



Control Of Carnation Wilt Diseases¹

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Fusarium and bacterial wilt of carnation have for many years caused serious economic losses to the carnation growers of the United States. Control of these diseases has been difficult because the causal organisms can infect the roots and grow within the water conducting tissues of the stem without the appearance of symptoms. Thus, they may be propagated and spread with the cutting without the knowledge of the grower and cause widespread destruction of seemingly healthy plants when conditions become favorable for disease development.

Since the discovery of Fusarium wilt and of bacterial wilt, investigators have searched for wilt resistant carnation varieties; however, at present there are no known commercially acceptable varieties resistant to either of the diseases. In fact, most of the Sim varieties are susceptible to attack by both organisms.

Control by the use of chemical treatments and antibiotics has been reported experimentally, but such treatments have not met with success commercially.

Some 60 years ago a Frenchman named Mangin suggested culture indexing as a means of detecting and eliminating cuttings infected with the Fusarium wilt fungus. As far as is known, however, no use of culture-indexing was made by the carnation industry of the United States until 1948, when A. W. Dimock of Cornell University introduced a commercially feasible method of indexing for Fusarium wilt. Modifications of Dimock's method were made in 1955 by Hellmers of Denmark, who developed the "broth method" to improve the detection of the bacterial wilt organism.

Effectiveness of Culture-Indexing

To determine the effectiveness of Hellmers' Broth Method, the authors carried out extensive culture-indexing studies over a two year period. During the winter and spring of 1957-58 cuttings were selected for culturing from commercial greenhouses in New York and Pennsylvania. Approximately 40 per cent of the plants from which the cuttings were taken showed symptoms of the two diseases. Some 3,564 cuttings were indexed by the Broth Method and of these 14 yielded the pathogens. To determine if the indexed cuttings were indeed free of the two

wilt organisms, 2,121 of these were rooted and established in an isolated block as single plants in pots (the nucleus block) and were observed for a 14 month period. During this time, three of the plants succumbed to Fusarium wilt and four to bacterial wilt.

From this study, it was concluded that:

1. Careful selection of cuttings from *symptomless* plants during the winter months will provide for the elimination of the majority, *but not all*, of the infected cuttings.
2. Hellmers' Broth Method of culture-indexing does not allow for 100 per cent detection of infected cuttings not eliminated by selection.
3. Because neither careful selection nor indexing allow for complete elimination of infected cuttings, the establishment of selected or indexed cuttings as single units in isolated blocks is essential to the control of the two wilt diseases. If one of the units succumbs to disease, it can be removed and destroyed without contamination of the other units.
4. Annual re-culturing of cuttings taken from plants in the nucleus block should gradually eliminate the known wilt organisms and will guard against the introduction of new organisms.

Selection, repeated culture-indexing, and the nucleus block have been utilized by several commercial carnation propagators for some time. The effectiveness of these measures in controlling Fusarium and bacterial wilt is well recognized by the cut flower producer who uses "cultured" stock.

Who Should Culture-Index?

The success of culture-indexing has left little doubt as to the advantages of its use; however, there has been some question as to *who* should index. Practical experience by numerous investigators over the past ten years has led to the conclusion that the program should be undertaken only by the specialist propagator. With few exceptions, attempts to establish such a program in carnation ranges primarily devoted to cut-flower production have failed; when the chips are down, flower production comes first and the diseases are soon re-introduced into the cultured stock. Also important is the fact that a large investment must be made in a laboratory and in laboratory equipment which actually will be utilized for a few days each year. Finally, rooted cuttings, derived from culture-indexed stock, of essentially all of the commercial varieties may be purchased from specialist propagators. For

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these reasons, it makes little sense for the cut-flower grower to embark upon a culture-indexing program.

It is advisable that cuttings of new varieties or varietal selections discovered by the cut-flower grower be culture-indexed before they are increased for release.

How Should "Cultured" Stock Be Used?

The method of producing carnation cuttings free of the wilt disease pathogens is diagrammatically illustrated in Figure 1. The specialist propagator culture-indexes, establishes the pathogen-free cuttings as single units in a nucleus block to protect against re-infection, and utilizes the increase block to multiply the number of cuttings to satisfy consumer demands. The rooted cuttings purchased by the cut-flower producer come not from the nucleus block, but from the increase block and may actually be several "generations" removed from the original cultured cuttings.

The cut flower producer has two choices for the use of his purchased pathogen-free rooted cuttings. These choices are illustrated diagrammatically in Figure 2.

The cuttings may be directly planted into steam treated benches for flower production. When the production period is over, the plants are removed and destroyed. Though this method may not be the most economical one, it is the best from the standpoint of disease control. A variation of this method is to harvest the cuttings from the first and second pinches, root them, and use them for later plantings. If this variation is used, care must be taken to prevent contamination of both the production plant and cuttings (see steps listed below).

