EFFECT OF TIME OF PLANTING ON THE GROWTH AND FLOWERING OF POPULAR BEDDING PLANTS

BY

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Dedicated to my beloved parents

and sisters

DECLARATION

I hereby declare that this thesis entitled "Effect of time of planting on the growth and flowering of popular bedding plants" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associate-ship, fellowship or other similar title, of any other University or Society.

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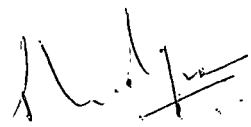
CERTIFICATE

Certified that this thesis entitled "Effect of time of planting on the growth and flowering of popular bedding plants" is a record of research work done independently by Smt. ROSE MARY JOICE under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.



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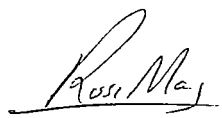

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INTRODUCTION

INTRODUCTION

Flowers are among the loveliest of all objects on the earth. Nothing quite equals the sheer pleasure of strolling through a garden, surrounded by masses of vibrant flowers. Gardening in its various forms is a tradition that spans hundreds of years and all continents. Yet, it is an ever-changing creative process too.

Bedding plants provide you and your garden with an overflowing oasis of beauty for a modest price. Their rewards are quick bringing and you get a new look to your landscape in a few weeks. Bedding plants can be used as a landscape material of a very special nature as plants to delight the gardener who enjoys colour. Growing bedding plants allow you the freedom of changing your mind and your colour scheme every growing season. Most bedding plants also boast the virtue of 'plant and forget' rarely needing more care than an occasional drink of water. The bedding plants chosen for the study were Marigold, Zinnia, Balsam, Phlox and Salvia.

Marigold is an important flower crop grown extensively in India. It is very popular amongst flower growers because of its easy culture and low cost of production. These annuals have wide adaptability to different soil and climatic conditions. These plants bloom for a long period

and the flowers keep remarkably well when cut. All these favourable points make marigold as one of the most popular annual flowers in India, for garden display as well as for commercial cultivation. They can be planted in beds for mass display in mixed border and can also be grown in pots. They are very suitable for hanging baskets, window boxes, rockeries and edgings. The cut flowers are used for making garlands, for floral arrangements andother indoor decorations and for religious purposes.

Zinnias are cultivated extensively as an annual garden plant. It has high commercial value because of the wide range of variation in its flower colour, size, shape and blooming period. The Zinnias are one of the most brilliant coloured annuals grown in the garden and are most suitable as cut flowers which last long. Zinnias are very easy to grow. These annuals provide a beautiful display of colour in the garden.

Balsam is a common bedding plant cultivated as an annual garden plant. This is best suited for growing in beds and pots. This is also grown along paths and borders. It requires warm sunny situation and rich moist soil.

Phlox is another annual producing small attractive flowers. These plants can be grown in pots or ground, window boxes, hanging baskets and good as cut flowers.

Salvia is an annual producing brilliant coloured flowers. These annuals come in different colours and provide a beautiful display of colour in the garden. Planting time is an important factor determining the growth and flowering of annuals. Proper planting time is critical for successful flowering in plants. Environmental factors like rainfall, temperature, humidity and sunshine affect the growth and flowering of plants.

Considering the above factors, the present study was undertaken with the following objectives.

To find out the effect of time of planting on growth and flowering of bedding plants.

To identify the appropriate time of planting for better growth and flowering.

To study the effect of seasonal variations on the incidence of pests and diseases of bedding plants.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The environmental factors like rainfall, temperature, humidity and sunshine were found to affect the growth and flowering of ornamental plants. The effect of these factors on various aspects of planting time with special reference to ornamental crops are reviewed hereunder.

2.1. Effect of time of planting on germination of seeds

Temperature has the greatest effect on seed germination if there are no other limiting environmental factors. Bullowa *et al* (1975) have reported that the optimal temperature range for germination of De Caen anemones was 10-20°C. Studies were also conducted by Papp and Szabo (1979), Kaspar and Williams (1982) and Cho *et al* (1985). The highest percentage of viability was observed in soyabean at a temperature range of 20-30°C. At lower temperatures germination was slow (Papp and Szabo, 1979). Kaspar and Williams (1982) studied the effect of temperature on the germination of selected wild flower seeds. They found that the optimum temperature for the germination of *Coreopsis tinctoria*, *Linum perenne* and *Asclepias tuberosa* was 30°C, 25°C and 30°C respectively. The optimum temperature for germination of *Aster tartaricus* L. var hortensis ranged from 25 to 30°C (Cho *et al*, 1985).

The effect of time of sowing on germination of seeds was studied by several investigators. The days for germination of direct sown chinaasters (Callistephus chinensis) was determined by Kobza (1981). The seeds were sown at intervals from October to May. It was found that the most suitable time for sowing to get the highest percentage of germination was between 20th March and 10th April. Male and Ivan (1984) compared three sowing dates (November, late March, mid April) for Tagetes signata and observed that November sown seeds failed to emerge. Biermann (1985) had determined the effects of two sowing dates, 1st February and 1st March for Cyclamen Cvs. He found that seeds sown on 1st February produced higher germination percentage.

2.2. Effect of time of planting on plant height

Several studies have shown that the height of the plant was influenced by the time of planting. EL.Gamassy et al (1965) compared the effect of three planting dates on Tagetes erecta and Zinnia elegans. They found that the final plant size in both plants were greater by planting on 15th April than a month later. Good and Corell (1982) reported that November planted coreopsis were smaller than those planted earlier in August, September or October. Carnation plants sown in June and July were comparatively dwarf (40.6 and 42.8 cm) and those sown in October, November

and December were taller (53.3, 50.8, 52.9 cm) (Mukhopadhyay, 1984). Gowda and Jayanthi (1986) and Dongre (1988) have observed maximum plant height in Tagetes erecta when planted in May. Sunflower seeds sown in May, June, July and August during kharif and April during summer were better in growth components than other months in a year (Ujjinaiah et al, 1988).

The seasonal influence on growth of carnation was studied by Bunt (1972) and Klapwijk (1987). Bunt (1972) studied the effect of season on growth rate of carnation and found that the growth rate was low in winter (1 per cent/day) than in summer (4.5 per cent/day). The stem elongation in spray carnation was less in winter (0.1 cm/day) and more in summer (0.5 cm/day) (Klapwijk, 1987).

Photoperiod influences the growth and development of plants. Debraux and Simon (1969) observed in Impatiens balsamina var, Buisson fleuri a reduced vegetative development when the plants were subjected to 8 hr days. Chrysanthemum plants given supplementary illumination from 6 pm to 6 am for 30 days from the date of planting showed increase in plant height (Shanmugam et al, 1972). Carpenter and Beck (1973) showed that plants of Zinnia given long days were taller than those given short days. Similar results were obtained by Han and Yeam (1978) in

Zinnia, Tagetes and Salvia and by Boyle and Stimart (1983) in Zinnia.

Sawhney et al (1981) reported that an increase in photoperiod beyond 12 h promoted extension growth in Calendula officinalis. Geranium seedlings grown under 13 h photoperiod were 23 per cent taller than those grown under 9 h photoperiod (Merritt and Kohl, 1985).

Temperature is an important factor that influences the growth of plants. Krizek et al (1972) have determined the effect of day and night temperature on Ageratum, Petunia and Tagetes. These annuals were grown in three D/N temperature regimes such as 18/12°, 24/18° and 30/24°C and they found that a D/N temperature of 30/24°C was optimal for early seedling growth based on stem elongation, dry matter accumulation and leaf area production. Similar studies were conducted by Bonaminio and Larson (1978), Fayyaz et al (1983), Ellis (1986), Kaczperski and Carlson (1988). Bonaminio and Larson (1978) have shown that stem elongation in Chrysanthemum morifolium decreased as the D/N air temperature decreased from 30/26 to 18/14°C. The shoot growth, root length and dry weight increased in chrysanthemums with warm (24°C) compared to cool (8°C) temperature. Fayyaz et al (1983) and Ellis (1986) have reported that higher growing temperature gave bigger plants in Begonia, Impatiens and

Salvia. Cool temperatures below 20°C decreased the total plant height in Petunia (Kaczperski and Carlson, 1988).

2.3. Effect of planting time on the number of days to flower and flowers per plant

Several studies have shown that number of days to flower and also the number of flowers per plant are influenced by the time of planting. Bunt and Sheard (1967) have studied the effect of time of planting (July, September, January and March) for carnation Cvs William Sim and White Sim. They found that the July and September planting produced significantly more flowers than others. Jauhari et al (1972) studied the response of phlox, Calendula and Dianthus to different dates of sowing. Seeds were sown at 10 days intervals from 21st August and found that plants from first sowings grew and flowered better than later sowings. The effects of planting dates on growth and flowering of Snapdragon (Antirrhinum majus), was studied by Das and Das (1981). Seedlings of Cv. Tip Top white were planted in pots at monthly intervals between 15 August and 15 February and found that October middle planting gave maximum number of flowers (261) followed by November middle planting. Mukhopadhyay and Banker (1981) compared the effect of planting dates between January to December on growth and flowering of tuberose cv - single and found that maximum number of spikes per plant (2.1 - 2.7) was obtained from April or May planting.

The number of days taken for flowering varied with different planting dates. The seeds of bedding plants like Antirrhinum, Celosia, Dahlia, Impatiens, Salvia and Tagetes were sown at intervals between December and May and it was observed that the time between sowing and anthesis decreased with later sowing dates. This was reported by Armitage (1983). Khanna and Gill (1983) while comparing 3 planting dates (mid August, mid September, mid October) for Gladioli, noticed that earlier planting resulted in earlier flowering. Planting of Tagetes erecta in May resulted in lates flowering (Dongre, 1988).

Mukhopadhyay (1984) found that the mean yield of flowers per plant in carnation was better when sown in October, November and December (18.8, 17.7, 18.5) and those sown in June, July and January (15.6, 16.5, 13.7). Chrysanthemum morifolium Ramat cvs yellow paragon and Copper Ann, when planted in January and February produced more flower stem breaks and greater flower weight compared to October and November planting (Hickbenton and Mc Rae, 1984). Matous (1985) found that highest total cut flower yields were produced by planting on 19th May or 14th July in Gerbera. The effect of planting dates (April to August) on Polyanthes tuberosa cv La Perla and Fiorentina was compared by Farina and Paterniani (1986). The highest flower production was obtained from early June planting for

La Perla and from early May planting for Fiorentina. Gradner and Reimherr (1986) studied the effects of 5 seedling planting dates between 17th July and 9th September for Anemone cv Monalisa and found that early planting produced highest yields. September sown Marigold (Tagetes patula) recorded the highest flower yield of 15.35 t per ha followed by November sown plants (12.32 t per ha) (Gowda and Jayanthi, 1986). Dongre (1988) reported that planting of Tagetes erecta in September gave maximum number of flowers per plant. The effect of planting dates on outdoor cut flower production of Celosia and Zinnia was studied by Aker and Healy (1988). Seedlings were planted on 19, and 27, May, 4 and 30, June and 16, July. The production of marketable Celosia stems was increased by planting after 4 June and Zinnia production was optimised by 19 May planting.

In long day plants, earlier flowering was noticed in long days and delayed flowering in short days. Huges and Cockshull (1966) have noticed earlier flowering in bedding plants like Antirrhinum, China aster, Pansy, Petunia and Phlox by a night break lighting of 2 hr period. Earlier flowering in Pelargonium by 2-4 days was observed by Bachthaler (1968) when natural day length was extended to 16 hrs. Welander (1984) studied flowering in Aeschynanthus speciosus in short days (8 h) and long days (20 h) combined with 12, 15, 18 or 21°C. An increase in per cent flowering

plants and a decrease in the time for first flower opening was noticed in long days and with increasing temperature. Pentas lanceolata flowered 7-10 days earlier in long days than in short days (Armitage, A.M. 1988).

In short day plants, short days advanced flowering and long days delayed flowering. Duda (1967) has shown that short days advanced flowering by 22 days and short days plus twilight delayed flowering by 10 days in Tagetes erecta and Zinnia elegans. Light interruptions of long inductive dark periods delayed the initiation of floral buds and their development into flowers and decreased the flower number in Impatiens balsamina (Sawhney and Tewari, 1969). Aung (1976) while studying the effect of photoperiods and temperature on vegetative and reproductive responses of Lycopersicon esculentum, noticed that the flower number was increased by short photoperiods and the days to first anthesis were decreased by short photoperiods and D/N temperature of 26°/22°C compared to long photoperiods and D/N temperature of 18/14°C. Simmonds (1982) observed earlier flower initiation and greater degree of flowering in New Guinea Impatiens hybrid cv Starburst at 8 and 14 hr photoperiods than in 18 hr photoperiods.

High temperature induces early flowering and low temperature causes delayed flowering in most of the plants.

Bedding plants like Petunia, Tagetes, Ageratum and Salvia raised at temperatures between 12 and 24°C from sowings made on 6th February, 2nd March and 20th March and shown that raising the seedlings at 15°C or below delayed flowering by about 4 weeks and flowering was earliest by raising at 24 or 21°C (Walla, 1973). Mastalerz (1978) observed delayed flowering by 2 or 6 days in poinsettias by lowering the temperatures to 10° or 15.5°C for 28 days when compared to the effect of growing at 21.1°C throughout. Cornover and Poole (1981) observed that plants of Saintpaulia ionantha placed under 2 klx flowered after 3 months while plants placed under 1 klx flowered after 6 months. Shading in Chrysanthemums reduced the number of flower heads and delayed flowering (Nell et al, 1981). Kawabath et al (1984) observed a retarded floral differentiation and subsequent elongation prior to flower emergence in Sterlitzia reginae at low temperatures (14-16°C). High temperatures (20/18°C) and 5 h) night interruptions at 100 lx. advanced flowering and induced flower production in Impatiens repens (Reimherr, 1984).

