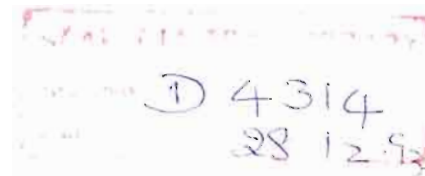


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STUDIES ON GROWTH, BEARING HABITS AND TEMPORAL DIOECISM IN RIDGE GOURD (Luffa acutangula Roxb.) L.



BY

M.V. MADHUSUDHAN

B.Sc. (Hort.)

THESIS SUBMITTED TO THE
ANDHRA PRADESH AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF
MASTER OF SCIENCE IN HORTICULTURE
IN THE FACULTY OF AGRICULTURE

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1993

CERTIFICATE

Mr. M.V. MADHUSUDHAN has satisfactorily prosecuted the course of research and that the thesis entitled "STUDIES ON GROWTH, BEARING HABITS AND TEMPORAL DIOECISM IN RIDGE GOURD (Luffa acutangula Roxb.) L." is a result of the original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by him for a degree of any university.



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Major Advisor

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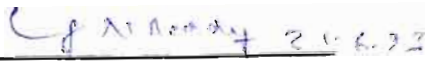
This is to certify that the thesis entitled "STUDIES ON GROWTH, BEARING HABITS AND TEMPORAL DIOECISM IN RIDGE GOURD (Luffa acutangula (Roxb.) L." submitted in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE IN HORTICULTURE of the Andhra Pradesh Agricultural University, Hyderabad, is a record of bonafide research work carried out by Mr.M.V.MADHUSUDHAN under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

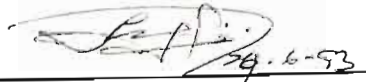
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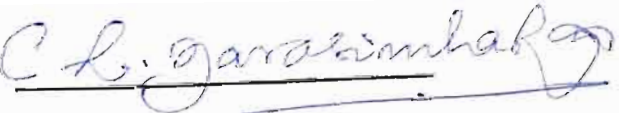

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(M.V.MADHUSUDHAN)

DECLARATION

I, M.V.MADHUSUDHAN hereby declare that the thesis entitled "STUDIES ON GROWTH, BEARING HABITS AND TEMPORAL DIOECISM IN RIDGE GOURD (Luffa acutangula Roxb.) L." is a result of the original research work done by me. It is further declared that the thesis or any part has not been published earlier in any manner.



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ABSTRACT

Investigations were carried out at Students Farm, College of Agriculture and Agricultural Research Institute, Rajendranagar, Hyderabad during summer and winter seasons (April to September, 1992) on growth, bearing habits and temporal dioecism of eleven genotypes of ridge gourd Luffa acutangula (Roxb.) L for twenty eight characters and also the effect of pollen sources on fruit and seed characters.

Significant differences were noticed among the eleven genotypes for the characters studied. Significant differences were observed between the seasons for some characters. Accessory bud production was observed in this crop. Character association studies revealed the importance of fruit number and fruit weight during the selection of high yielding genotypes.

In ridge gourd, branching started at earlier nodes on main axis and further branches were produced almost at every node with a few at alternate node and 2 nodes interval. Secondaries were also initiated and produced similarly on primaries.

In ridge gourd, male phase started first, then

female at later phase which intermixed with male phase on main axis and primaries and then female phase predominated on secondaries. This alternation of sexual phase established the existence of temporal dioecism in ridge gourd and is facultative xenogamy-a mating system and it is an adaptive strategy to maximise the reproductive effort.

Regarding the flower production, the female flowers were produced almost regularly on all the types of branches. Male flower production was more or less regular on all the branches.

The experiment to know the effectiveness of pollen on fruit and seed characters showed that the pollen from solitary male was efficient in producing desirable fruit and seed characters.

INTRODUCTION

CHAPTER I

INTRODUCTION

Ridge gourd Luffa acutangula (Roxb) L. ($2n=26$) is one of the important cucurbitaceous vegetable crops grown widely throughout India (Whitaker, 1979), which thrives best in warm humid regions. The fruits of ridge gourd are used in the peninsular India including Maharashtra. The juice of heated Luffa acutangula is good in adrenal type of diabetes (Nadkarni, 1927). Ridge gourd contains water (95.2%) protein (0.5%), fat (0.1%), mineral matter (0.5%), carbohydrates (3.4%), calcium (0.02%), phosphorus (0.03%), iron and carotene 0.5 mg and 33 ug respectively per 100 g of edible portion (Gopalan et al., 1982).

The yield potential of ridge gourd can be increased through the exploitation of hybrid vigour, identifying stable genotypes and also with the better understanding of flowering and fruiting habit. In biometrical analysis, the biometrical tools such as correlation and path coefficient analysis help the breeder in selection of superior genotypes either for direct selection and utilising for direct cultivation or to use as parents in the hybridization programmes.

Ridge gourd is a monoecious cucurbitaceous crop. It produces a large number of male flowers

leading to low yields as pistillate flowers only contribute towards yield. It has been shown by Wardlaw (1968) and Mooney (1972) that the maternal and paternal investments that a plant makes are sub-divided into separate sites and that the photosynthates are not evenly distributed in all reproductive shoots. The reproductive organs of a plant compete with other major sinks including shoot apices and other vegetative organs. Pollen grains are typically smaller than ovules and presumably cheaper to produce than ovules (Darwin, 1871). The most generally accepted theory concerning resource allocation in reproductive strategy of higher plants is the concept of r- and k-selection which was originally proposed by Mac Arthur and Wilson (1967) and expanded by Pianka (1970). According to them k-selection strategy operates in plants whose life expectancy is long and the energy and other captured resources which are devoted to reproduction is small. The other selection i.e., r-selection operates in plants which have short life expectancy and large reproductive effort. Hence, production of male and female flowers in relation to the adaptive strategies employed by the plant have to be understood more clearly in ridge gourd. Further, sex expression in cucurbits is largely influenced by its genetic makeup and environmental factors. Therefore, a shift from staminate to pistillate flower production achieved

through any of the above means is desirable to increase yields in ridge gourd.

The maintenance of genetic variation in natural population is usually considered to be important in maintaining ecological plasticity and evolutionary success. Outcrossing is obligatory or virtually so in self-incompatible and dioecious species, but self compatible xenogamous species, especially those with many flowers open at a time are liable to varying degrees of selfing through xenogamy (cross pollinations between flowers of the same plant). Selfing in xenogamous plants may result in inbreeding depression (Antovics, 1968; Darwin, 1895 and Watts, 1965). In xenogamous, self-compatible plants, therefore adaptation that decreases selfing should help in maximising fitness. One such adaptation system described by Cruden and Hermann-Parker (1977) was temporal dioecism, that permits little geitonogamy.

Temporal dioecism is the temporal alternation of staminate and pistillate function within an individual during a single flowering season (Cruden and Hermann Parker, 1977). Temporal dioecism is, in essence, a flowering sequence which is synchronised so that there is little or no overlap between staminate and pistillate phases of an individual plant. Temporal dioecism is strongly associated with monoecism (Cruden,

1988). Temporal dioecism has a broad taxonomic distribution and is clearly polyphyletic. Its occurrence was noticed in atleast 37 families and expected to exist in cucurbitaceae (Murawski and Gilbert, 1986). But there is no documentation regarding their existence of this phenomenon in ridge gourd. Hence, an attempt was made in the present investigation to observe the existence of the phenomenon of temporal dioecism and its advantage to the plant and/or the breeder.

In ridge gourd two types of male flowers exists 1) male inflorescence and 2) solitary male. An attempt was made to know the efficiency of pollen from both the sources on various fruit and seed characters by conducting crossing and selfings among some of the genotypes.

Practically very little information is available in ridge gourd in the above lines. Hence, keeping this in view, the present investigation was undertaken with the following objectives :

1. To study about the growth and bearing habits of the vine.
2. To examine the presence of temporal dioecism and the possibility of exploitation of this phenomenon.

3. To study different fruit and seed characters based on the source of pollen (solitary male and male inflorescence).

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

To formulate a successful breeding programme, a thorough knowledge of the association of various yield contributing characters with yield and among themselves, is essential. However in spite of the fact that the level of heterosis exhibited by hybrid was a function of genetic divergence between the parents (Moll et al., 1974), such studies are limited in ridge gourd. Hence, work done on related Cucurbitaceous crops like cucumber, bottle gourd, musk melon, water melon, etc. were reviewed to get an insight into the problems in respect to quantitative characters under the following sub heads.

- 2.1 Character association
- 2.2 Direct and indirect effects of traits
- 2.3 Temporal dioecism

2.1 CHARACTER ASSOCIATION

The correlation coefficients ('r') form a useful tool in plant breeding programme as they measure the extent and direction of association of characters (that show low heritability and or are difficult to measure). The characters which are positively

correlated with yield are of considerable importance to a plant breeder for selection purposes because it contributes to rapid progress under selection for a correlated response than from selection for the desired character itself. Phenotypic correlations are subjected to changes in environment, so it is necessary to find out genotypic correlations. The available literature on correlation studies is reviewed as follows.

2.1.1 Node number for the first female flower appearance

Kalloo et al. (1983) observed highly positive association between node number for the first female flower appearance and yield in musk melon. In contrast, negative association between these traits was observed by Abusaleha and Dutta (1988) in cucumber and Singh and Singh (1988) in water melon.

2.1.2 Number of primary branches per vine

Srivasthava and Srivasthava (1976), Ramachandran and Gopalakrishnan (1979) and Lawande and Patil (1989) reported that the number of branches per vine was positively associated with yield in bitter gourd. Similar positive and significant association was reported between yield and this trait by Solanki

and Seth (1980), Abusaleha and Dutta (1988) in cucumber, and Prasad et al. (1988) in water melon.

2.1.3 Length of the main axis

Gopalakrishnan et al. (1980) recorded highly positive correlation of length of main axis with yield in pumpkin. Similar correlation between that of main axis and yield was noticed by Ramachandran and Gopalakrishnan (1979), Indires (1982) and Lawande and Patil (1989) in bitter gourd, Solanki and Seth (1980), Abusaleha and Dutta (1988) in cucumber, and Prasad et al. (1988) in water melon.

2.1.4 Number of male flowers

In cucumber Solanki and Seth (1980) reported genotypically positively significant association between yield and number of male flowers, while Reddy and Rao (1984) recorded highly positive association between these traits both at phenotypic and genotypic levels in ridge gourd.

2.1.5 Number of female flowers

Ramachandran and Gopalakrishnan (1979) reported highly positive correlation between number of female flowers and yield in bitter gourd, both at Phenotypic and genotypic level. Similar correlation was reported by Solanki and Seth (1980) and Chaudhary

and Mandal (1987) in cucumber, Rana (1982) in pumpkin, Kondalraj et al. (1984) in snake gourd, and Reddy and Rao (1984) in ridge gourd, while Rana et al. (1985) observed positive correlation at phenotypic level in pumpkin.

2.1.6 Number of fruits per plant

Both phenotypically and genotypically positive and highly significant correlation was reported between yield and number of fruits in bottle gourd by Tyagi (1972). Similar association between these traits was reported by Srivasthava and Srivasthava (1976), Singh et al. (1977), Ramachandran and Gopalakrishnan (1979), Mangal et al. (1981) in bitter gourd, Smith and Lower (1977), Smith et al. (1978), Solanki and Seth (1980), Chaudhary and Mandal (1987), Abusaleha and Dutta (1988) in cucumber, Rana (1982), Rana et al. (1985) in pumpkin, Reddy and Rao (1984) and Prasad and Singh (1989) in ridge gourd, Singh and Nandpuri (1978), Kalloo et al. (1983) and Salk (1982) in musk melon, Panwar et al. (1984) in sponge gourd, Kondalraj et al. (1984) in snake gourd, Singh and Singh (1988) in water melon and Lawande and Patil (1989) in bitter gourd.

2.1.7 Percentage of fruit set

Haribabu (1985) reported highly positive association between yield and per cent fruit set in

cooking melon. Phenotypically positive and significant association between these traits, was observed by Rana et al. (1985) in pumpkin.

2.1.8 Fruit length

Tyagi (1972) in Bottle gourd, Singh et al. (1977), Ramachandran and Gopalakrishnan (1979) and Indires (1982) in bitter gourd reported highly positive correlations between yield and fruit length. Similar findings were reported by Thamburaj (1973) and Reddy and Rao (1984) in ridge gourd, Chaudhary and Mandal (1987) and Abusaleha and Dutta (1988) in cucumber, Singh et al. (1987) in pointed gourd and Prasad et al. (1988) in water melon.

2.1.9 Fruit girth

Tyagi (1972) in bottle gourd and Indires (1982) in bitter gourd, reported highly positive association between yield and fruit girth. Similar association was reported by Thamburaj et al. (1978) in snake gourd, Abusaleha and Dutta (1988) in cucumber, and Prasad et al. (1988) in water melon.

2.1.10 Fruit weight

Gopalakrishnan et al. (1980), Rana (1982), Rana et al. (1985) in pumpkin, reported highly positive and significant association between yield and fruit

weight. Similar correlation between these two traits was observed by Thamburaj (1973) in ridge gourd, Singh and Nandpuri (1978), Chhonkar et al. (1979), Kalloo et al. (1983), Haribabu (1985), and Chaudhary and Mandal (1987), in cucumber, Ramachandran and Gopalakrishnan (1979), Mangal et al. (1981), Indires (1982) and Lawande and Patil (1989) in bitter gourd, Sidhu and Brar (1981), Prasad et al. (1988) and Zhang and Wang (1989) in water melon.

2.1.11 Seed number per fruit

Tyagi (1972) reported positive and significant association between fruit number and yield in bottle gourd. Similar observation was made by Thamburaj (1973) in ridge gourd.

2.1.12 100 - Seed Weight

Highly significant and positive correlation was noticed by Tyagi (1972) in bottle gourd between yield and 100 seed weight. Similar highly significant and positive association between the two traits was reported by Sidhu and Brar (1981) in water melon.

2.1.13 Correlation among Yield Components

Tyagi (1972) reported that number of fruits per plant in bottle gourd was significantly correlated with length of main axis, number of seeds per fruit,

and girth of fruit. Length of fruit was significantly associated with number of seeds per fruit and 100 seed weight and girth of fruit was significantly correlated with length of main axis. Length of main axis was negatively correlated with yield while positive significant association was recorded with number of branches and number of seeds per fruit. Number of branches was significantly associated with number of seeds per fruit and number of seeds per fruit was strongly associated with 100 seed weight.

In bitter gourd, Singh et al. (1977) reported a positive and significant association between the number of fruits per plant and fruit length and number of fruits per plant.

According to Thamburaj et al. (1978), fruit length was positively associated with girth of the fruit in snake gourd.

In cucumber Solanki and Seth (1980) reported that vine length was positively correlated with number of female flowers per plant, number of fruits per plant and fruit weight. Chaudhary and Mandal (1987) observed positive inter-correlation between number of female flowers and number of fruits per vine. Fruit number/plant had positive correlation with fruit weight.

In ridge gourd, Reddy and Rao (1984) reported that, node at which first female flower appeared was negatively correlated with number of fruits per plant. Number of female flowers per plant was positively associated with fruit length and number of fruits per plant.

From the above literature it is evident that variations for the estimates of correlation coefficients were reported in same crop leading to the conclusions that these estimate might be specific to the genotype studied at a particular time.

2.2 DIRECT AND INDIRECT EFFECTS OF TRAITS

Association of characters determined by correlation coefficients may not provide an exact picture of the relative importance of direct and indirect influence of each of the yield components towards yield. As more variables are included in the correlation study, the indirect association become more complex. Path coefficient analysis provides an effective means of finding out direct and indirect causes of associations and permits a critical examination of specific forces acting to produce a given correlation and measures the relative importance of each character and thus gives an understanding of the nature and extent of direct and indirect influence

of the component characters in building up the ultimate yield. Importance is to be given to those characters which have major effects on yield in selection.

Tikka et al. (1974) found that fruit weight had highest direct effect on yield. Sidhu and Brar (1981) reported that number of nodes to the first female flower appearance had high direct as well as indirect effects on yield. Singh and Singh (1988) reported that number of fruits per vine had the highest direct effect on yield.

Ramachandran et al. (1978) in bitter gourd found that weight of the fruit followed by number of fruits per plant and length of main axis had maximum direct effect on yield, while the number of primary branches, number of female flowers had negative and low direct effect on yield.

Kondalraj et al. (1984) reported from path analysis in snake gourd that number of fruits per plant and number of female flowers per plant had high direct as well as indirect effects on yield.

Path coefficient analysis in pumpkin revealed that direct effect of fruit weight was highest on yield (Rana et al., 1985).

Chaudhary and Mandal (1987) from their path analysis studies in cucumber found that number of

female flowers per vine, number of fruits per vine were the important yield contributing factors. Abusaleha and Dutta (1988) found that number of fruits per vine had the greatest effect on yield in cucumber.

It is evident from the above cited literature that there were variations in the estimates of path coefficients in the same crop. This leads to the conclusion that estimates might be specific to the genotypes studied at a particular time.

2.3 TEMPORAL DIOECISM

2.3.1 Flowering behaviour, sex expression and flower bud differentiation in cucurbits

Three types of flowers viz., staminate (male), pistillate (female) and Hermophrodite (perfect) are common in cucurbits. A single vine may have one, two or all the three sexual types of flowers. Accordingly, the plants can be categorised into seven different groups viz., monoecious, androecious, andromonoecious, hermophrodite, gynoeceous, gynomonoecious and tri-monoecious (Zamski and Rudich, 1985).

Three major groups of flowers are commonly found along a shoot of monoecious squash and cucumber (Galun, 1958 and Nitsch et al., 1952). First male flower appears at the shoot base, followed by a mixed

phase of male and female flowers towards the shoot apex.

According to Frankel and Galun (1977), embryonic floral buds have a bisexual potential and may develop into male, female, or hermaphrodite flowers. A monosexual flower can be developed from a rudimentary bisexual bud, with one sex inhibiting the development of the other, resulting in a retarded organ which can be detected in the mature flowers (Atsmon and Galun, 1960). It is also possible for a monosexual flower to develop directly from a bud without passing a bisexual stage. In an ideal model, perfect flower differentiation follows a scheduled programme, starting at the lower (outer) sterile appendages (Sepals and Petals) and followed by sporophylls (stamens and carpels). During an early stage of differentiation, the lateral initials enter a plastic phase, bringing the primordium under control of the surrounding tissue and spatial location. Only latter the bud completely autonomous in its irreversible fate (Frankel and Galun, 1977). According to this simple model, a female cucumber flower bearing anther rudiments may be regarded as the result of a bud in which suppression of anther initials had taken place at a relatively late stage. A pure female flower bearing no male rudiments, probably arises from a bud, in which stamen suppression occurred

at a very early stage. If a monosexual flower can develop from an omnipotential bud it may suggest that such a bud contains the genetic information necessary to produce all the flower organs.

Temporal dioecism is the temporal alternation of staminate and pistillate function within an individual during a single flowering season (Cruden and Hermann . Parker, 1977). Temporal dioecism is adaptive because it maximises the fitness by minimising geitonogamy and maximises out crossing, in self compatible xenogamous plants. Geitonogamy may result in inbreeding depression, hence pollination efficiency may be maximised. Further this will increase the yield, if the pistillate phase is prolonged. Ridge gourd is a monoecious cucurbit bearing cluster of male flowers at lower nodes while the female flowers are borne, one on each of the upper nodes. Since temporal dioecism is strongly associated with monoecism we can expect the same phenomenon in this crop as well.

Varalakshmi (1992) reported that the temporal dioecism phenomenon was present in ridge gourd and it facilitated facultative xenogamy. Further it was reported that temporal dioecism in ridge gourd is an adaptive strategy to maximise the reproductive effort.

MATERIAL AND METHODS

CHAPTER III

MATERIALS AND METHODS

The present investigation on growth, bearing habits and temporal dioecism in ridge gourd were conducted during summer and winter season, 1992 at Students Farm, College of Agriculture, Rajendranagar and at Agricultural Research Institute, Rajendranagar, Hyderabad (Andhra Pradesh). The farm is situated at an altitude of 542.6 meters above mean sea level at the intersection of 80°5' N and 77°5' E. The soil is red sandy loam with good drainage. The materials used and methods adopted during the course of investigation were presented under the following heads.

- 3.1 Experimental details
- 3.2 Study on growth and bearing habits,
- 3.3 Study on temporal dioecism, and
- 3.4 Study on effect of pollen sources
on fruit and seed

3.1 Experimental details

The plant material used in this study consisted of eleven (11) genotypes of ridge gourd viz., 1. LA-46, 2. Jaipur Long, 3. LA-89, 4. GKVK, 5. Wardha Local, 6. LA-99, 7. Bijapur Local, 8. LA-43, 9. LA-15, 10. LA-32 and 11. LA-17. All the genotypes except

No.4, 5 and 7 were collected from Agricultural Research Institute, Rajendranagar. Remaining genotypes (4, 5 and 7) from Indian Institute of Horticultural Research, Bangalore. The details regarding the salient features of genotypes are given in Table-I.

The experiment in each season was laid out in a Randomised Block Design with three replications. Five randomly selected competitive plants in each line constituted the net plot. The crop was sown on 16.04.92 and 10.07.92 respectively for summer and winter seasons.

3.1.1 Crop husbandry

The experimental field was thoroughly ploughed and prepared well. The spacing followed was 3.0 X 0.6 m (inter and intra row) in both the seasons. Well decomposed farm yard manure was incorporated into the soil @ 40 tonnes/ha. The experimental plots were fertilized with 40 kgs N, 20 kgs P_2O_5 and 20 kgs K_2O per hectare. Half of the Nitrogen was applied in two equal splits at an interval of one month after sowing. The crop was grown under irrigated conditions duly adopting recommended cultural practices in two seasons. Need based plant protection measures were adopted to control the pests and diseases.

3.1.2 Collection of data

The following data was recorded on all five competitive plants in each line periodically till the crop ceased growth and showed signs of wilting.

3.2 STUDY ON GROWTH AND BEARING HABITS

The data collected in this experiment was divided into two parts.

3.2.1 Data collected on main axis.

3.2.2 Data collected on primaries and secondaries

3.2.1 Data collected on main axis

3.2.1.1 Number of nodes : The total number of nodes on the main axis of the vine were counted carefully from cotyledonary level in summer and winter seasons.

3.2.1.2 Node number of first female flower appearance : The node number, where the first female flower appeared was noted, counting its position from the cotyledonary node of the vine.

3.2.1.3 Node number of first male flower appearance : The node number, where the first male inflorescence and solitary male flower appeared was noted separately counting their position respectively from the cotyledonary node of the vine.

3.2.1.4 Percentage of nodes bearing female flowers :

The number of nodes that produced female flowers on each vine was noted, the total number recorded and the percentage nodes bearing female flowers was computed on main axis.

3.2.1.5 Percentage of nodes bearing male inflorescence

: The number of nodes that produced of male inflorescence on each vine was noted, the total number recorded and the percentage to the total nodes computed.

3.2.1.6 Percentage of nodes bearing solitary males :

The number of nodes that produced of solitary male flowers on main axis of each vine was noted, their total number recorded and percentage to the total number of nodes computed.

3.2.1.7 Percentage of nodes produced both female flower, and male inflorescence :

The number of nodes that produced both female and male inflorescence (at a single node) were noted, their total number recorded and the percentage to the total number of nodes on main axis of the respective plant was computed.

3.2.1.8 Percentage of nodes produced female, male inflorescence and solitary male :

The number of nodes that produced all the flowering units i.e., female, male inflorescence and solitary male were noted, their

total number recorded and their percentage to the total number of nodes of the respective plant was computed.

3.2.1.9 Percentage of nodes produced both female, solitary male : The number of nodes that produced both female and solitary male flower at a single node was noted, their total number recorded and percentage to the total number of nodes in the respective plant, was computed.

3.2.1.10 Percentage of nodes produced exclusively female flower : The number of nodes that produced exclusively female flower (without male inflorescence or solitary male) was noted, their total number recorded and percentage to the total number of nodes was computed.

3.2.1.11 Percentage of nodes produced exclusively male inflorescence : The number of nodes that produced exclusively male inflorescence (without female and solitary male) on main axis was recorded and the percentage to the total number of nodes of the respective vine was computed.

3.2.1.12 Percentage of nodes produced exclusively solitary male flower : The number of nodes that produced exclusively solitary male flower, (Without female and male inflorescence) were recorded on main

axis of each vine and their percentage to the total number of nodes of the respective vine was computed.

3.2.1.13 Node number of first primary production : The node number, where the first primary branch produced was noted counting its position from the cotyledonary node of the vine.

3.2.1.14 Percentage of barren nodes : The number of nodes that remained barren (the nodes produced neither branches nor the flower) on the main axis of the each vine was recorded and percentage to the total number of nodes of the respective vine was computed.

3.2.1.15 Node number at which fruit bearing started : The node number, where the first bearing started, i.e., first fruit set was recorded counting its position from the cotyledonary node of the vine.

3.2.1.16 Percentage of nodes produced fruits : The number of nodes that produced fruits on main axis of each vine was recorded and their percentage to the total number of nodes of the respective vine was computed.

3.2.1.17 Length of the main axis : The length of the main axis was measured with a twine at the end of the harvest from base of the plant to the tip of the main shoot and expressed in centimeter (cm).

3.2.2 Data collected on the growth and bearing habits on primaries and secondaries

3.2.2.1 Number of branches and total number of nodes : Number of primaries and secondaries on each vine were counted and the total number of nodes on all the branches of the vine were counted separately for both primaries and secondaries at the time of the final harvest.

3.2.2.2 Node number at which first female flower appeared : The node number at which first female flower appeared was noted separately for primaries and secondaries, counting their position from the first node of the branches.

3.2.2.3 Node number at which first male flower appeared : The node number where first male inflorescence and/or solitary male appeared was noted separately for both primaries and secondaries by counting their position from the first node of the branches.

3.2.2.4 Percentage of nodes bearing females : The number of nodes that produced female flower, on both primaries and secondaries were recorded, and percentages were computed to the total number of nodes of the respective branches.

3.2.2.5 Percentage of nodes bearing male flowers : The number of nodes that produced male inflorescence and solitary male were recorded separately for both primaries and secondaries were recorded separately and percentages were calculated to the total number of nodes of the respective branches.

3.2.2.6 Percentage of nodes bearing both female flower and male inflorescence : The number of nodes that produced both female flower and male inflorescence (at a single node) were recorded for both the types of branches and their percentages were calculated to the total number of nodes of the respective branches.

3.2.2.7 Percentage of nodes bearing both female and solitary male : The number of nodes that produced both female and solitary male (at a single node) were recorded for both the type of branches, their percentages were calculated to the total number of nodes of the respective branches.

3.2.2.8 Node number at which branching started on primaries : The node number, at which first secondary produced was noted on the primaries by counting its position from the first node of the branch.

3.2.2.9 Percentage of barren nodes : The total number of nodes that remained barren (the nodes produced neither branches, nor flowers) were recorded and the

percentages were calculated to the total number of nodes of the respective branches.

3.2.2.10 Node number at which fruit bearing started :

The node number at which first fruit set occurred was noted for both the types of branches, by counting their position from the first node of the branches.

3.2.2.11 Percentage of nodes bearing fruits :

The number of nodes that produced fruits for both the types of branches were recorded daily till harvest and the percentages were worked out to the total number of nodes of the respective branches.

3.2.2.12 Total number of fruits on whole plant :

All the marketable fruits harvested from both on main axis and branches of each vine during each picking were added to arrive at total number of fruits on whole plant.

3.2.2.13 Yield per plant : All the marketable fruits harvested from both the main axis and branches of each vine were weighed and added to arrive at the total yield per plant by weight and expressed in kilogram (Kg).

3.2.3 Statistical Analysis

The data for the individual seasons and pooled for the two seasons in respect of different characters

studied were subjected to the following statistical procedures.

3.2.3.1 Analysis of variance

3.2.3.2 Correlation and path coefficient analysis

3.2.3.1 Analysis of variance : To test the differences among genotypes in the experiments conducted, the data obtained for each character were analysed by following the Randomised Block Design analysis. The analysis was based on following linear model given by Fisher (1938).

3.2.3.2 Estimates of correlation coefficient and path coefficient analysis :

a) **Correlation Coefficient** : Correlation coefficients were worked out, using the formulae suggested by Singh and Chaudhary (1985).

The test of significance of correlation was carried out by refereeing to 'r' table values of Fisher and Yates (1963) at (n-1) degrees of freedom at one per cent and five per cent levels, where "n" denotes to the number of genotypes tested.

b) **Path coefficient analysis** : The path coefficients were obtained by solving the following simultaneous equations as suggested by Dewey and Lu (1955).

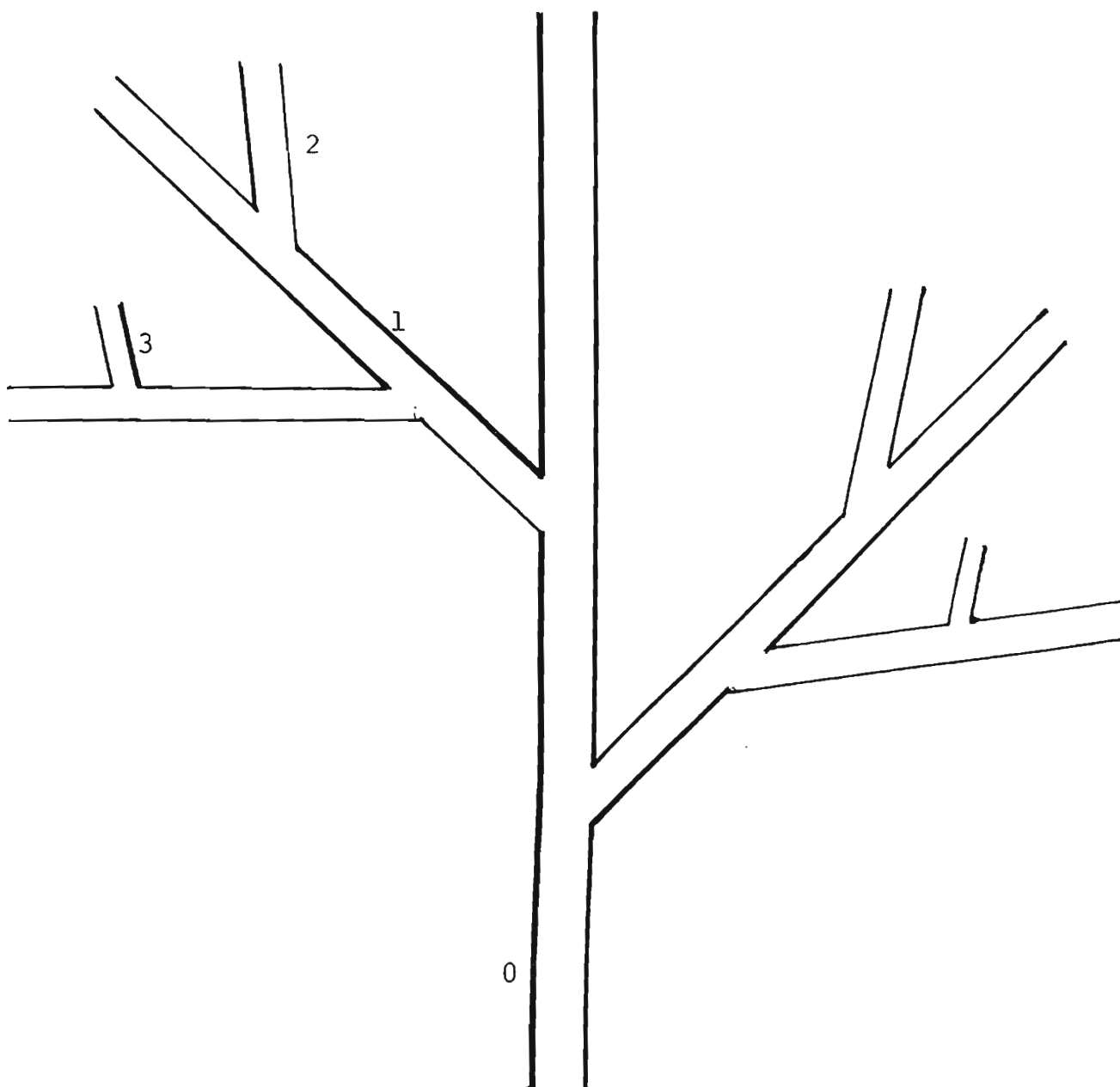


Fig.1 : Ordering branching system in plants by Botanical system

- 0 Main axis
- 1 Primary
- 2 Secondary
- 3 Tertiary

3.3 STUDIES ON TEMPORAL DIOECISM

3.3.1 Branch order terminology

For all purposes in this study the branches were ordered according to orthodox botanical system. In botanical terms, a branch is topographically one order higher than the axis on which it is inserted. Ordinal number, were used to describe branch order, thus the main axis was considered as Zero order, the branches produced on main axis as primaries, those produced on primaries as secondaries.

