TOUR GUIDE TO CURRENT FIELD PROJECTS IN TREE IMPROVEMENT AT THE OHIO AGRICULTURAL EXPERIMENT STATION

(Tour leader: Howard B. Kriebel)

Lath House, Hotbed, and Seedbeds

A. A protected storage area for trees in pots or flats, mainly during spring and summer. Rootstocks for grafting are potted a year in advance of use in the spring, and kept in the lath house. Trees propagated in the greenhouse during the winter are moved to the lath house in the spring or summer. Current material in the lath house includes:

(a) One-year-old seedlings from 1957 controlled pollinations of five-needle pines. The hybrid P. strobus x P. griffithii has shown vigorour growth to date.

(b) Grafted sugar maples: (1) birdseye selections from the Lake States (USFS); (2) sugar selections; (3) twin grafts (high and low sugar content) for study of rootstock effects.

(c) Some grafts of five-needle pines of Section Cembra, grafted on P. strobus.

(d) White pine seedlings from several native Ohio sources, growing in flats.

(e) Shortleaf pines of five northern origins, subjected to several durations of chilling period prior to most recent growing season.

(f) Potted white pine rootstocks for greenhouse grafting in 1959-60.

B. Hotbed. Used for conditioning rootstocks during early winter, prior to grafting, and for winter storage of lath house material (bottom heat from electric heating cables).

C. Seedbeds. Used for small lots of seed for greenhouse and field tests, including seed-source material, exotics, hybrids, etc. Larger numbers of seedlings of six sources of shortleaf pine are currently at Zanesville State Nursery. The only research material now in beds includes seedlings of sugar maple of Minnesota origin, for addition to field plots.

Lining-out Nursery

Rows	Identity
1-2	Residual 1954 sugar maple provenance stock.
3-4	Grafted sugar selections of Acer saccharum.
5-6	Pinus strobus, 4-year-old seedlings, seed origin Rabun County, Georgia.

Rows	Identity
7-8	1959 sugar maple phloem inversions, 3 treatments.
9-18	1958 white pine phloem inversions, 6 treatments.
19	Sugar maple - open pollination seedlings of Ohio sugar tree #358 (ay. sugar content 4 to 5 percent).
20-33	Ontario provenance collections - sugar maple 256-260 Sylvan Valley, Algoma District. 261-264 Powassan, Parry Sound County. 266-270 Angus, Simcoe County.
34-45	Sugar selections of Acer saccharum, origin Williamstown, Massachusetts.

Old nursery north of oak genotype plantation includes:

(1) 1 row 1959 sugar maple phloem inversions, 3 treatments.

(2) 2 rows Norway spruce selection for form and vigor (from Iowa).

(3) 2 rows Sugar maples from 1956 controlled pollinations to test inheritance of sugar content.

(a) crosses

(b) selfs

(c) open pollinations

Oak Genotype Plantation

This plantation is a replicate of similar tests in Pennsylvania, Delaware, Connecticut, and elsewhere. Seed was collected by cooperators and sent to the Morris Arboretum in Philadelphia, Pennsylvania for the establishment of an oak collection, known as the Michaux Quercetum. Through the informal cooperation of the Northeastern Forest Experiment Station, which participated in the study, the most complete set of these collections outside of the Philadelphia area was obtained for the Secrest Arboretum.

The objective of the test is to obtain information on genetic variability within numerous species of American oaks. These plots are not complete enough to be considered "seed-source" tests or race studies, but may be expected to show something of the range of diversity in both taxonomic and non-taxonomic characteristics of each species. Considering the range of northern red oak, for example, it is probable there is no such thing as a "typical" red oak. Red oak will show great variation when population samples from various parts of the species range are grown in one locality. There is a growing awareness that an arboretum as a living archive for study and identification must take this into account. It also provides basic information necessary for future genetic selection and breeding.

A total of 103 collections of three trees each were obtained for this test, of which 100 have survived to date and are in the plantation. Each collection is a sample from a single mother tree; one or several seed trees were sampled per seed source. The number of collections and seed sources varies with the species, Quercus rubra L. being the most complete with 21 collections.

Early measurements of the 1957 accessions indicate the probability of north-to-south trends in growth cessation and fall coloration in several species.

September, 1959 height measurements of the 1957 accessions yield some initial observations:

(a) Red oak (Q. rubra L.) of 4 widely-distributed geographic sources and 12 seed parents show no appreciable height differences between progenies, means of 3-tree groups ranging from 4.4 to 5.9 feet.