In some plants reduced temperature treatments increased the number of flowers produced (Jungbauer, 1974). Jungbauer (1974) reported that reduced temperature treatments (20 or 16°C reduced from 24°C) in Gloxinias increased the number of flowers per plant compared to plants raised at constant

temperature of 24°C. In a trial with Impatiens wallerana var. Petersiana, Zimmer (1980) observed that the flowerbud formation was greatest at 18°C. But in plants like Marigold higher temperatures promoted flowering. Summerfield et al (1977) noticed in Tagetes patula, that warmer nights from pricking out promoted flowering.

2.4. Effect of time of planting on number of branches

The effect of planting dates on the number of branches produced was studied by several Scientists. Mukhopadhyay (1984) observed more branches in carnations when raised in October (12.8), November (12.7) and December (14.7). Maximum branching in Chinaaster was obtained with 1st July planting (Ramachandra, 1987). Dongre (1988) observed maximum plant spread in Tagetes erecta when planted in May.

Photoperiod and temperature influences the branching in plants. Aung and Austin (1971) found that axillary shoot growth of tomato was promoted by short days. Heins et al (1979) reported that short photoperiods enhanced lateral shoot development and long photoperiods retarded lateral shoot development in Dianthus caryophyllus. In New Guinea Impatiens hybrid cv Starburst, a promotion of axillary branch elongation was observed in 12 h photoperiods and not in 8, 14 or 16 h photoperiods (Simmonds, 1985).

Maximum branching in bedding plants like Dahlias, Verbenas and phlox was observed when they were raised at a temperature of 15°C (Hildrum, 1973). Haruzochiguchi et al (1987) studied the effects of high temperatures on lateral shoot growth of Salvia and Impatiens. It was found that high temperature treatments retarded primary shoot growth of Salvia and Impatiens. Cool temperatures below 20°C increased the number of lateral branches in petunias (Kaczperski and Carlson, 1988).

2.5. Effect of time of planting on duration of flowering and size of flowers

Planting time is an important factor that affects the duration of flowering and size of flowers. Duration and size of flowers varied with different planting dates. Factors like temperature and photoperiod affects the duration and size of flowers.

Mukhopadhyay (1984) has stated that carnations sown in October and November gave greater flower size and duration of flowering. The productive period for carnations were shortest (2-3 months) with planting from September to April while planting in other times it lasted for 4-5 months (Vakula and Vlasov, 1986).

Ramachandra (1987) has showed that Chinaasters planted in first July gave longer duration of flowering.

According to Dongre (1988), Tagetes erecta planted in May gave maximum duration of flowering and March planting resulted in maximum stalk length and flower size.

Subbaiah et al (1974) has reported that long days increased the flower diameter in Chrysanthemum indicum cv yellow. In 'May Shoesmith' Chrysanthemums, plants grown at 10°C for 9 or 10½ h each night had flowers with greater diameter compared to plants grown at 16°C night temperature (Bonaminio and Larson, 1980). According to Boyle and Stimart (1983) plants of Zinnia elegans grown under long days (14, 16, 18 or 24 h) were greater in flower diameter compared to plants grown under short days (8, 10, 12 h). Norton and Yong (1987) studied the effect of day length on flowering of Meconopsis betonicifolia. They found that plants grown under 8 h days have smaller flowers (5 cm) and total flowering period of 17 days and plants grown under 16 h days have larger flowers, (10 cm diameter) and total flowering period was 36 days.

2.6. Effect of time of planting on flower longevity

Temperature is the most important factor that affects the longevity of flowers. Low temperatures tend to increase the longevity of flowers. High temperatures reduces flower longevity. Bondar and Klyavinya (1976) showed that low temperatures increased the longevity of Carnation flowers

by 40 days. Kusugi et al (1976) has studied the effect of temperatures on the keeping quality of Dutch irises cv. Wedgewood. They grew Irises at night temperatures of 10, 20 and 30°C and observed that at lower night temperature, life of the cut flowers were more. The flower longevity of New Guinea Impatiens hybrid varied from 12.7 days to 5.2 days (Winters, 1977). According to Armitage (1980) the flower petal abscission in geraniums were delayed by low temperature (1-5°C) than at 10° and 21°C. Dipner (1984) reported that the flower longevity of Calathea crocata increased upto 2 months at low temperatures (15°C).

MATERIALS AND METHODS

3. MATERIALS AND METHODS

Investigation was carried out with a view to study the effect of time of planting on the growth and flowering of popular bedding plants. The experiment was conducted during 1988-89 at the Department of Horticulture, College of Agriculture, Vellayani, under the Kerala Agricultural University.

3.1. MATERIALS

The study was started with the following bedding plants.

1. French Marigold - Tagetes patula var Lemonking
   (Family - Compositae)
2. Zinnia - Zinnia elegans var Candy Cane
   (Family - Compositae)
3. Balsam - Impatiens balsamina var Purple Violet
   (Family - Balsaminaceae)
4. Salvia - Salvia splendens var Fire Ball
   (Family - Labiatae)
5. Phlox - Phlox drummondi var Bright Crimson
   (Family - Polemoniaceae)

The seed material was supplied by M/s Sutton and Sons, Calcutta on request. Seeds were sown at monthly intervals in a medium consisting of sand, cowdung and soil mixed in 2:2:1 part by volume. For reason(s) not absolutely known stand of adequate size could not be obtained for

PLATE 1

Marigold var-Lemon king

PLATE 2

Zinnia var Candycane

PLATE 3

Balsam var Purple violet

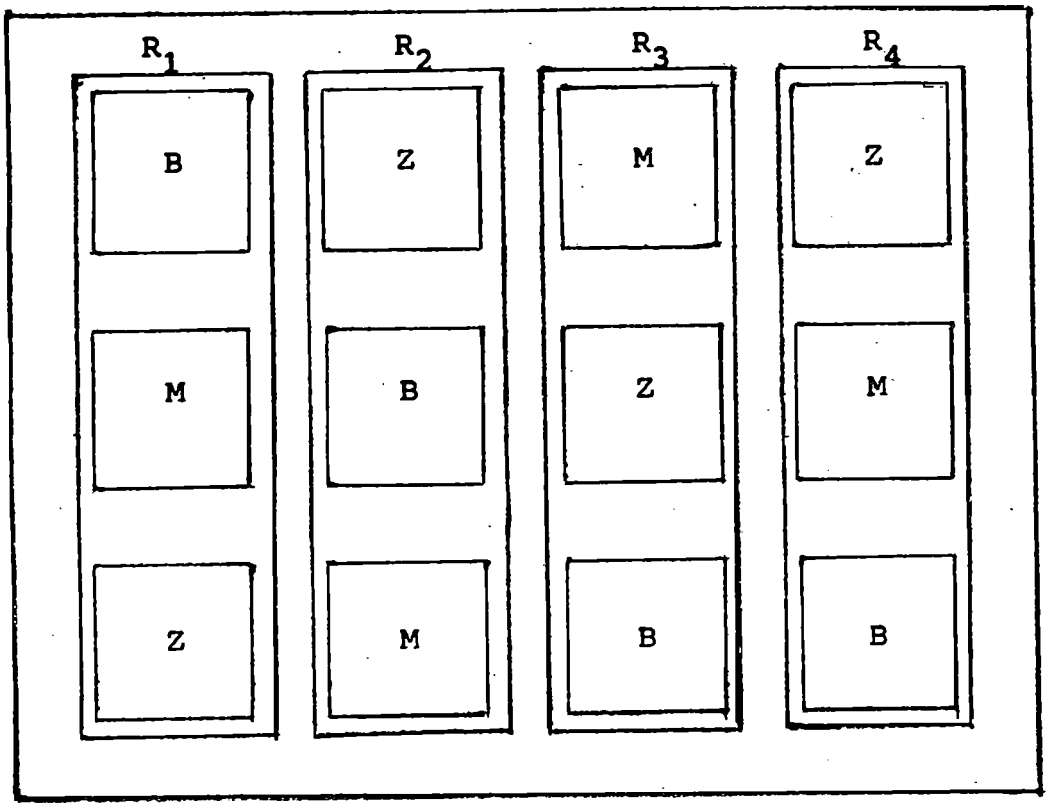
Salvia and Phlox and hence the two crops were not carried over through the remaining part of experiment.

The seeds of Marigold were sown on 3rd and that of Balsam and Zinnia on 8th of every month for 12 months beginning May 1988. Thirty days after sowing seedlings of Marigold, Zinnia and Balsam were transplanted on raised beds of 1.5 m x 1.5 m size. The transplantings were done in separate plots at 30 days intervals.

Cowdung was applied at the rate of 5 kg/bed at the time of preparation of land. Fertilizers in the form of garden mixture (7:10:5) were applied 15 days after transplantation at the rate of 10 gms/plant. The transplanted seedlings were provided with shade and staked to prevent lodging. The plants were irrigated sufficiently at the early stages.

3.2. METHODS

The experiment was laid out in four randomised blocks. The plants were spaced at 30 cm between rows and 30 cm within rows (5 rows of 5 plants in each). Thus 25 plants were accommodated in a bed of which 16 made the border leaving the remaining 9 inside. Data were collected from the inside plants only.



M-MARIGOLD Z-ZINNIA B-BALSAM

Fig 1. Layout plan of the experiment.

3.2.1. Treatments (Time of transplanting)

T_1 - June

T_2 - July

T_3 - August

T_4 - September

T_5 - October

T_6 - November

T_7 - December

T_8 - January

T_9 - February

T_{10} - March

T_{11} - April

T_{12} - May

3.2.2. Observations taken

The following observations were recorded for Marigold, Zinnia and Balsam.

1. Number of days taken for 50 per cent germination of seeds.

The seeds of the bedding plants chosen were counted and sown and the date of sowing was recorded. The number of seeds germinated each day from the date of sowing was recorded and the number of days taken for 50 per cent germination of seeds was computed.

2. Percentage of germination

The seeds were counted and sown. The number of seeds germinated were counted and the percentage of germination of seeds were calculated.

3. Climatological parameters

Climatological observations like rainfall (mm), maximum and minimum temperature (°C), relative humidity (%) and sunshine (hrs/day) were daily collected from the Instructional Farm, Vellayani.

4. Height of the plant

Height of the plant was recorded at fortnightly intervals measured in cm and the mean height was recorded.

5. Number of branches per plant

The number of branches was recorded from each of the observational plant and the average was taken.

6. Number of days to first flower

The number of days taken from the date of transplanting to the date of first flowering for each of the observational plants was recorded and the average was taken.

7. Number of flowers per plant

The number of flowers in each of the observational plant was recorded at fortnightly intervals and average was taken.

8. Size of flower

The size of the flowers was recorded at fortnightly intervals from each of the observational plant by measuring the diameter across the flowers in cm and average was taken.

9. Longevity of flowers

The date of opening of the flowers was recorded by tagging the flowers and the tag was removed on the date of senescence and thus the longevity of flower was computed and their average was taken.

10. Duration of flowering

The time interval between the date of opening of first flower and the date of senescence of last flower in each of the observational plant was recorded and the average duration taken.

11. Incidence of pests and diseases

The incidence of pest and disease were recorded as and when occurred.

3.2.3. Statistical analysis

The mean values for the different parameters were calculated and the data were analysed using the analysis of variance technique for R.B.D. The relationship of climatological parameters with biometric characters were worked out by applying correlation and regression technique.

RESULTS

RESULTS

The experimental data collected from the present study were statistically analysed to bring out the effect of time of planting on the growth and flowering of French Marigold, Zinnia and Balsam.

The results obtained using the mean tables under the present investigation were included in this chapter. The analysis of variance done for all the parameters are given in the appendices.

4.1. French Marigold

4.1.1. Number of days taken for 50 per cent germination of seeds

The data on the number of days taken for 50 per cent germination of seeds are presented in Table 1.

From the table it is clear that sowing in January and April took less number of days for 50 per cent germination of seeds (5 days) followed by March, May, November and December sowings (6 days). July sowing took the maximum number of days for 50 per cent germination of seeds (8 days).

4.1.2. Percentage of germination of seeds

The data on percentage of germination of seeds for 12 sowing are given in Table 1.

Table 1. Effect of time of sowing on the number of days taken for 50% germination of seeds and percentage of germination of seeds in Marigold

Time of sowing	Number of days taken for 50% germination of seeds	Percentage of germination of seeds
May	6	77.7
June	7	74.6
July	8	78.0
August	7	74.8
September	7	75.3
October	7	73.9
November	6	73.6
December	6	74.4
January	5	80.1
February	7	76.8
March	6	76.9
April	5	79.7

It is clear from the table that January sowing gave maximum percentage of seed germination (80.1) followed by April sowing (79.7). October and November sowings gave the least germination percentage of 73.9 and 73.6 respectively.

4.1.3. Plant height

The data on mean plant height are presented in Table 2 and the analysis of variance in Appendix I.

