr)
T_1	Bhima kiran	4.17 - 0.56
T_2	Bhima super	8.51 - 0.77
T_3	Bhima Dark Red	11.02 - 1.02
T_4	Bhima Light Red	7.47 - 0.69
T_5	Bhima Safed	9.98 - 0.42
T_6	Bhima Raj	9.80 - 0.15
T_7	Bhima Shakti	4.09 - 0.58
T_8	Bhima Shweta	9.26 - 0.69
T_9	Bhima Shubhra	9.52 - 0.57
T_{10}	Bhima Red	8.89 - 0.37
T_{11}	N-2-4-1	7.85 - 0.32
T_{12}	Phule Samarth	10.34 - 0.38

These results are in close conformity with results obtained by Bajaj *et al*., (1979), Lewicki *et al.,* (1998), Hatamipour *et al*., (2007), Kulkarni (2011), Olalusi. (2014), pooja *et al.*, (2018) and Revaskar *et al.,* (2014) reported that the entire drying process occurred in falling rate period and constant rate period was not observed. Five thin layer drying equations were investigated for their suitability to describe the drying behavior of onion slices. The effect of temperature and pre-treatment on drying behavior of onion slices in tray dryer was investigated.

4.4. Drying kinetics

4.4.1. Drying kinetics of different onion varieties

Typical drying curves of different onion varieties under convective air drying are shown in Fig. 1, 2, 3 and 4. The moisture content versus time curves for

drying of different onion varieties are shown in fig. 1. A general trend observed was that with increase in drying time there was a gradual decrease in moisture content. The initial moisture content of different onion varieties slices Bhima kiran, Bhima super, Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, Bhima Shubra, Bhima Red, N-2-4-1 and Phule Samarth was 82%, 83%, 86%, 84%, 87%, 83%, 82%, 88%, 85%, 85%, 84% and 86%, respectively. It nearly took 12 hrs, 11hrs, 11hrs, 9hrs, 11 hrs, 8hrs, 12hrs, 10hrs, 9hrs, 11hrs,7hrs and 7 hrs to achieve 50% moisture level in Bhima kiran, Bhima super, Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, Bhima Shubra, Bhima Red, N-2-4-1 and Phule Samarth, respectively. The subsequent drying pattern being slow, additional 4hrs, 3hrs, 4hrs, 3hrs, 4hrs, 4 hrs, 4hrs, 3rsh, 4hrs, 3 hrs, 3hr and 4hrs in Bhima kiran, Bhima super, Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, Bhima Shubra, Bhima Red, N-2-4-1 and Phule Samarth., respectively was required for the samples to reach the EMC. The total time required to dry different onion varieties slices from an initial moisture content of 82%, 83%, 86%, 84%, 87%, 83%, 82%, 88%, 85%, 85%, 84% and 86% to EMC in Bhima kiran, Bhima super, Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, Bhima Shubra, Bhima Red, N-2-4-1 and Phule Samarth was 16 hrs, 14hrs, 15hrs, 12hrs, 15 hrs, 12hrs, 16hrs, 13hrs, 13hrs, 14hrs,10hrs and 11 hrs hrs., respectively.

The change in dimensionless moisture loss of different onion varieties slices as a function of drying time is shown in fig 2. The pattern of loss of moisture is similar to that observed in fig 2 (representing moisture content versus drying time) (fig.3). Fig 5 (a), (b), (c), (d), (e), (f), (g), (h), (i), (j), (k) and (L) show the change in the logarithm of the inversed moisture ratios over drying time for different onion varieties slices at 60^0 C temperature. The solid line is the regression line described by the equation In (1/MR)-kt, with the drying constant of 0.479, 0.456, 0.382, 0.434, 0.353, 0.455, 0.482, 0.328, 0.409, 0.407, 0.429 and 0.375 in different onion varieties slices Bhima kiran, Bhima super, Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, Bhima Shubra, Bhima Red, N-2-4-1 and Phule Samarth, respectively.

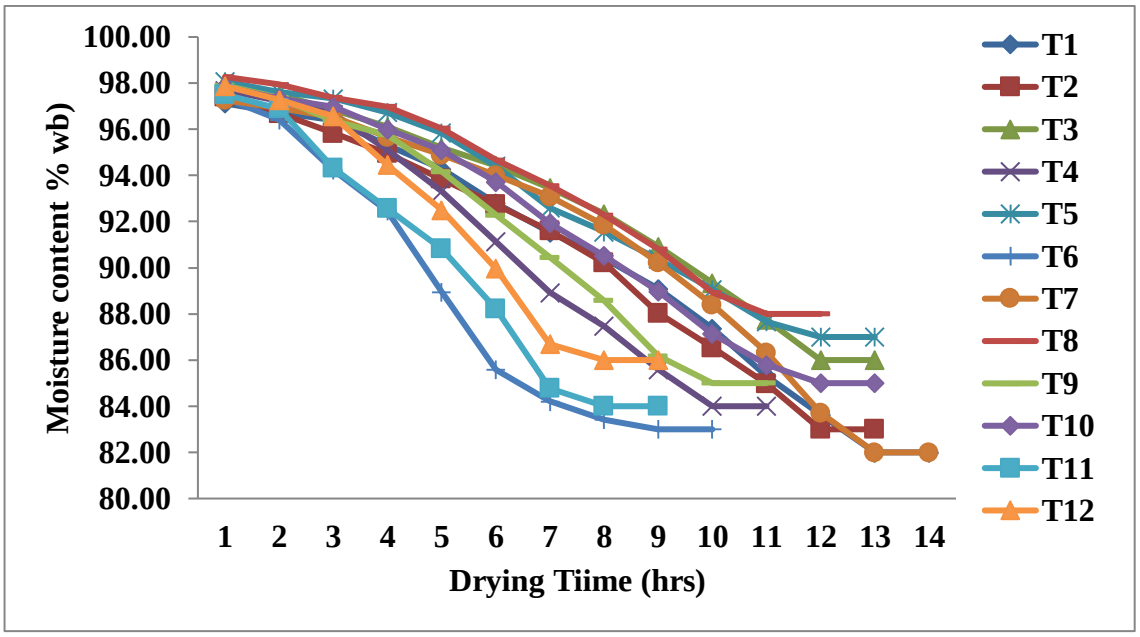

Fig.- 4.1 Moisture content versus drying time curve for drying of different varieties onion slices

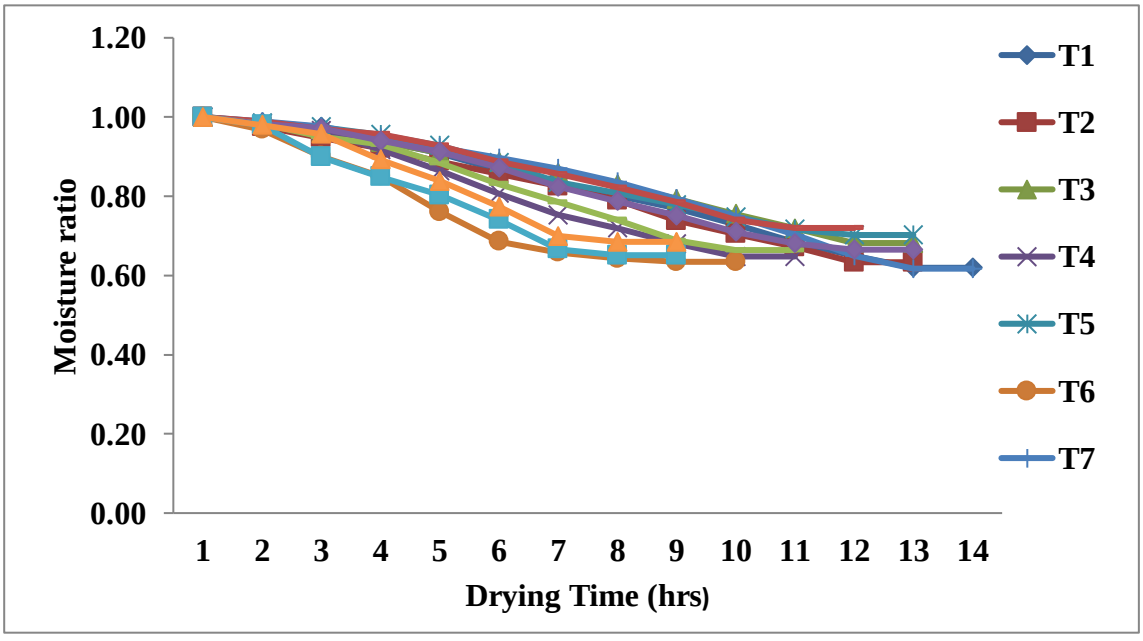

Fig. 4.2. Moisture ratio (decimal) versus drying time curve for convective air drying of different onion varieties slices

