SUMMARY

I. Effect of Time of Sowing on Growth and Flowering of Carnation

Field trials were carried out to find out the best time for sowing of carnation under Bangalore condition. For this purpose, seeds of Marguerite carnation cv. 'Crimson' were sown once in a month starting from June, 1978 and continued till May, 1979. However, it was observed that raising and establishing carnation seedlings beyond January was difficult and uneconomical, because seedling mortality was extremely high due to unfavourable weather condition during this period. Hence the results obtained from the sowing dates from June, 1978 to January, 1979 are considered worth mentioning and are summarized below.

(i) June and July sown carnation plants were comparatively stunted in growth, producing fewer number of branches. On the other hand, October to December sown plants were taller in height and produced slightly larger number of branches.

(ii) The flower bud appearance also was affected by sowing time. Flowering was somewhat delayed in plants raised during June to August. The flower bud appearance was considerably advanced in December and January sown plants, which were earlier by about 15 and 13 days, respectively than June sowing. Rate of flower development was also accelerated in these sowing dates.

(iii) The plants raised from October to December sowings gave higher yield of flowers than those raised earlier or later. The flower yield was minimum in plants raised from January sowing.
(iv) Flower quality in terms of its size and longevity showed marked improvement in October and November sowing. The smallest size flowers were produced in January sowing, which lasted minimum number of days.

(v) Growth and flowering of carnation seemed to be influenced markedly by prevailing temperature and light conditions. Although the optimum sowing time under Bangalore condition appears to be October-November, it can be extended from September to December, without affecting much the yield and quality of flowers.

II. Effect of Plant Spacing on Growth and Flowering of Carnation

A field trial was conducted at the Indian Institute of Horticultural Research, Bangalore to find out the optimum spacing for carnation. For this purpose, 7 spacings viz. 25 x 25, 30 x 30, 35 x 35, 40 x 40, 45 x 45, 50 x 50 and 55 x 55 cm were tried. The cultivar 'Crimson' was used in this trial. The important findings are summarized below.

(i) Spacing did not affect the height of plants to an appreciable extent; however, the number of branches produced per plant increased with the increasing spacing between plants. Such spacings as 40 cm x 40 cm and 45 cm x 45 cm appeared to be optimum as growth of carnation was concerned.

(ii) Flowering was slightly delayed in plants given widest spacings (50 cm x 50 cm and 55 cm x 55 cm). The yield of flowers per plant decreased greatly as the spacing was reduced. The highest yield per plant was recorded at a
spacing of 45 cm x 45 cm, closely followed by 40 cm x 40 cm. Further increase in spacing did not show any subsequent increase in flower number. Flower yield per unit area was found to be maximum at the spacing of 40 cm x 40 cm.

(iii) The flower quality also was affected by spacing. The smallest flowers were produced at a spacing of 25 cm x 25 cm, which lasted minimum number of days. The flower quality improved with the increase in spacing up to 45 cm x 45 cm. Further increase in spacing showed no more improvement in flower quality.

(iv) Considering the response of plants to different spacings, a spacing of 40 cm x 40 cm gave highest yield of improved quality flowers per unit area and hence is recommended under Bangalore condition.

III. Effect of Different Levels of N, P and K on Growth and Flowering of Carnation

A field experiment was conducted at the Indian Institute of Horticultural Research, Bangalore during 1979-80 to study the response of carnation to various levels of N, P and K added to the soil. There were 3 levels of N (0, 10 and 20 g/m²), 3 levels of P₂O₅ (0, 20 and 40 g/m²) and 3 levels of K₂O (0, 20 and 40 g/m²). The important results obtained in this experiment are summarized below.

(i) Nitrogen significantly stimulated the vegetative growth of plants as was evident from the increase in plant height, number of branches and leaves per plant and size of leaves.
Phosphorus also promoted the vegetative growth of plants, but its effect was less pronounced than that of nitrogen; whereas added potassium showed no significant effect on growth.

(ii) None of the nutrients applied brought about appreciable earliness in flowering or delayed flowering. However, the flower yield per plant increased appreciably with the application of nitrogen and phosphorus, while K showed no significant result on the yield of flowers.

(iii) The quality of flowers in respect of diameter and longevity showed improvement with the application of N, P and K.

(iv) A number of significant interaction between N x P, N x K, P x K and N x P x K was recorded.

Application of nitrogen together with phosphorus caused significant improvement in growth and flowering of carnation. In general, the response was more pronounced when nitrogen was applied at higher levels. Nitrogen and potassium also showed significant interaction almost in the same manner as in case of nitrogen and phosphorus. High nitrogen (20 g/m²) together with moderate supply of potash (20 g/m²) brought about maximum improvement in growth and flowering of carnation. P x K interaction showed no significant effect on plant height and number of branches per plant, but high levels of P₂O₅ (40 g/m²) along with moderate dose of K₂O (20 g/m²) resulted in appreciable improvement in number and size of leaves as well as number of flower buds per plant. The second order interaction
\[ (\alpha \times \beta \times \gamma) \text{ also showed significant interactions on a number of parameters. However, there were wide variability in the treatments giving best results. Thus while the yield of flowers increased markedly under treatments like } \frac{n_1p_2k_0}{2^0}, \frac{n_1p_0k_2}{2^0}, \frac{n_2p_2k_2}{2^0}, \frac{n_0p_0k_1}{2^0}, \frac{n_2p_1k_2}{2^0}, \text{ the size of flowers showed improvement under } \frac{n_2p_2k_2}{2^0}, \frac{n_1p_1k_1}{2^0}, \frac{n_1p_1k_2}{2^0}.
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(v) Leaf analysis results showed that application of high dose of a nutrient element brought about substantial improvement in its status in the tissue. Leaf N level was not affected by the variation in the application of P or K. High N supply caused decline in the foliar K content. Further, there was substantial reduction in the contents of N and P from vegetative stage to flowering stage. Interaction of N x K was reflected on the leaf K content at the flowering stage.

