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# A PROGRAM FOR ESTABLISHING AND MAINTAINING VIRUS-FREE CITRUS STOCK<sup>1</sup>

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The past two decades have been particularly fruitful ones in the development of our knowledge of citrus virus diseases. It is self-evident that this technical knowledge alone does not provide citrus growers with the means of eliminating virus diseases from new plantings. No matter how well informed a grower or nurseryman may be on citrus virus diseases, he normally does not have the technical knowledge, special skills in the use of techniques, and physical equipment needed to determine whether his budwood source trees are free of virus diseases, or to produce virus-free lines if the budwood source trees are contaminated. A long-range program involving technically trained personnel and special facilities is required to pass on to the citrus industry the fruits of the progress being made in citrus virus disease research, and to maintain freedom from virus diseases in new varieties and strains.

More than twenty years ago, the late H. S. Fawcett of the University of California published technical reports giving convincing evidence that scaly bark or psorosis was a bud-transmissible virus disease. Recognizing that his responsibility to the citrus industry did not end with the publication of technical information, in 1937 he assisted the California State Department of Agriculture in setting up a registration program. This made it possible for growers to purchase nursery trees known to be propagated from registered psorosis-free parent trees. At that time psorosis was the only known bud-transmissible disease.

In recent years the number of registered psorosis-free budwood source trees in California has decreased. Very likely the major factors in this decline are 1) the necessary restrictions imposed on the movement of budwood and nursery trees by the establishment of tristeza quarantine areas; 2) an awareness on the part of nurserymen and growers of the inadequacy of the psorosis registration program in the light of other bud-transmissible diseases such as stubborn, xyloporosis, and exocortis; and 3) the probability that the nucellar lines of citrus and new hybrids produced by the Citrus Experiment Station, though unregistered, are likely to be free not only from psorosis but also from most other bud-transmissible diseases.

At present, about 50 per cent of all lemon varieties and about 25 per cent of all orange varieties being propagated in California are nucellar lines of "old-line" varieties. Use of nucellar lines and new hybrids is likely to increase in the future. In fact, it seems highly probable that very few old-line varieties or strains will prove to be virus-free and that in time only nucellar lines of old-line varieties or hybrids of recent origin will be propagated. It is apparent that nucellar lines or new hybrid varieties will soon become contaminated if no counter measures are taken. The experience in Florida with Orlando tangelo, discussed by J. F. L. Childs elsewhere in this volume, provides

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an object lesson. In the experimental orchards of the Citrus Experiment Station at Riverside, one of the oldest nucellar Frost Eureka lemon trees has become contaminated, undoubtedly via root-grafts. Under commercial orchard conditions, virus symptoms are found on an occasional young-line tree which has become contaminated through some means.

Both Texas and Florida have set up "budwood certification" programs which are described in other papers in this volume. The more recent Florida program is broader in scope than the present California program. The stone fruit, grape, and strawberry industries in California have successful programs under way, handled as dictated by the special technical problems involved, but all having the common objective of providing growers with virus-free planting stock.

All of these matters were thoroughly discussed at a July, 1956, meeting of a subcommittee of the California Citrus Research Committee, which, among other things, establishes liaison between the citrus industry and the University of California's Division of Agricultural Sciences. As a result of these discussions, the University was asked to assume the responsibility for developing and maintaining "variety foundation plantings" in the several citrus-growing areas of California. These plantings are to serve as standard primary sources of virus-free budwood and seed of desirable, true-to-name citrus scion and rootstock varieties. Interested nurserymen, growers, and research workers will be able to obtain from these foundation plantings a very limited number of budsticks from registered trees of known origin and variety name, free of certain known virus diseases. Mother-block trees can be propagated from these budsticks for use in producing nursery trees which are virus-free and of known scion and rootstock variety.

