Fruit Varieties Journal 53(1):59-63 1999

The Pome Fruit Tree Quarantine Program of the Plant Germplasm Quarantine Office – Fruit Laboratory, USDA.

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Abstract

Introduction of healthy, foreign germplasm is vital to promoting a healthy fruit tree industry in North America. Importation of foreign germplasm into the United States is controlled by federal regulations. Quarantine programs are necessary to import prohibited species, e.g. *Malus, Pyrus,* and *Cydonia* spp., without simultaneously importing exotic pests. Topics included in this paper are: (1) federal regulations that control importation of pome fruit germplasm; (2) operations at the Plant Germplasm Quarantine Office (PGQO), including quantities and health of pome tree fruit germplasm imported through the program; and (3) changes in the quarantine and indexing protocol for pome fruit trees under consideration by the Animal and Plant Health Inspection Service (APHIS).

Introduction of healthy, foreign germplasm is vital to promoting a healthy fruit tree industry in North America. Quarantine programs are necessary to mitigate the risk of introducing and establishing new pathogens when introducing new germplasm into a geographic area. Yet the pome fruit tree quarantine programs operate without knowledge of the etiology of many of the fruit and bark deforming diseases. Pathogen detection has been based on graft-transmission tests to field-grown indicator plants that develop bark or fruit symptoms only after a 2-3 year incubation. Our pome fruit tree quarantine experience is primarily with nursery and orchard diseases from European countries, where diseases are the result of intensive manipulation and years of clonal propagation. These diseases may differ from those present in germplasm from diverse, worldwide, cultivated or wild origins. As fruit tree culture spreads, trees may be infected by pathogens that are unique to those new regions. Plant explorers are also expanding the geographic collection areas and the genetic diversity of our collections. Nature is not sterile, and typically host and pathogens evolve together. New genotypes may harbor new pathotypes. Data on the pathogens and vectors in these areas are meager or nonexistent. Therefore, quarantine programs are facing greater challenges and they may be more important than ever in ensuring a healthy fruit tree industry. However, fruit tree clients are eager for rapid release of germplasm and are concerned when this does not occur. An understanding of (1) federal laws regulating pome fruit germplasm quarantine, (2) demands on and the resources available to PGQO during the past 10 years, and (3) a new pome fruit quarantine protocol should be useful in evaluating this client-concern.

Federal Regulations Pertinent to Pome Fruit Tree Quarantine

Federal regulations prohibit the importation in commercial quantities of pome tree plant parts usable for vegetative propagation from all but six countries (Canada, Belgium, France, Germany, Great Britain and The Netherlands); clonal material from these countries is enterable only when accompanied by a phytosanitary certificate with the appropriate declarations (5). Material from approved sources in the

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five listed European countries require inspection under post-entry quarantine on the importer's premises. Germplasm or cultivars from other sources can legally enter the U.S. only through two quarantine facilities—PGQO in Beltsville, MD or NRSP5/IR-2 in Prosser, WA.

The regulated pests for pome tree fruits (*Malus, Pyrus, Cydonia,* and *Chaenomeles* spp.) include, but are **not limited to:** *Diaporthe mali* (leaf, branch, & fruit fungus), *Guignardia piricola* (leaf, branch, & fruit disease), *Gymnosporangium asiaticum* (rust), *Monilinia fructigena* (brown rot), *Valsa mali* (branch canker fungus), apple proliferation phytoplasma, apple chat fruit agent, apple green crinkle agent, apple ringspot agent, pear bud drop agent, pear blister canker viroid, quince sooty ringspot agent, quince stunt agent, and quince yellow blotch agent (5). The "not limited to" phrase allows APHIS to add pests to or delete them from quarantine indexing protocols.

APHIS typically requires a pathologist to oversee the quarantine and indexing of prohibited category species. The agency feels pathologists will recognize the potential to encounter and have the ability to detect known, foreign pests as well as new, undocumented pests.

In 1987, APHIS and ARS launched a joint project to centralize the USDA quarantine programs for prohibited species in one program to be located in the Beltsville Area (BA). The program, after numerous name changes, is currently known as the Plant Germplasm Quarantine Office-Fruit Laboratory (PGQO). Initially one and, later, two pathologists were given responsibility for processing more than 50 prohibited plant species, including pome and stone fruit tree spp. Subsequently, NRSP5/IR-2 was authorized as a quarantine facility for commercial varieties of pome and stone fruit trees. Unlike the BA program, NRSP5/IR-2 was established as a fee-for-services program.