There was significant difference in plant height at the different time of planting. The mean values recorded for plant height ranged from 30.23 cm by September planting to 42.08 cm by May planting. There was no significant difference in plant height for March and May plantings. Plant height obtained was not significant when sowing was done in June, July, August, September, October, November and December.

4.1.4. Number of branches per plant

The data on mean number of branches per plant are presented in Table 2 and the analysis of variance in Appendix II.

Significant difference in the number of branches per plant was observed for different dates of planting. The mean number of branches per plant ranged from 17.2 to

Table 2. Effect of time of planting on mean height, mean number of branches and mean days to flower in Marigold

Treatments	Time of planting	Mean height (cm)	Mean number of branches	Mean days to flower
T_1	June	31.37	19.18	28.19
T_2	July	31.45	19.75	30.65
T_3	August	30.68	18.45	29.95
T_4	September	30.23	30.78	33.23
T_5	October	30.70	27.33	28.13
T_6	November	30.88	25.90	30.93
T_7	December	31.18	24.75	31.08
T_8	January	39.45	25.03	30.95
T_9	February	40.23	20.64	49.93
T_{10}	March	40.73	21.11	77.33
T_{11}	April	40.40	19.44	59.28
T_{12}	May	42.08	17.20	65.97
CD (0.05)		1.52	2.85	2.97

30.78. Maximum number of branches were recorded for September planting (30.78) and minimum number of branches for May planting (17.20). It is clear from the table that there is no significant difference in number of branches among April, May, June, July and August plantings.

4.1.5. Number of days to flower

The data on the mean number of days taken for first flowering are presented in Table 2 and the analysis of variance in Appendix III.

Significant difference in the number of days taken for first flowering was observed by different dates of planting. The number of days taken for first flowering was maximum by March planting (77.33) and minimum by October planting (28.13). There is no significant difference in the number of days taken for flowering between June, July, August, October, November, December and January plantings.

4.1.6. Number of flowers per plant

The data on mean number of flowers per plant are presented in Table 3 and the analysis of variance in Appendix IV.

There was significant difference in the mean number of flowers per plant by different time of planting. The range of variation for number of flowers per plant between

the different treatments were ranging from 27.82 recorded by June planting to 36.45 recorded by September planting. There was no significant difference in the number of flowers produced in April, May, June, December and January plantings.

4.1.7. Size of flowers

The data on mean size of flowers are presented in Table 3 and the analysis of variance in Appendix V.

The mean size of the flowers were greater by June planting (5.32 cm diameter) and lower by November planting (3.63 cm diameter). From the table it is clear that there was no significant difference in flower size between July, October, November, December and January plantings.

4.1.8. Longevity of flowers

The data on mean longevity of flowers are presented in Table 3 and the analysis of variance in Appendix VI.

There was significant difference in the flower longevity by different time of planting. The mean values for flower longevity ranged from 15.4 days by June planting to 17.2 days by August planting. There was no significant difference in flower longevity between April, May,

Table 3. Effect of time of planting on mean number of flowers/plant, mean size of flowers, mean flower longevity and mean duration of flowering in Marigold

Treatments	Time of planting	Mean number of flowers/plant	Mean size of flowers (cm)	Mean flower longevity (days)	Mean duration of flowering (days)
T_1	June	27.82	5.32	15.4	91.75
T_2	July	29.73	3.88	17.0	73.28
T_3	August	29.82	4.40	17.1	81.53
T_4	September	36.45	4.33	15.7	80.60
T_5	October	33.70	3.68	16.5	74.80
T_6	November	30.70	3.63	17.0	72.90
T_7	December	28.83	3.84	17.1	95.78
T_8	January	28.98	3.89	16.4	115.13
T_9	February	30.85	4.48	15.8	160.78
T_{10}	March	31.33	4.44	15.6	119.83
T_{11}	April	29.10	4.78	16.8	100.43
T_{12}	May	27.93	4.83	16.9	97.75
CD(0.05)		1.64	0.47	0.5	3.26

July, August, November and December plantings. Flower longevity by February, March, June and September plantings also did not show any significant difference.

4.1.9. Duration of flowering

The data on mean duration of flowering were presented in Table 3 and the analysis of variance in Appendix VII.

There was significant difference in the mean duration of flowering by different time of planting. The duration of flowering was maximum by February planting (160.78 days) and minimum by November planting (72.90 days). There was no significant difference in the duration of flowering between July, October and November plantings.

4.1.10. Incidence of pests and diseases

Marigold was free from pests and diseases during the entire period of study.

4.2. ZINNIA

4.2.1. Number of days taken for 50 per cent germination of seeds

The data on the number of days taken for 50 per cent germination of seeds are presented in Table 4.

From the table it is clear that March, April and May sowings took the minimum number of days (6 days) for

Table 4. Effect of time of sowing on the number of days taken for 50% germination of seeds and percentage of germination of seeds in Zinnia

Time of sowing	Number of days taken for 50% germination of seeds	Percentage germination of seeds
May	6	96.6
June	7	71.7
July	8	76.6
August	9	73.9
September	7	75.7
October	8	76.3
November	8	70.7
December	7	78.9
January	7	77.3
February	7	75.6
March	6	82.8
April	6	81.2

50 per cent germination of seeds, and August sowing took the maximum number of days (9 days).

4.2.2. Percentage germination of seeds

The data on percentage of germination of seeds for 12 monthly sowings are given in Table 4.

The table shows that May sowing gave the maximum percentage of germination of seeds (96.6) followed by March (82.8) and April sowing (81.2). November sowing gave the lowest percentage of germination.

4.2.3. Plant height

The data on mean plant height are presented in Table 5 and the analysis of variance in Appendix VIII.

There was significant difference in plant height by the different times of planting. The mean values recorded for plant height ranged from 35.88 cm by September planting to 55.13 cm by May planting. It is clear from the table that there is no significant difference in plant height between March, April and May planting.

4.2.4. Number of branches per plant

The data on mean number of branches per plant are presented in Table 5 and the analysis of variance in Appendix IX.

Table 5. Effect of time of planting on mean height, mean number of branches and mean days to flower in Zinnia

Treatments	Time of planting	Mean height (cm)	Mean number of branches	Mean days to flower
T_1	June	46.30	5.80	42.60
T_2	July	44.78	6.15	40.85
T_3	August	39.35	9.93	43.85
T_4	September	35.88	11.15	38.15
T_5	October	38.30	10.38	34.90
T_6	November	41.20	13.55	38.35
T_7	December	38.83	7.88	41.70
T_8	January	45.45	6.98	46.83
T_9	February	51.03	9.08	49.70
T_{10}	March	53.30	11.13	48.75
T_{11}	April	53.33	9.68	46.80
T_{12}	May	55.13	13.03	47.60
CD(0.05)		2.14	1.07	1.56

Significant difference in the number of branches was observed by different dates of planting. The mean number of branches per plant ranged from 5.80 by June planting to 13.55 by November planting. It is clear from the table that there was no significant difference in the number of branches produced between May and November plantings and also between June and July plantings.

4.2.5. Number of days to flower

The data on mean number of days taken for the opening of the first flower are presented in Table 5 and the analysis of variance in Appendix X.

Significant differences in the number of days taken for flowering was observed on plants planted on different dates. In October planting, minimum number of days (34.90) was taken for flowering. Maximum number of days was taken for flowering in February planting (49.70). There was no significant difference in the number of days taken for flowering between February and March planting.

4.2.6. Number of flowers per plant

The data on mean number of flowers per plant are presented in Table 6 and the analysis of variance in the Appendix XI.

Significant differences in the number of flowers per plant was observed by different time of planting. The range of variation for the number of flowers per plant among the different treatments was from 8.78 recorded in July planting to 30.83 in May planting. There was no significant difference in the number of flowers produced between January, February, March, April and May plantings. Number of flowers produced by June and July plantings were also not significantly different.

4.2.7. Size of flowers

The data on mean size of the flowers are presented in Table 6 and the analysis of variance in Appendix XII.

There was significant difference in flower size by different time of planting. The mean size of the flowers was the least in November planting (6.95 cm diameter) and greatest in February planting (8.88 cm diameter). From the table it is clear that there was no significant difference in flower size between February, March and April planting. Flower size obtained by November and December planting were also not significantly different.

4.2.8. Longevity of flowers

The data on mean longevity of flowers are presented in Table 6 and the analysis of variance in Appendix XIII.

There was significant difference in flower longevity by different times of planting. The mean values for flower longevity ranged from 15.7 days in July planting to 23.9 days in April planting. There was no significant difference in flower longevity between March, April and May plantings. The longevity of flowers obtained by June, July and August plantings were also not significant different.

4.2.9. Duration of flowering

The data on mean duration of flowering are presented in Table 6 and the analysis of variance in Appendix XIV.

There was significant difference in the mean duration of flowering by different time of planting. The duration of flowering was maximum in March (111.15 days) planting and minimum in January planting (47.10 days). There was no significant difference in the duration of flowering between December and January plantings.

4.2.10. Incidence of pests and diseases

The incidence of pest was not noticed during the experiment period. The transformed data on the number of plants affected by the disease is given in Table 7 and the analysis of variance in Appendix XV. During February, March, April, May and July there was severe incidence of leaf blight disease. All the observational plant were

Table 6. Effect of time of planting on mean number of flowers/plant, mean size of flowers, mean flower longevity and mean duration of flowering in Zinnia

Treatments	Time of planting	Mean number of flowers/ plant	Mean size of flowers (cm)	Mean flower longevity (days)	Mean duration of flowering (days)
T_1	June	10.38	8.20	15.8	51.95
T_2	July	8.78	8.40	15.7	51.70
T_3	August	12.48	7.88	16.2	54.68
T_4	September	13.75	7.70	17.9	51.75
T_5	October	15.10	7.38	18.1	55.10
T_6	November	17.95	6.95	18.2	53.55
T_7	December	15.86	7.25	17.6	48.35
T_8	January	29.08	7.98	18.0	47.10
T_9	February	30.53	8.88	21.4	79.60
T_{10}	March	29.83	8.73	23.8	111.15
T_{11}	April	29.25	8.85	23.9	97.15
T_{12}	May	30.83	8.20	23.1	87.10
CD(0.05)		1.83	0.36	0.9	2.80

Table 7. Effect of time of planting on the incidence of disease in Zinnia and Balsam

Treatments	Time of planting	Number of plants affected by leaf blight	Number of plants affected by leaf spot in Balsam
T_1	June	4.97 (2.23)	5.97 (2.44)
T_2	July	9.00 (3.00)	9.00 (3.00)
T_3	August	5.74 (2.39)	6.49 (2.54)
T_4	September	4.97 (2.23)	6.22 (2.49)
T_5	October	4.23 (2.05)	4.73 (2.17)
T_6	November	3.70 (1.92)	2.95 (1.71)
T_7	December	3.23 (1.79)	2.68 (1.64)
T_8	January	5.97 (2.44)	5.21 (2.28)
T_9	February	9.00 (3.00)	9.00 (3.00)
T_{10}	March	9.00 (3.00)	6.98 (2.64)
T_{11}	April	9.00 (3.00)	6.22 (2.49)
T_{12}	May	9.00 (3.00)	8.74 (2.95)
CD(0.05)		0.19	0.24

Figures in the parenthesis are square root values

affected by leaf blight disease caused by Alternaria sp (9 plants). During November and December the number of plants affected were 3.70 and 3.23 respectively.

4.3. BALSAM

4.3.1. Number of days taken for 50 per cent germination of seeds

The data on the number of days taken for 50 per cent germination of seeds are presented in Table 8.

From the table it is clear that March, April and May sowings took less number of days for 50 per cent germination of seeds (4 days) followed by January, February, July, September and November sowings (6 days). June, August, October and December took more number of days for 50 per cent germination of seeds (7 days).

4.3.2. Percentage of germination of seeds

The data on percentage of germination of seeds for 12 sowings were given in Table 8.

It is clear from the table that June sowing gave maximum percentage of germination of seeds (97.0) followed by July sowing (95.7). February and November sowings gave minimum percentage of germination (88.2 and 88.7).

Table 8. Effect of time of sowing on the number of days taken for 50% germination of seeds and percentage of germination of seeds in Balsam

Time of sowing	Number of days for 50% germination of seeds	Percentage of germination of seeds
May	4	93.3
June	7	97.0
July	6	95.7
August	7	90.3
September	6	89.9
October	7	91.8
November	6	88.7
December	7	91.3
January	6	90.2
February	6	88.2
March	4	92.8
April	4	94.3

4.3.3. Plant height

The data on mean plant height are presented in Table 9 and the analysis of variance in Appendix XVI.

There was significant difference in plant height by the different times of planting. The mean values recorded for plant height ranged from 30.30 cm by December planting to 58.63 cm by March planting. It is clear from the table that there was no significant difference in plant height between March and May plantings. Plant height obtained by September, November and December plantings also did not show any significant difference.

4.3.4. Number of branches per plant

The data on mean number of branches per plant are presented in Table 9 and the analysis of variance in Appendix XVII.