(b) Black oak (Q. velutina Lam.) of 6 sources and 9 seed parents show more variability between progenies than red oak, although a part of this is due to dieback. Black oaks in general only show about half the height growth of red oaks.

(c) Shumard oak (Q. shumardii Buehl.) shows less height growth in southern trees than in northern trees, due to winter injury; 3 to 5 feet is the range of means of the 3-tree collections.

(d) Overcup oak (Q. lyrata Walt.) had up to the time of the tour very good growth and only moderate winter dieback. (Note: during the winter of 1959-60, all trees were killed back to ground level.)

The test is not designed for precise comparisons between species with respect to height growth and other factors very sensitive to environment; factors of this type are more readily compared for different parents and sources within a species.

Mortality has not been high. Greatest mortality to date has been in Q. marilandica and Q. prinoides.

All the above information is quite preliminary but indicative of the possibilities of initial establishment of various selections in northern Ohio. Coupled with results of tests in other regions, useful information should be obtained on geographic range of adaptability of intraspecific selections.

White Pine Breeding Arboretum

This area, at present containing only a few species of grafted pines, will be planted on a wide spacing with as complete as possible a collection of grafted species and cultivated varieties of soft pines of the closely-related group known as Section Cembra.

The trees will be used for later controlled intercrossing to produce hybrids of various species and varietal combinations. Because the grafted scions were mostly taken from mature trees, flower production will begin in a relatively few years (In fact, some of the grafted trees have already produced flowers in the greenhouse.).

Whenever possible, more than one clone is being obtained per species. Also, in the future, effort will be made to obtain scion material of known geographic origin. To date, all understocks have been Pinus strobus.

A list of species and cultivars grafted to date follows. A few have not survived; most have not yet been planted out.

Pinus koraiensis Sieb. & Zucc. - Korean pine
" cembra L. - Swiss stone pine
" " sibirica Loud. - Siberian stone pine
" pumila Reg. - Japanese stone pine
" flexilis James - Limber pine
" armandii Franch. - Armand pine
" ayacahuite Ehrenb. - Mexican white pine
" parviflora Sieb. & Zucc. - Japanese white pine
" " pentaphylla Mayr.
" " glauca Beiss - Silver Japanese white pine
" peuce Griseb. - Macedonian pine
" griffithii McClelland - Himalayan pine
" monticola Lamb. - Western white pine
" strobus L. - Eastern white pine
" " fastigiata Beiss. - Fastigiate white pine
" " compacta
" " densa
" " nana Carr - Dwarf white pine
" " pendula - Weeping white pine
" " pumila
" " umbraculifera Carr - Umbrella white pine

Sugar Maple Geographic Source Test

The oldest of the sugar maple provenance plots, this test was started in 1954 with seedlings averaging three feet in height, and includes several geographic origins not in the seed-source tests (see map on source data sheet). Although including only six trees per origin, the plot has yielded a considerable amount of statistically-valid information on difference in onset of spring growth, duration of shoot growth, time of growth cessation, fall coloration, and of leaf fall. This information, supplementing data from the more inclusive seed-source plots, has provided a detailed picture of range-wide patterns of variation in these physiological responses.

Since the duration of seasonal growth influences total height growth, the trees of southern origin, which have the longest growing season at Wooster, also have had a larger output of total stem growth, although this may be distributed over many stems rather than concentrated in a single main shoot and its laterals. Five-year growth records of single-stem trees in the plot show that of the 15 trees continuing growth beyond August 1 (1955), every tree had a total height increment of more than 8 feet. Among trees which stopped growth prior to August 1, only 8 of 28 exceeded 8 feet in total height growth.

Northern trees in the plot are the first to break bud in the spring, the first to stop growth in the summer, the first to show fall foliage coloration, and the first to drop their leaves. Southern ecotypes remain green until heavy frosts in November. The most extreme southern and southwestern selections retain the leaves all winter. Leaves of Oklahoma trees are retained until bud break. The trends are continuous from northern through southern trees.

The very bushy trees are of the floridanum subspecies, which intergrades into saccharum. There are some trees of the nigrum subspecies, which also shows introgression in parts of its geographic range. The diversity of forms includes one tree showing a distinct columnar habit and high vigor.

The plot is proving to be quite useful as a means of rapid evaluation of racial variation, supplementing or preceding intensive study in the larger areas. It will also be of value for selection of types for ornamental purposes.

