EVALUATION OF F_1 HYBRIDS OF RIDGE GOURD [*Luffa acutangula,* (Roxb. L.)]

by

Mr. Imatiyazahamed Teli
(Reg. No. 020/314)

A Thesis submitted to the
MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI – 413 722, DIST. AHMEDNAGAR
MAHARASHTRA, INDIA

in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE (HORTICULTURE)

in

VEGETABLE SCIENCE

DEPARTMENT OF HORTICULTURE

POST GRADUATE INSTITUTE
MAHATMA PHULE KRISHI VIDYAPEETH
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MAHARASHTRA, INDIA.
2022

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part

there of has not been submitted

by me or other person to any

other University or Institution

for a Degree or

Diploma

Place : MPKV., Rahuri

Date : / /2022 **(Imatiyazahamed Teli)**

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CERTIFICATE

This is to certify that the thesis entitled, **"EVALUATION OF F_1 HYBRIDS OF RIDGE GOURD [*Luffa acutangula*, (Roxb. L)]"** submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri Dist. Ahmednagar (M. S.) in partial fulfillment of the requirement for the award of the degree of **MASTER OF SCIENCE (HORTICULTURE)** in **VEGETABLE SCIENCE,** embodies the results of a piece of *bona fide* research work carried out by **Mr. IMATIYAZAHAMED TELI,** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been duly acknowledged.

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Place : MPKV., Rahuri

Date : / /2022 (U.D. Chavan)

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Place : MPKV., Rahuri. (Imatiyazahamed Teli)

Date : / / 2022

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LIST OF ABBREVIATIONS AND SYMBOLS

%	:	Per cent
/	:	Per (or)
°C	:	Degree Celsius
Avg.	:	Average
CD	:	Critical difference
cm	:	Centimetre
CV	:	Coefficient of variation
cv.	:	Cultivar
DAS	:	Days after sowing
et al.	:	And others (et alia)
etc.	:	Etcetera
F_1	:	First filial generation
Fig.	:	Figure
FYM	:	Farm Yard Manure
g	:	Gram
ha	:	Hectare
hrs	:	Hours
i.e.	:	That is
Kg	:	Kilogram (s)
m	:	Meter (s)
m^2	:	Meter square
Max.	:	Maximum
Min.	:	Minimum
mm	:	Millimetre
MPKV.	:	Mahatma Phule Krishi Vidyapeeth
mss	:	Mean Sum of Square
N.S.	:	Non-significant
No.	:	Number
RBD	:	Randomized Block Design

RH	:	Relative Humidity
SEm	:	Standard error of the mean
Sr.	:	Serial
t	:	Tonnes
t/ha	:	Tonnes per hectare
viz.	:	Videlicet (Namely)

ABSTRACT

EVALUATION OF F_1 HYBRIDS OF RIDGE GOURD [*Luffa acutangula*, (Roxb. L)]

By

Mr. Imatiyazahamed Teli

A candidate for the degree of
MASTER OF SCIENCE (HORTICULTURE)
in
VEGETABLE SCIENCE
2022

Research Guide	**:**	**Dr. Sharmila Shinde**
Department	**:**	**Horticulture**

The present investigation entitled "Evaluation of F_1 hybrids of ridge gourd [*Luffa acutangula* (L.) Roxb]" was conducted during the period from *kharif* 2021 at All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experiment was laid out in Randomized Block Design with two (2) replications and 22 treatments. The main objective of the experiment were to evaluate the hybrids for growth, yield and flower character, fruit character (quantitative), fruit character (qualitative) and per cent incidence of diseases and pests.

The analysis of variance revealed that mean sum of squares due to hybrids was highly significant for all characters like length of vine (m), number of primary branches per vine, days required for appearance of first male flower, days required for appearance of first female flower, days to 50 % flowering, number of male and female flowers per vine (sex ratio), node at which first female flower appeared and days required for first harvest of fruits, number of fruits per vine, yield per vine (kg), fruit yield (t/ha), weight of fruit (g), length of fruit (cm), fruit diameter at center, pedicel and stylar end (cm), downy mildew, gummosis and fruit fly. However, variation for powdery mildew disease incidence indicated non-significant variation among the hybrids under the study.

The maximum vine length was recorded in the treatment T_1 : COH-1 × Karjat Local (9.95 m) followed by T_5 : COH-1 × Navin Long (8.15 m). The maximum number of primary branches per vine was recorded in treatment T_1 : COH-1 × Karjat Local (8.40) followed by T_{20} : NRG-9 × Krishna-51 (8.17).

Minimum number of days for first male flower was recorded in treatment T_1 : COH-1 × Karjat Local (33.70 days). Minimum days taken by T_1 : COH-1 × Karjat Local (36.60 days) for appearing the first female flowers. Earliest days for first fruit harvest was recorded in T_1 : COH-1 × Karjat Local (44.10 days), which was followed by T_2 : COH-1 × Banaras Local (46.90 days). Minimum number of days for 50% plants to produce flower T_4 : COH-1 × Nidhi (39.50 days). Lowest sex ratio was observed in treatment T_1 : COH-1 × Karjat Local (4.78). Node at which first female flower in T_1 : COH-1 × Karjat Local (10.80).

The maximum average fruit weight was found in treatment T_3 : COH-1 × Arka Sujata (199.43 g) followed by T_1 : COH-1 × Karjat Local (192.70 g). The maximum fruit length was recorded in treatment T_{15} : Arka Sujata × Nidhi (46.95 cm) followed by T_{13} : Banaras Local × Arka Sujata (46.60 cm). The maximum fruit diameter at centre was recorded by treatment T_{15} : Arka Sujata × Nidhi (4.53 cm). The maximum fruit diameter at pedicel in treatment T_{19} : Navin Long × Krishna-51 (1.94 cm) and maximum fruit diameter at stylar end was recorded by treatment T_{18} : Arka Sujata × Krishna-51 (3.67 cm).

The maximum number of fruits per vine was recorded with treatment T_1 : COH-1 × Karjat Local (19.20 fruit per vine). The treatment T_1 : COH-1 × Karjat Local (4.30 kg) gave the highest fruit yield per plant followed by T_2 : COH-1 × Banaras Local. The maximum yield of ridge gourd per hectare was recorded in treatment T_1 : COH-1 × Karjat Local (24.67 t/ha) followed by T_2 : COH-1 × Banaras Local (23.65 t/ha).

There was least incidence of powdery mildew was recorded in the treatment in T_1 : COH-1 × Karjat Local and T_2 : COH-1 × Banaras Local with value of 10%. The minimum per cent incidence of downy mildew recorded in treatment T_1 : COH-1 × Karjat Local (15.00%) and Naga-(C_1) (15.00%). The minimum per cent incidence of

gummosis recorded on various treatment like T_1 : COH-1 × Karjat Local , T_2 : COH-1 × Banaras Local, T_3 : COH-1 × Arka Sujata, T_6 : COH-1 × NRG-9, T_7 : COH-1 × Krishna-51, T_9 : Karjat Local × Nidhi, T_{15} : Arka Sujata × Nidhi and Naga-(C_1) with value of 7.50 %. The minimum infestation of fruit fly observed in treatment T_1 : COH-1 × Karjat Local (9.77 %).

Based on the mean performance, the following hybrids COH-1 × Karjat Local, COH-1 × Banaras Local and COH-1 × Arka Sujata were found superior among all the hybrids for most of the characters.

1. INTRODUCTION

The family Cucurbitaceae is one of the most diverse groups of the crop in the plant kingdom. It is moderately a large family consisting of 118 genera and 825 species (Jeffrey,1990). India is having about 37 genera and 100 species. Some of the genera are *Momordica* (about 45 species), *Trichosanthes* (44 species), *Cucumis* (25 species), *Cucurbita* (15 species), *Lagenaria* (6 species), *Luffa* (6 species) and *Echinocystis* (15 species). Ridge or ribbed gourd (*Luffa acutangula* Roxb., 2n=26) originated in India. It is a popular Cucurbitaceous vegetable grown as spring and summer season crop. The fruits have 10 prominent longitudinal ridges (Kamble *et al,* 2018). Thus, the plant is also described as "angular loofah," "Chinese okra," "ridged gourd," or "fluted loofah." Ridge gourd is one of the least expensive vegetables to produce. It is cultivated on commercial scale and in kitchen garden. The crop is cultivated in India, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka and Taiwan. It is an annual, monoecious cross pollinating, running vine plants consisting of long taproot system, simple, sharply angled 5-lobed leaves and the fruits are dark green vegetable having white pulp with black seeds embedded in spongy flesh. Fruits vary in size and may be oblong or club-shaped. Cultivated species of ridge gourd are monoecious in nature with different sex forms *viz*. androecious, gynoecious, gynomonoecious andromonoecious and hermaphrodite plants are also reported (Choudhary and Thakur, 1965). It is rich in vitamin A, C and Fe (Yawalkar, 1985).

Fruit contains moisture (92.5 g), protein (0.5 g), fat (0.5 g), carbohydrate (3.4 g), energy (17k calories), calcium (18 mg), vitamin C (5 mg), riboflavin (0.01 mg), phosphorous (26 mg), iron (0.5 mg) and carotene (33 µg) per 100 g of edible portion (Sheshadri and Parthasarthy, 1980).

India is the second largest producer of vegetable with 2.8 per cent of area under vegetables production. In 2020, some 1.15 billion metric tonnes of vegetables were produced worldwide (statistics). The per capita availability is 145 g as against recommended requirement of 300 g (Anon., 2021a). In India it occupies 1,10,65,000 ha area with 19,98,82,000 metric tonnes production whereas in Maharashtra 9,62,130 ha

area with 1,42,12,360 metric tonnes. The major vegetable producing states are West Bengal, Uttar Pradesh and Madhya Pradesh (Anon., 2020-21b).

The dried fruits are used as a bath sponge, scrubber pads, doormats, pillows and mattresses and also for cleaning utensils. It is said to be good purgative agent as its fruits contain a gelatinous compound called luffein. It's abortifacient, antitumor, ribosome inactivating and immunomodulatory activities were also reported earlier (Wang and Ng, 2002). Ridge gourd fruit oftenly used as disinfectant, antithelmintic, anti-diarrhoea, anti-syphilitic and laxative (Ram *et al*., 2006).

Ridge gourd requires a long warm season for best production. It also grows best during the rainy season. Optimum temperature requirement for these crops is 25^0-27^0C. Due to its hard seed coat, there is a problem with seed germination when the temperature is low. The pistillate and staminate flowers may occur in the same axil also the flowers of ridge gourd like those of bottle gourd start anthesis in the evening and remain open throughtout the night and are ready for selfing and pollination in the early morning/forenoon (Ram, 1997).

The crop is grown in both the summer and rainy seasons. Summer season crop is sown in January-February and rainy season crop is sown in June-July. In different parts of the country, still local strains of ridge gourd are commercially grown by farmers which result into very low yield. Poor performance of local varieties is due to genetic impurities. No doubt, there are few improved varieties of ridge gourd available in our country and are exploited commercially. Therefore, more emphasis should be paid to ward the development of high yield varieties or hybrids. Exploitation of hybrid vigour has been recognized as an important tool for making genetic improvement of yield and its attributing characters in ridge gourd by several earlier workers.

Presently hybrids predominate in several vegetable crops (Kalloo, 1998). The advantages of hybrid vegetables are uniformity, increased vigour, earliness, higher yield and resistance to specific pests and pathogens. Preliminary identification of early maturing genotypes can be done based on characters like days to opening of female flowers, node number to first female flowering and days to fruit picking.

Collection and evaluation of germplasm is a pre-requisite for their utilization and detailed evaluation determines the potential of an accession in specific crop improvement programme.

Ridge gourd offers great scope for exploitation of hybrid vigour on commercial scale. The high number of hybrid seeds per cross makes F_1 seed production more economical in ridge gourd male sterility and its utilization for hybrid seed production for large scale (Hegade, 2009). The present investigation to evaluate the F_1 hybrid to identify the potential cultivar for different horticultural characters.

Therefore, a trial for evaluation of presently available ridge gourd hybrids was carried out entitled "Evaluation of F_1 hybrids of Ridge gourd [*Luffa acutangula* (Roxb. L)]" with following objectives.

1. To study the growth, yield and quality of F_1 hybrids.
2. To study the incidence of pest and diseases.

2. REVIEW OF LITERATURE

2.1 Growth Characters

Singh *et al.* (2002) studied genetic variability and heritability of different characters in ridge gourd with 80 genotypes. He concluded that the average mean of different attributes characters like length of main axis (cm) 383.70, primary branches/plant 8.09.

Rabbani *et al.* (2012) studied the correlation co-efficient of 60 genotype of ridge gourd indicated that yield per plant had highly significant positive relationship with vine length at harvest (r = 0.359**) with maximum vine length (9.55 m). He also found that the maximum number of primary branches at the time of harvest were 42.67 and mean of around 29.94 ± 2.74.

Choudhary *et al.* (2014a) evaluated genotypes of ridge gourd that the genotype AHRG 41 (4.13 m) have maximum vine length among the other genotypes and the genotype AHRG 47 (5.40) have maximum number of primary branches per branch. The results of this study could be used in breeding programs for improving local landraces of ridge gourd grown in Rajasthan.

Narasannavar *et al.* (2014) studied correlation and path analysis on different yield and yield attribute traits in 20 genotypes of ridge gourd revealed that number of branches at 90 DAS showed positive and significant association with vine length. Vine length at 90 DAS, days to first harvesting, number of fruits per vine and flesh thickness exhibited high negative direct effect on fruit yield per vine at both genotypic and phenotypic level.

Poshiya *et al*. (2015) reported in his heterosis studies that the best performing parents for vine length were ARGS-07-41, Pusa Nasdar and JRG-05-4. Among them best performing crosses were Pusa Nasdar x JRG-05-4, Jaipur Long x HARG-109 and Pusa Nasdar x HARG-109. He reported that the best performing crosses for primary branches were Pusa Nasdar x ARGS-07-41, Pusa Nasdar x Jaipur Long and Pusa Nasdar x JRG-05-4 in his trail.

Koppad *et al.* (2015) evaluated eighteen genotypes of ridge gourd for growth, earliness, biochemical, yield and fruit quality parameters in the field condition.

Arabhavi Local expressed significantly higher vine length of 147.97cm and 290.50 cm at 45 and 90 DAS respectively. Whereas, Chintamani Local exhibited minimum vine length of 74.83 cm at 45 DAS and Ghataprabha Local was 199.50 cm at 90 DAS. The genotypes having longer vine length resulted in higher yield per vine these results are in confirmation with Rao *et al.,* (2000). The number of branches per vine was found to be significantly higher in Arabhavi Local 3.83 and 6.17 and minimum numbers of branches were in Mandya Local 1.83 and 2.33 at 45 and 90 DAS, respectively.

Sarkar *et al.* (2015) evaluated eight parental lines and 28 F_1 hybrids of ridge gourd obtained from half-diallel to investigate the extent of combining ability and heterosis for earliness and vegetative characters. He found appreciable heterosis over better parent and check parent for the characters *viz*. vine length (m), number of primary branches. Crosses PCPGR 7256 x PRG 117, PCPGR 7256 x PRG 131 and PRG 132 x PRG 120 were recorded promising for vegetative traits.

Bhargava *et al.* (2017) investigated 26 different genotypes of ridge gourd. He concluded that among all the genotypes NDRG-15 (3.71 m) was founded to be superior in terms of vine length. Genotype NDRG-13 and NGRG-24 was recorded for lowest vine length (2.43). Results found that highest number of primary branches found in NDRG-10 (4.56) and lowest was recorded in NDRG-21 and NDRG-4.

Harshitha *et al.* (2019) studied different horticultural traits in ridge gourd. The studies found that the range of vine length 219.96-818.84 cm and mean of 438.68 cm. The studies also found that the range of number of branches 3.00-7.40 and mean of 4.09.

Ilyas *et al.* (2017) evaluated bottle guard varieties in agro-climatic condition of Peshawar valley with maximum plant height (15.1 m) was recorded Globe variety followed by Mahraya variety (9.82 m) while minimum plant length of NS550F1 variety (9.03 m) was recorded.

Rathore *et al.* (2017) investigated 12 genotypes of ridge gourd. His studies showed that, significant effect on the length of main vine (5.30m) was observed maximum in treatment with T_6 RIGVAR-6.

Yadav *et al*. (2017) screened forty-two genotypes of ridge gourd and studied for character association during summer season. He found that none genotype

recorded significantly longer in vine length than best check variety (Satputia i.e 5.04 m). However, five genotypes show longer vine length than the best check variety. Thirty-nine genotypes recorded significantly shorter main vine length than lowest check (Pant-Torai-1 i.e., 4.72). He also revealed that one genotype (PCPGR-3111 i.e., 9.22) recorded significantly more number of primary branches than best check variety (Satputia i.e., 7.98) and seventeen genotypes recorded significantly less number of primary branches than lowest check (Pant-Torai-1 i.e., 4.82).

Kamble *et al.* (2018) revealed that highly significant standard heterosis was found in Crosse ERG-1 x Deepthi (60.03 %) for vine length at 45 days after sowing, DMRG-3 x PSN (39.88 %) for vine length at 90 days after sowing. He also revealed that highly significant standard heterosis was found in Crosses DMRG-3 x PSN (40.38 %) for number of branches at 90 days after sowing.

Jadhav and Sapovadiya (2018) studied heterosis for fruit yield and its components of Twenty-one crosses of ridge gourd in a Line x Tester set. He found that the length of main vine one and seven F_1's expressed significant desirable heterobeltiosis and standard heterosis respectively of which cross JRG-13-05 x Jaipur Long had highest value for former and cross JRG-13-01 x Arka Sujata had highest value for later. He also found that the number of primary branches per vine, seven and six F_1's expressed significant desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-13-01 x Pusa Nasdar highest value for both the cases.