It is recognized that it is not feasible at present to eliminate all virus diseases from all stock in such foundation plantings. So far, short-term diagnostic techniques have not been developed for certain virus diseases. Undoubtedly, more citrus virus diseases remain to be uncovered by future research. However, we envision a dynamic program which will have complete freedom from all bud-transmissible diseases as the ultimate objective. To this end, new research information will be utilized in these plantings as fast as it becomes available.

The California Citrus Research Committee also asked the California State Department of Agriculture to consult with University research workers with a view to broadening the scope of the present citrus psorosis registration program to include registration for apparent freedom from certain other bud-transmissible diseases. Some of the results of these conferences with the personnel of the California State Department of Agriculture are outlined by Wray F. Hiltabrand elsewhere in this volume.

We feel that it would be desirable ultimately to set up four foundation plantings of about 10 acres each, probably in Tulare, Riverside (Coachella Valley), Ventura, and Orange counties. The first two locations are tristeza-free. Part of each foundation planting would contain several trees of each variety, strain, or line, one tree on each of the following rootstocks: trifoliate orange, Orlando tangelo, sour orange, sweet lime, and Rough lemon. This list of rootstocks may be revised as new information is developed.

The trees of the scion varieties to be established in the foundation plantings will have been indexed under quarantine conditions and demonstrated to be free of tristeza, psorosis, and vein enation, the three citrus disease viruses that can be detected by short-term indexing procedures. At the time the indexing tests are begun on a selected candidate tree, propagations from that tree will be made in the quarantine greenhouse. If the selection proves to be free of the above-named viruses, budwood will be taken from the greenhouse propagation of this selection for propagation of the trees to be grown in the foundation plantings. This procedure will provide propagative material

grown under quarantine from the time the indexing was started and thus not exposed to natural infection, particularly to tristeza, during the period required for indexing. In other words, it will eliminate the uncertainty that would be involved if the budwood for the trees in the foundation plantings were cut from field trees six months or longer after the index tests were started. Further indexing for exocortis, xyloporosis, cachexia, Rangpur lime disease, etc., will be carried out in a nursery-type planting in the foundation plantings. In a tristeza-free area, these procedures do not require security from insects, but they do require several years for reliable readings.

A quarantine greenhouse has been established at Riverside for indexing domestic scion and rootstock varieties and strains to go into the foundation plantings. This is a separate facility from that used for indexing the foreign importations described elsewhere in this volume by Wallace and Drake. Such a facility is required in order to comply with the present quarantine regulations and thus permit the movement of budwood of desired citrus selections or varieties from tristeza-affected areas to foundation plantings located in tristeza-free or non-quarantined areas. Its essential feature is maximum security against aphid infestation, which is attained by a double-door entrance, by covering all apertures with very fine mesh screen, and by rigorous preventive pest control measures. Budwood from indexed trees will be available for movement to tristeza-free areas in the spring of 1959. Although the indexing of domestic and foreign varieties is carried out in separate facilities, the foundation plantings will serve eventually for maintaining selected varieties, both domestic and foreign, that have successfully passed the indexing tests. Such trees in the foundation plantings will also allow preliminary evaluation of the selected varieties for horticultural promise in the area.

Seed for rootstocks for the first foundation planting will be planted in March, 1958, in Tulare County. At least four years will be required before the first budwood becomes available to nurserymen. A substantial fee will probably be charged for buds from registered trees in a foundation planting. A minimum of another two years will be required before registered nursery trees propagated from this budwood will be available for sale. However, some registered nursery trees may be available sooner if they are propagated "on speculation"—that is, on the chance that indexing tests, when completed, will show the parent trees to be virus-free.

Thus in California the responsibility of developing and maintaining primary sources of healthy, true-to-name propagating material of improved citrus scion varieties and rootstock has been assigned to the University. This program will be closely coordinated with the regulatory phase, which will be administered by the California State Department of Agriculture. We recognize that such a program is long overdue. A detailed plan has been developed jointly with the California State Department of Agriculture for carrying out the University's assignment. The first necessary steps have been taken toward implementing this program, but full development will be contingent on obtaining additional facilities and support.