

Registration and Certification of Citrus Propagative Materials in California

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Summary

A registration program for apparent freedom from psorosis was established by the Nursery Service of California in 1937, 4 years after Dr. H. S. Fawcett discovered psorosis to be a graft-transmissible disease. Since that time the program has undergone several revisions and now (late 1973) it is again being very extensively revised. The main purpose of the program will remain, as always, the provision, to growers and nurserymen, of true-to-name plants that are free of important pests and pathogens and which have superior production potential.

The California Citrus Registration Program

The original registration program provided for in-field inspection of all registered trees for young-leaf symptoms of psorosis and for other important symptoms, but contained no provision for indexing. Following the development of an index for psorosis by Dr. J. M. Wallace, an index was sometimes made by Dr. Wallace in a University of California greenhouse. Later in the 1950's the Nursery Service developed its own indexing facilities in Sacramento and Riverside. At first psorosis was the only index made on candidate trees, most of which were in privately owned orchards. Then, as it became practical to index for more diseases, tristeza, vein enation and exocortis indexes were included in the nursery service indexing for every candidate tree.

Since the mid-1960's the overall program for citrus improvement, including registration and certification, has had 2 parts:

- a) The interim program which is the expanded citrus psorosis registration program begun in 1937 and
- b) The long-range citrus registration and certification program which utilizes foundation stock from the University Citrus Variety Improvement Program (CVIP) which started in 1958 on the Riverside campus at the request of the citrus industry.

The vast majority of citrus trees grown in California during the decade of 1963-1973 have been propagated from orchard trees registered in the interim program. In the past few years a substantial number of trees have come from materials in the long-range program. It had been expected that the long-range program would soon provide budwood for a majority of the citrus trees produced in California. The development of stubborn disease in a substantial portion of the mother trees and in their bud progeny has precluded very extensive use of this program in its present form.

The long-range program provided for complete indexing, including cachexia and impietratura, of all selections entered in the program. Candidate trees of selections found entirely clean of bud transmissible pathogens and all disorders were planted in a foundation block at Lindcove, near Visalia in the San Joaquin Valley. After foundation trees fruited satisfactorily budwood from them was released to nurserymen for propagation of mother block trees to be grown on private property. Requirements for participation were so restrictive that few mother blocks were established. Those which were established had considerable trouble with stubborn disease infection. The percentage of stubborn disease infection in nursery trees propagated from registered mother block trees was also unacceptably high for sweet oranges and grapefruit. The infections appear to have occurred at sometime during the long period (10 years or more) of outdoor exposure to the presumed leafhopper vectors of stubborn.

Now we plan to combine the interim and long-range programs into a single registration and certification program that will greatly reduce the hazard from stubborn in certified stock while combining the best features of both programs. Details of the proposed new program will be discussed later.

Responsibilities for the operation of citrus registration programs in California will be as shown below:

- 1) California Department of Food and Agriculture Nursery and Seed Services assisted by County Departments of Agriculture.
 - a) Supervision of preparation of nursery sites, budwood cutting and maintenance of identity.

- b) Inspection and indexing of trees.
 - c) Registration of eligible scion and seed trees and cancellation of registration when necessary.
 - d) Certification of eligible nursery plants.
 - e) Maintenance of statistical records.
- 2) University of California, Riverside, assisted by specialists in the Agricultural Extension Service and the USDA.
- a) Obtain clean material of desired clones by selection, indexing, therapy, and culturing.
 - b) Maintain foundation material of desired clones indoors and outdoors.
 - c) Make foundation material available to nurserymen.
 - d) Provide consultation, information and training as necessary.
- 3) Nurserymen and growers
- a) Grow protected blocks indoors and nursery increase blocks and nursery stock indoors or outdoors.
 - b) Grow or locate orchard trees for registration.
 - c) Maintain identity records.
 - d) Support program by participating in it and by paying fees to support the program.

The proposed program will upgrade the present interim program by provision of annual inspection of all candidate or registered trees during the mature fruit season. In addition annual indexing for tristeza and triennial indexing for exocortis will be provided for all registered trees being used for budwood. Indexing for psorosis will normally be done only every sixth year. The main improvements in the program are more careful inspection for stubborn symptoms in source materials and nursery trees, better availability of completely tested foundation stock from the Lindcove foundation block and from an indoors foundation block at Riverside, and provision for indoor protected facilities to be operated by nurserymen.