Significant differences in the number of branches per plant was observed by different dates of planting. The mean number of branches per plant ranged from 9.05 to 15.8. Maximum number of branches was recorded in the crop planting in April (15.80) and minimum number of branches by June planting (9.05). It is clear from the table that there was no significant difference in the number of branches between February, April, September and October plantings. June and

Table 9. Effect of time of planting on mean height, mean number of branches and mean days to flower in Balsam

Treatments	Time of planting	Mean height (cm)	Mean number of branches	Mean days to flower
T_1	June	37.08	9.05	23.13
T_2	July	33.90	9.13	20.40
T_3	August	33.63	11.83	22.03
T_4	September	31.50	15.13	24.30
T_5	October	33.25	15.23	22.85
T_6	November	31.33	12.05	21.13
T_7	December	30.30	11.18	20.65
T_8	January	32.75	12.25	20.90
T_9	February	41.10	15.10	20.99
T_{10}	March	58.63	14.78	22.35
T_{11}	April	55.73	15.80	20.75
T_{12}	May	56.73	12.40	24.10
CD(0.05)		2.40	0.97	1.40

July plantings did not show any significant difference between them in the number of branches per plant.

4.3.5. Number of days to flower

The data on mean number of days taken for first flowering are presented in Table 9 and the analysis of variance in Appendix XVIII.

Significant difference in the number of days taken for first flowering was observed by different dates of planting. The number of days taken for first flowering was maximum by September planting (24.3) and minimum by July planting (20.4). There was no significant difference in the number of days taken for flowering between January, February, April, July, November and December plantings.

4.3.6. Number of flowers per plant

The data on mean number of flowers per plant are presented in Table 10 and the analysis of variance in Appendix XIX.

There was significant difference in the number of flowers per plant by different time of planting. The range of variation for number of flowers per plant between the different treatments was from 16.49 recorded by July planting to 51.85 recorded by March planting. It is clear from the table that there was no significant difference in the

number of flowers per plant between February and March plantings.

4.3.7. Size of flowers

The data on mean size of the flowers are presented in Table 10 and the analysis of variance in Appendix XX.

There was significant difference in flower size by different times of planting. The mean size of the flowers were greatest by April planting (5.10 cm diameter) and least by July planting (3.55 cm diameter). There was no significant difference in flower size between March, April and May planting. Flower size obtained in July, August, September and November were also not significantly different.

4.3.8. Longevity of flowers

The data on mean longevity of flowers are presented in Table 10 and the analysis of variance in Appendix XXI.

There was significant difference in the flower longevity by different times of planting. The mean values for flower longevity ranged from 7.12 by May planting to 8.87 by January planting. There was significant difference in the flower longevity by January, July, August, October and December plantings. Flower longevity in February, March, April, May, June, September and November plantings were not significantly different.

Table 10. Effect of time of planting on mean number of flowers/plant, mean size of flowers, mean flower longevity and mean duration of flowering in Balsam

Treatments	Time of planting	Mean number of flowers/plant	Mean size of flowers (cm)	Mean flower longevity (days)	Mean duration of flowering (days)
T_1	June	22.18	3.98	7.75	47.77
T_2	July	16.49	3.55	8.75	42.35
T_3	August	33.13	3.78	8.23	46.55
T_4	September	46.03	3.85	7.20	47.47
T_5	October	45.80	4.17	8.17	47.80
T_6	November	46.78	3.92	7.70	58.17
T_7	December	44.09	4.00	8.55	54.20
T_8	January	44.48	4.10	8.87	54.49
T_9	February	49.85	4.30	7.52	57.84
T_{10}	March	51.85	5.00	7.47	51.55
T_{11}	April	44.60	5.10	7.40	41.60
T_{12}	May	45.80	4.90	7.12	43.92
CD(0.05)		3.59	0.38	0.70	1.76

4.3.9. Duration of flowering

The data on mean duration of flowering are presented in Table 10 and the analysis of variance in Appendix XXII.

There was significant difference in the mean duration of flowering by different times of planting. The duration of flowering was maximum by November planting (58.17 days) and minimum by April planting (41.60 days). There was no significant difference in the duration of flowering between February and November planting. Duration of flowering by April and July planting were also not significantly different.

4.3.10. Incidence of pests and diseases

There was no incidence of pests in Balsam. The transformed data on the number of plants affected by diseases are given in Table 7 and the analysis of variance in Appendix XXIII.

During February and July there was severe incidence of disease. All the observational plants were affected by leaf spot disease caused by Cercospora sp (9 plants). The disease incidence was less during November and December (2.95 and 2.68 plants respectively).

4.4. Correlation studies

The correlation coefficients of the biometric

characters with weather parameters like rainfall, maximum and minimum temperatures, humidity and sunshine hours and their interrelationships are shown in Table 11.

4.4.1. MARIGOLD

The biometric characters for Marigold were correlated with the weather parameters and the results are given below.

4.4.1.1. Number of days taken for 50 per cent germination of seeds

The number of days taken for 50 per cent germination had significant negative correlation with maximum temperature (-0.6480), no correlation with minimum temperature, highly significant positive correlation with relative humidity (0.7696) and negative correlation with sunshine hours (-0.3615).

4.4.1.2. Percentage of germination of seeds

The percentage of germination of seeds had high significant positive correlation with maximum temperature (0.7731), no correlation with minimum temperature, significant negative correlation with relative humidity (-0.6046) and no correlation with sunshine hours.

4.4.1.3. Plant height

The height of the plants showed highly significant

Table 11. Correlation of the weather data with the biometric characters.

Table 11. Correlation Table

	Number of days for 50% germination of seeds			Percentage germination of seeds			Plant height			Number of branches			Number of days to flower		
	Marigold	Zinnia	Balsam	Marigold	Zinnia	Balsam	Marigold	Zinnia	Balsam	Marigold	Zinnia	Balsam	Marigold	Zinnia	Balsam
Rainfall	-	-	-	-	-	-	0.2538	0.3686**	0.5802**	-0.4251**	0.3285*	0.2131	0.5192**	0.2515	0.5157**
Maximum temperature	-0.6480*	-0.6818*	-0.8608**	0.7731**	0.6996*	0.408	0.8291**	0.6428**	0.6153**	-0.2963*	0.3237*	0.6612**	0.7032**	0.6013**	-0.0633
Minimum temperature	0.1686	0.0020	-0.1929	-0.1914	0.3761	0.5105	0.3109*	0.0440	0.3766**	-0.1416	0.2915*	0.1917	0.0430	-0.2560	0.3090*
Humidity	0.7696**	0.5165	0.5800*	-0.6046*	-0.5324	-0.3585	0.4450**	0.4309**	0.2575	-0.5012**	-0.0750	-0.1122	0.2076	0.5602**	0.0781
Sunshine hours	-0.3615	-0.1960	-0.2571	0.3190	0.5408	0.2925	0.5650**	0.3326*	0.2944*	-0.0754	0.3124*	0.4486**	0.4567**	0.5157**	-0.4144**

Correlation Table (contd.)

	Number of flowers per plant			Size of flowers			Longevity of flowers			Duration of flowering			Incidence of disease		
	Marigold	Zinnia	Balsam	Marigold	Zinnia	Balsam	Marigold	Zinnia	Balsam	Marigold	Zinnia	Balsam	Marigold	Zinnia	Balsam
Rainfall	0.0479	0.2616	-0.3190*	0.5411**	0.7646**	0.2032	-0.3036*	0.2858*	-0.9060	0.2292	4281**	-0.4351**	-	0.8866**	0.9101**
Maximum temperature	0.0928	0.1746	0.4646**	-0.3533*	-0.1636	-0.1576	-0.2542	-0.0484	0.1050	0.6632**	-0.1211	0.8816**	-	-0.2484	-0.2278
Minimum temperature	0.0376	0.2021	-0.1654	0.4430**	0.7708**	0.3320*	-0.1431	-0.3437*	-0.3075*	-0.1389	0.6245**	-0.3733**	-	0.6938**	0.6793**
Humidity	-0.2537	0.2815	0.1085	0.6996**	0.3252*	0.5216**	-0.0957	0.4502**	-0.5289**	0.0437	0.5032**	-0.4656**	-	0.3299*	0.3450*
Sunshine hours	0.0793	0.2866**	0.4648**	-0.3396*	-0.1002	0.0049	-0.2856*	0.0444	0.2353	0.5467**	-0.0389	0.8303**	-	-0.2634	-0.4075**

positive correlation with maximum temperature (0.8291), significant positive correlation with minimum temperature (0.3109), no correlation with rainfall, highly significant positive correlation with humidity (0.4450) and sunshine hours (0.5650).

4.4.1.4. Number of branches per plant

The number of branches per plant showed highly significant negative correlation with rainfall (-0.4251), significant negative correlation with maximum temperature (-0.2963), negative correlation with minimum temperatures (-0.1416), highly significant negative correlation with humidity (-0.5012) and negative correlation with sunshine hours (-0.0754).

4.4.1.5. Number of days to flower

The number of days taken for flowering showed high significant positive correlation with rainfall (0.5192), high significant positive correlation with maximum temperature (0.7032), no correlation with minimum temperature and humidity and significant negative correlation with sunshine hours (-0.0754).

4.4.1.6. Number of flowers per plant

The number of flowers per plant showed negative correlation with relative humidity (-0.2537), no correlation

with rainfall, maximum and minimum temperature, and sunshine hours.

4.4.1.7. Size of flowers

The size of the flowers showed highly significant positive correlation with rainfall (0.5411), significant negative correlation with maximum temperature (-0.3533), highly significant positive correlation with minimum temperature (0.4430), highly significant positive correlation with relative humidity (0.6996) and significant negative correlation with sunshine hours (-0.3396).

4.4.1.8. Longevity of flowers

The longevity of flowers showed significant negative correlation with rainfall (-0.3036), negative correlation with maximum (-0.2542) and minimum temperature (-0.1431), relative humidity (-0.0957) and significant negative correlation with sunshine hours (-0.2856).

4.4.1.9. Duration of flowering

Duration of flowering showed no correlation with rainfall, highly significant positive correlation with maximum temperature (0.6632), negative correlation with minimum temperature (-0.1389), no correlation with relative humidity and highly significant positive correlation with sunshine hours (0.5467).

4.4.2. ZINNIA

The biometric characters for Zinnia were correlated with the weather parameters and the results are given below.

4.4.2.1. Number of days taken for 50 per cent germination of seeds

The number of days taken for 50 per cent germination had significant negative correlation with maximum temperature (-0.6818), no correlation with minimum temperature and relative humidity and negative correlation with sunshine hours (-0.1960).

4.4.2.2. Percentage of germination of seeds

The percentage of germination of seeds had significant positive correlation with maximum temperature (0.6996), no correlation with minimum temperature, significant negative correlation with relative humidity (-0.5324) and no correlation with sunshine hours.

4.4.2.3. Plant height

The height of the plant showed highly significant positive correlation with rainfall (0.3686) and maximum temperature (0.6428), no correlation with minimum temperature, highly significant positive correlation with relative humidity (0.4309) and significant positive correlation with sunshine hours (0.3326).

4.4.2.4. Number of branches per plant

The number of branches per plant showed significant positive correlation with rainfall (0.3285), significant positive correlation with maximum temperature (0.3237), minimum temperature (0.2915), negative correlation with relative humidity (-0.0750) and significant positive correlation with sunshine hours (0.3124).

4.4.2.5. Number of days to flower

The number of days for flowering had no correlation with rainfall and showed highly significant positive correlation with maximum temperature (0.6013), negative correlation with minimum temperature (-0.2560), highly significant positive correlation with relative humidity (0.5602) and sunshine hours (0.5157).

4.4.2.6. Number of flowers per plant

The number of flowers per plant had no correlation with rainfall, maximum and minimum temperature, relative humidity and showed significant positive correlation with sunshine hours (0.2866).

4.4.2.7. Size of flowers

The size of flowers showed significant positive correlation with rainfall (0.7646), negative correlation with maximum temperature (-0.1636), significant positive

correlation with minimum temperature (0.7708), significant positive correlation with relative humidity (0.3252) and negative correlation with sunshine hours (-0.1002).

4.4.2.8. Longevity of flowers

The longevity of flowers showed significant positive correlation with rainfall (0.2858), negative correlation with maximum temperature (-0.0484), significant negative correlation with minimum temperature (-0.3437), highly significant positive correlation with relative humidity (0.4502) and no correlation with sunshine hours.

4.4.2.9. Duration of flowering

The duration of flowering showed significant positive correlation with rainfall (0.4281), negative correlation with maximum temperature (-0.1211), highly significant positive correlation with minimum temperature (0.6245), highly significant positive correlation with relative humidity (0.5032) and negative correlation with sunshine hours (-0.0389).

4.4.2.10. Incidence of disease

The number of plants affected by leaf blight disease showed highly significant positive correlation with rainfall (0.8866), negative correlation with maximum temperature (-0.2484), significant positive correlation with minimum

temperature (0.6938), significant positive correlation with relative humidity (0.3299) and negative correlation with sunshine hours (-0.2634).

4.4.3. BALSAM

The biometric characters for Balsam were correlated with the weather parameters and the results are given below.

4.4.3.1. Number of days taken for 50 per cent germination of seeds

The number of days taken for 50 per cent germination of seeds had highly significant negative correlation with maximum temperature (-0.8608), negative correlation with minimum temperature (-0.1929), significant positive correlation with relative humidity (0.5800) and negative correlation with sunshine hours (-0.2571).

4.4.3.2. Percentage of germination of seeds

The percentage of germination of seeds had no correlation with maximum and minimum temperature, negative correlation with relative humidity (-0.3585) and negative correlation with sunshine hours (-0.2925).

