# Future Germplasm Reserves of Pome Fruits

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The present situation concerning the maintenance of germ plasm of pome fruits (apples and pears, in particular) is not good and appears to be deteriorating. *The Register of Fruit Breeders* compiled by the fruit breeding committee of the American Society for Horticultural Science in 1970 lists 23 stations and 31 breeders working with apples and 12 stations and 13 breeders working with pears. Of these, at least 3 stations have phased out the apple breeding work since that time and presumably the variety collections in connection with those programs have been eliminated as well.

The latest literature on the availability of apple and pear cultivars is very much out of date as Fogle and Winters have pointed out (5). Fisher (3) lists approximately 1900 apple entries from 32 stations. Fisher (4) lists approximately 900 pear entries from about the same number of stations. Dr. C. M. Ritter (7, 8) lists 1500 apple entries from 19 stations and 800 pear entries from 15 stations. Unfortunately, these lists become out of date very quickly and I know that many of the cultivars in these lists have been lost, because I have written for scionwood of them and have also had communications from others who have been unable to find a particular variety. Since no one is responsible for the maintenance of these cultivars, their availability is entirely dependent on the value or usefulness that a breeder feels they have for him and when he no longer has any interest in a variety, it is discarded and sometimes totally lost.

Another aspect of this germ plasm problem is the standardization on a few varieties, not only in this country but worldwide. In apples, 'Delicious' and its sports, 'Golden Delicious', 'Jonathan', 'McIntosh' and 'Cox Orange' account for a very high proportion of the world's apples. One pear variety, 'Bartlett', must account for almost 60% of the world's production. Many countries where formerly a great diversity of varieties were grown, have now changed to growing the standard varieties. The local varieties and the genetic diversity which they represent are being lost.

Still another aspect of the problem is that some apple and pear species may, in fact, be in danger of extinction because of increased pressure world-wide to bring more land under cultivation. Species with relatively local adaptation could be completely eliminated because the residents of that area want to have something of more value growing on that land.

The importance of maintaining genetic diversity in our crop plants is most dramatically demonstrated by the epiphytotic of southern corn blight in 1970. Perhaps this sort of catastrophe will never happen to the apple industry, but for insurance, samples of the genera *Malus* and *Pyrus* as widely based as possible should be maintained. Another important reason for maintaining a germ plasm repository for a crop is the possibility of finding worthwhile characteristics such as disease and insect resistances, spur types of growth habit, precocious bearing, late blooming and resistance to adverse environmental conditions

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such as cold, drought, excess moisture, etc. The pome fruits have not been thoroughly screened for these characteristics and much valuable genetic material is in danger of being lost, including things which we have not even thought of. The spur type of growth was unheard of 20-30 years ago. Alston (1) lists sources of resistance to 8 insects and diseases and other characteristics of importance. Many of the sources were wild species but some are named cultivars. If the whole genus could be surveyed, it is certain that many more such useful characteristics could be identified.

Detailed suggestions for a repository for the preservation of apple germ plasm were drawn up by the fruit breeding staff of the New York State Agricultural Experiment Station at Geneva for the Agriculture Research Service Germ Plasm Coordinating Committee.* The committee met at Geneva with a number of ARS people and interested fruit breeders who work with different fruit crops. This working proposal was submitted for discussion and criticism. Most of what is said for apples would apply equally well to pears.

The objectives of the repository were stated as follows:

1. Assembling a working collection of *Malus* germ plasm for use by breeders and other interested researchers.

2. The maintenance of this germ plasm.

3. The description of entries, checking of the trueness-to-name, and taxonomic studies.

4. Identification of resistances and other special characteristics of value.

5. Preservation of historical cultivars. This objective was not uniformly supported at the meeting because it was felt that other institutions could fulfill this objective.

6. A last objective that was mentioned was synthesis or the combining of various worthwhile characteristics in one individual clone. This, too, was not uniformly supported as it was felt that it was really beyond the scope of the repository.

The repository should be located in an area where most of the cultivars and species are well adapted and where disease and insect pests are not limiting, i.e., they can be controlled fairly easily. For apples, one location would probably serve, although it would be better to have varieties adapted to areas of low-chilling growing in such an area. The Geneva area would be a good location for an apple repository because (1) the apple is well adapted, (2) there is already a collection of 1900 named cultivars and selections at the New York State Agricultural Experiment Station, (3) there is an active apple breeding program in progress there.

The implementation of the repository was suggested as follows:

1. The materials to be collected would include cultivars having special characteristics. This should be broadly interpreted rather than in a narrow sense. It is expected that 1600 cultivars might be included in this class. The numbers of entries to be maintained is a very real problem. Our estimates have been fairly liberal, but not excessive. There are many more named cultivars in existence.

2. Primitive materials—that is, species, subspecies, taxons or ecotypes. These might be grown primarily as seedlings, although selections might be made with special characters which could be maintained as clones. The taxonomy of *Malus* is rather confused.

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Rehder lists 25 species and 56 subspecies, related species, species hybrids, etc. *Standardized Plant Names* lists 61 species. It is doubtful that a subspecies differentiated on the basis of a single gene difference (e.g., color of leaves or drooping growth habit) should be maintained, but where the differences are greater and represent different adaptations to environment, the subspecies probably should be maintained as a separate entity. It is quite likely that species with a wide geographical range might have numerous ecotypes representing adaptations to different environmental conditions and these should be grown as well. Perhaps as many as 100 of these primitive accessions would be grown. Where seed is obtained from a species or ecotype, at least 10 trees should be grown to get an idea of the variability present in the material. Also, since apples are for the most part self-incompatible, to preserve the genetic identity of this material, seed should be the result of controlled intercrossing individuals of the particular accession.