3.3.2 Data recorded on growth pattern

3.3.2.1 Interval of primary branch production : The number of first order branches produced at each node and at intervals of 1 node, 2 nodes and above 2 nodes on main axis were computed to get an idea of the branching interval of primaries.

3.3.2.2 Interval of secondary branch production : The number of secondaries produced at each node and at intervals of 1 node, 2 node and above 2 nodes of first order branches were computed to get an idea of branching interval of second order branches.

3.3.3 Data recorded on flowering pattern to discern the temporal dioecism

3.3.3.1 Interval of male flower production on main

axis, primaries and secondaries : The number of male flowering units (clusters) and solitary male produced on main axis at each node, 1 node, 2 nodes and above 2 nodes interval were computed to get an idea of the interval of male flower production, on main axis. The interval of male flower production on primaries and secondaries was computed in the same manner as in main axis.

3.3.3.2 Interval of female flower production on main axis primaries and secondaries : These are calculated in the same manner as calculated for interval of male flower production.

3.4 STUDIES ON EFFECT OF POLLEN SOURCES ON FRUIT AND SEED

The following fruit characters were studied from the fruits obtained by crossing and selfing among the genotypes studied, with the pollen from two sources (male inflorescence and solitary male). Totally three crosses (LA-46 X Jaipur Long, GKVK X Wardha Local and LA-99 X Bijapur Local), one reciprocal cross between the lines LA-17 and LA-32 and selfings in two lines (LA-15 and LA-17) were made in the present study.

3.4.1 Fruit weight

The fruit weight was arrived by weighing the

each individual fruit obtained by selfing or crossing of genotypes and expressed in g.

3.4.2 Fruit length

The fruit length was measured from tip to the base of the fruit and expressed in cm.

3.4.3 Fruit girth

The girth of the fruit was measured approximately at the middle of the fruits by using Vernier Calipers and expressed in cm.

3.4.4 Seed number per fruit

The number of seeds per fruit were counted at full dry stage of the fruit.

3.4.5 Seed weight

The seeds from the individual fruits was weighed and expressed in g.

Table - I : Description of the genotypes

S.No.	Genotype	Description
1.	LA-46	Vines long, late flowering, fruits medium, fairly resistant to powdery mildew.
2.	Jaipur Long	Vines long, fruits long, late flowering, fairly resistant to powdery mildew.
3.	LA-89	Vines short, early flowering, fruits long, resistant to powdery mildew.
4.	GKVK	Released by GKVK, Bangalore, vine length medium, late flowering, fruits long, moderately resistant to powdery mildew.
5.	Wardha Local	Collection from Wardha (Maharashtra), vine length medium, early flowering, fruits long, susceptible to powdery mildew.
6.	LA-99	Vines short, early flowering, fruits long, moderately resistant to powdery mildew.
7.	Bijapur Local	Collection from Bijapur (Karnataka) vines long, early flowering, fruits long, susceptible to powdery mildew.
8.	LA-43	Vines short, late flowering, less no. of male flowers, fruits short, moderately resistant to powdery mildew.
9.	LA-15	Vines short, early flowering, fruit bearing will be in clusters, susceptible to powdery mildew.
10.	LA-32	Vines long, late flowering, fruits will be medium, moderately resistant to powdery mildew.
11.	LA-17	Vines long, late flowering, fruits long, susceptible to powdery mildew.

RESULTS

CHAPTER IV

EXPERIMENTAL RESULTS

The results of the studies on growth, bearing habits and temporal dioecism in eleven genotypes of ridge gourd over two seasons along with pooled analysis of the two seasons are presented under the following heads.

- 4.1 Studies on growth and bearing habits
 - 4.1.1 Growth characters
 - 4.1.2 Flowering characters
 - 4.1.3 Character association among yield and yield attributes
 - 4.1.4 Direct and indirect effects^{ck} yield contributing characters towards yield
- 4.2 Studies on temporal dioecism
 - 4.2.1 Growth pattern
 - 4.2.3 Flowering pattern
- 4.3 Studies on effect of pollen from various sources on fruit and seed

The data collected on 28 characters on main axis, primaries and secondaries over two seasons was combinedly (pooled) subjected to statistical analysis as detailed under Materials and Methods.

4.1 STUDIES ON GROWTH AND BEARING HABITS

4.1.1 Growth Characters

4.1.1.1 Number of nodes on main axis : The number of nodes on main axis was significantly different among the lines and seasons but the interaction effect was not significant (Table 2). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line Jaipur Long produced more number of nodes on main axis (37.66) followed by LA-46, LA-17, GKVK and LA-32 which were at par with each other. Least number of nodes on main axis were produced by LA-15 (22.33) followed by LA-99 and Bijapur Local. Rest of the lines were intermediate.

During winter more number of nodes were produced (31.03) than in summer (29.81).

4.1.1.2 Length of main axis : Significant differences were observed for this characters between lines and seasons but the interaction was not significant (Table 2). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line Jaipur Long produced maximum length of main axis (248.38) followed by LA-46 (226.20) which was at par with LA-17 (225.96). Least length of main axis was observed in the line LA-15 (150.20).

Table 2 : Growth habits of the ridge gourd vine

Sl. No.	Name of the line	Nodes on main axis			Length of main axis (cm)		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	31.33	35.66	33.50	206.30	246.10	226.20
2.	Jaipur Long	36.00	39.33	37.66	236.76	260.00	248.38
3.	LA-89	29.00	31.66	30.33	190.80	209.50	200.15
4.	GKVK	31.00	33.66	32.33	204.30	222.10	213.20
5.	Wardha Local	32.33	30.66	31.50	147.86	211.60	179.73
6.	LA-99	27.00	27.66	27.33	186.06	190.90	188.48
7.	Bijapur Local	31.33	27.33	29.33	188.00	172.10	180.05
8.	LA-43	22.66	28.00	25.33	156.40	193.20	174.80
9.	LA-15	22.00	22.66	22.33	151.80	148.60	150.20
10.	LA-32	32.00	31.00	31.50	220.80	204.90	212.85
11.	LA-17	33.33	33.66	33.50	230.00	221.93	225.96
Mean		29.81	31.03		192.64	207.35	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
Lines		5.51	S	15.74	12.35	S	35.25
Seasons		2.35	S	6.71	5.26	S	15.03
Interaction		7.80	NS	--	17.47	NS	--

S - Significant NS - Not significant
(contd.,)

Significantly more length of the main axis was observed in winter (207.35) than summer (192.64).

4.1.1.3 Number of primary branches : There was significant difference among the lines, seasons and interaction (Table 2). The line LA-46 produced maximum number of primary branches per vine (7.66) followed by Jaipur Long (4.66) which was at par with Bijapur Local (4.33), LA-89 and GKVK (4.16). Least number of primary branches per vine were produced in the line LA-43 (2.50) which was at par with LA-15 (3.00).

More number primary branches were produced during summer (4.72) than winter (3.72).

During summer significantly more number of branches were observed in LA-46 (8.33) followed by Jaipur Long (6.33), GKVK (5.00). The least number of primary branches were found in LA-43 (2.66) which was at par with LA-15 and LA-17. Rest of the lines were intermediate. During winter also LA-46 had maximum number of primary branches (7.00), followed by LA-99 (5.00). Least number of branches were found in LA-43 (2.33), it was at par with Wardha Local (2.66), LA-15, LA-32 and Jaipur Long (3.00).

There was a general decrease in the number of primary branches during winter in most of the lines except LA-99 where there was an increase. There was

significant decrease in the number of branches in the lines Jaipur Long, GKVK, Wardha Local and Bijapur Local. Rest of them did not differed.

4.1.1.4 Number of nodes on primaries : This character exhibited significant difference among the lines, seasons and interaction (Table 2). The data on number of nodes per branch for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-46 produced maximum number of nodes on primaries (100.66) followed by Jaipur Long (80.16). Least number of nodes on primaries were produced by LA-15 (38.83).

Significantly more number of nodes on primaries were produced during summer (60.63) than winter (65.81).

During summer Jaipur Long had maximum number of nodes (100.33) followed by LA-46 and LA-17 which were at par with each other. The Least number of nodes were observed in LA-15 (32.33), which were at par with LA-43, LA-89 and LA-99. During winter the line LA-46 had significantly higher number of nodes (119.33). LA-32 had least number of nodes (42.00), with the rest of the lines being intermediate. Almost all the lines differed for this character except the line LA-17 which

produced maximum number of nodes on primaries during summer season.

4.1.1.5 Number of secondary branches per vine : This character exhibited significant difference among the lines. There was no significant difference for this character between the seasons and thereby interaction (Table 2). The line LA-17 produced maximum number of secondary branches per vine (5.00) followed by LA-32 (4.16) which was at par with Wardha Local (4.00). Least number of secondaries were observed in the line LA-99 (1.33) which was at par with LA-43 (1.66). An equal number of secondary branches were produced in the lines LA-17 and LA-43 in both the seasons (5.00 and 1.66) respectively.

4.1.1.6 Number of nodes on secondaries : There was significant difference for this character between the lines and seasons but the interaction effect was not significant (Table 2). The data on number of nodes per branch for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-17 produced maximum number of nodes on secondaries (46.00) followed by LA-32 (35.50) which was at par with LA-46 (34.16). Least number of nodes on secondaries were observed in the line LA-99 (11.66) followed by LA-43 (13.33).

Table 2 (contd.) Growth habits of the ridge gourd vine

Sl. No.	Name of the line	Number of primary branches			Number of nodes on primaries			Number of nodes on primaries			Number of nodes on secondaries		
		Summer	Winter	Pooled	Summer	Winter	Pooled	Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	8.33	7.00	7.66	82.00	119.33	100.66	3.00	3.66	3.33	24.00	44.33	34.16
2.	Jaipur Long	6.33	3.00	4.66	100.33	60.00	80.16	2.12	4.00	3.06	35.33	32.00	33.66
3.	LA-89	4.33	4.00	4.16	46.00	68.00	57.00	3.00	3.33	3.16	25.33	19.33	22.33
4.	GKVK	5.00	3.33	4.16	57.33	73.00	65.16	4.00	3.33	3.66	28.33	29.33	28.83
5.	Wardha Local	4.66	2.66	3.66	56.33	49.66	53.00	3.33	4.66	4.00	31.00	34.00	32.50
6.	LA-99	4.33	5.00	4.66	49.33	88.00	68.66	1.00	1.66	1.33	9.00	14.33	11.66
7.	Bijapur Local	5.00	3.66	4.33	64.00	58.00	61.00	2.33	2.66	2.50	22.00	23.00	22.50
8.	LA-43	2.66	2.33	2.50	35.00	50.66	42.83	1.66	1.66	1.66	13.66	13.00	13.33
9.	LA-15	3.00	3.00	3.00	32.33	45.33	38.83	1.50	2.50	2.00	12.66	23.00	17.83
10.	LA-32	4.66	3.00	3.83	66.33	42.00	54.16	3.66	4.66	4.16	30.33	40.66	35.50
11.	LA-17	3.66	4.00	3.83	78.00	70.00	74.00	5.00	5.00	5.00	49.00	43.00	46.00
Mean		4.72	3.72		60.63	65.81		3.03	3.45		25.51	28.72	
Lines		0.35	S	1.01	4.38	S	12.50	0.57	S	1.64	0.96	S	2.76
Seasons		0.15	S	0.43	1.86	S	5.33	0.24	NS	--	0.41	S	1.17
Interaction		0.50	S	1.43	6.19	S	17.68	0.81	NS	--	1.36	NS	3.90

S - Significant NS - Non significant

More number of nodes on secondaries were produced during winter (28.72) than summer (25.51).

4.1.2 Flowering characters

4.1.2.1 Node number of first female flower appearance on main axis : Significant differences were observed among the lines for this character (Table 3). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. There were no significant differences for this character between the seasons and thereby interaction. LA-89 produced the first female flower at farthest node (14.00) followed by LA-32, LA-43 and LA-17 which were at par with each other. LA-15 produced the first female flower at earliest node (7.50) followed by GKVK (8.66), Wardha Local (9.16), LA-99 (9.83) the later three were at par with each other. Rest of the lines were intermediate for this character. The lines LA-32 and LA-17 produced first female flower on main axis at similar node in winter season (12.33).

4.1.2.2 Node number of first male inflorescence appearance on main axis : This character exhibited significant difference among the lines and seasons but the interaction effect was not significant (Table 3). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-

46 produced first male inflorescence at farthest node (6.66) which was at par with Jaipur Long (6.33). The male inflorescence production on main axis was observed at earliest node in the line LA-43 (3.66) followed by LA-15 (4.00) which was at par with LA-89 and GKVK (4.16).

First male inflorescence production on main axis was observed at earliest node in winter (4.42) than summer (5.12).

4.1.2.3 Node number of first solitary male flower appearance on main axis : Significant differences were observed among the lines for this character (Table 3). There was no significant difference for this character between the seasons but the interaction effect was significant. The line LA-46 produced first solitary male flower at farthest node (10.33) followed by GKVK (9.16) which was at par with Wardha Local and LA-32 (8.66). The line LA-15 produced first solitary male flower at earliest node (5.16) which was at par with LA-43 (5.83).

During summer, the line GKVK produced the first solitary male flower at farthest node (10.33) followed by Jaipur Long LA-17 (8.66), Wardha Local LA-46 (8.33) which were at par with each other. The lines LA-43 (5.16) and LA-15 (5.83) produced first solitary male

Table 3 : First flower appearance on main axis - Node number

Sl. No.	Name of the line	Female		Male		Inflorascence		Solitary male		
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled	
1.	LA-46	11.00	13.00	12.00	6.00	7.33	6.66	8.33	12.33	10.33
2.	Jaipur Long	11.66	11.00	11.33	7.00	5.66	6.33	8.66	8.66	8.66
3.	LA-89	14.33	13.66	14.00	3.00	5.33	4.16	7.33	7.00	7.16
4.	GKVK	8.00	9.33	8.66	4.33	4.00	4.16	10.33	8.00	9.16
5.	Wardha Local	9.66	8.66	9.16	3.33	3.66	3.50	8.33	9.00	8.66
6.	LA-99	9.66	10.00	9.83	5.66	5.00	5.33	7.00	6.33	6.66
7.	Bijapur Local	11.00	11.33	11.16	4.66	4.66	4.66	6.66	6.66	6.66
8.	LA-43	13.33	12.66	13.00	4.66	2.66	3.66	4.66	7.00	5.83
9.	LA-15	8.00	7.00	7.50	5.00	3.00	4.00	4.66	5.66	5.16
10.	LA-32	14.00	12.33	13.16	6.00	4.00	5.00	8.00	9.33	8.66
11.	LA-17	13.00	12.33	12.66	6.66	3.33	5.00	8.33	5.66	7.00
	Mean	11.24	11.03		5.12	4.42		7.48	7.78	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	0.42	S	1.21	0.66	S	1.90	0.66	S	1.89
	Seasons	0.18	NS	--	0.28	S	0.81	0.28	NS	--
	Interaction	0.60	NS	--	0.94	NS	--	0.93	S	2.67
S -	Significant		NS	-	Non significant					

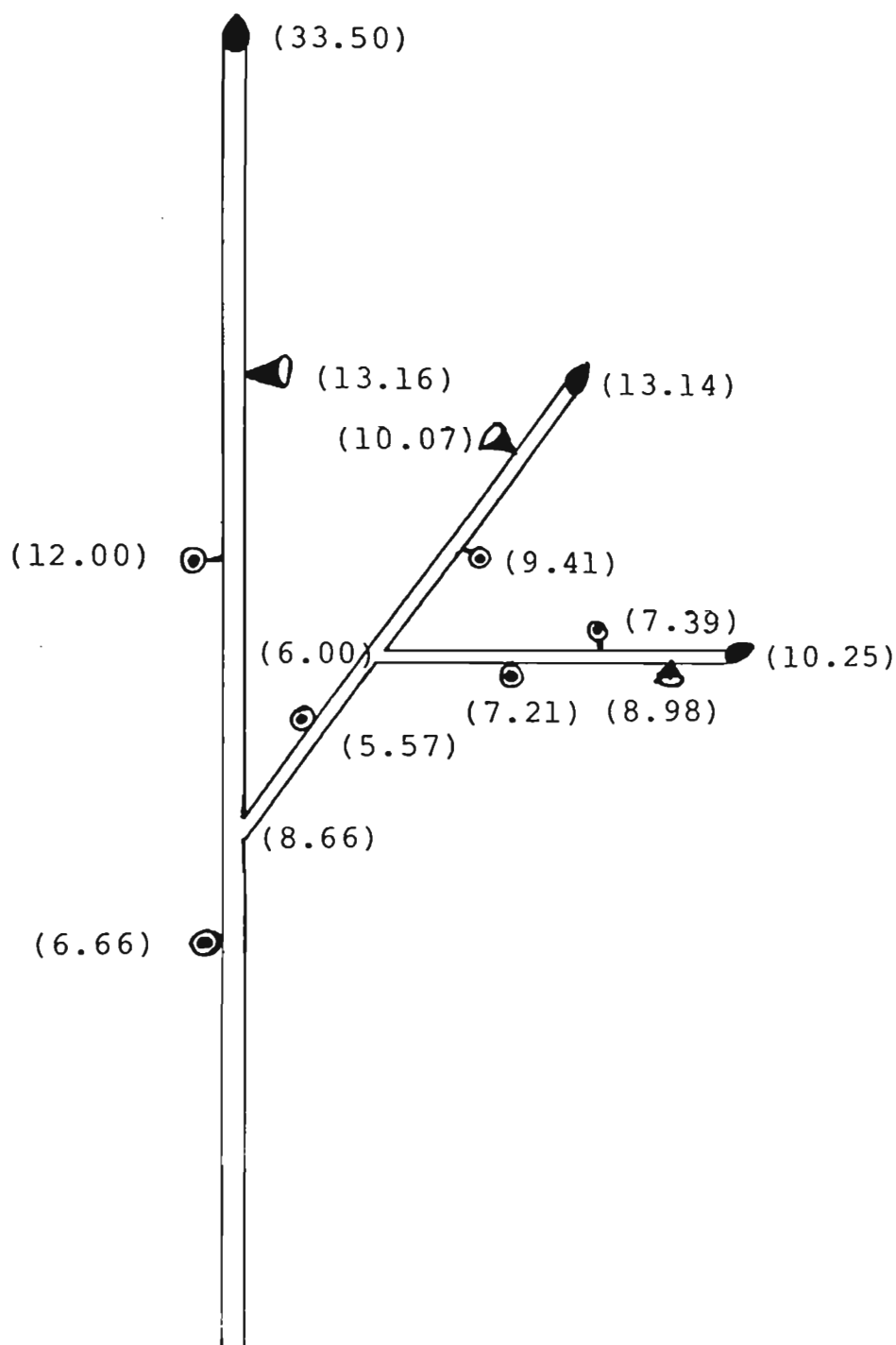


Fig.2 : Diagrammatic representation of growth habit in the line LA-46

(Relative numbers are given in brackets)

- Number of nodes
- ⊙ First male flower appearance
- ⊙ First female flower appearance
- ◐ First fruit appearance
- ◐ First branch appearance

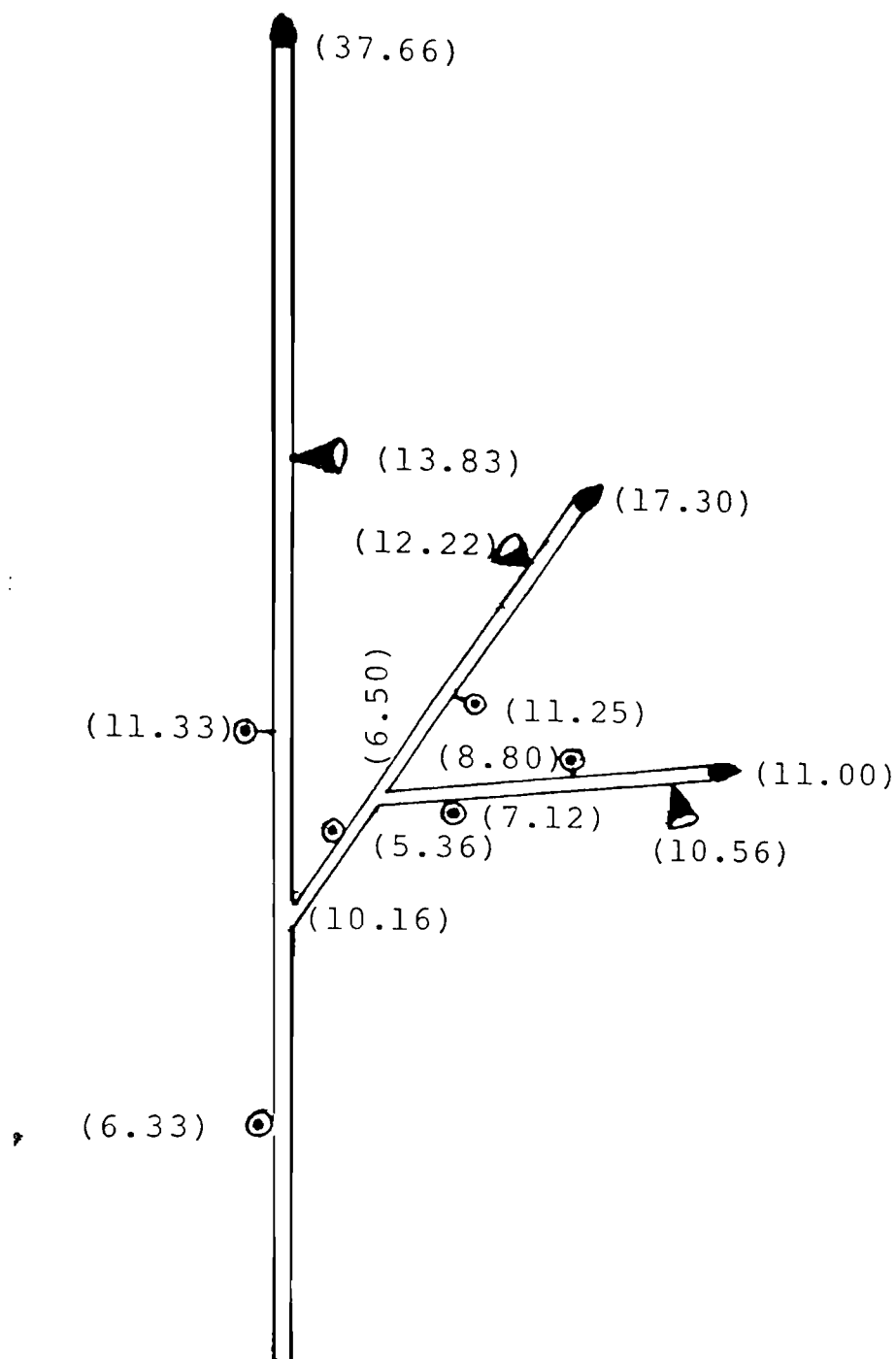


Fig.3 : Diagrammatic representation of growth habit in the line Jaipur Long

(Relative numbers are given in brackets)

- Number of nodes
- ⊙ First male flower appearance
- ⊙ First female flower appearance
- ◐ First fruit appearance
- First branch appearance

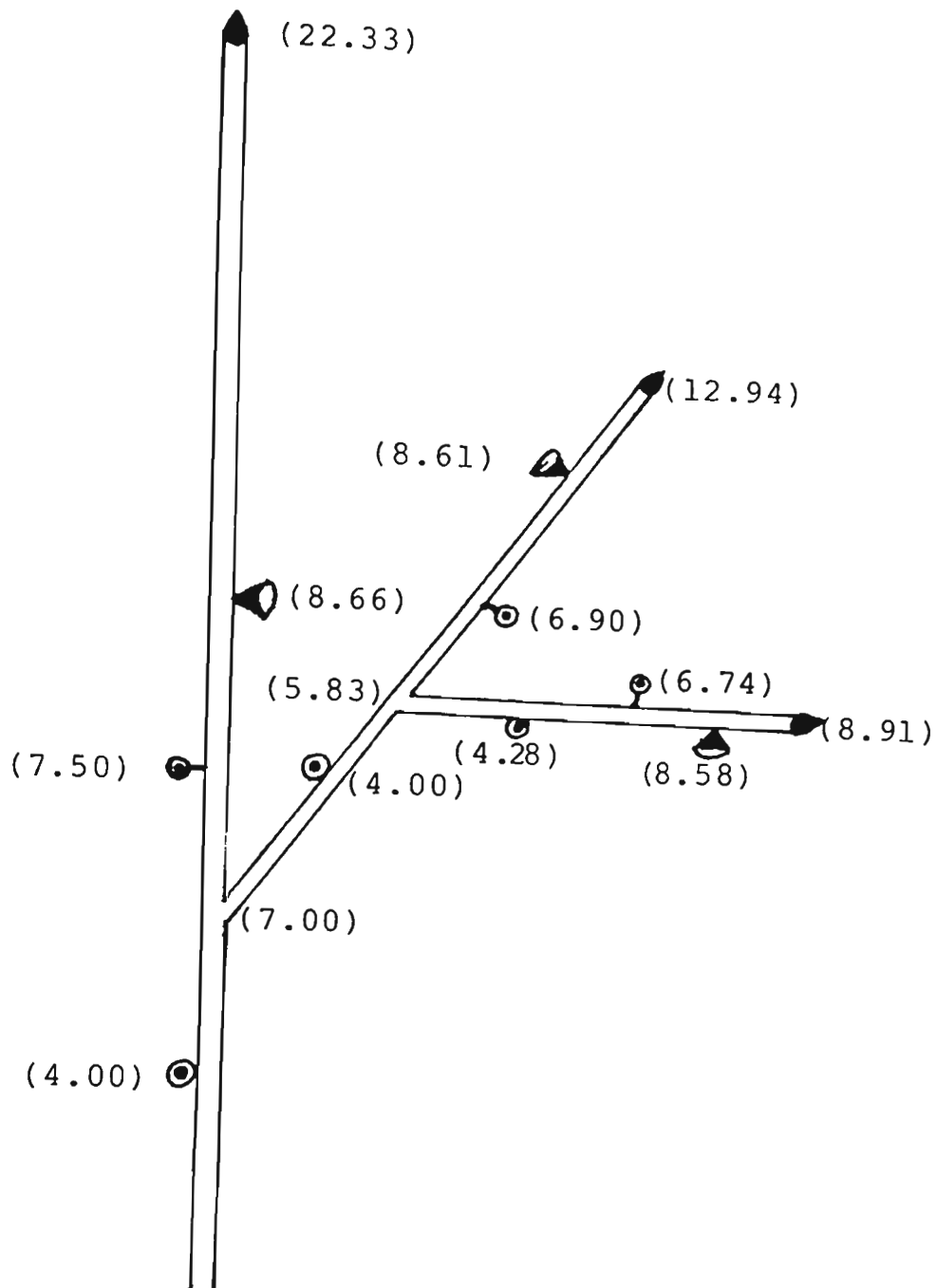


Fig.4 : Diagrammatic representation of growth habit in the line LA-15

(Relative numbers are given in brackets)



Number of nodes



First male flower appearance



First female flower appearance



First fruit appearance

First branch appearance

flower at earliest node, followed by Bijapur Local, LA-99 and LA-89 which were at par with each other. During winter season, the line LA-46 produced the first solitary male flower at farthest node (12.33), followed by LA-32 (9.33), Wardha Local (9.00), Jaipur Long (8.66) which were at par with each other. Rest of the lines were intermediate. The lines LA-15 and LA-17 produced the first solitary male flower at earliest node (5.66) followed by LA-99 (6.33), Bijapur Local (6.66) and LA-43 (7.00) which were at par with each other. Rest of the lines were intermediate.

The line LA-46 produced first solitary male flower at earliest node in summer than in winter, while LA-17 produced first solitary male flower at earlier node during winter than in summer. The line Jaipur Long (8.66) and Bijapur Local (6.66) produced the first solitary male flower at similar node both in summer and winter.

4.1.2.4 Number of nodes bearing female flowers on main axis : There were significant differences among the lines only (Table 4). There were no significant differences between the seasons and interaction. The line Jaipur Long produced female flowers at maximum number of nodes (21.50), followed by LA-17, LA-46, LA-89 and GKVK which were at par with each other. Least number of nodes with female flowers on main axis was

produced by LA-15 (12.50) followed by LA-43 (12.66) which were at par with each other. Rest of the lines were intermediate. The line LA-46 produced equal number of female flowers on main axis in both the seasons (19.66).

4.1.2.5 Number of nodes bearing male inflorescence on main axis : Significant differences were observed for this character among the lines, but there were no differences for this character between the seasons and for interaction. ^(Table -4) The line LA-17 produced maximum number nodes with male inflorescence on main axis (13.00), followed by GKVK (10.83), Jaipur Long (10.50) the later two were at par with each other. Least number of nodes with male inflorescence on main axis, were produced by LA-15 (5.16), followed by LA-43 (5.33) and LA-99 (7.50) with the former two being at par with each other. Rest of the lines were intermediate for the character.

