The Florida Citrus Budwood Registration Program

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Summary

Prior to 1959 only 5 of each 1,000 citrus trees in Florida was a product of the Citrus Budwood Registration Program. Thirteen years later in December 1971, the date of the latest published Citrus Tree Inventory (4), more than 30% of all commercial grove trees represent registered budlines. Since 1968, 86% of the citrus nursery stock produced has been fully registered or validated; additionally, each year company-owned nurseries produce many thousand trees for use in company groves that are propagated from registered bud sources. More than 2,500 candidate parent trees have been indexed for tristeza, psorosis, xyloporosis and exocortis, 32% of these being seedling lines that include rootstock types. Viruses are widely distributed in old line trees, and only 14% (247) of those tested were free of the 4 major diseases. Exocortis, present in 83% of the old line selections, is the most prevalent virus contaminant; xyloporosis occurred in 54% of the old line trees tested. Psorosis virus has been under mandatory control since January 1961, and with nucellar selections included, the supply of budwood free of psorosis, xyloporosis and exocortis is more than adequate for all standard varieties except 'Temple' and 'Thompson' grapefruit, which appear to be totally contaminated with exocortis and which do not normally develop true-to-type seedlings. Exocortis-free budwood for 13 commercial citrus varieties comes directly from the program's work with nucellar seedlings. Prior to 1960 tristeza rates were low and no infected trees were retained in the program, although no official assurance of tristeza freedom was made. In recent years the incidence of tristeza has increased sharply, and since 1964, infected trees have been retained in the program.

Introduction

Florida's Budwood Registration Program was a product of the rapidly expanding knowledge of citrus viruses that came about in the 1940's and early 1950's. Florida growers became aware of effective psorosis control programs in California and Texas, and during this interval tristeza, psorosis, xyloporosis (cachexia) and exocortis were recognized in Florida. In 1951 a widely supported movement developed among citrus industry leaders for a virus control program, and this movement culminated in November 1951 when the Florida State Horticultural Society adopted a resolution to sponsor a citrus budwood certification program. A large permanent budwood committee was appointed with members representing almost every segment of the citrus industry (10). The budwood committee was active during 1952 and in a series of working meetings developed a program policy and the sound, flexible procedures that are still in use. Thus from its inception the Florida program has enjoyed wide support, and the result is truly a product of a cooperative effort by industry, and the research, extension, and regulatory agencies that support the world's largest citrus industry. This paper will consider the program in 3 parts: the developmental stage 1953-58; the period of expansion and maturity 1959-73; and finally will explore future possibilities which may result from the transition now underway. The effect of several important decisions and events will be discussed.

The Developmental Years 1953 Through 1958

The phrase "continuity with flexibility" characterizes the Florida Citrus Budwood Registration Program. Utilizing an emergency appropriation in 1952, the State acquired land for a virus test plot and indicator seedlings were planted. The program began operation in January 1953 when a modest one-man, one-woman office was opened in Winter Haven. A State Plant Board regulatory official, Gerald G. Norman, was placed in charge and he continued to direct the program for nearly 12 years.

From the beginning, the basic program responsibility has been to provide the industry with budwood and nursery stock free of detrimental viruses. However, the original statement of policy recognized the need for standard rootstock seed source trees, and also the critical importance of the horticultural features of trees destined to supply large amounts of budwood. Responsibility for horticultural considerations was placed directly on the program's voluntary cooperators who sought to enter candidate parent trees to become registered for virus freedom. To be acceptable a candidate tree had to be free from visible evidence of disease, an outstanding specimen at least 10 years old, fruitful, free from evidence of bud mutation, and produce fruits typical of the most desirable type for the variety. It soon became apparent that the task of selecting a desirable candidate was a demanding one. When after many trees offered as candidates were rejected because of bud variation, program workers began operating as teams in many of Florida's best groves to assist in the selection of superior trees displaying only minimal amounts of bud variation since no trees examined appeared to be completely free from this

defect.

