THE EFFECTS OF SOME ECOLOGICAL FACTORS ON THE GROWTH AND FLOWERING OF CARNATION

(<u>DIANTHUS</u> <u>CARIOPHYLLUS</u> L.)

BY

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INTRODUCTION

Carnation (Dianthus caryophyllus L.) belongs to the family Caryophyllaceae (Theophrastos had mentioned it as "Diosanthos Flower of the Gods").

It is native to a large area extending from Southern Europe to India and is in cultivation in more than 20 countries. It is 2 to 3½ ft. tall, with a brittle stem. Leaves are opposite and one shoot grows from each node. The lateral shoots are arranged spirally around the stem.

The original type produced single flowers in spring months only. Modern carnation have strong stems and large double flowers. It is also distinguished by a long flowering season. The flowers are usually ruffled or toothed. The red, white and pink predominate with occasionally yellow or purple. Varigations occur but usually on body colors of yellow or white.

Carnation is considered one of the few principal crops for cut flower and second to roses. This is due to its great decorative value. The flower looks beautiful from most angles. The wide range of colours makes it fit for many purposes. The flowers last long time after cutting whether they are put in water or not in the different uses. It could be added also that carnation is easy in propagation.

The main object of the work reported in part 1 was to evaluate the growth and flowering of the carnation plants exposed to additional light in comparison with those grown under natural light conditions in Egypt. Many workers came to the conclusion that carnations can flower early by using additional light. A particular attention was paid for the chemical composition during the plant growth and flower developmental stages to add knowledge about the relationships between flowering and the chemical composition.

The second part of the research was to study the effect of the additional illumination of carnation plants on mineral uptake when three levels of fertilizers were used. The effects of the fertilizers added on the growth and flowering were also studied.

The summer seasons in the Arab Republic of Egypt are sufficiently warm with high light intensity. The work in the third part was to study whether it would be benifical to use different shades to maintain more favourable conditions for better growth and flowering of carnations.

Many workers came to the conclusion that pinching had a remarkable effect on the growth and time of flowering of the carnation plants. The last part of the research was to study the most suitable pinching practice and date of planting under the local conditions of Egypt.

REVIEW OF LITERATURE

(A) Effect of additional light on the growth flowering and chemical composition:

It was found by many workers that the growth rate of the carnation plants was affected by the length of the photoperiod . Among them was Sarret (1965) who reported that there was an absence of secondary shoots in carnation plants that were exposed to day length equivalent to that occuring naturally during the summer solstice. Gortz (1966) stated also that the illuminated plants were taller with longer internodes but had fewer lateral shoots; the flower stems were thinner but harder than the controls. Similar results were observed by Schaffer (1959) about stem strength. He found that lighted had sturdier stems than those from unlighted plants. But Pokorny (1960) found different results for stem length. He stated that the longest stems, sometimes too long, were produced by plants grown to flowering under short days (8 hours). Less number of nodes were formed on plants that were exposed to long days. Blake (1955) found that short days of 8 hours produced flowering shoots with significantly more nodes than were produced in long days. Harris and Harris (1962) showed that long days reduced the number of leaves formed below the flower, and the internode length was greater in short days. They stated also that photoperiod, however, had no appreciable effect on carnation growth in terms of dry weight. Afterwards Freeman and Langhans (1965a) observed that shoots on plants grown under 18-hour days generally had 3 to 4 fewer nodes than shoots on 9-hour plants.

Holley and Baker (1963) reported that the carnation was originally a long-day plant, flowering only in summer. The development of its perpetual flowering habit by the French breeders and later by the American breeders rid this plant of most of its response to daylength. However the researches of many workers showed that flowering of carnations could be accelerated by the extention of daylength.