4.1.2.6 Number of nodes bearing solitary male flowers on main axis : There were significant differences among the lines for the character, but there were no significant differences for this character between the seasons and interaction (Table 4). The line Jaipur Long produced most number of nodes with solitary male flowers on main axis (14.50), followed by LA-46 (13.16), LA-17 (12.83), GKVK (12.66), Wardha Local and Bijapur Local (12.50), LA-32 (12.33) with the later 6

Table 4 : Number of nodes bearing different flowers on main axis

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	19.66	19.66	8.33	8.00	12.00	14.33
2.	Jaipur Long	20.33	22.66	9.66	11.33	14.00	15.00
3.	LA-89	19.66	19.33	8.66	10.66	12.00	11.33
4.	GKVK	17.00	21.33	12.33	9.33	14.00	11.33
5.	Wardha Local	18.66	20.00	9.33	10.33	14.00	11.00
6.	LA-99	15.66	16.33	6.66	8.33	11.00	11.00
7.	Bijapur Local	19.00	17.66	9.66	7.00	13.33	11.66
8.	LA-43	11.33	14.00	5.00	5.66	8.00	11.33
9.	LA-15	13.00	12.00	5.33	5.00	9.00	8.33
10.	LA-32	18.66	17.33	8.00	9.33	13.33	12.33
11.	LA-17	19.66	20.33	13.33	12.66	11.33	14.33
	Mean	17.51	18.24	8.75	8.87	12.00	11.90
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	0.98	S	2.79	0.97	S	2.85
	Seasons	0.41	NS	--	0.41	NS	--
	Interaction	1.38	NS	--	1.37	NS	--
S - Significant		NS - Non significant					

lines being at par with each other. Least number of nodes with solitary male flowers on main axis was observed in the line LA-15 (8.66), followed by LA-43 (9.66), with the two being at par with each other. Rest of the lines were intermediate for this character.

4.1.2.7 Percentage of nodes bearing female flowers on main axis : Significant differences were observed for this character among the lines, but there were no differences for this character between the seasons and for interaction (Table 5). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line LA-89 produced maximum percentage of nodes with female flowers on main axis (64.24), followed by Bijapur Local (62.59) and Wardha Local (61.48), the later two being at par with each other. Least percentage of nodes with female flowers on main axis was observed in the line in LA-43 (49.96) followed by LA-15 (56.46) and LA-32 (56.97) with the later two being at par with each other.

4.1.2.8 Percentage of nodes bearing male inflorescence on main axis : There was significant difference for the character among the lines, but not for the seasons and interaction (Table 5). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line LA-17 produced maximum percentage of nodes with male inflorescence on main

axis (39.21), followed by GKVK (33.77) and LA-89 (31.78), Wardha Local (30.97), however the later two were at par with each other. Least percentage of nodes with male inflorescence on main axis was observed in LA-43 (21.19), followed by LA-15 (22.54) and LA-46 (24.64). The rest of the lines were intermediate.

4.1.2.9 Percentage of nodes bearing solitary male flowers on main axis : There were no significant differences for the character either among the lines or between the seasons or for interaction (Table 5). The line Bijapur Local produced maximum percentage of nodes with solitary male flowers (42.50) while the least percentage of nodes with solitary male flowers were observed in the line LA-43 (37.56).

4.1.2.10 Number of nodes bearing both female flower and male inflorescence on main axis : Significant differences were observed for this character between the lines and seasons but the interaction effect was not significant (Table 6). The line LA-17 produced maximum number of nodes with both female flower and male inflorescence on main axis (6.66), followed by Wardha Local (6.33), Bijapur Local (6.16) being at par with each other. Least number of nodes with female flower and male inflorescence was observed in the line LA-15 (4.00), followed by LA-43 (4.16), LA-99 (4.66),



Table 5 : Percentage of nodes bearing different flowers on main axis

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	62.72	55.08	26.71	22.56	38.38	40.20
2.	Jaipur Long	56.58	57.81	26.91	28.49	38.92	38.13
3.	LA-89	67.70	60.79	29.66	33.90	41.51	35.66
4.	GKVK	54.84	63.34	39.74	27.80	45.26	33.69
5.	Wardha Local	57.69	65.27	28.33	33.61	42.97	35.70
6.	LA-99	57.57	58.98	24.70	30.34	41.03	39.47
7.	Biapur Local	60.45	64.72	30.46	25.61	42.24	42.76
8.	LA-43	50.26	49.66	21.99	20.39	35.12	40.00
9.	LA-15	59.60	53.33	23.14	21.93	40.16	36.22
10.	LA-32	58.08	55.86	24.90	30.10	41.60	36.46
11.	LA-17	58.77	60.50	40.63	37.80	33.20	42.59
	Mean	58.75	58.67	28.83	28.41	40.03	38.27
	Lines	2.43	S	3.01	S	2.66	NS
	Seasons	1.03	NS	1.28	NS	1.13	NS
	Interaction	3.43	NS	4.26	NS	3.76	NS

C.D.
at 5%C.D.
at 5%

F test

S.E.

C.D.
at 5%

F test

S.E.

C.D.
at 5%

F test

S.E.

S - Significant NS - Non significant

being at par with each other. Rest of the lines were intermediate for this character.

In general, significantly more number of nodes with female flower and male inflorescence were produced in winter (5.84) than summer (5.21). The lines Wardha Local and LA-15 produced equal number of nodes with both female flower and male inflorescence on main axis in both the seasons (6.33 and 4.00).

4.1.2.11 Number of nodes bearing female flower, male inflorescence and solitary male flower on main axis :

There were no significant differences for this character either between the lines or seasons or interaction (Table 6). The line Jaipur Long produced maximum number of nodes with female flower, male inflorescence and solitary male flower on main axis (3.83) followed by LA-32 and GKVK (3.66), LA-89 and LA-46 (3.50). Least number of nodes with female flower, male inflorescence and solitary male flower on main axis was observed in the line LA-15 (2.33), followed by LA-99 (2.66).

4.1.2.12 Number of nodes bearing both female flower and solitary male flower on main axis : There was significant difference for this character among the lines but no significant differences were observed either between the seasons or for interaction effect

Table 6 : Number of nodes bearing both females and males on main axis

Sl. No.	Name of the line	Female + Male inflorescence		Female + Male inflorescence + Sol. male		Female + Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	5.33	5.66	5.50	3.33	3.66	3.50
2.	Jaipur Long	5.66	7.00	6.33	3.66	4.00	3.83
3.	LA-89	5.33	6.00	5.66	4.00	3.00	3.50
4.	GKVK	4.66	6.33	5.50	3.33	4.00	3.66
5.	Wardha Local	6.33	6.33	6.33	3.00	3.00	3.00
6.	LA-99	4.00	5.33	4.66	3.00	2.33	2.66
7.	Bijapur Local	6.66	5.66	6.16	3.33	2.66	3.00
8.	LA-43	3.00	5.33	4.16	2.00	4.00	3.00
9.	LA-15	4.00	4.00	4.00	3.00	1.66	2.33
10.	LA-32	6.00	5.66	5.83	4.00	3.33	3.66
11.	LA-17	6.33	7.00	6.66	3.00	3.66	3.33
Mean		5.21	5.84		3.24	3.21	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
Lines		0.44	S	1.26	0.36	NS	--
Seasons		0.18	S	0.54	0.15	NS	--
Interaction		0.62	NS	--	0.52	NS	--
					0.80	S	2.30
					0.34	NS	--
					1.14	NS	--
S - Significant		NS - Non significant					

(Table 6). The line Jaipur Long produced maximum number of nodes with female flower and solitary male flower (8.83), followed by LA-17 (7.33), LA-46, LA-99 and Bijapur Local (7.16), LA-32(7.00), the lines except Jaipur Long being at par with each other. The least number of nodes with female flower and solitary male flower was produced by LA-43 (4.66) followed by LA-15 (4.83). Rest of the lines were intermediate.

4.1.2.13 Percentage of nodes bearing both female flower and male inflorescence on main axis : There were no significant differences for this character either between the lines or for interaction or between the seasons (Table 7). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line Bijapur Local produced maximum percentage of nodes with female flower and male inflorescence on main axis (21.15) followed by Wardha Local (20.18), LA-17 (19.92). Least percentage of nodes with female flower and male inflorescence on main axis was observed in the line LA-43 (16.17) followed by LA-46 (16.39), Jaipur Long (16.82), GKVK (16.95) .

4.1.2.14 Percentage of nodes bearing female flower, male inflorescence and solitary male flower on main axis : There was no significant difference for this character either between the lines or seasons or for interaction (Table 7). The line LA-89 produced maximum

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percentage of nodes with female flower, male inflorescence and solitary male flower on main axis (11.74). The least was observed in the line GKVK (9.55).

In general, more percentage of nodes with female flower, male inflorescence and solitary male flower was observed in summer season (10.98) than in winter (10.26).

4.1.2.15 Percentage of nodes bearing both female flower and solitary male flower on main axis : This character was not significant either between the lines or seasons or for interaction (Table 7). The line Bijapur Local produced maximum percentage of nodes with female flower and solitary male flower on main axis (24.49) and the least was observed in the line LA-43 (18.27).

4.1.2.16 Number of nodes bearing exclusively female flower on main axis : There was no significant difference for the character either between the lines or seasons or for interaction (Table 8). The line Jaipur Long produced maximum number of nodes with exclusive female flower on main axis (4.16). Least number of nodes with exclusive female flower was observed in the line LA-15 (2.33). Rest of lines were intermediate.

Table 7 : Percentage of nodes bearing both females and males on main axis

Sl. No.	Name of the line	Female + Male inflorescence		Female + Male inflorescence + Sol. male		Female + Solitary male				
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled			
1.	LA-46	16.86	15.92	16.39	10.63	10.24	10.43	20.35	22.43	21.39
2.	Jaipur Long	15.80	17.83	16.82	10.25	10.19	10.22	25.11	22.05	23.58
3.	LA-89	18.21	18.87	18.54	13.99	9.50	11.74	26.28	20.90	23.59
4.	GKVK	15.10	18.80	16.95	10.79	11.88	11.33	22.52	17.82	20.17
5.	Wardha Local	19.74	20.62	20.18	9.38	9.72	9.55	25.47	19.58	22.53
6.	LA-99	14.66	19.36	17.01	11.11	8.68	9.89	19.71	22.55	21.13
7.	Bijapur Local	21.53	20.77	21.15	10.59	9.74	10.16	23.32	25.66	24.49
8.	LA-43	13.41	18.93	16.17	8.91	13.99	11.45	18.89	17.65	18.27
9.	LA-15	18.65	17.62	18.13	13.62	7.41	10.52	19.08	23.21	21.15
10.	LA-32	18.71	18.18	18.44	12.55	10.70	11.63	21.65	22.42	22.03
11.	LA-17	19.09	20.76	19.92	8.97	10.85	9.91	17.27	25.79	21.53
	Mean	17.43	18.83		10.98	10.26		21.79	21.82	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	1.45	NS	--	1.25	NS	--	2.33	NS	--
	Seasons	0.61	NS	--	0.53	NS	--	0.99	NS	--
	Interaction	2.05	NS	--	1.78	NS	--	3.30	NS	--
S -	Significant		NS	-		Non significant				

4.1.2.17 Number of nodes bearing exclusively male inflorescence on main axis : Significant difference for this character was observed between the seasons, but there was no significant difference between the lines or for interaction (Table 8). The line LA-17 produced maximum number of nodes with exclusive male inflorescence (4.16), while the least was observed in the line LA-15 (2.16).

In general, more number of nodes with exclusive male inflorescence was observed during winter (3.84) than in summer (2.84). The line LA-99 produced equal number of nodes with exclusive male inflorescence on main axis in both the seasons (3.66).

4.1.2.18 Number of nodes bearing exclusively solitary male flower on main axis : The character was not significant either between the lines or seasons of interaction (Table 8). The lines LA-46, GKVK and LA-99 produced maximum number of nodes bearing exclusively solitary male flower on main axis (2.50) and least was observed in the line LA-89 (1.16).

4.1.2.19 Percentage of nodes bearing exclusively female flower on main axis : There was no significant difference for this character either between the lines or seasons or for interaction (Table 9). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in

Figs.5, 6 and 7 respectively. The lines LA-46 and LA-99 produced maximum percentage of nodes with exclusive female flower on main axis (12.14). Least percentage of nodes with exclusive female flower, was observed in the line GKVK (9.64).

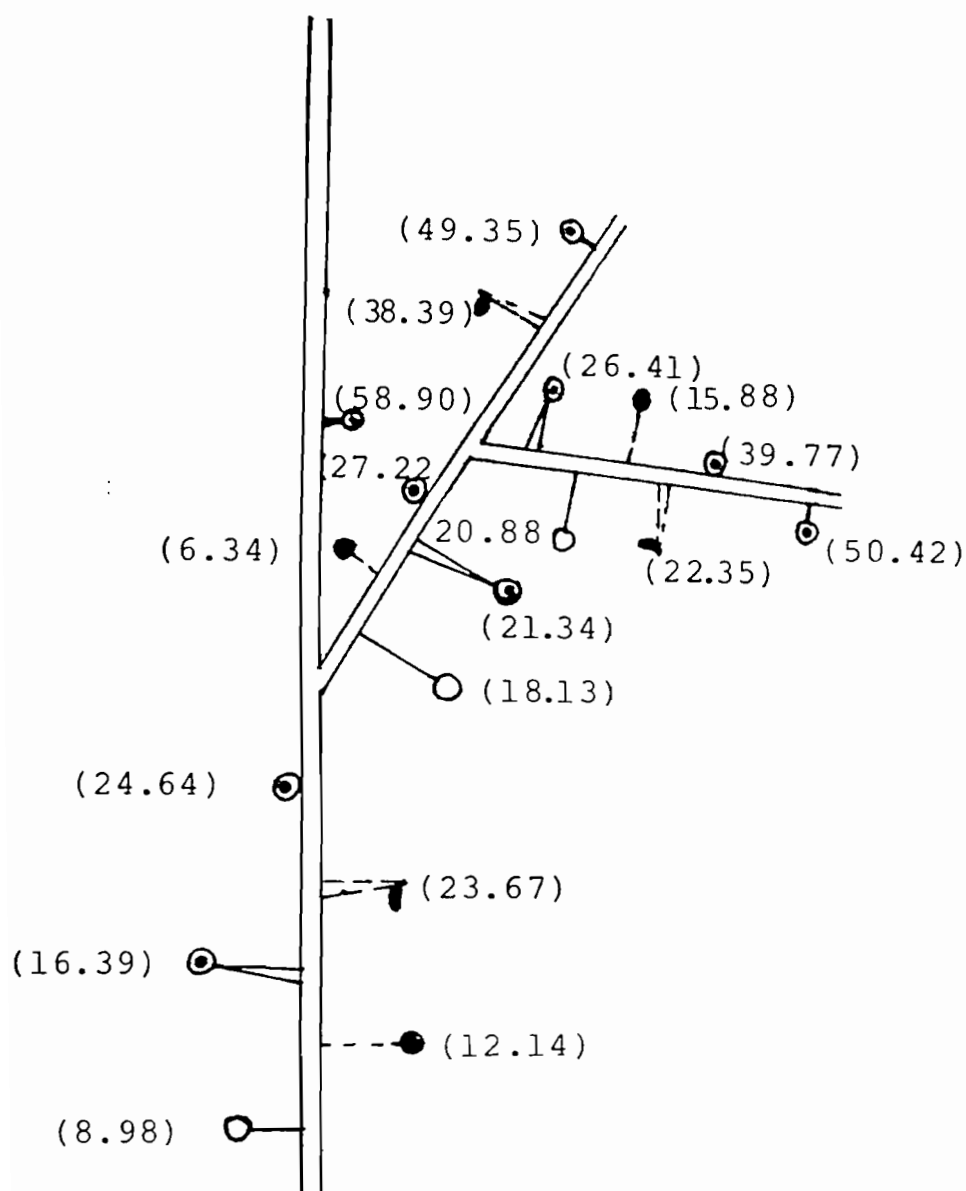
4.1.2.20 Percentage of nodes bearing exclusively male inflorescence on main axis : Significant difference was observed for this character between the seasons, but there was no significant difference either between the lines or for interaction (Table 9). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line Bijapur Local produced maximum percentage of nodes with exclusively male inflorescence on main axis (13.45) and the least was observed in the line LA-46 (8.98).

Significantly more percentage of nodes with exclusive male inflorescence was observed in winter (12.65) than summer (9.53).

4.1.2.21 Percentage of nodes bearing exclusively solitary male flower on main axis : There was no significant difference for this character either between the lines or seasons or for interaction (Table 9). The line GKVK produced maximum percentage of nodes with exclusive solitary male flower on main axis (7.96). Least percentage of nodes with exclusive

Table 8 : Number of nodes bearing exclusive sexes on main axis

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	4.66	3.33	3.00	3.00	2.33	2.66
2.	Jaipur Long	3.33	4.16	3.66	3.50	1.33	2.33
3.	LA-89	2.66	4.66	2.00	3.50	0.66	1.66
4.	GKVK	2.00	4.33	3.66	3.50	3.66	1.33
5.	Wardha Local	2.33	4.66	3.33	3.00	2.66	2.00
6.	LA-99	3.66	3.00	3.66	3.66	2.66	2.33
7.	Bijapur Local	3.66	3.33	2.66	3.83	2.66	2.50
8.	LA-43	2.33	3.33	3.66	3.16	1.66	2.33
9.	LA-15	2.66	2.00	1.33	2.16	1.66	1.33
10.	LA-32	2.66	4.00	2.66	3.33	2.33	1.83
11.	LA-17	4.33	2.33	4.00	4.16	2.33	2.16
	Mean	3.12	3.63	2.84	3.84	2.18	1.93
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	0.60	NS	--	0.57	NS	--
	Seasons	0.25	NS	--	0.24	S	0.70
	Interaction	0.85	NS	--	0.82	NS	--
S - Significant		NS - Non significant					



Diagrammatic representation of flowering habit in the line LA-46

(Relative percentages of flowering are given in brackets)

- ⊙ Male
- Female
- ==○ Female + male
- Exclusive male
- Exclusive female
- Barren nodes

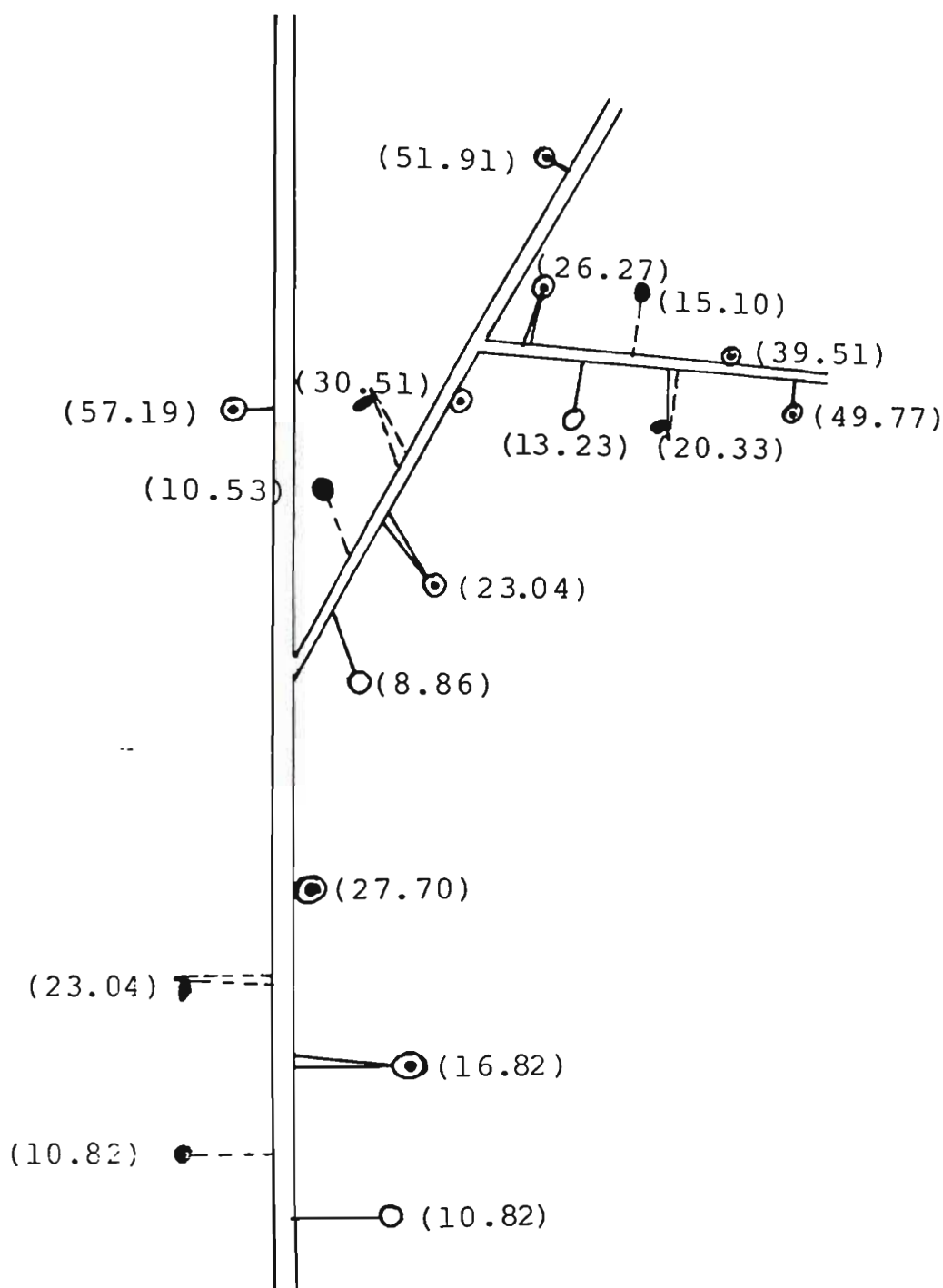


Fig.6 : Diagrammatic representation of flowering habit in the line Jaipur Long

(Relative percentages of flowering are given in brackets)

- Male
- Female
- ⌵ Female + male
- Exclusive male
- Exclusive female

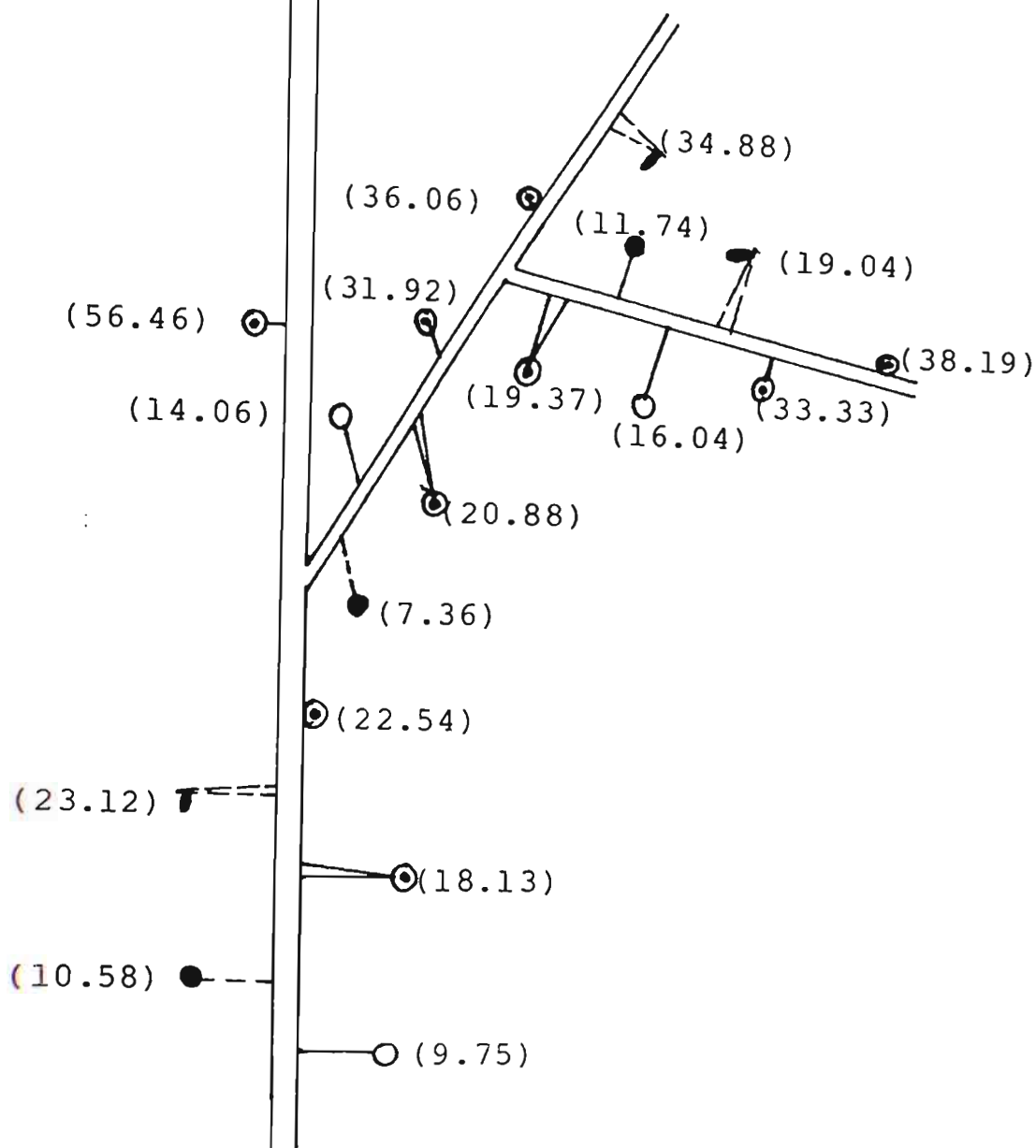


Fig.7 : Diagrammatic representation of flowering habit in the line LA-15

(Relative percentages of flowering are given in brackets)

- ⊙ Male
- Female
- ≡○ Female + male
- Exclusive male
- - -○ Exclusive female
- ≡≡○ Barren node

Table 9 : Percentage of nodes bearing exclusive sexes on main axis

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male				
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled			
1.	LA-46	14.87	9.42	12.14	9.62	8.34	8.98	7.40	7.52	7.46
2.	Jaipur Long	9.15	12.49	10.82	9.22	9.31	9.26	3.55	5.88	4.72
3.	LA-89	9.21	14.85	12.03	6.76	15.92	11.34	2.38	5.26	3.82
4.	GKVK	6.42	12.86	9.64	10.66	10.90	10.78	11.94	3.98	7.96
5.	Wardha Local	7.11	15.34	11.23	8.20	10.83	9.52	8.11	6.46	7.28
6.	LA-99	13.53	10.76	12.14	13.53	13.19	13.36	10.20	8.23	9.21
7.	Bijapur Local	11.89	12.17	12.03	8.64	18.25	13.45	8.33	7.36	7.84
8.	LA-43	10.44	12.37	11.40	11.61	13.04	12.32	7.32	8.35	7.84
9.	LA-15	12.23	8.92	10.58	6.11	13.39	9.75	7.45	5.59	6.52
10.	LA-32	8.02	12.93	10.47	8.49	13.13	10.81	7.38	4.34	5.86
11.	LA-17	13.42	6.90	10.16	12.00	12.91	12.46	6.95	5.94	6.44
	Mean	10.57	11.73		9.53	12.65		7.36	6.26	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	1.99	NS	--	2.01	NS	--	2.50	NS	--
	Seasons	0.85	NS	--	0.85	S	2.45	0.90	NS	--
	Interaction	2.82	NS	--	2.85	NS	--	3.40	NS	--
S -	Significant		NS	-	Non significant					

solitary male flower on main axis was observed in the line LA-89 (3.82) followed by Jaipur Long (4.72).

4.1.2.22 Node number of first female flower appearance on primaries : Significant differences were observed for this character between the lines and seasons and there by interaction (Table 10). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-15 produced first female flower at earliest node (6.90) followed by LA-89 (8.35) which was at par with Wardha Local (8.71). The line LA-32 produced first female flower at farthest node (12.59) followed by LA-43 (11.97) which was par with Jaipur Long and LA-17 (11.25).

In general, in summer season the first female flower was produced on primaries at the earlier node (9.90) compared to winter (10.34).

During summer season, the line LA-15 produced the first female flower at earliest node (6.72) which was at par with LA-89 (7.83) and GKVK (8.23). The line LA-32 produced the first female flower on primaries at farthest node (12.69) which was at par with LA-43 (12.05), Jaipur Long (11.26), LA-17 (11.23). Rest of the lines were intermediate. During winter season, the line LA-15 produced the first female flower at earliest node (7.08) followed by LA-89 (8.86) and Wardha Local

(9.20). The line LA-32 produced the first female flower at farthest node (12.50) which was at par with LA-43 (11.89), LA-17 (11.26) and Jaipur Long (11.23). The rest of the lines were intermediate.

The lines LA-46 and GKVK differed significantly in producing the first female flower on primaries between the seasons.

4.1.2.23 Node number of first male inflorescence appearance on primaries : Significant differences were observed for this character between the lines and interaction but there was no significant difference between the seasons (Table 10). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-15 produced the first male inflorescence at earliest node on primaries (4.00) which was at par with Bijapur Local (4.51). The line LA-17 produced the first male inflorescence at farthest node (7.09) which was followed by LA-32 (6.59). Rest of the lines were intermediate.

The line Jaipur Long differed significantly for this character between the seasons. The lines LA-89, Bijapur Local, LA-15 produced the first male inflorescence at an earlier node during summer season while the rest during winter season.

Table 10 : First flower appearance on primaries - Node number

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male			
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled		
1.	LA-46	8.20	10.63	9.41	5.38	5.57	6.32	7.44	6.88
2.	Jaipur Long	11.26	11.23	11.25	4.50	5.36	6.83	6.62	6.73
3.	LA-89	7.83	8.86	8.35	6.00	5.91	7.70	6.85	7.28
4.	GKVK	9.93	11.33	10.63	5.11	5.15	6.76	6.90	6.83
5.	Wardha Local	8.23	9.20	8.71	5.44	5.56	7.62	7.41	7.52
6.	LA-99	10.26	10.24	10.25	5.00	5.26	7.43	7.32	7.38
7.	Bijapur Local	10.50	9.54	10.02	4.61	4.51	7.66	7.66	7.66
8.	LA-43	12.05	11.89	11.97	5.24	5.48	5.23	6.31	5.77
9.	LA-15	6.72	7.08	6.90	4.08	4.00	4.96	5.63	5.29
10.	LA-32	12.69	12.50	12.59	6.27	6.59	6.56	6.30	6.43
11.	LA-17	11.23	11.26	11.25	6.74	7.09	8.09	8.07	8.08
	Mean	9.90	10.34		5.69	5.30	6.83	6.95	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	F test	C.D. at 5%
	Lines	0.29	S	0.84	0.28	S	0.33	S	0.95
	Seasons	0.12	S	0.36	0.11	NS	0.14	NS	--
	Interaction	0.41	S	1.19	0.39	S	0.47	NS	--
	S - Significant		NS	-	Non significant				

4.1.2.24 Node number of first solitary male . flower appearance on primaries : Significant difference was observed for this character between the lines, but there was no significant difference either between the seasons or for interaction ((Table 10). The line LA-15 produced the first solitary male flower at earliest node (5.29), which was at par with LA-43 (5.77). The line LA-17 produced first solitary male flower at farthest node (8.08) which was at par with Bijapur Local (7.66), Wardha Local (7.52), LA-99 (7.38) and LA-89 (7.28). Rest of the lines were intermediate. The line Bijapur Local produced first solitary male flower at similar node in both the seasons (7.66).