The first inoculations of virus indicator plants with budwood from candidate trees took place in June 1953, 6 months after the budwood office opened. The first year indexing was begun on 353 candidate trees and in 1954 another 289 trees were accepted from the 44 participants in the infant program. Later the momentum of the program gradually increased as it became better known, particularly as psorosis, and then psorosis and xyloporosis-free budwood became available.

Several things are noteworthy about this interval. First, no definite indexing time was specified before registration for exocortis freedom. Reports varied on the time required for *Poncirus trifoliata* rootstocks of test plants to develop the cracking and scaling symptoms of exocortis, but it seemed likely that 6 or even 8 years might be needed. Throughout the entire history of the program exocortis indexing has presented problems. Often test trees on *P. trifoliata* grew poorly and scaling was delayed or failed to appear at all. A dye test (3) gave inconsistent results. The indexing difficulty was not resolved by budding additional trifoliata test plants nor by the use of 'Rangpur' lime indicators (9). It was not until July 1966 when Garnsey (6) transmitted exocortis on tools that it became clear why in some instances one test plant would grow normally and the other would develop typical exocortis symptoms. Exocortis indexing was vastly improved with the development of the presently used rapid indexing technique with sensitive citron indicators (2). It now appears that even this method must be modified to include a mechanical transfer from citron to citron, if tristeza is present in the budwood under test. Some tristeza virus strains cause vein clearing, stem pitting and severe stunting of citron indicator plants, making it impossible to obtain the vigorous growth needed to detect mild strains of exocortis.

Secondly, a major factor contributing to the State's present budwood position was the early and continued interest of program personnel in nucellar budlines. Working with the 1954 bloom, Dr. Mortimer Cohen, then a State Plant Board employee, used *P. trifoliata* pollen for closed pollination work at the old experiment station grove in Gainesville. Nearly 300 of the resulting nucellars and approximately 50 of the new hybrids were transplanted to permanent locations at the State's Budwood Foundation Grove in 1960, when that planting got underway. In addition, beginning in 1955 program workers made selections of natural nucellars in seedling groves of 'Valencia', 'Parson Brown' and 'Pineapple' that were then approximately 15 years of age. Later, many more mature natural nucellar trees representing most commercial varieties were located and indexed for viruses. These nucellar parent trees and their progeny have been carefully observed, and cumulative yield records maintained since they entered the program. Today the best of the nucellar clones provide the State's only tested exocortis-free bud sources for 13 commercial citrus varieties.

In the early years, when registered trees were very scarce, program participants often shared their registered nursery stock with each other, with the result that most eligible trees were planted in scion groves, thereby contributing greatly to the rapid build-up of registered budwood supplies. The establishment of 26,000 registered parent and scion bud source trees made possible by the program's vigorous indexing effort was a major program accomplishment of the '53-58 period. It was these registered trees that enabled budwood registration to keep pace with the planting boom just getting underway.

Expansion and Maturity 1959-1973

The first 7 years of this period reflect the greatest citrus planting boom Florida has ever experienced. Program participation quadrupled between 1959 and 1965 as the number of cooperators rose from 117 to 501. Whereas the total of registered nursery trees produced prior to July, 1959 was only 218,000, by July, 1966 production had exceeded 15½ million. At that stage planting slowed, but the production of registered nursery stock remained substantial with a present total of 24.3 million trees produced. The declining production of non-registered nursery stock since 1966 and the continued popularity of registered trees have increased the proportion of registered trees to the present 86% level.