In order to check for the existence of different dehydration periods, drying rate was computed. The experimental drying rate (kg water /kg dry matter /min) of different onion varieties slices, as a function of moisture (kg water /kg dry matter) is shown in Fig 3. The drying rate curves of different onion varieties slices typically demonstrate a smooth diffusion controlled drying behaviour. The drying rate decreased with increasing time for all the varieties. The drying rate was higher in the beginning, in all different onion varieties (Bhima kiran, Bhima super, Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, Bhima Shubra, Bhima Red, N-2-4-1 and Phule Samarth) , followed by constant rate period. The drying rate, as represented by plots of kg water /kg dry matter /hr versus time , for different onion varieties, consistently show a later initial falling rate and a constant drying rate period (Fig.3). Drying rate was recorded 4.17 kg water/kg dry matter/hr to 0.56 kg water/kg dry matter/hr, 8.51 kg water/kg dry matter/hr to 0.77 kg water/kg dry matter/hr, 11.02 kg water/kg dry matter/hr to 1.02 kg water/kg dry matter/hr, 7.47 kg water/kg dry matter/hr to 0.69 kg water/kg dry matter/hr, 9.98 kg water/kg dry matter/hr to 0.42 kg water/kg dry matter/hr, 9.80 kg water/kg dry matter/hr to 0.15 kg water/kg dry matter/hr , 4.09 kg water/kg dry matter/hr to 0.58 kg water/kg dry matter/hr, 9.26 kg water/kg dry matter/hr to 0.69 kg water/kg dry matter/hr, 9.52 kg water/kg dry matter/hr to 0.57 kg water/kg dry matter/hr, 8.89kg water/kg dry matter/hr to 0.37 kg water/kg dry matter/hr, 7.85 kg water/kg dry matter/hr to 0.32 kg water/kg dry matter/hr and 10.34 kg water/kg dry matter/hr to 0.38 kg water/kg dry matter/hr in Bhima kiran, Bhima super , Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, Bhima Shubra, Bhima Red, N-2-4-1 and Phule Samarth, respectively.

The variations of the drying rates with moisture constant (% db) are shown in Fig. 4. It was observed that both drying rate and moisture content decreased as the drying progressed. Initially the drying rate was higher because in initial phase, water for evaporation came from regions near the surface. As drying progressed, the drying rate decreased with decrease of moisture content, as the water to be evaporated came from within the structure and had to be transported to the surface Also, some resistance to water movement might exist due to shrinkage of the product on the surface, which considerably reduced the drying rate. The drying rates were higher at the beginning of the process probably due to evaporation of moisture from the surface of the onion slices and later decreased with decreasing moisture content. It is clearly visible from the Fig. 4 that there was no constant rate drying period for all the varieties at drying temperature of 60°C. This suggested predominance of internal diffusion phenomenon as the mass transfer controlling process. The absence of a constant drying rate period might be due to thin layer of product that did not provide a constant supply of water for an applied period of time (Pathare and Sharma, 2006).

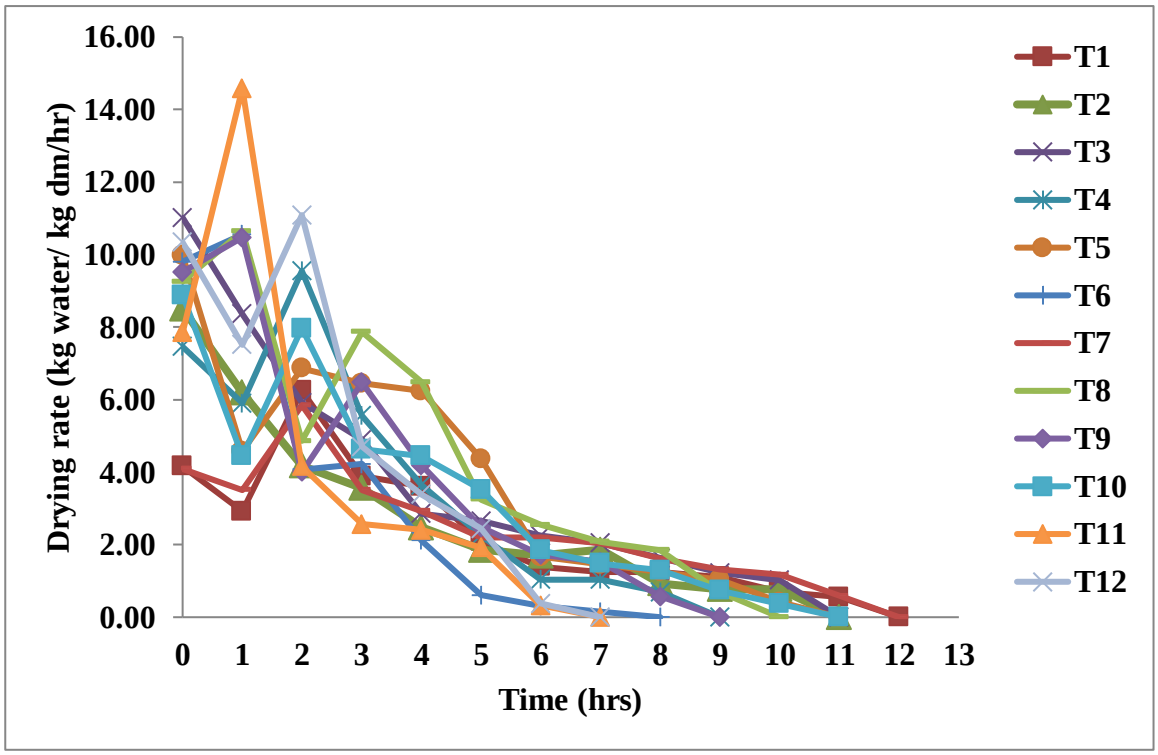

Fig. 4.3 Drying rate versus drying time curve for convective air drying of onion slices

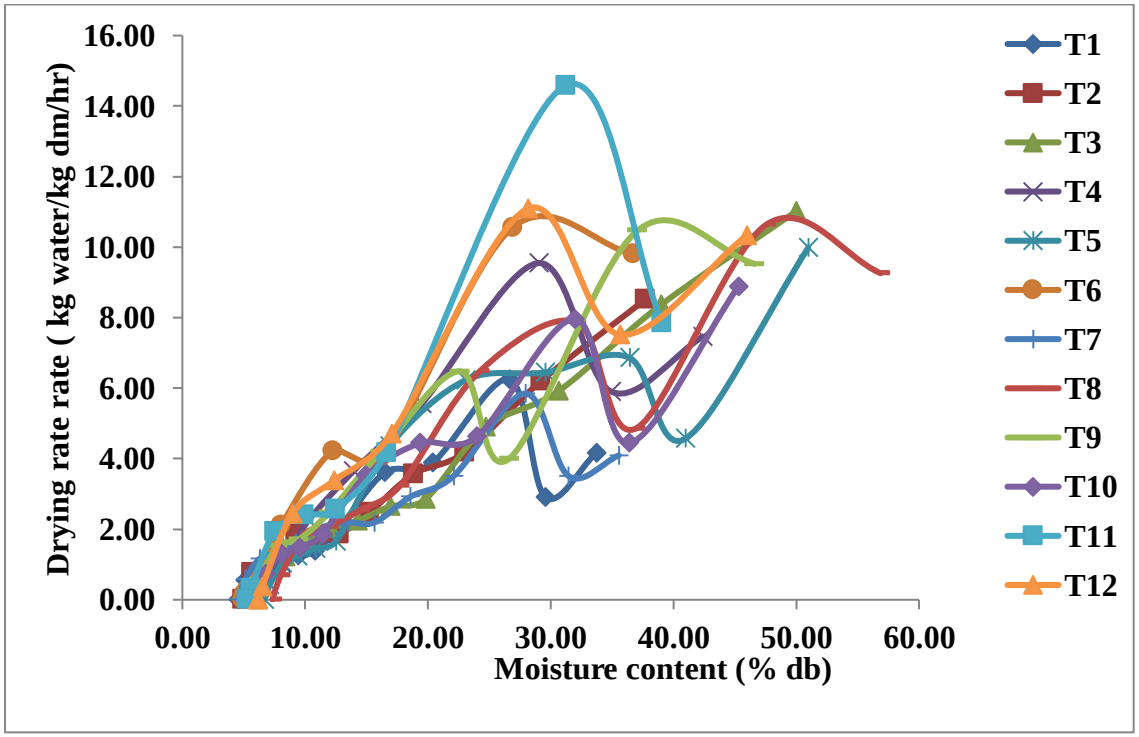

Fig. 4.4 Drying rate versus moisture content curve for convective air drying of onion slices

The drying rate curves of the onion samples can be broken down into 2 to 3 falling rate periods. The falling rate drying period is indicative of an increased resistance to both heat and mass transfer through the inner structure of the onion flakes and rings. The drying time at which the falling rate changed from one to another, varied with the variety. The first falling rate drying period was for a very short time. The second falling rate period was the one where the drying rate decreased steadily.