4.1.2.25 Number of nodes producing female flowers on primaries : The character exhibited significant difference among the lines and for interaction, but there were no significant differences between the seasons (Table 11). The line LA-46 produced maximum number of nodes with female flowers on primaries (51.50) followed by Jaipur Long (42.33), GKVK and LA-17 (34.50), the later two were at par with each other. Least number of nodes with female flowers was observed in the line LA-15 (13.50) followed LA-43 (17.66) which was at par with Bijapur Local (18.33). Rest of the lines were intermediate.

The lines LA-46, Jaipur Long LA-89, GKVK, LA-32 and LA-17 differed significantly in producing the number of nodes with female flowers during summer than winter.

4.1.2.26 Number of nodes producing male inflorescence on primaries : There was no significant difference either between the lines or between the seasons or for interaction (Table 11). The line Jaipur Long produced maximum number of nodes with male inflorescence on primaries (24.33). The line LA-15 produced least number of nodes with male inflorescence on primaries (13.99).

4.1.2.27 Number of nodes producing solitary male flowers on primaries : There was no significant difference either between the lines or seasons or interaction (Table 11). The line LA-46 produced maximum number of nodes with solitary male flowers (27.33) followed by Jaipur Long (22.66) and LA-17 (22.16). Least number of nodes with solitary male flowers was observed in the line LA-15 (8.50).

4.1.2.28 Percentage of nodes bearing female flowers on primaries : There was no significant difference for this character either between the lines or seasons but the interaction effect was significant (Table 12). The data for the lines LA-46, Jaipur Long and LA-15 are

Table 11 : Number of nodes bearing different flowers on primaries

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male				
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled			
1.	LA-46	35.66	67.33	51.50	23.66	30.66	22.16	16.33	38.33	27.33
2.	Jaipur Long	54.66	30.00	42.33	25.33	23.33	24.33	32.66	12.66	22.66
3.	LA-89	16.66	36.66	26.66	15.00	19.66	17.33	7.66	21.00	14.33
4.	GKVK	26.00	43.00	34.50	18.33	18.00	18.16	10.00	23.66	16.83
5.	Wardha Local	21.66	27.33	24.50	19.00	16.33	17.66	12.33	8.66	10.50
6.	LA-99	23.66	29.00	26.33	17.66	24.66	21.16	8.33	28.00	18.16
7.	Biapur Local	24.00	12.66	18.33	22.33	21.33	21.83	15.33	7.33	11.33
8.	LA-43	12.33	26.00	17.66	13.00	18.33	15.66	7.00	13.66	10.33
9.	LA-15	31.00	17.00	13.50	11.33	16.66	13.99	6.66	10.33	8.50
10.	LA-32	41.66	14.66	28.16	21.00	11.00	16.00	21.33	9.33	15.33
11.	LA-17	47.33	21.66	34.50	23.66	24.33	23.99	24.33	20.00	22.16
	Mean	30.42	29.30		19.12	20.39		14.72	17.54	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	4.77	S	13.63	2.90	NS	--	2.50	NS	--
	Seasons	2.03	NS	--	1.23	NS	--	0.88	NS	--
	Interaction	6.75	S	19.28	4.10	NS	--	3.38	NS	--
S -	Significant		NS	-	Non significant					

depicted in Figs.5, 6 and 7 respectively. The line Jaipur Long produced maximum percentage of nodes with female flowers on primaries (51.91). Least percentage of nodes with female flowers was observed in the line Bijapur Local (30.93).

The lines LA-32 and LA-17 differed significantly for this character between the seasons.

4.1.2.29 Percentage of nodes producing male inflorescence on primaries : There was no significant difference for this character either between the lines or seasons or for interaction (Table 12). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line Bijapur Local produced maximum percentage of nodes with male inflorescence (36.06). Least percentage of nodes with male inflorescence was observed in the line LA-46 (27.22).

4.1.2.30 Percentage of nodes producing solitary male flowers on primaries : There was no significant difference either between the seasons or lines but the interaction effect was significant (Table 12). The line LA-17 produced maximum percentage of nodes with solitary male flowers on primaries (30.07) followed LA-32 (27.20), Jaipur Long (27.03). The line Bijapur Local produced least percentage of nodes with solitary

Table 12 : Percentage of nodes bearing different flowers on primaries

Sl. No.	Name of the line	Female		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	43.13	55.50	28.85	25.58	20.15	31.31
2.	Jaipur Long	53.84	49.98	24.99	38.82	32.98	21.09
3.	LA-89	36.03	52.55	31.93	30.25	16.36	29.13
4.	GKVK	44.03	58.66	32.06	24.52	15.50	32.50
5.	Wardha Local	38.46	53.92	33.61	34.17	22.27	17.50
6.	LA-99	48.01	34.07	35.63	26.12	17.01	32.53
7.	Bijapur Local	38.12	23.75	35.50	36.61	23.11	12.12
8.	LA-43	33.96	44.26	36.35	35.27	18.97	27.41
9.	LA-15	30.22	33.63	35.55	36.47	20.55	22.39
10.	LA-32	63.44	34.81	31.97	26.10	32.06	22.34
11.	LA-17	60.34	33.68	30.79	34.60	31.73	28.41
	Mean	44.51	43.17	32.47	31.68		
		S.E.	F test	S.E.	F test	S.E.	F test
			C.D. at 5%		C.D. at 5%		C.D. at 5%
Lines							
Seasons							
Interaction							
S - Significant	NS - Non significant						

male flowers on primaries (17.62) followed by Wardha Local (19.88).

The lines Jaipur Long, LA-89, GKVK, LA-99 and LA-17 differed significantly between the seasons for this character.

4.1.2.31 Number of nodes producing both female flower and male inflorescence on primaries : There was significant difference for this character between the lines but no significant difference was observed either between the seasons or for interaction (Table 13). The line LA-46 produced maximum number of nodes with both female flower and male inflorescence on primaries (21.83) followed by Jaipur Long (17.66), LA-17 (16.83), the later two were at par with each other. Least number of nodes with female flower and male inflorescence was observed in the line LA-15 (8.66) followed by LA-43 (10.33) with the rest being intermediate.

4.1.2.32 Number of nodes producing both female flower and solitary male flower on primaries : Significant differences were observed for this character between the lines and seasons and for interaction (Table 13). The line LA-46 produced maximum number of nodes with both female flower and solitary male flower (22.50) followed by Jaipur Long and LA-17 (16.66). The least

number of nodes with both female flower and solitary male flower on main axis was observed in the line LA-43 followed by LA-15 (4.50) which was at par with Wardha Local (6.33).

In general, during winter season more number of nodes with female flower and solitary male flower were produced (13.08) than in summer (9.72).

During summer the line Jaipur Long produced maximum number of nodes with female flower and solitary male flower (26.00) followed by LA-17 (20.00). Least number of nodes with female flower and solitary male flower was observed in LA-15 (2.00) which was at par with LA-43 (2.33) with the rest being intermediate. During winter season LA-46 produced maximum number of nodes with female flower and solitary male flower (32.66) followed by Wardha Local (21.00), GKV (20.33) the later two being at par with each other. Least number of nodes bearing female flower and solitary male flower was observed in the line Bijapur Local (3.33) which was not at par with LA-32 (4.66) with the rest being intermediate.

4.1.2.33 Percentage of nodes producing both female flower and male inflorescence on primaries : There was no significant difference for this character either between the lines or seasons but the interaction effect

Table 13 : Number of nodes bearing both females and males on primaries

Sl. No.	Name of the line	Female + Male inflorescence			Female + Solitary male		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	18.00	25.66	21.83	12.33	32.66	22.50
2.	Jaipur Long	18.33	17.00	17.66	26.00	7.33	16.66
3.	LA-89	9.66	14.00	11.83	2.66	17.00	9.83
4.	GKVK	13.66	14.00	13.83	7.66	20.33	14.00
5.	Wardha Local	14.33	13.00	13.66	6.00	6.66	6.33
6.	LA-99	14.00	15.66	14.83	5.66	21.00	13.33
7.	Bijapur Local	13.33	16.00	14.66	5.33	3.33	4.33
8.	LA-43	8.00	12.66	10.33	2.33	10.66	6.50
9.	LA-15	5.33	12.00	8.66	2.00	7.00	4.50
10.	LA-32	17.66	8.33	13.00	17.00	4.66	10.83
11.	LA-17	17.00	16.66	16.83	20.00	13.33	16.66
	Mean	13.57	15.00		9.72	13.09	
		S.E.	F test	C.D. at 5%	S.E.	F tes	t C.D. at 5%
	Lines	1.79	S	5.11	1.80	S	7.50
	Seasons	0.76	NS	--	0.90	S	3.20
	Interaction	2.53	NS	--	2.70	S	10.70
	S - Significant	NS	-	Non significant			

was significant (Table 14). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line Wardha Local produced maximum percentage of nodes with female flower and male inflorescence on primaries (26.07), and the minimum was observed in the line LA-15 (20.88).

The lines Jaipur Long, GKVK, LA-99, Bijapur Local, LA-15, LA-32 differed significantly for this character between the seasons while the lines LA-46, LA-89, Wardha Local, LA-17 did not differ.

4.1.2.34 Percentage of nodes producing both female flower and solitary male flower on primaries : There was no significant difference for this character either between the lines or seasons but the interaction effect was significant (Table 14). The line LA-17 produced maximum percentage of female flower and solitary male flower producing nodes on primaries (22.36) and the least was observed in the line Bijapur Local (6.71).

The lines LA-46, Jaipur Long, LA-89, GKVK, LA-99, LA-43, LA-15, LA-32 and LA-17 for this character between the seasons.

4.1.2.35 Number of nodes producing exclusively female flower on primaries : Significant differences were observed between the seasons and for interaction but there was no significant difference between the lines

Table 14 : Percentage of nodes bearing both females and males on primaries

Sl. No.	Name of the line	Female + Male inflorescence			Female + Solitary male		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	21.47	21.20	21.34	14.76	26.53	20.64
2.	Jaipur Long	17.81	28.28	23.04	25.57	12.23	18.90
3.	LA-89	20.69	21.44	21.07	5.78	22.86	14.32
4.	GKVK	23.85	19.20	21.52	12.34	28.07	20.21
5.	Wardha Local	25.29	26.86	26.07	11.39	12.86	12.12
6.	LA-99	28.28	15.75	22.02	11.55	24.70	18.12
7.	Bijapur Local	21.88	27.32	24.60	8.28	5.15	6.71
8.	LA-43	22.87	24.73	23.80	5.59	21.74	13.67
9.	LA-15	15.63	26.13	20.88	6.37	14.59	10.48
10.	LA-32	26.76	19.79	23.27	25.47	11.13	18.30
11.	LA-17	21.83	23.63	22.73	26.05	18.68	22.36
	Mean	22.39	23.12		13.92	18.05	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	2.21	NS	--	2.90	NS	--
	Seasons	0.94	NS	--	1.23	NS	--
	Interaction	3.13	S	8.94	4.10	S	11.70
S - Significant		NS - Non significant					

for this character (Table 15). The line Jaipur Long produced maximum number of nodes with exclusive female flowers (8.33) followed by LA-17 (7.66). Least number of nodes with exclusively female flowers on primaries was observed in the line LA-43 (2.50) which was at par with LA-15 (2.83).

More number of nodes with exclusive female flowers in winter (5.72) than in summer (5.27).

During summer the lines Jaipur Long and LA-17 produced maximum number of nodes with exclusive female flowers (10.33) followed by LA-32 (7.00). Least number of nodes with exclusive female flower was produced by LA-43 (2.00) which was an par with LA-15 (2.66). The rest of the lines were intermediate. During winter LA-46 produced maximum number of nodes with exclusive female flowers (9.00) which was at par with GKVK and LA-99 (8.66). Least number of nodes with exclusive female flowers was observed in the lines LA-43 and LA-15 (3.00) followed by LA-32 (4.33).

The lines LA-46, LA-99 and LA-17 differed significantly for this character between the seasons, while the lines Bijapur Local, LA-15, Jaipur Long and LA-89 did not differ between the seasons. During summer season GKVK and Wardha Local produced equal number of nodes with exclusive female flowers (4.66).

4.1.2.36 Number of nodes bearing exclusive male inflorescence on primaries : There was no significant difference for this character either between the lines or seasons or for interaction (Table 15). The line LA-17 produced maximum number of nodes with exclusive male inflorescence (7.33) and the least were observed in line Wardha Local (4.00).

4.1.2.37 Number of nodes bearing exclusive solitary male flower on primaries : There was no significant difference either between the lines or seasons or for interaction (Table 15). The line Bijapur Local produced maximum number of nodes with exclusive solitary male flower (7.16) and the least was observed in the lines GKVK and LA-43 (3.50).

4.1.2.38 Percentage of nodes bearing exclusive female flower on primaries : Significant differences were observed between the lines but there was no significant difference for this character either between the seasons or for interaction (Table 16). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line LA-32 produced maximum percentage of nodes with exclusive female flower on primaries (10.72) which was at par with Jaipur Long (10.53). Least percentage of nodes with exclusive female flowers was observed in the line LA-43 (5.60) followed by Bijapur Local (6.32) which was at

Table 15 : Number of nodes bearing exclusive sexes on primaries

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	4.00	9.00	5.66	5.00	4.00	5.66
2.	Jaipur Long	10.33	6.33	7.00	6.33	6.66	5.33
3.	LA-89	4.33	5.66	5.33	5.66	3.66	4.00
4.	GKVK	4.66	8.66	4.66	4.00	3.66	3.33
5.	Wardha Local	4.66	5.66	4.66	3.33	4.33	2.00
6.	LA-99	3.66	8.66	3.66	9.00	2.00	7.00
7.	Bijapur Local	4.33	3.66	9.00	5.33	10.33	4.00
8.	LA-43	2.00	3.00	5.00	5.66	4.00	3.00
9.	LA-15	2.66	3.00	5.66	4.66	4.66	3.33
10.	LA-32	7.00	4.33	5.00	3.66	4.33	5.33
11.	LA-17	10.33	5.00	6.66	8.00	4.33	6.66
	Mean	5.27	5.72	5.66	5.51	4.72	4.51
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	1.07	S	3.07	1.01	NS	--
	Seasons	0.46	NS	--	0.43	NS	--
	Interaction	1.52	S	4.35	1.43	NS	--
	S - Significant		NS	-	Non significant		

par with LA-46 (6.34). Rest of the lines were intermediate.

4.1.2.39 Percentage of nodes bearing exclusively male inflorescence on primaries : There was no significant difference for this character either among the lines or seasons or for interaction (Table 16). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line LA-15 produced maximum percentage of nodes with exclusive male inflorescence on primaries (14.06) followed by LA-43 (12.01) and the least was observed in the line GKVK (6.76) followed by LA-99 (7.81).

4.1.2.40 Percentage of nodes bearing exclusively solitary male flower on primaries : There was no significant difference for this character either between the lines or seasons or for interaction (Table 16). The line Bijapur Local produced maximum percentage of nodes with exclusive solitary male flower (11.12), while the least was observed in the line LA-46 (5.08).

4.1.2.41 Node number of first female flower appearance on secondaries : Significant difference was observed for this character among the lines but there was no significant difference for this character either between the seasons or for interaction (Table 17). The

data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-43 produced first female flower at the farthest node (10.67), which was at par with Bijapur Local (10.16). First female flower at the earliest node was produced in the LA-15 (6.74) followed by LA-46 (7.21). Rest of the lines were intermediate for this character.

4.1.2.42 Node number of first male inflorescence appearance on secondaries : There were significant differences for this character between the lines, seasons and for interaction (Table 17). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-32 produced first male inflorescence on secondaries at farthest node (7.83) followed by LA-17 (7.62) which was at par with LA-46 (7.39) and Jaipur Long (7.12). The line LA-15 produced first male inflorescence at earliest node (4.28) on secondaries followed by Bijapur Local (5.73).

During winter season the male inflorescence was produced at an earlier node in most of the lines (6.35) than summer (6.70).

During summer the line LA-15 produced the first male inflorescence at earliest node (4.33) followed by Bijapur Local (5.13) which was at par with GKVK (5.67), LA-89 (6.22). The line Jaipur Long

Table 16 : Percentage of nodes bearing exclusive sexes on primaries

Sl. No.	Name of the line	Female		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	4.87	7.81	7.38	4.38	5.38	4.78
2.	Jaipur Long	10.45	10.61	7.18	10.54	7.40	8.86
3.	LA-89	9.55	8.23	11.23	8.80	7.86	6.26
4.	GKVK	7.84	11.38	8.21	5.32	6.33	4.42
5.	Wardha Local	8.14	10.55	8.32	7.30	7.60	4.63
6.	LA-99	7.46	9.45	7.34	10.37	4.04	7.83
7.	Bijapur Local	6.62	6.03	13.61	9.28	15.27	6.97
8.	LA-43	5.49	5.71	13.48	10.54	10.34	5.66
9.	LA-15	8.22	6.50	17.77	10.34	14.18	7.80
10.	LA-32	11.21	10.23	7.41	8.53	6.59	12.68
11.	LA-17	12.45	6.69	8.95	11.60	5.67	9.73
	Mean	8.39	8.47	10.08	8.82	8.24	7.24
		S.E.	F test	S.E.	F test	S.E.	F test
			C.D. at 5%		C.D. at 5%		C.D. at 5%
	Lines	1.90	NS	2.19	NS	1.85	NS
	Seasons	0.80	NS	0.93	NS	0.40	NS
	Interaction	2.70	NS	3.11	NS	2.25	NS
S - Significant		NS - Non significant					

produced the first male inflorescence on secondaries at farthest node (8.06) which was at par with LA-32 (7.89), LA-17 (7.79), LA-46 (7.39), Wardha Local (7.23) and LA-43 (7.09). Rest of the lines were intermediate for the character. During winter season the line LA-15 produced the first male inflorescence at earliest node (4.23) followed by LA-43 (5.72) which was at par with LA-99 (5.78) and Wardha Local (5.85). The line LA-32 produced the first male inflorescence at farthest node (7.77) which was at par with LA-17 (7.46), LA-46 (7.39). Rest of the lines were intermediate for this character.

4.1.2.43 Node number of first solitary male flower appearance on secondaries : Significant difference for this character was observed among the lines but there was no significant difference for the character either between the seasons or for interaction (Table 17). The line LA-15 produced the first solitary male flower at earliest node (5.65) which was at par with LA-43 (5.70). The line LA-17 produced the first solitary male flower on secondaries at farthest node (7.65) which was at par with Wardha Local (7.41), Bijapur Local (7.22). Rest of the lines were intermediate.

4.1.2.44 Number of nodes bearing female flower on secondaries : Significant differences were observed for this character between the lines but there was no

Table 17 : First flower appearance on secondaries - Node number

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	7.53	6.89	7.21	7.39	6.31	7.57
2.	Jaipur Long	8.45	9.15	8.80	6.17	7.12	7.15
3.	LA-89	8.38	8.12	8.25	6.38	6.30	7.54
4.	GKVK	9.94	8.27	9.11	6.80	6.23	6.67
5.	Wardha Local	9.05	7.88	8.46	5.85	6.54	7.45
6.	LA-99	9.86	8.77	9.31	5.78	6.36	7.39
7.	Biwapur Local	9.62	10.70	10.16	6.33	5.73	7.11
8.	LA-43	10.63	10.71	10.67	5.72	6.40	5.29
9.	LA-15	6.08	7.41	6.74	4.23	4.28	5.63
10.	LA-32	9.65	9.06	9.35	7.77	7.83	7.17
11.	LA-17	8.02	8.14	8.08	7.46	7.62	7.55
	Mean	8.84	8.64		6.70	6.35	6.76
							6.94
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	0.37	S	1.07	0.26	S	0.16
	Seasons	0.16	NS	--	0.11	S	0.10
	Interaction	0.53	NS	--	0.37	S	0.26

S - Significant NS - Non significant

significant difference either between the seasons or for interaction (Table 18). The line LA-17 produced maximum number of nodes with female flower on secondaries (23.50) followed by LA-32 and LA-46 (17.33) which were at par with Jaipur Long (16.83) and Wardha Local (16.33).

4.1.2.45 Number of nodes bearing male inflorescence on secondaries : Significant differences were observed for the character between the seasons and lines but the interaction effect was not significant (Table 18). The line LA-17 produced maximum number of nodes with male inflorescence on secondaries (21.00) followed by LA-32 (16.00) which was at par with LA-46 (14.50) and GKVK (14.00). Least number of nodes with male inflorescence on secondaries was observed in the line LA-99 (4.83) which was at par with LA-43 (5.33).

Significantly more number of nodes with male inflorescence on secondaries was observed during winter (13.00) than summer (10.45).

4.1.2.46 Number of nodes bearing solitary male flower on secondaries : Significant difference was observed for this character between the lines but there was no significant difference observed between the seasons and interaction (Table 18). The line LA-17 produced maximum number of nodes with solitary male flowers on

Table 18 : Number of nodes bearing different flowers on secondaries

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	11.33	23.33	17.33	8.00	21.00	14.50
2.	Jaipur Long	19.33	14.33	16.83	15.33	11.66	13.50
3.	LA-89	9.66	7.66	8.66	11.00	8.00	9.50
4.	GKVK	13.66	12.66	13.16	12.33	15.66	14.00
5.	Wardha Local	16.66	16.00	16.33	13.66	14.00	13.83
6.	LA-99	2.00	5.00	3.50	2.66	7.00	4.83
7.	Bijapur Local	12.00	8.66	10.33	6.33	10.00	8.16
8.	LA-43	5.66	6.33	6.00	5.33	5.33	5.33
9.	LA-15	5.66	9.33	7.50	5.66	11.00	8.33
10.	LA-32	15.33	19.33	17.33	12.66	19.33	16.00
11.	LA-17	26.33	20.66	23.50	22.00	20.00	21.00
	Mean	12.51	13.03		10.45	13.00	
					5.63	5.72	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	2.42	S	6.91	2.52	S	7.21
	Seasons	1.03	NS	--	1.07	S	3.07
	Interaction	3.42	NS	--	3.57	NS	--
					1.29	S	3.69
					0.55	NS	--
					1.82	NS	--
	S - Significant		NS	- Non significant			

secondaries (10.33) followed by Jaipur Long and LA-32 (7.50) which was at par with Wardha Local (7.33). Least number of nodes with solitary male flowers was observed in the line LA-99 (1.50) followed by LA-43 (2.83) which was at par with LA-15 (3.66). The rest of the lines were intermediate.

4.1.2.47 Percentage of nodes bearing female flowers on secondaries : Significant difference was observed for this character between the lines but there was no significant difference either between the seasons or for interaction (Table 19). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line LA-17 produced maximum percentage of nodes with female flowers on a secondary (50.64) which was at par with LA-46 (50.42), Jaipur Long (49.77) and Wardha Local (49.41). Least percentage of nodes with female flowers was observed in the line LA-99 (17.56) followed by LA-43 (29.12), LA-15 (33.33). Rest of the lines were intermediate for the character.

4.1.2.48 Percentage of nodes bearing male inflorescence on secondaries : There was no significant difference for this character either between the lines or seasons or for interaction (Table 19). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line GKVK produced maximum

percentage of nodes with male inflorescence (46.66), while the line LA-99 produced minimum percentage of nodes with male inflorescence on secondaries (24.29).

4.1.2.49 Percentage of nodes bearing solitary male flower on secondaries : There was no significant difference for this character either between the lines or seasons or for interaction (Table 19). The line LA-17 produced maximum percentage of nodes with solitary male flower on secondaries (22.67) and the least was observed in the line LA-99 (7.54) followed by LA-43 (13.76), LA-15 (18.12).

4.1.2.50 Number of nodes bearing both female flower and male inflorescence on secondaries : Significant difference was observed for this character among the lines but there was no significant difference either between the seasons or for interaction (Table 20). The line LA-17 produced maximum number of nodes with female flower and male inflorescence on secondaries (13.16) followed LA-32 (9.83) which was at par with LA-46 and Jaipur Long (9.00). Least number of nodes with female flower and male inflorescence was produced by LA-99 (1.83) followed by LA-43 (3.16) which was at par with LA-89 (3.50). Rest of the lines were intermediate.

4.1.2.51 Number of nodes bearing both female flower and solitary male flower on secondaries : There was

Table 19 : Percentage of nodes bearing different flowers on secondaries

Sl. No.	Name of the line	Females		Male inflorescence		Solitary male	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	47.40	53.44	50.42	33.44	46.09	39.77
2.	Jaipur Long	55.37	44.17	49.77	43.07	35.95	39.51
3.	LA-89	39.91	36.42	38.16	41.19	41.93	41.56
4.	GKVK	45.32	42.90	44.11	39.81	53.52	46.66
5.	Wardha Local	52.74	46.09	49.41	42.52	41.13	41.82
6.	LA-99	13.13	21.98	17.56	18.43	30.15	24.29
7.	Bijapur Local	49.60	38.16	43.88	33.06	42.57	37.81
8.	LA-43	27.67	30.57	29.12	26.15	26.57	26.36
9.	LA-15	28.50	38.16	33.33	30.05	46.34	38.19
10.	LA-32	47.57	46.82	47.19	41.15	47.17	44.16
11.	LA-17	53.13	48.15	50.64	44.36	43.45	43.90
	Mean	41.81	40.62		35.75	41.35	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	7.88	S	15.91	8.22	NS	--
	Seasons	3.36	NS	--	3.50	NS	--
	Interaction	11.15	NS	--	11.63	NS	--

S - Significant NS - Non significant

significant difference between the lines for the character but there was no significant difference between the seasons or interaction (Table 20). The line LA-17 produced maximum number of nodes with female flower and solitary male flower (4.33), followed by LA-32 (3.00) which was at par with Jaipur Long (2.83), LA-46 and Wardha Local (2.66). Least number of nodes with female flower and solitary male flower was observed in the line LA-99 (0.66) which was at par with LA-43 (1.16) and LA-15 (1.33).

More number of nodes with female flower and solitary male flower were produced during summer (2.45) than winter (2.03).

4.1.2.52 Percentage of nodes bearing both female flower and male inflorescence on secondaries : Significant difference was observed for this character between the lines but there was no significant difference for the character either between the seasons or for interaction (Table 21). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line LA-17 produced maximum percentage of nodes with female flower and male inflorescence (27.97) followed by LA-32 (26.61) which was at par with Wardha Local (26.54), LA-46 (26.41), GKVK (26.30) and Jaipur Long (26.27). Least percentage of nodes with female flower and male inflorescence was observed in the line

Table 20 : Number of nodes bearing both females and males on secondaries

Sl. No.	Name of the line	Female + Male inflorescence			Female + Solitary male		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	5.66	12.33	9.00	2.00	3.33	2.66
2.	Jaipur Long	11.00	7.00	9.00	3.00	2.66	2.83
3.	LA-89	3.66	3.33	3.50	2.66	1.33	2.00
4.	GKVK	8.00	7.66	7.83	2.66	1.66	2.16
5.	Wardha Local	9.66	8.00	8.83	2.33	3.00	2.66
6.	LA-99	0.66	3.00	1.83	0.66	0.66	0.66
7.	Bijapur Local	4.00	5.33	4.66	3.00	0.66	1.83
8.	LA-43	2.33	4.00	3.16	1.66	0.66	1.16
9.	LA-15	2.00	6.66	4.33	2.00	0.66	1.33
10.	LA-32	9.33	10.33	9.83	2.33	3.66	3.00
11.	LA-17	14.66	11.66	13.16	4.66	4.00	4.33
	Mean	6.45	7.21		2.45	2.03	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	2.12	S	4.29	0.64	S	1.83
	Seasons	0.90	NS	--	0.27	NS	--
	Interaction	3.01	NS	--	0.90	NS	--

S - Significant NS - Non significant

LA-99 (8.34) followed by LA-89 (15.05) which was at par with LA-43 (15.35). Rest of the lines were intermediate.

Higher percentage of nodes were produced with female flower and male inflorescence on secondaries during winter (22.76) than summer (20.66).

4.1.2.53 Percentage of nodes bearing both female flower and solitary male flower on secondaries : Significant difference was observed for this character between the lines but there was no significant difference either between the seasons or for interaction (Table 21). The line LA-17 produced maximum percentage of nodes with female flower and solitary male flower on secondaries (9.72) followed by Jaipur Long (8.39) which was at par with LA-32 (8.38), LA-43 (8.13) and LA-89 (8.08). Least percentage of nodes was observed in the line LA-99 (3.15) followed by LA-43 (5.36) which was at par with Bijapur Local (6.33). Rest of the lines were intermediate.

4.1.2.54 Number of nodes bearing exclusively female flower on secondaries : Significant difference was observed for this character between the lines but there was no significant difference for this character either between the seasons or for interaction (Table 22). The line LA-17 produced maximum number of nodes with

Table 21 : Percentage of nodes bearing both females and males on secondaries

Sl. No.	Name of the line	Female + Male inflorescence			Female + Solitary male		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	24.03	28.79	26.41	8.26	8.00	8.13
2.	Jaipur Long	31.65	20.89	26.27	8.40	8.39	8.39
3.	LA-89	15.51	14.60	15.05	10.48	5.69	8.08
4.	GKVK	25.22	27.39	26.30	9.02	5.08	7.05
5.	Wardha Local	29.86	23.22	26.54	7.55	7.74	7.65
6.	LA-99	3.92	12.77	8.34	3.92	2.38	3.15
7.	Bijapur Local	18.28	22.89	20.59	10.17	2.48	6.33
8.	LA-43	11.56	19.14	15.35	8.05	2.66	5.36
9.	LA-15	10.24	28.51	19.37	10.24	2.63	6.43
10.	LA-32	27.79	25.43	26.61	8.05	8.70	8.38
11.	LA-17	29.20	26.74	27.97	9.57	9.88	9.72
	Mean	20.66	22.76		8.52	5.78	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	3.85	S	11.00	1.94	S	5.56
	Seasons	1.64	NS	--	0.63	NS	--
	Interaction	5.45	NS	--	2.75	NS	--
S - Significant		NS - Non significant					

exclusive female flower on secondaries (7.83) followed by LA-46 and Wardha Local (5.66) which was at par with LA-32 (4.83). Least number of nodes with exclusive female flower was observed in LA-99 (0.83) followed by LA-43 (1.66). Rest of the lines were intermediate.

4.1.2.55 Number of nodes bearing exclusively male inflorescence on secondaries : There was no significant difference for this character either between the lines or seasons or for interaction (Table 22). The line LA-17 produced maximum number of nodes with exclusive male inflorescence on secondaries (7.83) and the least number of nodes by LA-43 (2.16).