The CVIP will continue to be responsible for indexing, maintenance, and protection of materials under its jurisdiction and has facilities for heat therapy of exocortis-free budlines that are desirable but infected with psorosis or another heat-labile pathogen. CVIP also is equipped to handle foreign selections received from USDA Plant Quarantine facilities at Glenn Dale Maryland. Occasionally CVIP cooperates in obtaining meristem-tip or nucellar-tissue cultures from budlines containing pathogens that cannot be eliminated by heat treatment.

The CVIP has indexed and processed more than 300 selections of citrus. Of these more than 200 remain in the program. The others were dropped mostly because of infection though some were discarded for chimeras, poor quality, etc.

Selections retained in the program have been indexed or are under index for all known virus diseases of citrus and for stubborn disease. Short-term indexing is now done on seedlings of 'Troyer' citrange, *Citrus excelsa*, 'Mexican' lime, 'Kara' mandarin, 'Madam Vinous' and/or 'Pineapple' sweet orange, standard sour orange and 'Dweet' tangor and on 'Etrog' citron and 'Parsons Special' mandarin budlings.

Details of the indexing have been reported in various places. Basically healthy index plants free of nutritional imbalance and pests are grafted with buds, leaf patches, side- or shoot-tip grafts, then cut back and forced into new growth which is inspected periodically for symptoms. Bark is peeled from 'Mexican' lime plants to detect tristeza pitting and from 'Parsons Special' on 'Rough' lemon to detect cachexia gumming. At least 4 plants are used for each index and 2 or more pieces of inoculum are grafted into each plant.

Charts showing flow patterns of the existing and proposed programs are shown in Figures 1-3. It must be emphasized that the proposed scheme has been developed especially for the California situation and environment and that certain parts of it may be of no value or unworkable under other circumstances in other areas.

The approximate form of certain definitions and regulations are given below:

Definitions: Words defined in the Food and Agricultural Code have the same meanings in this article and in addition:

- (a) **"Virus-infected"** means infected by a serious virus or graft-transmissible disease or manifesting symptoms or behavior characteristic of a serious virus or other graft-transmissible disease.
- (b) **"Index"** means testing a plant for infection by grafting with tissue from it to an indicator plant or by other approved means.
- (c) **"Virus-free"** means plants produced under terms of this regulation and free of serious virus or other graft-transmissible disease as determined by index testing and inspection procedures outlined in this article.
- (d) **"Off type"** means different from the variety, strain, or selection listed on the application for registration or certification.
- (e) **"Selected tree"** means a tree for which registration is intended when inspection and testing are completed.
- (f) **"Tested tree"** means a tree tested for virus infection and found to be in compliance with specific quarantine requirements but not eligible for registration under the terms of this regulation.
- (g) **"Registered"** means a registration number has been assigned by the Department to a tree that has been inspected and tested in accordance with the provisions of this article to serve as a source of propagating material for certified nursery stock.
- (h) **"Foundation block"** means a planting, maintained by state or federal agencies, in which trees may be registered to serve as a primary source of propagating material.
- (i) **"Protected block"** means a planting of trees in an approved glasshouse or screenhouse, propagated and grown there with foundation stock scions, which are to be registered and maintained by an applicant as a source for growing certified nursery stock.
- (j) **"Nursery increase block"** means a planting of citrus nursery stocks, propagated directly from registered trees. Trees in a nursery increase block which are 18 months old or less from budding may be used as a supplementary source of scions for growing certified nursery stock.
- (k) **"Certified block"** means a planting of citrus nursery stock for the production of certified nursery stock.
- (l) **"Foundation stock"** means propagating material produced from a registered tree in a foundation block or from properly indexed material propagated and grown in an approved state, federal, or university glasshouse or screenhouse.
- (m) **"Registered stock"** means propagating material from a registered tree or a nursery increase block.
- (n) **"Certified citrus nursery stock"** means trees propagated by using scions from registered stock, and certified in accordance with the provisions of this article.

