

ful. Certification should be for procedures rather than for virus-cleanliness.

A minimum clean-stock program, then, would consist of: (1) a foundation block of plants true to variety, horticulturally desirable, and free of viruses and genetic disorders; (2) mother blocks or second-stage plantings conveniently located for increase of budwood, and regularly inspected and sample-indexed; and (3) rootstocks that meet standards comparable to those for topstock, or with acceptable variance.

LITERATURE CITED

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MODERATOR RODEBAUGH: Thank you George. Our next speaker on the program today is Mr. Stan Mather who is Chief of the Nursery Service Division, California Department of Agriculture. Stan will give us a brief review of the certification program and then we will see a film which describes the program in a little greater detail.

CALIFORNIA'S NURSERY STOCK REGISTRATION AND CERTIFICATION PROGRAMS

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Nursery stock is a primary means by which plant pests may be introduced. Even though recognized as such and given close attention over the years, serious virus diseases and other pests have been perpetuated unwittingly by man through his propagation of plants. The exclusion of plant pests from nursery stock propagating sources is not an easy task. Close coordination between research, regulatory and industry activities is needed if we are to succeed. Index testing for virus diseases, laboratory techniques for the detection of nematodes, and eradication treatments have and are being developed. These improved procedures will permit nurserymen to maintain plant propagative sources for the production of high quality nursery stock.

Regulatory and industry activities in past years have been directed toward reducing pest infestation through visual observation of plants and by quarantine restrictions. Experience has shown that certain plant pests can be present that were either not recognizable or not detectable by ordinary means of inspection. Emphasis has shifted to inspection of nursery stock at origin and exclusion of plant pests from nursery grow-

ing grounds. Inspection and index testing of plant propagation sources by the Department's Bureau of Plant Pathology and the enforcement of nursery inspection regulations by county agricultural commissioners have resulted in cleaner high quality nursery stock. From both the regulatory and the nursery production viewpoints it is more economical to exclude pests from propagating stocks and from the growing grounds than to control or eradicate them after they become established.

Close cooperation between the nursery industry, research workers of the University of California and the U. S. Department of Agriculture and the California Department of Agriculture has made possible the establishment of several practical programs of registration and certification.

Program Authority

The Agricultural Code of California authorizes the California Department of Agriculture to establish regulations for the certification of nursery stock and to maintain registries of plants based upon their pest condition. The regulations, lawfully adopted in accordance with the Administrative Procedure Act, become a part of the California Administrative Code.

Technical information as well as the practical aspects of nursery practices are considered in establishing procedures which will assure continued identity and pest cleanliness of nursery stock under certification. The registrations or certifications made by the Department are to identify nursery stock which have been propagated in accordance with inspection and testing procedures established by the regulations. The application of scientific and practical knowledge through voluntary regulatory procedures makes it possible to produce nursery stock with some assurance that it is the best available from a pest cleanliness stand point.

The use of the words registered and certified as applied to nursery stock are protected by the grades and standards requirements of the Agricultural Code of California. It is unlawful to sell or transport to any purchaser any nursery stock represented to be certified or registered nursery stock unless it has been produced and labeled in accordance with the procedures, and in compliance with the rules and regulations of an official agency.

Program Development

For many years there has been a close working relationship between the University of California, U. S. Department of Agriculture and the California Department of Agriculture. Supporting this is the cooperation and interest of fruit producers and nurserymen. The success of the programs is due to this close cooperation between government and industry and recognition of their respective responsibilities.

Research workers of the University of California and the U. S. Department of Agriculture develop new techniques for

the detection of plant pests and also establish repositories of clean propagating sources. In the California Department of Agriculture, the Bureau of Plant Pathology has a Federal-State matching fund program with the U. S. Department of Agriculture, Agricultural Marketing Service. The project title is "Improvement in Quality of Nursery Stock and Development of Methodology for Certification that Fruit, Nut, Vine, Ornamental and Other Nursery Stocks are Free of Virus Diseases and Other Serious Pests and Disorders."