4.1.2.56 Number of nodes bearing exclusively solitary male flower on secondaries : Significant difference for this character was observed between the lines but there was no significant difference for the character between the seasons or for interaction (Table 22). The line LA-17 produced maximum number of nodes with exclusive solitary male flower on secondaries (6.00) followed by Jaipur Long (4.66) which was at par with LA-32 (4.50) and LA-46 (4.16). Least number of nodes with exclusive solitary male flower was observed in the line LA-99 (0.83) followed by LA-43 (1.66) which was at par with LA-15 (1.83). Rest of the lines were intermediate. The line Jaipur Long produced equal

Table 22 : Number of nodes bearing exclusive sexes on secondaries

Sl. No.	Name of the line	Female		Male inflorescence		Solitary male				
		Summer	Winter	Pooled	Summer	Winter	Pooled			
1.	LA-46	3.66	7.66	5.66	2.33	8.66	5.50	3.00	5.33	4.16
2.	Jaipur Long	5.33	4.66	5.00	4.33	4.66	4.50	4.66	4.66	4.66
3.	LA-89	3.33	2.33	2.83	7.00	4.66	5.83	3.00	2.33	2.66
4.	GKVK	2.66	3.33	3.00	5.33	8.00	6.66	3.00	3.33	3.16
5.	Wardha Local	6.33	5.00	5.66	6.00	6.00	6.00	3.66	5.66	4.66
6.	LA-99	0.33	1.33	0.83	2.00	4.00	3.00	0.33	1.33	0.83
7.	Bijapur Local	5.00	3.00	4.00	2.33	3.66	3.00	3.33	1.66	2.50
8.	LA-43	1.66	1.66	1.66	3.00	1.33	2.16	1.66	1.66	1.66
9.	LA-15	2.33	2.66	2.50	3.66	3.66	3.66	1.66	2.00	1.83
10.	LA-32	4.33	5.33	4.83	3.33	9.00	6.16	3.66	5.33	4.50
11.	LA-17	10.66	5.00	7.83	7.33	8.33	7.83	7.00	5.00	6.00
	Mean	4.15	3.81		4.24	5.63		3.18	3.48	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	1.01	S	2.89	1.65	NS	--	0.73	S	2.10
	Seasons	0.43	NS	--	0.70	NS	--	0.31	NS	--
	Interaction	1.43	NS	--	2.34	NS	--	1.34	NS	--
	S - Significant		NS	-	Non significant					

number of nodes with exclusive solitary male flower on secondaries in both seasons (4.66).

4.1.2.57 Percentage of nodes bearing exclusive female flower on secondaries : There was no significant difference for this character either between the seasons or for interaction but significant differences were observed between the lines (Table 23). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line Bijapur Local produced maximum percentage of nodes with female flowers on secondaries (18.07) followed by Wardha Local (17.41), LA-17 (16.53). Least percentage of nodes with exclusive female flower were produced in LA-99 (4.39) followed by LA-43 (8.41). Rest of the lines were intermediate.

4.1.2.58 Percentage of nodes bearing exclusive male inflorescence on secondaries : There was no significant difference for this character either between the lines or seasons or for interaction (Table 23). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.5, 6 and 7 respectively. The line LA-89 produced maximum percentage of nodes with exclusive male inflorescence (25.58) and the least was produced by Jaipur Long (13.23).

4.1.2.59 Percentage of nodes bearing exclusive solitary male flower on secondaries : Significant difference

was observed for this character between the lines but there was no significant difference either between the seasons or for interaction (Table 23). The line Wardha Local produced maximum percentage of nodes with exclusive solitary male flower on secondaries (14.28) followed by Jaipur Long (13.95), LA-17 (12.94) which were at par with LA-46 (12.59) and LA-89 (12.58). Least percentage of nodes with exclusive solitary male flower was produced by LA-99 (4.39) followed by LA-15 (7.52) which was at par with LA-43 (8.41). Rest of the lines were intermediate.

4.1.2.60 Node number of first bearing on main axis : Significant difference was observed for this character among the lines but there was no significant difference for the character either between the seasons or for interaction (Table 24). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-15 produced first fruit at earliest node on main axis (8.66) followed by LA-89 (11.50) which was at par with Wardha Local and LA-99 (11.66), Bijapur Local (11.83). The line Jaipur Long produced the first fruit at farthest node (13.83) followed by LA-43 and LA-15 (13.50), LA-17 (13.33) and LA-46 (13.16). Rest of the lines were intermediate.

4.1.2.61 Node number of first bearing on primaries : Significant differences were observed for this

character between the lines, seasons and interaction (Table 24). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-32 produced first fruit on primaries at farthest node (13.62) followed by LA-43 (13.21). The line LA-15 produced first fruit at earliest node (8.66).

First fruit was produced on primaries at an earlier node during summer (10.99) than winter (11.46).

During summer LA-15 produced the first fruit on primaries at earliest node (8.47) which was at par with LA-89 (8.86) and LA-46 (8.95). The line LA-32 produced first fruit at farthest node on primaries (13.71) which was at par with LA-43 (13.19). Rest of the lines were intermediate. During winter also the line LA-15 produced the first fruit at earliest node (8.75) which was at par with LA-89 (9.56). The line LA-32 produced the first fruit on primaries at farthest node (13.54) which was at par with LA-43 (13.23). Rest of the lines were intermediate.

The lines LA-46, GKVK, Wardha Local differed between the seasons while the lines LA-17, LA-32, LA-15 and Jaipur Long did not differed. Rest of the lines were intermediate.

Table 24 : First fruit appearance on different branches - Node number

Sl. No.	Name of the line	Main axis		Primaries		Secondaries				
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled			
1.	LA-46	12.33	14.00	13.16	8.95	11.19	10.07	9.21	8.76	8.98
2.	Jaipur Long	14.33	13.33	13.83	12.41	12.02	12.22	10.70	10.43	10.56
3.	LA-89	10.33	12.66	11.50	8.86	9.56	9.21	10.29	10.07	10.18
4.	GKVK	15.66	14.66	15.16	10.50	12.53	11.51	10.76	10.54	10.65
5.	Wardha Local	11.33	12.00	11.66	9.27	10.56	9.91	10.97	9.49	10.23
6.	LA-99	11.00	12.33	11.66	11.42	11.48	11.45	11.77	11.80	11.78
7.	Bijapur Local	11.66	12.00	11.83	11.67	10.81	11.24	11.43	11.63	11.53
8.	LA-43	13.66	13.33	13.50	13.19	13.23	13.21	12.06	11.39	11.72
9.	LA-15	9.33	8.00	8.66	8.47	8.75	8.61	8.39	8.77	8.58
10.	LA-32	13.66	13.33	13.50	13.71	13.54	13.62	11.96	11.57	11.76
11.	LA-17	13.66	13.00	13.33	12.44	12.45	12.45	11.35	12.14	11.74
	Mean	12.45	12.60		10.99	11.46		10.81	10.60	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	0.55	S	1.57	0.30	S	0.88	0.34	S	0.69
	Seasons	0.28	NS	--	0.13	S	0.37	0.14	NS	--
	Interaction	0.78	NS	--	0.43	S	1.24	0.48	NS	--
S -	Significant		NS	-	Non significant					

4.1.2.62 Node number of first bearing on secondaries :

Significant difference for this character was observed between the lines but there was no significant difference either between the seasons or for interaction (Table 24). The data for the lines LA-46, Jaipur Long and LA-15 are depicted in Figs.2, 3 and 4 respectively. The line LA-99 produced the first fruit at farthest node (11.78) which was at par with LA-32 (11.76), LA-17 (11.74) and LA-43 (11.72). The line LA-15 produced the first fruit on secondary at earliest node (8.58) which was at par with LA-46 (8.98). Rest of the lines were intermediate.

4.1.2.63 Number of nodes bearing fruits on main axis :

There was significant difference for this character between the lines but no significant differences were observed either between the seasons or for interaction (Table 25). The line LA-89 produced maximum number of fruits on main axis (13.66) which was at par with LA-46 (13.50), Jaipur Long (12.83), LA-17 (12.66) and Bijapur Local (12.16). Least number of nodes with fruits on main axis was produced by LA-43 (6.66) followed by LA-15 (8.66). Rest of the lines were intermediate.

4.1.2.64 Number of nodes bearing fruits on primaries :

Significant differences were observed for this character between the lines, seasons and for inter-

action (Table 25). The line LA-46 produced maximum number of fruits on primaries (40.49) followed by Bijapur Local (25.66) which was at par with LA-17 (24.83). The lines LA-43 and LA-15 produced least number of fruits on primaries (12.66).

Significantly higher number of nodes with fruits were produced during winter (22.60) than in summer (17.09).

During summer season LA-17 produced maximum number of nodes with fruits on primaries (27.33) followed by LA-46 (25.66) and Jaipur Long (22.00). Least number of nodes with fruits was produced by LA-15 (7.33) followed by LA-43 (10.00). Rest of the lines were intermediate. During winter season the line LA-46 produced maximum number of nodes with fruits on primaries (46.33) followed by GKVK (31.00). Least number of nodes with fruits was produced by LA-32 (8.00) followed by LA-43 (14.33).

The lines GKVK, LA-99 and LA-46 differed for this character between the seasons while the lines Wardha Local, Bijapur Local, LA-43, LA-15 and LA-17 did not differ. The line Bijapur Local produced equal number of nodes with fruits on primary in both seasons (18.66).

4.1.2.65 Number of nodes bearing fruits on secondaries : There was significant difference for this character between the lines but no significant difference was observed between the seasons and interaction (Table 25). The line LA-46 and produced maximum number of nodes with fruits on secondaries (8.50) which was at par with LA-17 and Wardha Local (8.16). Least number of nodes with fruits were produced by LA-99 (1.33) followed by LA-43 (2.83). The line GKVK produced equal number of nodes with fruits on secondaries in both the seasons (7.00).

4.1.2.66 Percentage of nodes bearing fruits on main axis : Significant difference was observed for this character between the lines but there was no significant difference either between the season or interaction (Table 26). The data is depicted in Fig. 8. The line LA-89 produced maximum percentage of nodes with fruits on main axis (44.80) followed by Bijapur Local (41.31), LA-99 (37.23). Least percentage of nodes with fruits on main axis was produced by LA-43 (25.80) followed by Wardha Local (33.29) which was at par with Jaipur Long (34.39). The rest were intermediate.

4.1.2.67 Percentage of nodes bearing fruits on primaries : This character exhibited significant difference between the seasons while there was no

significant difference either between the lines or for interaction (Table 26). The data is depicted in Fig.8. The line LA-99 produced maximum percentage of nodes with fruits on primaries (35.85) and the least was observed in LA-32 (24.12).

During winter season more percentage of nodes were produced with fruits on primaries (38.13) than summer (33.48).

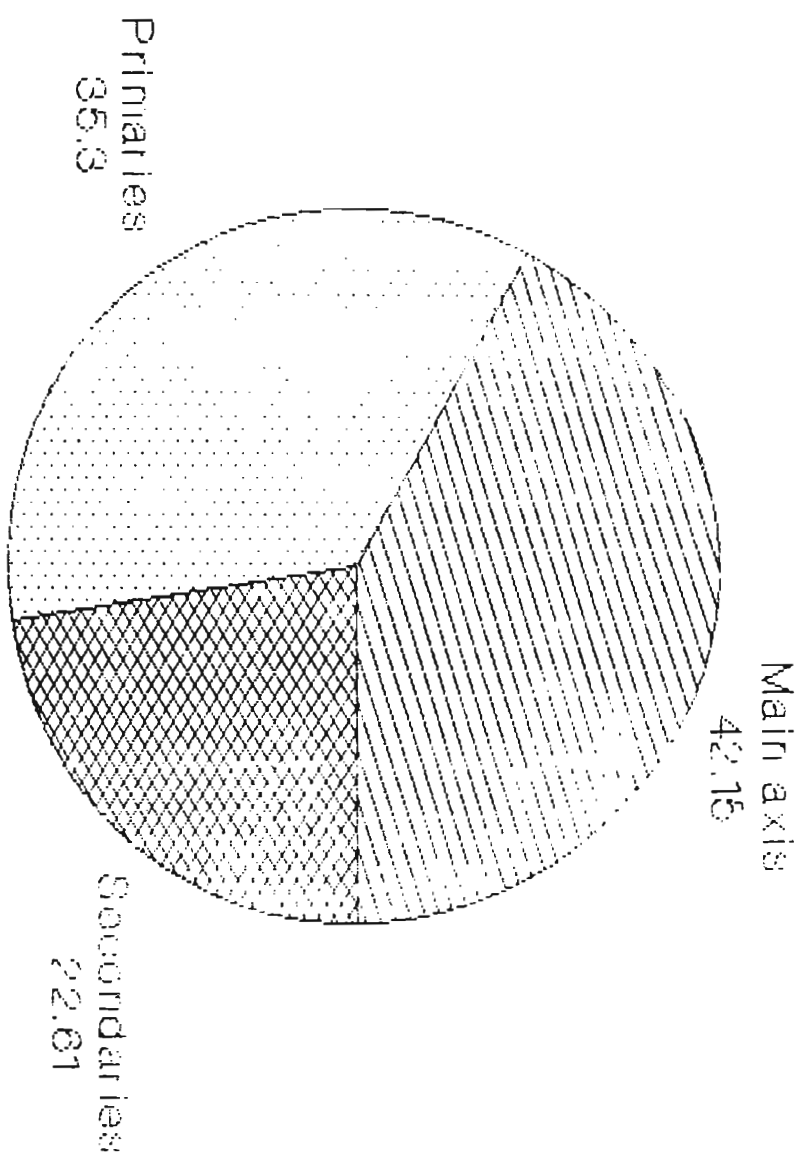
4.1.2.68 Percentage of nodes bearing fruits on secondaries : Significant differences were observed for this character among the lines but there was no significant difference either between the seasons or for interaction (Table 26). The data is depicted in Fig.8. The line LA-46 produced maximum percentage of nodes with fruits on secondaries (25.22) which was at par with Wardha Local (24.76). Least percentage of nodes with fruits was produced by LA-99 (6.94) followed by Jaipur Long (9.19). Rest of the lines were intermediate.

4.1.2.69 Number of fruits per plant : Significant differences were observed for this character between the lines, seasons and interaction (Table 27). The line LA-46 produced maximum number of fruits per plant (59.66) followed by LA-17 (45.16). Least number of fruits were produced in the line LA-43 (23.30).

Table 26 : Percentage of nodes bearing fruits on different branches

Sl. No.	Name of the line	Main axis		Primaries		Secondaries	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	42.36	38.21	40.28	30.38	38.85	34.61
2.	Jaipur Long	38.29	30.49	34.39	22.31	29.48	25.89
3.	LA-89	45.40	44.20	44.80	26.27	33.92	30.10
4.	GKVK	35.54	37.70	36.62	23.90	41.01	32.45
5.	Wardha Local	36.02	30.55	33.29	26.90	35.24	31.07
6.	LA-99	37.37	37.09	37.23	35.67	36.04	35.85
7.	Biwapur Local	42.32	40.29	41.31	30.29	31.26	30.77
8.	LA-43	21.65	29.95	25.80	26.05	27.35	26.70
9.	LA-15	39.25	38.42	38.80	22.00	37.77	29.88
10.	LA-32	33.22	38.58	35.90	29.60	18.64	24.12
11.	LA-17	38.33	37.68	38.01	34.49	29.42	31.96
	Mean	42.75	42.25		33.48	38.13	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	2.48	S	7.08	4.97	NS	--
	Seasons	1.05	NS	--	2.12	S	4.28
	Interaction	3.50	NS	--	7.04	NS	--
S - Significant			NS	-	Non significant		

Fig.8 : Percentage contribution of different branches towards yield per annum



Significantly higher number of fruits were produced during winter season (41.42) than summer (34.54).

During summer LA-17 produced maximum number of fruits per vine (49.33) which was at par with LA-46 (48.00). Least number of fruits per vine were produced by LA-43 (17.33) followed by LA-15 (22.66). The rest of the lines were intermediate. During winter LA-46 produced maximum number of fruits per plant (71.33) followed by GKVK (50.66). Least number of fruits per plant was produced by LA-43 (29.33) followed by Jaipur Long and Bijapur Local (34.00) which was at par with LA-32 (34.66) and Wardha Local (35.66). The rest of the lines were intermediate. The lines LA-46, GKVK, LA-99 and LA-15 differed for this character between the seasons.

4.1.2.70 Yield per plant : Significant differences were observed for this character between the seasons and lines but the interaction effect was not significant (Table 27). The line LA-46 produced maximum yield per plant (13.12) followed by LA-17 (11.08) which was at par with LA-99 (11.03). Least yield per plant was produced by LA-15 (8.47).

During winter season more yield per plant was observed (11.31) than in summer (8.94).

Table 27 : Yield per plant

Sl. No.	Name of the line	Fruit Nos.			Kg.		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	48.00	71.33	59.66	10.56	15.69	13.12
2.	Jaipur Long	40.66	34.00	37.33	8.94	10.84	9.89
3.	LA-89	30.33	40.33	35.33	9.70	9.97	9.83
4.	GKVK	27.66	50.66	39.16	7.68	11.14	9.41
5.	Wardha Local	37.00	35.66	36.33	9.10	12.95	11.03
6.	LA-99	28.66	45.66	37.16	9.17	11.72	10.45
7.	Bijapur Local	41.00	34.00	37.50	9.02	9.41	9.21
8.	LA-43	17.33	29.33	23.33	6.90	10.64	8.77
9.	LA-15	22.66	39.00	30.83	7.34	9.61	8.47
10.	LA-32	37.33	34.66	36.00	9.11	11.09	10.10
11.	LA-17	49.33	41.00	45.16	10.85	11.32	11.08
	Mean	34.54	41.42		8.94	11.31	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	3.29	S	9.41	2.52	S	7.21
	Seasons	1.40	S	4.01	1.07	S	3.07
	Interaction	4.66	S	13.31	3.57	NS	--
S - Significant		NS	Non significant				

4.1.2.71 Number of barren nodes on main axis : Significant differences were observed for this character between the lines and for interaction but there was no significant difference between the season (Table 28). The line Jaipur Long produced maximum number of barren nodes on main axis (8.67) followed by LA-46 (8.00) which was at par with GKVK and LA-32 (7.50), LA-32 (7.16) and Wardha Local (7.00). The line LA-15 produced least number of barren nodes on main axis (5.16) which was at par with LA-99 (6.33). Rest of the lines were intermediate.

The lines LA-46 differed significantly for this character between the seasons with more number of barren nodes produced during winter. The lines Jaipur Long and LA-15 produced equal number of barren nodes in both seasons (8.66 and 6.33).

4.1.2.72 Number of barren nodes on primaries : Significant difference was observed for this character between the lines but there was no significant difference either between the seasons or for interaction (Table 28). The lines Bijapur Local produced maximum number of barren nodes on primaries (36.06) which was at par with LA-15 (36.01) and LA-43 (35.81). Least number of barren nodes on primaries was produced by LA-46 (27.27) which was at par with GKVK (28.29), LA-32 (29.04). Rest of the lines were intermediate.

Table 28 : Number of barren nodes on different branches

Sl. No.	Name of the line	Main axis		Primaries		Secondaries	
		-----		-----		-----	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	6.33	9.66	34.66	41.33	6.33	7.66
2.	Jaipur Long	8.66	8.66	32.00	17.66	6.66	6.33
3.	LA-89	6.33	7.00	19.00	21.66	6.33	6.00
4.	GKVK	6.66	8.33	22.00	22.66	6.00	6.67
5.	Wardha Local	7.66	6.33	24.66	18.66	7.00	6.00
6.	LA-99	6.33	6.33	19.66	26.66	4.67	4.00
7.	Bijapur Local	6.33	6.00	21.66	30.00	5.33	6.33
8.	LA-43	4.66	6.00	14.66	15.66	3.33	3.66
9.	LA-15	5.00	5.33	11.33	15.33	2.66	4.33
10.	LA-32	7.66	6.66	22.00	15.66	7.33	7.00
11.	LA-17	8.00	7.00	23.00	13.00	7.00	7.00
Mean		6.69	7.03	22.24	21.66	5.69	5.90
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
Lines		0.18	NS	--	1.25	S	8.41
Seasons		0.60	NS	--	2.94	NS	--
Interaction		0.78	NS	--	4.16	NS	--
S - Significant		NS - Non significant					

4.1.2.73 Number of barren nodes on secondaries :

Significant difference for this character was observed between the lines but no difference was observed either between the seasons or for interaction (Table 28). The lines LA-46 and LA-17 produced maximum number of barren nodes on secondaries (7.00) which were at par with Jaipur Long and Wardha Local (6.50), GKVK (6.33) and LA-89 (6.16). Least number of barren nodes on secondaries were produced in LA-43 and LA-15 (3.50) which at par with LA-99 (4.33).

4.1.2.74 Percentage of barren nodes on main axis :

There were no significant differences for this character either between the lines or seasons or for interaction (Table 29). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.5, 6 and 7 respectively. The line GKVK produced maximum percentage of nodes on main axis (24.15) and the least percentage was observed in the line LA-43 (21.07).

4.1.2.75 Percentage of barren nodes on primaries :

There was no significant difference for this character either between the lines or seasons or for interaction (Table 29). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.5, 6 and 7 respectively. The line Bijapur Local produced maximum percentage of barren nodes on primaries (44.18) followed by Wardha Local (40.62), and LA-43 (38.53). Least percentage of

Table 29 : Percentage of barren nodes on different branches

Sl. No.	Name of the line	Main axis		Primaries		Secondaries				
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled			
1.	LA-46	20.22	27.12	23.67	41.50	35.29	38.39	26.85	17.85	22.35
2.	Jaipur Long	24.05	22.04	23.04	31.57	29.46	30.51	19.03	21.63	20.33
3.	LA-89	21.72	22.10	21.91	42.15	32.37	37.26	27.62	35.27	31.45
4.	GKVK	21.51	26.80	24.15	39.41	31.51	35.50	24.84	24.14	24.49
5.	Wardha Local	23.72	20.74	22.18	44.33	36.92	40.62	23.39	19.23	21.31
6.	LA-99	23.44	22.88	23.16	39.97	31.86	35.92	37.06	20.47	28.76
7.	Bijapur Local	20.20	21.95	21.07	34.31	54.06	44.18	29.18	29.38	29.28
8.	LA-43	20.91	21.42	21.16	45.48	31.59	38.53	16.35	19.90	18.12
9.	LA-15	22.72	23.52	23.12	35.14	34.63	34.88	14.68	23.39	19.04
10.	LA-32	23.96	21.17	22.56	34.04	37.62	35.83	25.58	18.73	22.16
11.	LA-17	24.24	22.32	23.28	29.71	21.05	25.38	14.74	18.16	16.45
	Mean	22.42	22.90		27.96	34.22		23.57	22.56	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	5.30	NS	--	4.53	NS	--	5.44	NS	--
	Seasons	2.20	NS	--	1.93	NS	--	2.32	NS	--
	Interaction	7.50	NS	--	6.41	NS	--	7.10	NS	--
S -	Significant		NS	-	Non significant					

barren nodes were produced by LA-17 (25.38) followed by Jaipur Long (30.51). Rest of the lines were intermediate.

4.1.2.76 Percentage of barren nodes on secondaries :

There was no significant difference for the character either between the lines or seasons or for interaction (Table 29). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.5, 6 and 7 respectively. The line LA-89 produced maximum percentage of barren nodes on secondaries (31.45) followed by Bijapur Local (29.28) which was at par with LA-99 (28.76). Least percentage of barren nodes were produced by LA-17 (16.45), followed by LA-43 (18.12) which was at par with LA-15 (19.00).

4.1.3 Character association among yield and yield attributes

The correlation coefficient(r) between various yield components and yield are furnished in Table 30 and depicted in Fig. 9.

Length of main axis exhibited highly significant positive correlation with number of nodes on main axis (0.929**), number of nodes bearing female flowers on main axis (0.773**), number of nodes bearing male flowers on main axis (0.727**).

Number of nodes on main axis had highly positive correlation with number of nodes bearing female flowers on main axis (0.840**) and number of nodes bearing male flowers on main axis (0.769**).

Number of nodes on primaries exhibited higher positive association with number of nodes bearing female flowers on primaries (0.960**) and number of nodes bearing male flowers on primaries (0.978**) and number of fruits per plant (0.813**).

Number of nodes on secondaries had positive association with number of nodes bearing female flowers on secondaries (0.803**) and number of nodes bearing male on secondaries (0.937**).

Number of nodes bearing female flowers on main axis exhibited significant positive correlation with number of nodes bearing male flowers on main axis (0.700*).

Number of nodes bearing female flowers on primaries had high positive correlation with number of nodes bearing male flowers on main primaries (0.828**).

Number of nodes bearing female flowers on secondaries had high positive correlation with number of nodes bearing male flowers on secondaries (0.943**).

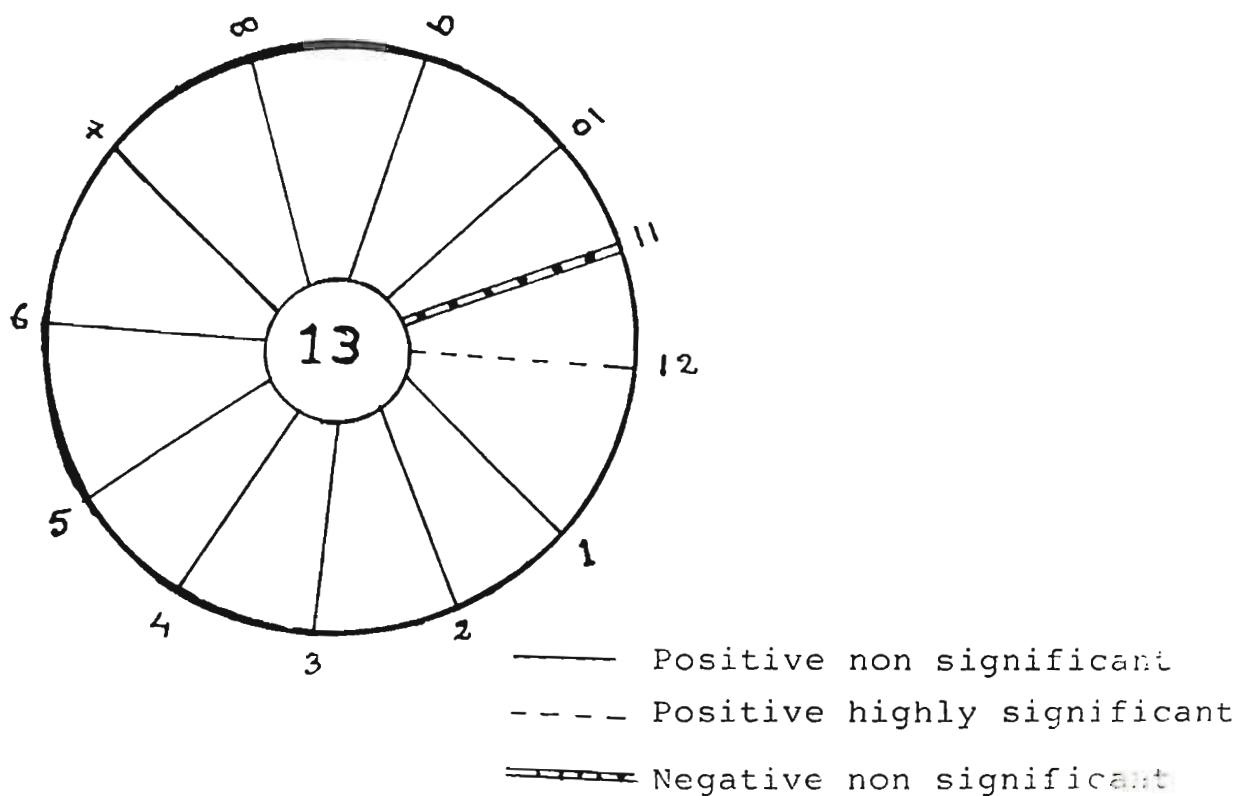


Fig.9 : Diagram showing association of various characters with fruit yield in ridge gourd

- | | |
|---|--|
| 1. Length of main axis | 8. Number of nodes bearing males on main axis |
| 2. Number of nodes on main axis | 9. Number of nodes bearing males on primaries |
| 3. Number of nodes on primaries | 10. Number of nodes bearing males on secondaries |
| 4. Number of nodes on secondaries | 11. Average fruit weight |
| 5. Number of nodes bearing females on main axis | 12. Number of fruits per plant |
| 6. Number of nodes bearing females on primaries | 13. Yield per plant |
| 7. Number of nodes bearing females on secondaries | |

Number of nodes bearing male flowers on primaries had highly positive correlation with number of fruits per plant (0.752**).

Average fruit weight exhibited high negative correlation with number of fruits per plant (-0.694**).

Number of fruits per plant exhibited significant positive correlation with yield per plant (0.736**).

Yield per plant by weight had high positive association with number of fruits per plant (0.736**). Other characters like length of main axis, nodes on main axis, primaries, secondaries, number of nodes bearing female flowers on main axis, primaries, secondaries, number of nodes bearing male flowers on main axis, primaries and secondaries were associated positively but not significantly. Similarly this character had negative association with average fruit weight but it was not significant.

4.1.4 Direct and indirect effect of yield contributing characters towards yield

The correlation between yield per plant and its component characters were partitioned into corresponding direct and indirect effects through path coefficient analysis and the values with total yield

are furnished in the Table 31. The direct effects of yield attributes on yield and their mutual association as measured by correlation coefficients are presented diagrammatically in Fig.10.

4.1.4.1 Length of main axis : The direct effect of this character on yield per plant was positive (0.110). The indirect effect of this character on yield per plant was positive (0.472).

4.1.4.2 Number of nodes on primaries : The character had positive direct effect on yield per plant (0.469). There was positive indirect effects on yield per plant through length of main axis length (0.224), Number of nodes on main axis (0.225), primaries secondaries (0.179), number of nodes bearing female flowers on main axis (0.195), primaries (0.151), secondaries (0.451), number of nodes bearing male flowers on main axis (0.177), primaries (0.168), secondaries (0.459), number of fruits per plant (0.246), yield per plant (0.421). The character had negative indirect effect on total yield per plant weight through average fruit weight (-0.159).

4.1.4.3 Number of nodes on Secondaries : Yield per plant by numbers (-0.162). The character exhibited positive indirect effect on yield per plant (0.554).

4.1.4.4 Number of nodes bearing female flowers on main axis : The character had high positive indirect effect on yield per plant (0.425).

4.1.4.5 Number of nodes bearing female flowers on secondaries : The character exhibited negative direct effect on yield per plant (-0.184). Secondaries (-0.174), number of fruits per plant (-0.100). There was positive indirect effect this character on yield per plant (0.386).

4.1.4.6 Number of nodes bearing male flowers on secondaries : The character had negative direct effect on yield per plant (-0.344). The character exhibited negative indirect effects on yield per plant through length of main axis (-0.153), number of nodes on main axis (-0.150), primaries (-0.337), secondaries (-0.120), number of nodes bearing female flowers on main axis (-0.137), secondaries (-0.325), number of nodes bearing male flowers on main axis (-0.126), primaries (-0.110), number of fruits per plant (-0.174). The character had positive indirect effect on yield per plant through average fruit weight (0.104).