Another class of material that should be grown and tested is rootstock material. Perhaps as many as 300 of these would be included. Still another class might be called primitive cultivars, local cultivars or cultivars having combinations of desirable characteristics. These classifications would not be hard and fast, and there undoubtedly would be a great deal of overlapping but they are broken up this way to indicate the sorts of material that would be grown and maintained in the repository.

The maintenance of the cultivars would be on virus-free dwarfing stocks such as 'M.9' or 'M.26' at a spacing of approximately 8′ x 14′. Accessions would be routinely indexed for common viruses and would be planted in a virus-free or a virus-infected block, depending on the screening results. Since apple viruses are not known to be insect transmitted, it would not be necessary to have wide isolation between these blocks. Primitive materials would be grown as seedlings. Some of these could be stored as seed for periods of up to 10 years or so. The entire planting would be grown as well as possible, with thorough control of pests and diseases by spraying.

One of the first responsibilities of the repository staff would be to make detailed descriptions of the cultivars and to check each cultivar for its trueness-to-name. A standardized description form capable of computerization would have to be devised and each accession described. The species and primitive material would also have to be checked. The repository would offer an excellent opportunity for a chemo-taxonomic study such as was done on pears by Challice and Westwood (2)—although it was not envisioned that the repository staff would be able to do a study in this detail.

The identification of special characteristics of the material included in the repository could be carried out on a routine basis. When an accession is brought in, perhaps 5 extra trees could be propagated for this work. They could be planted in pots and tested for resistances to insects and diseases in the greenhouse. Techniques of testing for resistance to apple scab, cedar apple rust, fire blight, collar rot and mildew have been fairly well worked out and could be done the year after the accession was received. Tests for various insect pests could also be run and a determination made of low temperature resistance of the material. Virus tolerance could also be determined on these. It is not envisioned that the repository would do any heat treatment for the elimination of viruses; that being a prerogative of the IR-2 program.

There will be a problem with the U.S.D.A. Plant Introduction screening program because the repository would probably request many more cultivars than the Glenn Dale staff are set up to handle. Also, it is most likely that some cultivars that should be included in the repository will be infected with viruses. Possibly some sort of post-entry quarantine and growing the trees in tubs in screenhouses could be worked out.

The information collected on these accessions should be taken so that computerization is possible and the information can be published yearly. This annual publication would be most important. When a cultivar has been described for a period of perhaps 5 years, it could be put into an inactive file and only notes on the response to exceptional conditions be taken on these.

Services that the repository would render aside from the annual publication of records would be first of all, supplying propagating wood to interested people. Since the trees in the repository would be relatively small, large amounts of budwood or scions would not be available. An availability list such as P.I. and the IR-2 project publishes would be made up. People who might take advantage of these materials would be breeders and other research people, possibly commercial horticultural enterprises and interested amateurs. Probably a system of priorities should be established for these various types of requests and within these priorities a first-come, first-served policy be set up.

The repository might also supply pollen, seed, or perhaps even controlled crosses, or the use of trees as parents in a breeding program. As with the scionwood, a uniform procedure for handling requests should be set up. The possibility of charges for these services was discussed. The idea was put forward that if a charge is made for services, administrators might tend to feel that the repository is self-supporting, so that it was probably preferable not to make any charge. On the other hand, high labor services such as collecting and taking out pollen, making crosses, collecting and cleaning up seeds, would be extremely difficult to provide without some charge to pay for the labor.

On the subject of funds to pay for the support of the repository, it was brought out again and again that every means possible should be taken to insure that after a period of time these funds should not be cut off in an economy move. This work is expensive and to cut off support would mean that money already spent would have been largely wasted. The suggestion was made that it should be funded jointly, perhaps by ARS and the regional funds. In this way, one organization could not unilaterally cut off funds and kill the program. Just where these funds might come from has not as yet been decided. It is certain that it will take the continued interest and support of the people who are convinced that it is worthwhile and who will benefit from the repository to bring it about.

The Curator of the repository could identify needs for exploration. He would be in the best position to know what is on hand and what gaps there might be that could be collected in foreign countries. The United States is not the only country interested in germ plasm preservation and if an active program of cooperation could be set up amongst the other repositories, materials might be obtained relatively inexpensively.

It was proposed that a committee of interested research people should be set up to assist in the operation of the repository. The committee should be representative of the source of sup-

port. The committee would advise the Curator on cultivars that should be obtained, those that might be dropped, priorities for services, etc.

In any plan it is necessary to make some estimates of cost, which in a time of inflation such as we are presently experiencing, is rather difficult. However, it is necessary to list some specifics.

Concerning the number of cultivars and species that would be maintained, we estimated some 1600 named cultivars, 300 rootstock cultivars and 1000 cultivars with special characteristics and 100 species and ecotypes. That is some 5600 trees on dwarfing stocks which at a spacing of 14′ x 8′ would require a little more than 15 acres, and 1000 seedling trees on their own roots planted at a spacing of 20′ x 10′ would require 4.5 acres. This is a total of 20 acres for the collection plantings. Buildings and greenhouses were estimated as requiring an additional 5 acres and the nursery and some space for a little rotation in replanting 15 acres—for a total of 40 acres. Our estimate of the personnel required to operate this facility would be one Ph.D., 2 technical assistants and 2 laborers. The capital required to set this up would include the investment for the land, which in this area is approximately $800/acre. Buildings would include a laboratory, greenhouse, storage buildings. Equipment needed would include a tractor, sprayer, plows and cultivation equipment, mower, truck, etc. Scientific equipment for the lab would also be required. This is an expensive proposal, but in our opinion the results will well justify the costs.

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