Manoj *et al.* (2018) evaluated thirty-five ridge gourd genotypes which were grouped into eight clusters, where Cluster I and II included eleven lines followed by cluster IV and VI with four genotypes each and cluster VII with two, whereas cluster III, V and VIII were solitary. He found the cluster mean for vine length was highest in the cluster VI (3.50) followed by cluster V (3.13). The lowest cluster mean was observed in the cluster VII. He found that the highest cluster mean for the number of branches per plant was observed for the cluster IV (5.70) followed by cluster V (5.40). The lowest cluster mean was observed for the cluster III (4.60).

Kannan *et al.* (2019) conducted an experiment on ridge gourd that results revealed selection for vine length in crosses L3 x T1 (5.274; 4.761) and L3 x T2 (7.116; 6.101). It showed higher yield and high heritability for most characters and can be

summated that these two crosses are promising in providing better source population for exercising selection.

Reddy *et al.* (2019) developed thirty-six F_1 hybrids of sponge gourd developed through diallel fashion were evaluated for yield and related traits. The best performing parents and hybrids for different characters *viz*., Swarna Prabha (13.04 m) and SG-5 × SG-3 (13.40 m) was observed for vine length. The best performing parents and hybrids for different characters for number of branches per plant Kulgod local × Pusa Chikni (14.88).

Triveni *et al.* (2020) conducted research to evaluate twenty different genotypes of ridge gourd reported that the genotype "Arka Sujata" recorded maximum vine length (3.84m). He also reported that the genotype "Arka Sujata" recorded maximum number of primary branches (7.40). Based on this research work genotypes can be selected for further crop improvement programme.

Vijayakumar *et al*. (2020) studied on genetic variability, correlation and path analysis in F_6 generation of ridge gourd. The study result revealed that low percent PCV and GCV were recorded in the traits like vine length (6.57; 4.22). The selected cultures showed higher yield with high heritability and it can be promising in providing better source of population for utilization.

Madhavi *et al.* (2021) conducted a study was carried out to study the performance of fifteen hybrids developed from the six parents of ridge gourd the cross IC 523892 × Arka Sujat recorded longest vine and the cross-maximum number of branches recorded by the hybrids IC 398599 × IC 308561.

2.2 Flowering Characters

Singh *et al.* (2002) studied genetic variability and heritability of different characters in ridge gourd with 80 genotypes. He concluded that the average mean of different attributes characters like number of nodes for appearance of female flower 18.58, days taken for appearance of first male flower 42.20, days taken for appearance of first female flower 48.47, fruits/plant 5.70, fruit length (cm) 19.35, fruit diameter (cm) 4.63, fruit weight (g) 145.80, yield/plant (kg) 0.82.

High heritability was observed for days to first male flower opening (91.80), node at which first female flower was formed (80.30), days to first female flower

opening (89.90), node at which first female flower formed (82.60), days to first harvest (83.40) and hundred seeds weight (98.90) (Narayanankutty *et al*. 2006). These characters are governed by non-additive gene action and hence hybridization followed by selection may be used for the sponge gourd improvement of these traits.

Sundaram (2009) studied eight genetically diverse parents of bitter gourd along with fifty-six F_1 hybrids which were obtained through full diallel mating of the parents under saline soil for yield and yield contributing characters. He found that the parent Paravai Local was the earliest to flower (31.55 days). The hybrid combination MDU 1 x Vadipatti Local (31.78 days) was found to be the earliest to flower among the top performing hybrids and was followed by Bikaneer 3 x IC 85643 (32.55 days) and Paravai Local x IC 85643 (32.55 days). The parent Vadipatti Local recorded the first female flower production at the lowest node (9.11) on the vine. The first female flower on the lowest position was observed in the hybrid Bikaneer 1 x IC 85643 (12.89). As a narrow sex ratio of male to female is preferable in cucurbits, the hybrids Vadipatti Local x IC 85643 (4.64), Paravai Local x IC 85643 (9.48) and Paravi Local x Bikaneer 3 (9.48) which had recorded a narrow sex ratio of male flowers to female flowers could be regarded as the best.

Kamal *et al.* (2012) reported wide range of variability were recorded in 10 diverse bottle gourd entries for the quantitative traits of fruit, yield and seed characters *viz*., days to germination 50 per cent (7.23 to 11.01), days to first male flower anthesis (42.86 to 54.62), days to first female flower anthesis (51.11 to 61.78), node no. of first male flower (4.22 to 9.35), node no. of first female flower (5.32 to 11.81), days to first fruit harvest (63.20 to 75.90).

Rabbani *et al*. (2012) studied the correlation coefficient of 60 genotypes of ridge gourd indicated that the sex ratio and circumference of fruit exhibited negative association with yield. Sex ratio range of 14.74 - 41.62.

Karmakar *et al.* (2013) investigated seven parental lines, including two hermaphrodite lines and 28 F_1 hybrids of ridge gourd obtained from half diallel mating. It was observed that $P_1 \times P_6$ (DRG-2 × Satputia Long) and $P_2 \times P_7$ (Pusa Nasdar × Satputia Small) were early in maturity and may be recommended for commercial exploitation.

Narayan (2013) conducted an experiment on 10 diverse genotype of bottle gourd and reported variability for fruit and seed characters *viz*., days to 50 % germination, days to first male flower anthesis, days to first female flower anthesis, node number of first male flower, node number of first female flower, days to first fruit harvest.

Choudhary *et al.* (2014a) evaluated genotypes of ridge gourd that the genotype AHRG 29 was the earliest in terms of harvesting which took 51.85 days for first fruit harvest from sowing and was found to be statistically at par with AHRG 31 (54.90) and AHRG 33 (56.20). He recorded the genotype AHRG 29 was found to be significantly earliest to produce first female flower among six genotypes which took 46.15 days for anthesis. He observed that the first female flowers were also appeared at lower node (13.95) in AHRG 29 which was significantly lower than all genotypes except AHRG 33 (14.75).

Choudhary *et al.* (2014b) studied variability, heritability, genetic advance, correlation and path analysis in hermaphrodite ridge gourd. The fruit length had the highest heritability (93.5 %) followed by node at which first hermaphrodite flower appeared (78.0 %). Range of node at which first hermaphrodite flower appeared 6.40-13.53. Range of Days to first fruit harvest 45.07-57.67. Therefore, these characters would be useful in improvement program of hermaphrodite ridge gourd through selection as well as hybridization.

Narasannavar *et al.* (2014) studied correlation and path analysis on different yield and yield attribute traits in 20 genotypes of ridge gourd revealed that node to first female flowering showed positive and significant correlation with vine length.

Eighteen genotypes were evaluated of ridge gourd for growth, earliness, biochemical, yield and fruit quality parameters in the field condition. The genotype Arabhavi Local was earliest to open its first female flower (46.33 days) and the genotype Jaipur Long took maximum number of days (54 days) for female flower appearance. The range for this attribute being 46.33 days to 54 days with mean of 49.78 days was observed. For the days to first harvesting, Arabhavi Local given its first fruit at 58.33 days and Ghataprabha Local took maximum number of days (71.33 days). Minimum sex ratio (Male: female) was observed in Arabhavi Local (18.33) and maximum was

observed in Green long (28.83). Sex ratio (male flowers for one female flower) ranged from 18.33 to 28.83 with mean of 24.99. Earliness is desirable character and breeder's preference trait (Koppad *et al.,* 2015).

Padmakshi *et al.* (2015) twenty-two bottle gourd genotypes were evaluated for different quantitative characters. Analysis of variance revealed that mean sum of squares due to genotypes was highly significant for all characters. Among twenty-two genotypes, the genotype 2012 BOG VAR 4 was noted for earliness (25 DAT) for days to 50 % flowering and the same genotype was also noted for early male and female flowering i.e., 16.26 and 25.66 DAT. The genotype 2010 BOGVAR 3 exhibited early fruit setting (31.93 DAT) and also noted for early harvesting i.e., 41.33 DAT. Maximum number of fruits per plant (14.83) was recorded in NDBG 104. Studies revealed that the genotypes 2012 BOG VAR 6, 2012B OG VAR 4, 2011 BOG VAR 3, 2010 BOG VAR 3 and NDBG 104 were found to be promising for earliness and fruit yield.

Poshiya *et al*. (2015) conducted the heterosis study for fruit yield and its attributes in ridge gourd. He studied on the attributes days to open first female flower, node number at which first female flower appeared, days to first picking.

Sarkar *et al.* (2015) evaluated eight parental lines and 28 F_1 hybrids of ridge gourd obtained from half-diallel to investigate the extent of combining ability and heterosis for earliness and vegetative characters. He found appreciable heterosis over better parent and check parent for the characters *viz*., days to first female flower, node number to first female flower and days taken to 1st fruit harvesting. Crosses PCPGR 7256 x PRG 142, PRG 117 x PRG 142, PRG 117 x PRG 131, PRG 117 x PRG 132 and PRG 117 x PRG 120 were found promising for earliness.

Thakur *et al.* (2015) compared 22 genotypes of bottle gourd and found that the genotype 2012 BOG VAR 4 was early (25 DAT) for days to 50 % flowering including early male and female flowering i.e., 16.26 and 25.66 DAT respectively. The 9 genotypes 2010 BOG VAR 3 exhibited early fruit setting (31.93 DAT) and also noted for early harvesting i.e., 41.33 DAT. Analysis of variance revealed that mean sum of squares due to genotypes was highly significant for all characters.

Bhargava *et al*. (2017) studied 26 diverse genotypes of ridge gourd. He recorded considerable variations from all the characters. The GCV and PCV estimate

were high for node no. to anthesis of first staminate flower per plant followed by node no. to anthesis of first pistillate flower, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, days to anthesis of first pistillate flower, days to first fruit harvest, number of nodes per vine.

Gautam *et al.* (2017) evaluated forty-two genotypes of ridge gourd the clustered like I, II and III comprises 5, 22 and 15 genotypes, respectively. He concluded that the cluster means of forty-two genotypes reveals that lowest mean value for days to first female/hermaphrodite flower anthesis (41.97) followed by number of node of first female/hermaphrodite flower (4.16) and days of first fruit harvesting (48.34) were found in genotypes of cluster I.

Krishnamoorthy and Ananthan (2017) evaluated 20 genotypes of ridge gourd. Among them LA15 (Ottanchatram Local), recorded the earliest flowering (52.67 days) followed by LA6 (Melur local) (98.33 days) and LA18 (Natham Local) (103 days) and late flowering was observed is LA 20 (Srirampuram Local) (127 days). He concluded that the node at which the female flower appears also decides the earliness of the variety. LA15 (Ottanchatram Local) recorded the earliest female flowering node (11.23) followed by LA17 (Kannapatti Local), (16.57) and LA6 (Melur local) (17.90). The late flowering was observed is by LA20 (Srirampuram Local) (23.47). LA 15 collected from Ottanchatram recorded earliness in first female flowering node and first female flowering days (11th node and 52.67 days).

Rani *et al.* (2017) evaluated totally thirty-five ridge gourd genotypes were grouped into five clusters based on D2 values, which exhibited no association between geographical and genetic divergence. Genotypes in Cluster V registered the highest cluster mean value for lesser days taken to first female flower appearance (43.58), less node number for first female flower appearance (22.50), less male flowers number per vine (408.58), more female flowers number per vine (61.43), sex ratio (6.65), lesser days taken to first harvest (47.36).

Rathore *et al.* (2017) investigated 12 genotypes of ridge gourd. His studies showed that, significant effect on the minimum days to days to first appearance of male and female flower (34.07 and 38.30 days), sex ratio (34.00), node number at which first

male and female flower appear (5.60 and 11.53) and minimum days to first harvesting (43.93 days) was observed maximum in treatment with T_6 RIGVAR-6.

Yadav *et al*. (2017) screened forty-two germplasm of ridge gourd and studied for character association during summer season. He found that monoecious genotypes PCPGR-7446, PCPGR-3112, PCPGR-5563 were earlier in first fruit harvesting i.e., 54.20, 53.58 and 53.50, respectively than the best check (Pant- Torai-1). However, genotypes (hermaphrodite ridge gourd) PCPGR-3239, PCPGR-3715, PCPGR-5991 were found earlier in first fruit harvesting i.e., 48.41, 48.15, 47.71, respectively than the best check (Satputia). He suggested that none of the genotypes recorded significantly lower value in node number to first female flower than best check variety (Satputia i.e., 5.11). However, seven genotypes recorded significantly higher value in node number to first female flower than the lowest check variety (Pant-Torai-1 i.e., 7.83). He stated that eleven germplasm recorded significantly earlier in days to first female flower anthesis than best check variety (Satputia i.e., 39.60). The three genotypes recorded significantly late in days to first female flower anthesis than the lowest check variety (Pant-Torai-1 i.e., 49.16).

Jadhav and Sapovadiya (2018) studied heterosis for fruit yield and its components of twenty-one crosses of ridge gourd in a Line x Tester set. He found that the crosses which showed high heterosis for fruit yield per vine also had high heterosis for node number of first female flower, length of main vine, number of fruits per vine, fruit weight, length of fruit. The results thus, revealed that the heterosis for fruit yield per plant was associated with the heterosis expressed by its component characters. Top most nine high yielding hybrids JRG-13-04 x Jaipur Long, JRG-13-04 x Arka Sujata, JRG-13-04 x Pusa Nasdar, JRG-13-02 x Jaipur Long, JRG-13-06 x Jaipur Long, JRG-13-07 x Jaipur Long, JRG-13- 05 x Jaipur Long, JRG-13-07 x Pusa Nasdar and JRG-13-06 x Arka Sujata can be exploited in practical plant breeding for selection of better transgressive segregants.

Kamble *et al.* (2018) revealed that highly significant standard heterosis was found in crosses, DWD local x CO-1 (-19.84 %) for days to first male flowering, CKM local x CO-1 (-34.09 %) for node to first male flowering, DMRG-1 x Deepthi (-35.19 %) for days to first female flowering, IC-92637 x CO-1 (-10.64 %) for node to first

female flowering, DWD local x CO-1 (- 13.93 %) for days to first harvest, ERG-2 x PSN (- 50.87 %) for sex ratio.

Manoj *et al.* (2018) evaluated thirty-five ridge gourd genotypes which were grouped into eight clusters, where Cluster I and II included eleven lines followed by cluster IV and VI with four genotypes each and cluster VII with two, whereas cluster III, V and VIII were solitary. He found that the highest cluster means for days to first male flower shown by cluster VI (37.59). The lowest cluster mean observed in cluster III (31.10). For days to first female flower, the highest cluster mean shown by cluster V (44.15). The lowest cluster mean observed in cluster III (36.70). For node at which first female flower appears, the highest cluster mean found for the cluster III and cluster VIII (12.7). The lowest cluster indicates observed for the cluster II (10.94). The highest cluster means for days to 50 percent flowering seen in the cluster V (45.05). The lowest cluster mean observed for the cluster III (37.90). The lowest cluster mean for sex ratio was observed for cluster VII (5.52). The highest cluster mean was observed for the cluster IV (14.44). The lowest cluster mean for days to the first harvest was observed for cluster III (49.70). Highest cluster mean was observed for the cluster VI (56.29).

Harshitha *et al.* (2019) studied different horticultural traits in ridge gourd. The studies found that the average number of days to anthesis for first male flower 25.85, days to anthesis for first female flower 34.59, number of nodes to female flower 34.59, Days to 50 % flowering 44.50, days to first harvest 47.98, Sex ratio 24.19.

Kandasamy *et al.* (2019) studied the morphological characters like vine length, days to first male flowering, days to first female flowering, node number of first male flower, node number of first female flower, days to first fruit harvest. Analysis of variance revealed that there were significant differences among the genotypes studied for all the characters except node number of first male flower. On the basis of mean performance, among 20 genotypes, LS12 was identified as the best genotypes as it has recorded higher mean values for six out of twelve characters studied.

Kannan *et al.* (2019) conducted an experiment that results revealed selection for vine length in crosses days to first female flowering in crosses L3xT1 (7.37; 5.35) and L3xT2 (6.28; 4.26), node to first male flower in crosses L3xT1 (9.04; 6.40) and L3xT2 (9.41; 8.08), sex ratio in crosses L3xT1 (5.27; 4.51) and L3xT2 (3.72; 1.29), days

to first harvest in crosses L3xT1 (7.85; 6.11) and L3xT2 (2.18; 1.39). He found that highly significant standard heterosis was found in crosses DWD local x CO-1 (-19.84 %) for days to first male flowering, CKM local x CO-1 (-34.09 %) for node to first male flowering, DMRG-1 x Deepthi (-35.19 %) for days to first female flowering, IC-92637 x CO-1 (-10.64 %) for node to first female flowering, DWD local x CO-1 (- 13.93 %) for days to first harvest and ERG-2 x PSN (- 50.87 %) for sex ratio.

Reddy *et al*. (2019) developed thirty-six F_1 hybrids of sponge gourd developed through diallel fashion were evaluated for yield and related traits. The best performing parents and hybrids for different characters for sex ratio KRCCH-2 (14.49) and SG-5 × Swarna Prabha (17.95).

Reshmika *et al.* (2019) 16 hybrids and 5 check varieties of bitter gourd collected from public and private sectors. Observations were recorded for 14 characters and ranking of hybrids was done based on cumulative index worked out for the characters like, nodes to 1st female flower appearance, days to 1st picking. Significant difference was observed among the hybrids for the selected characters. Promising 5 F_1 hybrids selected based on the cumulative index were MC-142, MC-136, MC-139, MC-138 and MC-1.

