Germplasm Reserves of North American Nut Trees

RICHARD A. JAYNES[1]

ABSTRACT

Existing germplasm collections of the different nut tree species are correlated with the amount of research and the commercial value of the nut crop. There is a need to delineate specific objectives of germplasm collections for each species followed by commitments on a long term basis. A national committee would be of benefit in achieving the desired results. Nut tree species, of *Carya, Castanea, Corylus, Juglans,* and *Pistacia* are discussed. All the species are highly heterozygous. Germplasm reserves should be maintained in clonal collections: Seedling material, with the exception of black walnut, is of secondary importance. Genetic vulnerability is a serious threat only for those species where commercial production is limited to one or a few clones. Yet, valuable germplasm may be lost forever if greater effort is not given to its preservation.

Pecan, *Carya illinoensis*

The U. S. Pecan Field Station, Brownwood, Texas, has most of the pecan cultivars in propagation, with the exception of some Northern types. In addition, there are approximately 21,000 seedlings from controlled pollinations. Propagation wood is available and regularly sent to cooperators. There are presently 209 testing sites established in 18 states. The germplasm at Brownwood has been a source of disease resistance, adaptability to various soils and climate, diversity of market types and nut maturity, improved quality, precocity, and higher yields. The 160 acres are maintained by five USDA employees. The outlook for continued support is excellent. Additional facilities and staff expansion are anticipated.

Two other sites should be designated as major germplasm reserves for pecan to ensure against loss of material. A few pecan cultivars and 130 promising selections are maintained at the U. S. Fruit and Nut Laboratory, Byron, Georgia. The Pecan Laboratory at Shreveport, Louisiana, operated by Louisiana State University, also has a collection of cultivars and USDA selections.

There are less climatic and disease hazards at Brownwood than most other areas of the pecan belt. For example, in the Southeast, pecan scab would be a serious threat.

Northern Pecans

The Department of Horticulture of the University of Missouri maintains a collection of 53 clones at New Franklin. Of these, eight are selections collected under the NC-7 Pecan Exploration Project. There is suitable land available for expansion and the present outlook for continued support is good. The Kansas Agricultural Experiment Station has a pecan collection at Chetopa; Oklahoma State University in cooperation with the Northeastern Oklahoma Pecan Growers Association

[1]Connecticut Agricultural Experiment Station, New Haven, Connecticut.
I am indebted to the following for information on specific nut crops: H. I. Forde, Staff Research Associate, University of California, Davis; D. T. Funk, Principal Plant Geneticist, North Central Forest Experiment Station, Carbondale, Illinois; A. Hibbard, Professor of Horticulture, University of Missouri, Columbia; L. E. Joley, Research Horticulturist (retired), Agricultural Research Service, Chico, California; H. B. Lagerstedt, Research Horticulturist, USDA, Corvallis, Oregon; L. H. MacDaniels, Pomologist Emeritus, Cornell University, Ithaca, New York; G. Madden, Research Leader, U. S. Pecan Field Station, Brownwood, Texas.

has a grove near Tulsa; and the Western Kentucky Experiment Station has a collection of cultivars at Princeton. In addition there are several private collections of cultivars.

There is a need for improved northern selections but virtually all the pecan improvement work is located at the USDA Pecan Field Station at Brownwood where the primary effort is devoted to cultivars adapted for the Southern pecan belt. Pecan is one of the few economic food crops native to the mainland U. S. The native stands, confined to flood plains of major streams, are gradually being eliminated. The NC-7, New Plants, Regional Research Committee authorized a domestic plant exploration project to collect valuable remaining germplasm. In the past only trees that might be introduced as cultivars were collected, whereas this exploration is searching for trees with superior single traits which could be valuable to future pecan breeders. Native stands have a wide genetic base and may be of particular value to pecan breeders in the future. When such stands already exist on public lands they should be designated for preservation.

Hickories, Excluding Pecan

Attempts to select and maintain reserves of superior clones of hickories have been disappointing and ineffective. Practically the only selection and propagation has been through the members of the Northern Nut Growers Association. Discovery has been mostly through having contests to locate the best clones. There has been no concerted, continuing effort to propagate and maintain the prize winning clones. There are some 100 named cultivars but only a few of these have been commercially propagated. These are mostly shagbark hickories, *Carya ovata,* but also include some species hybrids and selections of shellbark hickory, *C. laciniosa.*

There is presently a small collection of cultivars at the Cornell Plantations, Ithaca, N. Y. This should be expanded and two others established, one in Virginia and one in the Midwest. Seed or seedling collections are not warranted at this time. Annual expenses would not be excessive for a cultivar collection that might include 100 or fewer selections, but it would be wasteful to start unless the commitment were for at least 25 years.