Studies are made to determine the feasibility of a program and methods which would assure the continued pest cleanliness of nursery stock if so developed. Requirements are determined and incorporated in the regulations to establish the required procedures to be followed by nurserymen, the Department and the University in the identification, maintenance, inspection and testing of stocks grown for certification.

Pests considered to be worthwhile subjects for a program are those which do not lend themselves to reasonable or practical control measures once they become established in a commercial planting or those not readily detected by ordinary means of inspection. Examples of such pests are viruses, nematodes or other serious soil-borne pathogens. Once clean materials have been established it is important that a protected repository be provided to assure a continuing source of clean propagative material.

In California, the Foundation Plant Materials Service established by the University of California at Davis, serves as a repository for deciduous fruit and nut tree, grapevine and berry plant propagating sources. The Citrus Variety Improvement Program of the University of California at Riverside maintains a foundation planting of citrus at Lindcove to serve as a repository of citrus. Both repositories now serve as a source of propagating stock for distribution to growers of nursery stock. Inspection and testing of plants that are maintained and propagated in these repositories is done by the plant pathologists and pomologists of the University and the U. S. Department of Agriculture. The procedures followed by research workers are as strict or even more so than those required of persons participating in the various programs. Nurserymen or others who wish to establish a registered or certified planting may obtain foundation stock from these repositories. Resident inspectors of the Department's Nursery Service identify stock shipped from the University and supervise the planting to be grown under the terms of the registration and certification regulations.

Definition of Terms

The standards of the International Crop Improvement Association serve as a guide in defining terms used in the programs and the colors of tags used for identification purposes. Terms used are as follows:

Foundation Stock is stock that may be used in the propagation of registered and certified stocks. Foundation stock is generally maintained by the University of California at their repositories. A white tag is used to identify foundation stock.

Registered Stock is stock that is generally maintained by participants in isolated plantings, to serve as a source of propagating material for the production of certified stock. A purple tag is used to designate registered stock for use as propagating stock by nurserymen.

Certified Stock is stock that has been propagated directly from registered stock or from foundation stock. Certified stock is the end product for planting by fruit producers. A blue tag is used to identify certified nursery stock. Official seals may also be used to seal bundles of certified nursery stock to assure its continued identity.

There are now seven programs for the registration and certification of nursery stock governed by regulations administered by the California Department of Agriculture. These are (1) Certification of Avocado Nursery Stock (2) Registration of Citrus Trees Found Free from Psorosis Symptoms (3) Registration and Certification of Citrus Trees (4) Registration and Certification of Deciduous Fruit and Nut Trees (5) Registration and Certification of Grape Vines (6) California Certified Strawberry Plants (7) and California Certified Seed Garlic.

Avocado

Avocado nursery stock is eligible for certification when grown in accordance with procedures designed to exclude and protect against infection by *Phytophthora cinnamomi*, the fungus causing avocado root rot. Certification is made of both seed and container grown trees. The regulations specify (1) a hot water treatment for avocado seed used as root stocks for certified avocado trees, (2) treatments for sterilization of soil and containers, and (3) isolation and other sanitary precautions for growing and maintaining nursery stock eligible for certification. Certification is refused any avocado nursery stock grown or stored in a nursery where *Phytophthora cinnamomi* is found.

This program was first established in 1958 as a means of preventing introduction of avocado root rot into new plantings by means of nursery stock. At the present time studies are being made to update this program to keep in line with current research and provide a more practical basis for participation.

Citrus (Interim Program)

A program for the registration of citrus trees found free from psorosis symptoms has been in effect since 1937. This program was substantially revised in 1962 and 1965 to include index testing for tristeza and exocortis viruses in addition to psorosis.

A selected tree growing in an orchard or other location may be registered as a propagating source if the following conditions have been met: (1) the tree is not less than five years of age (2) inspection and index testing on Mexican lime, citron and a suitable indicator host for psorosis is complete and (3) the tree is found in good vigor, free from apparent mutations or disorders which may obscure disease symptoms or make the tree undesirable as a propagating source. The registration is for a period of three years. Trees may be re-registered by repeating the inspection and index testing.