General Provisions: Participation in this program shall be voluntary and may be withdrawn at the option of the applicant. Registration or certification shall not imply any warranty on the part of the Department or of any employee thereof. Registration, certification, approvals, and supervision mentioned herein shall be conducted by the Department.

- (a) **Responsibility of applicant:** The applicant shall be responsible for the:
 - (1) Selection of the tree for testing.
 - (2) Selection of the location and of the proper maintenance of any plants being grown under the provision of this article.
 - (3) Application for the registry or re-registry of plants being grown under the provision of this article.
 - (4) Identity of all plants entered in this program.
- (b) **Location of plantings:** Each planting location shall be subject to approval and shall be in an area having minimal risks for spread of infectious pests by drainage, flooding, irrigation, or by other means.

A protected block, nursery increase block, and certified block shall be located not less than 50 feet distant from any established citrus tree. Each nursery increase block and certified block shall be a separate planting sufficiently apart from any other planting to maintain its identity.

Selected trees for registration, other than those grown in a protected block, may be selected from any location with the approval of the Department.

- (c) **Maintenance of plants:** All plants entered in this program shall be kept in a thrifty growing condition and pests shall be effectively controlled. Suitable precautions shall be taken in cultivation, irrigation, movement and use of equipment and in other farming and nursery practices to guard against spread of pests to plants entered in this program.

To assure that the inspections required herein may be made properly and to provide close working knowledge of field operations, the applicant shall notify the Department in advance of any planting, propagating or pruning operation or removal of nursery stock or trees in any planting entered in this program.

All pruning shears, saws or other implements shall be disinfected in an approved manner prior to any fruit picking or cutting of any selected or registered tree, or any clonal selection within an increase block or certified block.

Any plant found to be off-type, showing symptoms characteristic of stubborn disease, or infected with a virus, may be required to be removed immediately from any planting. Approval may be given to remove off-type parts of a registered tree without revoking registration of the tree.

Labeling of each selected or registered tree and of nursery stock growing in planting entered in the program to identify it as to rootstock and as to its scion source shall be done in an approved manner.

(d) Eligibility and Planting Requirements:

- (1) **Rootstock Propagation:** The rootstock of any plant entered in the program may be grown from seed or it may be vegetatively propagated providing the propagating wood meets the same requirements as the scion to be used for the plant.
- (2) **Foundation Block:** A selected tree may be planted in a foundation block when propagated with a scion from a registered tree in a foundation block or when propagated from a greenhouse - or screenhouse - grown scion that has passed the short-term inspection and testing procedures required in this article and has completed or is under the cachexia-xyloporosis index. The tree may be registered when inspection and testing procedures prescribed in this article have been completed with satisfactory results and, if an outdoor planting, when the tree has produced sufficient fruit to give acceptable evidence that it is not off-type. A selected tree found to be ineligible for registration shall be removed from a foundation block.
- (3) **Protected Block:** Trees in a protected block shall be grown in an approved manner and the rootstock for each tree shall be horticulturally suited to the scion variety.

At least 1 duplicate tree propagated from each budstick used to produce protected block trees shall be planted outdoors, in a climate suitable for the variety, for visual inspections of growth habits, trueness to variety, and disease symptoms.

A protected block tree may be registered when it is at least 9 months old and has shown good normal growth free of disease symptoms. A tree shall be removed from a protected block when it is found to be ineligible for registration. Registration of a protected block tree may be cancelled if the duplicate outdoor tree produces an excessive amount of off-type fruit and off-type growth.

- (4) **Selected Outdoor Trees:** Any individual orchard, yard, or container tree may be selected for inspection and indexing for registration under the terms of this regulation.
- (5) **Nursery Increase Block:** Scions used to propagate the nursery stock therein shall be from registered trees. Within 18 months of propagation, scions may be taken from the block for use in growing certified nursery stock. Trees in a nursery increase block also may be certified.
- (6) **Certified Block:** Scions used to propagate the nursery stock therein for certification shall be from registered trees or from a nursery increase block.