4.4.3.3. Plant height

The height of the plant showed highly significant positive correlation with rainfall (0.5802), maximum

temperature (0.6153), minimum temperature (0.3766), no correlation with relative humidity and significant positive correlation with sunshine hours (0.2944).

4.4.3.4. Number of branches per plant

The number of branches per plant showed no correlation with rainfall, significant positive correlation with maximum temperature (0.6612), no correlation with minimum temperature, negative correlation with relative humidity (-0.1122) and significant positive correlation with sunshine hours (0.4486).

4.4.3.5. Number of days to flower

The number of days taken for flowering showed significant positive correlation with rainfall (0.5157), negative correlation with maximum temperature (-0.0633), positive correlation with minimum temperature (0.3090), no correlation with relative humidity and highly significant negative correlation with sunshine hours (-0.4144).

4.4.3.6. Number of flowers per plant

The number of flowers per plant showed significant negative correlation with rainfall (-0.3190), highly significant positive correlation with maximum temperature (0.4646), negative correlation with minimum temperature (-0.1654), no correlation with relative humidity and highly

significant positive correlation with sunshine hours (0.4648).

4.4.3.7. Size of flowers

The size of the flowers had no correlation with rainfall and sunshine hours, showed negative correlation with maximum temperature (-0.1576), significant positive correlation with minimum temperature (0.3320) and highly significant negative correlation with relative humidity (-0.5216).

4.4.3.8. Longevity of flowers

The longevity of flowers showed negative correlation with rainfall (-0.0960), no correlation with maximum temperature, significant negative correlation with minimum temperature (-0.3075), significant negative correlation with relative humidity (-0.5289) and no correlation with sunshine hours.

4.4.3.9. Duration of flowering

The duration of flowering showed significant negative correlation with rainfall (-0.4351), significant positive correlation with maximum temperature (0.8816), significant negative correlation with minimum temperature (-0.3733), significant negative correlation with relative humidity (-0.4656) and significant positive correlation

with sunshine hours (0.8303).

4.4.3.10. Incidence of disease

The number of plants affected by leafspot disease showed highly significant positive correlation with rainfall (0.9101), negative correlation with maximum temperature (-0.2278), significant positive correlation with minimum temperature (0.6793), significant positive correlation with relative humidity (0.3450) and significant negative correlation with sunshine hours (-0.4075).

DISCUSSION

DISCUSSION

An experiment was conducted at the College of Agriculture, Vellayani to determine the effect of time of planting on the growth and flowering of popular bedding plants such as Marigold, Zinnia and Balsam.

Data on biometric characters like number of days taken for 50 per cent germination, percentage of germination of seeds, height of the plant, number of days for first flowering, number of flowers per plant, number of branches per plant, size of the flowers, longevity of flowers, duration of flowering and incidence of pest and diseases were recorded.

The experimental data were statistically analysed to infer the results. The correlations of the biometric characters with weather parameters like rainfall, maximum and minimum temperature, humidity and sunshine hours were worked out.

The results obtained on the above mentioned parameters are briefly discussed in this chapter.

5.1 French Marigold

5.1.1 Number of days taken for 50 per cent germination of seeds and percentage of germination of seeds

Even though the number of days taken for 50 per cent

germination in Marigold showed significant negative, positive and positive correlations with maximum temperature relative humidity and sunshine hours respectively, 50 per cent germination was recorded almost within the same duration (5-8 days). The percentage of germination also did not show appreciable difference (73.6 - 80.1). The observation seems to suggest that seed germination in the crop is not drastically affected by factors in the environment like maximum temperature, relative humidity and the duration of sunshine.

5.1.2 Plant height and number of branches per plant

Plant height was considerably more in May transplantation (42.08 cm). This is a clear indication of accelerated growth tendency. Gowda and Jayanthi (1986) and Dongre (1988) have observed maximum plant height in Tagetes erecta when planted in May.

Least plant height was recorded by September planting (30.23 cm). Plant height showed significant positive correlation with maximum and minimum temperature, relative humidity and sunshine hours. The observation seems to suggest that plant height in this crop is affected by environmental factors like maximum temperature, minimum temperature, humidity and sunshine hours. High temperature caused elongation of internodes and resulted in taller

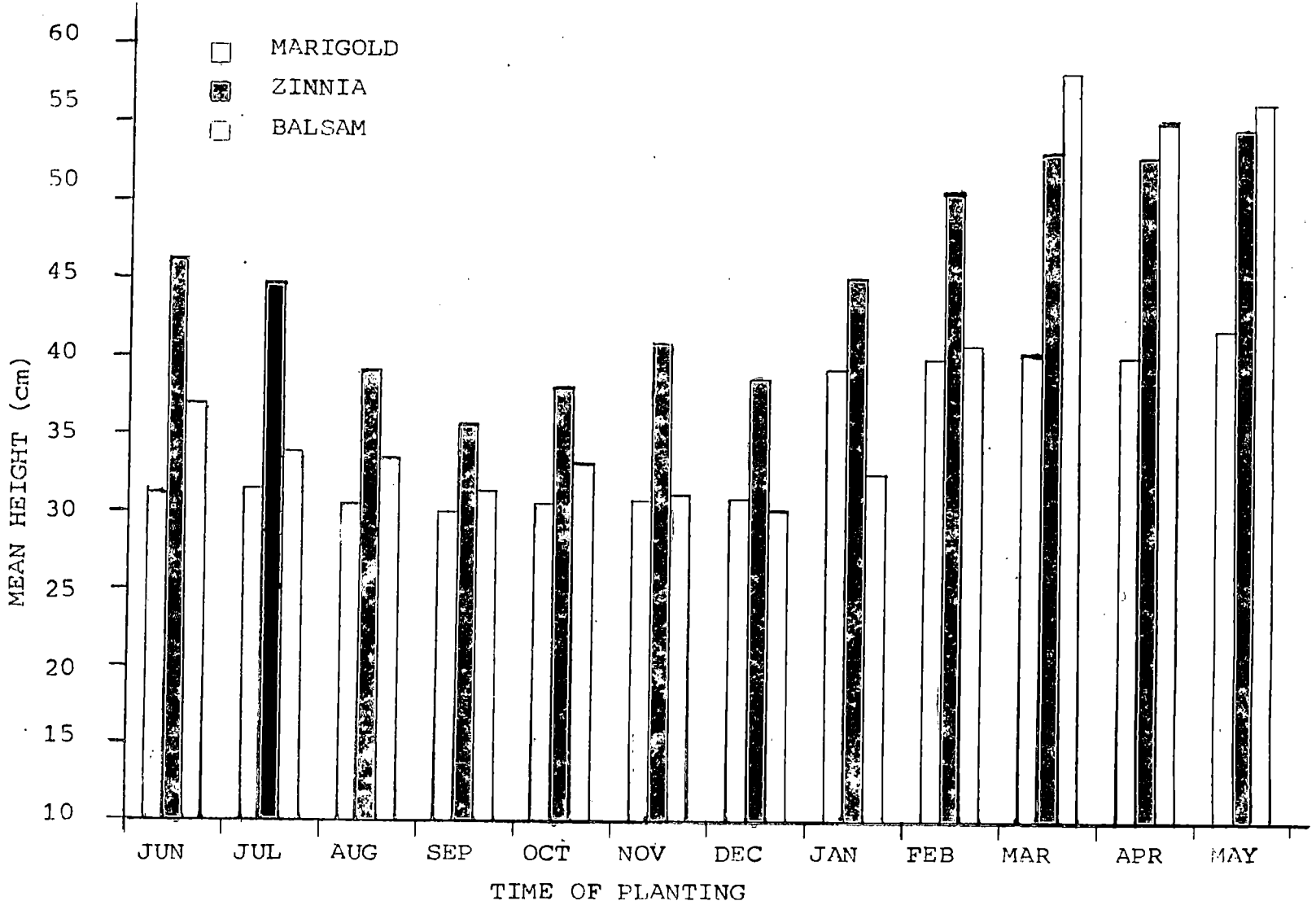


Fig 2. Effect of time of planting on mean height of Marigold, Zinnia & Balsam.

plants. High relative humidity increases the plant height, Marigold seedlings were significantly taller at 65 per cent relative humidity than at 40 per cent relative humidity, Krizek et al (1971).

September transplantation gave maximum number of branches (30.78) and least plant height (30.23 cm). The number of branches showed negative correlation with rainfall, maximum and minimum temperatures, humidity and sunshine hours. Less number of branches obtained by September planting may be due to comparatively short days of September than May. Similar report was given by Heins et al (1979) in Carnations.

5.1.3 Number of days to flower and duration of flowering

Transplantation during the month of October is ideal for early blooming initiation (28.13 days). Through a period of subsequent 75 days flowering continued. At the same time transplantation during March delayed blooming initiation upto 77.33 days. Through a period of subsequent 120 days flowering continued.

A comparison of the two different sowings as mentioned to above, October planting had a total stand duration of 103 days of which the latter 75 days promised ready flowering. As against, the March planting that held the

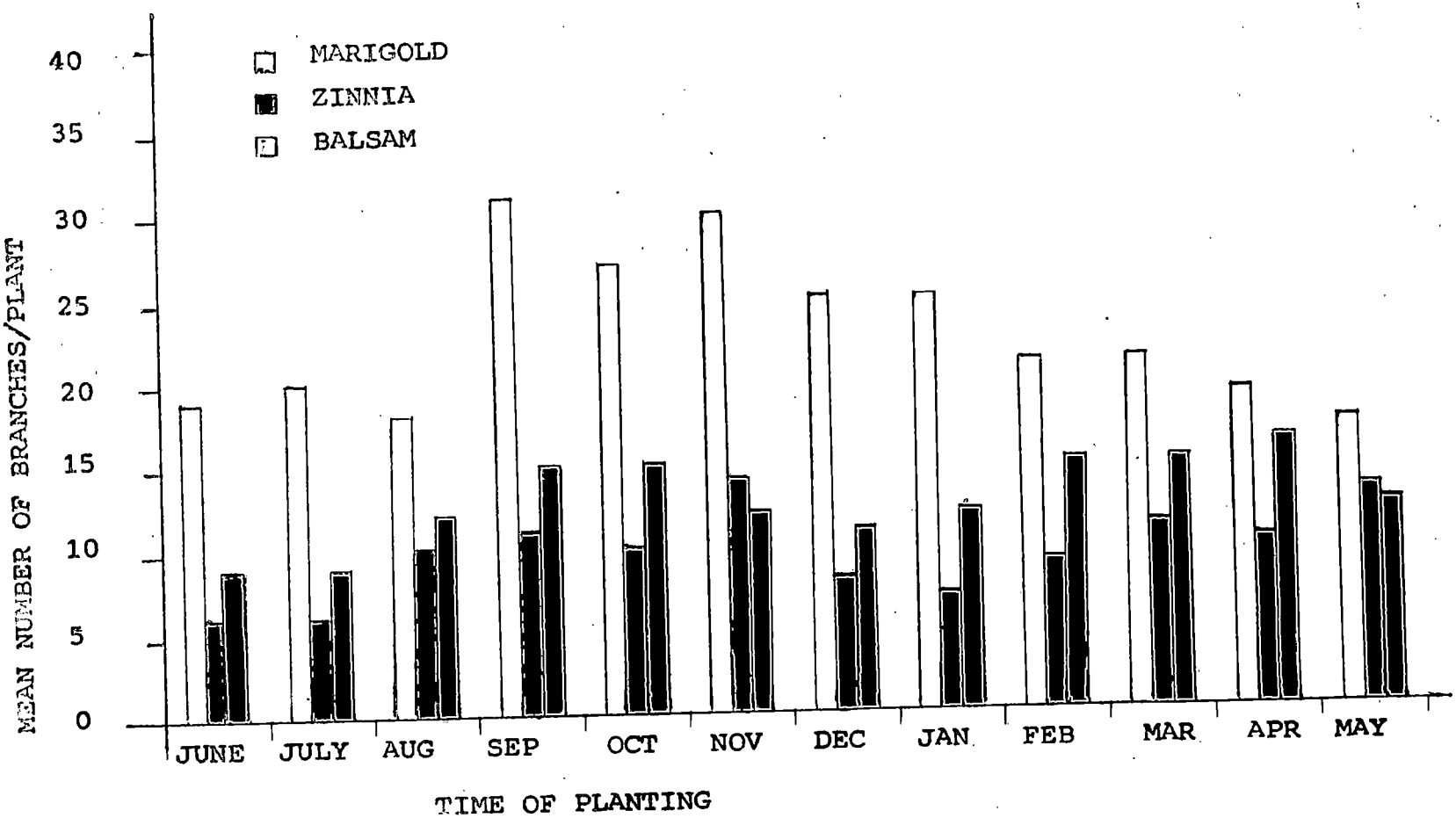


Fig 3 .Effect of time of planting on mean number of branches in Marigold, Zinnia and Balsam.

stand for a much longer (197 days) period of which flowers were available towards the latter 120 days.

5.1.4. Number of flowers per plant, flower longevity and flower size

September transplantation gave maximum number of flowers (36.45). This was in agreement with the findings of Dongre (1988). He observed that September planting resulted in maximum number of flowers in Tagetes erecta. Even though the average flower yield was more in September, the duration of flowering was comparatively less (80.6 days). At the same time May planting gave more duration of flowering (97.75 days).

Number of flowers per plant showed negative correlation with relative humidity. Transplantation during warm months was good for more number of flowers. However slight variation probably on account of duration of plant to blooming initiation. Transplantation during rains was not good for profuse flowering.