Registered trees growing outside of the quick decline quarantined area in California are eligible for issuance of permits by county agricultural commissioners under the terms of the Quick Decline Interior Quarantine which restricts the movement of citrus nursery stock into major citrus areas in California unless propagated from a tested source. The presence of exocortis is detected by use of the citron indicator host plant.

Losses of citrus due to tristeza and the establishment of new citrus plantings in new areas created increased interest in the establishment of clean propagating sources of citrus nursery stock. As of July 1, 1968, the number of registered citrus trees totaled 3,255.

Citrus (Long Range Program)

The citrus registration and certification program is an improved citrus program referred to as the "long range program" which became effective with the adoption of a new regulation in 1962. The original request for this program was made in 1956 by the Citrus Research Committee. Details of the program were developed cooperatively with the staff members of the University of California Citrus Research Center and Agricultural Experiment Station at Riverside, and with representative members of the Citrus Variety Sub-committee, the California Citrus Nurserymen's Society and other growers of citrus.

Selection of trees in this program is by horticulturists and plant pathologists of the University of California and the U. S. Department of Agriculture. Both short and long term index tests to detect known citrus viruses are included.

The foundation block planting established at Lindcove has served as a source of budwood for the propagation of candidate trees by nurserymen. Candidate trees are planted in mother blocks which will serve as a source of scionwood for the production of certified citrus trees. There are now 69 trees registered by the department in the University's foundation block at Lindcove. By 1968 nurserymen had established nine mother block plantings with a total of 22 registered trees and 789 candidate trees propagated from the registered sources at Lindcove.

Deciduous Fruit and Nut

Deciduous fruit and nut trees may be registered for the purpose of providing root stock and scion sources for the propagation of certified nursery stock. This program was initiated in 1956 with the establishment of several cherry varieties by the Foundation Plant Materials Service of the University of California at Davis.

Index testing for known stone fruit viruses includes 'Elberta' peach, 'Bing' cherry, 'Montmorency' cherry, 'Italian' prune, 'Shiro-fugen' cherry, 'Tilton' apricot and 'Shiro' plum. Foundation stock released by the University is planted in mother blocks or scion orchards of nurserymen to provide scion sources for the propagation of certified nursery stock. Certified stocks are required to be propagated on rootstocks originating from registered seed source trees.

A foundation block of more than 210 registered trees is maintained by the University at Davis. Of this number, 53 varieties have been released to participants including 22 peach, 4 nectarine, 10 plum, 3 apricot, 4 almond and 11 cherry varieties. In addition 148 stone fruit seed source trees are registered for the Plant Materials Service.

In 1968 the regulation was amended to provide for broader participation by nurserymen and to bring the program in line with current information. There are now 12 nurserymen participating with 21 plantings for the production of registered and certified stock. There are also 334 seed source trees registered in the program. The plantings include cherry, peach and almond varieties.

Grape

Grapevines or grapevine plantings may be registered as root stock and scion sources for the propagation of nursery stock when inspected and tested for virus diseases and other pests. Nursery stock grown from these registered sources may be certified. The purpose of the program is to exclude known grape viruses including fanleaf, leafroll, yellow vein, yellow mosaic, and other harmful pests that may be introduced into new vineyards by means of nursery stock. This program is of particular significance to vineyardists who plan on planting vineyards on new or fumigated soils.

The program for certification of grapevines is similar in its operation and development to that for deciduous fruit and nut trees. Nurserymen and vineyardists may obtain foundation stock to establish plantings referred to as mother blocks and increase blocks that may be registered. Cuttings or budwood taken from these registered plantings may be sold as certified stock or as registered stock for use in the propagation of certified grapevines.

Registered mother block plantings maintained by nurserymen, are used to produce registered stock that may be used for the establishment of increase block plantings. Increase

blocks are vineyards large enough to provide a commercial fruit crop as well as the large number of cuttings and buds needed for the propagation of certified grape nursery stock. No index testing for virus is required in mother blocks or increase blocks although it may be done if any vines are suspected as infected with a virus. Two visual inspections each year are required in a mother block and one is required each year in an increase block.