Scotch Pine Christmas Tree Selection Test

(Tour stop speaker: John Hacskaylo)

Fifteen nursery selections of Scotch pine were planted in the spring of 1955 to compare the rates of growth, color of foliage during fall and winter months, and form with regard to Christmas tree production. Five additional selections of Scotch pine were planted in the spring of 1956.

Fifty trees of each source were planted in two rows on a 4-foot spacing. One row was sheared and the other remained as a control.

The foliage of trees of "Riga", Central Swiss Alps, Austrian and Polish sources becomes yellow during the fall and winter months. The French and Spanish selections, and some commercial selections including "Nye Branch", "Nodwell", "Pine Hill", "Musser's Special" and "Van's Green" remain green during the fall and winter months.

The average rates of growth are comparable for most of the trees, except the French, "Booneville", and "Van's Green", which are lower. The trees which seem to have the best form as a result of shearing are "Nye Branch", "Nelson King", "Van's Green" and "Booneville". The French strain has a slow rate of growth and quite a crooked bole. The Spanish selections are susceptible to winter damage in the Wooster area. Ninety percent of the trees had foliage that turned brown due to severe winter injury last year.

It is recognized that this block is not a critical study of Scotch pine sources but it has been valuable to Christmas tree growers by allowing them to make a comparison of available commercial seedling sources.

Black Locust Selections

These small plots were planted in 1958 as 1-year-old rooted cuttings for an initial test and demonstration, to be followed by a more extensive randomized replicated experiment tentatively scheduled for planting in the spring of 1960. The latter will be one of a series being established in different regions under the overall initiative of the Soil Conservation Service.

			Characteristics of original stand or subsequent plantings*		
OAES Accession Number	Beltsville No.*	Source*	Apical Dominance	Vigor	Freedom from Borer Injury
490	8470	Bryantsburg, Ind.	High	High	High
491	4191	Blackwood, Va. (cv. "Appalachia")	High	High	Unknown
492	4192	Bartow, W. Va.	High	High	Unknown
493	4193	Townsend's Draft, W.Va.	High	High	Unknown
494	4194	" " "	Intermediate	Intermediate	Unknown
495	8295	Bryantsburg, Inc.	Low**	High	High
496	8316	Unknown (nursery selection)	High	High	High
497	8449	Bryantsburg, Ind.	High	High	High
498	8450	" "	High	High	High
499	8452	" "	High	High	High

*Information supplied by W. W. Steiner, Plant Materials Technician, Soil Conservation Service, Upper Darby, Pennsylvania.

**Very good form in closely-spaced stands.

A Prostrate Mutant of Black Locust

The following description has also been published in 1960 with illustrations, in the Journal of Forestry (V.58(3), p.222).

"A prostrate specimen of black locust(Robinia pseudoacacia L.) was recently discovered in Ohio and propagated from root cuttings in 1958 at the Ohio Agricultural Experiment Station. The tree is quite procumbent, as shown in Figure 1. Ramets obtained from the tree exhibit the same form characteristics as the tree from which they were taken (Figure 2).

The tree was discovered by Robert Mingus of the Ohio Division of Reclamation in a young strip-mine spoil bank plantation of black locust on land of the Ohio Power Company near East Fultonham, Ohio. No flowering or fruiting has yet been observed. The tree was planted as a seedling and was about five years old at the time the photograph was taken.

Several form variations of the species are listed in the literature (1), (2) but the writer has been unable to find any published report of a prostrate mutant. No other distinguishing characteristics have yet been noted.

The prostrate form has aroused interest because of its possibilities for use on strip-mined areas. Black locust is the primary species planted on these areas and is used in mixture with other more valuable hardwoods because of its high survival capacity and its leguminous characteristic of nitrogen fixation. However, it soon overtops the other species and becomes an inhibiting factor. A low-growing form of locust would eliminate this problem if it could be satisfactorily propagated. It might also be useful on other areas where a low-growing form of plant is desirable.

Since the mutant is a cultivated variety (cultivar), of lower rank than species, it can be considered to fall within the province of the new International Code of Nomenclature for Cultivated Plants, as formulated in 1953 and modified in 1958(3). This code has been adopted by botanists, agriculturalists, and foresters, and is in full agreement with the International Code of Botanical Nomenclature (4).

Although it was previously the practice to give Latin epithets to plants in cultivation, the new code for cultivars requires that the name must be in a modern language rather than Latin. For purposes of identification therefore, the mutant will be designated as the 'Ohio Prostrate' black locust, or in formal terms, *Robinia pseudoacacia* 'Ohio Prostrate'."