Inspection and Testing Procedures: Inspection and indexing procedures prescribed in this article may be made by the University of California, the United States Department of Agriculture, or the Department and shall be conducted in an approved manner at times determined as suitable by the Department. In the indexing procedures required in this section, the Department may approve the substitution of other indicator plants, if equally suitable, or may approve indexing on a

fewer number of indicator plants, or may approve other procedures for testing for virus infection if determined equally suitable.

Additional inspections or indexing other than provided in this section may be required by the Department if seasonal conditions or other factors tend to obscure virus symptoms or make adequate inspection impossible, or when virus infection is suspected, or when virus symptoms may be masked in a particular variety.

The Department shall assign a number to a selected tree pending registration.

(a) *Trees in a Foundation Block:* The scion parent of any tree planted in a foundation block shall have been indexed for and not found to be infected with the viruses of citrange stunt, concave gum, exocortis, psorosis, tatterleaf, seedling yellows tristeza, tristeza, vein-eneation and yellow vein by short-term indexing on *Citrus excelsa*, 'Dweet' tangor, 'Etrog' citron, 'Mexican' lime, sour orange, sweet orange and 'Troyer' citrange plants. The scion parent or the selected tree must be indexed for cachexia-xyloporosis virus in 'Parsons Special' mandarin plants in a warm glasshouse and these indicator plants must remain free of cachexia symptoms for at least 1 year before the selected tree may be registered. Only the tristeza and exocortis indexes shall be required if the scion parent of the selected tree is a registered tree in a foundation block. Trees to be planted in a foundation block must be grown in an approved glasshouse or screenhouse.

Following planting in a foundation block, a tree shall be indexed on 'Mexican' lime for tristeza and vein-eneation viruses and on suitable indicators for psorosis and exocortis viruses within the 12-month period before registration. In subsequent years after registration, tristeza indexing shall be repeated within 1 year prior to budwood collection from a registered tree. Each registered tree shall be reindexed for exocortis virus every third year and for psorosis virus every sixth year. Each foundation block tree shall receive 1 or more visual inspections each year. The fruit of bearing trees, except lemons and limes shall also be inspected each year after color break.

(b) *Trees in a Protected Block:* Each tree in a protected block shall be indexed for exocortis every third year and for tristeza every sixth year. In addition, annual visual inspection is required for each tree.

(c) *Non-Protected, Selected Trees of Participants:* A selected tree and trees adjacent to it shall be given at least 1 visual inspection prior to registration. The selected tree also shall be indexed on 'Mexican' lime and 'Etrog' citron and a suitable indicator host for psorosis prior to the initial registration. Such selected trees shall be of good vigor and free from apparent mutations, or disorders which may obscure disease symptoms or make the tree undesirable as a propagating source.

Indexing for tristeza virus is required for a registered outdoor tree each year in which approval for cutting budwood is requested; for exocortis indexing is required every third year, and for psorosis every sixth year.

Each tree shall be given 1 visual inspection each year. For fruiting trees outdoors, inspection shall be during the period that mature fruits are on the tree after color break, except for lemons and limes.

(d) *Order of Indexing:* Indexing shall be made in the order in which applications are received and as indicator host plants are available.

(e) *Registration shall be for a period of 3 years* from June 30 in the calendar year in which indexing is commenced

(f) *Registration may be continuous* provided application for inspection and testing is filed with the Department prior to the expiration date of registration.

(g) *Nursery Increase Block, Certified Block:* One visual inspection shall be made each year of plants in a certified block or in a nursery increase block.

- (h) *Refusal or Cancellation of Registration or Certification:* Registration or certification may be refused or canceled for any plants in part or all of a planting if:
- (1) The requirements of this article have not been met.
 - (2) A selected or registered plant is found to be off-type or virus-infected. At the discretion of the Department, a plant growing outdoors, determined to be infected with vein-eneation virus or tristeza, may be registered or certified when it is growing in an area where such virus is known to be prevalent.
 - (3) A tree is found to be within the range of possible root graft of another tree found to be virus-infected.
 - (4) The pest cleanliness requirements for nursery stock in the nursery inspection regulations of the California Administration Code have not been met.
 - (5) For any reason the identity of a plant becomes uncertain or has not been properly maintained.
 - (6) A registration number is misused or misrepresented.
 - (7) An accumulated percentage of more than 1/2 percent of the trees of the same variety on the same kind of root-stock are found virus-infected in a nursery increase block or more than 2 percent virus infected or stubborn affected trees in a certified block. Either visual inspections or the results of indexing or both may be used as a basis for calculating the number of trees that may be infected.