The flower size obtained were maximum by June and May planting (5.32 and 4.83 cm respectively). But in June and May least number of flowers were obtained. This shows that flower size is inversely proportional to the number of flowers. The flower-size showed significant negative correlation with maximum temperature. Similar report was given

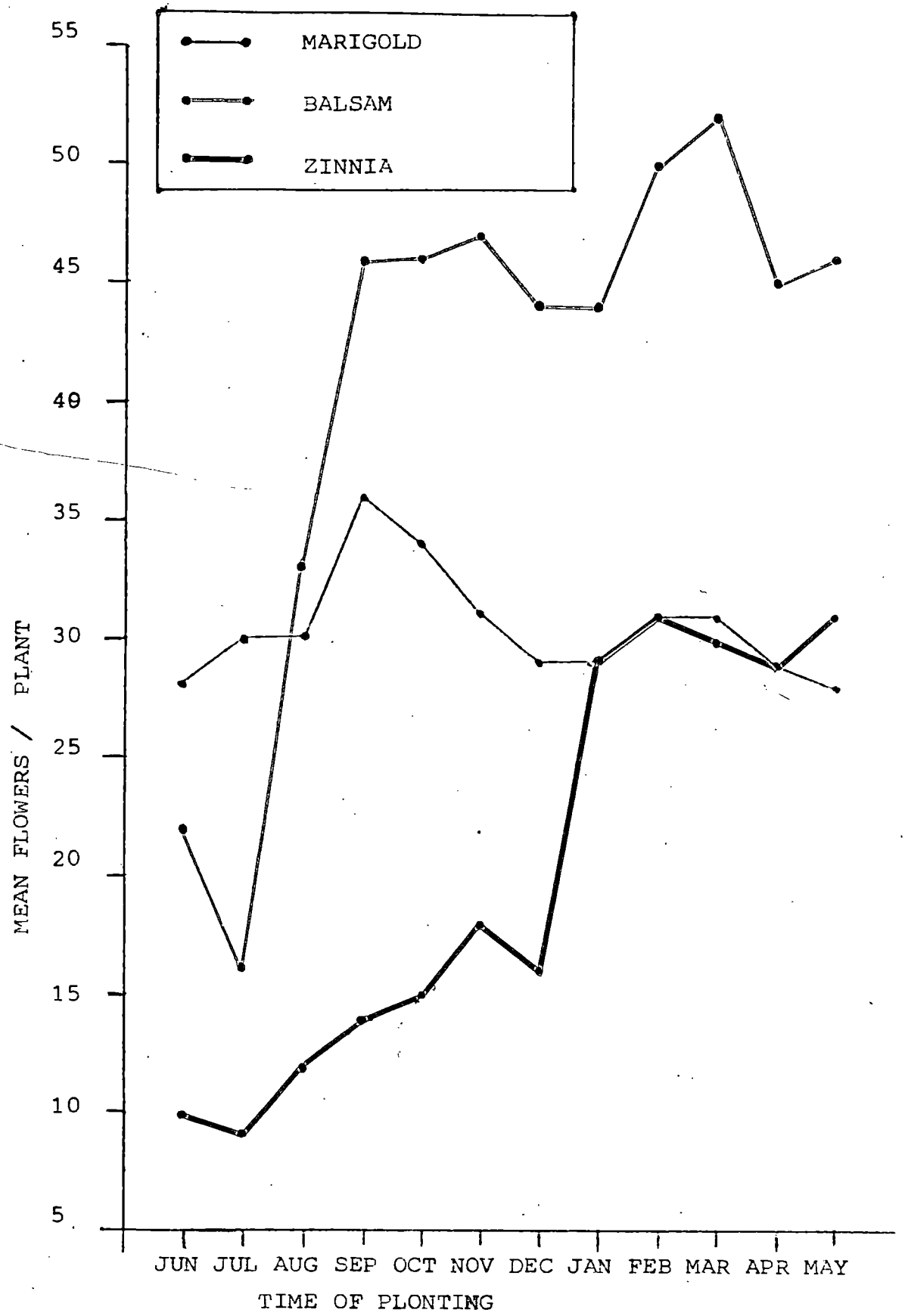


Fig 4. Effect of time of planting on mean flowers/plant.

by Bonaminio and Larson (1980) in 'May Shoesmith' Chrysanthemums.

Although June transplantation gave larger flowers (5.32 cm) the flower longevity was comparatively less (15.4 days). The flower longevity showed significant negative correlation with rainfall, maximum and minimum temperature and sunshine hours. High temperature and rainfall caused heavy shedding of flowers.

This finding is helpful in standardising the most appropriate time of transplantation to resolve the best flowering performance in this crop. Eventually recommendations can be made for realising better benefits. It is recommended that as far as the crop is concerned transplantation done during the months of September, October and November is ideal for early flower initiation maximum number of flowers, branches and less plant height. But flower size and duration of flowering was comparatively less during these months. September planting gave maximum number of flowers at a minimum plant height.

February and March planting are ideal for getting maximum duration of flowering. But February and March planting took longer time for flower initiation. This planting time also gave medium sized flowers with good flower longevity.

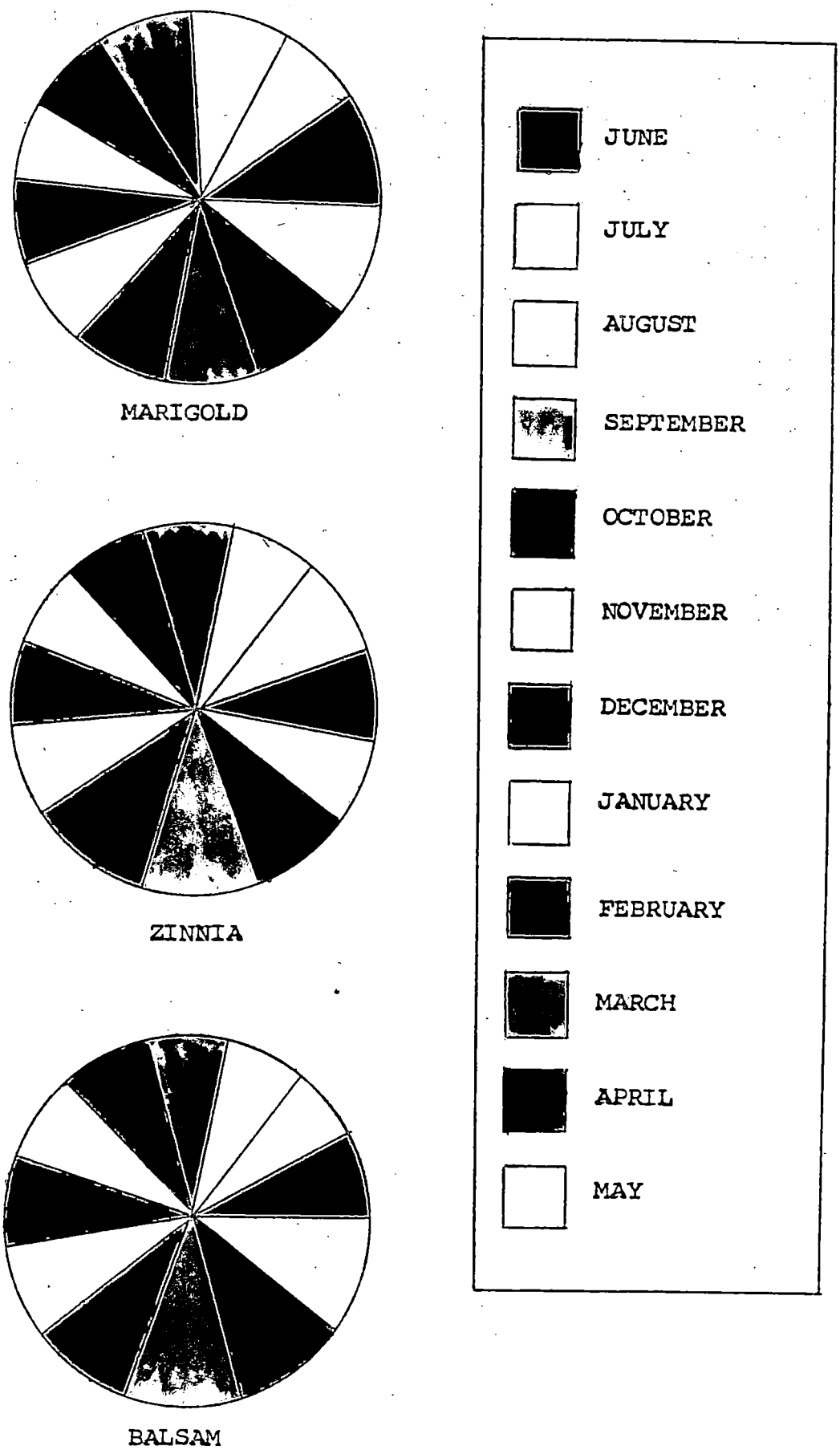


Fig.5. Effect of time of planting on mean size of flowers in Marigold, Zinnia and Balsam.

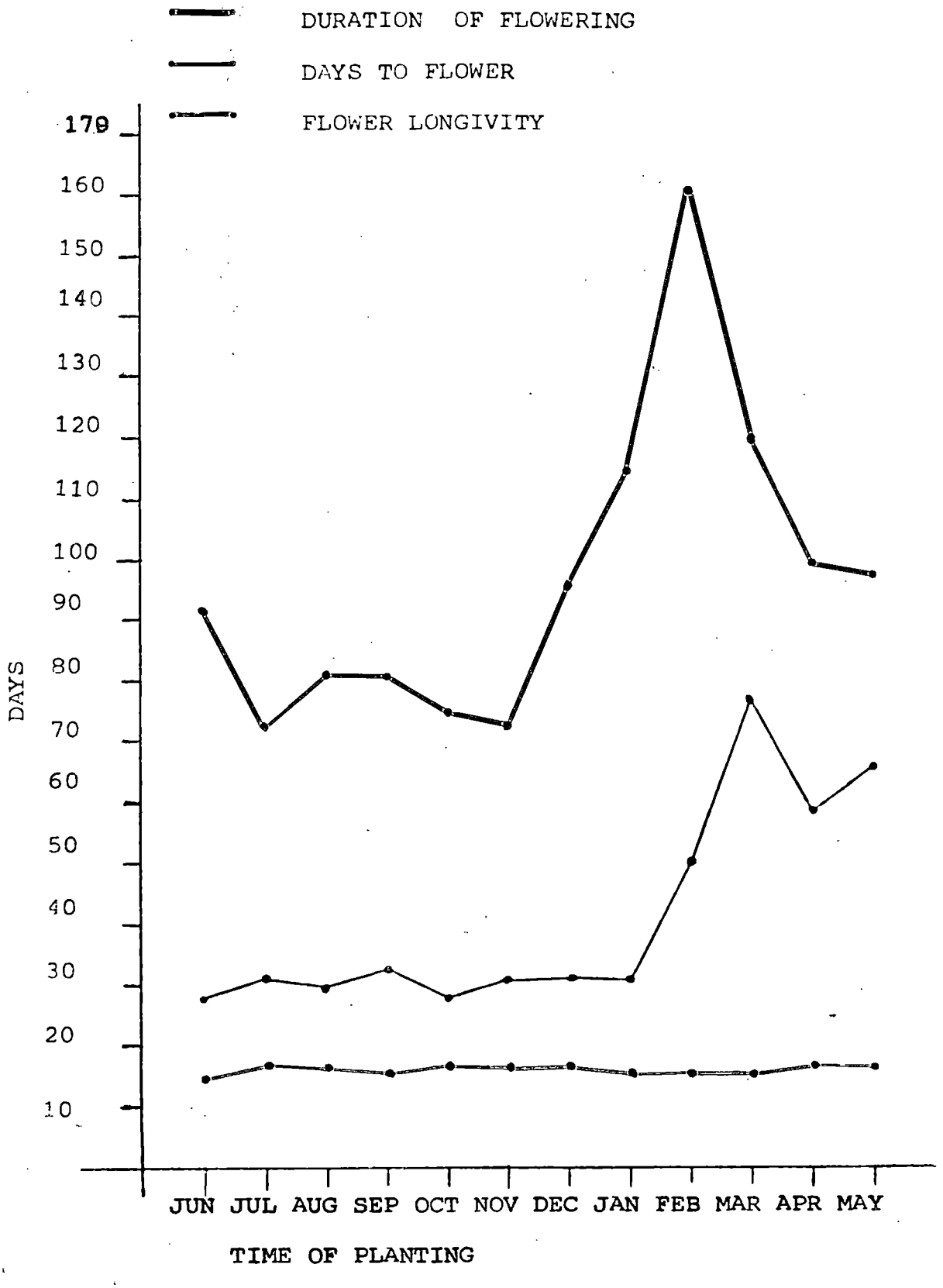


Fig 6. Effect of time of planting on mean days to flower mean duration of flowering and mean flower longevity in Marigold.

5.2. ZINNIA

5.2.1. Number of days taken for 50 per cent germination of seeds and percentage of germination of seeds

Germination (50 per cent) in Zinnia showed significant negative correlation with maximum temperature and sunshine hours. Germination was recorded (50 per cent) almost within the same duration (6-9 days). But the percentage of germination showed appreciable difference. It ranged from 70.7 per cent recorded by November planting to 96.6 per cent by May planting. The percentage of germination of seeds showed significant positive and negative correlations with maximum temperature and relative humidity respectively. The observation seems to suggest that seed germination in the crop is drastically affected by environmental factors like maximum temperature and relative humidity. Germination was slow in Soyabean at lower temperatures (Papp and Szabo, 1979).