Singh *et al*. (2019) studied seven parental lines and 21 F_1 hybrids of ridge gourd resulting from half diallel the extent of heterosis for earliness, *viz*., days to first female flower anthesis and days to first fruit harvest. The crosses Pusa Nasdar × CO-1, DRG-71 × Swarna Phar and Pusa Nasdar × Swarna Uphar were found to be the most promising for earliness as they showed negative and significant heterosis over better parent and standard variety.

Kumar and Aswini (2020) developed Ridge gourd F_1 hybrids exploiting cytoplasmic genic male sterility (CGMS) system. Hybrid MS × LA 102 (55.3) days to harvest while LA 101 (56.6) days to harvest.

Malve *et al*. (2020) estimated for general combining ability effects which revealed that none of the parents showed good general combiners for all characters. The parents RHR RG-2, RHR RG-6 and RHR RG-8 were the good general combiners as they displayed significant GCA effects in desirable direction for most of the characters like earliness and yield attributing character.

Triveni *et al*. (2020) revealed that earliness in ridge gourd is dependent on the number of days taken for its first female flower. The genotype "12-Pata jhinga" showed earliest to open first female flower (40.67) and took minimum days (45.00) to harvest.

Vijayakumar *et al.* (2020) studied on genetic variability, correlation and path analysis in F_6 generation of ridge gourd. The study result revealed that low percent PCV and GCV were recorded in the traits like the days to first male flowering (6.40; 4.62), days to first female flowering (9.57; 7.54), node to first male flower (7.83; 5.19), node to first female flower (8.28; 3.62), sex ratio (6.11; 5.73), days to first harvest (6.47; 4.72).

Durga *et al.* (2021) estimated to assess the magnitude of genetic variability in F_3 population of four crosses *viz*., cross-1 (VRG-24 x VRG-13), cross-2 (Swarna Manjari x Arka Prasan), cross-3 (Swarna Manjari x VRG-16) and (Arka Prasan x VRG-16). She observed that the mean value of the paramters *viz.*, days to male flowering (30.06 days), days to female flowering (39.14 days), node of first female flower (11.90) and sex ratio (%) (7.60).

2.3 Yield characters

Purohit *et al.* (2007) evaluated 28 F_1 hybrids of ridge gourd along with eight parental lines *viz*., JRGL-13, CHRG-I, CHRG-2, IIHR-7, KRG-5, Co-I, Pusa Nasdar and Jaipur Long. He analyzed parental lines and he observed that Pusa Nasdar had the highest fruit yield (1.92 kg) per vine followed by JRGL-13 (1.90 kg) and Jaipur Long (1.75 kg). It was observed that parents which showed high GCA effects for fruit yield and its attributes were also found to produce high *per se* yield and yield components.

Islam *et al*. (2008) studied 10 hybrids of sponge gourd developed through Line × Tester method and were evaluated for yield and related traits. Significant variation in mean performance was noticed for all the characters studied. Different hybrids were found best for different traits. The best performing hybrids for different characters include DSG-6 × Pusa Sneha for earliness, DSG-7 × PSG-9 for fruit length and average fruit weight, DSG-6 × CHSG-2 for fruit diameter and vine length, DSG-7 × NSG-1-11 for number of fruits per plant, average fruit weight and total yield per plant.

Lodam *et al.* (2009) conducted a study for accessing hybrid vigour of 28 crosses of ridge gourd over standard parent during late *kharif*. He found that in crosses, maximum heterosis was observed for fruit yield per vine followed by primary branches per vine. The highest economic heterosis was observed for fruit yield in ARGS 98-06 x ARGS 00-03 (63.81 %) which was followed by ARGS 02-14 x ARGS 03-18 (37.38 %), ARGS 04-23 x ARGS 00-03 (34.76 %), ARGS 00-03 x ARGS 03-18 (31.67 %), ARGS 02-14 x ARGS 98-06 (28.33 %), ARGS 04-23 x ARGS 98-06 (26.67 %) and SKNRG 21 x ARGS 03-18 (25.00 %).

Sundaram (2009) evaluated eight genetically diverse parents of bitter gourd along with fifty-six F_1 hybrids obtained through full diallel mating of the parents under saline soil for yield and yield contributing characters. He found that the parents CO 1 (18.30 cm) and MDU 1 (15.43 cm) were found superior with regard to length of fruit. The hybrid combinations Bikaneer 1 x CO 1 (17.59 cm), CO 1 x MDU 1 (15.64 cm) and Bikaneer 1 x MDU 1 (15.30 cm) were found to produce long fruits. The girth of fruit ranged from 8.83 cm (MDU 1 x Vadipatti Local) to 13.89 cm (Bikaneer 1 x Bikaneer 3) among the top hybrids. The average fruit weight among the parents (4.60 gm to 55.19 gm) and hybrids (11.33 gm to 57.82 gm) also showed the presence of wide variation for this trait. The average fruit weight was the highest for Bikaneer 1 x CO 1 (57.82 gm). Maximum number of fruits per vine was recorded in Vadipatti Local (342.00) among the parents. Out of the twenty top performing hybrids Vadipatti Local x IC 85643 (192.22) had produced the maximum number of fruits per vine. The yield among the top twenty hybrids ranged from 1733.67 gm to 2777.22 gm. The study revealed that none of the hybrid was found to exhibit superior performance for all the characters.

Harika *et al.* (2012) investigated with 25 bottle gourd genotypes evaluating their performance for various horticultural characters. The genotype Sarika was found to possess maximum number of primary branches, while, Anand Bottle gourd-1 recorded maximum vine length. The cultivar Thar Samridhi was noted for maximum number of leaves and thicker flesh and the genotype NBBL-12 was noted for earliness to flowering and fruiting. The genotype Gaja was found to be superior and promising for lower sex ratio (male to female), more number of fruits per vine, higher fruit yield and

seed yield per hectare. Performance studies revealed that the genotypes Gaja, NS-421, NBBL-12, Sharada, INDAM-204, NS-443, Super Dhana, Arka Bahar and Krushi Sampada were found promising for fruit yield and Anand, Gaja, Gutkha and NS-443 for seed yield.

Rabbani *et al*. (2012) studied the correlation coefficient of 60 genotypes of ridge gourd indicated that yield per plant had highly significant positive relationship with the number of fruits per plant (r = 0.874**). Path co-efficient analysis showed that number of fruits per plant exhibited the highest positive direct effect (0.7192) on yield followed by average fruit weight (0.4656) with maximum fruit weight 173.69 g. Further he indicated that yield per plant had highly significant positive relationship with length of fruit (r = 0.334**) with maximum fruit length of 34.67 cm.

Karmakar *et al.* (2013) investigated Seven parental lines, including two hermaphrodite lines and 28 F_1 hybrids of ridge gourd obtained from half diallel mating. He observed that P1 × P6 (DRG-2 × Satputia Long) and P2 × P7 (Pusa Nasdar × Satputia Small) had high number of fruits per plant and may be recommended for commercial exploitation. He observed that the high yielding F_1 hybrids were P1 × P7 (DRG-2 × Satputia Small) and may be recommended for commercial exploitation.

Thangamani and Pugalendhi (2013) studied the combining ability and heterosis for yield and quality characters, full diallel analysis in bitter gourd. He revealed that parental mean and GCA effects of the parents Preethi, CO-1, MC-30, Uchha Bolder, Green Long and MC-105 were the best genotypes for improvement of yield, combined with quality characters. Hybrids, *viz*., Preethi x MC-30, KR x USL, MC-105 x MC-10 and Priyanka x CO-1 registered favourable values for mean, significant SCA and standard heterosis for yield and quality parameters. Comparison of parental GCA and SCA of hybrids revealed that hybridization between good x good, good x poor, medium x poor and poor x good combiners gave rise to hybrids with significant SCA effects. Considering the mean performance, SCA and standard heterosis, hybrid ‘Preethi x MC-30’ registered favourable values for the most important characters like earliness, number of fruits, fruit yield and quality. Top performing F_1 hybrids can be tested over seasons and locations for assessing stability for high yield and quality.

Choudhary *et al*. (2014a) evaluated genotypes of ridge gourd that average number of fruits per plant was the highest in AHRG 29 (21.75) and the lowest in AHRG 27 (17.30). Ridge gourd that the marketable yield/plant had positive and highly significant correlation with fruit weight (0.834) and number of marketable fruit/plant (0.624) at phenotypic level. Average number of marketable fruits per plant was maximum in AHRG 29 (21.75) which was significantly higher than all genotypes except AHRG 41 (19.65) and AHRG 47 (19.45). The average fruit weight was the highest in AHRG 27 (109.46 g) and the genotype AHRG 27 which had the highest fruit length (27.26 cm) and the genotype AHRG 27 which had the highest fruit diameter (5.13 cm). The results of this study could be used in breeding programs for improving local landraces of ridge gourd grown in Rajasthan.

Choudhary *et al.* (2014b) studied variability, heritability, genetic advance, correlation and path analysis in hermaphrodite ridge gourd. Significant positive correlation was found between fruit yield per plant and fruit weight (0.877), number of fruits per cluster (0.590) and fruit length (0.356) at phenotypic level, range of number of fruits/plant 122.93-147.53 and range average yield/plant (kg) 1.60-4.69. The fruit length had the highest heritability (93.5 %) followed by node at which first hermaphrodite flower appeared (78.0 %). Therefore, these characters would be useful in improvement program of hermaphrodite ridge gourd through selection as well as hybridization.

Narasannavar *et al.* (2014) revealed that correlation co-efficient analysis that fruit yield per vine showed highly significant and positive genotypic and phenotypic correlation with number of fruits per vine (G=0.951, P=0.450) with number of fruits per vine (G=0.951, P=0.450) with fruit length (G=0.600, P=0.547).

Koppad *et al.* (2015) evaluated eighteen ridge gourd genotypes for growth, earliness, biochemical, yield and fruit quality parameters in the field condition. Fruit diameter was significantly higher in the genotype Dalasanur Local (31.92 mm) which was on par with Arabhavi Local (30.49). Whereas, lowest was recorded in the line Srinivasapur Local (22.29 mm) with range (22.29 - 30.69 mm). Number of fruits per vine is one of the yield contributing trait, the genotype Arabhavi Local (9.66) bred more number of fruits whereas lowest was recorded in the line Pusa Nasdar (5.50) with range (5.50 - 9.66). Mean fruit yield was maximum in Arabhavi Local (1760.63 g) and

minimum was recorded in Jaipur Long (695.98 g). The genotype Arabhavi Local having long fruits (33.03 cm), whereas the line Deepthi having shorter fruits (19.70 cm) among all genotypes with range (19.7-33.03). The final yield and yield attributing characters are basically governed by vegetative growth as dry matter production and its distribution.

Poshiya *et al.* (2015) conducted the heterosis study in ridge gourd carried out in ridge gourd (*Luffa acutangula* (Roxb.) L.) through 8 x 8 diallel mating design (excluding reciprocal). The magnitude of heterotic effects was high for fruit yield per vine (kg) and number of fruits per vine. He investigated that the fruit yield per vine was found to be the most heterotic trait as heterosis for fruit yield per vine ranged from -45.93 to 67.46 per cent and -52.12 to 80.51 percent over better parent and standard check, respectively. Cross of Pusa Nasdar x JRG-05-6 performed the best among them. the best performing crosses for average fruit weight (g) were Pusa Nasdar x JRG-05-6. He recorded that the best performing parents for average length were Jaipur Long, Pusa Nasdar and JRG-05-6. Best performing crosses were Pusa Nasdar x Jaipur Long, Pusa Nasdar x JRG-05-6 and JRG-05-6 x HARG-11. Crosses could be exploited for practical plant breeding programme in ridge gourd.

Rani *et al.* (2015) evaluated twenty-eight F_1 crosses developed from 8 x 8 diallel analysis excluding reciprocals. He determined the various parameters of genetic variability and nature of interrelationships among traits affecting yield in bitter gourd. Analysis of variance showed highly significant differences for all the characters studied. High heritability in association with high genetic advance as per cent of mean was observed for yield/vine, number of fruits per vine, average fruit weight, fruit length, vine length and number of laterals per vine.

Visen *et al*. (2014) studied genetic parameters between yield and yield contributing characters of different bottle gourd genotypes. Analysis of variance showed significant variation among the genotypes for all tested characters. The highest fruit yield was recorded in genotype IBG-11 (536.66 q/ha) followed by IBG 25 (226.66 q/ha) and IBG 14 (223.26 q/ha).

Sahu (2016) evaluated 8 varieties of bottle gourd and found maximum fruit yield with variety Anokhi (592.90 q/ha) followed by variety Varad (579.84 q/h) and minimum yield (351.08 q/ha) in variety BGPL-4.

A field experiment conducted by Bhargava *et al.* (2017) on different ridge gourd genotypes revealed that the ridge gourd NDRG-1 (19.06) had the highest number of fruits per vine whereas NDRG-21 (12.23) with the least number of fruits per vine. He also revealed that among all the genotypes NDRG-21 (2.51 kg) possess the maximum yield per plant while NDRG-28 (1.37) with minimum yield.

Gautam *et al.* (2017) evaluated forty-two ridge gourd genotypes. He clustered like I, II and III comprises 5, 22 and 15 genotypes, respectively. He found that the highest mean value for fruit length (18.68 cm), fruit diameter (4.03 cm), average fruit weight (13.36 g) in genotypes of cluster I while, highest mean value for average fruit weight (15.45 g) was recorded in genotypes of cluster III.

Ilyas *et al.* (2017) evaluated bottle guard varieties in agro-climatic condition of Peshawar valley showed that maximum fruit (0.49 m) was recorded for Ns550f1 variety on followed by variety Mahraya (0.43 m) while minimum fruit length of Globe variety (0.38 m) was recorded.

Krishnamoorthy and Ananthan (2017) evaluated 20 genotypes of ridge gourd. He revealed that the mean value of number of fruits per plant ranged from 11.50 to 33.47. The highest number of fruits per plant was recorded by the genotype LA19 9 (Seranma Devi Local) (33.47). The fruit yield per plant in the twenty genotypes ranged between 2.60 to 9.37 kg. The genotype LA 2 (Co 1) recorded the highest yield (9.37 kg) per plant. The genotypes LA 15 (Ottanchatram Local) (2.60 kg) recorded lower fruit yield per plant. He found that the mean fruit weight varied significantly among the genotypes. The mean fruit weight ranged between 176.67 to 576.33 g among the genotypes. The genotypes LA1 (PKM 1) (576.33 g) recorded the highest value. The genotype LA 15 (Ottanchatram Local) (176.67 g) registered lesser fruit weight among the twenty genotypes. The maximum fruit length was recorded by the genotype LA19 (Seranma Devi Local) (26.67 cm) and the least number of fruits was recorded in LA15 (Ottanchatram Local) (11.32 cm). He suggested that the mean fruit diameter ranged from 11.53 to 36.67 cm.

Muthaiah *et al.* (2017) evaluated twenty-eight crosses of ridge gourd hybrids and the crosses were evaluated along with parents. He provided that the opportunity to exploit heterosis in ridge gourd, the positive heterosis exhibited for most

of growth and yield characters *viz*., vine length, number of leaves, fruit yield per vine and fruit yield per hectare. The present study showed that the crosses DMRG-36 × DMRG-25, DMRG-25 × Arka Sumeet and DMRG-25 × DMRG-22 were exhibited high heterosis for yield characters.

Rathore *et al.* (2017) investigated 12 ridge gourd genotypes. His studies showed that, significant effect on the maximum fruit yield (60.17 t/ha) was observed maximum in treatment with T_6 RIGVAR-6. The treatment T_6 (RIGVAR-6) was found to be the best out of 12 genotypes in terms of growth, yield, quality and economic returns. His studies showed that, significant effect on the maxiumu fruit weight (132.60 gm) was observed maximum in treatment with T_6 RIGVAR-6. The studies showed that, significant effect on the maxiumu fruit length (24.27 cm) was observed maximum in treatment with T_6 RIGVAR-6. His studies showed that, significant effect on the maximum fruit diameter (4.75 cm) was observed maximum in treatment with T_6 RIGVAR-6.

Yadav *et al*. (2017) screened forty-two genotypes of ridge gourd were studied for character association during summer season. He concluded that among all the forty genotypes only two genotypes recorded significantly higher in number of fruits per plant than the best check variety (Satputia i.e., 15.97). Highest fruit yield (q/ha) was recorded in monoecious genotypes PCPGR-3711 (119.33). While in genotypes of hermaphrodite ridge gourd, genotype Satputia, PCPGR-3716, PCPGR-7275 and PCPGR-3702 were recorded significantly higher fruit yield (qa/ha). He found that only five genotypes recorded significantly higher in fruit yield than the best check variety (Pant-Torai-1 i.e., 96.69 q/ha). Only five genotypes recorded significantly higher in average fruit weight than the best check variety (Pant-Torai-1 i.e., 124.96 g). None of the genotype recorded significantly higher fruit diameter than best check variety (Pant-Torai-1 i.e., 4.67 cm).

Manoj *et al.* (2018) evaluated 35 germplasm which were grouped into eight clusters, where Cluster I and II included eleven lines followed by cluster IV and VI with four genotypes each and cluster VII with two, whereas cluster III, V and VIII were solitary. He found that the cluster V (6.35) recorded the highest cluster mean for the number of fruits per plant. He found that the highest cluster means for fruit yield per plant was observed for the cluster VII (1.08 kg). He found that the highest cluster mean

for fruit yield per hectare was observed for the cluster VII (7.17 t) and the lowest cluster mean observed for the cluster VI (4.41 t). He found that the highest cluster means for fruit weight observed for the cluster VIII (207.8 g). He found that the cluster VI (4.18 cm) showed highest cluster means for fruit diameter. He found that the highest cluster mean for the number of ridges per fruit was observed for the cluster VIII (10.25).