Literature Cited

(1) Rehder, Alfred, 1949. Manual of cultivated trees and shrubs hardy in North America. Second ed. The Macmillan Co., New York; xxx + 996 pp.

(2) Kelsey, Harlan P. and Wm. A. Dayton. 1942. Standardized plant names. Second ed. American Joint Comm. on Hort. Nomencl. McFarland Co., Harrisburg, Pa. xvi + 675 pp.

(3) International Code of Nomenclature for Cultivated Plants. 1958. International Union of Biological Sciences, Utrecht. 28 pp.

(4) International Code of Botanical Nomenclature. 1956. International Association for Plant Taxonomy. Utrecht. 338 pp.

Controlled Pollination of Soft Pines

Species hybridization may achieve useful results in several ways. Some of these are:

(1) A tree species valuable for its timber characteristics but lacking in resistance to a point disease or insect pest may be combined with a closely-related resistant species to produce a hybrid including all the desirable characteristics.

(2) A species desirable for a certain region from a forestry standpoint but lacking in winter or summer hardiness may be combined with a hardy species to produce a hybrid adaptable to the region.

(3) Two related but geographically- or ecologically-isolated species may when crossed yield a progeny showing hybrid vigor (i.e. greater vigor than either of the parent species show when grown in the same locality).

Two methods are available for production of hybrid seed in commercially-usable quantities.

(1) Direct utilization of F1 or first generation hybrid seed produced by hand-controlled pollination if viable seed yields are fairly high, or by open pollination if trees are isolated from others of the same species.

(2) Utilization of the F1 generation as an intermediate for the production of F2 generation hybrids in seed orchards by open pollination or by controlled pollination, often through a backcross with one of the parent species.

Eastern white pine is by far more extensively planted for timber in Ohio than any other coniferous species. It is also used very extensively in other neighboring states. It is very adaptable and at present relatively pest-free in this region. However, silvicultural experience in other regions where white pine has been planted very extensively for a longer period indicates the hazard of too great a reliance upon a single species. Extensive plantations of one species pave the way for the build-up of a pest such as the white pine weevil, sawfly, or blister rust. It seems therefore desirable to augment our planting stock with additional species and hybrids, providing they are adaptable in the region. Through hybridization of closely-related species with the versatile Pinus strobus, genes for resistance to pests may be incorporated into hybrids with all the desirable wood properties of eastern white pine.

Species of soft pines available in the Secrest Arboretum for use as seed parents include:

P. <u>strobus</u> L.
P. <u>flexilis</u> James
P. <u>griffithii</u> McClelland
P. <u>parviflora</u> Sieb. & Zucc.
P. <u>koraiensis</u> Sieb. & Zucc.

Of these five, only the first four have flowered during the past four years, and the specimen of P. <u>parviflora</u> has produced few flowers.

The following table shows species and varietal crosses tried during 1957, 1958, and 1959 at the Ohio Agricultural Experiment Station.

	Male Parent													
Female Parent	koraiensis	cembra	pumila	albicaulis	flexilis	armandii	lambertiana	ayacahuite	parviflora	parviflora glauca	peuce	griffithii	monticola	strobus
flexilis		X			X		X		<u>X</u>	<u>X</u>	<u>X</u>	X	<u>X</u>	X
parviflora					X				<u>X</u>			X		X
griffithii		X		<u>X</u>	X		X		X	X	<u>X</u>	X	X	X
strobus				X	X		X		X	X	X	X	X	X

Underlined attempted crosses have not been reported in the literature

Only 1957 seed has yet germinated and yielded seedlings, since two growing seasons are required for seed maturity. The 1957 pollination program was relatively small, involving only local species. The following combinations were obtained from the 1957 species crosses:

P. <u>strobus</u> x P. <u>flexilis</u> - probable hybrids

P. <u>strobus</u> x P. <u>griffithii</u> - hybrids

P. flexilis x P. <u>strobus</u> - 1 seedling died after 3 months, hybridity uncertain

Several hybrids can be expected from the later crosses, none of which have yet been field tested in Ohio. Future breeding work will concentrate on species crosses using specific geographic origins wherever possible, also interracial crosses and individual selections.

Sugar Maple Provenance Tests

A. Height growth. Of the 30 seed sources in plantation L-15, the selections having the greatest average height as of September 17, 1959 are those from central and southern Illinois and from Ohio. The trees from central Illinois (McLean County) have shown generally good form and consistently good vigor throughout the first six years of the test. This is also true of trees of this source in the "seedling source" test (Plot H-5). Poorest growth to date is shown by trees from the northeastern and west-central (Iowa, N. Illinois) parts of the species range.