These results are in close conformity with results obtained by Revaskar *et al*., (2014) concluded that effective moisture diffusivity different in ranging between 0.78 to 1.21 × 10^{-10} m^2/s in non-treated onion sample determining by drying air temperature. Outcome of temperature and pre-treatment on drying behavior of onion slices in tray dryer.

Goudra *et al.*, (2018) revealed that the sample of Arka kalyan onion required 17 to 21 h to dry under open yard sun drying and 15-17 h in solar tunnel drier to bring down initial moisture content ranging from 545.16- 992.905% (db) to final moisture content of 4.95-5.21% (db).

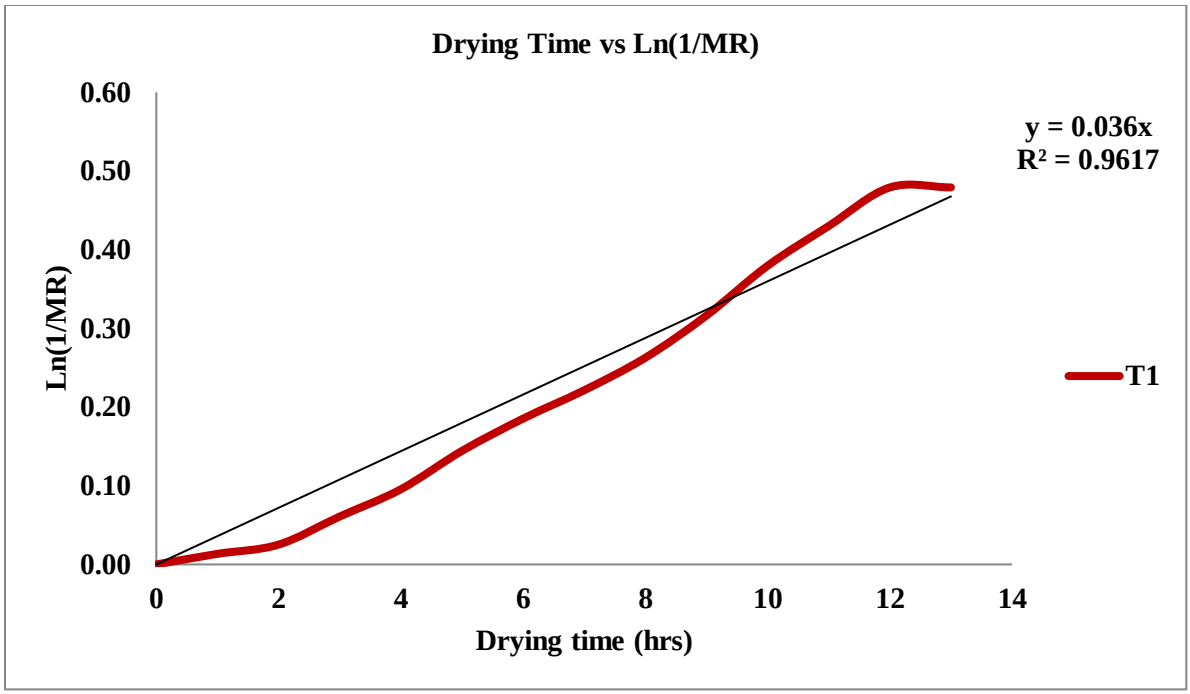

Fig. 4.5. (a) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_1 of onion slices

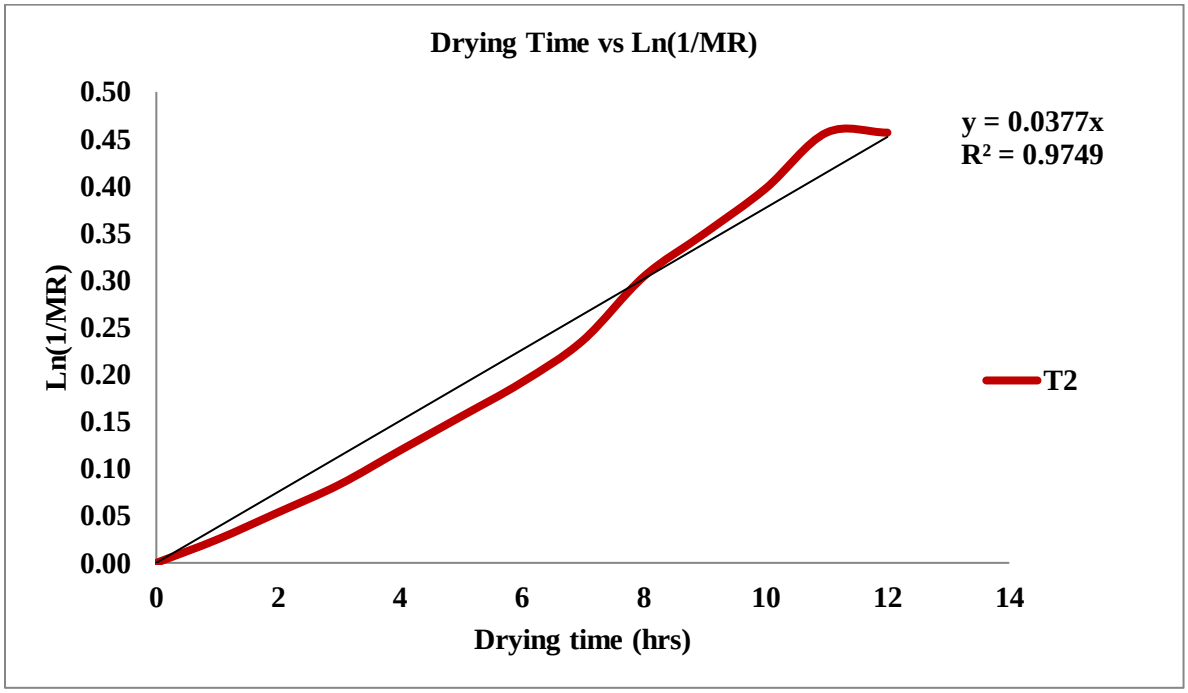

Fig. 4.5. (b) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_2 of onion slices

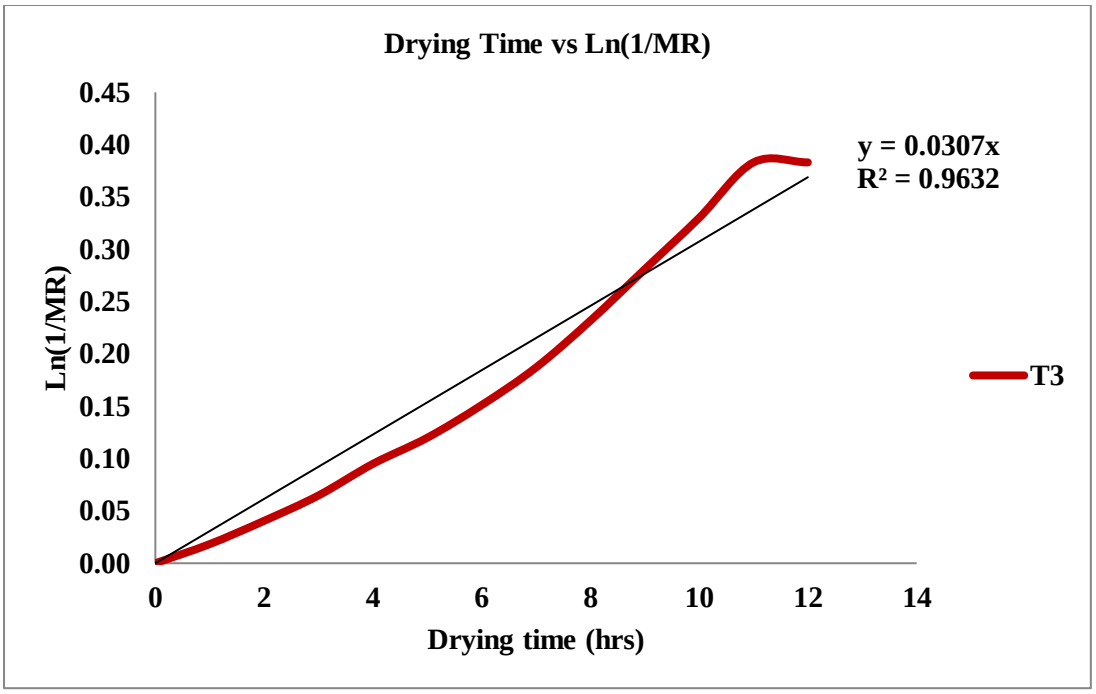

Fig. 4.5. (c) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_3 of onion slices