PGQO Capacity vs. Acquisitions.

The average number of accessions processed annually by NRSP5/IR-2 and the Canadian fruit tree quarantine programs is ca. 30 (personal communication, J. Foster and D. Thompson). The number of accessions (divided into apple and pear/quince fruit types) received by PGQO each year since 1986 is provided in Table 1. A total of ca. 240 apples and 300 pears/quince, or an average of 49 items per year, were imported from 1986 through 1996. The range of yearly acquisitions varied from 10 to 158. This is nearly double the number processed in the two other North American quarantine facilities. In addition, the PGQO program was assigned in 1987 to process >400 pome fruit trees backlogged in quarantine at Glenn Dale, MD. Using 30 accessions as a reasonable annual goal for a unit of its size (1 technician, 1 gardener, 0.25 pathologist), the PGQO pome tree quarantine was begun with 13 years of work already on hand. A new facility on the BARC-East Beltsville campus significantly increased the ability to carry out the quarantine program when it was made available by APHIS in 1989.

ARS took the position from the onset that PGQO would release only "healthy germplasm." The presence of one or more pathogens in a majority of the initial 400 pome fruit trees and those subsequently imported (Table 1) has thus hampered the release of germplasm. "Conditional releases" were used by PGQO to release and distribute pome fruit tree germplasm in 1995/96. This may be an opportunity for the user community to make recommendations to ARS on the usefulness of such releases. These issues are discussed in detail by John Hartung (3), the new unit leader of PGQO.

A New Quarantine Protocol for Pome Fruit Tree Germplasm

A new indexing protocol may shorten the quarantine period for pome fruit tree germplasm. Working with the NRSP5/IR-2, representatives of the fruit tree industry developed recommendations

Table 1. The annual introduction of pome fruit trees since 1986 and the percent found to be infected.

Year imported	Number received		Percent infected	
	Apple[a]	P/Q[b]	Apple	P/Q
1986	46	112	40	60
1987	18	22	75	29
1988	42	44	76	93
1989	8	30	75	67
1990	22	11	56	90
1991	5	16	33	9
1992	11	7	17	25
1993	14	25	71	58
1994	9	1	100	0
1995	20	22	13	60
1996	44	9	11	60
1997	4	8	0	67
Subtotal	243	307	49	63
Totals (a+b)	550		54%[c]	

[a] = *Malus* spp.
[b] = *Pyrus, Cydonia, Chaenomeles* spp.
[c] = based on 331 tested accessions.

for changes in the indexing protocols. APHIS presented those proposals to a group of fruit tree pathologists gathered in Bethesda, MD in June, 1997, for the "XVII International Symposium on Fruit Tree Virus Diseases." After thorough discussion, U.S. and Canadian scientists endorsed modified versions of the protocols presented to them. A portion of the pome fruit tree protocol that they endorsed is illustrated in Figure 1.

As illustrated, a "source tree" is established using the imported budwood. The budwood is used also to perform molecular tests for phytoplasmas and viroids and to graft-inoculate greenhouse-grown and mature, field-grown indicator plants. The "source tree" is tested by mechanical inoculations to herbaceous indicator plants. A second molecular test for phytoplasmas is performed using "source tree" tissues in May or August, depending on the origin of the budwood. If laboratory and greenhouse assays are negative, a "provisional release" may be requested. If any test is positive, even for commonly occurring pome fruit tree viruses, APHIS will not authorize a provisional release. This protocol allows a recipient to obtain budwood from the "source tree" within 6-8 months after importation of the germplasm. The recipient's State Department of Agriculture must issue that person a permit before he/she can acquire the germplasm. Formerly, PGQO could not complete the tests required for a provisional release in less than two years. The time reduction is largely a result of the use of molecular based assays to replace/supplement the bioassays previously used in indexing.

During the second winter (Figure 1), greenhouse and laboratory tests are repeated, using tissues from the "source tree." During the second and third summers, the field-grown indicator plants and the "source tree" are observed for symptoms. At the end of the third summer, germplasm is eligible for "final release," if all tests were negative and the introduction appears healthy. The field indexing formerly required 4-5 years to complete because PGQO was required to simultaneously graft indicator buds and inoculum to seedling rootstocks. The indicator buds were then grown to mature, fruiting trees. In the proposed protocol, mature, fruiting indicator plants will be inoculated and observed two years for fruit symptoms.