The real challenge of the 1960's was coping with the greatly increased workload without lowering program standards. As the number of new candidate trees decreased, greater attention was directed to horticultural factors. Scion trees planted in the 1950's were fruiting well, and by examining trees with mature crops present, the effort to eliminate substandard trees was more effective. For example, 2 entire clones -- one 'Pineapple' orange and one 'Duncan' grapefruit -- were eliminated when excessive fruit chimeras were observed frequently on progeny trees. A late maturing, pebbly-skinned mutation of 'Hamlin' orange was detected at several locations and these were also discarded. Maturity test data revealed a clone of 'Queen' orange that failed to develop the total sugars characteristic of the variety. Not all significant clonal differences, however are as readily determined as the examples given, and program efforts to obtain reliable horticultural information

utilize several sources. The several hundred scion groves established by program cooperators provide valuable observational information. These numerous plantings are widely scattered, on many different soils with various rootstocks, and being under different management are representative Florida groves when considered as a whole. Characteristically, scion plantings contain a number of fruit varieties, and several clonal sources of each; they are carefully mapped and each bud-source is identified. Scion groves are regularly subject to critical examination by owners, by Division of Plant Industry inspectors, and often by buyers who want to see what can be expected from trees being purchased. In such plantings not only can side-by-side clonal comparisons be made, but when a question comes up, the point raised can generally be checked in 20 or more plantings within a matter days. Presently, over 100 registered budlines are included in formal yield trials, generally in cooperation with research personnel, and many commercial plantings representing one or more registered clones have been located for periodic future examination. The Budwood Foundation Grove at the intersection of U.S. Highway 27 and Interstate Highway 4, however, is the most important single source of horticultural information for the program. This multiple-purpose planting which has been and could continue to be the source of a great deal of valuable information is soon to be lost to the industry -- a victim of "progress". This loss, however, is not without its compensations, and actions are underway to minimize the adverse effects.

Program activity during the 1960's was not confined to horticultural considerations. In 1965, during spring flush inspection, psorosis was found on registered scions with 'Carrizo' rootstocks but not on sister trees with other stocks. 'Carrizo' seedlings involved at the several locations could be traced to a single non-indexed source, evidence pointing to substantial seed transmission of the virus (1).

Psorosis seed transmission in 'Carrizo', the knowledge that exocortis virus could be mechanically transmitted on tools, and the sharp increase in the spread of tristeza; all of these factors emphasized the need for large scale indexing since 1965. All told, 2,513 parent trees have been indexed; 457 special psorosis tests of 'Carrizo' seed trees were completed; 11,050 separate citron exocortis tests made; and nearly 42,000 tristeza tests initiated.

Budwood program effectiveness is reflected by the total impact on the industry served and by the quantity and quality of the budwood provided. Since adverse virus effects are often related to rootstock-scion combinations, it is worthwhile to know which stocks are in use, and which may be in future demand. The tree census of 1957 provides reliable data on older plantings, and the rootstocks used under registered nurseries since that era give a clear picture of rootstock preference and trends. These data appear in Table 1.

Table 1. Rootstock Distribution in Florida Groves

Date Produced	Rough Lemon	Sour Orange	Cleo	Carrizo	Milam	Rangpur	Other
Prior to 1957*	61%	29%	3%				7%
1958-1971**	40%	38%	10%	4%	1%		7%
1972***	13%	42%	19%	17%	6%		3%
1973***	2%	42%	12%	29%	6%	3%	6%

*Figures from 1957 tree census

**Rootstocks for 20 million registered trees

***Rootstocks for 1.5 million registered trees

Program functions were broadened in 1965. The new project, called Validation, would provide virus indexing for promising new citrus cultivars prior to their release by a research agency. Validation also included the establishment of authentic bud and/or seed source plantings and the production of correctly identified nursery stock involving newly released varieties. Nursery and scion grove procedures similar to those required for registration protected validated stock against misidentification and virus problems; however, validated material is processed separately until all requirements for registration, including tree age, are met.

Activity involving rootstocks dates from the program's beginning. Provisions for registered rootstock trees were included in the original Citrus Budwood Registration policy statement, resulting in a number of rootstock trees being indexed and registered. At that time, however, very few people were willing to devote valuable land to seed source groves.