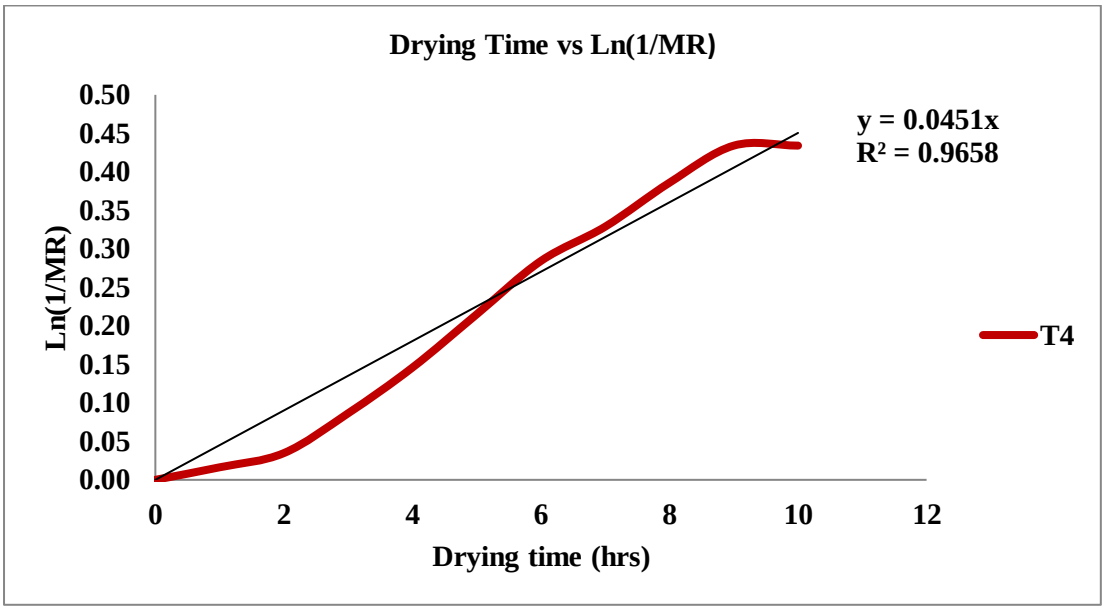

Fig. 4.5. (d) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_4 of onion slices

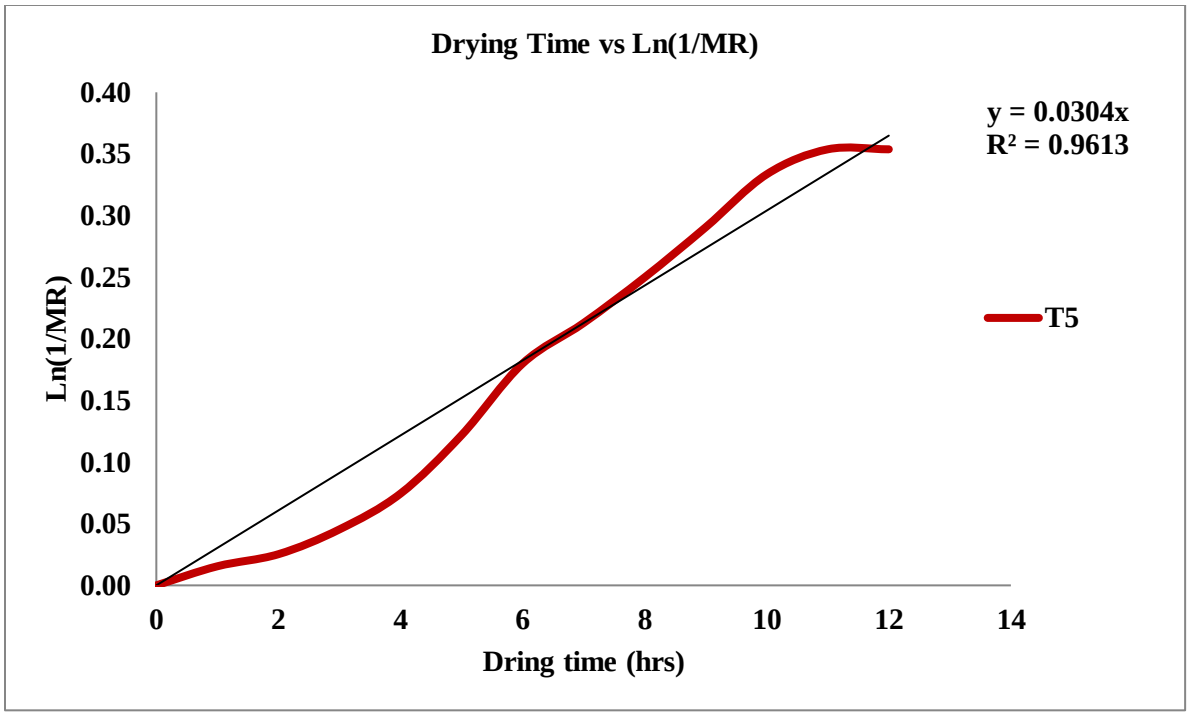

Fig. 4.5. (e) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_5 of onion slices

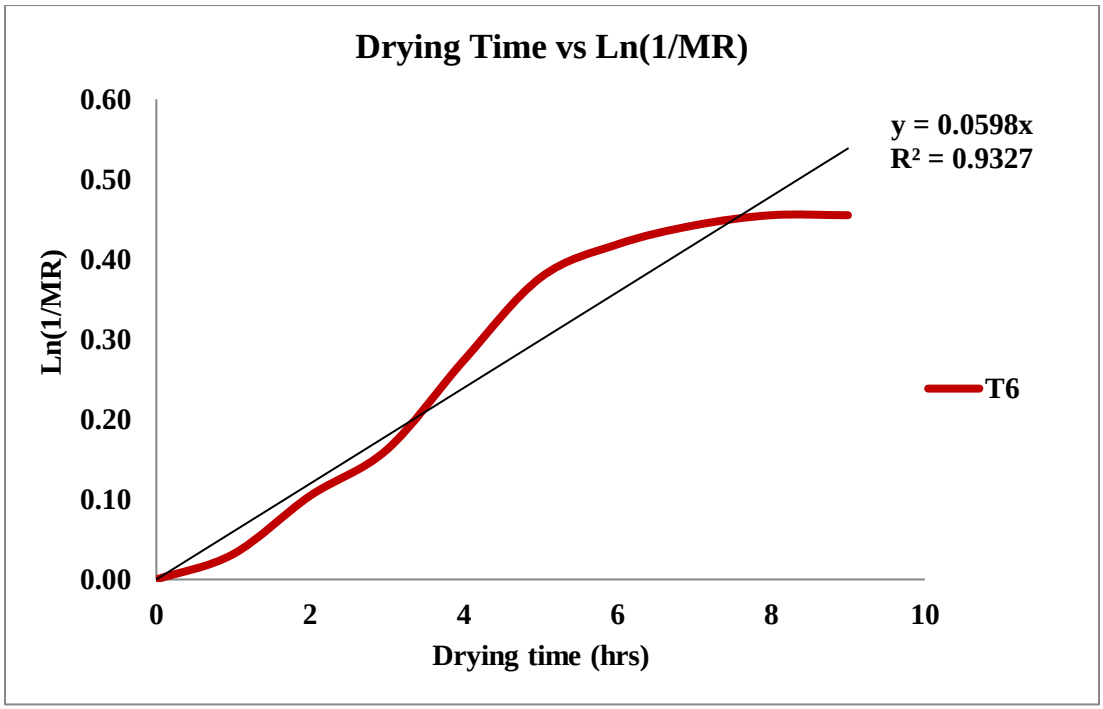

Fig. 4.5. (f) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_6 of onion slices