To reduce the initial cost of the pathogen-free cuttings, the cut-flower grower may establish his own increase block, so that one cutting may provide many production plants. This involves several additional steps between the purchased cutting and the production plant. Because each additional step increases the hazard of infecting the plants with the wilt disease pathogens, the increase block should be established and maintained as follows:

1. Use *raised* benches located away from the major avenues of commercial production. Don't allow every "visiting fireman" to man handle the plants.
2. Steam treat the bench and soil, making certain that the coolest spot reaches 180°F. and remains at that temperature for at least 30 minutes.
3. Direct plant the cuttings according to variety. Wash your hands thoroughly in detergent and water before planting. Plant direct from the shipping container. It is not necessary to plant each cutting in a separate pot, but it is a good idea to place watertight barriers between each variety (See Figure 2).
4. About 7-14 days after planting, initiate a regular fungicide spray program to prevent the occurrence of leaf and stem diseases. This is particularly important for the control of Fusarium stem rot (See P.F.G. Bull. No. 95, Dec. 1958, or N. Y. State Flower Growers Bull. No. 171, March, 1960). Sprays should be applied on a seven day schedule *alternately* using Zineb (Parzate, Dithane Z-78, Ortho Zineb) at 1½ to 2 lbs./100 gallons and captan 50W at 1½ to 2 lbs./100 gallons.

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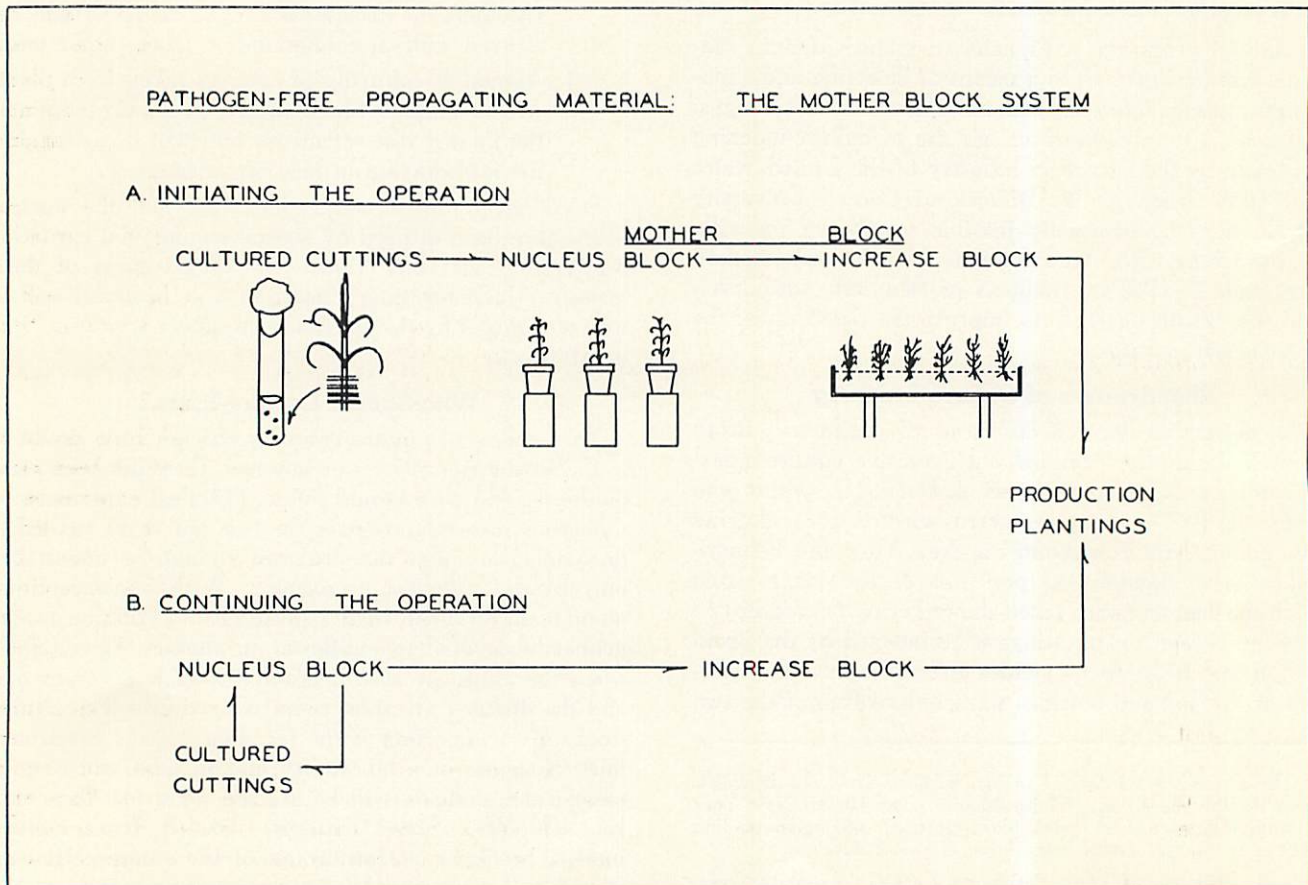


Figure 1. Diagrammatic illustration of the methods used to produce pathogen-free carnation cuttings.