The effects of daylength on the flower initiation of carnation were reported by many workers. Blake (1955) showed that short days of 8-hours delayed flower initiation. Later in 1956 he also found that up to the time of flower bud initiation daylength was the most important environmental factor. Once the buds were formed temperature became important than daylength. Harris and

Griffin (1961) treated carnation plants, grown from [illegible] or leaf bud cuttings with : (i) short day treatment, i.e. 8 hours of natural daylength, (ii) extended days, i.e. the same plus, hour of supplementary artificial light given before and after the 8 hours, natural light and (iii) interrupted nights, i.e. the same with supplementary artifical light given in the middle of the dark period. After 4 or 5 months the plants were examined, and the flower primordia were only found in the plants given treatment(iii). Harris and Harris (1962) found that short days delayed flower initiation with White Sim carnation. Emino (1966) mentioned also that long photoperiods hastened flower initiation but had no effect on flower development, whereas short photoperiods delayed flower initiation. Harris and Ashford (1967) reported similar responses to daylength. Increasing in photoperiod up to 24 hours hastened flower initiation of White Sim carnation. Illumination throughout the night was more effective in promoting flowering than any photoperiodic treatments particularly when day time light intensities were low.

Many reports on earlier flowering as a result of supplementary light were reviewed. Among them Harold(1960), who found that carnation plants that were given supplemental light and an extended photoperiod of 14 hrs.; grew and developed buds more rapidly than plants under natural day length. Supplemental light and a 14-hour photoperiod caused plants to flower 28 to 34 days earlier than unlighted plants. Flower production was significantly greater for lighted plants in November and early December. The total flower production for lighted plants was also greater for the harvest period of November to April. Similar effect caused by additional light was obtained by White (1961) who found in 1957 - 1958 that Red Sim carnations potted on December 30th received supplementary light to provide 14 - hour photoperiods from January 13th to April 21st flowered 28 - 34 days ealier than plants grown without supplementary light. But he found that the total flower production was not affected by photoperiod. In 1958 - 59, plants set in benches on July 11th were given 14-hour photoperiods from August 18th to April 21st. Once again the plants receiving supplementary light flowered earlier than those grown in natural day lengths, and in addition flower production was increased during the period from November to April. Sarret (1965) employed 3 light intensities (120 w., 80 w. and 60 w. per sq. m. giving 2.700, 1.700 and 1.300 lumens respectively) to provide an average day length equivalent to that occurring naturally during the summer solstice. The carnation plants were planted in August 1963, and picking began in mid - October, 6 weeks earlier than from the control. Freeman and Langhans (1965a) stated that plants grown under an 18-hour photoperiod flowered a month earlier than those grown under shorter days. Gortz (1966) in his investigations supplied Scania and Solerd carnations planted on January, 15th with additional incandescent light. Their flowering was advanced by almost 3 weeks. He found also that 60 % of the first flush of flowers could be cut in June on the illuminated plots compared with 30 % in the controls. Levonen (1966) reported that flowering was advanced by 2 months when intermittent lighting was provided during the winter months. Recently, Statens (1970) reported that long - day treatments given to unstopped young plants of William Sim in winter advanced their flowering by 30 to 40 days when applied for 4 weeks to plants with shoots about 20 cms. long. With stopped plants, the best response was obtained by 4 weeks of long days to plants with five to six leaf pairs (shoots about 18 cms. long).

Blake and Whitehead (1961) reported that extention of day-length to 17 hours throughout the winter accelerated flower production so that more flowers were produced in early spring and fewer in summer. There was also a small increase in the total flower production. Hall (1965) found also that extra flowers in carnation obtained in May by use of a night break were offset by a reduction in the crop in September and October. Stohr (1966) reported that supplementary lighting at low intensity (40 w) to extend the day length, induced flowering from January to April, but the plants were weakened. Klougart (1966)found that extra light for February-planted carnations accelerated the first flush of flowering, compared with that of control plants.

Flower yield of carnations were increased by using long photoperiods. Laurie and Poesch (1932) and Arthur and Harvill (1938) obtained an increase in flower production with additional illumination. Cox (1967) used Pink Sim carnations which were grown with supplementary lighting by 150- Watt bulbs; lighting was supplied from dusk to dawn over the period of December 7th to January 20th. The lighted plants cropped far more heavily than unlighted controls, during March to May. During January, February and June the controls produced most flowers. In general, continuous dusk to dawn lighting had the maximum effect. The cheapest and most profitable method was to provide