4.1.4.7 Average fruit weight : The character had high direct effect on yield per plant (0.827). There was negative indirect effects on yield per plant through

Table 31 : Direct and indirect effects of yield contributing characters towards yield in ridge gourd

Character	Length of main axis	Number of nodes on main axis	Number of nodes on primaries	Number of nodes on secondaries	Number of nodes bearing females on main axis	Number of nodes bearing females on primaries	Number of nodes bearing females on secondaries	Number of nodes bearing males on main axis	Number of nodes bearing males on primaries	Number of nodes bearing males on secondaries	Average Fruit Weight	Number of fruits per plant	Yield/Plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(13)
1.	(0.110)	0.102	0.052	0.056	0.08	0.066	0.054	0.080	0.054	0.049	-0.031	0.052	0.472
2.	0.012	(0.013)	0.006	0.007	0.011	0.007	0.006	0.010	0.006	0.005	-0.004	0.006	0.430
3.	0.224	0.225	(0.469)	0.179	0.195	0.151	0.451	0.177	0.168	0.459	-0.159	0.246	0.421
4.	-0.083	-0.086	(-0.162)	-0.071	-0.071	-0.130	-0.066	-0.060	-0.152	-0.056	0.094	-0.132	0.554
5.	-0.0004	-0.0004	-0.0002	-0.0002	(-0.0005)	-0.0002	-0.0002	-0.0004	-0.0002	-0.0002	-0.0002	-0.0002	0.425
6.	-0.024	-0.022	-0.013	-0.033	-0.016	(-0.04)	-0.014	-0.014	-0.034	-0.011	0.017	-0.026	0.464
7	-0.091	-0.092	-0.177	-0.075	-0.076	-0.064	(-0.184)	-0.069	-0.068	-0.174	0.072	-0.100	0.386
8.	0.0355	0.037	0.018	0.018	0.034	0.016	0.018	(0.048)	0.017	0.017	-0.014	0.015	0.266
9.	0.011	0.011	0.0083	0.021	0.008	0.019	0.0087	0.0082	(0.023)	0.0074	-0.012	0.017	0.523
10.	-0.153	-0.150	-0.337	-0.120	-0.137	-0.097	-0.325	-0.126	-0.110	(-0.344)	0.104	-0.174	0.410
11.	-0.237	-0.292	-0.280	-0.480	-0.270	-0.347	-0.324	-0.241	-0.438	-0.251	(0.827)	-0.574	0.081
12.	0.669	0.684	0.736	1.143	0.663	0.884	0.73	0.448	1.057	0.709	-0.975	(1.40)	0.736
R ²	0.052	0.0056	0.1981	-0.0900	-0.0002	-0.0182	-0.0713	0.0127	0.0122	-0.1417	-0.067	1.050	
R Square = 0.9263 Residual effect = 0.2714													

1. Length of main axis
2. Number of nodes on main axis
3. Number of nodes on primaries
4. Number of nodes on secondaries
5. Number of nodes bearing females on main axis
6. Number of nodes bearing females on primaries
7. Number of nodes bearing females on secondaries
8. Number of nodes bearing males on main axis
9. Number of nodes bearing males on primaries
10. Number of nodes bearing males on secondaries
11. Average fruit weight
12. Number of fruits per plant
13. Yield per plant

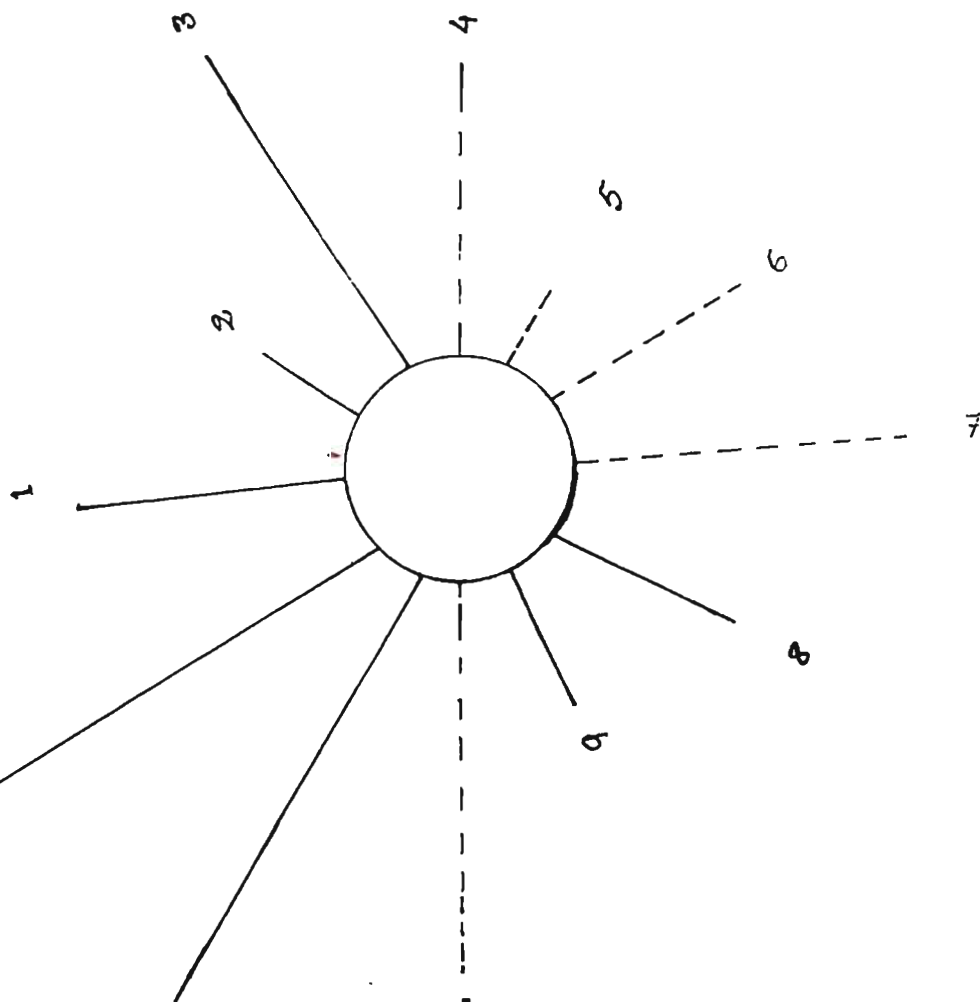


Fig.10 : Metroglyph showing the magnitude of direct effects of various characters on yield in ridge gourd

length of main axis (-0.237), number of nodes on main axis (-0.292), primaries (-0.280), secondaries (-0.480), number of nodes bearing female flowers on main axis (-0.270), primaries (-0.347), secondaries (-0.324), number of nodes bearing male flowers on main axis (-0.241), primaries (-0.438), secondaries (-0.251), number of fruits per plant (-0.574).

4.1.4.9 Number of fruits per plant : There was high positive direct effect on yield per plant (1.40). The character exhibited positive direct effects on yield per plant through length of main axis (0.69), number of nodes on main axis (0.684), primaries (0.736), secondaries (1.143), number of nodes bearing female flowers on main axis (0.663), primaries (0.884), secondaries (0.730), number of nodes bearing male flowers on main axis (0.448), primaries (1.05), secondaries (0.709). There was negative indirect effect of this character on yield per plant through average fruit weight (-0.975).

4.2 STUDIES ON TEMPORAL DIOECISM

4.2.1 Growth pattern

4.2.1.1 Node number of first branching on main axis : The character exhibited significant difference between the seasons, lines and interaction (Table 32). The

data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.2, 3 and 4 respectively. The line LA-46 produced first primary at farthest node on main axis (10.16) followed by LA-17 (9.00) which at par with GKVK (8.50) the lines LA-43 and LA-15 produced first primary at earliest node on main axis (7.00). The branches were produced at an earlier node during summer (7.90) than winter (8.66).

During summer LA-43 produced first branch on main axis at earliest node (6.33) which was at par with LA-46 (6.66), LA-15 (7.00), LA-89, GKVK and Bijapur Local (7.66). The line Jaipur Long produced first branch on main axis at farthest node (10.00) which was at par with LA-17 (9.33), Wardha Local and LA-32 (8.66). The rest of the lines were intermediate. During winter the line LA-46 produced first branch at farthest node (10.66) which was at par with Jaipur Long (10.33), GKVK (9.33) and LA-89 (9.00). The line LA-15 produced first branch at earliest node (7.00) which was at par with Wardha Local and LA-43 (7.66). Rest of the lines were intermediate.

The lines LA-46, LA-89, GKVK differed between seasons. The lines LA-15 and LA-32 produced first branch on main axis at similar node in both seasons (7.00 and 8.66).

Table 32 : First branch appearance on main axis and primaries - Node number

Sl. No.	Name of the line	Main axis			Primaries		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	6.66	10.66	8.66	5.33	6.66	6.00
2.	Jaipur Long	10.00	10.33	10.16	6.33	6.66	6.50
3.	LA-89	7.66	9.00	8.33	6.33	7.33	6.83
4.	GKVK	7.66	9.33	8.50	6.00	7.33	6.66
5.	Wardha Local	8.66	7.66	8.16	5.33	6.66	6.00
6.	LA-99	7.66	8.33	8.00	5.66	8.00	6.83
7.	Bijapur Local	7.33	8.00	7.66	6.00	9.33	7.66
8.	LA-43	6.33	7.66	7.00	6.33	7.00	6.66
9.	LA-15	7.00	7.00	7.00	5.00	6.66	5.83
10.	LA-32	8.66	8.66	8.66	5.66	6.33	6.00
11.	LA-17	9.33	8.66	9.00	7.33	7.33	7.33
	Mean	7.90	8.66		5.93	7.21	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	0.45	S	1.31	0.45	NS	--
	Seasons	0.19	S	0.55	0.19	S	0.55
	Interaction	0.65	S	1.85	0.63	NS	--
S - Significant		NS - Non significant					

4.2.1.2 Node number of first branching on primaries : Significant difference was observed for this character between the seasons but there was no significant difference between the lines and interaction (Table 32). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.2, 3 and 4 respectively. The line Bijapur Local produced first secondary at farthest node on primary (7.66), while the line LA-15 produced first secondary at earliest node (5.83).

The first branch on primaries was produced at an earliest node during summer (5.93) than winter (7.21)

4.2.1.3 Interval of primary production on main axis (Each node) : Significant differences were observed for this character between the seasons and lines but the interaction effect was not significant (Table 33). The line LA-46 produced maximum number of primaries at each node interval on main axis (3.16) followed LA-89 (2.00). The lines GKVK, Wardha Local, LA-43 and LA-17 produced minimum number of primaries at each node interval on main axis (0.83).

More number of primaries were produced at each node interval during winter (1.63) than in summer (1.06).

Table 33 : Interval of primaries production on main axis

Sl. No.	Name of the line	Each node		Alternate node		2 nodes	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	3.00	3.33	3.16	2.00	1.66	1.66
2.	Jaipur Long	1.66	1.33	1.50	1.83	1.66	0.33
3.	LA-89	1.33	2.66	2.00	1.16	0.66	0.33
4.	GKVK	1.00	0.66	0.83	1.83	1.66	1.16
5.	Wardha Local	0.66	1.00	0.83	1.33	2.00	0.66
6.	LA-99	0.00	2.00	1.00	1.50	2.00	1.50
7.	Bijapur Local	1.66	1.00	1.33	1.83	1.00	1.00
8.	LA-43	0.33	1.33	0.83	1.00	0.66	0.33
9.	LA-15	0.66	1.33	1.00	1.33	0.33	0.66
10.	LA-32	1.33	1.66	1.50	1.16	1.66	0.33
11.	LA-17	0.00	1.66	0.83	1.50	1.33	0.66
Mean		1.06	1.63		1.36	1.33	0.63
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
Lines		0.44	S	1.26	0.35	NS	--
Seasons		0.18	S	0.54	0.14	NS	--
Interaction		0.62	NS	--	0.49	NS	--
					0.25	S	0.73
					0.10	S	0.31
					0.36	NS	--
S - Significant		NS - Non significant					

4.2.1.4 Interval of primary production on main axis (Alternate node) : There were no significant differences for this character either between the lines or seasons or interaction (Table 33). The line LA-46 produced maximum number of primaries on main axis at alternate node interval (2.00) and least number of primaries at alternate nodes were produced by LA-43 and LA-89 (1.16).

4.2.1.5 Interval of primary production on main axis (2 nodes interval) : Significant differences were observed for this character between the seasons and lines but the interaction effect was not significant (Table 33). The line LA-46 produced maximum number of primaries at 2 node interval on main axis (1.66) followed Jaipur Long and Bijapur Local (1.00).

During summer more number of primaries were produced at 2 nodes interval (1.33) than winter (0.63). The lines LA-46 and Bijapur Local produced equal number of primaries at 2 nodes interval in both the seasons (1.66 and 1.00).

4.2.1.6 Interval of secondary production on primaries (Each node) : The character exhibited significant difference between the lines but there was no significant difference for this character between the seasons and for interaction (Table 34). The lines LA-

Table 34 : Interval of secondaries production on primaries

Sl. No.	Name of the line	Each node			Alternate node		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	2.33	2.00	2.16	0.33	1.66	1.00
2.	Jaipur Long	1.60	1.52	1.56	2.00	1.00	1.50
3.	LA-89	1.66	3.00	2.33	1.33	0.33	0.83
4.	GKVK	2.00	1.66	1.83	1.66	1.00	1.33
5.	Wardha Local	1.33	2.66	2.00	1.66	1.66	1.66
6.	LA-99	0.66	1.33	1.00	0.33	0.33	0.33
7.	Bijapur Local	1.66	2.66	2.16	0.66	0.00	0.33
8.	LA-43	1.33	1.66	1.50	0.33	0.00	0.16
9.	LA-15	1.33	1.33	1.33	0.33	1.00	0.66
10.	LA-32	1.66	2.33	2.50	1.66	1.33	1.50
11.	LA-17	2.33	2.66	2.50	2.00	1.33	1.66
	Mean	1.66	2.36		1.12	0.87	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	0.38	S	1.10	0.30	S	0.88
	Seasons	0.16	NS	--	0.13	NS	--
	Interaction	0.54	NS	--	0.43	NS	--
	S - Significant	NS	Non significant				

32 and LA-17 produced maximum number of secondaries on primaries at each node interval (2.50) followed by LA-89 (2.33) which was at par with LA-46 and Bijapur Local (2.16), Wardha Local (2.00). Least number of secondaries at each node interval were produced with LA-43 (1.50) which was at par with LA-15 (1.66) and GKVK (1.83).

More number of secondaries were produced during winter (2.36) than in summer (1.66).

4.2.1.7 Interval of secondary production on primaries (Alternate node) : This character exhibited significant difference between the lines but there was no significant difference between the seasons and interaction (Table 34). The lines Wardha Local and LA-17 produced maximum number of secondaries on primaries at alternate node interval (1.66) which was at par with Jaipur Long and LA-17 (1.50). Least number of secondaries at alternate node interval were produced in the lines LA-43 (0.16) which was at par with LA-99 and Bijapur Local (0.33), LA-89 (0.83). The rest of the lines were intermediate.

4.2.2 Flowering pattern

4.2.2.1 Interval of female flower production on main axis (Each node) : The lines exhibited significant difference for this character but there was no signi-

ficant difference either between the seasons or for interaction (Table 35). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line Jaipur Long produced maximum number of female flowers on main axis at each node interval (20.00), followed by the lines LA-46 and LA-17 (18.33) which was at par with LA-89, Wardha Local (17.66) and GKVK (17.50). Least number of female flower production at each node interval was observed in the line LA-43 (10.50) which was at par with LA-15 (10.66). Rest of the lines were intermediate for this character.

4.2.2.3 Interval of female flower production on main axis (Above 2 nodes) : There were no significant differences for this character either between the lines or seasons or for interaction (Table 35). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-43 produced maximum number of female flowers at above 2 nodes interval (2.16) which was followed by LA-99, Bijapur Local and LA-32 (2.00). Least number of female flower production at above 2 nodes interval was observed in the line LA-46 (1.33).

4.2.2.4 Interval of male inflorescence production on main axis (Each node) : Significant differences were observed for this character between the lines and seasons but the interaction effect was significant

Table 35 : Interval of female flower production on main axis

Sl. No.	Name of the line	Each node		Above 2 nodes		
		Summer	Winter	Summer	Winter	
		Pooled		Pooled		
1.	LA-46	18.66	18.00	1.00	1.66	1.33
2.	Jaipur Long	18.66	21.33	1.66	1.33	1.50
3.	LA-89	18.33	17.00	1.33	2.33	1.83
4.	GKVK	15.33	19.66	1.66	1.66	1.66
5.	Wardha Local	17.00	18.33	1.66	1.66	1.66
6.	LA-99	14.00	14.00	1.66	2.33	2.00
7.	Bijapur Local	16.33	16.33	2.66	1.33	2.00
8.	LA-43	8.66	12.33	2.66	1.66	2.16
9.	LA-15	11.00	10.33	2.00	1.66	1.83
10.	LA-32	16.66	15.33	2.00	2.00	2.00
11.	LA-17	17.66	19.00	2.00	1.33	1.66
	Mean	15.66	16.51	1.84	1.72	
		S.E.	F test	S.E.	F test	C.D. at 5%
	Lines	1.04	S	0.38	NS	--
	Seasons	0.44	NS	0.16	NS	--
	Interaction	1.47	NS	0.54	NS	--
S -	Significant	NS	-	Non significant		

(Table 36). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-17 produced maximum number of male inflorescences at each node interval on main axis (3.83) which was at par with Jaipur Long (3.33). Least number of male inflorescences at each node interval produced by the line LA-43 (0.83) which was at par with LA-15 (1.00) and LA-46 (1.33).

During winter season more number of male inflorescence were produced at each node interval (2.70) than summer (1.72). The line LA-46 produced equal number of male inflorescences on main axis at each node interval in both the seasons (1.33)

4.2.2.5 Interval of male inflorescence production on main axis (Alternate node) : There were no significant differences for this character either between the lines or seasons or for interaction (Table 36). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-99 produced maximum number of male inflorescence at alternate node interval on main axis (3.50) and the least was observed in the line LA-32 (2.00).

4.2.2.6 Interval of male inflorescence production on main axis (2 nodes) : Significant difference was observed between the lines but there was no significant

difference either between the seasons or for interaction (Table 36). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-17 produced a maximum number of male inflorescence on main axis at 2 node interval (3.16) which was at par with LA-46 and GKVK (2.83), Jaipur Long (2.66), LA-32 and LA-89 (2.50), Wardha Local, LA-99 and Bijapur Local (2.33). Least number of male inflorescence at 2 nodes interval on main axis was produced by LA-15 (1.50) which was at par with LA-43 (1.83). The lines LA-99 produced equal number of male inflorescence at 2 node interval on main axis in both the seasons (2.33) each respectively.

4.2.2.7 Interval of male inflorescence production on main axis (Above 2 nodes) : Significant difference for this character was observed between the seasons, but there was no significant difference either between the lines or for interaction (Table 36). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. Significantly more number of male inflorescence production at above 2 nodes interval was observed during summer than winter (1.57) than during winter (1.00). The lines Jaipur Long and LA-15 produced equal number of male inflorescence on main axis at above 2 nodes interval (1.33 and 0.66).

Table 36 : Interval of male inflorescence production on main axis

Sl. No.	Name of the line	Each node			Alternate node			2 nodes			Above 2 nodes		
		-----			-----			-----			-----		
		Summer	Winter	Pooled	Summer	Winter	Pooled	Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	1.33	1.33	1.33	3.00	2.33	2.66	2.33	3.33	2.83	1.66	1.00	1.33
2.	Jaipur long	2.66	4.00	3.33	3.00	3.33	3.16	2.66	2.66	2.66	1.33	1.33	1.33
3.	LA-89	2.00	3.00	2.50	3.00	3.33	3.16	2.33	2.66	2.50	1.33	1.66	1.50
4.	GKVK	2.00	3.66	2.83	3.33	3.00	3.16	3.33	2.33	2.83	3.66	1.33	2.50
5.	Wardha Local	1.66	4.00	2.83	3.33	3.66	3.16	2.66	2.00	2.33	1.66	0.66	1.16
6.	LA-99	0.66	2.33	1.50	2.33	2.66	3.50	2.33	2.33	2.33	1.33	1.00	1.16
7.	Bijapur Local	2.66	2.00	2.33	2.66	3.00	2.50	2.66	2.00	2.33	1.66	0.00	0.83
8.	LA-43	1.00	0.66	0.83	2.33	2.33	2.83	1.33	2.33	1.83	0.33	0.66	0.50
9.	LA-15	1.33	0.66	1.00	1.66	2.33	2.33	1.66	1.33	1.50	0.66	0.66	0.66
10.	LA-32	1.33	3.00	2.16	2.66	3.00	2.00	3.00	2.00	2.50	1.00	1.33	1.16
11.	LA-17	2.33	5.33	3.83	4.00	3.33	2.83	3.66	2.66	3.16	2.66	1.33	2.00
	Mean	1.72	2.72		2.84	2.93		2.54	2.33		1.57	1.00	
	Lines	0.65	S	1.86	0.40	NS	--	0.31	S	0.90	0.45	NS	--
	Seasons	0.27	S	0.79	0.17	NS	--	0.13	NS	--	0.19	S	0.55
	Interaction	0.92	NS	--	0.57	NS	--	0.44	NS	--	0.64	NS	--

S - Significant NS - Non significant

4.2.2.8 Interval of solitary male flower production on main axis (Each node) : Significant differences were observed for this character between the lines and seasons but the interaction effect was not significant (Table 37). The line Jaipur Long produced maximum number of solitary male flowers at each node interval (5.83) followed by Wardha Local (5.00). Least number of solitary male flower production at each node interval on main axis was observed in the line LA-15 (2.16).

More number of solitary male flowers were produced at each node interval during winter (4.45) than summer (3.64).

4.2.2.9 Interval of solitary male flower production on main axis (Alternate node) : There were no significant differences for this character either between the lines or seasons or for interaction (Table 37). The line LA-15 produced maximum number of solitary male flower at alternate node interval on main axis (7.56) and the least was observed in the line LA-46 (4.76).

4.2.2.10 Interval of solitary male flower production on main axis (2 nodes interval) : There were no significant differences for this character either between the seasons or lines or for interaction (Table

37). The line LA-46 produced maximum number of solitary male flowers at above 2 nodes interval (3.16) and the least was observed in LA-32 (2.16). The lines LA-99 and LA-17 produced equal number of solitary male flowers on main axis at 2 nodes intervals in both the seasons (2.66 and 2.33).

4.2.2.11 Interval of solitary male flower production on main axis (Above 2 nodes) : Significant differences for this character was observed between the seasons but no significant difference was observed either between the lines or interaction (Table 37). The line LA-46 and GKVK produced maximum number of solitary male flowers at above two nodes interval on main axis (2.16) with the least observed in the line LA-43 (0.83).

During summer relatively more number of solitary male flowers were produced at above 2 nodes interval (1.96) than in winter (1.42).

4.2.2.12 Interval of female flower production on primaries (Each node) : The character exhibited significant differences between the lines, seasons and for interaction (Table 38). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-46 produced maximum number of female flowers at each node interval on primaries

Table 37 : Interval of solitary male production on main axis

Sl. No.	Name of the line	Each nodes			Alternate nodes			2 nodes			Above 2 nodes		
		Summer			Summer			Summer			Summer		
		Winter	Pooled	C.D. at 5%	Winter	Pooled	C.D. at 5%	Winter	Pooled	C.D. at 5%	Winter	Pooled	C.D. at 5%
1.	LA-46	3.33	5.33	4.33	3.66	3.33	4.76	3.00	3.33	3.16	2.00	2.33	2.16
2.	Jaipur Long	5.00	6.66	5.63	5.00	4.33	5.85	2.00	2.66	2.33	2.00	1.33	1.66
3.	LA-89	3.00	4.00	3.50	3.33	3.66	6.10	3.33	2.33	2.83	2.33	1.33	1.83
4.	GKVK	4.66	3.00	3.83	4.33	4.00	5.86	2.33	2.66	2.50	2.66	1.66	2.16
5.	Wardha Local	5.33	4.66	5.00	3.00	2.66	5.99	3.00	2.33	2.66	2.66	1.33	2.00
6.	LA-99	3.00	4.00	3.50	4.00	3.33	5.57	2.66	2.66	2.66	1.33	1.33	1.33
7.	Bijapur Local	4.00	3.66	3.83	4.33	3.33	5.79	3.00	2.66	2.83	2.00	2.00	2.00
8.	LA-43	1.66	4.66	3.16	3.00	3.66	7.17	2.33	2.33	2.33	1.00	0.66	0.83
9.	LA-15	2.00	2.33	2.16	3.33	2.66	7.56	2.00	2.33	2.16	1.66	1.00	1.33
10.	LA-32	4.66	4.66	4.66	3.33	3.33	6.09	3.33	2.00	2.66	2.33	1.33	1.83
11.	LA-17	3.33	6.00	4.66	4.00	4.66	6.27	2.33	2.33	2.33	1.66	1.33	1.50
	Mean	3.63	4.45		3.75	3.54		2.66	2.51		1.96	1.42	
	Lines	S.E. 0.50	F test S	C.D. 1.80	S.E. 0.47	F test NS	C.D. --	S.E. 0.58	F test NS	C.D. --	S.E. 0.43	F test NS	C.D. --
	Seasons	S.E. 0.21	F test S	C.D. 0.77	S.E. 0.20	F test NS	C.D. --	S.E. 0.25	F test NS	C.D. --	S.E. 0.18	F test S	C.D. 0.53
	Interaction	S.E. 0.71	F test NS	C.D. --	S.E. 0.67	F test NS	C.D. --	S.E. 0.83	F test NS	C.D. --	S.E. 0.61	F test NS	C.D. --

S - Significant

NS - Non significant

(44.66) followed by Jaipur Long (35.16) with the least observed in the line LA-15 (11.83).

Relatively higher number of female flowers were produced at each node interval on primaries in winter season (25.03) than in summer (23.12).

During summer season the line Jaipur Long produced maximum number of female flowers, at each node interval (46.33) followed by LA-17 (40.00) and LA-32 (35.33). Least number of female flowers at each node interval were produced in the line LA-15 (8.00) followed by LA-43 (10.33) and LA-89 (12.66). Rest of the lines were intermediate. During winter season the line LA-46 produced maximum number of female flowers at each node interval (60.33) followed by GKVK (31.33), LA-89 (27.66) which were at par with LA-99 (26.66) and LA-17 (26.66). Least number of female flowers at each node interval were produced in the line LA-32 (12.00) followed by Bijapur Local (14.66) which was at par with LA-15 (15.66) and LA-43 (17.00).

Most of the lines produced more number of female flowers at each node interval on primaries in the winter season except the line Jaipur Long, Bijapur Local, LA-32 and LA-17 which produced more number of female flowers at each node interval during summer

Table 38 : Interval of female flower production on primaries

Sl. No.	Name of the line	Each node			Above 2 nodes		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	29.00	60.33	44.66	6.66	7.00	6.83
2.	Jaipur Long	46.33	24.00	35.16	5.00	6.00	5.50
3.	LA-89	12.66	27.66	20.16	4.00	4.00	4.00
4.	GKVK	21.66	31.33	26.50	4.33	3.00	3.66
5.	Wardha Local	16.66	19.33	18.00	5.00	4.66	4.83
6.	LA-99	17.33	26.66	22.00	5.66	6.00	5.83
7.	Bijapur Local	17.00	14.66	15.83	3.66	3.66	3.66
8.	LA-43	10.33	17.00	13.66	2.33	4.66	3.50
9.	LA-15	8.00	15.66	11.83	2.33	3.66	3.00
10.	LA-32	35.33	12.00	23.66	6.33	4.00	5.66
11.	LA-17	40.00	26.66	33.37	7.33	5.00	6.66
	Mean	23.12	25.03		4.78	4.69	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	0.46	S	1.32	0.75	NS	--
	Seasons	0.19	S	0.55	0.32	NS	--
	Interaction	0.65	S	1.87	1.07	NS	--
	S - Significant	NS	-	Non significant			

season. All the lines differed for this character between the seasons.

4.2.2.12 Interval of female flower production on primaries (Above 2 nodes) : The character was not significant either between the lines or seasons or for interaction (Table 38). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-46 produced maximum number of female flowers at above 2 nodes interval (6.83) and the least number was observed in the line LA-15 (3.00).

4.2.2.13 Interval of male inflorescence production on primaries (Each node) : The character exhibited significant differences among the lines and interaction, but the difference between the seasons was not significant (Table 39). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-46 produced maximum number of male inflorescence at each node interval on primaries (10.33) which was at par with Jaipur Long (10.00). Least number of male inflorescence at each node interval on primaries were observed in the line LA-15 (4.33) followed by LA-32 (5.83) which was at par with LA-89 and GKVK (6.16) and Wardha Local (6.33). Rest of the lines were intermediate.

The lines LA-46, Bijapur Local, LA-99, LA-32 differed for this character between the seasons while the rest did not. The lines LA-89 and GKVK produced equal number of male inflorescence at each node interval in both summer and winter seasons (7.06 and 7.15) respectively.

4.2.2.14 Interval of male inflorescence production on primaries (Alternate nodes) : This character was not significant either between the lines or seasons or for interaction (Table 39). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-17 produced maximum number of male inflorescence at alternate node (8.00) and the least was produced in the line LA-32 (4.50).

4.2.2.15 Interval of male inflorescence production on primaries (2 nodes) : Significant difference was observed for this character between the lines but there was no significant difference for this character either between the seasons or for interaction (Table 39). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The lines LA-46 and LA-17 produced maximum number of male inflorescence at 2 node interval (4.66) which was par with Jaipur Long (4.33) and GKVK (3.83). Least number of male inflorescence production at 2 node interval was observed in the lines LA-15 (2.66) which was at par.

Table 39 : Interval of male inflorescence production on primaries

Sl. No.	Name of the line	Each node			Alternate node			2 nodes			Above 2 nodes		
		Summer	Winter	Pooled	Summer	Winter	Pooled	Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	8.00	12.66	10.33	6.66	8.66	7.66	4.66	4.66	4.66	4.33	4.33	4.33
2.	Jaipur Long	10.33	9.66	10.00	6.66	6.00	6.33	4.33	4.33	4.33	4.00	3.33	3.66
3.	LA-89	7.00	5.33	6.16	4.00	6.00	5.00	2.33	4.66	3.50	1.66	3.66	2.66
4.	GKVK	7.00	5.33	6.16	5.33	5.66	5.50	4.00	3.66	3.83	2.00	3.33	2.66
5.	Wardha Local	8.00	4.66	6.33	5.00	6.00	5.50	3.00	3.33	3.16	3.00	2.33	2.66
6.	LA-99	6.00	10.00	8.00	4.66	7.00	5.83	3.33	4.00	3.66	2.66	3.66	3.16
7.	Bijapur Local	8.66	7.66	8.16	8.00	7.00	7.50	3.66	3.33	3.50	2.00	3.33	2.66
8.	LA-43	3.66	6.33	5.00	5.66	5.33	5.50	2.00	3.66	2.83	1.66	3.00	2.33
9.	LA-15	3.00	5.66	4.33	4.00	6.66	5.33	3.00	2.66	2.66	1.33	2.00	1.66
10.	LA-32	8.33	3.33	5.83	6.00	3.00	4.50	4.33	2.33	3.33	2.33	1.66	2.0
11.	LA-17	7.66	8.00	7.83	8.33	7.66	8.00	5.00	4.33	4.66	2.66	4.33	3.50
	Mean	7.06	7.15		5.84	6.27		3.60	4.69		2.51	3.18	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	1.06	S	3.04	1.22	NS	--	0.85	S	1.50--	0.61	NS	--
	Seasons	0.45	NS	--	0.52	NS	--	0.48	NS	--	0.26	S	0.75
	Interaction	1.50	S	4.30	1.73	NS	--	1.23	NS	--	0.87	NS	--

S - Significant NS - Non significant

with LA-43 (2.83), Wardha Local (3.16) and LA-17 (3.33). Rest of the lines were intermediate. The lines LA-46 and Jaipur Long produced equal number of male inflorescence at 2 node interval in both the seasons (4.66 and 4.33) respectively.