Nursery stock for certification may be grown for a period not to exceed two years in a nursery row. Requirements of isolation specify that each planting shall be located in an area where contamination by soil-borne viruses of grapes and damage from herbicides or plant growth regulators are not likely to occur. Each planting must be located at least 100 feet distant from any land on which any grapevines have grown within the past 10 years, or shall be in a location approved by the Department. Certification may be refused in part or all of a planting if a plant is found that is off type, infested with a serious virus, or infected with a nematode pest.

Inspection and testing of vines in the foundation blocks maintained at Davis is done by the University and U. S. Department of Agriculture research workers. The regulations require that each registered vine maintained in the foundation block be indexed every fourth year on 'St. George', 'Baca 22 A' and 'Carignane' varieties of grapevines for the detection of known viruses. *Chenopodium sp.* may be used in lieu of 'Carignane'. The tests are observed for at least two successive growing seasons.

Through practical experience and continued research, most of the commercially important varieties of grapevines may now be certified by the Department as having been propagated from registered sources which have been tested without finding any of the known virus diseases that affect grapevines. The impact of this program on the California grape industry is just beginning as commercial vineyards planted with certified stock are bearing yields that exceed those previously obtained.

In the 1967-68 season there were 28 participants with five mother blocks, 25 increase blocks, and six certified blocks totaling 125 acres. A substantial number of certified cuttings and rootings is available for planting by vineyardists.

Strawberry

The strawberry certification program was adopted in 1949. Originally only visual field inspections were made. By 1951, the development through research of strawberry indicator plants for virus diseases resulted in substantial improvement in this program.

All California certified strawberry plants originate within a three year period from a plant which was actually tested by indexing on 'UC-1.' This sensitive indicator host plant is

an improved clone originated at the University of California at Berkeley.

Approval of foundation stock or as registered stock may be refused or cancelled when it is determined that (1) the plant is off type (2) the plant, clone, or planting is virus infected (3) a planting is found infested with any of the harmful pest nematodes including spring dwarf, summer dwarf, stem, root knot or lesion nematodes, or found infected with the red stele fungus, *Phytophthora fragariae*, unless it is determined that the infestation can be safely treated, delimited or rogued. Any planting may be refused further registration or certification if it is determined that spread of virus may have occurred except when the total number of virus infected plants does not exceed 0.5 percent.

Isolation requirements limit the production of certified strawberry plants to areas in which strawberry virus diseases are not prevalent. Foundation plantings must be maintained not less than one mile distant from other kinds of strawberry plants. An approved insect proof screenhouse may be used in lieu of the one mile isolation distance. A certified planting in an isolated area is permitted to be grown no closer than 500 feet to strawberry plants not similarly entered in the certification program.

In the 1967-68 season there were seven firms participating in the program with plant beds totaling 158 acres. Varieties included are 'Tioga', 'Shasta', 'Marshall', 'Northwest', 'Torrey', 'Hood' and 'Lassen'. 'Siletz', 'Puget', 'Beauty', 'Nisqually' and 'Qinalt' are in increase blocks and should be available as certified plants in 1969.

The strawberry program differs from other registration and certification programs in that foundation stock is maintained by nurserymen in their isolated plantings rather than by the Foundation Plant Materials Service of the University. However, plants from tested sources are obtainable from the University. Studies are now being made to exclude some bacterial and fungus pathogens. The Strawberry Plant Growers Association has provided a screenhouse in which pathogen free plants are now under propagation. The plants originated through meristem propagation by University research workers.

Seed Garlic

A program for certified seed garlic was adopted in 1960. This program is based on the propagation of foundation stock of seed garlic known to be free of stem and bulb nematode, *Ditylenchus dipsaci*. The regulations require the growing of certified seed garlic in areas where this nematode is not prevalent and where contamination is not likely to occur. Other serious pests, including the white rot fungus, *Sclerotium cepivorum*, are cause for rejection from further certification if found in any planting.