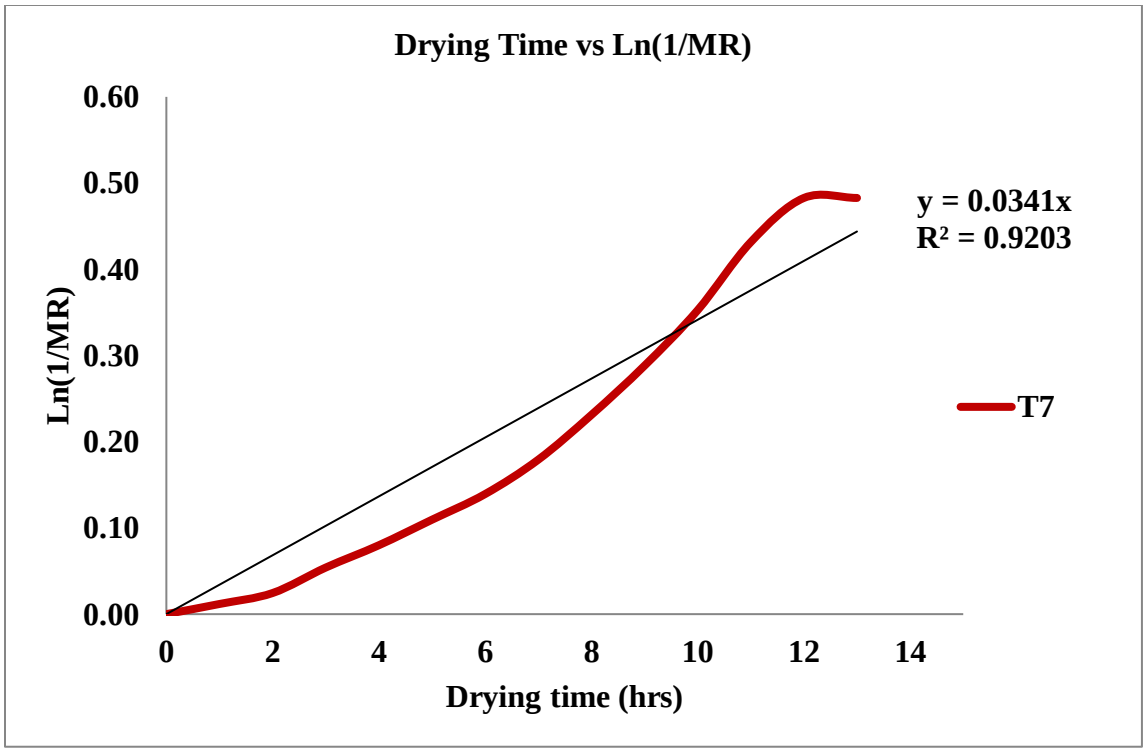

Fig. 4.5. (g) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_7 of onion slices

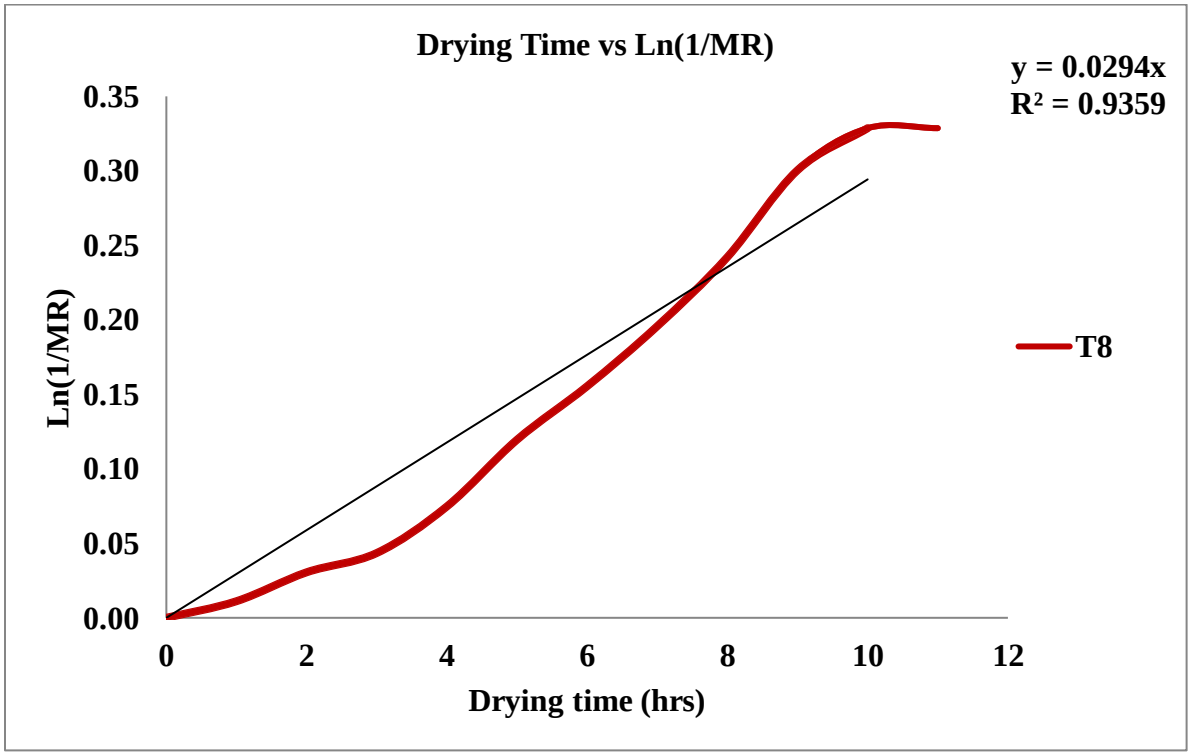

Fig. 4.5. (h) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_8 of onion slices

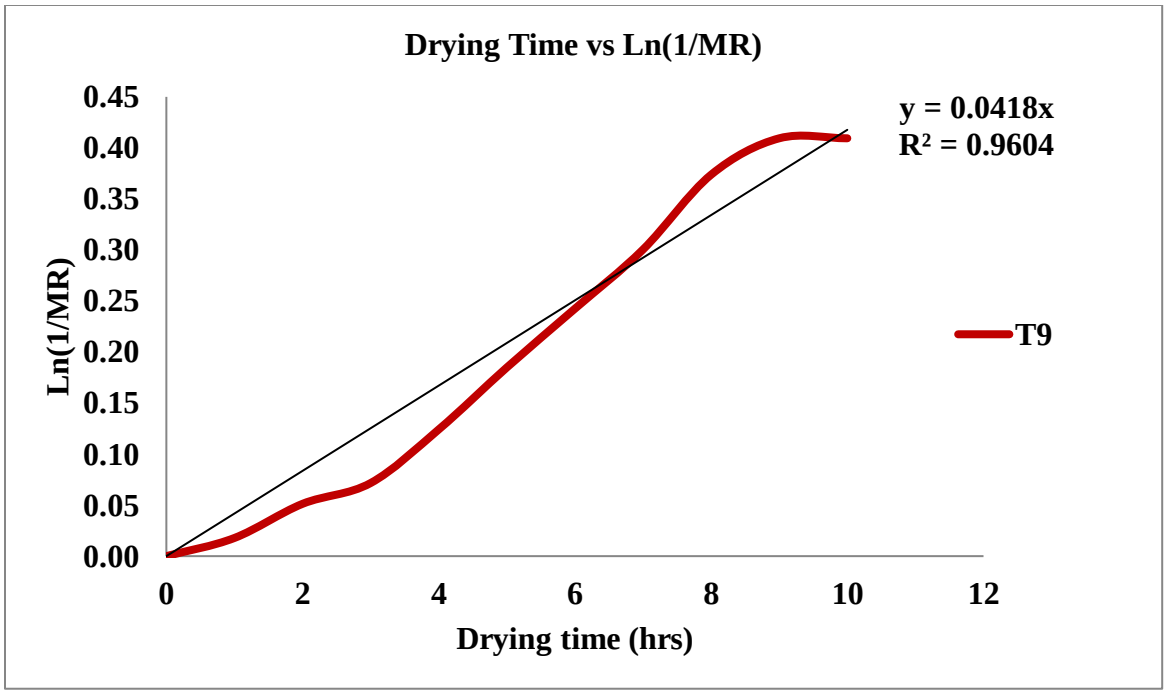

Fig. 4.5. (i) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_9 of onion slices