Application and Fees:

- (a) *Application:* The applicant shall furnish information requested and shall give his consent to the Department to take plant materials from any planting for inspection or indexing purposes. An application submitted for the acceptance of any plant or planting and for subsequent inspections, approvals, registration or certification may be refused unless made sufficiently in advance of time of planting to permit the Department to establish the origin of the stock, to determine the suitability of the location, and to supervise any treatment that may be required.
- (b) *Fees:* Fees established in this article are payable in advance of the work to be done and are for the sole purpose of defraying expenses incurred in the inspection, indexing, approval, registration and certification procedures herein provided and are not to obtain any right or privilege.

Fees shall not be charged the University of California or the United States Department of Agriculture for registration or for the inspection and testing of trees providing there shall be no expense to the Department other than for observation of the inspection and indexing required in this article and for the keeping of records. When the procedures are conducted by the University of California or by the United States Department of Agriculture, they shall not be less than provided in this article and the Department shall be notified each year of the trees to be entered or continued in the program.

- (1) *Fees:* The Department shall establish a schedule of fees for services provided in this article. The fee shall be based upon the approximate cost of the services rendered.
- (2) *Refunds:* Fees paid for services that are not rendered shall be refunded to the applicant.

Details of the above proposal are tentative at this time. Some definitions and regulations may be modified, added or deleted. It seems desirable to add another category "protected foundation block" to cover foundation material kept in an insect-free facility operated by the University, State or the USDA.

In addition to the programs for registration of trees to be used primarily as sources of scion material, California has a program for registration of seed source trees for trueness to type and freedom from all kinds of psorosis. In this program trees may be registered as seed source trees after being inspected and found apparently true to name and healthy and after being indexed for psorosis.

Considering the importance, the destructiveness and ease of transmission of several graft-transmitted and bud-perpetuated citrus diseases it seems unlikely that a large and viable citrus industry can survive more than a few decades without employing some organized registration system for reducing the spread and preventing the incidence of graft-transmissible diseases such as stubborn, greening and certain severe forms of tristeza. In addition, special measures may have to be taken to prevent 1 of these 3 diseases from becoming established in new areas or of causing catastrophic losses in areas already infested.