University of California field crop specialists developed the original foundation stock. This original stock was distributed to growers in qualified areas and planted in increase blocks for the production of registered stock. Registered stock may be grown for one additional year to be harvested as certified seed garlic. Laboratory examination for stem and bulb nematode is made of samples of garlic cloves taken from the increase and certified blocks. Sampling in increase blocks is more intensive than in the certified blocks.

Ordinances adopted by Lassen, Modoc and Siskiyou Counties are designed to protect the seed garlic growing industry in those areas by excluding any garlic infested with stem and bulb nematode or infected with the white rot fungus. The county agricultural commissioners, through county ordinances, have maintained the identity of the registered and certified seed garlic planted in approved locations. Permits are issued for the plantings and supervision is given by the county agricultural commissioners. This assistance permits the required inspection and supervision to be carried on at less cost to the participants than otherwise would be required if all field work were performed by field men of the Department.

During the 1966-67 season a total of 29 acres were entered for certification by three participants. A total of 243,530 lbs. of certified seed garlic was produced. Varieties are 'California Early', 'California late', and 'Creole'.

Demand for certified seed garlic is increasing even though hot water treatment has through research been found effective in eliminating stem and bulb nematode. Growers appear to prefer certified seed since the treatment may reduce germination of the cloves.

Cost Vs. Benefits

High capitalization of agriculture requires the greatest return in production and quality for any unit of land to be farmed. Many of the viruses and other pests which are the subject of certification may not produce obvious distress in a young planting. In many instances virus disease symptoms do not manifest themselves until a tree or vine sets fruit or approaches maturity. Trueness to type and variety is assured by propagation from known registered tree or plant sources. Certified stocks are worthy of consideration even though a premium price may be asked for such stock.

Nurserymen participating in the growing of certified stock also share in the benefits. Many participants have noted increased yield and uniformity of nursery stock grown from clean propagating sources. Conveniently located propagating sources simplifies the collection of budwood and may also reduce costs of production.

The Agriculture Code of California requires that these optional programs of registration and certification be self-supporting through fees collected for the inspection, testing

and supervision work done by the Department. California nurserymen paid more than \$28,000 in fees to the Department for work in the 1967-68 season. Conditions of isolation and special handling of certified nursery stock imposes hidden costs that are often far in excess of fees paid the Department.

Participants in the registration and certification programs deserve support for their part in providing better plants for better crops. We are hopeful that California certified nursery stock will become recognized as the best available planting stock known to the agricultural industry.

MODERATOR RODEBAUGH: Thanks, Stan, for the excellent presentation and movie this afternoon. I think that concludes our first panel of the afternoon.

WALTER KRAUSE: Our next session deals with the practical approach to certification programs. The moderator for this session is Don Luvisi, of the California Agricultural Extension Service, Bakersfield, California.

MODERATOR LUVISI: Thank you Walter. I would like to start by saying that I think we are very fortunate today in having the panel that we do have. I did some quick calculating and we have something like 75 years of experience in this particular area represented, and of course we do have representation from the three basic areas that we are concerned with in certification programs. I think at this time we can start by asking ourselves some questions.

PRACTICAL APPROACH TO CERTIFICATION PROGRAMS

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“Why do we have a certification program?” “How successful has it been?” These questions can be answered in many different ways depending on what commodity is chosen. On stone fruits we are concerned with increased efficiency of propagation. It has definitely resulted in greater efficiency for the nurseryman. However, have we improved the variety, actually increased the life of the tree or orchard, increased the yield, maturity, or fruit quality? We know that in citrus the elimination of virulent viruses causing low productivity or tree death is an important part of the program. The certification program for wine grapes has been successful while table grapes have lagged. When we get into ornamentals what are the advantages or disadvantages of certification? Is it economical increases in efficiency through higher stands of plants for the nurseryman or is it longer life, more flowers, more or less desirable foliage for the consumer?