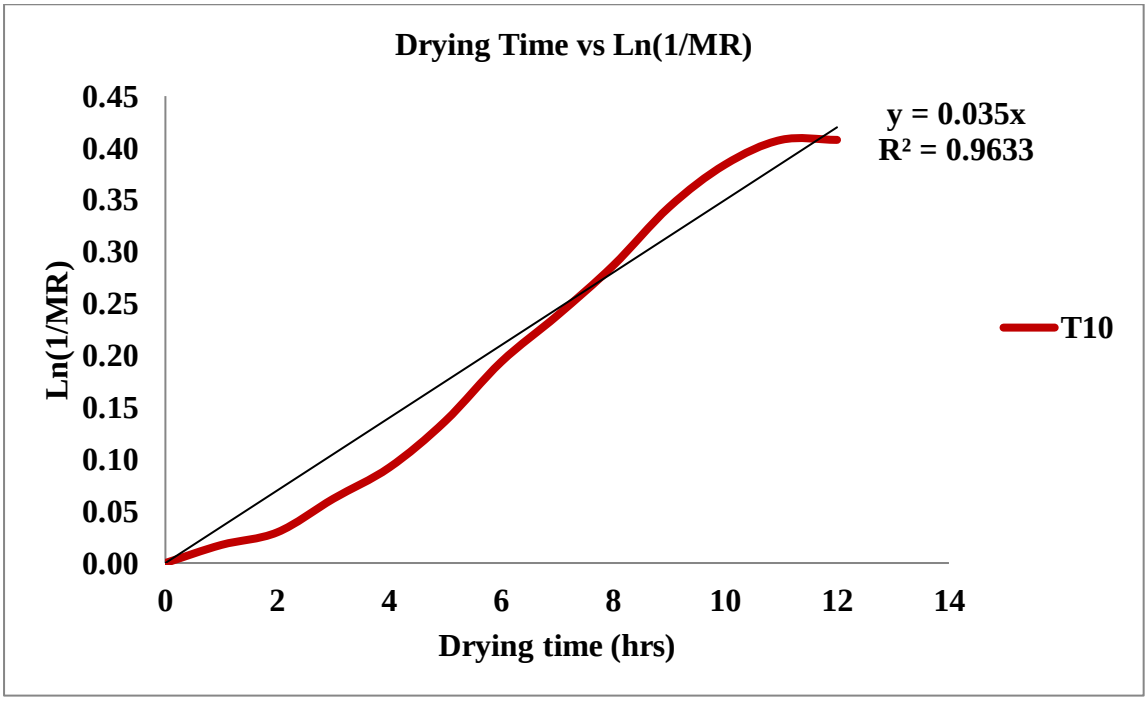

Fig. 4. 5. (j) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_{10} of onion slices

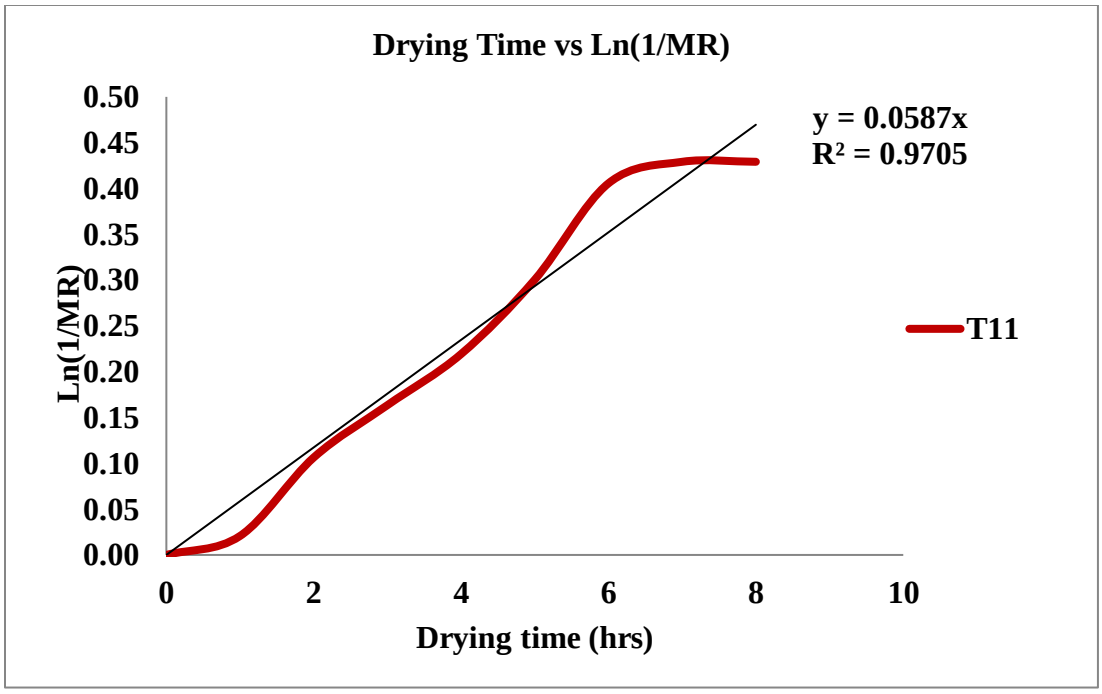

Fig. 4.5. (k) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_{11} of onion slices

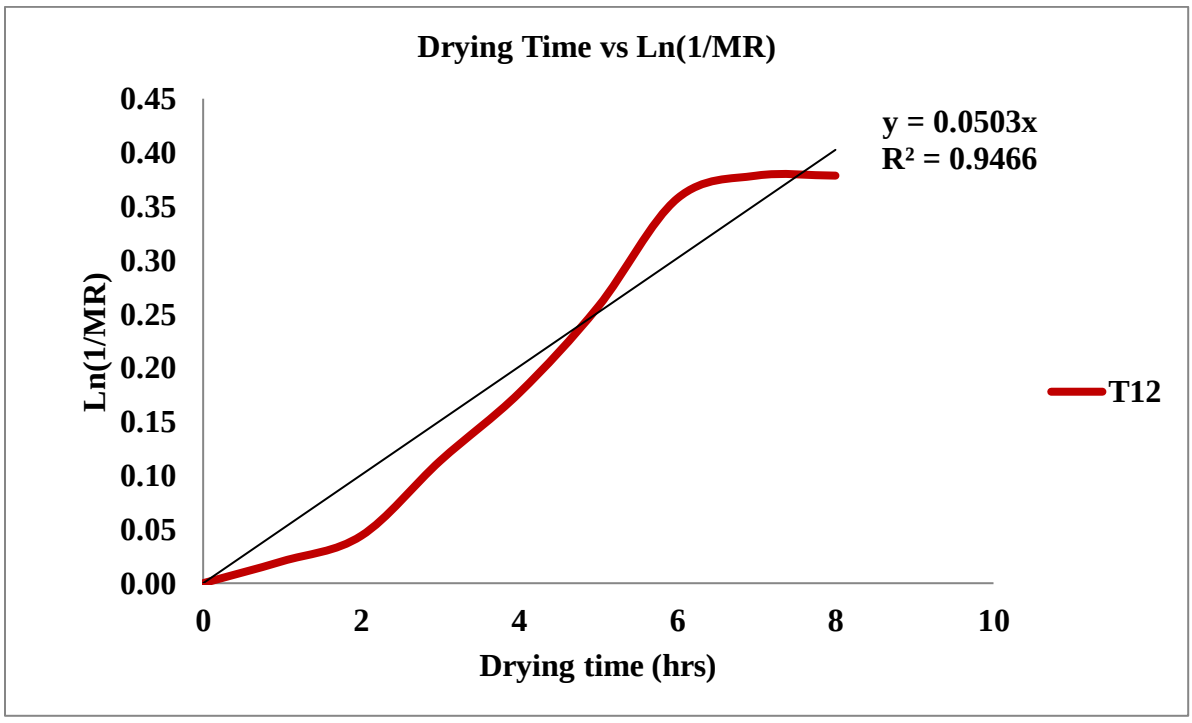

Fig. 4.5. (L) Change in the Logarithm of the Inversed Moisture Ratios Over Drying Time in Treatment T_{12} of onion slices

4.4.2. Dehydration ratio

The data on dehydration ratio of different varieties of onion are presented in Table No.4.15.