4.2.2.16 Interval of male inflorescence production on primaries (Above 2 nodes) : This character was significant between the seasons but no significant difference was observed either between the lines or for interaction (Table 39). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively.

During winter season significantly higher number of male inflorescence were produced at above 2 node intervals on primaries (3.18) than summer (2.51). The line LA-46 produced equal number of male inflorescence at above 2 node intervals on primaries in both the seasons (4.33).

4.2.2.17 Interval of solitary male flower production on primaries (Each node) : Significant difference were observed for this character between the lines and for interaction, but the difference between the seasons was not significant (Table 40). The line LA-46 produced maximum number of solitary male flowers at each node interval on primaries (11.00) which was at par with

Jaipur Long (10.00). Least number of solitary male flowers production at each node interval was observed in the lines Wardha Local and LA-15 (2.83) which was at par with LA-43 (3.83) and Bijapur Local (4.16). Rest of the lines were intermediate.

The lines LA-46, Jaipur Long, LA-89, GKVK, LA-99 and LA-32 differed for this character while between the seasons.

4.2.2.18 Interval of solitary male flower production on primaries (Alternate node) : There was no significant difference for this character either between the lines or seasons but the interaction effect of was significant. The line LA-46 produced maximum number of solitary male flowers at alternate node interval (7.50) followed by LA-17 (7.33). The least was observed in the line Wardha Local (3.16).

During summer the line Jaipur Long produced maximum number of solitary male flowers at alternate node interval (10.33) followed by LA-32 and LA-17 (6.66) which was at par with LA-46 (6.33). The least was observed in the line LA-15 (2.00). During winter the line LA-46 produced maximum number of solitary male flowers at alternate node interval (8.66) which was at par with LA-17 (8.00). The least was observed in the lines Jaipur Long and LA-32 (3.00)

4.2.2.19 Interval of solitary male flower production on primaries (2 nodes) : Significant differences were observed for this character between the lines and interaction while the seasons were not significant for this character. The line LA-46 produced maximum number solitary male flowers at 2 nodes interval (4.83) followed by LA-99 (4.00) which was at par with LA-17 (3.83). Least number of solitary male production at 2 nodes interval was observed in the line LA-43 (1.66) which was at par with LA-15 (2.00).

During summer the line LA-17 produced maximum number solitary male flowers at 2 nodes interval (4.33) which was at par with Wardha Local (4.00). The least number of solitary male flowers were produced at 2 nodes interval in the line LA-43 (1.00). During winter the line LA-46 produced maximum number of solitary male flowers at 2 nodes interval (7.33) followed by LA-99 (4.66) which was at par with LA-89 and GKVK (4.33), while the least was observed in the line Bijapur Local (0.66).

4.2.2.20 Interval of solitary male flower production on primaries (Above 2 nodes) : This character was not significant either between the lines or seasons or for interaction (Table 40). The line LA-46 produced maximum number of solitary male flowers at above 2

Table 40 : Interval of solitary male production on primaries

Sl. No.	Name of the line	Each node			Alternate node			2 nodes			Above 2 nodes		
		Summer	Winter	Pooled	Summer	Winter	Pooled	Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	6.66	15.33	11.00	6.33	8.66	7.50	2.33	7.33	4.83	1.00	7.00	4.00
2.	Jaipur Long	15.33	4.66	10.00	10.33	3.00	6.66	3.66	2.66	3.16	3.33	2.33	2.83
3.	LA-89	2.33	7.33	4.83	3.33	5.66	4.50	1.33	4.33	2.83	0.66	3.66	2.11
4.	GKVK	3.33	9.00	6.16	2.66	6.00	4.33	2.00	4.33	3.16	1.33	4.33	2.83
5.	Wardha Local	3.33	2.33	2.83	2.66	3.66	3.16	4.00	1.66	2.83	2.33	1.00	1.60
6.	LA-99	1.33	11.00	6.16	2.66	7.33	5.00	3.33	4.66	4.00	1.00	5.00	3.00
7.	Bijapur Local	5.66	2.66	4.16	4.33	4.00	4.16	3.33	0.66	2.00	2.00	0.00	1.00
8.	LA-43	2.33	5.33	3.83	3.66	5.00	4.33	1.00	2.33	1.66	0.00	1.00	0.50
9.	LA-15	2.66	3.00	2.83	2.00	4.66	3.33	1.66	2.33	2.00	0.33	1.00	0.66
10.	LA-32	9.33	3.00	6.16	6.66	3.00	4.83	3.66	2.66	3.16	2.00	1.33	1.66
11.	LA-17	9.33	6.66	8.00	6.66	8.00	7.33	4.33	3.33	3.83	3.66	2.00	2.83
Means		5.60	6.39		4.66	5.36		2.78	3.30		1.60	2.60	
Lines		1.12	S	3.22	0.94	NS	--	0.63	S	1.80	0.50	NS	--
Seasons		0.48	NS	--	0.40	NS	--	0.26	NS	--	0.40	NS	--
Interaction		1.59	NS	--	1.32	S	3.79	0.89	S	2.55	0.90	NS	--
S - Significant		NS - Non significant											

nodes interval (4.00) followed by LA-99 (3.00) and the least number was observed in winter season.

4.2.2.21 Interval of female flower production on secondaries (Each node) : Significant difference was observed for this character between the lines but no significant difference was observed either between the seasons or for interaction (Table 41). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-17 produced maximum number of female flowers at each node interval on secondaries (20.50) followed by LA-32 (14.66), LA-46 (14.33) and Jaipur Long (14.16). Least number of female flower production at each node interval was observed in the line LA-99 (2.33) followed by LA-43 (4.83) and LA-15 (5.83). Rest of the lines were intermediate.

4.2.2.22 Interval of female flower production on secondaries (Above 2 nodes) : This character was not significant either between the seasons or for interaction but significant difference was observed between the lines (Table 41). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The lines LA-46 and LA-17 produced maximum number of female flowers at above 2 nodes interval (3.00) and the least was observed in the line LA-99 (1.00). Rest of the lines were inter-mediate.

Table 41 : Interval of female flower production on secondaries

Sl. No.	Name of the line	Each node			Above 2 nodes		
		Summer	Winter	Pooled	Summer	Winter	Pooled
1.	LA-46	8.66	20.00	14.33	2.66	3.33	3.00
2.	Jaipur Long	16.33	12.00	14.16	3.00	2.33	2.66
3.	LA-89	7.66	6.33	7.00	2.00	1.33	1.66
4.	GKVK	11.33	10.00	10.66	2.33	2.66	2.50
5.	Wardha Local	13.33	14.00	13.66	3.33	2.00	2.66
6.	LA-99	1.00	3.66	2.33	1.00	1.00	1.00
7.	Bijapur Local	10.00	7.33	8.66	2.00	1.66	1.83
8.	LA-43	4.33	5.33	4.83	1.33	1.00	1.16
9.	LA-15	4.00	7.66	5.83	1.66	1.66	1.66
10.	LA-32	15.66	13.66	14.66	3.00	2.33	2.66
11.	LA-17	23.00	18.00	20.50	3.33	2.66	3.00
	Mean	10.48	10.72		2.33	2.00	
		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%
	Lines	1.99	S	5.70	0.48	S	1.18
	Seasons	0.85	NS	--	0.17	NS	--
	Interaction	2.82	NS	--	0.58	NS	--
	S - Significant	NS	-	Non significant			

4.2.2.23 Interval of male inflorescence production on secondaries (Each node) : This character was not significant between the seasons and interaction, but the difference between the lines was significant (Table 42). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-17 produced maximum number of male inflorescence at each node interval (7.16) followed by LA-32 (6.16) which was at par with Wardha Local (5.50), LA-46 (5.33) and GKVK (5.00). Least number of male inflorescence production at each node interval was observed in the line LA-99 (2.00) which was at par with LA-43 (2.33). Rest of the line were intermediate.

The lines LA-99 and LA-43 produced equal number of male inflorescence at each node interval on secondaries in both seasons (2.00 and 2.33) respectively.

4.2.2.24 Interval of male inflorescence production on secondaries (Alternate nodes) : The character was not significant either between the seasons or for interaction but significant difference was observed for this character between the lines (Table 42). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-17 produced maximum number of male inflorescence at alternate node interval (6.33) followed by Jaipur Long

(4.66) and least number of male inflorescence at alternate node interval on secondaries were produced in the line LA-99 (1.33). Rest of the lines were intermediate.

The lines Jaipur Long, Bijapur Local, LA-43 and LA-17 produced equal number of male inflorescence at alternate node interval on secondaries in both the seasons (4.66, 2.33, 1.66, 6.33) respectively.

4.2.2.25 Interval of male inflorescence production on secondaries (2 nodes) : Significant difference was observed for this character between the lines but there was no significant difference for this character either between the seasons or for interaction (Table 42). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs.11, 12 and 13 respectively. The line LA-17 produced maximum number of male inflorescence at 2 nodes interval on secondaries (3.83) which was at par with LA-32 (3.33) and LA-46 (3.16). Least number of male inflorescence production at 2 nodes interval on secondaries was observed in the line LA-99 (0.83) which was at par with LA-43 (1.00). Rest of the lines were intermediate.

4.2.2.26 Interval of male inflorescence production on secondaries (Above 2 nodes) : The character was not significant for interaction but significant differences

Table 42 : Interval of male inflorescence production on secundarie

Sl. No.	Name of the line	Each node			Alternate node			2 nodes			Above 2 nodes		
		Summer			Winter			Summer			Winter		
		Pooled	F test	C.D. at 5%	Pooled	F test	C.D. at 5%	Pooled	F test	C.D. at 5%	Pooled	F test	C.D. at 5%
1.	LA-46	3.00	7.66	5.33	5.33	3.00	5.33	4.16	2.00	4.33	3.16	0.00	3.66
2.	Jaipur long	5.00	4.33	4.66	4.66	4.66	4.66	4.66	3.00	1.66	2.33	2.66	1.00
3.	LA-89	4.66	3.00	3.83	3.83	3.00	2.00	2.50	2.33	2.66	2.50	1.00	0.33
4.	GKVK	5.33	4.66	5.00	5.00	3.66	4.66	4.16	1.66	3.00	2.33	1.66	3.33
5.	Wardha Local	6.00	5.00	5.50	5.50	4.00	3.00	3.50	2.33	3.00	2.66	1.33	2.33
6.	LA-99	2.00	2.00	2.00	2.00	0.33	2.33	1.33	0.33	1.33	0.83	0.00	1.33
7.	Bijapur Local	2.66	3.66	3.16	3.16	2.33	2.33	2.33	1.33	2.00	1.66	0.00	2.00
8.	LA-43	2.33	2.33	2.33	2.33	1.66	1.66	1.66	1.33	0.66	1.00	0.00	0.66
9.	LA-15	2.66	4.00	3.33	3.33	1.66	3.00	2.33	1.33	2.33	1.83	0.00	1.66
10.	LA-32	5.00	7.33	6.16	6.16	3.33	5.00	4.16	2.66	4.00	3.33	1.66	3.00
11.	LA-17	7.00	7.33	7.16	7.16	6.33	6.33	6.33	4.33	3.33	3.83	4.33	3.00
	Mean	4.15	4.66			3.09	3.66		2.06	2.57		1.15	2.03
		S.E.	F test	C.D. at 5%		S.E.	F test	C.D. at 5%	S.E.	F test	C.D. at 5%	S.E.	F test
Lines		0.93	S	--	--	0.75	S	2.14	0.87	S	1.76	0.71	NS
Seasons		0.39	NS	--	--	0.32	NS	--	0.37	NS	--	0.30	S
Interaction		1.32	NS	--	--	1.06	NS	--	1.23	NS	--	1.00	NS
S - Significant		NS - Non significant											

for this character was observed between the lines and seasons (Table 42). The data for the lines LA-46, Jaipur Long and LA-15 is depicted in Figs. 11, 12 and 13 respectively. The line LA-17 produced maximum number of male inflorescence at 2 nodes interval on secondaries (3.66) followed by GKVK (2.50) which was at par with LA-32 (2.33). Least was observed in LA-43.

Significantly more number of male inflorescence production at above 2 nodes interval was observed during winter (2.03) than in summer (1.15).

4.2.2.27 Interval of solitary male flower production on secondaries (Each node) : The character was significant between the lines but there was no significant difference either between the seasons or for interaction (Table 43). The line Jaipur Long produced maximum number of solitary male flowers at each node interval on secondaries (3.66) which was at par with LA-17 (3.33), LA-32 (3.16). Least number of solitary male flowers production at each node interval on secondaries was observed in the line LA-99 (0.66) which was at par with LA-43 (1.16). Rest of the lines were intermediate. The lines GKVK and LA-99 produced equal number of solitary male flowers at every node interval on secondaries in both seasons (2.33 and 0.66) respectively.

4.2.2.28 Interval of solitary male flower production on secondaries (Alternate node) : This character was not significant either to between the seasons or interaction but significant difference was observed between the lines (Table 43). The line LA-17 produced maximum number of solitary male flowers at alternate node interval on secondaries (3.66) which was at par with Wardha Local (3.00) and the least number of solitary male flowers at alternate node interval was observed in the line LA-99 (0.83) which was at par with LA-89 and Bijapur Local (1.00) and LA-43 (1.16). Rest of the lines were intermediate. The line LA-15 produced equal number of solitary male flowers at alternate node interval in both the seasons (1.33).

4.2.2.29 Interval of solitary male flower production on secondaries (2 nodes) : Significant difference was observed for this character between the lines but there was no significant difference either between the seasons or for interaction (Table 43). The line LA-17 produced maximum number of solitary male flowers at 2 nodes interval on secondaries (2.16) which was at par with LA-32 and Jaipur Long (1.66), LA-46 (1.33). The line LA-99 did not produced the solitary male flowers at 2 nodes interval.

Table 43 : Interval of solitary male production on secondaries

Sl. No.	Name of the line	Each node		Alternate nodes		2 nodes	
		Summer	Winter Pooled	Summer	Winter Pooled	Summer	Winter Pooled
1.	LA-46	2.66	3.00	2.83	2.66	2.33	1.33
2.	Jaipur Long	3.33	4.00	3.66	2.00	1.33	1.66
3.	LA-89	2.66	3.00	2.83	1.66	1.00	0.66
4.	GKVK	2.33	2.33	2.33	1.66	1.00	0.83
5.	Wardha Local	2.33	3.33	2.83	3.66	1.00	0.83
6.	LA-99	0.66	0.66	0.66	1.33	0.00	0.00
7.	Bijapur Local	2.66	2.33	2.50	0.66	1.33	1.00
8.	LA-43	1.66	0.66	1.16	1.33	0.66	0.50
9.	LA-15	2.00	2.33	2.16	1.33	0.00	0.16
10.	LA-32	3.00	3.33	3.16	2.33	1.00	1.66
11.	LA-17	3.66	3.00	3.33	3.00	2.66	2.16
Mean		2.45	2.54		1.84	1.03	0.93
Lines		0.48	S	1.37	0.46	0.45	0.90
Seasons		0.20	NS	--	0.19	0.09	--
Interaction		0.68	NS	--	0.66	0.40	--
S - Significant		NS - Non significant					

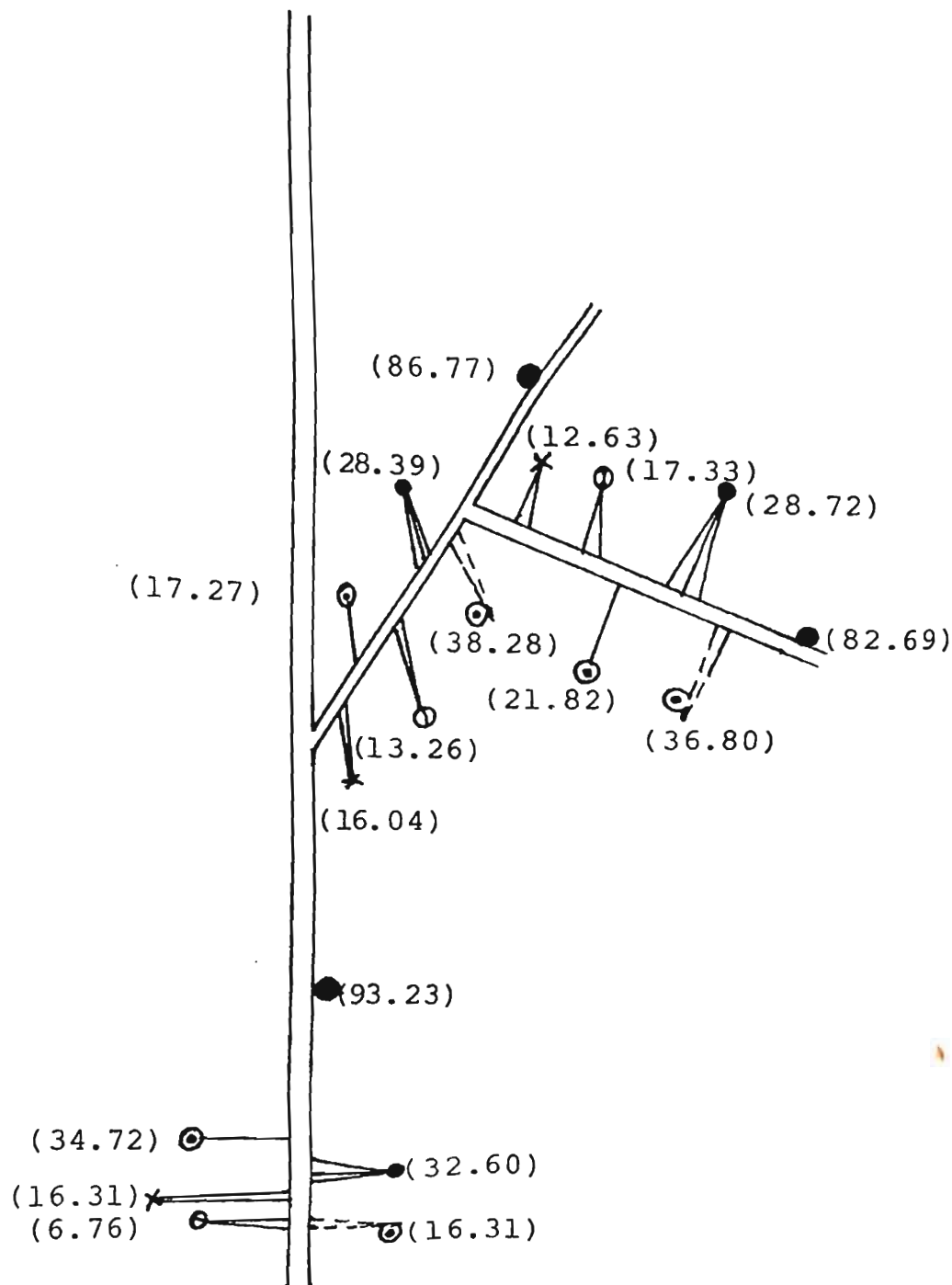


Fig.11 : Diagrammatic representation of flowering interval in the line LA-46

(Relative percentages of interval are given in brackets)

---○--- Male (Each node)

≡● Male (Alternate node)

—○— Male (2 nodes)

≡× Male (Above 2 nodes)

● Female (Each node)

≡○≡ Female (Above 2 nodes)

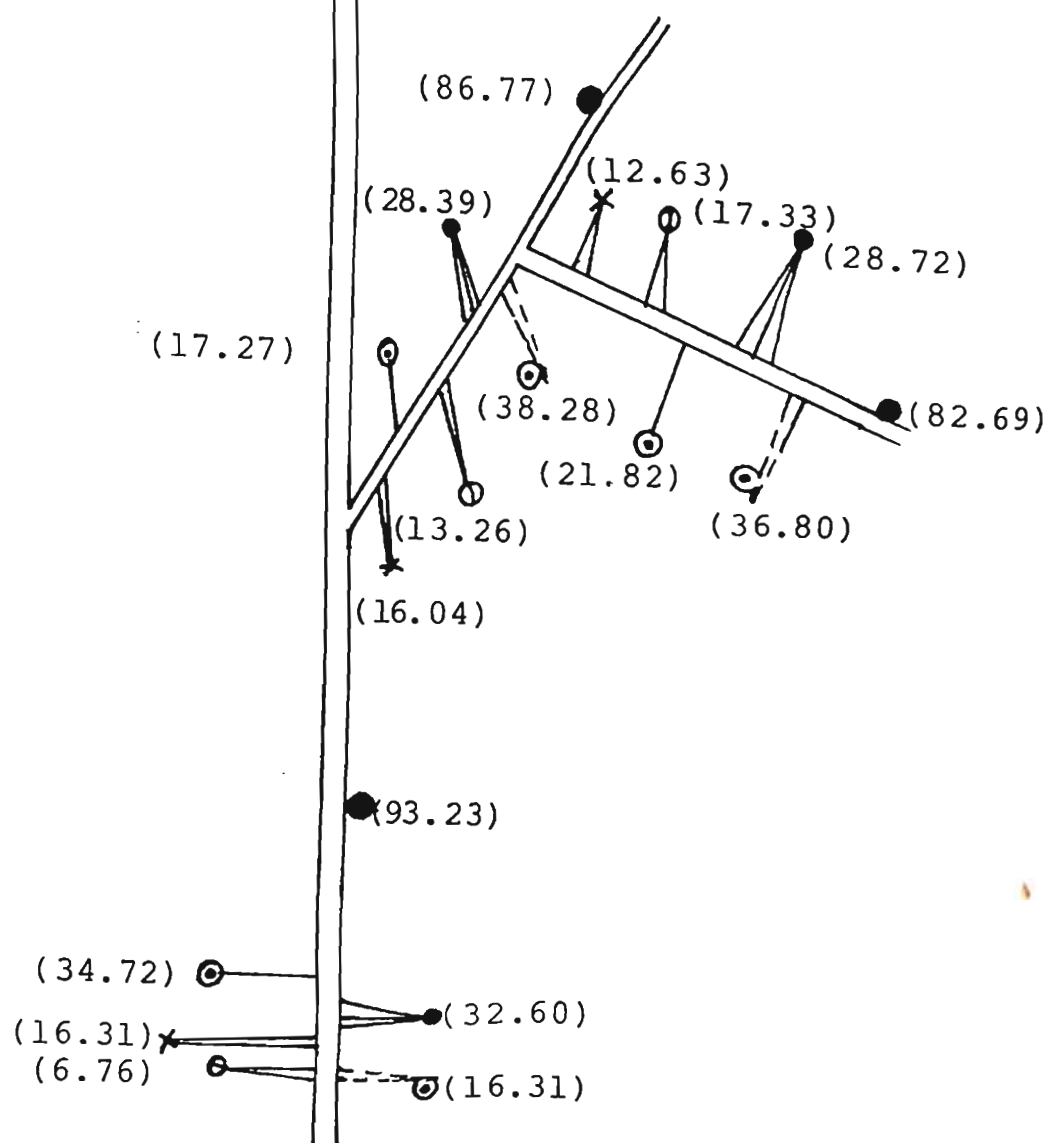
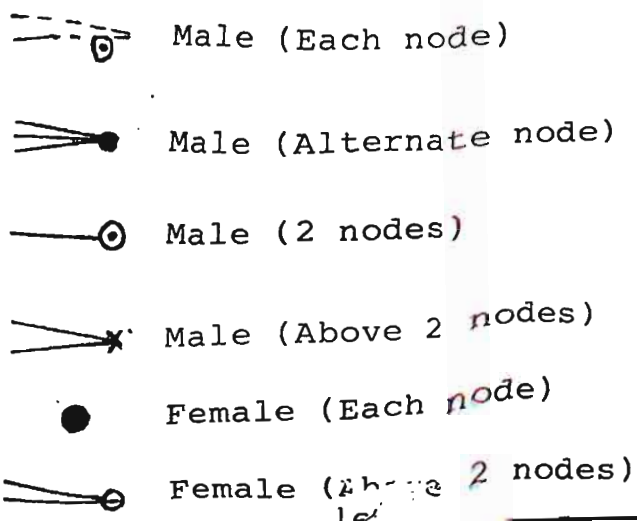


Fig.11 : Diagrammatic representation of flowering interval in the line LA-46

(Relative percentages of interval are given in brackets)



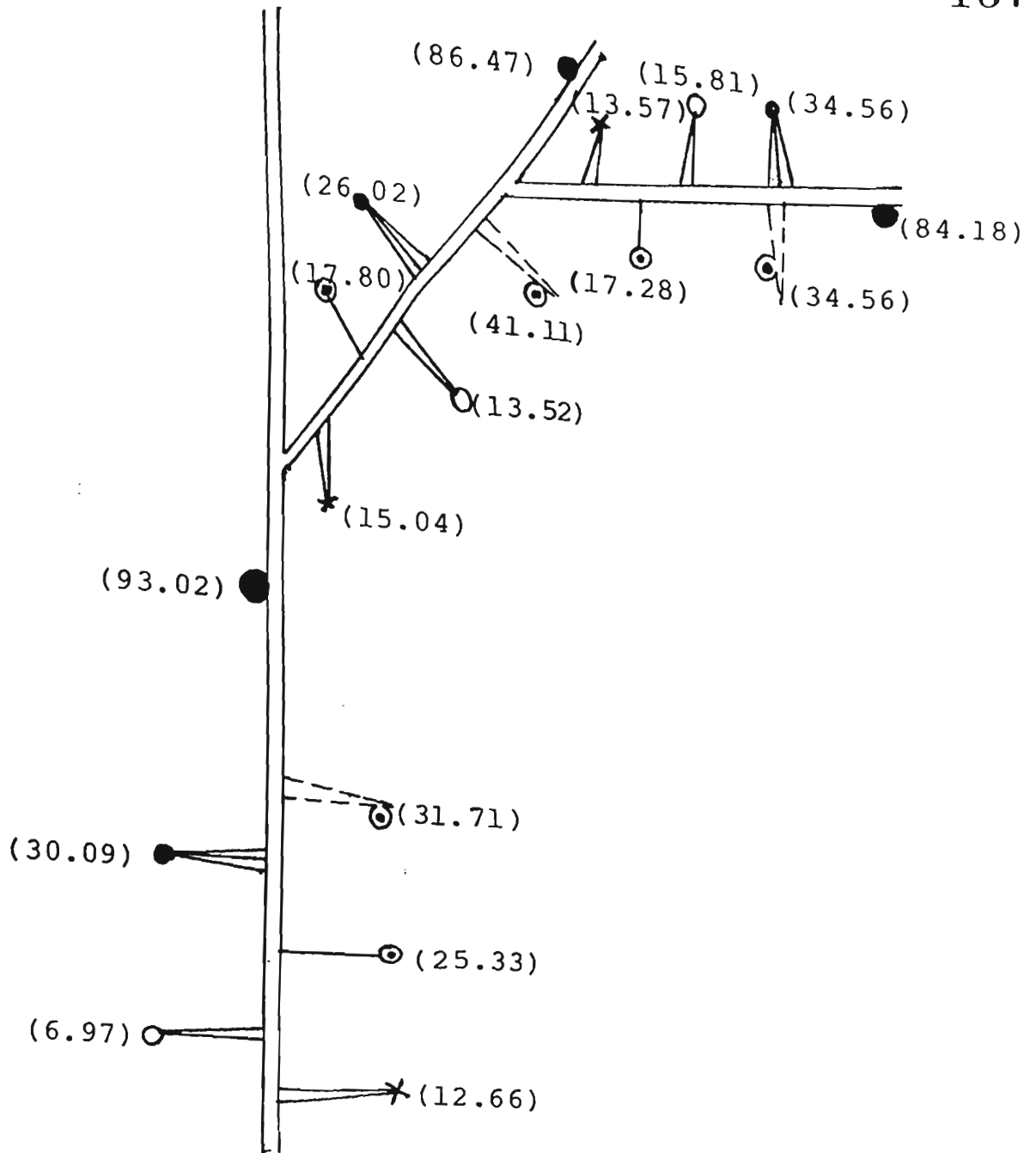


Fig.12 : Diagrammatic representation of flowering interval in the Jaipur Long
(Relative percentages of interval are given in brackets)

Male (Each node)

Male (Alternate node)

Male (2 nodes)

Male (Above 2 nodes)

Female (Each node)

Female (Above 2 nodes)

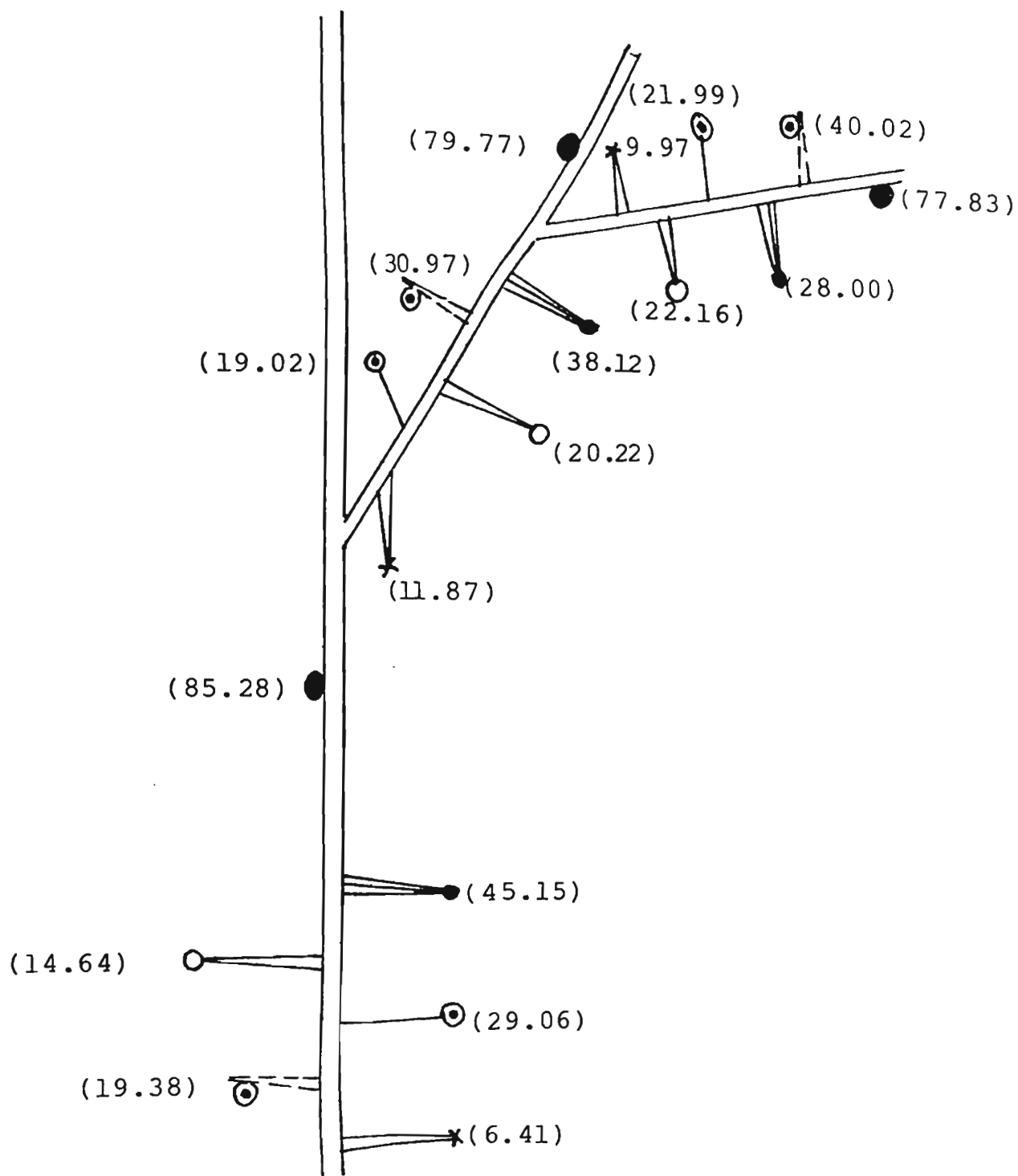
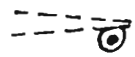


Fig.13 : Diagrammatic representation of flowering interval in the line LA-15.
(Relative percentages of interval are given in brackets.)