Shagbark hickory has a highly regarded, distinctive flavor. Notable selections have been made; their greatest value could be as source material in future improvement programs.

Persian (English) Walnut, *Juglans regia*

Commercial production is mainly confined to California, followed by Oregon and Washington. Hardy selections, largely from the Carpathian Mountains, are grown extensively in the Midwest and East, but generally on a non-commercial basis. The largest North American collection of Persian walnuts is maintained by the Department of Pomology at the University of California, Davis. The collection has diminished in size in recent years but still includes material from all over the world. In addition several species of *Juglans* are included as well as some 28 cultivars and several hundred seedlings of *J. regia* from the University of California breeding program.

Collections of hardy or Carpathian clones are scattered and smaller in size with orchards at Kansas State University, Manhattan; Iowa State University, Ames; Vineland Experiment Station, Vineland, Ontario; and elsewhere.

Persian walnut is a highly variable species and readily crosses with some of the other walnuts. Its wide distri-

bution of cultivars and seedlings in the U. S. and southern Ontario ensures a broad genetic base. Selected additional germplasm acquisitions from overseas could well add useful variation, but it is initially more important to preserve existing selections both within and outside the areas of present commercial production. Trees of proven resistance to existing insects or diseases are needed.

Black Walnut, *Juglans nigra*

There are approximately forty black walnut germplasm collections, some of which also contain a few accessions of *J. cinerea, J. regia, J. sieboldiana* and their hybrids. Most of these are collections derived from open-pollinated seed, but some include grafted nut or timber selections. The collections are located in 20 states and provinces and the majority are maintained by public agencies, so relative availability of material is good. The outlook for continuing support is satisfactory.

Substitutes for both walnut meats and wood will continue to be introduced but heavy demand for the real product is expected to continue. The greatest need is for open pollinated lines that produce both satisfactory wood and abundant nuts for commercial cracking. There is presently a shortage of wood and nuts. Most requirements for sources of pest resistance and climatic adaptation can be met within the broad natural range of black walnut within the U. S.

Present black walnut research is oriented largely towards wood production and not development of better cultivars for orchard or yard production. Additional clone banks for timber selections are not necessary but responsibility for maintenance of selected nut bearing clones should be fixed so that selections made over the past 100 years are not lost.

Walnut seed may be stored for up to four years. There is no problem with international shipment of methyl bromide treated seed.

Filbert, *Corylus* sp.

The principal *Corylus* germplasm collections in the U. S. are located at Corvallis, Oregon. Dr. Maxine M. Thompson, Dept. of Horticulture, Oregon State University has an extensive collection of *C. avellana* cultivars and selections which number over 200. These cultivars were mainly collected in Oregon and from the Mediterranean countries. Scionwood from this collection has been sent freely upon request. The collection is used primarily for a filbert breeding program and is supported by funds from the Oregon Filbert Commission. Dr. Harry B. Lagerstedt, USDA Research Horticulturist, working in cooperation with the Dept. of Horticulture at Oregon State University has collected most of the *Corylus* species and ornamental forms of *C. avellana* available from U. S. nurseries, arboreta and botanical gardens. For example, all *Corylus* forms available at Arnold Arboretum, Morton Arboretum or Rochester Parks are included. Dr. Donald K. Ourecky, New York Experiment Station, Geneva, maintains a small planting of *C. americana, C. avellana* and their hybrids.

Genes for resistance to diseases and insects, for hardiness and the non-suckering characteristics, or for yield, early maturity or nut quality factors are all available. It remains for the various breeders to combine them into a single, easily propagated plant. The 'Barcelona' filbert is the principal cultivar of U. S. commerce. It is susceptible to a western bacterial blight *(Xanthomonas corylina)* and an eastern fungus blight *(Apioparthe anomala)*. The average nut set is 2.2 per cluster and could be improved. Earlier maturity would aid mechanical har-

vesting and if its suckering habit could be eliminated it would solve a major cultural problem. Hardiness becomes a most important factor to trees not grown in Oregon. Some cultivars of *C. avellana* are susceptible to bud mite *(Phytocoptella avellanae)* for which there is no control other than resistant forms.

Clonal repositories for *Corylus* material would be most practically maintained by the interested breeders. It would be desirable if a single arboretum (such as the Holden Arboretum in Mentor, Ohio) took an interest in collecting the various available forms of *Corylus* as a part of their nut tree collection. However, climatic conditions of the Midwest or East may not permit as complete a collection as could be maintained in the Willamette Valley of Oregon.

