Colorado Flower Growers Association, Inc.

IN COOPERATION WITH COLORADO STATE UNIVERSITY

Doris Fleischer, Executive Secretary

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The Evolution of Present-day Methods of

Carnation Propagation

by W. D. Holley

Carnation propagation has gone through more improvement in the past decade than in all the previous time since Dalmais developed it in 1842. To list the major developments would include such advances as culturing of cuttings, mother blocks, cutting storage, the use of intermittent mist, and perlite as a rooting medium. There are many minor points in propagation that have also contributed a share in the improvement of carnation cuttings and the resulting crops grown from them. It is the purpose of this paper to bring these to the attention of carnation growers.

Culturing of cuttings began with Dimock's work on chrysanthemums (2), which more recently has been applied to carnations by many workers. Culturing methods have been improved further by Hellmers (3) and by Tammen, et. al. (8). Carnation cuttings are presently cultured free of the wilt disease organisms by many commercial firms as well as experimental stations. Shoot-tip culture conceived by Neergaard of the Danish Plant Pathological Service, and Miss Quaak of Wageningen, Holland, gives promise of ridding carnations of virus diseases as well as other pathogens. This new technique may well be the next great advance in carnation propagation.

Mother block culture was first used widely on chrysanthemums, although this method has long been used in increasing varieties of all flower crops. As soon as select carnation plants were available, this was the natural method for multiplication. The large-scale adoption of this program for rapid propagation of select stock was first accomplished by Larry Taylor of Denver Wholesale Florist Company of Denver, Colorado. Many of the innovations in mass propagation and culture of mother blocks have been perfected by this company. Mother block propagation concentrates the potential errors inherent in this system, however. Extremely few nucleus plants are responsible for almost all planting stock. These nucleus plants must be good. They must be free of disease and they must produce flowers of high quality. One nucleus plant at Colorado State University may be responsible for over 60,000 plants by the time they are planted in producing benches.

The cold storage of carnation cuttings (4), either rooted or unrooted, is widely used. At Colorado State University we prefer a storage period not in excess of three months, however longer periods, especially for unrooted cuttings, are often successful. Only vigorous, disease-

free cuttings should be stored. Convenient-sized boxes lined with polyethylene film are satisfactory as containers. The film should be folded over the cuttings, never sealed. Insufficient oxygen will cause rapid deterioration of cuttings, usually accompanied by bleaching of the foliage and an ensilage-like odor. Cuttings which have been stored too long show deterioration of the lower foliage and some loss of color. Disease problems in storage are usually due to too much moisture on the cuttings and to the storage of cuttings from unsprayed mother plants. Alternaria and other leaf spots develop freely in storage, if the spores are on the cuttings when stored. Storage temperatures of 32 to 33°F are satisfactory.

Langhans (5) gave us one of the greatest tools yet conceived for propagation when he worked out the use of intermittent mist. The use of mist allows carnations to be rooted in full sun with good air circulation. Before mist propagation was developed, cuttings were often rooted in heavily shaded areas hence had very low food reserves following rooting. The use of paper as a close covering made ideal moist chambers for disease infection. Losses were heavy and recovery of the cuttings following planting was slow. Mist has made possible the propagation of carnations at any season.

Propagating media have steadily improved. Water and air are essential for the rapid formation of healthy roots. Coarse sand performs these functions well, but sand is highly variable. Butterfield (1) and Odom (6) have shown that sand containing more than 15 per cent of the very fine fraction (passing 50 mesh/inch) caused sloughage of the roots from carnation cuttings. With the use of mist propagation this fine fraction could be eliminated to good advantage. Perlite (heat expanded sand) has proven the ideal medium for propagating with mist. Perlite is screened into several grades, the finest of which is not good for propagative purposes because insufficient air is available to the bases of cuttings.

Anatomy of a cuttings

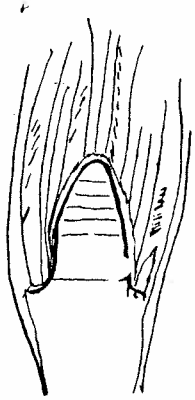
When removed for rooting, a heel cutting should contain 14 to 15 pairs of leaves. The lower 6 to 8 pairs give rise to one vegetative lateral each, while the upper buds grow into flower buds with gradations in reproductiveness from lower to upper. Carnation leaves are opposite, however only one bud usually grows from each pair of leaves. The arrangement of the buds which grow is spirally on the stem, or almost opposite.

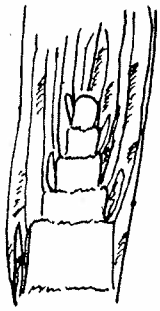
If all laterals should grow on a flower stem and are rooted as cuttings, the top lateral will be the most reproductive and the bottom lateral the most vegetative, with a gradation between. The uppermost laterals will bloom quickly, if not pinched; the lowest ones will require much longer to bloom. To remove this reproductive tendency to a great extent, the shoot end is removed early and all cuttings tend to become almost uniformly vegetative.