Jadhav and Sapovadiya (2018) studied heterosis for fruit yield and its components of Twenty-one crosses of ridge gourd in a Line x Tester set. He found that the with regard to number of fruits per vine appeared, nine F_1's exhibited positive and significant heterobeltiosis and standard heterosis respectively, of which cross JRG-13-04 x Jaipur Long highest value for both the cases. Revealed that tester Jaipur Long and lines JRG-13-04, JRG-13-06 and JRG-13-07 were good general combiners for fruit yield per vine and some of its components. He found that the fruit weight 11 and nine F1's expressed significant desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-13-07 x Pusa Nasdar had highest value for former and cross JRG-13-04 x Jaipur Long had highest value for later. He found that the length of fruit, four and one hybrids expressed significant desirable heterobeltiosis and standard heterosis respectively, of which cross JRG-13-02 x Pusa Nasdar had highest value for former and cross JRG-13-07 x Pusa Nasdar had highest value for later.

Jain *et al*. (2018) evaluated the bottle gourd characters *viz*., days to first harvest, number of fruits per plant, marketable fruit yield (kg/plant). The grand mean of marketable fruit yield (kg/plant) was 4.37 kg with the lowest fruit yield per plant of 1.46 kg recorded in NDBG-613-2 and the highest fruit yield of 7.95 kg, per vine recorded in NDBG-619-11-2 other genotypes were found to be non-significant for this character. The general mean for all genotypes was 4.36 for this character and out of forty genotypes were non-significant.

Kamble *et al.* (2018) revealed that highly significant standard heterosis was found in crosses DWD local x PSN (20.87 %) for number of fruits per vine. revealed that highly significant standard heterosis was found in crosses DWD local x CO-1 (143.01 %) for fruit yield per vine. revealed that highly significant standard heterosis was found in crosses DWD local x CO-1 (128.01 %) for fruit yield per hectare. revealed that highly significant standard heterosis was found in Crosses DWD local x CO-1 (90.30 %)

for average fruit weight. He revealed that highly significant standard heterosis was found in Crosses HSN local x Deepthi (41.20 %) for fruit length. revealed that highly significant standard heterosis was found in crosses DWD local x CO-1 (22.05 %) for fruit diameter.

Harshitha *et al.* (2019) studied different horticultural traits in ridge gourd. The studies found that the average number of fruits plant i.e 4.47. The studies also found that the average fruit yield plant i.e 948.49 (g). The studies found that the average fruit weight (g) i.e 208.75 (g). The studies found that the average fruit length (cm) i.e 27.07 cm. The studies found that the average fruit diameter (mm) i.e., 46.26 mm.

Kandasamy *et al.* (2019) studied the morphological characters of bottle gourd like fruit length, fruit girth, average fruit weight, number of fruits per vine, 100 seed weight and yield per 12 vines were studied. Analysis of variance revealed that there were significant differences among the genotypes studied for all the characters except node number of first male flower. On the basis of mean performance, among 20 genotypes, LS12 was identified as the best genotypes as it has recorded higher mean values for six out of twelve characters studied.

Kannan *et al.* (2019) evaluated with Deepthi, Haritham, Satputia, CO2, IC-92672 and IC-92685 accessions to evaluate their yield characters. Accession IC-92684 produced highest number of fruit (32.2) while the F_1 (MS × Arka Sumeet) hybrid recorded highest yield per plant (6.4 kg/plant). Genotypes, backcrosses and three way crosses differed significantly with respect to average fruit length, number of harvests, number of fruits per plant and yield per plant. The genotype Arka Sumeet produced longest fruit (44.33 cm) while the accession IC-92685 produced maximum number of fruits per plant (52.66). The three way cross (MS × IC-92671) × Arka Sumeet exhibited highest yield per plant (7.79 kg/plant). Genotypes and F_1 (MS × Arka Sumeet) differed significantly with respect to all fruit characters, *viz.,* average fruit length, average fruit weight and fruit girth. Arka Sumeet produced fruits with maximum length and fruit weight (43.6 cm and 0.243 g, respectively). Cultivar Deepthi recorded maximum fruit girth (15.5 cm).

Methela *et al*. (2019) investigated 29 genotypes of ridge gourd. Correlation coefficient study reveals that yield per plant had highly significant positive

relationship with fruit length (rg = 0.43*, rp = 0.40*) and individual fruit weight (rg = 0.69**, rp = 0.67**). In general, genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients suggesting that the environmental influence reduces the relationship between yield and yield contributing characters of ridge gourd. On the other hand, plant height, fruit diameter and fruit thickness exhibited negative association with yield. Path co-efficient analysis showed that individual fruit weight exhibited the highest positive direct effect (0.8462) on yield followed by number of fruits per plant (0.7040).

Palghadmal *et al.* (2019) evaluated the growth and yield performance of ten bottle gourd selections. The data revealed that among different selection of bottle gourd, the selection RHRBG-19 also recorded the maximum fruit length (38.53 cm), highest diameter (7.62 cm) and average fruit weight (690.00 g). Similarly, the selection RHRBG-19 recorded more number of fruits per vine (23.00), highest fruit yield/vine (15.87 kg) and per hectare (529.00 q) followed by RHRBG-18 which recorded fruit length (35.73), diameter (7.24), average fruit weight (608.00 g), number of fruits per vine (22.20), fruit yield/vine (13.37) and per hectare (449.66 q).

Reddy *et al.* (2019) developed thirty-six F_1 hybrids of sponge gourd developed through diallel fashion were evaluated for yield and related traits. The best performing parents and hybrids for different characters for number of fruits per plant Kulgod local × Pusa Chikni (22.91) and also for fruit yield per plant Kulgod local × Pusa Chikni (2.99 kg). The best performing parents and hybrids for different characters for average fruit weight SG-5 × KRCCH-1 (213.82 g) and for fruit length SG-3 (28.33 cm) and Swarna Prabha × KRCCH-1 (30.17 cm) and for fruit diameter SG-3 (3.95 cm) and SG-6 × SG-5 (4.03 cm). Significant variation in mean performance was noticed for all the characters studied. Different parents and hybrids were found best for different traits.

Reshmika *et al.* (2019) 16 hybrids and 5 check varieties of bitter gourd collected from public and private sectors. Observations were recorded for 14 characters and ranking of hybrids was done based on cumulative index worked out for the characters like, fruit weight (g), fruit length (cm), fruit diameter (cm), relative early yield (kg), yield/plant (kg) and number of fruits per plant. Significant difference was observed

among the hybrids for the selected characters. Promising 5 F_1 hybrids selected based on the cumulative index were MC-142, MC-136, MC-139, MC-138 and MC-133.

Singh *et al.* (2019) studied seven parental lines and 21 F_1 hybrids of ridge gourd resulting from half diallel the extent of heterosis for its attributing characters *viz*., number of fruits per plant. The two most promising F_1 hybrids found were Pusa Nutan × Arka Sujata and Pusa Nutan × DRG-7 which were early in maturity, had higher number of fruits/plant and showed 84.38 and 51.26 per cent heterosis for yield and for the highest positive and significant heterosis estimate was recorded in the cross Pusa Nutan × Arka Sujata over better parent (87.62 %) and standard check (84.38 %) while Pusa Nutan × DRG-7 ranked second with heterosis values of 51.45 per cent (BPH) and 51.46 per cent (SH) for total fruit yield. For fruit weight character maximum significant and positive heterosis for fruit weight over better parent was shown by Pusa Nasdar × Swarna Uphar (21.92 %) while Pusa Nutan × Arka Sujata exhibited highest heterosis over standard variety (19.50 %).

Varalakshmi *et al.* (2019) evaluated fifty-one ridge gourd germplasm for yield and qualitative traits during 2011-14. There were significant differences among the germplasm for all the 11 quantitative and nine out of 22 qualitative parameters studied. Regarding plant growth habit, 34 had long vines, 16 had medium long vines and only one germplasm, IC92618 had short vines. Fifteen germplasm lines recorded dark green fruit skin colour, 33 had green coloured fruits and only three germplasm had light green coloured fruits, hence this variability can be exploited for developing green and dark green coloured varieties which are very much preferred in different markets. With respect to fruit taste, 29 lines had normal fruit taste, 18 lines were sweet and four lines, *viz*., IC92625, IC92685, IIHR-17 and IIHR-51 had bitter fruits.

Kumar and Aswini (2020) developed ridge gourd F_1 hybrids exploiting cytoplasmic genic male sterility (CGMS) system. Hybrid KRH-1 is male fertile and produces more number (12.6 fruits/plant). Hybrid, KRH1 is a cross between male sterile female line (KAU-MS-LA 101) and male fertile male line LA-102. It has proved to be highly heterotic with a high yield (7.419 kg/plant) bearing attractive long slender fruits. Hybrid MS × LA 102 is male fertile and superior in terms of total yield (7.386 kg/plant)

when compared to other parents and hybrids. Hybrid MS × LA 102 (0.333 kg) with maximum fruit weight.

Malve *et al.* (2020) worked on specific combining ability effects which indicated that the cross combinations 1 x 8 (RHR RG-1 x RHR RG-8), 2 x 7 (RHR RG-2 x RHR RG-7), 2 x 8 (RHR RG-2 x RHR RG-8), 5 x 8 (RHR RG-5 x RHR RG-8), 6 x 7 (RHRG-6 x RHRRG-7) and 6 x 8 (RHRRG-6 x RHRRG-8) displayed significant and positive specific combining ability for weight of fruits per vine and number of fruits per vine and also showed significant negative SCA effects for desirable traits.

Triveni *et al.* (2020) conducted research to evaluate twenty different genotypes of ridge gourd reported that genotype "Arka Sujat" was having more number of fruits per plant (11.93). He also reported that the fruit yield was maximum in the genotype "Arka Sujat" (1.00kg/plant) and that the average fruit weight was recorded maximum in "Chithrala" (233.73g). The average fruit length was recorded maximum in the genotype "Arka Sujat" (25.11cm). Based on this research work genotypes can be selected for further crop improvement programme.

Vijayakumar *et al.* (2020) studied on genetic variability, correlation and path analysis in F_6 generation of ridge gourd. The study result revealed that low percent PCV and GCV were recorded in the traits like number of fruits per plant (6.51; 5.16). It also revealed that low percent PCV and GCV were recorded in the traits like fruit weight (9.38; 7.77). The results also indicated that moderate GCV, PCV and high heritability along with high genetic advance as percentage of mean recorded for the character fruit length (13.14 %, 14.06 % and 87.44 %, 25.32 %).

Srikanth *et al.* (2021) studied the combining ability of ten different lines of ridge gourd. The cross combination, VRG-25 x Swarna Manjari exhibited highest SCA effect for number of fruits per vine. He found that out of the ten parents studied VRG-25 and VRG-24 were found to be good general combiners for fruit yield and quality characters. The knowledge of combining ability helps in identifying good combiners for hybridization.

Sravani *et al.* (2021) studied variability for eighteen characters of ridge rourd in F_2 generation of four crosses *viz*., Swarna Manjari x VRG-16, Arka Prasan x

VRG-16. VRG-24 x VRG-13 and Swarna Manjari x Arka Prasan. High PCV and GCV were recorded for average fruit weight, average fruit weight and fruit yield per vine.

2.4 Per cent incidence of diseases and pests

Downy mildew, a foliar disease caused by the oomycete *Pseudoperonospora cubensis* Rostow., is one of the most destructive pathogens of cucurbits. Cucurbit downy mildew is an obligate parasite and, with the rare exception of oospore production, can only survive and reproduce on living host tissue. *Pseudoperonospora* species produce asexual spores called sporangia which germinate and release zoospores. The zoospores are biflagellate and motile in water, once they encyst they will produce a germ tube that enters host stomatal pores. *Peronospora* species produce asexual spores that germinate by means of a germ tube, these spores are commonly called conidia. The germ tube from the conidia directly enters the host through stomatal pores (Palti and Cohen, 1980; Thakur and Kusum, 2002).

Resistant cultivars are available but nevertheless yield losses are high if fungicides are not used. Higher levels of resistance are needed to reduce the use of pesticides while maintaining adequate yields. The objective of this experiment was to identify new sources of resistance to downy mildew among plant introduction accessions.

Thomas and Jourdain (1992) conducted field evaluations for resistance against downy mildew, incited by *Pseudoperonospora cubensis* [(Berk. and Cart.) Rostow], on 942 U.S. Plant Introductions (PI) of *Cucumis melo* L. A disease index (DI) was calculated for each entry. Based on DI, PI 124112 was highly resistant (DI = 3.7) and PIs 124111, 122847, 124210, 145594 and 165525 were resistant (DI = 3.0, 2.8, 2.6, 2.7 and 2.5, respectively). PIs 124111 and 124112 had one or more plants that exhibited a highly resistant reaction type (RT 4). Resistant (RT 3) plants were identified in 31 accessions and 49 accessions bad moderately resistant (RT 2) plants. Based on Disease Index (DI), PI 124112 was highly resistant (DI = 3.7) and PIs 124111,122847, 124210, 145594 and 165525 were resistant (DI = 3.0, 2.8, 2.6, 2.7 and 2.5, respectively). PIs 124111 and 124112 had exhibited a highly resistant to downy mildew of melon.

Thammaiah *et al*. (1995) studied the varietal reactions of ridge gourd to powdery mildew (*Erysiphe cichoracearum*) and downy mildew (*Pseudoperonospora*

cubensis). Variety Raichur local-2 was resistant to downy mildew and powdery mildew and recorded the highest yield.

In this study Fugro *et al.* (1997) grouped ridge gourd genotypes as follows Highly susceptible: Bombay special, Samurapur, Mysore, Solapur, Sathadol, Saswad, Torai, Wardha, Kasegaon, Tendoli Sel. 5, Sel. 4-12, RG-I04, RG- 108, RG-I13 and RTN-3. (51-100 % downy mildew inferction). Susceptible: Poona, Panvel, Konkan Harita, Hatargi, Pusa Nasdar, Tendoli Sel. I, Co-I, Pali, GBGN, Kapali, Vani Sel, Green long, Kawalapur, Vengurla-I, Goteshwar, Pangari, Sagaon, Punjab Sadabahar, Save local, RG Long, Konkani, AEC- 90, AEC-91, RG-107, RG-IIO, RG Round, Tendoli Sel-3, Tendoli Sel 6., Surekha (Hybrid), RTN-1, RTN-2 and Kerala type (21-50 % of infection). Moderately resistant: DPL-RG-16 (11-20 % infection). Resistant: DPL-RG-29 and DPL-RG-33 (0-10 % infection).

In ridge gourd Jamadar and Desai (1999) reported that none of the cultivars showed immune or highly resistant reaction tom downy mildew infection. But among the cultivars screened Raichur Local-1, Raichur Local -2 and Jumnal Local showed moderate resistance with an average PDI of 30.9, 32.4 and 35 per cent respectively. The other cultivars were showing susceptibility with a PDI range between 39 to 67 per cent whereas maximum infection was noticed on Hittinhalli Local (67 % PDI).

Artificial inoculation of the pathogen on bitter gourd revealed that out of 148 germplasm lines of bitter gourd screened against *Pseudoperonospora cubensis*, NIC-12285 and VRBT-39 were moderately resistant with high degree of tolerance. IC-50524A, Wild-27, VRBT-1, IC- 68250B, IC-68313, IC-85618, VRBT-21 were found moderately susceptible to the disease. Slow mildew resistance (SMR) was observed in IC-50520B, Wild-27, IC-68250B and IC-68314 (Pandey *et al.,* 2005).

The seventy cultivars of cucumber were evaluated in greenhouse condition (Adam *et al.,* 2008). The result showed that the most resistant 10 cultigens were Ames 2353, Ames 2354, PI 197085, PI 197088, PI 234517, PI 321008, PI 330628, PI 432878, PI 605996 and PI 618931. The most susceptible cultigens over locations were PI 137848, PI 169328, PI 169385 and PI 172846.

Pandey *et al.* (2008) reported that out of 29 genotypes of cucumber, only one genotype DC-l was rated as resistant. The genotypes B-184 and B-157 were observed to be highly resistant. But, in case of B-184 genotype, there was no disease appearance till last stage of the crop. Six genotypes were observed to be moderately resistant *viz..,* VRC-112, CHC-2, DR/NKV/02-13, PCUC-8, 5el.-75-2-1 and EC-362927 and about 28-30 per cent leaf area infection appeared in these genotypes. Four genotypes of cucumber *viz.,* DRlNKV/02-91, CH-20, FZCU-4, VRC-7, were observed to be susceptible.

Resistance to downy mildew appeared to be controlled mainly by dominance effects. Therefore, the inbred lines IIHR 121 and IIHR 122 could be used strategically to exploit heterotic effects in muskmelon (Shashikumar *et al.,* 2010).

Call *et al.* (2012a) reported that the most resistant cultigens of cucumber against downy mildew were WI 2238, Wellington, Moxie, LJ 90430, Atlantis, Fancipak, Picklet and Vlaspik. Moderately resistant cultigen was observed in Line M 21. The cultivars Coolgreen, Wis. SMR 18 and Straight 8 were identified as moderately to highly susceptible.

Cucumber cultigens have been found that significantly outperform checks in all resistance traits. The mean combined ratings for these cultigens ranged from 2.8 to 3.0. Call *et al.* (2012b) reported that the highest performing checks were Slice and M 21. The most resistant accessions downy mildew were PI 605996, PI 618893, PI 330628, PI 605924, PI 605928, PI 197086 and PI 197088.