B. Survival. Drought resistance has been the most important factor affecting survival. Winter hardiness has not been a factor; even the most southern trees have been remarkably winter-hardy, although moderate dieback can be seen in Plot L-16 among the *floridanum* trees. Variation in drought resistance follows racial patterns; trees from seed originating in the Northern Hardwood forest region are more susceptible to drought than are trees from the Central Hardwood region or from the Gulf Coastal Plains.

Trees from southern Illinois exhibit a remarkable combination of drought resistance, winter hardiness and vigor. Form is generally poor in this type, although there are selection possibilities, since some trees have single stems.

C. Future applications. Planting of sugar maple will become a more practical proposition than it has been in the past if high survival rate can be obtained along with good form and vigor. To a considerable degree this can be accomplished by selection of the proper geographic sources of seed. It can be accomplished to an even greater degree later by single-tree selection *after* seed-source selection. Although additional provenance plots are needed in other regions, by identification of racial patterns these tests in northern and southern Ohio are defining regional genetic characteristics which are correlated with climate of the seed source and will be applicable over a wide geographic area. Certain important characteristics, such as wood quality, have not yet been studied. Given a genetic selection of sufficient value on a "per tree" basis, planting of sugar maple is likely to be a much more profitable proposition in the future than it has been in the past.

Sugar Maple Seed Orchard

This plantation is designed to include 20 clones of sugar maple selected for high sugar content of the sap. At present it is less than 50 percent stocked with selected trees, although most rootstocks are established for future field grafting. It originally included 19 clones when planted in April 1958, but this number is now down to 15 due to early mortality. It includes grafted trees from the 1956-57 greenhouse and field grafting programs, and some clones budded in 1957. Mortality was highest among budded trees.

The plantation includes 10 trees per clone, and is laid out in a 30' x 30' triangular pattern, using the systematic design described by Langner (Zeitschr fir Forstgen. 4:81-88) as applied in some German seed orchards. Characteristics of the design are (1) equal distance between a tree and all those adjacent to it, and (2) wide isolation of individual members of any particular clone, to avoid self-pollination, since evidence indicates a relatively high degree of self-fertility in Acer saccharum.

The selections include many of the highest-yield sugar trees in the United States for which long-term records are available. Every selection is based on records of sugar content taken several times a season over a period of several years. Testing is easily accomplished by applying a drop of fresh sap to a hand refractometer, which reads directly in percent "brix" (percent solids or in practical terms percent sucrose).

The heritability of "sweetness" of maple sap has not yet been proved. Environmental factors, including ample growing space for development of a full crown with large photosynthetic surface, seasonal and short-term fluctuations all cause variability in yield. The relation of vigor to yield is not clear. In spite of environment fluctuation, long-term records show that certain trees test consistently higher than other trees. This is true in forest stands as well as among open-grown trees. In order to test heritability, we have made controlled crosses of trees of high, low, and intermediate sugar content, as well as selfing the trees. In addition, double grafts of scions from high and low yield trees on a single rootstoxk will provide further evidence - not of heritability, but of the inherent capacity of the parent tree to yield sweet sap under varying environmental conditions. All available evidence points to the probability that sweetness of the sap is inherited.

The relationship of geographic origin to sugar content is also being tested in Plot H-5 as trees reach sufficient size for sap extraction. There is a possibility of racial variation.

The trees in this seed orchard, being grafts, may start bearing seed at an earlier age than would seedlings. They will be allowed to intercross by open pollination.

In grafting sugar maple, the type of graft is not a critical factor. In a complex test of factors affecting success of grafting, vigor of the scion was found to be the most important factor. Greenhouse grafts made in late winter or early spring and spring field grafts have been the most successful. Our budding has not been as successful as the grafting.

White Pine Seed-Source Tests

Plantation AC-2 is a test of white pine (Pinus strobus L.) of 16 seed origins. The test is being made in cooperation with the Central States Forest Experiment Station, USFS, which furnished the planting stock. Other similar tests have been established in various parts of the Central States region. In turn, the Central States program is a part of a larger, range-wide study of geographic variation in _Pinus strobus_ being conducted through the joint efforts of the Northeastern, Southeastern, Lake States, and Central States Forest Experiment Stations, the Ontario Department of Lands and Forests, and several state agencies.