At the end of the third summer, germplasm harboring only the common pome viruses may be "conditionally released" to recipients in accordance with regulations of the person's State Department of Agriculture. If regulated pathogens are detected in any test, release and distribution of the germplasm is prohibited until therapeutic treatments are applied and the treated propagules test negative for the pathogens.

This protocol was approved by APHIS in January, 1998. Its implementation can reduce the quarantine period by two years and allow distribution of germplasm in less than one year under "provisional releases."

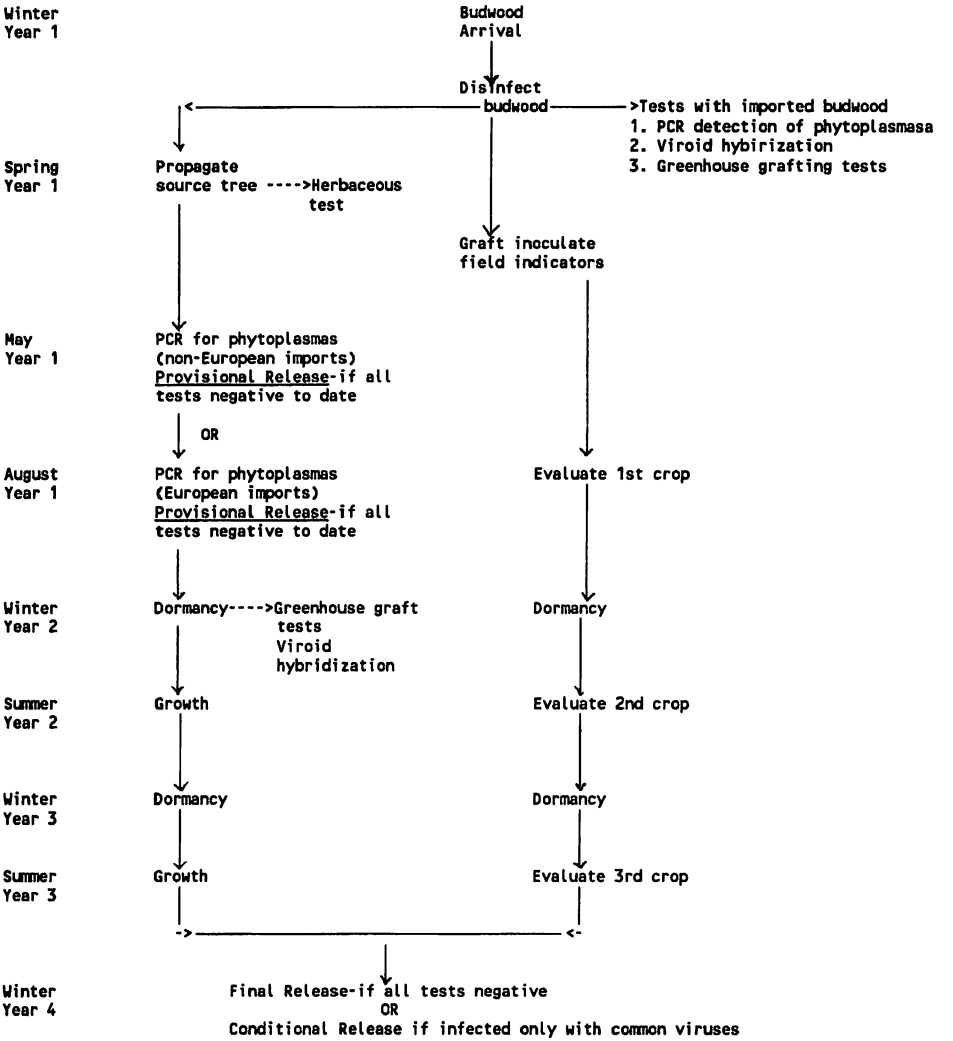

Figure 1. Flow chart illustration of the primary steps in the new protocol for pome tree fruit quarantine approved by APHIS.

Discussion

The purpose of a quarantine is to mitigate the risk of introduction and establishment of pathogens into a geographic area. Using advances in technological methods, scientists are determining the etiologies of some older diseases (e.g., apple scar skin and pear blister canker [1] viroids); finding new pathogens (e.g., apple dimple fruit [2] and apple fruit crinkle [4] viroids); and developing more sensitive and faster detection methods (e.g., nonradioactive hybridization and polymerase chain reaction based assays). These advances can shorten quarantine periods and expedite germplasm exchange. Nonetheless, the number of introductions that PGQO can process will not be limitless. The user community and quarantine administrator must work

together to match germplasm import quotas with PGQO monetary, facility, and human resources, if the PGQO is to succeed.

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