The genotypes of bottle gourd *viz.,* Gutkha, Sarika and Kaveri were found to show resistant reaction (disease score of 1.0) against downy mildew, while Arka Bahar, INDAM-204, NS-421, NBOH-1, Bio Gaurav, US-15, Reena, Super Dhana, Anand and Sharada were found to exhibit moderately resistant reaction (disease score of 2.0). The genotypes INDAM-320, NS-443, Anand Bottlegourd-1, Gaja, NBBL-12, Warad, NBBL-52, Elina, Krushi Sampada and Louki exhibited moderately susceptible reaction (disease score of 3.0). Thar Samridhi and Champion were found to show susceptible reaction (disease score of 4.0) against downy mildew (Harika *et al.,* 2012).

Pitchaimuthu *et al.* (2012) revealed that wild species *Cucumis hardiwickii*-14 and 15*, Cucumis sativus* var *sativus* and SM 12735 exhibited a high level of resistance to downy mildew diseases with 0-25 % PDI. Five accessions namely (IIHR-27, IIHR-35,

IIHR-303, IIHR-64 and IIHR 82) had < 40 % PDI exhibited moderately resistance to DM disease of cucumber.

Reddy *et al.* (2012) screened fourteen genotypes of Gherkin against *P. cubensis* under artificial epiphytotic condition. The results revealed that out of 14 genotypes evaluated none of them was found to be resistant. However, genotypes *viz.,* Sparta (20.05 PDI) was moderately resistant and genotypes Vertina (35.08PDI), Nun-5508 (43.07 PDI) and Shakthi-RZ (25.20 PDI) showed moderate susceptibility.

Varalakshmi *et al.* (2014) evaluated 24 selections of ridge gourd for artificial screening against downy mildew disease resistance. Out of twelve lines evaluated, four advanced selections showed least incidence of downy mildew compared to susceptible checks and commercial varieties/ hybrids. Out of the four selections, IIHR-17-2-1 was moderately resistant (16.25 PDI) and the rest three selections *viz.*, IIHR-17-1-7-4 (29.09 PDI), IIHR-7-5-1 (21.4 PDI), IIHR-17-1-7-3(21.6 PDI) showed moderate susceptibility, whereas the susceptible checks, IIHR-52-1-30 (92.18 PDI) and IIHR-23-8-10 (91.85 PDI) were highly susceptible.

Seven cucumber varieties were screened for resistance against downy mildew (Waris *et al.* 2014). The result showed that Super green special variety was graded 3 and the other varieties Beithoalfa, Marketmore-76, Cucumber 363, Anmol, Marketmore and Desi graded 6,6,6,7,7 and 8 respectively which revealed that these varieties were highly resistant.

Haldhar *et al*. (2015) evaluated 15 varieties/genotypes of ridge gourd against melon fruit fly, the varieties/genotypes; AHRG-57, Pusa Nasdar and AHRG-29 were resistant; AHRG-35, Arka Sujata, AHRG-41, AHRG-36, S. Manjari and S. Uphar were moderately resistant; AHRG-49, AHRG-33, AHRG-42 and AHRG-30 were susceptible whereas AHRG-47 and AHRG-31 were the highly susceptible varieties/ genotypes in both seasons.

Poshiya *et al.* (2015) showed that the best performing parents for fruit fly infestation (%) were ARGS-05-31, Pusa Nasdar and HARG-109. He recorded that the best performing crosses were ARGS-05-31 x ARGS-07-41, HARG-109 x ARGS-07-41 and Pusa Nasdar x HARG-110. Such crosses can be used in improvement of ridge gourd.

Lebeda *et al.* (2016) reported that two accessions of *C. melo* subsp. *agrestis* (PI 614174 and PI 614442) were incompletely resistant to downy mildew. The accession with resistance to *P. cubensis* is PI 315410 belongs to the *C. melo* subsp. *melo.* Two of the three accessions of *C. melo* subsp. *agrestis* were also incompletely resistant.

Uraiha *et al.* (2018) reported that, out of thirteen varieties tested, three *viz*., Amrit, Ankit and Anmol were free from the disease and showed immune response against downy mildew. Two (Manya, Ns-433), four (Chutki, Haruna, Latto and Naveen) and three (Angad, Mahima and Sarita) varieties were found resistant, moderately resistant and moderately susceptible, respectively. One variety (Divya) was susceptible against the disease and none of the variety was found highly susceptible.

Zakeri *et al*. (2022) studied the development of downy mildew disease in cucumber, it was investigated in a commercial variety (Sakata F_1 Hybrid Saso), three hybrids and eight pure lines of cucumber, four pure squash lines, and one commercial cultivar of watermelon (Sakata F_1 Charleston Gray 243) in two consecutive years (2017 and 2018 spring and summer) at the experimental field of the University of Guilan, Iran to identify the sources of resistance. The disease was measured using standard scale and Image J software at five stages in the plant growing season. Comparison of disease progress curves, final severity of the disease, and area under the disease progress curve (AUDPC) showed that cucumber B10 and A12 pure lines were the most susceptible and resistant in both years, respectively. None of the squash lines were infected in the first year, but in the second year, two lines showed the disease symptoms, and the severity of the disease in these lines was close to each other. The commercial cultivar of watermelon was not infected in both years.

3. MATERIALS AND METHODS

The present investigation entitled "Evaluation of F_1 hybrids of ridge gourd [*Luffa acutangula* (L.) Roxb] for growth and yield" was conducted during the period from *kharif 2021* at All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experimental field has an altitude of 532 m above mean sea level, latitude of $19^0$47' to $19^0$57' N and longitude of $74^0$82' to $74^0$91' E. The temperature range 7.30^{0}C to 39.30^{0}C with 65 per cent relative humidity. Annual rainfall varies from 307 to 619 mm and average rainfall is about 475 mm. The details of the materials used, applied methodologies and the experimental techniques employed for the studies are outlined in this chapter.

3.1 Experimental Material

The experimental material comprised of 20 hybrids and 2 check cultivars of ridge gourd developed by random mating at the All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri. The sowing of experimental material was done on 23 June 2021. Five random competitive vines were selected from each plot and following observation were recorded. The average value of each observation was calculated on the basis of five vines for each hybrid in every replication. List of all the hybrids is given as below.

3.2 Details of Experiment

The details of the experimental techniques employed for the present investigation are described as under:

1.	**Crop**	**:**	Ridge gourd [*Luffa acutangula* (L.) Roxb]
2.	**Location**	**:**	AICRP on Vegetable Crops, Department of Horticulture, MPKV, Rahuri.
3.	**Experimental Design**	**:**	Randomized Block Design (RBD)
4.	**Plot Size**	**:**	5.0 x 1.5 m^2
5.	**Spacing**	**:**	1.5 m x 1.0 m
6.	**Treatments**	**:**	22 (20 hybrids + 2 Check)
7.	**Replications**	**:**	02

8. Date of Sowing : 23/06/2021

9. Number of plants per plot : 05

10. Total number of plots : 44

3.3 Treatment Details

T_1	:	COH-1 × Karjat Local	T_{12}	:	Karjat Local × Krishna-51
T_2	:	COH-1 × Banaras Local	T_{13}	:	Banaras Local × Arka Sujata
T_3	:	COH-1 × Arka Sujata	T_{14}	:	Banaras Local × Nidhi
T_4	:	COH-1 × Nidhi	T_{15}	:	Arka Sujata × Nidhi
T_5	:	COH-1 × Navin Long	T_{16}	:	Arka Sujata × Navin Long
T_6	:	COH-1 × NRG-9	T_{17}	:	Arka Sujata × NRG-9
T_7	:	COH-1 × Krishna-51	T_{18}	:	Arka Sujata × Krishna-51
T_8	:	Karjat Local × Banaras Local	T_{19}	:	Navin Long × Krishna-51
T_9	:	Karjat Local × Nidhi	T_{20}	:	NRG-9 × Krishna-51
T_{10}	:	Karjat Local × Navin Long	T_{21}	:	Naga (Check - 1)
T_{11}	:	Karjat Local × NRG-9	T_{22}	:	Pusa Nasdar (Check - 2)

3.3.1 Experimental design and layout

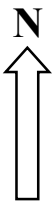
The experiment was laid out in Randomized Block Design with two replications. The experiment was conducted at All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during the *kharif* 2020-21.

3.4 Cultural operations

The schedules of various cultural operations were carried out during the course of investigation according to need and time of operation.

3.4.1 Field preparation

The land was brought to fine tilth by ploughing and harrowing to pulverize the soil and finally the field was levelled with planker. The experimental area was divided into plots of 5.0 x 1.5 m^2 size. Well decomposed farmyard manure @ 25 t/ha was incorporated by mixing with the soil uniformly as basal application and filled up to 3-5 cm above the ground level.



RI	RII
$P_1 \times P_2 : T_1$	$P_1 \times P_4 : T_3$
$P_1 \times P_3 : T_2$	$P_1 \times P_6 : T_5$
$P_1 \times P_4 : T_3$	$P_1 \times P_8 : T_7$
$P_1 \times P_5 : T_4$	$P_2 \times P_3 : T_8$
$P_1 \times P_6 : T_5$	$P_2 \times P_6 : T_{10}$
$P_1 \times P_7 : T_6$	$P_2 \times P_7 : T_{11}$
$P_1 \times P_8 : T_7$	$P_2 \times P_8 : T_{12}$
$P_2 \times P_3 : T_8$	$P_3 \times P_4 : T_{13}$
$P_2 \times P_5 : T_9$	$P_4 \times P_5 : T_{15}$
$P_2 \times P_6 : T_{10}$	$P_4 \times P_7 : T_{17}$
$P_2 \times P_7 : T_{11}$	$P_6 \times P_8 : T_{19}$
$P_2 \times P_8 : T_{12}$	$P_7 \times P_8 : T_{20}$
$P_3 \times P_4 : T_{13}$	Pusa Nasdar-(C_2)
$P_3 \times P_5 : T_{14}$	Naga-(C_1)
$P_4 \times P_5 : T_{15}$	$P_1 \times P_2 : T_1$
$P_4 \times P_6 : T_{16}$	$P_1 \times P_3 : T_2$
$P_4 \times P_7 : T_{17}$	$P_1 \times P_5 : T_4$
$P_4 \times P_8 : T_{18}$	$P_1 \times P_7 : T_6$
$P_6 \times P_8 : T_{19}$	$P_2 \times P_5 : T_9$
$P_7 \times P_8 : T_{20}$	$P_3 \times P_5 : T_{14}$
Naga-(C_1)	$P_4 \times P_6 : T_{16}$
Pusa Nasdar-(C_2)	$P_4 \times P_8 : T_{18}$

Fig. 3.1. Plan of layout of ridge gourd evaluation trial in *kharif*-2020-21

3.4.2 Fertilizer Application

Recommended dose of fertilizers 100 kg N, 75 kg P_2O_5 and 60 kg K_2O was applied to the soil. The entire quantity of phosphorus and potassium and half of nitrogen were thoroughly mixed and broadcasted in each plot in equal amount as basal dose before sowing. Two top dressings with 1/4th quantity of nitrogen at 45 DAS and 60 DAS were done.

3.4.3 Selection of seed and sowing

Pure and healthy seeds of each hybrid were collected before sowing. The seeds were soaked in water for 12 hours to get good germination. The sowing was done on 23rd June, 2021.

3.4.4 Intercultural operation and plant protection

Weeding was done three times as per the requirement for maintaining uninterrupted growth of the crop and proper plant protection measures were taken timely.

3.4.5 Irrigation management

Irrigation was provided by furrow irrigation system. First irrigation was given immediately after sowing. Further, irrigations were given as per the need of the crop.

3.4.6 Selection of plants for observation

In a field experiment, detail study of the entire population is rather difficult. Since all the plants get identical environment, i.e. some plants from the population were randomly selected for detailed investigations, so five plants were selected at random in each plot and tagged for identification and recording their observations on all the traits.

3.5 Observations recorded

Data on the following characters were recorded during the experimentation. Each plot comprised eight plants and the data on different characters were recorded from five plants of each plot.

A. Growth characters

1. Length of vine (m)

Length of the vine was measured for five plants from cotyledonary node to the tip of the plant at the time of final harvest and the average was taken and expressed in meter.

2. Number of primary branches per vine

All the primary branches on shoots of the vine was recorded while final crop harvest.

B. Flower characters

1. Days required for appearance of first male flower

The number of days taken from the date of sowing to the date of first male flower anthesis was observed in all the five selected vines from each replication and their average was calculated.

2. Days required for appearance of first female flower

The number of days taken from the date of sowing to the date of first female flower anthesis was observed in all the five selected vines from each replication and their average was calculated.

3. Days to 50 % flowering

The number of days taken by 50 per cent of plants to produce female flowers in each treatment was recorded.

4. Node at which first female flower appear

The node number at which the first female flower appears gives an indication of earliness in cucurbits, therefore the node at which first pistillate flower appeared was noted for all the observational plants and mean was calculated.

5. Sex ratio (Male : Female)

Total number of female and male flowers was counted. Observations were recorded daily in the evening when the flowers start blooming. Sex ratio was calculated by using the formula

$$\text{Sex ratio} = \frac{\text{Number of male flowers}}{\text{Number of female flowers}}$$

6. Days required to first harvest of fruit

Number of days taken from the date of sowing to the date of first harvest of the edible green fruits in a vine was recorded as days to first harvest for particular treatment (hybrids).

C. Fruit characters (quantitative)

1. Average fruit weight (g)

Average weight of each fruit was recorded in gram from five randomly selected plants of each plot in each replication and then average fruit weight was calculated.

2. Length of fruit (cm)

Five harvested fruits were measured with the help of thread and it is compared with meter scale in centimetre. Then average fruit length was calculated for every hybrid.

3. Fruit diameter at centre, pedicel and stylar end (cm)

The diameter of each fruit was measured at the centre, pedicel and stylar end with help of digital vernier calliper and average diameter was worked out.

D. Fruit characters (qualitative)

1. Shape of fruit

Every hybrid has specific fruit shape. The fruit shape was categorized into oblong, elongate and elliptical in shape.

2. Colour of fruit

Every hybrid has a specific colour of fruit. Colour of fruits was observed by simple visualization of eye. The fruit colour was categorized in to different group dark green, light green, green etc.

3. Number of ridges

Number of ridges were counted on visual observations.

E. Yield characters

1. Number of fruits per vine

The number of edible fruits harvested from five randomly selected vines in each treatment was collected during each picking counted and totaled together and average fruits per vine were calculated.

2. Yield of fruits per vine (kg)

The total edible green fruit from all the picking was recorded for each treatment and yield per vine was obtain after dividing total yield by number of vines per plot.

3. Fruit yield (t/ha)

Fruit yield (t/ha) was calculated on the basis of yield per plot.

G. Per cent incidence of diseases and pests

1. Per cent incidence of pest and diseases

Number of plants infected by incidence of powdery mildew, downy mildew and gummosis were counted and the per cent disease incidence (PDI) worked out as per following formula.

$$\text{Per cent of disease incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

Fruit fly incidence of pest was recorded at ten days interval. The incidence of above-mentioned pests was calculated as follows:

$$\text{Per cent incidence of fruit fly} = \frac{\text{Number of infected fruits}}{\text{Total number of fruits}} \times 100$$

3.6 Statistical Analysis

The mean values of five plants computed for each of the twenty-one characters for each of the hybrid in each replication were subjected to statistical analysis.

3.6.1 Analysis of variance

The data collected on different parameters during the course of investigation were subjected to statistical analysis as per method of analysis of variance (Panse and Sukhatme, 1985) to find out the significance of hybrids. The model of analysis of variance Table adopted is given below.

To test the significance of treatment, the calculated value of “F” was compared with tabular value of “F” at 5 and 1 per cent levels of probability against error degree of freedom.

The skeleton of ANOVA used in given below:

Source of variation	Degree of freedom	Sum of Squares	Mean sum of squares	F value	
				Calculated	Tabulated
Replication	(r-1)	RSS	RMS		
Treatment	(t-1)	Tr SS	Tr MS	Tr Ms /Er SS *Significant at 5%, **Significant at 1%	
Error	(r-1) (t-1)	Er SS	EMS		

Where,

r = Number of replications

t = Number of treatments

RSS = Sum of squares due to replication

Tr SS = Sum of squares due to treatment (genotypes)

Er SS = Sum of squares due to error

A. Critical Difference

CD = SEd x t Value at 5% at error degree of freedom

$$SEd = \sqrt{\frac{2EMS}{r}}$$

Where,

SEd = Standard error of difference between two treatment means

EMS = Error Mean of square

r = Number of replications

B. Standard Error of Mean

$$SEd = \pm\sqrt{\frac{2EMS}{r}}$$

C. Coefficient of Variation (CV) (%)

Coefficient of variation is standard deviation expressed as percentage of Mean.

$$CV\ \% = (SD / X) \times 100$$

Where,

SD = Standard deviation

x = Mean of character

D. Mean

Mean of the character was estimated by summing up of all the observation and dividing the sum by the number of observations.

$$(X) = \Sigma Xi / N$$

Where,

ΣXi = Summation of all the observations,

N = Number of observations

4. RESULTS AND DISCUSSION

The present investigation entitled "Evaluation of ridge gourd [*Luffa acutangula*, (Roxb. L).] hybrids for growth and yield" was carried out to study the mean performance of ridge gourd hybrid for growth, fruit yield and its component characters.

The observations of the ridge gourd hybrid *viz*., growth, flowering, yield, qualitative and quantitative characters of fruits and incidence of pest and diseases were recorded to study the mean performance of different hybrids.