California Interim Registration Program for Citrus

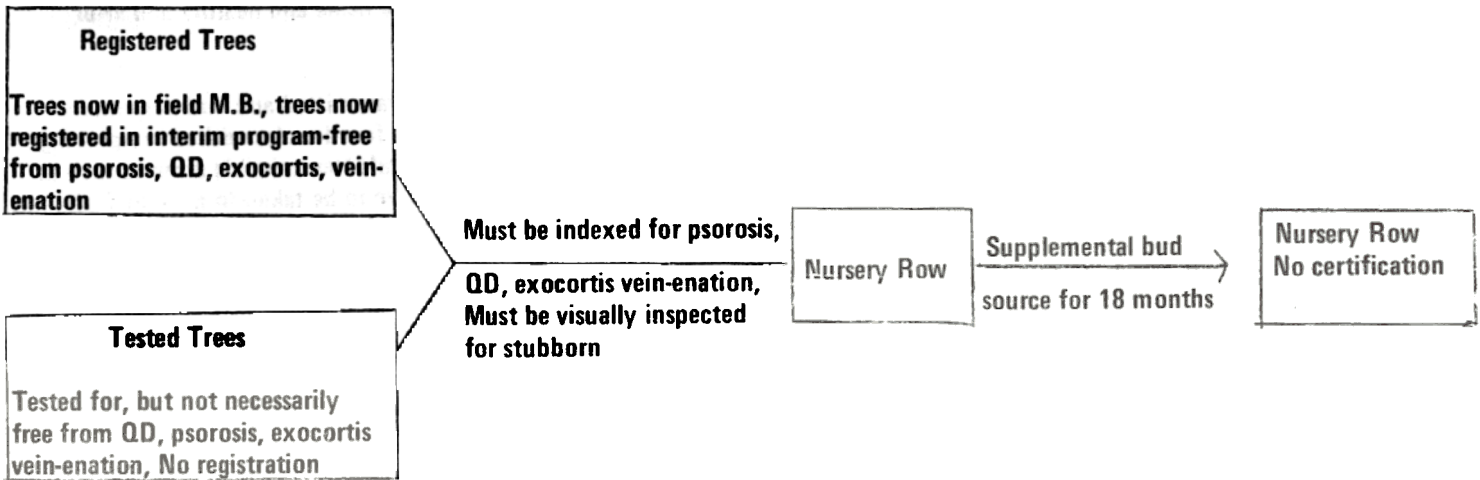


Figure 1. Interim registration program in effect 1963-1973.

California Citrus Registration and Certification Program (Long-Range)



Figure 2. Long-range program in effect 1968-1973.

Proposed California Citrus Registration and Certification Program 1973

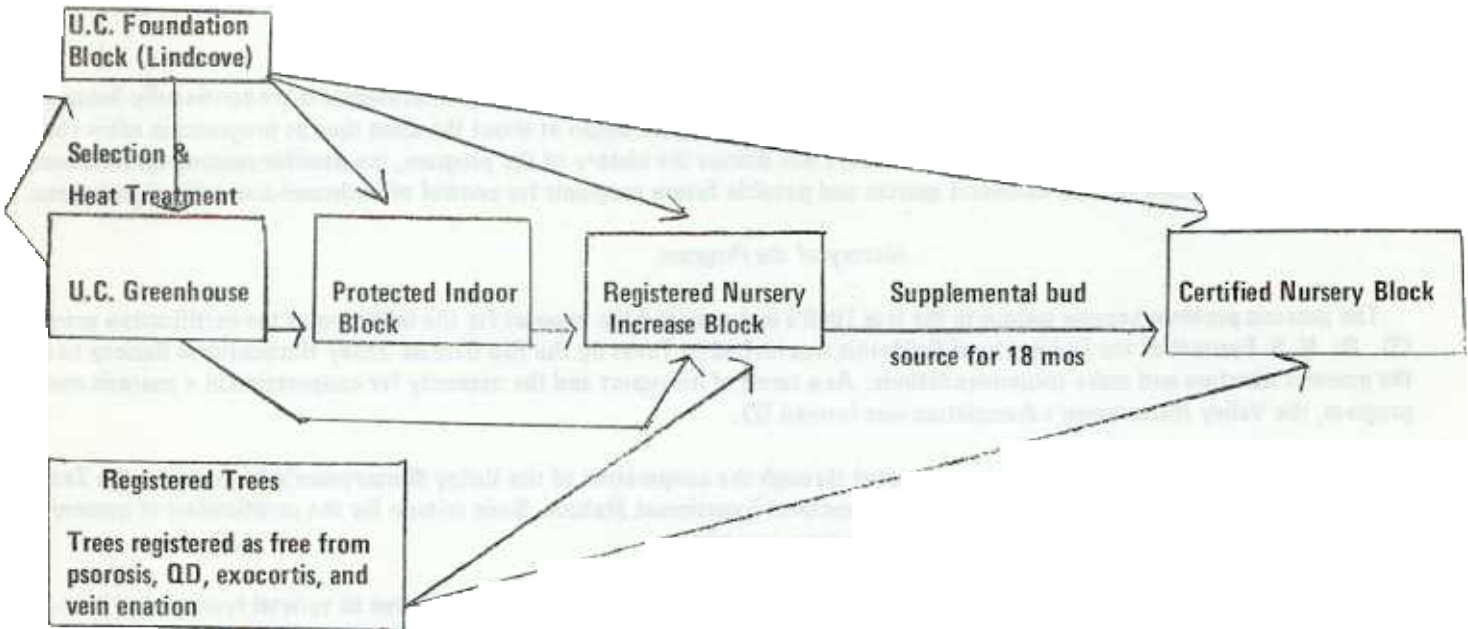


Figure 3. Proposed combination of interim and long-range registration and certification programs.