-  Male (Each node)
-  Male (Alternate node)
-  Male (2 nodes)
-  Male (Above 2 nodes)
-  Female (Each node)
-  Female (Above 2 nodes)

4.3 STUDIES ON EFFECT OF POLLEN SOURCES ON FRUIT AND SEED

In ridge gourd two types of male flowers exists (1) male inflorescence (2) solitary male flower. An experiment was conducted to know the effect of the pollen from these two sources on fruit character (Table 44). Totally 3 crosses, 2 selfings and 1 reciprocal cross were made with the pollen from above sources and the fruit characters were studied.

In the first cross LA-46, Jaipur Long were crossed with the pollen from solitary male flower and male inflorescence were used. When the pollen solitary male flower was used, fruit weight recorded was maximum (45.00 g), than when pollen from male inflorescence was used (35.00 g). Regarding the fruit length it was maximum (46.00 cm) when the pollen from solitary male flower was used, while it was minimum (34.00 cm) when the pollen from male inflorescence was used in crossing programme. Likewise maximum and minimum fruit girths were recorded when the pollen from solitary male flower and male inflorescence was used respectively (29.40 and 22.00 cm). Maximum number of seeds and weight of the seeds was recorded when the pollen from solitary male flower was used (72 and 10.00 g), while minimum number of seeds and weight of the seeds was recorded when

the pollen from male inflorescence was used (51 and 7.00 g).

When the lines GKVK and Wardha Local were crossed using the pollen from both solitary male flower and male inflorescence the following observations were made. Maximum dried fruit weight was observed when the pollen from solitary male flower was used for crossing (45.00 g), while it was less when pollen from male inflorescence was used (28.00 g). Likewise maximum fruit length and girth were recorded when the pollen from solitary male flower was used (20.00 and 15.50), while they were less when the pollen from male inflorescence was used (14.75 and 9.80). Maximum number of seeds and seed weight was recorded when the pollen from solitary male flower was used (45 and 10.00 g), while they were less when the pollen from male inflorescence was used for crossing purposed (21 and 6.00 g).

In the third cross also, when LA-99 and Bijapur Local were crossed with the pollen from both the solitary male flower and male inflorescence were used similar observations were recorded i.e. maximum dried fruit weight, fruit length, fruit girth, number of seeds and seed weight were recorded when the pollen from solitary male flower was used (37.50 g, 27.50 cm, 19.00 cm, 111, 15.0 g). while they were less when the

pollen from male inflorescence was used for crossing (20.00 g, 25.50 cm, 14.00 cm, 52, and 6.4 g).

A reciprocal cross was also made between the lines LA-17 and LA-32 with the pollen from solitary male flower when LA-32 was used as male parent, while the pollen from male inflorescence was used when LA-17 was used as male parent. Maximum fruit weight (dried), fruit length, fruit girth, number of seeds and seed weight were recorded when the pollen from solitary male flower was used (51.00 g, 41.30 cm, 21.20 cm, 125 and 68.00 g) while they were minimum when the pollen from male inflorescence was used (35.00 g, 31.80 cm, 19.70 cm, 58 and 16 g).

In addition to these crossings, selfing of two lines were also made for LA-17 and LA-15, with the pollen from both the sources. When LA-17 was selfed more fruit weight (dried), fruit length, fruit girth, number of seeds, seed weight were recorded with the pollen from solitary male flower (36.75 g, 21.50 cm, 18.75 cm, 182 and 20.00g).

When LA-15 was selfed by using the pollen from both the sources also similar observations were made i.e. maximum fruit weight (dried), fruit length, fruit girth, number of seeds and seed weight when the pollen from solitary male flower was used (20.00 g, 10.00 cm,

4.65 cm, 20 and 4.0 g), than when the pollen from male inflorescence was used (10.00 g, 8.75 cm, 3.82 cm, 18 and 4.0 g).

Table 44 : Studies on effect of pollen sources on fruit and seed characters

Sl. No.	Name of the cross or self	Source of pollen	Dried ft.wt. (g)	Fruit length (cm)	Fruit girth (cm)	Seed No.	Seed weight (gms)
1.	LA-46 X Jaipur Long	Solitary Male	45.00	46.00	29.40	72	10.0
2.	LA-46 X Jaipur Long	Male inflorescence	35.00	34.00	22.00	51	7.0
3.	GKVK X Wardha Local	Solitary male	45.00	20.00	15.50	45	10.0
		Male inflorescence	28.00	14.75	9.80	21	6.0
4.	L.A-99 X Bijapur Local	Solitary male	37.50	27.50	19.00	111	15.0
		Male inflorescence	20.00	25.50	14.00	52	6.4
5.	L.A-17 X L.A.-32	Solitary Male	51.00	41.30	21.20	125	68.0
	L.A-32 X L.A.-17	Male inflorescence	35.00	31.80	19.70	58	16.0
6.	L.A-17	Solitary Male	36.75	21.50	18.75	182	20.0
		Male inflorescence	25.00	16.25	11.20	39	5.3
7.	L.A-15	Solitary Male	20.00	10.00	4.65	20	4.0
		Male inflorescence	10.00	8.75	3.82	18	4.0

DISCUSSION

CHAPTER V

DISCUSSION

The results obtained from the studies on growth, bearing habits and temporal dioecism in ridge gourd are discussed hereunder.

5.1 GROWTH AND BEARING HABITS

Studies on growth habits of different order branches showed that number of nodes present on main axis were higher than average number of nodes per branch on both primaries and secondaries (Table 2). This indicated that the main axis is vigorous than both primaries and secondaries.

Regarding the number of primaries produced per vine, it was observed that the line with maximum and least number of primaries produced almost similar yield. The lines LA-46 and LA-99 were observed with this tendency (Tables 2 and 27). Though more number of primary branch production per vine was observed in the line LA-46 the number of nodes per branch on both primaries and secondaries was higher in LA-99. Because of less number of nodes per branch in the line LA-46 the potential bearing area gets reduced. This leads to increase in the inter nodal length and ultimately the

source gets reduced while the sink remains the same. Further, the resources required for branch production will be higher compared to that of flower production. It was reported that in a number of species the photosynthates are not evenly distributed to all reproductive shoots, but each flower and fruit predominantly utilises metabolites from adjacent leaves (Wardlaw, 1968 ; Mooney, 1972). When the source gets reduced, the flowers and fruits will be deprived of resources and huge shedding will be there. The reproductive organs of a plant compete with other major sinks, including shoot apices, roots and organs of vegetative production. The line LA-46 with profuse vegetative growth may not be able to provide sufficient resources for reproductive phase.

The studies on the appearance of the first flower revealed that in the line LA-15 the first female flowers appearance was noticed at earliest node on all the types of branches in both the seasons, it produced comparatively lesser yield than other lines (Tables 3, 10, 17 and 27). Due to the meagre number of nodes on all the branches in this line the inter nodal length is more, hence the potential bearing area and the source gets reduced. As the flowers and fruits draw their resources from adjacent leaves (Mooney, 1972) the flowers and fruits will be deprived of resources due

to lack of source, as a result natural abscission takes place.

The studies on number of female flower production showed that the yield difference was meagre between the lines with maximum and minimum female flower production on main axis (Tables 5 and 27). The line LA-89 produced comparatively more number of flowers on all the types of branches than the line LA-43. The line LA-43 produced more number of nodes with exclusive male flowers. This indicates that the line LA-89 produced more number of female flowers in combination with male flowers at a single node. It was reported that more resources are required for female flower production than for male flower (Gross and Soule, 1981). It is apparent that for the production of both female and male flowers at a single node more resources are required than for the production of exclusive sexes. The line LA-43 with lesser number of branches and female flowers will be able to divert its resources to fruit set and development whereas the line LA-89 can provide meagre resources for the fruit set and development. Naturally this leads to abscission of the fruits.

When productivity of the different order branches were compared, the productivity of main axis was higher than primaries and secondaries. Main axis

produced more number of nodes than primaries and secondaries (Table 26). So the total number of leaves produced will be more on main axis leading to higher source potential than primaries and secondaries. When both the seasons i.e. summer and winter were compared, it was observed that more yield was recorded during winter season. The number of nodes on main axis were more during winter. It was reported that pistillate flower production occurred at earlier node under short photoperiods (Bukovac and Wittwer, 1961). In the present studies also similar trend was observed i.e. the first female flower appearance was noticed at earlier node during winter than summer. With more number of nodes on main axis and almost equal number of primaries and secondaries and with the high average number of nodes on both primaries and secondaries in winter season the yield was high.

In the present investigation, it was observed that the yield difference was meagre between the lines recording maximum and minimum number of nodes on main axis (Tables 2 and 27). The lines Jaipur Long and LA-15 were observed with this type of behaviour. Comparatively more vegetative growth was produced in Jaipur Long than LA-15. The line LA-15 produced the first female flower at earliest node. It is evident that the line LA-15 has put up sufficient vegetative

growth by the time the first female flower appeared and possibly could divert its resources towards reproductive phase, whereas the line Jaipur Long continues to spent its resources on the vegetative phase at the cost of reproductive phase.

In the present studies it was observed that the lines LA-43 and LA-17 with equal number of secondaries per vine in both the seasons, produced more yield during winter and summer seasons respectively (Tables 2 and 27). More number of female flower production was observed during winter season in LA-43 while the line LA-17 produced more number of female flowers during summer season. Significantly more yield was produced during winter season in LA-43 while the line LA-17 produced more yield during summer season. The lines during adverse environmental conditions completed the vegetative growth by the time the first female flower appeared and adapted a pessimistic reproductive approach (rapid achievement of maximum reproductive growth in the adverse environment) as stated by Zeide, (1978).

The line LA-46 with equal number of flowers on main axis, in both the seasons, produced more yield in winter than summer (Tables 4 and 27). The vegetative growth was more during winter than summer in this line. The first female flower appearance was noticed at an

earlier node during winter in this line. Besides higher source potential in this line, it has put up sufficient vegetative growth by the time the first female flower appeared and diverted all its resources towards the reproductive phase in winter season.

The above discussion can be linked to theory of resource allocation. According to this r-selection species will have short life expectancy and large reproductive effort, whereas the k-selection species will have long life expectancy and small reproductive effort (Mac Arthur and Wilson, 1967). According to this the line LA-15 exhibited r-selection strategy in both the seasons. The lines LA-46, LA-17 and LA-43 exhibited r-selection strategy during summer season but the same lines with late initiation of female phase and more vegetative growth adopted k-selection strategy during winter season. Similar observations in Pusa Nasdar variety of ridge gourd were reported by Varalakshmi (1992).

It was observed in the present studies that accessory buds were produced in ridge gourd which is evident by production of female and male flowers at the same node. It was reported that the leaf axils of cucumber have accessory buds (Frankel and Galun, 1977). They reported that whenever the first floral bud is male, additional buds of that axil develop into male

flowers. However, female flowers are usually borne individually, and if additional flowers occur and develop to anthesis, they will be either female or male. But in the present studies it was observed that the female flower production occurred mostly in combination with male flowers on all the branches. Cytokinins are known to induce axillary bud production (Wickson and Thimmann, 1958).

Sex differentiation in cucurbits mostly influenced by growth hormones. When the young leaves from monoecious cucurbits were removed, it resulted in masculinization. This may be due to the removal of auxin source. When the synthetic auxins were supplied more feminization occurred. (Galun, 1959). Similarly when the level of endogenous gibberellins is more it will lead to the production of male flowers (Atsmon, Lang and Light, 1968). The application of kinetin caused a tilt towards femaleness (Catarino, 1964). The application of growth inhibitors have male sterilizing effect. The hormone level in the individual bud rather than at a particular node at a particular time and space might influence the occurrence of accessory buds and their differentiation in cucurbit species.

When different order branches were compared with this type of behaviour, main axis produced maximum number of accessory buds than primaries and

secondaries. It was also observed that 3 types of flowers were produced (Female, male inflorescence and solitary male) at a single node on main axis which was absent on both primaries and secondaries. Over 10 percent of nodes exhibited this type of behaviour. It was already discussed that the production of more than one sex at a single node involves lot of resources than the production of one sex, which will have its effect at a later stage on bearing due to depletion of resources. The main axis with high resource status will be able to meet the demand for the production of all the types of sexes.

5.2 CORRELATION STUDIES

Yield is a complex character. Direct selection may not give good results in any crop improvement programme, hence correlation studies between yield and other economic traits which are otherwise simple are of immense help in selecting suitable plant type. However, the number of independent variables influencing a particular dependent variable is increased, certain amount of inter dependence arises among independent variables. Under such complex situation, the correlations alone are insufficient to explain the true association for an effective manipulation of the characters. In such a

situation path analysis furnishes a method for separating out the direct and indirect effects so as to measure the relative importance of the causal factors involved. Such studies were carried out in the present investigation and the results of the important characters are discussed briefly hereunder.

Among the thirteen characters studied, yield per plant exhibited strong positive association with number of fruits per plant (Table 30). The most important yield attributes viz., length of main axis, number of nodes on main axis, number of nodes on primaries, number of nodes on secondaries, number of nodes bearing female flowers on main axis, number of nodes bearing female flowers on primaries, number of nodes bearing female flowers on secondaries, number of nodes bearing male flowers on main axis, primaries and secondaries contributed positively to the yield. Such association of the above yield components with yield was reported by Reddy and Rao (1984) and Thamburaj (1973). This type of strong positive association between yield and number of fruits per plant indicate that the breeder should give due weightage for these characters in selection, by which the yield of the ridge gourd can be improved.

Length of main axis showed significant positive association with number of nodes on main axis

and number of nodes bearing females on main axis. Number of nodes on main axis showed significant positive association with number of nodes bearing female and male flowers on main axis. Number of nodes on primaries showed significant positive association with number of nodes bearing female flowers and male flowers on primaries. In the same way, number of nodes on secondaries showed significant positive association with number of nodes bearing female flowers and male flowers on secondaries. Number of nodes on secondaries showed strong positive association with number of fruits per plant.

Number of nodes bearing female flowers on main axis, primaries and secondaries showed significant positive association with number of nodes bearing male flowers on main axis, primaries and secondaries respectively.

The character association studies revealed that yield per plant was positively correlated with length of the main axis, number of nodes on main axis, primaries and secondaries, number of nodes bearing female flowers on main axis, primaries and secondaries number of nodes bearing male flowers on main axis, primaries, and secondaries and number of fruits per plant. Ridge gourd improvement in this line will directly influence the productivity of the crop.

The significant positive association of number of fruits per plant with yield was due to its positive direct effect on yield per plant (Table 31). Other positive direct effects on yield were shown by length of main axis, number of nodes on main axis, primaries, number of nodes bearing male flowers on main axis, primaries, average fruit weight.

The direct effect of number of nodes on secondaries, number of nodes bearing female flowers on main axis, primaries and secondaries, number of nodes bearing male flowers on secondaries were negative with the yield per plant.

The positive indirect effects number of fruits per plant, through length of main axis, through number of nodes on main axis, primaries, number of nodes bearing male flowers on main axis, primaries led towards the positive association of these traits with yield per plant. This indicates the importance of these characters in selection programmes for selecting high yielding lines.

The indirect effects on yield per plant was negative through number of nodes on secondaries, through number of nodes bearing female flowers on main axis, primaries and secondaries, through number of nodes bearing male flowers on primaries and through average fruit weight.

Number of fruits and average fruit weight in addition to having high positive direct effects on yield, influence other characters to a greater extent through their indirect effects also.

Thus, both correlation and path coefficient studies revealed importance of these two characters during the selection of high yielding lines. Hence, selection can be practiced in the desirable direction by considering the characters with high positive direct effect and indirect effects on total yield through component characters.

5.3 STUDIES ON TEMPORAL DIOECISM

The study on the initiation of primaries branches revealed that they were generally initiated at earlier node during summer (7.90) than in winter (8.66).

Average number of primaries produced were 4.22. A maximum number of primaries were produced at alternate node and each node on main axis followed by of the branches at 2 nodes interval.

Secondaries were initiated at an earlier node in summer (5.93) than in winter (7.21). Number of secondaries produced on primaries at each node was maximum in winter (72.83 percent) than in summer (51.23

percent) followed by at one node interval (48.00) in summer and (26.85) in winter. There was no production of secondaries at 2 nodes and above 2 nodes interval on primaries. The number of second order branches were 3.24 on an average.

Maximum number of male inflorescence were produced at alternate node interval in both summer and winter seasons (32.27 and 33.29 percent) followed by at each node in both seasons (28.56 and 30.90 percent). The male inflorescence production at 2 nodes and above 2 nodes interval was minimum in both the seasons. Regarding the solitary male flower production also similar trend was observed i.e., maximum number of solitary male flowers were produced at alternate node interval and at each node on main axis. This indicates that maximum male flowers were produced at initial nodes and almost regularly on main axis.

Data regarding flowering on primaries reveals that male inflorescence were produced mostly at each node followed by one node, two nodes and above 2 nodes interval. Similar trend was observed regarding the solitary male flower production also on primaries. This indicates that the production of male flowers was almost regular on the primaries.

On secondaries, production of both male inflorescence and solitary male flowers was maximum at

each node followed by alternate node, 2 nodes and above 2 nodes interval, indicating that production of male flowers was at earlier nodes and was almost regular on secondaries.

The pattern showed that male flowers were initiated at earlier nodes on main axis, primaries and secondaries, and were produced almost regularly on all the types of branches.

Female flower production started at higher nodes compared to the male initiation. Female flower initiation on main axis was at (11.13). Data on the interval of female flower production on main axis revealed that maximum number of female flowers were produced at each node (90.03 per cent) least number of female flowers at above 2 nodes interval on main axis (9.75 per cent). These observations on male and female flower production on main axis shows that only male phase existed at the initial stages until the appearance of female flower, then the female phase started in combination with male phase finally female phase predominated in ridge gourd. Frankel and Galun (1977) reported similar flowering pattern in cucumber.

The interval of female flower production on primaries showed that maximum number of female flowers were produced at each node interval (80.76 percent) followed by above 2 nodes interval (15.85 percent).

With respect to the female flower production on secondaries, the initiation was at earlier node (8.24) when compared to main axis and primaries. After initiation most of the female flowers were produced at each node interval (82.99 per cent) followed by above 2 nodes interval (16.98 per cent) in summer and winter seasons respectively.

The observations on the flowering pattern on main axis, primaries and secondaries shows that the female flower production was at higher nodes and was almost regular on all the types of branches. The production of female flowers was more or less regular at each node on primaries and secondaries when compared to main axis. This type of production of female flowers was also observed by Frankel and Galun (1977) in cucumber.

Temporal dioecism is the temporal alternation of staminate and pistillate functions within an individual during a single flowering seasons (Cruden, 1988). It has a broad taxonomic distribution and is clearly polyphyletic. Its occurrence was noticed in atleast 37 families and expected to exist in cucurbitaceae (Murawski and Gilbert, 1986).

In general, three major groups of flowers are commonly found along a shoot of monoecious acorn squash

and cucumber (Zamaski and Rudich, 1988), first male flowers appear at the shoot base, then a mixed phase of female and male and finally a female phase of flowers near shoot apex. There is gradual increase in feminization towards the top of the shoot, with a concomitant reduction in male flowers.

In the present investigation on the flowering pattern in ridge gourd, it was observed that the staminate phase started at earlier node (4.77) of the main axis and female flower production started at higher node (11.13). Later, the production of male and female flowers was intermixed on the main axis. The male flower production on primaries started at an earlier node than female phase. Thus, staminate phase started earlier on primaries than pistillate phase and further, an intermixed phase of staminate and pistillate flowers continued. The production of female flowers was more or less regular at each node.

Temporal dioecism is reported to be strongly associated with monoecism and compatibility (Cruden, 1988). Temporal dioecism is to be expected in monoecious families because the flowering sequence within single inflorescence/plants assures temporal separation of sexual function. In ridge gourd, male flower production i.e. staminate phase started first on main axis and later it intermixed with pistillate phase

on main axis and primaries. Finally predominantly pistillate phase of flowers occurred on the secondaries. This alternation of staminate and pistillate flower production occurring in ridge gourd falls under additional temporal phenotypes enumerated by Cruden (1988). It appears to be similar to duodichogamy in which a staminate phase followed by pistillate phase and a second staminate phase described by stout (1928).

Temporal dioecism in plants is a form of mating system, it is comparable to heterostyly and dioecism and minimizes geitonogamy (Jos et al, 1980; Henderson, 1984 and Cruden, 1988).

In the present study on temporal dioecism in ridge gourd, it was observed that both male and female flowers were intermixed after the initiation of female flower and open more or less at the same time. Similar observations were made by Cruden (1988) in carex species (Cyperaceae), which is a monoecious species.

The phenotypes of facultatively xenogamous relatives of temporally dioecious species are characterised by an overlap of sexual function either within and or between inflorescence. Facultative xenogamy has evolved in a number of phyletic lines, and most facultatively xenogamous species flower at a time

or in habitats where pollinators are unreliable, conditions that favour the evolution of facultative xenogamy (Cruden, 1977). In ridge gourd the spatial separation of male and female flowers on branches, leads to xenogamy i.e. facultative xenogamy which prevents or minimizes geitonogamy.

Temporal dioecism occurs primarily in genera and families characterised by self compatibility and this is considered as being evolutionary alternative to self incompatibility. Though there is no evidence that ridge gourd is self compatible, Bose and Som (1986) reported that about 20-40 per cent of self pollination occurs in cucurbits. From these observations it can be presumed that the temporal dioecism in ridge gourd is a facultative xenogamy-a mating system.

The evolution of sexes in plants is commonly explained as an adaptation that enforces out crossing and the selective advantage of out crossing is hypothesised to lie in the production of a varied progeny for a varied environment (Lloyd, 1974; Levin, 1975; Williams, 1975; Treisman, 1976 and Smith, 1976). Temporal dioecism is reported to be an evolutionary alternative to self incompatibility and facilitates xenogamy, minimizing geitonogamy (Forde, 1975; Madden and Malstorm, 1975; Jos et al, 1980; Henderson, 1984). In the present study, it is established that temporal

dioecism existed in ridge gourd and that it facilitated facultative xenogamy. The difference between the growth pattern and temporal dioecism between the seasons led to speculate that temporal dioecism is an adaptive strategy to maximize the reproductive effort.

The plant selection strategies and their resource allocation can be further understood by the following concepts. Pollen grains are typically smaller than ovules and presumably cheaper to produce than ovules (Darwin, 1871). The reproductive organs of a plant compete with other major sinks including shoot apices and other vegetative organs. The reproductive investments must be coordinated with the other activities of the plant. The delayed outset of female phase and less fruit set on main axis has increased the proliferation of primaries and secondaries, accumulating the resources with these. Heslop and Harrison (1957) and Frankel and Galun (1977) reviewed a number of instances in which high light or nutrition levels favoured the production of female flowers, suggesting that females are produced when stress is lacking. This type of favour towards femaleness under high resource status might be due to the large reproductive effort of the species in seeds, fruits, and associated structures. With the increased resources available in the later phase of plants life

with primaries and secondaries accompanied by a late female phase maximized the reproductive gains for the plants through increased fecundity. Such a strategy of maximization of reproductive success and reallocation of resources has been reported in Croton bonplandianum Baill by Uma and Ganeshaiah (1984).

In the experiment to study the effect of pollen from various sources on fruit and seed characters, crosses involving 6 lines (LA-46 x Jaipur long, GKVK x Wardha local, LA-99 x Bijapur local) and reciprocal cross (LA-17 x LA-32) and selfings for two lines (LA-17 and LA-15) were made. It was observed that the pollen from solitary male flower produced maximum fruit weight, length, girth, seed number per fruit and seed weight in all the fruits obtained by above crosses than with the pollen from male inflorescence. The maternal and paternal investments that a plant makes are subdivided into many separate units - inflorescences, flower primordia, single flower and fruit. The male inflorescence consists of numerous male flowers, hence the resources available to male flowering unit in an inflorescence may also change as a result of paternal investment itself and depletion of resources. Hence the solitary male flower as a single flowering unit could tap more resources than a male flowering unit in an inflorescence which has to compete

with other flowers in the same inflorescence for resources.

The fruits obtained from crossing between the lines LA-17 and LA-32 recorded maximum fruit weight than others when LA-32 was used as pollen parent and with solitary male was the sources of pollen (Table 44). Similarly maximum fruit length and girth were recorded in the fruits obtained by crossing the lines LA-46 and Jaipur Long as pollen parent and solitary male flower was used as pollen source (Table 44). With more amount of resources accumulated in the solitary male flower the pollen from it will be more effective than the pollen from male inflorescence. Further, it was reported that the investments in each developmental unit are independent of each other, since the investment units compete for resources and their relative conditions may be largely determined by their position on the plant (Lloyd, 1980). So the fruits recorded maximum fruit weight, fruit length and girth might be in a favourable position and could tap more resources than others.

The fruits obtained from the crossing of LA-17 and LA-32 with pollen from LA-32 recorded maximum number of seeds and seed weight, solitary male as source of pollen (Table 44). It was reported that, to succeed in producing seeds, maternal investment in

gynoecium must continue over a prolonged period that encompasses the initiation of flower, and the development of gametes (Ashton, 1975). Besides, the efficiency of pollen from solitary male flower the line LA-17 which was used as female parent produced moderate number of female flowers and vegetative growth and could spend its maternal investments in gynoecium over a prolonged period.

SUMMARY

CHAPTER VI

SUMMARY

The growth, bearing habits, character association through correlation and path analysis for 13 characters and temporal dioecism in a collection of eleven genotypes of ridge gourd Luffa acutangula (Roxb) L. were studied during summer and winter seasons, 1992 at Students Farm, College of Agriculture and Agricultural Research Institute, Rajendranagar, Hyderabad. The results of these studies are summarised as follows.

Significant variations were observed for most of the characters among the genotypes studied. Significant differences were also observed between the seasons for some characters.

In the present studies it was observed that the accessory bud production occurred in ridge gourd. It was more on main axis than on primaries and secondaries. On main axis all the sexes female, male inflorescence and solitary male were produced at a single node and this phenomenon is absent on primaries and secondaries.

Character association studies revealed that yield per plant was significantly and positively

correlated with number of fruits per plant. It was positively correlated with number of nodes on main axis, primaries and secondaries, number of nodes bearing female flowers on main axis, primaries and secondaries, number of nodes bearing male flowers on main axis, primaries and secondaries. Selection based on these traits would help in improving the yield in ridge gourd.

Path analysis studies revealed that number of fruits per plant exhibited significant positive direct effect on yield per plant. Other positive direct effects on yield were shown by length of main axis, number of nodes on main axis, primaries, number of nodes bearing male flowers on main axis, primaries and average fruit weight.

Number of fruits per plant and average fruit weight in addition to having high positive direct effects on yield, influenced other characters to a greater extent through their indirect effects. This emphasised the importance of these characters in the identification of high yielding genotypes.

The studies on general growth pattern and branching in ridge gourd revealed that the primaries and secondaries were generally initiated at an earlier node during summer than winter. Most of the primaries

were produced at each node and at alternate node only with a minimum number of primaries produced at 2 nodes interval.

Sixty per cent of the secondaries were produced at each node interval on primaries. The secondaries production was almost regular at each node of primaries.

In ridge gourd, first male flower produced at the initial nodes of the main axis and their further production was more or less regular at every node. Similar trend was observed on primaries.

On main axis, female flower production started at higher nodes and about 90 per cent of the female flowers were produced at each node.

Regarding the flower production on primaries, the initiation of female flowers was at later nodes on primaries than on secondaries, their production interval was regular on both primaries and secondaries.

In ridge gourd, male or staminate phase started first on main axis, then female phase which intermixed with male phase on main axis and primaries and finally female phase predominated on secondaries. This alternation of staminate and pistillate flower

production established the existence of temporal dioecism in ridge gourd.

During the present investigation it was observed that the line LA-15 in both the seasons maximised its reproductive efforts under temporarily available environments i.e., the line adopted r-selection strategy in both the seasons. The lines LA-43, LA-17 and LA-46 adopted r-selection strategy during summer season. During winter the same lines with the late initiation of female phase and increased vegetative growth adopted k-selection strategy.

Pollination studies conducted to know the effectiveness of pollen sources on fruit and seed characters, revealed that the pollen from solitary male flower was effective than the pollen from male inflorescence.

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* Originals not seen.

APPENDICES

Appendix-1 : Meteriological data during the period of investigation (April 1992 to October 1992)

Period Month	Standard week	Temperature °C		Relative humidity		Sunshine (hours)	Total Rain fall (mm)
		Maximum	Minimum	7.14hrs	14.14hrs		
Summer							
15.04 to 21.04	16	38.3	23.9	45	21	9.9	4.7
22.04 to 28.04	17	37.7	23.6	54	22	10.1	7.1
29.04 to 04.05	18	39.3	24.8	46	17	10.1	4.2
05.05 to 11.05	19	38.8	24.6	51	19	8.1	3.1
12.05 to 18.05	20	40.4	24.1	48	15	10.4	7.3
19.05 to 25.05	21	40.6	25.7	45	17	10.6	6.4
26.05 to 01.06	22	38.9	24.3	59	26	7.7	6.0
02.06 to 08.06	23	39.3	24.2	46	19	10.3	13.4
09.06 to 15.06	24	37.4	24.8	53	22	8.9	13.9
16.06 to 22.06	25	31.5	22.9	73	46	2.0	30.7
23.06 to 29.06	26	32.4	22.2	77	39	6.7	28.4
30.06 to 06.07	27	33.4	23.0	68	33	7.8	28.4
Winter							
07.07 to 13.07	28	32.8	23.4	70	33	7.5	35.5
14.07 to 20.07	29	31.0	22.7	76	34	6.3	33.0
21.07 to 27.07	30	31.0	23.0	77	41	4.1	34.1
28.07 to 03.08	31	30.5	22.3	76	41	5.4	42.8
04.08 to 10.08	32	30.1	21.9	81	46	4.1	33.4
11.08 to 17.08	33	30.5	21.8	85	56	2.2	34.5
18.08 to 24.08	34	29.7	22.4	77	50	6.2	43.4
25.08 to 31.08	35	29.5	22.1	78	46	4.7	21.2
01.09 to 06.09	36	30.3	22.9	80	46	6.0	29.4
07.09 to 13.09	37	31.9	21.9	85	38	6.9	34.7
14.09 to 20.09	38	32.2	22.9	66	33	9.3	23.0
21.09 to 27.09	39	31.7	20.8	72	34	9.8	45.9
28.09 to 04.10	40	31.0	20.0	71	38	7.0	37.2

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