4.1 Analysis of variance

The analysis of variance of all the characters under study is presented in Table 4.1. This analysis of variance revealed that mean sum of squares due to hybrids was highly significant for all characters like length of vine (m), number of primary branches per vine, days required for appearance of first male flower, days required for appearance of first female flower, days to 50 % flowering, number of male and female flowers per vine (sex ratio), node at which first female flower appeared and days required for first harvest of fruits, number of fruits per vine, yield per vine (kg), fruit yield (t/ha), weight of fruit (g), length of fruit (cm), fruit diameter at centre, pedicel and stylar end (cm), downy mildew, gummosis and fruit fly.

However, variation for powdery mildew disease incidence indicated non-significant variation among the hybrids under the study.

Mean performance

The observations on five plants from each hybrid in two replications for growth characters were used for calculating the mean performance. The observations were averaged for five vines taken randomly for each hybrid in each replication and were later averaged over the replications. The mean performance for growth parameters of different hybrids is presented in Table 4.1.

Table 4.1. Analysis of variance for yield and its yield contributing component characters in ridge gourd F_1 hybrids

Sr. No.	Character (df)	Mean sum of square		
		Replication (1)	Treatment (21)	Error (21)
1.	Length of vine (m)	3.26	10.93**	0.89
2.	Number of primary branches per vine	0.89	9.44**	0.72
3.	Days required for appearance of first male flower	3.75	267.30**	3.69
4.	Days required for appearance of first female flower	1.83	320.76**	3.30
5.	Days to 50% flowering	2.40	367.97**	3.25
6.	Sex ratio	2.61	37.56**	1.34
7.	Node at which first female flower appeared	5.361	76.39**	1.59
8.	Days required for first harvest of fruit	2.14	452.56**	3.81
9.	Number of fruits per vine	0.79	49.59**	2.086
10.	Yield per vine (kg)	0.039	1.87**	0.088
11.	Fruit yield (t/ha)	1.98	83.21**	3.67
12.	Average weight of fruit (g)	17.66	5548.37**	223.02
13.	Length of fruit (cm)	13.19	307.27**	29.77
14.	Fruit diameter at centre (cm)	0.0027	2.46**	0.0025
15.	Fruit diameter at pedicel	0.0052	0.56**	0.09
16.	Fruit diameter at stylar end	0.064	1.57**	0.08
17.	Powdery mildew	298.90	1164.99^{NS}	1023.57
18.	Downy mildew	14.91	187.451**	3.48
19.	Gummosis	1.52	95.91**	0.370
20.	Fruit fly	4.26	104.90**	1.10

* Significant at 5 % ** Significant at 1 %

* Degrees of freedom (n-1)

4.2 Growth parameters of ridge gourd hybrids

4.2.1 Vine length (m)

The observation of vine length was taken at the time of final harvest. The mean performance of ridge gourd hybrids for length of vine is presented in Table 4.2.

The vine length of ridge gourd differed significantly among the hybrids. The vine length of different hybrids were ranged from 4.05 m to 9.95 m with an overall mean of 5.85 m. The hybrid $T_1 : P_1 \times P_2$ (9.95 m) recorded significantly maximum vine length, at par by $T_5 : P_1 \times P_6$ (8.15 m) and $T_3 : P_1 \times P_4$ (8.01 m). The minimum vine length was recorded in $T_{11} : P_2 \times P_7$ (4.05 m). Madhavi *et al.* (2021) reported maximum length of vine (7.5m) ridge gourd hybrid, IC 523892 × Arka Sujata recorded the highest vine length while Rathore *et al.* (2017) recorded longest vine length (5.07 m) in genotype RIGAVAR-6. Similar results were in tune with Choudhary *et al.* (2014a), Kamble *et al.* (2018), Reddy *et al.* (2019) and Triveni *et al.* (2020).

Table 4.2. Performance of ridge gourd F_1 hybrids for growth characters during *kharif* season

Hybrids	Length of vine (m)	Number of primary branches per vine
$T_1 : P_1 \times P_2$	9.95	8.40
$T_2 : P_1 \times P_3$	7.87	7.34
$T_3 : P_1 \times P_4$	8.01	7.60
$T_4 : P_1 \times P_5$	7.75	8.05
$T_5 : P_1 \times P_6$	8.15	7.88
$T_6 : P_1 \times P_7$	5.86	6.30
$T_7 : P_1 \times P_8$	5.96	6.55
$T_8 : P_2 \times P_3$	6.35	6.40
$T_9 : P_2 \times P_5$	6.10	6.25
$T_{10} : P_2 \times P_6$	4.75	5.60
$T_{11} : P_2 \times P_7$	4.05	5.25
$T_{12} : P_2 \times P_8$	4.65	6.20
$T_{13} : P_3 \times P_4$	6.35	7.40
$T_{14} : P_3 \times P_5$	4.85	5.90
$T_{15} : P_4 \times P_5$	5.40	6.50
$T_{16} : P_4 \times P_6$	6.20	5.90
$T_{17} : P_4 \times P_7$	6.10	6.60
$T_{18} : P_4 \times P_8$	4.60	6.20
$T_{19} : P_6 \times P_8$	6.43	7.84
$T_{20} : P_7 \times P_8$	6.98	8.17
Naga-(C_1)	7.54	6.75
Pusa Nasdar-(C_2)	6.88	7.15
General Mean	5.85	6.20
S.E. ±	0.67	0.60
C. D. at 5 %	1.96	1.76
C. V. (%)	14.28	15.31

4.2.2 Number of primary branches per vine

The observation recorded for number of primary branches per vine is depicted in Table 4.2. Among all hybrids number of branches per vine ranged from 5.25-8.40 with an overall mean of 6.20. The trait was statistically significant to reveal the effect of treatments and the maximum number of primary branches per vine was recorded the hybrid T_1: $P_1 \times P_2$ (8.40), at par by T_{20}: $P_7 \times P_8$ (8.17), T_4: $P_1 \times P_5$ (8.05), T_5: $P_1 \times P_6$ (7.88), T_3: $P_1 \times P_4$ (7.95), $T_{19} : P_6 \times P_8$ (7.84), $T_{13} : P_3 \times P_4$ (7.40), $T_2 : P_1 \times P_3$ (7.34), Pusa Nasdar-(C_2) (7.15) and Naga-(C_1) (6.75). However, minimum number of primary branches per vine was recorded in hybrid T_{11}: $P_2 \times P_7$ (5.25). Present findings were in line with Bhargava *et al.* (2017) reported 4.25 primary branches for ridge gourd hybrid NDRG-10. These findings were alike with results Harshitha *et al.* (2019), Reddy *et al.* (2019) and Triveni *et al.* (2020) who also obtained maximum number (7.40) of primary branches in the genotype Arka Sujata.

4.3 Flower characters of ridge gourd hybrids

4.3.1 Days required for appearance of first male flower

The mean performance of ridge gourd hybrids for days required for appearance of first male flower is presented in Table 4.3. Days to appearance of first male flower ranged from 33.70 to 43.90 days. The hybrid $T_1 : P_1 \times P_2$ (33.70 days) was significantly earliest for appearance of first male flower which was statistically at par with $T_2 : P_1 \times P_3$ (36.10 days), $T_5 : P_1 \times P_6$ (36.30 days), $T_4 : P_1 \times P_5$ (36.40 days), $T_8 : P_2 \times P_3$ (36.60 days), $T_{19} : P_6 \times P_8$ (36.90 days), $T_9 : P_2 \times P_5$ (37.10 days), $T_{20} : P_7 \times P_8$ (37.20 days), $T_6 : P_1 \times P_7$ (37.50 days). While $T_{18} : P_4 \times P_8$ took maximum number of days (43.90 days) for first male flower to open with a mean of 34.98 days was observed. Harshitha *et al.* (2019) evaluated 25 genotypes of ridge gourd and found the genotype IC-335912 was earliest to open first male flower (21 days) and these results are in analogous with reports of Rathore *et al.* (2017) and Yadav *et al*. (2017).

4.3.2 Days required for appearance of first female flower

Significant differences were noted with regard to days required for appearance of first female flower (Table 4.3). Days to first female flower appearance ranged from 36.60 to 47.60 days with an overall mean of 38.43 days. Significantly the hybrid $T_1 : P_1 \times P_2$ took minimum number of days (36.60 days) for appearance of first

female flower statistically which was statistically at par with T_2 : $P_1 \times P_3$ (39.20 days), Pusa Nasdar-(C_2) (39.40), T_8 : $P_2 \times P_3$ (39.60 days), T_{20} : $P_7 \times P_8$ (39.60 days), T_4 : $P_1 \times P_5$ (39.90 days), T_3 : $P_1 \times P_4$ (40.30 days) and Naga-(C_1) (40.30 days). The hybrid T_{18} : $P_4 \times P_8$ took 47.60 days for first female flower appearance. Yadav *et al*. (2017) studied forty-two genotypes of ridge gourd and found eleven genotypes significantly earlier in days to first female flower anthesis than best check variety (Satputia i.e., 39.60). These results were parallel to the research outlines of Kandasamy *et al.* (2019), Triveni *et al*. (2020) and Harshita *et al.* (2019) recorded the genotype IC-144613 with minimum number of days (23.80 days) to first female flower in ridge gourd.

4.3.3 Days to 50 % flowering

In all treatments significant differences were noted with regard to days taken for days to 50 % flowering (Table 4.3). Days required for first harvest of fruit ranged from 39.50 days to 51.10 days with an overall mean of 40.80 days. The hybrid T_4: $P_1 \times P_5$ recorded significantly lowest number of days (39.50 days) for 50 % plants to produce flower which was statistically at par with T_1 : $P_1 \times P_2$ (40.10 days), T_2 : $P_1 \times P_3$ (40.70 days), T_5 : $P_1 \times P_6$ (41.40 days), T_8 : $P_2 \times P_3$ (41.90 days) and T_3 : $P_1 \times P_4$ (42.80 days) whereas hybrid T_{17} : $P_4 \times P_7$ took maximum number of days (51.10 days) for 50 % of plants produce female flowers. Similar results were in findings with Harshitha *et al.* (2019) noticed 44.50 days to 50% flower with genotype Mysuru Local, while these sequences were comparable with results of Kamal *et al.* (2012), Malve *et al*. (2020) and Manoj *et al.* (2018) evaluated 35 ridge gourd germplasm and found Kadatti local-3 and Mudigere local with 37.90 days to 50 % flower.

4.3.4 Sex ratio (Male : Female)

The mean performance of ridge gourd hybrids for number of sex ratio is presented in Table 4.3. The sex ratio of ridge gourd differed significantly among the treatments. Significantly lowest sex ratio (Male: Female flowers) was observed in T_1 : $P_1 \times P_2$ (4.78) which was at par with T_2 : $P_1 \times P_3$ (6.70) and T_5 : $P_1 \times P_6$ (6.98). The numerically maximum number of male and female flower per vine (sex ratio) was recorded with T_{11} : $P_2 \times P_7$ (16.70). Sex ratio (male flowers to one female flower) ranged from 4.78-6.70 with a mean of 8.79. Present findings of the investigation coincide with results of Rani *et al.* (2017), Kannan *et al*. (2019) and Vijayakumar *et al.* (2020) studied

eleven crosses, found on an average of 5.40 sex ratio in ridge gourd hybrids. Durga *et al.* (2021) reported 7.60 sex ratio in ridge gourd genotypes.

Table 4.3. Performance of ridge gourd F_1 hybrids for flower characters during *kharif* season

Hybrids	Days required for appearance of first male flower	Days required for appearance of first female flower	Days to 50 % flowering	Sex ratio	Node at which first female flower appeared	Days required for first harvest of fruit
$T_1 : P_1 \times P_2$	33.70	36.60	40.10	4.78	10.80	44.10
$T_2 : P_1 \times P_3$	36.10	39.20	40.70	6.70	11.25	46.90
$T_3 : P_1 \times P_4$	37.60	40.30	42.80	7.57	11.60	47.15
$T_4 : P_1 \times P_5$	36.40	39.90	39.50	7.35	12.30	47.70
$T_5 : P_1 \times P_6$	36.30	40.80	41.40	6.98	12.65	48.05
$T_6 : P_1 \times P_7$	37.50	42.30	43.80	10.78	16.75	48.80
$T_7 : P_1 \times P_8$	37.80	41.80	45.80	8.01	17.86	50.30
$T_8 : P_2 \times P_3$	36.60	39.60	41.90	8.79	13.55	47.59
$T_9 : P_2 \times P_5$	37.10	42.10	47.10	8.93	14.75	46.60
$T_{10} : P_2 \times P_6$	41.50	43.20	46.50	14.80	21.35	51.85
$T_{11} : P_2 \times P_7$	42.60	45.80	46.90	16.70	21.75	53.59
$T_{12} : P_2 \times P_8$	41.40	43.70	46.30	15.10	21.30	50.35
$T_{13} : P_3 \times P_4$	37.80	42.30	45.20	8.35	20.96	49.25
$T_{14} : P_3 \times P_5$	38.60	43.30	46.28	8.23	19.04	50.10
$T_{15} : P_4 \times P_5$	38.50	43.10	47.40	8.80	17.96	52.15
$T_{16} : P_4 \times P_6$	37.90	42.45	46.70	7.20	15.54	50.80
$T_{17} : P_4 \times P_7$	42.30	47.20	51.10	14.75	21.15	55.30
$T_{18} : P_4 \times P_8$	43.90	47.60	49.70	13.40	21.50	54.80
$T_{19} : P_6 \times P_8$	36.90	42.60	47.10	8.56	12.90	49.77
$T_{20} : P_7 \times P_8$	37.20	39.60	41.30	7.38	11.95	46.57
Naga-(C_1)	37.90	40.30	43.70	7.99	13.63	47.40
Pusa Nasdar-(C_2)	38.70	39.40	45.50	7.50	16.71	48.40
General Mean	34.99	38.43	40.80	8.80	14.87	45.41
S.E. ±	1.36	1.28	1.27	0.89	0.89	1.38
C. D. at 5 %	3.99	3.77	3.74	2.40	2.62	4.06
C. V. (%)	10.10	11.14	10.42	2.32	13.74	10.34

4.3.5 Node at which first female flower

The observation recorded on number node at which first female flower is depicted in Table 4.3. Number of nodes to first female flower ranged from 10.80 to 21.75 with an overall mean of 14.87. The first female flower appeared at different nodes in

different hybrids with highest value of 21.75 in T_{11} : $P_2 \times P_7$. The hybrid T_1 : $P_1 \times P_2$ (10.80) exhibited lowest number node at which female flower appeared which was statistically at par with T_2 : $P_1 \times P_3$ (11.25), T_3 : $P_1 \times P_4$ (11.60), T_{20} : $P_7 \times P_8$ (11.95), T_4 : $P_1 \times P_5$ (12.30), T_5 : $P_1 \times P_6$ (12.65) and T_{19} : $P_6 \times P_8$ (12.90). These results confirm with results of Bhargava *et al*. (2017) studied twenty-nine germplasm and recorded node number to anthesis of first pistillate flower appears on earlier node in NDRG-1, NDRG-6, NDRG-17, NDRG-23, NDRG-4 and NDRG-13. Similar results were supported by Durga *et al.* (2021) and Krishnamoorthy and Ananthan (2017).

4.3.6 Days required for first harvest of fruit

The perusal of data in Table 4.3 revealed that the days required for first harvest of fruit was significantly affected by various treatment with range from 44.10 days to 55.30 days with an overall mean of 45.41 days. This recording showed significant differences in the mean between the treatment. The hybrid T_1 : $P_1 \times P_2$ (44.10 days) showed earliest to days required for first harvest of fruit which was at par with T_2 : $P_1 \times P_3$ (46.90 days), T_3 : $P_1 \times P_4$ (47.15 days), T_4 : $P_1 \times P_5$ (47.70 days), T_5 : $P_1 \times P_6$ (48.05 days), T_8 : $P_2 \times P_3$ (47.59 days), T_9 : $P_2 \times P_5$ (46.60 days), T_{20} : $P_7 \times P_8$ (46.57 days), Naga-(C_1) (47.40 days). While T_{17} : $P_4 \times P_7$ (55.30 days) took maximum number of days for first harvest. Sarkar *et al*. (2015) investigated 28 F_1 hybrids of ridge gourd and found the hybrid PRG 117 x PRG 120 with 39 days for first harvest of fruit. Bhargava *et al*. (2017) and Harshitha *et al.* (2019) also noticed similar trend in ridge gourd.

4.4 Fruit characters (quantitative) of ridge gourd hybrids

The data on fruit characters are present in Table 4.4.

4.4.1 Average fruit weight (g)

Statistical analysis depicted that there was significant differences in the average fruit weight depending upon different treatments. The observations recorded on average fruit weight is given in Table 4.4. Average weight of fruit ranged from 152.66 to 199.43 g with a mean of 159.91 g. The hybrid $T_{3:}$ $P_1 \times P_4$ (199.43g) was recorded statistically significant fruit weight which was at par with T_1 : $P_1 \times P_2$ (192.70 g), T_{17} : $P_4 \times P_7$ (190.88 g), Pusa Nasdar-(C_2) (186.63g), Naga-(C_1) (185.40g), T_{20} : $P_7 \times P_8$ (183.39g), T_{19} : $P_6 \times P_8$ (180.19g), T_{15} : $P_4 \times P_5$ (176.72g), T_8 : $P_2 \times P_3$ (176.31 g) and T_2 : $P_1 \times P_3$ (177.25 g). The minimum fruit weight was observed in T_{18} : $P_4 \times P_8$ (152.66 g).