The area of filbert breeding is so limited that workers interested in this crop soon become acquainted and begin exchanging material. The only other breeding of filberts is done in France and Italy. The major country of production, Turkey, has only a selection program.

Oregon, Washington and California have quarantines against the importation of filbert material from east of the Rocky Mountains. Introductions must be grown under post-entry quarantine supervised by the respective state departments of agriculture.

Chestnuts, *Castanea* sp.

Research projects on chestnut and the chestnut blight are diffuse, with some activity in Connecticut, Maryland, North Carolina, Tennessee, and West Virginia. The Connecticut Agricultural Experiment Station has the largest collection of chestnut species and hybrids, but the number of sources maintained has diminished in recent years. Typical of such collections, it was developed and maintained for local or regional needs and not managed as a national resource. A cooperative planting of hybrid and American chestnut seedlings has been established at the Lesesne Forest and is managed by the Virginia Division of Forestry.

The demand for hardy, pest resistant chestnut trees for nut bearing for home and orchard is likely to increase. Difficulty in clonal propagation of promising selections presently restricts wider distribution and test of named cultivars. However, current research indicates that the rooting of cuttings is feasible with many clones. Chestnut is potentially an important commercial nut crop in the Midatlantic and Southeastern United States and possibly some areas in the far west. The chestnut blight fungus is a serious problem but adequate field resistance occurs in the Chinese chestnut and some of its hybrids. Chestnut weevils (*Curculio* sp.) are the most serious insect pest; they attack the developing nuts. There has been no screening for weevil resistance.

Long term commitments to maintain clonal collections of chestnut may be difficult to obtain, yet for future options it is crucial that a range of selected material be perpetuated. A minimum of two germplasm orchards, one in the Northeast and one in the Southeast, should be established. Besides the Chinese chestnut there are 12 other species. Consideration should be given to them and their hybrids in establishing germplasm collections. In addition to the value of chestnut as an orchard tree, it has value as an ornamental and game food plant and is potentially a forest tree.

The chestnut blight fungus *(Endothia parasitica)* does not normally occur in North America outside the range of the native American chestnut (Eastern U. S.). Clones susceptible to the chestnut blight could be maintained in plantings in the Midwest or

West. No clones of the American chestnut have yet been demonstrated to have good field resistance to the chestnut blight fungus.

Pistacio

The major clonal collection of *Pistacia* was placed in jeopardy with the closing of the Chico, California, Plant Introduction Station. The land is now under the jurisdiction of the U. S. Forest Service. The Pistacio (growers) Association is attempting to arrange for the preservation of the most valuable germplasm. A small collection is maintained at the University of California, Davis. The threatened loss of the only major collection of pistacio in the country is of serious concern and an argument for duplicating germplasm collections.

CONCLUSIONS

Relatively good germplasm collections are being maintained for those nut crops with an active and intensive research program. The danger lies in losing material of those crops which are not now commercially important. Germplasm collections exist but their maintenance is often at the whim of one person and they are not viewed as a national resource. This is the Achilles' heel or weak spot of the present system. Once a general, widespread need for germplasm collections is truly recognized, it may be easier to obtain commitments for their maintenance. Specifically, a National Plant Genetic Resources Committee could have the leadership, respect, and influence to bring about better and more permanent germplasm reserves (1). Existing commercial and amateur nut growers groups, arboreta and botanic gardens, and state and federal agencies will shoulder much of the responsibility without the input of new money if leadership develops at the national level.

For most of the species discussed there is inadequate duplication of germplasm material in separate collections to forestall loss from natural disaster or precipitate management action. Care has to be exercised in assembling clonal orchards that not just commercial cultivars are included but also material representing the great genetic diversity available which might have use in future breeding and selection programs.

Each commercial nut species must be individually examined to evaluate the specific need and manner of establishing germplasm reserves. The value of germplasm reserves in nut tree breeding programs has been clearly demonstrated with the USDA pecan work at Brownwood, Texas, and the University of California Persian walnut breeding program at Davis. We know the tree crops can be improved with traditional breeding and selection methods. We are just beginning to realize what may be possible by tissue culturing tree cells and screening them with techniques common to the fungal geneticist. Whatever improvement techniques are applied in the future, germplasm will be needed to provide the raw material. Germplasm collections should be located where research on the crop is being conducted for its most efficient management and utilization.

Literature Cited

1. Recommended actions and policies for minimizing the genetic vulnerability of our major crops. 1973, November. Special Report Agr. Res. Policy Advisory Comm. USDA and National Assoc. State Univ. and Land Grant Colleges. 33p.