5.2.2. Plant height and number of branches per plant

Plant height was considerably more in May transplantation (55.13 cm). Least plant height was recorded by September planting (36.88 cm), plant height showed significant positive correlation with rainfall, maximum temperature and relative humidity. Increase in plant height was noticed with increase in temperature. This was in

agreement with findings of Fayyaz et al (1983).

November and May transplantation gave maximum number of branches (13.55 and 13.03 respectively). The number of branches per plant showed significant positive correlation with rainfall, maximum temperature and sunshine hours. Least number of branches was obtained by June and July planting. May transplantation gave maximum plant height (55.13 cm) and more number of branches.

5.2.3 Number of days to flower and duration of flowering

Transplantation during the month of October is ideal for early blooming initiation (34.9 days). Through a period of subsequent 55 days flowering continued. At the same time transplantation during February and March delayed blooming initiation upto 49.70 and 48.75 days respectively. Through a period of subsequent (80 and 111 days respectively) flowering continued.

A comparison of the three different plantings as mentioned to above, October planting had a total stand duration of 90 days of which latter 55 days promised ready flowering. As against, February and March planting that held the stand for longer (130 and 160 days respectively), period of which the flowers were available towards the latter 90 and 111 days respectively.

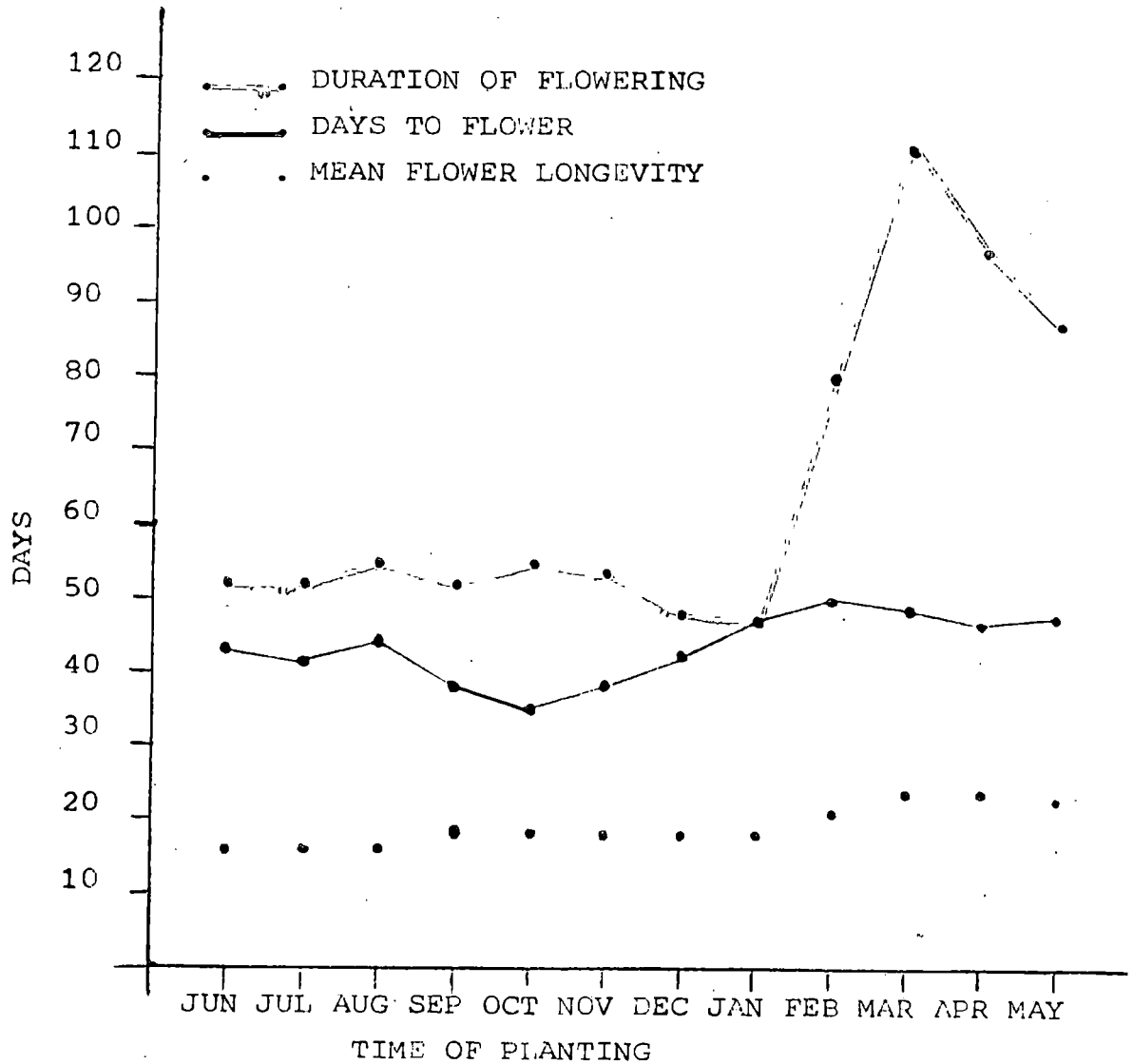


Fig 7. Effect of time of planting on mean days to flower, mean flower longevity and mean duration of flowering in Zinnia.

The duration of flowering showed positive correlation with rainfall and negative correlation with maximum temperature.

5.2.4 Number of flowers per plant, flower longevity and flower size

February and May transplantation gave maximum number of flowers (30.53 and 30.83 respectively). At the same time June and July planting gave minimum number of flowers (10.38 and 8.78 respectively). The duration of flowering was also comparatively more (79.6 and 87.1 days respectively) for February and May transplanting. The positive correlation of the number of flowers with sunshine hours showedthat the flower numbers increased with increase in sunshine. March planting also gave more number of flowers (29.83). Duration of flowering (111.15 days) was maximum in March.

A warm season bedding assures adequate blooming in Zinnia. However, slight variation probably on account of duration of plant to blooming initiation.

The flower size obtained was maximum (8.88 cm) for February planting. Thus February transplantation gave maximum number of (30.53) large sized flowers (8.88 cm). Flower longevity was also more by February planting (21.4 days). At the same time, March and April planting gave

the highest flower longevity (23.8 and 23.9 days respectively).

4.2.5 Incidence of disease

The disease incidence was more in February, March, April and May transplantings. The number of plants affected by leaf blight disease showed positive correlation with rainfall and relative humidity. This showed that the disease was favoured by humid weather or abundant rains. Similar weather conditions were favourable for early blight of potato and leaf spot of Crucifer (Singh, 1985).

This finding is helpful in standardising the most appropriate time of transplantation to resolve the best flowering performance in this crop. Eventually recommendations can be made for realising better benefits. It is recommended that as far as the crop is concerned transplantation during the months of February, March, April and May is ideal for getting maximum number of large sized long lasting flowers, and longer duration of flowering.

5.3 Balsam

5.3.1 Number of days taken for 50 per cent germination of seeds and percentage of germination of seeds

Even though the number of days taken for 50 per cent germination of seeds showed significant negative, negative

and positive correlations with maximum temperature, minimum temperature and relative humidity respectively. Germination was recorded (50 per cent) almost within the same duration (4-7 days). But the percentage of germination of seeds showed appreciable difference (88.23 - 97%). Percentage of germination of seeds showed negative correlation with relative humidity. Comparatively lesser percentage of germination obtained for February (88.23 per cent) and September (89.9 per cent) sowing can be attributed to low temperature at that time. Low temperature reduced the germination process in seeds.

5.3.2 Plant height and number of branches

Plant height was considerably less in September, November and December (31.50 cm, 31.33 cm and 30.30 cm) transplantation. March, April and May plantings (58.63 cm, 55.73 cm, 56.73 cm respectively) gave almost double the above mentioned height. The plant height showed significant positive correlation with rainfall, maximum and minimum temperature and sunshine hours. From the observations it is clear that plant height is affected by environmental factors like rainfall temperature and sunshine hours. High temperatures caused elongation of internodes and resulted in taller plant. This is in agreement with the findings of Ellis (1986) in Begonias, Impatiens and Salvias.

April transplantation gave the highest number of branches (15.80) followed by October, September and February. The height was also more for April planting (55.73 cm).

5.3.3 Number of days to flower and duration of flowering

Although the number of days for flowering showed significant positive, negative, positive and negative correlation with rainfall, maximum temperature, minimum temperature and sunshine hours respectively, the blooms initiated almost after the same period (21 - 24 days). The observation seems to suggest that the number of days taken for flowering in this crop is not drastically affected by factors in the environment like rainfall, maximum and minimum temperature and sunshine hours.

November, December, January and February transplantations gave maximum duration of flowering. The duration of flowering showed negative correlation with rainfall and positive correlation with maximum temperature and sunshine hours. So from these observations, it can be elucidated that rainfall reduced the duration of flowering and temperature and sunshine hours increased the duration of flowering.

5.3.4 Number of flowers per plant, flower longevity and flower size

February and March transplantation gave maximum

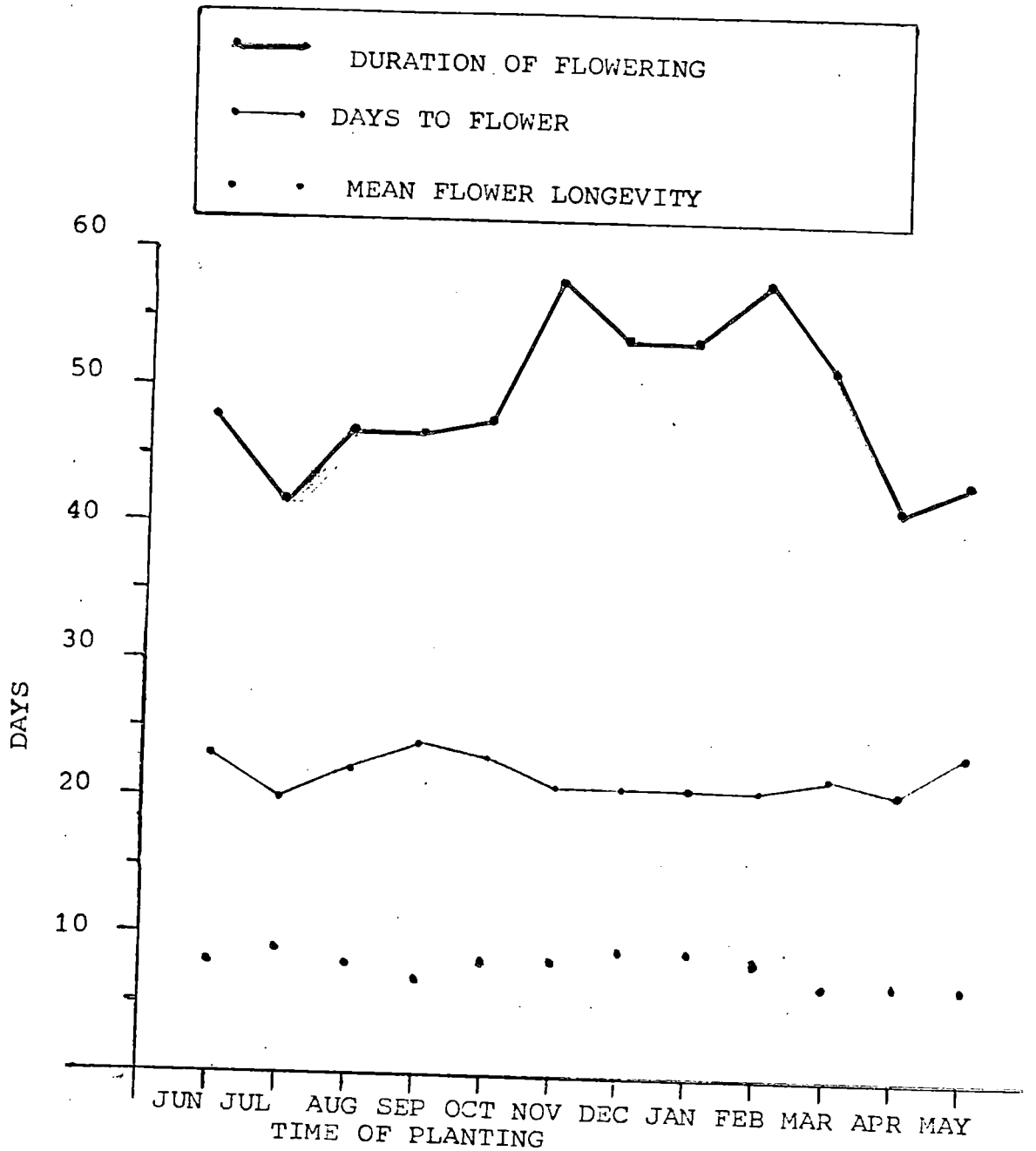


Fig 8. Effect of time of planting on mean days to flower, mean duration of flowering and mean flower longevity in Balsam.

number of flowers (49.85 and 51.85 respectively). The negative correlation of the number of flowers with the rainfall showed that rainfall reduced the number of flowers.