Madhavi *et al*. (2021) studied the performance of fifteen hybrids developed from the six parents of ridge gourd, the cross IC 523892 × Arka Sujata was observed to be superior for average fruit weight while average weight of 227.35g reported by Rani *et al.* (2017) in ridge hybrid genotype. These results are similar with findings by Harshitha *et al.* (2019), Krishnamoorthy and Ananthan (2017) and Durga *et al.* (2021).

Table 4.4. Quantitative fruit characters of ridge gourd hybrids during *kharif* season

Hybrids	Average fruit weight (g)	Length of fruit (cm)	Fruit diameter at centre (cm)	Fruit diameter at pedicel (cm)	Fruit diameter at stylar end (cm)
$T_1 : P_1 \times P_2$	192.70	38.49	3.53	1.69	2.75
$T_2 : P_1 \times P_3$	177.25	43.70	4.44	1.77	3.07
$T_3 : P_1 \times P_4$	199.43	44.10	3.65	1.58	2.84
$T_4 : P_1 \times P_5$	166.67	42.70	3.58	1.71	2.93
$T_5 : P_1 \times P_6$	165.33	35.80	3.70	1.61	2.45
$T_6 : P_1 \times P_7$	175.74	34.70	3.50	1.52	2.82
$T_7 : P_1 \times P_8$	172.83	38.80	3.90	1.68	2.50
$T_8 : P_2 \times P_3$	176.31	37.00	3.74	1.77	2.77
$T_9 : P_2 \times P_5$	174.85	40.50	3.50	1.85	3.06
$T_{10} : P_2 \times P_6$	167.56	36.73	3.75	1.85	2.64
$T_{11} : P_2 \times P_7$	172.23	37.60	3.65	1.76	2.33
$T_{12} : P_2 \times P_8$	172.52	36.30	2.80	1.85	2.53
$T_{13} : P_3 \times P_4$	175.21	46.60	4.25	1.89	3.06
$T_{14} : P_3 \times P_5$	171.61	44.60	3.86	1.80	3.13
$T_{15} : P_4 \times P_5$	176.72	46.95	4.53	1.89	2.77
$T_{16} : P_4 \times P_6$	173.93	39.60	3.95	1.86	3.02
$T_{17} : P_4 \times P_7$	190.88	37.63	4.25	1.74	3.11
$T_{18} : P_4 \times P_8$	152.66	31.31	3.75	1.85	3.67
$T_{19} : P_6 \times P_8$	180.19	38.80	4.15	1.94	2.83
$T_{20} : P_7 \times P_8$	183.39	43.20	3.90	1.71	2.55
Naga-(C_1)	185.40	40.40	4.10	1.70	2.30
Pusa Nasdar-(C_2)	186.63	38.05	3.95	1.90	3.02
General Mean	159.91	36.45	3.65	1.61	2.58
S.E. ±	8.32	3.15	0.04	0.10	0.19
C. D. at 5 %	23.30	9.26	0.10	0.28	0.58
C. V. (%)	14.86	13.83	10.54	10.70	11.00

4.4.2 Length of fruit (cm)

The perusal of data for length of fruit (cm) is presented in Table 4.4. Length of ridge gourd fruit ranged from 31.31 to 46.95 cm with an overall mean of 36.45 cm. Significantly maximum fruit length was recorded T_{15}: $P_4 \times P_5$ (46.95 cm) followed by T_{13} : $P_3 \times P_4$ (46.60 cm), T_{14} : $P_3 \times P_5$ (44.60 cm) and T_3 : $P_1 \times P_4$ (44.00 cm). The minimum length of fruit was recorded in T_{18} : $P_4 \times P_8$ (31.31 cm). Vijayakumar *et al.* (2020) studied eleven crosses, recorded an average of 30.72 cm fruit length in ridge gourd hybrids. This is in agreements with the findings of Krishnamoorthy and Ananthan (2017), Rani *et al.* (2017), Rathore *et al.* (2017) and Murthy *et al.* (2020) for fruit length of 44.56 cm in ridge gourd cultivar.

4.4.3 Fruit diameter at centre (cm)

The data accessible on fruit diameter at centre (cm) presented in Table 4.4. Average diameter of ridge gourd fruit at centre ranged from 2.8 to 4.53 cm with an overall mean of 3.65 cm. Significantly maximum fruit diameter at centre was recorded by T_{15} : $P_4 \times P_5$ (4.53 cm) which was at par with T_2 : $P_1 \times P_3$ (4.44 cm). The minimum fruit diameter was recorded in hybrid T_{12} : $P_2 \times P_8$ (2.59 cm). This result of fruit diameter is analogous to those studied by Harshitha *et al.* (2019) who informed 4.60 cm diameter of ridge gourd. Similar differential responses for fruit diameter at centre in different genotypes of ridge gourd was earlier reported by Rathore *et al.* (2017) who recorded 4.75 cm fruit diameter at centre. Similar observations were earlier reported by Dubey and Ram (2007), Krishnamoorthy and Ananthan (2017) and Vijayakumar *et al.* (2020).

4.4.4 Fruit diameter at pedicel (cm)

The data accessible on fruit diameter at pedicel (cm) presented in Table 4.4. Average diameter of ridge gourd fruit at pedicel ranged from 1.52 cm to 1.94 cm with an overall mean of 1.61 cm. However the minimum fruit diameter at pedicel was recorded in T_6 : $P_1 \times P_7$ (1.52 cm). Significantly maximum fruit diameter at pedicel recorded by hybrid T_{19} : $P_6 \times P_8$ (1.94 cm) followed by Pusa Nasdar-(C_2) (1.90 cm), T_{13} : $P_3 \times P_4$ (1.89 cm) and T_{15} : $P_4 \times P_5$ (1.89 cm). The similar results were also noted by Dubey and Ram (2007), Gondane *et al*. (2020) and Krishnamoorthy and Ananthan (2017).

4.4.5 Fruit diameter at stylar end (cm)

The data accessible on fruit diameter at stylar end (cm) presented in Table 4.4. Average diameter of ridge gourd fruit at stylar end ranged from 2.30 to 3.67 cm with an overall mean of 2.58 cm. The minimum fruit diameter at stylar end was recorded the Naga (C_1) (2.30 cm). Significantly maximum fruit diameter at stylar end was recorded by T_{18} : $P_4 \times P_8$ (3.67 cm), at par with T_{14} : $P_3 \times P_5$ (3.13 cm) and T_{17} : $P_4 \times P_7$ (3.11 cm). These similar observations were earlier noticed by Gondane *et al*. (2020) and Krishnamoorthy and Ananthan (2017).

4.5 Mean performances of ridge gourd hybrids for fruit yield

4.5.1 Number of fruits per vine

The data accessible on number of fruits per vine presented in Table 4.5. The number of fruits per vine of ridge gourd differed significantly among the hybrids. The number of fruits per vine ranged from 8.55 to 19.20 with a mean of 11.38. Significantly maximum number of fruits per vine was recorded with hybrid T_1 : $P_1 \times P_2$ (19.20 fruit per vine) which was statistically at par with T_2 : $P_1 \times P_3$ (16.20 fruit per vine) then followed by T_4 : $P_1 \times P_5$ (15.50 fruit per vine), T_5 : $P_1 \times P_6$ (15.20 fruit per vine), Naga-(C_1) (14.90 fruit per vine) and T_3 : $P_1 \times P_4$ (14.85 fruit per vine). The minimum number of fruits per vine was recorded by hybrid T_{10} : $P_2 \times P_6$ (8.55 fruits per vine).

Madhavi *et al*. (2021) evaluated the performance of fifteen hybrids developed from the six parents of ridge gourd, recorded the cross IC 539714 × Arka Sujata has recorded maximum number of fruits per plant. Similar differential responses for yield and yield attributes in different genotypes of ridge gourd was earlier reported by Koppad *et al.* (2015), Bhargava *et al.* (2017), Krishnamoorthy and Ananthan (2017), Rathore *et al.* (2017) and Triveni *et al*. (2020).

4.5.2 Yield of fruit per vine (kg)

The observation recorded on fruit yield per vine is depicted in Table 4.5. Average yield of fruit per vine recorded from 1.31 to 3.70 kg with a mean 2.03 kg. The trait was statistically significant to reveal the effect of treatments and the maximum fruit yield per vine was observed in hybrid T_1 : $P_1 \times P_2$ (3.70 kg) which was statistically at par with T_2 : $P_1 \times P_3$ (3.55 kg). Later followed by T_3 : $P_1 \times P_4$ (2.97 kg), Naga-(C_1) (2.76 kg) and $P_7 \times P_8$: T_{20} (2.68 kg). The minimum yield per plant was observed with hybrid T_{11} :

$P_2 \times P_7$ (1.31 kg). Narasannavar *et al.* (2014) twenty hybrids of ridge gourd, the hybrid COHB-1 × Deepthi was selected as the best hybrid for yield per vine and its total yield was 4.95 kg per vine as compared to 3.93 kg per vine of the commercial check (Naga). Similar observations were recorded with earlier observations with Lodam *et al.* (2009), Krishnamoorthy and Ananthan (2017), Rani *et al.* (2017), Rathore *et al.* (2017) and Harshitha *et al.* (2019).

Table 4.5. Performances of ridge gourd F_1 hybrids for fruit yield during *kharif* season

Hybrids	Number of fruits per vine	Yield of fruits per vine (kg)	Fruit yield (t/ha)
$T_1 : P_1 \times P_2$	19.20	3.70	24.67
$T_2 : P_1 \times P_3$	16.20	3.55	23.65
$T_3 : P_1 \times P_4$	14.85	2.97	19.77
$T_4 : P_1 \times P_5$	15.50	2.61	17.37
$T_5 : P_1 \times P_6$	15.20	2.59	17.24
$T_6 : P_1 \times P_7$	10.80	1.91	12.73
$T_7 : P_1 \times P_8$	11.40	2.02	13.52
$T_8 : P_2 \times P_3$	12.60	2.29	15.24
$T_9 : P_2 \times P_5$	12.40	2.15	14.30
$T_{10} : P_2 \times P_6$	8.55	1.41	9.40
$T_{11} : P_2 \times P_7$	7.40	1.31	8.71
$T_{12} : P_2 \times P_8$	8.70	1.49	9.99
$T_{13} : P_3 \times P_4$	12.80	2.22	14.81
$T_{14} : P_3 \times P_5$	10.10	1.77	11.78
$T_{15} : P_4 \times P_5$	11.30	1.89	12.65
$T_{16} : P_4 \times P_6$	13.20	2.13	14.20
$T_{17} : P_4 \times P_7$	8.90	1.71	11.39
$T_{18} : P_4 \times P_8$	9.35	1.39	9.28
$T_{19} : P_6 \times P_8$	13.80	2.33	15.53
$T_{20} : P_7 \times P_8$	14.50	2.68	17.85
Naga-(C_1)	14.90	2.76	18.41
Pusa Nasdar-(C_2)	12.20	2.27	15.18
General Mean	11.38	2.03	13.55
S.E. ±	1.021	0.21	1.75
C. D. at 5 %	3.00	0.62	4.38
C. V. (%)	15.58	18.10	15.71

4.5.3 Fruit yield (t/ha)

Statistical analysis depicted that there was significant differences in the fruit yield of ridge gourd (t/ha). These significantly variation might have due to the number of fruits per vine and yield per vine. The observations recorded on fruit yield of ridge gourd (t/ha) given in Table 4.5. Average fruit yield of ridge gourd were recorded 8.71 to 24.67 t/ha with an overall mean 13.55 t/ha. The hybrid T_1 : $P_1 \times P_2$ (24.67 t/ha) was statistically superior, which was at par with hybrid T_2 : $P_1 \times P_3$ (23.65 t/ha) which was later followed by the hybrid T_3 : $P_1 \times P_4$ (19.77 t/ha), Naga (C_1) (18.41). The minimum fruit yield of ridge gourd (t/ha) was recorded in hybrid T_{11} : $P_2 \times P_7$ (8.71 t/ha). Rathore *et al.* (2017) investigated 12 genotypes of ridge gourd, the maximum yield (t/ha) was recorded in RIGVAR-6 (60.17 t/ha), also reported by Varalakshmi & Krishnamurthy (2017) who evaluated hybrids of ridge gourd, found 23.3 t/ha fruit yield per hectare. Similar observations were earlier reported by Muthaiah *et al.* (2017), Yadav *et al.* (2017), Murthy *et al.* (2020) and Madhavi *et al.* (2021).

4.6 Qualitative fruit characters of ridge hybrids

4.6.1 Shape of fruit

The data presented on shape of fruit is depicted in Table 4.6. As regards to fruit shape in ridge gourd, result found that all the hybrids observed elonagate in shape. These results coincide with the results recorded by Krishnamoorthy and Ananthan (2017) and Mitu *et al*. (2018).

4.6.2 Colour of fruit

The perusal of data in Table 4.6 revealed that the colour of different hybrids were classified as light green, green and dark green. In case of fruit colour in ridge gourd, the hybrids T_1 : $P_1 \times P_2$, T_4 : $P_1 \times P_5$, T_7 : $P_1 \times P_8$, T_8 : $P_2 \times P_3$, T_{13} : $P_3 \times P_4$, T_{14} : $P_3 \times P_5$, T_{15} : $P_4 \times P_5$, T_{16} : $P_4 \times P_6$, T_{17} : $P_4 \times P_7$, T_{20} : $P_7 \times P_8$ and Pusa Nasdar-(C_2), were observed in light green in colour, while the hybrids T_2 : $P_1 \times P_3$, T_5 : $P_1 \times P_6$, T_6 : $P_1 \times P_7$, T_9 : $P_2 \times P_5$, T_{10} : $P_2 \times P_6$, T_{11} : $P_2 \times P_7$, T_{12} : $P_2 \times P_8$, T_{18} : $P_4 \times P_8$, T_{19} : $P_6 \times P_8$ and Naga-(C_1) and observed in green colour. The hybrid T_3 : $P_1 \times P_4$ was observed in dark green colour. Varalakshmi *et al.* (2016) evaluated fifty-one germplasm of ridge gourd, the fruit skin colour was light-green, green and dark-green. Fifteen germplasm lines recorded dark-green fruit skin colour, 33 had green colour fruits and only three

germplasm had light-green colour fruits. In general, green and dark-green coloured varieties are preferred in the market. These results coincide with the findings recorded by Mitu *et al*. (2018) and Perez *et al*. (2021).

Table 4.6. Qualitative fruit characters of ridge gourd hybrids during *kharif* season

Hybrids	Shape of fruit	Colour of fruit	Number of ridges
T_1 : $P_1 \times P_2$	Elongate	Light green	10
T_2 : $P_1 \times P_3$	Elongate	Green	10
T_3 : $P_1 \times P_4$	Elongate	Dark Green	10
T_4 : $P_1 \times P_5$	Elongate	Light green	10
T_5 : $P_1 \times P_6$	Elongate	Green	10
T_6 : $P_1 \times P_7$	Elongate	Green	10
T_7 : $P_1 \times P_8$	Elongate	Light green	10
T_8 : $P_2 \times P_3$	Elongate	Light green	10
T_9 : $P_2 \times P_5$	Elongate	Green	10
T_{10} : $P_2 \times P_6$	Elongate	Green	10
T_{11} : $P_2 \times P_7$	Elongate	Green	10
T_{12} : $P_2 \times P_8$	Elongate	Green	10
T_{13} : $P_3 \times P_4$	Elongate	Light green	10
T_{14} : $P_3 \times P_5$	Elongate	Light green	10
T_{15} : $P_4 \times P_5$	Elongate	Light green	10
T_{16} : $P_4 \times P_6$	Elongate	Light green	10
T_{17} : $P_4 \times P_7$	Elongate	Light green	10
T_{18} : $P_4 \times P_8$	Elongate	Green	10
T_{19} : $P_6 \times P_8$	Elongate	Green	10
T_{20} : $P_7 \times P_8$	Elongate	Light green	10
Naga-(C_1)	Elongate	Green	10
Pusa Nasdar-(C_2)	Elongate	Light Green	10

4.6.3 Number of ridges

The data presented on number of ridges in Table 4.6. Result in respect of number of ridges indicates that all the hybrids and check variety observed 10 ridges on fruit surface. Similar result was also reported by Hanumegowda *et al.* (2012), Kamble *et al.* (2018) and Manoj *et al.* (2018).

4.7 Per cent incidence of disease

4.7.1 Powdery mildew

The data pertaining to the per cent incidence of powdery mildew in ridge gourd is presented in Table 4.7. The incidence of powdery mildew observed was non-significance. The per cent incidence of powdery mildew was recorded after 90 days of sowing. The per cent incidence of downy mildew was observed ranged from 10.00-22.50 per cent with the overall mean of 28.27 per cent. Significantly least incidence of powdery mildew was recorded in the hybrids in T_1 : $P_1 \times P_2$ and T_2 : $P_1 \times P_3$ with value of 10 per cent. The maximum incidence of powdery mildew was recorded in hybrid T_{11} : $P_2 \times P_7$ (22.50 %). Similar results were also reported by Pitchaimuthu *et al.* (2012), Thammaiah *et al.* (1995) and Yasmin *et al*. (2008).

4.7.2 Downy mildew

The per cent incidence of downy mildew in ridge gourd is presented in Table 4.7. The per cent incidence of downy mildew was recorded after 90 days of sowing. The per cent incidence of downy mildew was observed ranged from 15-27.50 per cent with the overall mean of 27.35 per cent. Significantly minimum per cent incidence of downy mildew recorded in hybrid $T_{1:}$ $P_1 \times P_2$ (15.00 %) and Naga-(C_1) (15.00 %) followed by $T_{3:}$ $P_1 \times P_4$ (16.00 %). The maximum per cent incidence of downy mildew was more observed in hybrid $T_{11:}$ $P_2 \times P_7$ (27.50 %). These results were analogous with report of Harshitha *et al.* (2019), Pitchaimuthu *et al.* (2012), Uraiha *et al.* (2018) and Varalakshmi *et al.* (2014).