The data regarding to the dehydration ratio, maximum dehydration ratio was recorded in variety Bhima Shubra and Bhima Dark red (7.14) followed by Bhima Shewta, Bhima light red and Bhima Red (6.94). However, minimum dehydration ratio was recorded in variety Bhima Kiran and (6.25).

The data regarding to the rehydration ratio, highest rehydration ratio was recorded in variety Bhima Shubra (5.74) followed by Bhima Super, (5.66). However, lowest rehydration ratio was recorded in variety Bhima light red (5.42).

Table 4.15 : Dehydration ratio and rehydration ratio in different varieties of onion.

Treatment Symbol	variety	Dehydration ratio	Rehydration ratio
T_1	Bhima kiran	6.25	5.40
T_2	Bhima super	6.58	5.66
T_3	Bhima Dark Red	7.14	5.54
T_4	Bhima Light Red	6.94	5.42
T_5	Bhima Safed	6.76	5.46
T_6	Bhima Raj	6.41	5.65
T_7	Bhima Shakti	6.58	5.46
T_8	Bhima Shweta	6.94	5.58
T_9	Bhima Shubhra	7.14	5.74
T_{10}	Bhima Red	6.94	5.52
T_{11}	N-2-4-1	6.41	5.48
T_{12}	Phule Samarth	6.58	5.45
SE ±		**0.009**	**0.009**
CD @ 5%		**0.026**	**0.026**

Our results are in close conformity with results obtained by Djaeni *et al*., (2017), Rayar (2014) and also Priyanka (2014) reported that the moisture content of dried onion sample increased throughout storage period 30 days and dehydration

ratio of slices was observed high in onion sample dried in cabinet and microwave drying.

4.4.3 Browning index

The data on browning index of different varieties of dehydrated onion are presented in Table No. 4.16.

Data in respect of browning index of dehydrated onion showed significant difference among varieties. Minimum browning index was recorded in variety Bhima Shubhra (7.54 mg/g), which was at par with variety Bhima Shweta (8.61 mg/g) and Bhima Safed (8.66 mg/g). While maximum browning index was found in variety Bhima Raj (12.38 mg/g).

Table 4.16 : Effect of drying on browning index in different onion varieties

Treatment Symbol	Variety	Browning Index (mg/g)
T_1	Bhima kiran	9.38
T_2	Bhima super	9.68
T_3	Bhima Dark Red	10.99
T_4	Bhima Light Red	9.01
T_5	Bhima Safed	8.66
T_6	Bhima Raj	12.38
T_7	Bhima Shakti	9.70
T_8	Bhima Shweta	8.61
T_9	Bhima Shubhra	7.54
T_{10}	Bhima Red	8.16
T_{11}	N-2-4-1	11.82
T_{12}	Phule Samarth	9.80
SE ±		**0.34**
CD @ 5%		**1.00**

Our results are in confirmation with the findings of Djeani *et al.*, (2017) reported that the colour changes of onion powder drying. Browning of onion influenced by the temperature and drying time. Browning value decreased indicated

that the colour changes red into brown during drying. Also Patil (2011) reported that Pusa White Flat cultivar of onion more suitable for dehydration, less browning as compared with Pusa Red cultivar of onion. Also Rathod (2013) reported that the onion slices of Pusa White flat showed the greater results for the physicochemical parameters and organoleptic characters, highest browning rate for Bhima Shweta and lowest in pusa white flat.

CHAPTER – V

SUMMARY AND CONCLUSIONS

CHAPTER-V

SUMMERY AND CONCLUSION

An experiment entitled “Studies on evaluation of different varieties of onion for dehydration.” was conducted during year 2020-21 at Horticulture Research Scheme (vegetable), Department of Horticulture, VNMKV, Parbhani. The experiment was laid out in Randomised Block Design for field work and Completely Randomized Design for laboratory experiment with three replications and twelve varieties viz. Bhima kiran, Bhima Super, Bhima Dark Red, Bhima Light Red, Bhima Safed, Bhima Raj, Bhima Shakti, Bhima Shweta, BhimaShubhra, Bhima Red, N-2-4-1, Phule Samarth . Similar package of practices followed to twelve onion varieties in trial.

Analysis of variance revealed significant differences among the varieties in all characters. The results obtained in present investigation in respect of growth, quality and yield parameters contributing observed in different onion varieties are summarized below.

5.1 Growth parameter

5.1.1 Height of plant

Data regarding height of plant showed significant differences among the varieties. Significantly maximum plant height was recorded in variety Bhima Light Red (56.74 cm) followed by in Bhima Safed (56.29 cm) while minimum plant height was recorded in variety Phule Samarth (50.63 cm).

.5.1.2 Number of leaves

The number of leaves per plant was significantly influenced by onion varieties. Significantly maximum number of leaves per plant was found in variety Phule Samarth (12.8) followed by Bhima super (9.70), Bhima Safed (9.64) and Bhima Dark Red (9.47). However, minimum number of leaves was recorded in Bhima Red (8.33).

5.1.3 Chlorophyll a and b

The data in respect to chlorophyll-a showed significants differences in the varieties. Significantly maximum chlorophyll-a (20.92) and chlorophyll-b (10.34) were found in variety Phule Samarth followed by Bhima Shakti (19.94) and (10.09), respectively, Bhima Shubhra (19.31) and Bhima Light Red (8.62), respectively which

was at par with each other. While minimum chlorophyll-a and chlorophyll-b in onion variety Bhima Kiran (16.4) and Bhima Drak Red (6.36), respectively.

5.2 Yield parameters

5.2.1 Length of bulb (cm)

Significantly maximum length of bulb was recorded in variety Phule Samarth (6.70 cm) followed by in Bhima Red (5.04), Bhima super (4.90 cm) and Bhima Shubhra (4.87) which were at par with each other. However, minimum length of bulb was recorded in variety Bhima Light Red (4.3 cm).

5.2.2 Diameter of bulb (cm)

The maximum diameter of bulb was recorded in variety Phule Samarth (6.72cm) followed by in N-2-4-1 (6.33cm) and Bhima Safed (6.20cm). However minimum diameter of bulb was recorded in variety Bhima Raj (5.32cm).

5.2.3 Average weight of bulb (g)

Significantly maximum average weight of bulb was recorded in variety Phule Samarth (116.17 g) followed by in Bhima Kiran (99.20 g) and Bhima Shubhra (97.25g) which were at par with each other. However, minimum average weight of bulb was recorded in variety Bhima Red (71.14g).

5.2.4 Yield per plot (kg)

Significantly highest yield of bulb per plot was recorded in variety Phule Samarth (21.99 kg) followed by in Bhima Shakti (17.00 kg) and Bhima super (16.69 kg) which were at par with each other. However, minimum yield of bulb per plot was recorded in variety Bhima kiran (12.81 kg).

5.3 Quality Parameters

5.3.1 Total soluble solids (TSS)

Significantly highest TSS of fresh onion was observed in variety Bhima Shakti (15.80%) which was at par with variety Bhima Kiran (14.59%) while the lowest TSS was recorded in variety Phule Samarth (11.25 %) followed by in varieties Bhima Drak Red (11.29%).

Significantly maximum TSS of dehydrated onion was found in variety Bhima Kiran (17.94%) which was at par with variety Bhima Shakti (17.82%) while the minimum TSS was recorded in variety Bhima Raj (13.11%).

5.3.2 Acidity.

Data in respect of acidity of fresh onion showed significant difference among varieties. Highest acidity was recorded in variety Bhima Super (1.97%) followed by Bhima Drak Red (1.69). However, minimum acidity was found in variety Bhima Shweta (1.01%).

Data on titrable acidity of dehydrated onion showed significant difference among varieties. Maximum acidity was recorded in variety N-2-4-1(25.03%) followed by Bhima Shubhra (21.80%). However, minimum acidity was found in variety Bhima Kiran (14.57%).

5.3.3 Ascorbic acid

Significant differences were found in onion varieties. The highest ascorbic acid content of fresh onion was found in variety Bhima Kiran (20.21mg/100g) which was at par with the variety Bhima Shubhra (19.84mg/100g) and the lowest ascorbic acid content was recorded in variety Bhima Super (10.60mg/100g).

Significantly maximum ascorbic acid of dehydrated onion was found in variety Bhima Kiran (17.93mg/100g) which was at par with the variety Bhima Safed (17.75mg/100g), Bhima Shubhra (16.74mg/100g). The minimum ascorbic acid content was recorded in variety Bhima Light Red (11.49mg/100g).