In 1955, in order to obtain true-to-type virus-free trees of rough lemon, budwood bureau personnel made selections for indexing among feral seedlings growing in the Kissimmee River Swamp east of Avon Park. These indexed trees, all fruiting specimens, were physically moved to the Winter Haven virus test plot where those surviving the 1962 freeze continue to provide both seed and budwood.

Later, when the Budwood Foundation Grove was planted in 1960, a rootstock block was established, and that source presently provides the industry with registered budwood for rootstock types.

Interest in seed-source plantings began to increase after the release of the burrowing nematode tolerant and resistant rootstocks (5). Grower concern over the source of seed continues to mount as young tree decline problems worsen and more owners become aware that important differences exist among individuals of a single horticultural variety (7, 8). Since 1966, as part of an effort to further improve industry standards requested by progressive Florida nurserymen, the Citrus Budwood Registration Program has carried out the hot water treatment procedures for controlling fungal organisms in citrus seed. More than 5,000 quarts of seed have been treated each year for the past 3 seasons. Another requirement of the Premium Quality Nursery Stock Program is approval of seed fruit by Citrus Budwood Registration Program personnel prior to harvest. This interim procedure is a prelude to a requirement that only registered or validated seeds are permitted. The trend toward stricter sanitary precautions in nurseries and careful seed selection is expected to continue.

Despite unsolved problems, the varied budwood program activities of the 1959-73 period add up to experience, and this experience contributes to a feeling of confidence that the program can make worthwhile contributions in the future.

Future Activitie

Earlier in this paper, references were made to a period of transition and to the loss of the Budwood Foundation Grove. In November 1972 a decision was reached in Tallahassee to exchange the 50 acres containing the Foundation Grove to be acquired by developers of a circus-oriented tourist attraction for other lands suitable for budwood program work. One factor contributing to this decision was the consideration that the present triangular-shaped plot could be reached only through the attraction's grounds. Problems with traffic, the use of pesticides, and cold protection appeared inevitable. Even more important was the fact that the exchange would provide immediately available funds absolutely necessary for effective future activities. Specifically these needs include: (1) a screenhouse facility where bud-source plants can be maintained free of tristeza and possibly other insect-vectored diseases; (2) heat therapy equipment to eliminate tristeza virus from important registered clones now completely infected; and (3) a glasshouse facility suitable for effective exocortis indexing.

Eighty acres of land near Dundee, all in bearing grove, was chosen by program personnel, and subsequently purchased by the company. At this time deeds to all land parcels are in escrow, and the move, which must be completed by November 1975, is underway. In addition to funds for the needs enumerated earlier, the new location offers several advantages:

(1) The entire acreage is high, warm, well-drained typical Lakeland find sand really prime grove land.

(2) The new location is less distant from the Budwood office in Winter Haven, 10 miles rather than 17, and it is readily accessible day or night by improved country road, yet is off the major highway system.

(3) With 80 acres, more than double the usable land at the old Foundation Grove site, the new location should provide space for a wider range of rootstocks and some replication of foundation grove trees which was not possible at the old site.

(4) The program's revenue potential will be increased, an advantage our state legislature appreciates.

(5) The entire new acreage will have fixed irrigation requiring far less labor than the portable pipe used at the old grove

Although the advantages listed above are important ones, the real challenge will be the task of converting this new land into a unit that is producing vital information. There is presently no indication that a major change in program policy or procedures will be required in the near future. The Citrus Budwood Program will, however, continue its close association and cooperative projects with researchers in such problem areas as the new 'Milam' stem pitting disease, tristeza, and young tree decline. Active program participation in projects designed to increase knowledge in the area of new rootstocks is part of the overall effort to be prepared for whatever changes may become necessary. Finally, to supplement moderately extensive work already begun, budwood program personnel, using the 1973 bloom, continued to produce a new series of nucellars that could substantially benefit the industry 20 years from now.