4.7.3 Gummosis

The per cent incidence of gummosis in ridge gourd was observed only on stem portion instead of fruit at later stage i.e. at 90 days after sowing and the data is presented in Table 4.7. The incidence of gummosis observed was significance. Significantly minimum per cent incidence of gummosis i.e. 10 per cent was recorded in the hybrids T_1 : $P_1 \times P_2$, T_2 : $P_1 \times P_3$, T_3 : $P_1 \times P_4$, T_6 : $P_1 \times P_7$, T_7 : $P_1 \times P_8$, T_9 : $P_2 \times P_5$, T_{15} : $P_4 \times P_5$ and Naga-(C_1) with value of 7.50 %. The maximum per cent incidence of gummosis was more observed in hybrid T_{11} : $P_2 \times P_7$ with 15 % of incidence. These results were akin with reported by Jain *et al.* (2021) and Mhaske *et al.* (2018).

Table 4.7. Per cent incidence of pest and diseases in different ridge gourd F_1 hybrids during *kharif* season

Hybrids	Powdery mildew	Downey mildew	Gummosis	Fruit fly
$T_1 : P_1 \times P_2$	10.00 (18.43)	15.00 (22.79)	7.50 (15.90)	9.77 (18.21)
$T_2 : P_1 \times P_3$	10.00 (18.43)	17.50 (24.73)	7.50 (15.90)	10.15 (18.58)
$T_3 : P_1 \times P_4$	12.50 (20.70)	16.00 (23.58)	7.50 (15.90)	10.54 (18.94)
$T_4 : P_1 \times P_5$	12.50 (20.70)	17.50 (24.73)	10.00 (18.43)	10.99 (19.36)
$T_5 : P_1 \times P_6$	15.00 (22.79)	20.00 (26.57)	10.00 (18.43)	11.15 (19.51)
$T_6 : P_1 \times P_7$	17.50 (24.73)	22.50 (28.32)	7.50 (15.90)	13.35 (21.43)
$T_7 : P_1 \times P_8$	16.00 (23.58)	23.50 (29.00)	7.50 (15.90)	12.87 (21.00)
$T_8 : P_2 \times P_3$	17.50 (24.73)	23.50 (29.00)	10.00 (18.43)	11.85 (20.13)
$T_9 : P_2 \times P_5$	15.00 (22.79)	22.50 (28.32)	7.50 (15.90)	11.37 (19.70)
$T_{10} : P_2 \times P_6$	20.00 (26.57)	25.00 (30.00)	10.00 (18.43)	14.21 (22.14)
$T_{11} : P_2 \times P_7$	22.50 (28.32)	27.50 (31.63)	15.00 (22.79)	15.45 (23.14)
$T_{12} : P_2 \times P_8$	20.00 (26.57)	25.00 (30.00)	10.00 (18.43)	13.95 (21.93)
$T_{13} : P_3 \times P_4$	15.00 (22.79)	20.00 (26.57)	7.50 (15.90)	12.95 (21.10)
$T_{14} : P_3 \times P_5$	17.50 (24.73)	20.00 (26.57)	10.00 (18.43)	13.35 (21.43)
$T_{15} : P_4 \times P_5$	12.50 (20.70)	17.50 (24.73)	7.50 (15.90)	14.65 (22.50)
$T_{16} : P_4 \times P_6$	15.00 (22.79)	20.00 (26.57)	10.00 (18.43)	12.35 (20.60)
$T_{17} : P_4 \times P_7$	17.50 (24.73)	22.50 (28.32)	10.00 (18.43)	14.15 (22.10)
$T_{18} : P_4 \times P_8$	20.00 (26.57)	25.00 (30.00)	12.50 (20.70)	15.15 (23.00)
$T_{19} : P_6 \times P_8$	15.00 (22.79)	17.50 (24.73)	10.00 (18.43)	11.35 (19.70)
$T_{20} : P_7 \times P_8$	15.00 (22.79)	20.00 (26.57)	10.00 (18.43)	10.45 (18.90)
Naga-(C_1)	12.50 (20.70)	15.00 (22.79)	7.50 (15.90)	10.75 (19.13)
Pusa Nasdar-(C_2)	15.00 (22.79)	17.50 (24.73)	10.00 (18.43)	12.35 (20.60)
General Mean	28.27 (32.12)	27.35 (31.53)	18.91 (25.78)	21.73 (27.78)
S.E. ±	22.62	1.32	0.43	0.74
C. D. at 5 %	N.S.	3.88	1.30	2.17

4.7.4 Fruit fly

There was significant difference between the treatments on the percent incidence of fruit fly in ridge gourd (Table 4.7). The infestation of fruit fly at field condition was found in most the hybrids of ridge gourd which were ranged from 9.77 to 15.45 % with the overall mean of fruit fly 21.73 %. The hybrid T_1 : $P_1 \times P_2$ (9.77 %) was found significantly least infestation of the fruit fly which was followed by the hybrids T_2 : $P_1 \times P_3$ (10.15 %), T_{20} : $P_7 \times P_8$ (10.45 %), T_3 : $P_1 \times P_4$ (10.54 %) and Naga-(C_1) (10.75 %). The maximum infestation observed in T_{11} : $P_2 \times P_7$ (15.45 %). These results were correspondent with the results recorded by Dubale *et al.* (2018) and Poshiya *et al.* (2015).

5. SUMMARY AND CONCLUSIONS

The present investigation entitled "Evaluation of F_1 hybrids of ridge gourd [*Luffa acutangula,* (Roxb. L)]" was undertaken with following objectives

1. To study the growth, yield and quality of F_1 hybrids.
2. To study the incidence of pest and diseases.

Twenty hybrids were evaluated from different sources and received from All India coordinated research project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) and conducted the trail during *kharif* season of the year 2020-21. The experiment of ridge gourd was laid out in Randomized Block Design (RBD) with two replications to estimate the variance and mean performance of the hybrids for the characters like growth, flowering, yield, fruit quantitative, qualitative characters and incidence of pest and diseases.

Five randomly selected plants were considered for observations of different characters *viz*., vine length (m), number of primary branches per vine, days to first male and female flower appears, days to 50% flowering, number of male and female flower per vine (sex ratio), node at which first female flower appear, days required for first harvest of fruits, number of fruits per plant, fruit yield per vine (kg), fruit yield (t/ha), average fruit weight (g), fruit length (cm), fruit diameter at centre (cm), pedicel (cm) and stylar end (cm), shape of fruit, colour of fruit, number of ridges per fruit and pest and diseases incidence. Findings of the research work are summarized below under the following heads.

5.1 Summary

The analysis of variance revealed that mean sum of squares due to hybrids was highly significant for all characters except powdery mildew. Significant mean sum of squares due to fruit yield and yield attributing characters revealed presence of significant difference in material studied for evaluation of various traits.

5.1.1 Growth character

The maximum vine length was recorded in the treatment T_1 : COH-1 × Karjat Local (9.95 m) followed by T_5 : COH-1 × Navin Long (8.15 m) and minimum

vine length was recorded in treatment T_{11} : Karjat Local × NRG1-9 (4.05 m). The maximum number of primary branches per vine was recorded in treatment T_1 : COH-1 × Karjat Local (8.40) followed by T_{20} : NRG-9 × Krishna-51 (8.17). The minimum number of primary branches per vine was recorded in hybrid $T_{11:}$ Karjat Local × NRG1-9 (5.25).

5.1.2 Flowering characters

Days for appearing first male flower was recorded minimum in treatment T_1 : COH-1 × Karjat Local (33.70 days) which was followed by T_2 : COH-1 × Banaras Local (36.10 days). The treatment T_{18} : Arka Sujata × Krishna-51 took maximum number of days (43.90 days) for appearance of male flower. Minimum number of days taken for appearance of first female flower was recorded in treatment $T_{1:}$ COH-1 × Karjat Local (36.60 days) which was followed by T_2 : COH-1 × Banaras Local (39.20 days). Maximum number of days for first female flower were recorded in treatment T_{18} : Arka Sujata × Krishna-51 (47.60 days). The treatment $T_{4:}$ COH-1 × Nidhi took minimum number of days (39.50 days) for 50 % plants to produce flower followed by T_1 : COH-1 × Karjat Local (40.10 days). The treatment T_{17} : Arka Sujata × NRG-9 (51.10 days) recorded maximum days for 50 % appearance of flower. Numerically lowest sex ratio (Male: Female flowers) was observed in treatment T_1 : COH-1 × Karjat Local (4.78) followed by T_2 : COH-1 × Banaras Local (6.70). Maximum number of male and female flower per vine (sex ratio) was recorded with treatment T_{11} : Karjat Local × NRG1-9 (16.70). The first female flower appeared at different nodes in different hybrids with highest value of 21.75 in the treatment T_{11} : Karjat Local × NRG1-9 and lowest value 10.80 in T_1 : COH-1 × Karjat Local followed by T_2 : COH-1 × Banaras Local (11.25). The treatment T_1 : COH-1 × Karjat Local (44.10 days) took least number of days for the first fruit harvest followed by T_2 : COH-1 × Banaras Local (46.90 days). The maximum number of days was taken by the treatment T_{17} : Arka Sujata × NRG-9 (55.30 days).

5.1.3 Quantitative fruits characters

The maximum average fruit weight was found in treatment T_3 : COH-1 × Arka Sujata (199.43 g) followed by T_1 : COH-1 × Karjat Local (192.70 g). The treatment T_{18} : Arka Sujata × Krishna-51 (152.66 g) recorded minimum average fruit weight. The maximum fruit length was recorded in treatment T_{15} : Arka Sujata × Nidhi (46.95 cm) followed by T_{13} : Banaras Local × Arka Sujata (46.60 cm). The minimum fruit length was

recorded from the treatment T_{18} : Arka Sujata × Krishna-51 (31.31 cm). The maximum fruit diameter at centre was recorded by treatment T_{15} : Arka Sujata × Nidhi (4.53 cm) later T_2 : COH-1 × Banaras Local (4.44 cm). The minimum diameter at centre was recorded by treatment T_{12} : Karjat Local × Krishna-51 (2.59 cm). The maximum fruit diameter at pedicel recorded by treatment T_{19} : Navin Long × Krishna-51 (1.94 cm) followed by Pusa Nasdar-(C_2) (1.90 cm) and minimum was in treatment T_{16} : Arka Sujata × Navin Long (1.52 cm). The maximum fruit diameter at stylar end was recorded by treatment T_{18} : Arka Sujata × Krishna-51 (3.67 cm) and minimum in the check Naga-(C_2).

5.1.4 Yield characters

The maximum number of fruits per vine was recorded with treatment T_1 : COH-1 × Karjat Local (19.20 fruit per vine) and minimum number of fruits was recorded in T_{10} : Karjat Local × Navin Long (8.55). The treatment T_1 : COH-1 × Karjat Local (4.30 kg) gave the highest fruit yield per plant followed by T_2 : COH-1 × Banaras Local. The minimum fruit yield per vine was found in treatment T_{11} : Karjat Local × NRG1-9 (1.31 kg). The maximum yield of ridge gourd per hectare was recorded in treatment T_1 : COH-1 × Karjat Local (24.67 t/ha) followed by T_2 : COH-1 × Banaras Local (23.65 t/ha) and minimum in the treatment T_{11} : Karjat Local × NRG1-9 (8.71 t/ha).

5.1.5 Per cent incidence of diseases and pest

There was least incidence of powdery mildew was recorded in the treatment in T_1 : COH-1 × Karjat Local and T_2 : COH-1 × Banaras Local with value of 10% and maximum in treatment T_{11} : Karjat Local × NRG1-9 (22.50 %). The minimum per cent incidence of downy mildew recorded in treatment T_1: COH-1 × Karjat Local (15.00 %) and Naga-(C_1) (15.00 %) whereas maximum was recorded in treatment T_{11}: Karjat Local × NRG1-9 (27.50 %). The minimum per cent incidence of gummosis recorded on various treatment like T_1: COH-1 × Karjat Local, T_2 : COH-1 × Banaras Local, T_3 : COH-1 × Arka Sujata, T_6 : COH-1 × NRG-9, T_7 : COH-1 × Krishna-51, T_9 : Karjat Local × Nidhi, T_{15} : Arka Sujata × Nidhi and Naga-(C_1) with value of 7.50 % gummosis incidence. The minimum infestation of fruit fly observed in treatment T_1: COH-1 × Karjat Local (9.77 %) and maximum in the treatment T_{11} : Karjat Local × NRG1-9 (15.45 %).

5.2 Conclusions

1. The analysis of variance showed that significant differences existed among the hybrids for most of the characters, showing possibilities of potential of high yielding and its attributes.
2. For growth characters like length of vine (m) and number of primary branches per vine showed that the treatment T_1 : COH-1 × Karjat Local, T_5 : COH-1 × Navin Long, T_3 : COH-1 × Arka Sujata, T_2 : COH-1 × Banaras Local and T_4 : COH-1 × Nidhi were superior over all the hybrids.
3. For flowering characters like days required for appearance of first male flower, days required for appearance of first female flower, days to 50% flowering, sex ratio, node at which first female flower appear and days required to first harvest of fruit showed the hybrids i.e., T_1 : COH-1 × Karjat Local, T_2 : COH-1 × Banaras Local, T_4 : COH-1 × Nidhi, T_3 : COH-1 × Arka Sujata and T_8 : Karjat Local × Banaras Local were found promising among all hybrids.
4. Regarding yield characters such as number of fruits per vine, yield of fruits per vine (kg) and fruit yield (t/ha) the treatments *viz*., T_1 : COH-1 × Karjat Local, T_2 : COH-1 × Banaras Local and T_3 : COH-1 × Arka Sujata were found superior over all the treatments.
5. The least incidence of powdery mildew was recorded in the treatment in T_1 : COH-1 × Karjat Local and T_2 : COH-1 × Banaras Local and the minimum per cent incidence of downy mildew recorded in treatment T_1 : COH-1 × Karjat Local and Naga-(C_1).
6. The minimum per cent incidence of gummosis recorded on various treatment like T_1 : COH-1 × Karjat Local , T_2 : COH-1 × Banaras Local, T_3 : COH-1 × Arka Sujata, T_6 : COH-1 × NRG-9, T_7 : COH-1 × Krishna-51, T_9 : Karjat Local × Nidhi, T_{15} : Arka Sujata × Nidhi and Naga-(C_1) while for fruit fly infestation the minimum infestation was observed in treatment T_1 : COH-1 × Karjat Local.
7. Based on the mean performance, the following hybrids COH-1 × Karjat Local, COH-1 × Banaras Local and COH-1 × Arka Sujata were found superior among all the hybrids for most of the characters.

8. The results from the present investigation concluded that the ridge gourd hybrids viz., COH-1 × Karjat Local, T_2 : COH-1 × Banaras Local, and COH-1 × Arka Sujata were identified as the superior hybrids in terms of growth, yield and quality. However, since these results are based on one season experiment therefore further trials for testing of adaptability and stability may be substantiated the results and can be used for commercial exploitation.

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7. APPENDIX

Appendix-I : Details of weekly meteorological data during experimental period (June, 2021 to October, 2021)

MW	Date	Temperature (^{0}C)		Relative humidity		Sun shine hrs	Wind speed (km/h)	Rain fall (mm)	No. of Rainy days	Evapo ration (mm/ day)
		Max	Min	Morn.	Even.					
June - 2021										
1	04-10	32.4	24.9	78	52	5.1	01.8	021.2	1	05.9
2	11-17	33.9	25.4	76	45	6.0	06.1	006.4	1	08.2
3	18-25	33.1	24.7	76	46	6.0	06.0	009.0	1	06.8
4	26-01	30.3	23.9	86	62	3.4	03.0	087.2	4	04.5
July										
5	02-08	34.1	25.1	76	45	8.4	3.3	000.0	-	7.5
6	09-15	30.3	23.8	91	68	2.3	1.8	118.6	4	4.5
7	16-22	30.1	23.9	85	66	3.0	2.3	043.6	4	4.2
8	23-29	30.1	24.6	82	59	3.6	6.9	002.8	-	4.8
9	30-05	28.0	23.6	83	67	2.1	6.7	004.8	1	4.4
August										
10	06-12	31.3	24.2	80	58	5.5	3.2	001.2	-	5.3
11	13-19	25.8	22.7	78	68	2.9	2.4	034.6	4	4.7
12	20-26	27.8	22.2	93	68	4.2	00.9	048.8	3	3.4
13	27-02	29.3	22.9	88	66	4.7	01.1	081.2	2	4.5
September										
14	03-09	29.6	23.0	92	67	4.3	02.6	117.4	4	3.5
15	10-16	29.8	23.9	84	64	4.3	05.0	007.6	1	4.2
16	17-23	28.9	23.1	87	69	3.6	01.8	051.6	3	3.7
17	24-30	28.6	22.4	92	69	1.7	01.3	058.8	5	3.2
October										
18	01-07	31.2	22.7	94	65	7.7	01.0	063.2	4	5.1
19	08-14	30.8	22.7	92	59	6.1	00.7	025.4	-	4.9
20	15-21	32.3	20.7	85	39	8.3	00.9	000.0	-	5.5
21	22-28	32.1	18.5	84	32	9.8	01.3	000.0	-	5.8
22	29-04	31.3	18.2	79	36	8.6	01.2	000.0	-	5.3

8. VITAE

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in

VEGETABLE SCIENCE

2022

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