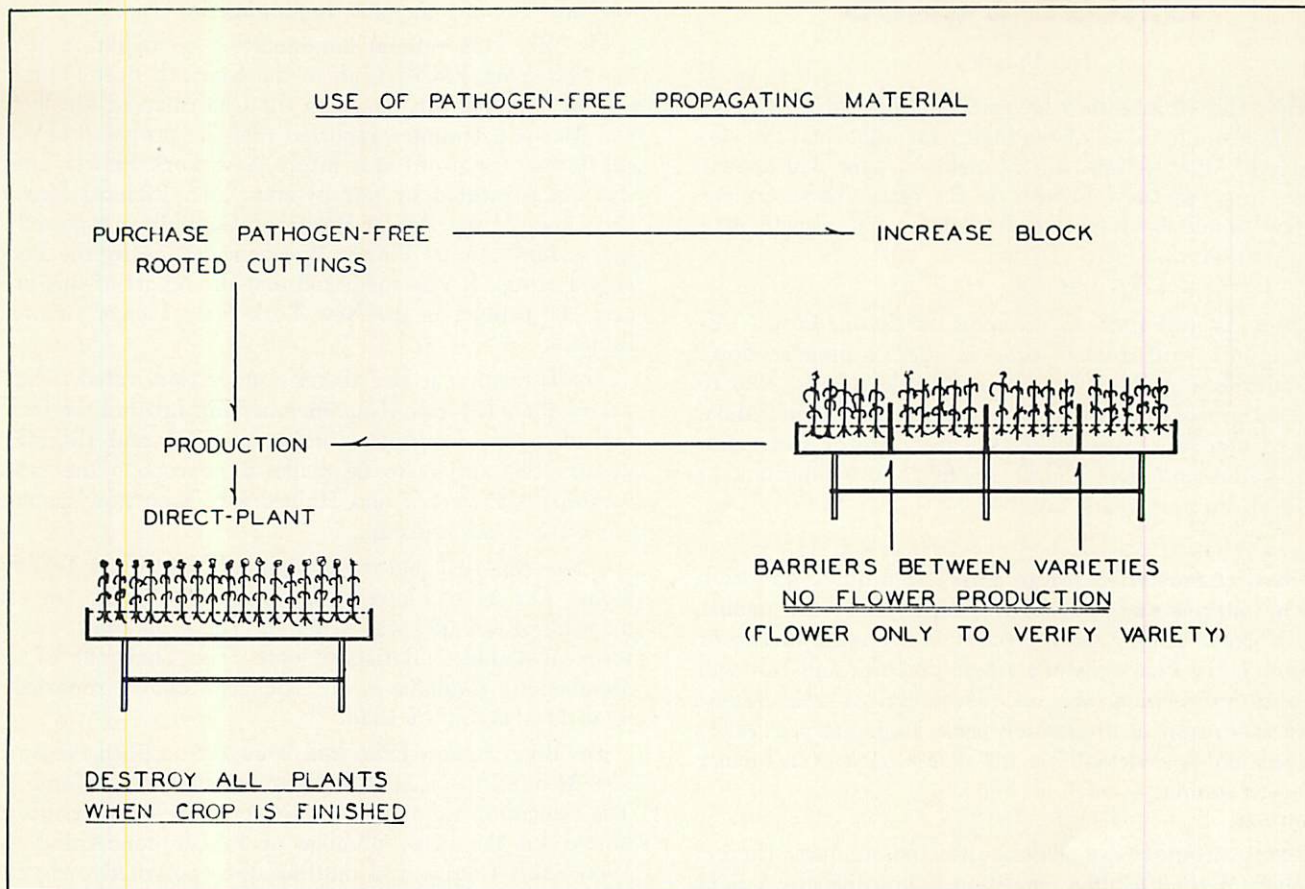


Figure 2. Diagrammatic illustration showing the use of "cultured" cuttings for cut-flower production.

5. Before pinching or taking cuttings from plants in the nucleus block, wash hands thoroughly with detergent and water.
6. Break, don't cut, the cutting from the "mother" plant and put the cuttings immediately into dry, sterile containers (new plastic bags).
7. Steam treat the propagating bench before striking the cuttings and between each group of cuttings.

The increase block, if properly handled, can serve as a source of pathogen-free cuttings for at least a year. Some have been used for longer period, but unless the block has been very carefully guarded against contamination, it is best to renew it annually

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