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Plant Quarantine: A Personal Experience

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The problem of getting pome and stone fruits through the Plant Germplasm Quarantine Office (PGQO) is not new! When I first came to Oregon State University in 1965, my predecessor, Quentin Zielinski, who was responsible for evaluating new fruit cultivars, often complained about the difficulties of importing fruit germplasm. The questions always were—will it survive at the PGQO and if so, how long will it take to be released? Over the past three decades, during discussions with plant breeders about plant introduction, I have heard comments such as "Why bother ?", "I never try to import anything.", "Why send it to the 'black hole' (the common nickname for our service unit)?, and "You may get it established at the Center but you'll never get it out before you retire." Overall, the reputation of this service unit among the scientific user community has long been dismal and disgraceful.

Throughout my career I was fortunate to work with hazelnuts, a crop subject only to post-entry quarantine restrictions. That is, I could introduce scions or plants from any part of the world (with the exception of eastern North America) and as soon as the plants flowered, they could be incorporated into the breeding program.

My other project was evaluation of sweet cherries, a collection that was limited to old European and newer Canadian and United States cultivars. Although during several trips to Europe I observed many interesting new cultivars, I never attempted to introduce them because of the negative image I had about the PGQO.

My personal experience with the PGQO actually arose following a USDA-ARS-sponsored plant exploration trip in 1988. David Brenner and I joined with the Plant Genetic Resources Staff at the National Agriculture Research Center in Islamabad, Pakistan for a six and a half month exploration for temperate fruit and nut germplasm in the mountains of northern Pakistan. This comprehensive collection consisted of scions and/or seeds of cultivars and wild related species of 52 fruit species, including apple, pear, peach, apricot, plum, almond, walnut, pistachio, hazelnut, grape, fig, mulberry, persimmon, and several berry species. Tucked away in remote valleys among the mighty Himalayan and Karakorum mountains we found several unique cultures, each so isolated from the others that not only had they evolved different languages (we heard at least six) but also a different assemblage of fruit cultivars. Originally, the various groups of people probably drifted south into the mountains from Tibet, Central Asia, and Afghanistan but they have been there so long that their languages are distinct from those in Central Asia today. They must have brought fruits and nuts with them from their original homelands because most species are not native in these arid regions. Following hundreds of years of selection, there is a great deal of diversity among some fruit species.

Apricot, in particular, was one of the most diverse. Before the Karakorum highway penetrated these mountain passes, this crop had long been an essential staple food in this region because of its reliable, heavy annual cropping ability. It provided fresh fruit throughout the summer, dried fruit and sweet, edible seeds all winter as well as oil from the bitter seeds. We observed many traits never before

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Table 1. Chronology of events for 102 apricot clones introduced into the U. S. Plant Germplasm Quarantine Office (PGQO) in Beltsville, Maryland, December, 1988.

Date	Amount of apricots alive	Amount distributed	Comments from PGQO
October 1998	92	0	
June 1991	75	0	Bud failures due to inexperienced propagator.
August 1993	??	0	Unexplained losses. Many failed to break dormancy.
May 1996	11	11 to Adair. Scions too weak to propagate	Mysterious collapse of most. Conditional release of remaining clones.
September 1996	0	0	

seen in United States or European cultivars such as Brix readings as high as 34°, a 3-month span in fruit maturity, 70% of clones with sweet seeds, good storage ability, and high quality, juicy fresh fruit. We were very excited to discover such genetic diversity in a crop that has such a narrow genetic base in the western world. In the summer, we collected seeds from cultivars and in late November, we went back for dormant scions, often from the same trees. We collected good quality scions (about 6 bud sticks from each cultivar), keep them cool until our departure from Pakistan, hand-carried them to the Seattle airport and gave them to the Plant Quarantine officer who had been alerted of our arrival by George White, Plant Introduction Officer, and urged to expedite the transfer of the scions to the PGQO, which he did. Previous to our undertaking the trip, the PGQO staff had been consulted regarding how many of each species they could handle and we complied with these limitations. Therefore, I know that the scions arrived in good condition and that rootstocks should have been available for immediate propagation.