Fig. 1. Long internodes indicate that a flower bud has initiated in the cutting (3).

Bud initiation occurs in normal cuttings when they are 6 to 8 inches long. Examination with a microscope shows distinct differences between the flower and vegetative primordia. Wagner (9) found bud initiation to occur around 12 weeks after a shoot originates, varying of course with the season of the year, and the position of the lateral on the plant.

Premature budding and elongation of cuttings after they are removed from mother stock has often been a problem in mother block culture. This problem occurs most frequently in the fall of the year, or on the first crop of cuttings taken





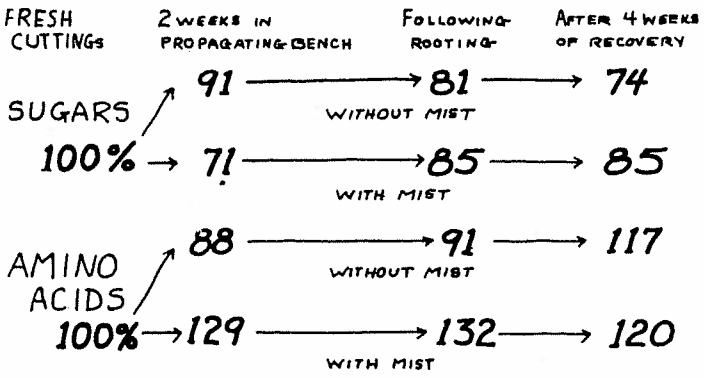
VEGETATIVE REPRODUCTIVE

from young mother stock. If unpinched, these cuttings may have as few as 8 pairs of leaves, long internodes, and often only one to three vegetative breaks.

This problem is really a combination of two problems. The unusual elongation on cuttings after they are removed from mother stock, but before they have completed rooting, is probably an influence of a temperature increase, such as changing over from cooling to conventional ventilation, or some other sudden increase in temperature. Premature budding of cuttings following rooting is usually due to flower bud initiation in the cutting before it is removed from the mother plant. Cuttings which are left on the mother stock too long produce inferior plants. This practice of leaving them on too long is also harmful to the crop of cuttings which follow, as they will be shaded and thin in diameter. A mother block operation should be thought of as continuous. The cuttings should be removed as soon as they are of optimum size so the next crop will have better light and less competition for the sugars to be stored.

Food storage in cuttings

The amount of usable food stored in a cutting was probably more important when they were rooted in darker environments. Food is stored in carnation cuttings as sugar. Odom and Holley (7) found the maximum sugar in cuttings 2 to 4 hours following the maximum light intensity for the day. Cuttings also had more food reserves if taken during or immediately following several sunny days. Food reserves decreased gradually during storage, but remained relatively constant during the propagative period, except during root formation. At root formation there was a rapid and serious drain of food from the tops of the plants. This work was done before the use of mist propagation so the cuttings were rooted in reduced light.



PERCENTAGE CHANGES IN TOTAL SUGARS AND TOTAL AMINO ACIDS IN CARNATION CUTTINGS THROUGH THE PROPAGATIVE AND RECOVERY PROCESSES. — D. YOUNGER (1957)

Younger (10) investigated changes in total sugars and amino acids in carnation cuttings through the propagative period and during recovery. She compared cuttings propagated with and without benefit of mist. Total sugars and amino acids were measured by means of partition chromatography. Total sugars decreased rapidly the first two weeks under mist, increased following rooting, and remained constant the first four weeks in a nursery bed. Lack of turgor complicated the sugar measurement of cuttings propagated without mist. However, the total sugar level was lower in these cuttings after four weeks of recovery indicating a slower recovery rate. Amino acids were significantly higher under mist during the propagative phase, but both treatments contained essentially the same amino acid levels four weeks later.

Trimming cuttings

A practice that has long been with us, and our fathers before us, is the careful preparation of cuttings for sticking. Certain leaves are removed, or the base of the cutting is trimmed, or broken just right. No doubt there were reasons why some of these practices were started. We have investigated the need for any and all practices as they were called to our attention and have found no specific method of trimming or cutting to be of value. With mist propagation, water loss from the cutting is no longer a problem. Simplification of the propagative process and the elimination of unnecessary steps is entirely in order. Reducing labor and the chance

for disease infection should be the principal concerns of the propagator. The removal of all or parts of leaves from cuttings serves only to delay rooting and to weaken the cuttings by removal of stored food and the capacity for making food while the cutting is in the propagative bench.