IV. Effect of Pinching (Stopping) at Different Stages of Growth on Growth and Flowering of Carnation

There were two experiments on pinching. In the first experiment, the plants were pinched 50, 60 and 70 days after transplantation. In the second experiment, the pinching was done 40, 50 and 60 days after transplantation. Necessary controls (unpinched) were provided in both experiments. The important findings are epitomized below.

(i) Apparently, pinching had no appreciable effect on the height of plants, but the number of branches increased significantly as a result of pinching; however, the response was less when pinching was as late as 70 days after transplantation.
(ii) Although pinching did not affect the time of anthesis, it markedly increased the number of flowers produced per plant over control, except when pinching was done very late.

(iii) Pinching resulted in the improvement of flower quality in terms of diameter of flowers as well as its longevity. Early pinching (40 days) was found most effective in this respect, while late (70 days) pinching was mostly ineffective.

(iv) From the results of these experiments, it can be concluded that in order to get optimum yield of better quality flower, carnation plants should be pinched between 40-60 days after transplantation under Bangalore condition.

V. Effect of Disbudding on Growth and Flowering of Carnation

Two experiments were carried out to study the effect of disbudding on growth and flowering of carnation. In the first experiment, disbudding was done 7, 14 and 21 days after the appearance of the axillary buds. In the second trial, disbudding was done at 0, 5 and 10 days after the appearance of axillary buds. In both trials appropriate controls (no disbudding) were provided. Given below are the important observations of these experiments.

(i) Disbudding soon after emergence of axillary buds (0 days) stimulated the vegetative growth of plants as was evident from the increase in height of plants and number of branches and leaves per plant.

(ii) Early disbudding resulted in earlier anthesis than control. Anthesis was advanced by about 10 days when disbudding was done soon after bud emergence (0 days).
(iii) Disbudding caused large reduction in flower number; however, the diameter and longevity increased appreciably as a result of disbudding, especially when done in the early stages of bud development.

(iv) The results indicate that to obtain maximum benefit disbudding should be done within 7 days of axillary bud appearance.

VI. Effect of Growth Regulators on Growth and Flowering of Carnation

The efficacy of NAA at 100, 250 and 500 ppm, GA3 at 10, 50 and 100 ppm, ethrel at 50, 100, 250, 500 and 1000 ppm and Cycocel at 1000, 2500 and 5000 ppm in influencing the growth and flowering of carnation was tested in this study. Each chemical was sprayed twice - 30 and 45 days after transplantation. The important results obtained under each chemical are summarized below.

Effect of NAA

(i) The plant height tended to decrease with concomitant increase in branch and leaf number as a consequence of spray with NAA. NAA at 500 ppm was found most effective in this regard. NAA-treated leaves were smaller in size than the control.

(ii) Although NAA delayed the emergence of the flower to some extent, it increased the number of flowers per plant, the increase being more with higher concentration of NAA but the magnitude of such increase was not statistically significant. NAA showed no marked effect on quality of flowers.
Effect of gibberellic acid (Ga$_3$)

(i) Ga$_3$ at 100 ppm promoted plant growth as was evident from the increase in plant height, number of branches and leaves per plant. Lower concentrations of Ga$_3$ were mostly ineffective.

(ii) Ga$_3$ at the concentrations used in this experiment neither brought about earliness nor delayed flowering to an appreciable extent. However, it tended to increase the number of flowers per plant, although the magnitude of such increase was statistically insignificant. Ga$_3$ increased the size of flowers but had no appreciable effect on longevity.

Effect of ethrel:

(i) Ethrel at the concentrations of 50 to 250 ppm did not affect the growth and flowering of carnation. On the other hand, higher concentrations of ethrel (500 and 1000 ppm) markedly reduced the height of plants with concomitant increase in the number of branches and leaves. The leaves of plants treated with higher concentrations were smaller in size than the control.

(ii) Flower bud emergence was delayed by nearly 25 days as a consequence of 1000 ppm of ethrel spray. Flower development was also slow in this treatment. However, the number of flowers increased significantly in plants receiving a spray of 1000 ppm of ethrel.

(iii) Ethrel at higher concentrations marginally reduced the diameter of flowers, but slightly increased the longevity, while lower concentrations showed no appreciable effect on flower quality.
Effect of Cycocel

(i) Cycocel at 2500 and 5000 ppm markedly suppressed the extension growth of plants, but increased the number of branches and leaves; higher concentration being found more effective than lower concentration. Leaves of Cycocel-treated plants were markedly smaller in size than control.

(ii) Cycocel at the highest concentration (5000 ppm) used in this experiment slightly delayed the appearance of flower buds, but resulted in increased flowering. There was no conspicuous effect of Cycocel on flower size; however, the longevity of flowers was extended by nearly 3 days as a result of treatment with Cycocel at 5000 ppm.