Because I was so fascinated by this apricot diversity and anxious to see it in the hands of breeders as soon possible, I tracked the fate of the accessions in the PGQO (Table 1). After the second year, in 1991, I was told that several clones had failed in propagation because of an inexperienced budder and his failure to re-bud because the extra budwood was allowed to dry out in storage. By 1993, I was told that many potted trees "failed to break dormancy" (a euphemism for "died"). By May, 1996, there was a "mysterious collapse" of most trees and a conditional release of the 11 remaining clones to a nurseryman, all of which failed because the scions were too weak to propagate and, as expected, by September, 1996, these same apricot clones had all died at the PGQO. This same nurseryman told me that whenever he has received scions from the PGQO they were usually too weak to propagate. Thus, after seven years at the PGQO, not a single one of 102 apricot cultivars survived.

In my dismay at the progressive loss of these unique apricots, I became interested in the experiences of other fruit breeders who have introduced fruit cultivars through PGQO in recent years. The responses were not at all encouraging. Amy Iezzoni, cherry breeder at Michigan State University, introduced 12 clones of sour cherry in 1991, all of which failed. She reintroduced the same 12 clones in 1992 and all failed. In 1995, she introduced these same 12 plus 7 more and as of Sept. 1996 six of these had already failed. Greg Reighard, pomologist at Clemson University, introduced 7 *Prunus* clones in 1993, all of which failed, and in 1995 two of the four clones he introduced died by Sept., 1996. Of 69 cultivars introduced in 1991 by Robert Andersen, fruit breeder at Cor-

Table 2. *Prunus* acquisitions at the U. S. Plant Germplasm Quarantine Office (PGQO) in Beltsville, Maryland from 1979 to 1993.

Year	Number introtuced	Number released	Percent released	Mean years	Range	Number of failures	Percent fail	No data	Percent of no data	Combined fail/no data
1979	55	13	24	12.5	11-16	12	22	29	54	75
1980	37	8	22	12.1	10-15	14	38	11	30	69
1981	164	34	21	10.9	9-15	100	61	23	14	75
1982	73	8	11	9.5	9-12	43	59	22	30	89
1983	251	44	18	9.4	8-13	23	9	177	71	80
1984	214	93	43	8.8	7-12	31	14	81	38	52
1985	175	69	39	8.3	6-11	11	6	79	45	51
1986	129	34	26	8.3	5-10	84	65			65
1987	59	19	32	8.3	5-9	36	61			61
1988	134	14	10	5.4	4-7	116	86			86
1989	21	7	33	5.6	3-7	12	57			57
1990	473	253	53	4.9	2-6	212	45			45
1991	76	9	12	3.5	2-4	64	84			84
1992	61	8	13	3	3	47	77			77
1993	39	1	3	3	3	33	85			85
Total	1961	614	32			838				64

nell University, over 50% had failed by May, 1996.

Last year, I became aware that Jan Bowman, computer specialist at the PGQO, had computerized all the data that was available about Prunus acquisitions since 1979. She very kindly supplied me with printouts of this information which I have summarized in Table 2. Since, according to Jan Bowman, the 1979-1985 data was incomplete, she simply recorded some as "No data" (ND). In my summary, I felt justified to include these ND in the "failed" category because there is no record of their release and doing so does not inflate the percentage failed as compared to succeeding years. Unfortunately, similar data for pome fruits was not made available.

The most encouraging revelation about *Prunus* is the decrease in number of years to release; namely, 12.5 years in 1979 to 3 years in 1993 (Table 2). This reduction in time is due partly to the fact that in recent years a much higher percentage of seedlings (which require fewer tests and therefore less time) as compared

Table 3. Percent of clonal and seedling apricot accessions received at the National Plant Germplasm Quarantine Office (PGQO), Beltsville, Maryland from 1990 to 1993. A total of 182 clones and 469 seedlings were originally introduced.

	Clones	Seedlings
Released	3	57
Failed	90	43
At PGQO	5	0
Virus positive	2	0

to clonal materials have passed through the PGQO. Previous to about 1989, most *Prunus* seeds were not required to be tested. A second factor contributing to the reduced time in quarantine is the recent reduction in APHIS-required tests. APHIS is currently reassessing the need to continue testing for some 65 virus-like pathogens that have never been seen in incoming germplasm. The most promising new development is APHIS's recent acceptance of rapid laboratory techniques for *Prunus*; namely, molecular tests to detect phytoplasmas and viroids. Thus, it appears that changes in testing methods and requirements are underway that will help solve the problem of the long duration at PGQO. Provided that there is sufficient staff to handle the volume of material, it is expected that *Prunus* plants may be released within 2 years of entering the System. This shortened period of time at the PGQO will also contribute towards solving the next problem, i.e., survival at the PGQO.