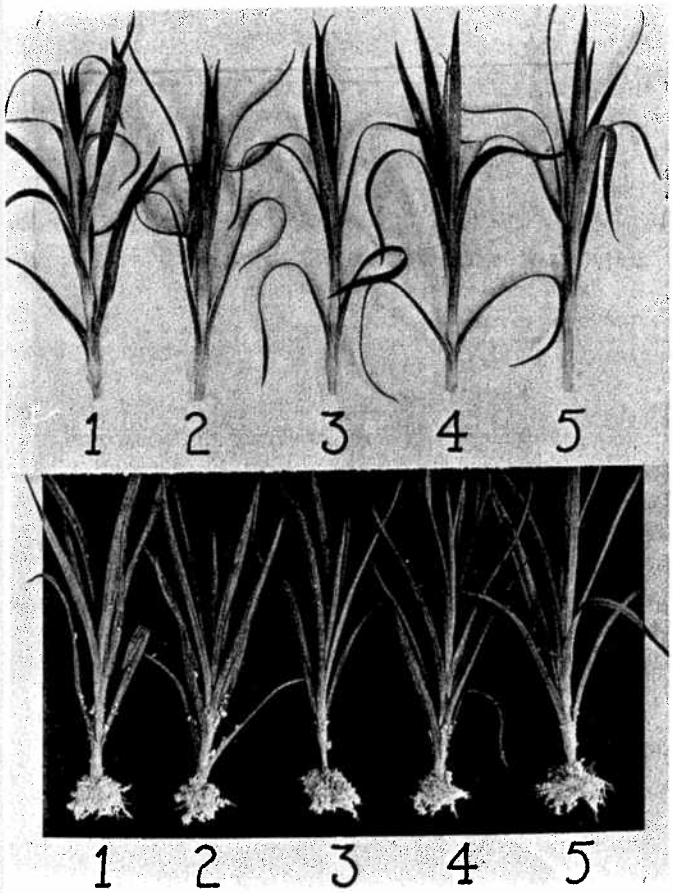


Fig. 2. Root formation is not influenced by the preparation of basal ends of cuttings before sticking.

Typical cuttings were illustrated in Fig. 2 from a recent test in which the basal ends of cuttings were prepared in several ways. The paired photographs show five treatments as follows: 1) base of cutting torn and mashed, 2) base cut with sharp razor blade, 3) cutting broken from mother plant between nodes, 4 and 5) cuttings broken off just below or at nodes with the bottom pair of leaves removed from 5. The lower photograph shows typical cuttings from each treatment following rooting. No difference could be observed in the rooting of these cuttings, regardless of preparation for sticking in the medium. The least labor is required when cuttings are stuck exactly as they come from the mother plants. This labor can be a significant factor. Also, the more cuttings are handled, the better the chances for disease infection.

Hormones

Preparations of root promoting hormones are beneficial in hastening rooting of carnations and in increasing the amount of roots formed. Preparations containing naphthalene acetic acid have proven superior in CSU tests. Indole butyric acid is also beneficial, at least some times of the year. Naphthalene acetic at a strength of 1/4 of 1% in talc is an excellent root promoting chemical for carnations. Higher concentrations of root promoting chemicals can cause injury by delaying rooting, causing uneven rooting, or even burning the bases of the cuttings. Hormone powders are to be preferred over liquids and dips since the latter help spread diseases. A dusting apparatus whereby the bases of the cuttings are dusted with hormone powder is highly desirable from a disease prevention standpoint. Root promoting chemicals incorporated in aerosols have been successful when applied evenly.

Uneven rooting

The rooting of cuttings on one side is usually caused by high temperature or uneven application of hormone powders. Uneven rooting in which some cuttings root quicker than others may be due to the two previously listed causes, or to uneven bottom heat, or uneven coverage by mist.

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Aids in Stem Rot Control

by Ralph Baker

If the spores of Fusarium roseum could advertise their presence, there is no doubt they would soon be wiped out. But these propagules are not visible until it's too late. Thus it is difficult to stand beside a vigorous mother block and realize that on those green, lush cuttings there may be thousands of spores, any one of which might attack during propagation and incite damaging losses.

To the alert propagator this leaves but one course of action: a definite program of prevention to suppress this unseen antagonist.

> The single most important control measure is that of weekly application of captan sprays to reduce the inoculum on the cuttings. Failure to follow this has resulted in disaster.

Other measures contributing to control of "roseum" are:

1. Strict application of sanitation measures. Only a few responsible employees should participate in a mother block program.
2. Splashing of water and soil should be kept to a minimum during watering. With this in mind it should be apparent that watering systems which eject water under pressure should be avoided in mother blocks.
3. Cuttings should be grown as high above the soil as possible.

No one in the Denver area needs a demonstration to prove that F. roseum can be destructive. It makes good sense to apply these simple precautions. The time to start using ALL of these measures is now.

your editor,
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