The flower size obtained were maximum by March, April and May transplanting (5, 5.1 and 4.9 cm respectively). Although March, April and May transplantation gave larger flowers the flower longevity was comparatively less. The flower longevity showed negative correlation with rainfall. Rainfall reduced the flower longevity by causing shedding of flowers.

5.3.5 Incidence of disease

The disease incidence was more in February, May and July transplantings. The number of plants affected by leaf spot showed positive correlation with rainfall and relative humidity. This showed that the disease was favoured by humid weather or abundant rains. Similar weather conditions were favourable for leaf spot of Cucurbits (Singh, 1985).

This finding is helpful in standardising the most appropriate time of transplantation to resolve the best flowering performance in this crop. Eventually recommendations can be made for realising better benefits. It is recommended that as far as this crop is concerned transplantations during the months of February, March, April and

May is ideal for getting maximum number of large sized flowers with maximum number of branches. November, December, January and February transplantings are ideal for getting maximum duration of flowering.

SUMMARY

SUMMARY

An investigation was taken up at the Department of Horticulture, College of Agriculture, Vellayani during 1988-'89 to find out the effect of time of planting on the growth and flowering of popular bedding plants namely Marigold, Zinnia, Balsam, Phlox and Salvia. For reason(s) not absolutely known stand of adequate size could not be obtained for Salvia and Phlox and hence the two crops were not carried over through the remaining part of experiment.

Observations on number of days taken for 50 per cent germination of seeds, percentage of germination of seeds, height of the plant, days to flower, number of branches per plant, size and longevity of flowers, duration of flowering, incidence of pest and disease were recorded. The results of the study are summarised below:

1. For Marigold, January and April sowings took minimum number of days and July sowing took maximum number of days for 50 per cent germination of seeds. In the case of Zinnia, March, April and May sowings took less number of days, and August sowing took more number of days for 50 per cent germination of seeds. For Balsam, March, April and May sowings took less number of days and June, August, October and December took more number of days for 50 per cent germination of seeds.

2. January sowing gave the highest and October and November sowings gave the lowest germination percentages in Marigold. In Zinnia, May sowing gave the maximum and November sowing gave the minimum germination percentage. June sowing gave the highest and February sowing gave the least germination percentage in Balsam.

3. Maximum plant height for Marigold was recorded by May planting and minimum by September planting. For Zinnia also maximum plant height was recorded in May planting and minimum in September planting. Maximum plant height for Balsam was recorded in March planting and minimum in December planting.

4. For Marigold, highest number of branches was recorded in September planting and lowest number in May planting. Highest number of branches was obtained for Zinnia in November planting and lowest number in June planting. For Balsam, highest number of branches was recorded in April planting and lowest number in June planting.

5. Marigold showed earlier flowering in October and June plantings whereas flowering was delayed in March planting. In Zinnia, October planting gave earlier flowers and February planting gave later flowers. In the case of Balsam, July planting gave earlier flowering whereas September planting caused delayed flowering.

6. Maximum number of flowers were obtained for Marigold in September planting and minimum number in June planting. For Zinnia, maximum number of flowers were obtained in May planting and minimum number in July planting. Maximum number of flowers were obtained for Balsam in March planting and minimum number in June planting.

7. The mean size of flowers in Marigold were highest in June planting and least in November planting. In Zinnia, the mean size of the flowers were highest in February planting and least in November planting. The mean size of flowers in Balsam were highest in April planting and least in July planting.

8. The flower longevity for Marigold was maximum in August planting and minimum in June planting. For Zinnia, maximum flower longevity was obtained in April planting and minimum in July planting. The flower longevity for Balsam was maximum in January planting and minimum in May planting.

9. The duration of flowering for Marigold was maximum in February planting and minimum in November planting. For Zinnia, maximum duration of flowering was obtained in March planting and minimum duration in January planting. The duration of flowering for Balsam was maximum in November planting and minimum in April planting.

10. In Marigold there was no incidence of pest and disease throughout the period of study. In Zinnia, there was no incidence of pests. But during February, March, April, May and July there was severe incidence of leaf blight caused by Alternaria. During November and December disease incidence was less. In Balsam also there was no incidence of pests. But during February and July there was severe incidence of leaf spot disease caused by Cercospora. The disease incidence was less in November and December.

11. The correlation of all the characters with the weather parameters like rainfall, maximum and minimum temperature, relative humidity and sunshine hours were also studied.

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* Original not seen

APPENDICES

APPENDIX I

Analysis of variance table for the height of the plant in Marigold

Source	dF	SS	MSS	F
Replication	3	11.30469	3.768229	3.3812*
Treatments	11	1106.129	100.5572	90.2291**
Error	33	36.77735	1.114465	

* Significant at 5% level

** Significant at 1% level

APPENDIX II

Analysis of variance table for the number of branches per plant in Marigold

Source	dF	SS	MSS	F
Replication	3	7.609375	2.536458	0.644742
Treatments	11	770.6621	70.06019	17.808589**
Error	33	129.8242	3.934067	

* Significant at 5% level

** Significant at 1% level

APPENDIX III

Analysis of variance table for the number of days to flower in Marigold

Source	dF	SS	MSS	F
Replication	3	32.20313	10.73438	2.516344
Treatments	11	13104.68	1191.335	279.2717**
Error	33	140.7734	4.265862	

* Significant at 5% level

** Significant at 1% level

APPENDIX IV

Analysis of variance table for the number of flowers per plant in Marigold

Source	dF	SS	MSS	F
Replication	3	4.6875	1.5625	1.203062
Treatments	11	273.5664	24.86967	19.14865**
Error	33	42.85938	1.298769	

* Significant at 5% level

** Significant at 1% level

APPENDIX V

Analysis of variance table for the size of the flowers in Marigold

Source	dF	SS	MSS	F
Replication	3	3.9386	1.3129	1.2149
Treatments	11	119.9539	10.0867	10.0559**
Error	33	35.6622	1.0807	

* Significant at 5% level

** Significant at 1% level

APPENDIX VI

Analysis of variance table for the longevity of flowers in Marigold

Source	dF	SS	MSS	F
Replication	3	7.5781	2.5260	2.4113
Treatments	11	186.7969	16.9815	16.2102**
Error	33	34.5703	1.0476	

* Significant at 5% level

** Significant at 1% level

APPENDIX VII

Analysis of variance table for the duration of flowering in Marigold

Source	dF	SS	MSS	F
Replication	3	78.4375	26.1458	5.0707
Treatments	11	28412.35	2582.941	500.9339**
Error	33	170.1563	5.15625	

* Significant at 5% level

** Significant at 1% level

APPENDIX VIII

Analysis of variance table for the height of the plant in Zinnia

Source	dF	SS	MSS	F
Replication	3	66.42969	22.14323	9.9599**
Treatments	11	1963.688	178.5171	80.2956**
Error	33	73.36719	2.223248	

* Significant at 5% level

** Significant at 1% level

APPENDIX IX

Analysis of variance table for the number of branches in Zinnia

Source	dF	SS	MSS	F
Replication	3	24.1211	8.0403	1.4453
Treatments	11	276.9468	25.1769	4.5256**
Error	33	183.584	5.5632	

* Significant at 5% level

** Significant at 1% level

APPENDIX X

Analysis of variance table for the number of days to flower in Zinnia

Source	dF	SS	MSS	F
Replication	3	22.6563	7.55208	6.6426
Treatments	11	977.1797	88.83452	75.5916**
Error	33	38.78125	1.175189	

* Significant at 5% level

** Significant at 1% level

APPENDIX XI

Analysis of variance table for the number of flowers per plant in Zinnia

Source	dF	SS	MSS	F
Replication	3	15.92969	5.309896	3.2515*
Treatments	11	3402.506	309.3187	189.4118**
Error	33	53.89063	1.633049	

* Significant at 5% level

** Significant at 1% level

APPENDIX XII

Analysis of variance table for the size of the flowers in Zinnia

Source	dF	SS	MSS	F
Replication	3	4.5044	1.50147	2.3408
Treatments	11	176.1572	16.0143	24.9668**
Error	33	21.1669	0.6414	

* Significant at 5% level

** Significant at 1% level

APPENDIX XIII

Analysis of variance table for the longevity of flowers in Zinnia

Source	dF	SS	MSS	F
Replication	3	6.25	2.0833	0.5156
Treatments	11	4148.887	377.172	93.3453**
Error	33	133.339	4.0406	

* Significant at 5% level

** Significant at 1% level

APPENDIX XIV

Analysis of variance table for the duration of flowering in Zinnia

Source	dF	SS	MSS	F
Replication	3	10.09375	3.364583	0.8816
Treatments	11	21256.45	1932.405	506.3572**
Error	33	125.9375	3.816288	

* Significant at 5% level

** Significant at 1% level

APPENDIX XV

Analysis of variance table for the incidence of disease in Zinnia

Source	dF	SS	MSS	F
Replication	3	16.6931	5.5643	3.1864
Treatments	11	96.9977	8.8179	5.4965**
Error	33	57.6264	1.7463	

* Significant at 5% level

** Significant at 1% level

APPENDIX XVI

Analysis of variance table for the plant height in Balsam

Source	dF	SS	MSS	F
Replication	3	14.6172	4.8724	1.7359
Treatments	11	5199.305	472.6641	168.3985**
Error	33	92.625	2.8068	

* Significant at 5% level

** Significant at 1% level

APPENDIX XVII

Analysis of variance table for the number of branches in Balsam

Source	dF	SS	MSS	F
Replication	3	6.7969	2.2656	0.494015
Treatments	11	246.6167	22.4197	48.88572**
Error	33	151.3428	4.5861	

* Significant at 5% level

** Significant at 1% level

APPENDIX XVIII

Analysis of variance table for the number of days to flower in Balsam

Source	dF	SS	MSS	F
Replication	3	32.8516	10.9505	1.1454
Treatments	11	828.8828	75.348	7.8814**
Error	33	315.4883	9.5602	

* Significant at 5% level

** Significant at 1% level

APPENDIX XIX

Analysis of variance table for the number of flowers per plant in Balsam

Source	dF	SS	MSS	F
Replication	3	72.5468	24.1823	3.87709
Treatments	11	4752.352	432.032	69.2668*
Error	33	205.8281	6.2372	

* Significant at 5% level

** Significant at 1% level

APPENDIX XX

Analysis of variance table for the size of the flowers in Balsam

Source	dF	SS	MSS	F
Replication	3	6.6895	2.2298	0.3184
Treatments	11	11.3192	1.0290	0.14694**
Error	33	231.1035	7.0031	

* Significant at 5% level

** Significant at 1% level

APPENDIX XXI

Analysis of variance table for the longevity of flowers in Balsam

Source	dF	SS	MSS	F
Replication	3	20.7519	6.917318	2.8579
Treatments	11	160.0415	14.5492	6.0111**
Error	33	79.8731	2.4204	

* Significant at 5% level

** Significant at 1% level

APPENDIX XXII

Analysis of variance table for the duration of flowering in Balsam

Source	dF	SS	MSS	F
Replication	3	54.8438	18.2813	1.2113
Treatments	11	14376.64	1306.967	86.5981**
Error	33	498.0469	15.0923	

* Significant at 5% level

** Significant at 1% level

APPENDIX XXIII

Analysis of variance table for the incidence of disease in Balsam

Source	dF	SS	MSS	F
Replication	3	14.9262	4.9754	1.8488
Treatments	11	88.1674	8.0152	2.9784**
Error	33	88.8062	2.6911	

* Significant at 5% level

** Significant at 1% level

EFFECT OF TIME OF PLANTING ON THE GROWTH AND FLOWERING OF POPULAR BEDDING PLANTS

BY

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ABSTRACT

A field experiment was conducted at the College of Agriculture, Vellayani during 1988-'89 to study the effect of time of planting on the growth and flowering of popular bedding plants namely Marigold, Zinnia, Balsam, Phlox and Salvia. For reason(s) not absolutely known stand of adequate size could not be obtained for Salvia and Phlox and hence the two crops were not carried over through the remaining part of experiment.

Time of planting had profound influence on characters like plant height, number of branches per plant, number of days to flower, number of flowers per plant, size of flowers, longevity of flowers and duration of flowering in Marigold, Zinnia and Balsam.

In Marigold the number of days taken for 50 per cent germination of seeds and the percentage of germination of seeds were not much influenced by sowing dates. Transplantation during the months of September, October and November is ideal for early flower initiation, maximum number of flowers and branches and less plant height. February and March planting gave longer duration of flowering with medium sized flowers and good flower longevity.

In Zinnia the number of days taken for 50 per cent

germination of seeds were not much affected by sowing time. But the sowing time influenced the percentage germination of seeds. May sowing gave the highest percentage germination of seeds. Transplantation during the months of February, March, April and May is ideal for getting maximum number of large sized long lasting flowers with longer duration of flowering. However, it was noticed that incidence of leaf blight disease was more during these months, as compared to other months. September, October and November gave lesser plant height with more number of branches and earlier flowering.

Sowing time did not influence the number of days taken for 50 per cent germination of seeds in Balsam. However sowing time influenced th- percentage germination of seeds. June sowing gave the highest germination percentage. Plant height was reduced by planting in September, October, November, December and January. Transplantation during the months of February, March, April and May is ideal for getting maximum number of large sized flowers with maximum number of branches. However, it was noticed that incidence of leaf spot disease was more during these months, as compared to other months. November, December, January and February transplantings are ideal for getting maximum duration of flowering.