The major problem remaining to be addressed is the survival rate. As is evident from Table 2, since 1979 there has been no significant increase in survival. The exceptionally high percentage (53%) of 1990 accessions released was due to the fact that most of these were seedlings. Of the 473 accessions, only 8% of those released were clonals. A comparison of the failure rates of clonal (90%) as compared to seedling accessions (43%) received in recent years (1990 to 1993) is presented in Table 3. The causes of this intolerable loss of clonal materials must be investigated and appropriate measures taken to correct the problems. Is the loss due to the arrival of poor quality scions, to poor propagation techniques, to inappropriate rootstocks, or to careless cultural management? Although it is not generally understood by breeders of seed-propagated crops, every fruit breeder knows that it is superior clones that are needed to use as parents; not a few unselected open-pollinated seedlings from selected cultivars. This is especially true of cross-pollinated crops where open pollination results in highly heterogeneous populations.

A final problem, one that relates to survival, that needs to be addressed is the release of scions that are too weak to propagate. If cultural management can be improved, more vigorous plants would provide strong scions that the user community can propagate successfully. Too often, recipients are unable to propagate the weak scions distributed by the PGQO.

The cost in dollars as well as in human effort per clonal accession actually released must be astronomical if one considers the cost of plant exploration trips to collect and the costs of propagating, maintaining, and testing the plants at the PGQO only to lose most of them during the process. Further, there is incalculable loss of potential profits from new cultivars which might have been developed had the germplasm reached the breeders and been incorporated into superior, economically more valuable, new cultivars.

Plans must be made and implemented to correct this abominable loss of fruit germplasm at the PGQO. Suggestions that I offer here are as follows:

1) Create an advisory committee for the PGQO consisting of crop specialists for each major crop dealt with there. They should meet annually at the Center to monitor the maintenance and progress of plant materials through the system and to provide advice where needed in order to keep the plants alive and in a healthy condition. Such a group would not only have the personal interest in the plants, but also, the expertise to help solve the horticultural problems.

2) Since the limited staff at the PGQO is obviously overloaded with too many plants, some mechanism should be set up to limit the number of accessions accepted each year. This could be done via plant import permits which are valid only for the current year. The PGQO staff could decide how many accessions they could

handle each year and permits issued only for that amount.

Somehow, if resources are limited, the amount of plant materials accepted must be limited also so the staff has time to do a good job with the plants they receive.

3) Preferably, more staff members should be added to the PGQO. The fruit user community, scientists and industry representatives, should agitate politically for allocation of more resources to handle the large amount of plant materials that enter the system each year.

These are a few suggestions that I offer and I'm sure that the new ARS administrator for the PGQO, John Hartung, will be open to any constructive ideas to help solve the problems associated with plant quarantine. The users of fruit germplasm must continue to make suggestions and apply pressure for improvements in this system.

My hope is that the PGQO may develop into a facility that can maintain all valuable, exotic germplasm in a healthy condition while performing appropriate tests for diseases and can transfer it to the users as rapidly as possible. It is essential that this Center improve its performance and thereby gain the respect and confidence of the users so that US citizens are not driven, in desperation, to the illegal importation of fruit scions. This is a common and dangerous practice which undermines the efforts and substantial funds expended by the quarantine program, and which is a serious threat to the health of the U.S. fruit industry.

(Ed. Note: The following points were suggested during the audience discussion period following the oral presentations at the meeting on July 26, 1997.)

Summary of Discussion Points

- Institute an advisory committee for the Plant Germplasm Quarantine Office.
- Improve communication with existing crop germplasm committees.
- Consider establishing an examination fee schedule.
- Growers and the public should write congressmen to show support for additional funding for the quarantine office.
- Growers and the public should communicate with Dr. Judy St. John, Associate Deputy Administrator, USDA, ARS.
- Scientists requesting USDA Plant Exploration funding for clonal fruit and nut crops should request additional money to support those crops during quarantine.
- The PGQO should establish a goal of about 50 pome fruits to be processed each year.
- The limited testing performed annually at the PGQO could be ordered by lottery
- The limited testing performed annually at the PGQO could be ordered by committee.
- Ask Canadian Quarantine officials for ideas on improvement.
- Don't have a competition between Beltsville and Prosser.

Hedrick Award Student Paper

'A Protocol for Rooting and Growing Apple Rootstock Microshoots' by D. K. Isutsa, M. P. Pritts and K. W. Mudge. April 1998 *Fruit Varieties Journal* 107-116 was second place Hedrick Award for 1998.