5.3.4 Sugars (%)

A) Reducing sugar

Significantly maximum reducing sugar of fresh onion was recorded in variety Bhima Red (1.42 %) followed by in Bhima Safed (1.35%) and Bhima Kiran (1.35%) which were at par with each other. However, minimum was recorded in variety Phule Samarth (1.06%). While significantly higher reducing sugar of dehydrated onion was recorded in variety Bhima Kiran (21.27 %) at par with Bhima Raj (19.46%). However, lower was recorded in variety Phule Samarth (9.77%).

B) Non reducing sugars

Significantly higher non- reducing sugars of fresh onion was recorded in variety Bhima Kiran (5.13 %) which was at par with Bhima Shweta (5.01%). However, lower in variety Phule Samarth (5.04%).

Significantly maximum non-reducing sugar of dehydrated onion was recorded in variety Bhima Shubhra (12.73%) followed by in Bhima Light Red (11.24 %). However, minimum non-reducing sugar in variety Bhima Kiran (6.65%).

5.3.5 Moisture (%)

Maximum moisture content (%wb) was recorded in variety Bhima Shweta (98.27-82.00 %) followed by Bhima Safed (98.08-87.00 %) and Bhima Dark Red (98.04-86.00%). However, minimum was recorded in variety Bhima Kiran (97.12-82.00 %). While highest moisture content (%db) was recorded in variety Bhima Shweta (56.87-7.33 %) followed by Bhima Safed (50.98-6.69 %) and Bhima Dark Red (50.02-6.14%). However, lowest was recorded in variety Bhima Kiran (33.72- -4.56 %)

5.3.6 Dehydration ratio

Maximum dehydration ratio was recorded in variety Bhima Shubra and Bhima Dark red (7.14) followed by Bhima Shewta, Bhima light red and Bhima Red (6.94). However, minimum dehydration ratio was recorded in variety Bhima Kiran and (6.25). While rehydration ratio, highest rehydration ratio was recorded in variety Bhima Shubra (5.74) followed by Bhima Super, (5.66). However, lowest rehydration ratio was recorded in variety Bhima light red (5.42).

5.3.7 Moisture Ratio

Significantly minimum moisture ratio was recorded in variety Bhima Shakti and Bhima Kiran (0.62%), followed by in Bhima super and Bhima Raj (0.63%) while, maximum was observed in variety Bhima Shweta (0.72 %).

5.3.8 Drying rate

Significantly highest drying rate was found in variety Bhima Dark Red (11.02 – 1.02 kg water /kg dry matter /hr) followed by Phule Samarth (10.34 - 0.38 kg water /kg dry matter /hr) and Bhima Safed (9.98 - 0.42 kg water /kg dry matter /hr). However, lowest was recorded in variety Bhima Kiran (4.17 - 0.56 kg water /kg dry matter /hr).

5.3.9 Browning index

Data in respect of browning index of dehydrated onion showed significant difference among varieties. Minimum browning index was recorded in

variety Bhima Shubhra (7.54 mg/g), which was at par with variety Bhima Shweta (8.61 mg/g) and Bhima Safed (8.66 mg/g). While maximum browning index was found in variety Bhima Raj (12.38 mg/g).

CONCLUSION

Based on results obtained in present investigation concluded that

i) In respect of vegetative growth characters, variety Bhima Light Red recorded maximum plant height (56.74 cm). While maximum number of leaves (12.8), chlorophyll-a content (20.92) and chlorophyll-b (10.34) were recorded in Phule Samarth. The variety Phule Samarth showed at par results for all growth characters except plant height.

ii] In respect of yield parameters highest yield of fresh onion per plot, length of bulb, diameter of bulb and average weight of bulb were found in Phule Samarth (21.99 kg), (6.70cm), (6.72cm) and (116.17g), respectively. The variety Phule Samarth showed best results for all yield parameters.

iii] In respect of quality parameters of fresh onion, highest TSS was found in variety Bhima Shakti (15.80 %) and lowest in Phule Samarth (11.25%), maximum acidity was recorded in variety Bhima Super (1.97) and minimum in Bhima Shweta (1.01%), highest ascorbic acid content was found in variety Bhima Kiran (20.21mg/100g) and lowest in Bhima Super (10.60mg/100g), maximum total sugars was recorded in variety Bhima shweta (6.41%) and minimum in Phule Samarth (5.32%).

iv] In respect of quality parameters of dehydrated onion, highest TSS percent was found in variety Bhima Kiran (17.94 %) and lowest in Bhima Raj (13.11%), maximum acidity was recorded in variety N-2-4-1 (25.03%) and minimum in Bhima Kiran (14.57%), highest ascorbic acid content was found in variety Bhima Kiran (17.93mg/100g) and lowest in Bhima Light Red (11.49mg/100g). While maximum total sugars of dehydrated onion was recorded in Bhima Kiran (27.76%) and minimum in variety Bhima Drak Red (19.09%) and lowest browning index was recorded in variety Bhima Shubhra (7.54 mg/g) while maximum browning index was found in variety Bhima Raj (12.38 mg/g).

v] In respect of moisture content on wet basis maximum moisture content was recorded in variety Bhima Shweta (98.27-82.00 %), however, minimum was recorded in variety Bhima Kiran (97.12-82.00 %) and moisture content on dry basis,

highest was recorded in variety Bhima Shweta (56.87-7.33 %) and lowest in variety Bhima Kiran (33.72- -4.56 %). minimum moisture ratio was recorded in variety Bhima Kiran (0.62 %), while maximum was observed in variety Bhima Shweta (0.72 %). Highest drying rate was found in variety Bhima Dark Red (11.02 – 1.02 kg water /kg dry matter /hr), however, lowest in variety Bhima Kiran (4.17 - 0.56 kg water /kg dry matter /hr).

On the basis of quality parameter and on account of drying ratio, dehydration ratio and browning index, as compared to rest of the varieties of onion under studies, the Bhima shubhra, Bhima Shweta and Bhima dark red varieties were more suitable for dehydration purpose. However, it needs to be confirmed by conducting the same investigation.

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APPENDIX

APPENDIX-I

WEEKLY WEATHER DATA RECORDED DURING EXPERIMENTAL SEASON AT CENTRAL METEROLOGY OBSERVATIORY PARBHANI 2020-21

Date	RF	Temperature °C		Humidity (%)	
		Max	Min	RH1	RH2
November 2020					
1 to 8	0.0	32.0	13.4	87	26
9 to 16	0.0	30.8	11.8	84	30
17 to 24	0.0	32.8	17.7	82	37
25 to 31	0.0	30.1	15.3	81	42
December 2020					
1 to 8	0.0	31.02	9.9	87	28.37
9 to 16	0.0	30.35	14.65	83.37	36.12
17 to 24	0.0	28.47	8.86	88.5	33
25 to 31	0.0	29.15	10.57	88.57	34.17
January 2021					
1 to 8	0.0	28.27	16.13	88.37	51.12
9 to 16	0.0	31.13	14	87.87	37.37
17 to 24	0.0	31.55	14.05	82.87	33.87
25 to 31	0.0	31.1	17.32	91.42	35
February 2021					
1 to 7	0.0	30.25	11.81	74.85	23.57
8 to 14	0.0	31.54	11.68	66.42	22
15 to 21	15.3	29.65	14	87	39.42
22 to 28	0.0	34.6	13.3	84	24.3
March 2021					
1 to 7	0.0	36.4	15.7	62	11
8 to 14	0.0	36.4	17.4	60	22
15 to 21	11.2	36.2	19.8	63	20
22 to 31	3.1	37.6	17.6	66	18
April 2021					
1 to 7	0.0	39.9	18.6	50	10
8 to 14	0.0	36.3	21.31	58	25
15 to 22	0.0	39.9	19.5	54	14

CURRICULUM VITAE

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Full name of the candidate	:	Rohini Govindrao Dethe
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Title of the thesis	:	Studies on evaluation of different varieties of onion for dehydration.

Academic qualification :

Course / Deg ree	Name of the college / institut e	University / Board	Year of passing	(%) / CGPA	Class / Grade
SSC	Maharashtra High School Jalna, 431203	Aurangabad.	2012-13	82.55 %	First class
HSC	Shivchhatrapati college, N-3 CIDCO, Aurangabad 431003	Aurangabad.	2015-16	73.08%	Second class
B.SC. (Agri.)	College of Agriculture Kharpudi, Jalna 431203.	VNMKV, PARBHANI.	2018-19	8.47	First class

Place : Parbhani **Signature**

Date : /08/2021 **(Rohini Govindrao Dethe)**