The range of eastern white pine extends from southern Canada to Georgia and from the Maritime Provinces to Iowa. A wide genetic variability is therefore probable and indiscriminate planting without regard to seed origin is no longer advisable. Experience has shown that failures are often the result of improper selection of seed source, and such failures or relatively poor results can be costly. Nor can it necessarily be assumed that a local source is necessarily the best for seed, although this is often the case. Proper seed selection requires knowledge of racial variation, and geographically-replicated plantations indicate performance of each selected source throughout various parts of the eastern United States.

Plantation AC-3 includes trees supplied by the Northeastern Forest Experiment Station, as well as some of the same stock furnished by the Central States Station. There are trees of 15 sources from stock grown in Beltsville, Maryland and 16 from the stock used in Plantation AC-2 and grown in Asheville, North Carolina. Eight sources are common to both nurseries. Thus there are 23 seed origins and 31 treatments, and the experiment includes a comparison of effect of nursery on growth.

Initial effect of nursery was quite evident. Stock from the Beltsville nursery was fully twice as large in most cases as stock from the Asheville nursery. Records will show the duration of this initial influence.

The complete randomization design of AC-3 was adopted because there was no indication of site stratification. Randomized blocks, as used in AC-2, are only superior to complete randomization if they can aid in isolating variation due to site stratification. Lacking such stratification (the AC-2 area does show stratification), complete randomization is statistically much more efficient. Also, variable survival rate in the latter is less of a problem in analysis. The additional effort required to lay out and plant an area of this type is considered to be justified in view of the great amount of effort required to collect the seed and raise the nursery stock, while maintaining identities and records, and the long-term nature of the experiment. Actually, planting requires relatively little additional time in comparison with non-randomized or block tests.

McKee Hybrid Poplar
Populus generosa Henry
(P. _angulata_ x P. _trichocarpa_) Strain F

(Tour stop speaker: Oliver D. Diller)

This is a patented clone. Three plantings of this selection were established at this Station in 1947, 1949, and 1951, respectively. This 5-acre plantation was started in the spring of 1951 from unrooted 12-inch cuttings which were planted in plowed ground with a mechanical tree planter at an approximate 8 x 8-foot spacing. Weeds were partially controlled by disking twice during the first growing season. Initial survival was approximately 80 percent.

August, 1959 five 1/10-acre sample plots were established in this plantation. Two plots were thinned on a pulpwood management basis, two were dated for an eventual yield of lumber or veneer, and the fifth was left untreated.

All trees were pruned to 7 feet above ground. Crop trees (170 and 220 per acre) were selected, banded with white paint, and high-pruned to 17 feet on plots No. 2 and No. 5. A later thinning, following crown closure, should reduce the stand to 125 - 175 trees per acre at the end of a 35-year rotation.

An average of all five sample plots, before treatment, shows 462 poplars per acre, with a mean diameter of 4.8 inches, mean total height of 40 feet and a volume of 1,181 cubic feet or 13.1 cords per acre. This represents a mean annual increment of 131.2 cubic feet after nine growing seasons. About one-half the volume was removed at this first thinning.

Clonal Lines of Populus

In 1952, two plantations of poplar selections from the collections of Dr. Scott Pauley, at that time of the Cabot Foundation, Harvard University, were planted in the east end of the bottomland area north of Secrest Road. These trees are rooted cuttings of numerous collections, varying within each of several species with regard to latitude, longitude, and altitude of geographic origin. Several species are represented, including *Populus deltoides* Marsh (eastern cottonwood), *Populus trichocarpa* Hook. (black cottonwood or western balsam poplar), and *Populus tacamahaca* Mill.(balsam poplar).

There are also sixteen seedling collections of several species, all native to North America with the exception of one collection of *Populus maximowiczii* Henry from Japan.

There were originally five specimens of nearly every clone and seedling collection. Some have died, and the remainder show great variation in growth rate between clones. There are far more selections of P. *trichocarpa* in the tests than of P. *deltoides* or other species. Therefore if survival were strictly environmental or random, greater survival of P. *trichocarpa* could be expected, as is the case. It is not possible to evaluate survival accurately, in the absence of plot replication. Growth rate differences may also be entirely environmental, although this hardly seems likely in some instances in which there are striking differences between adjacent plots and fair uniformity within the plot. Form of the trees can be observed to vary greatly with the species. There is also visual evidence of variability in disease resistance.

Some of the clones showing the most vigorous growth have been labeled with the accession number and can be identified by reference to the charts. More complete source data can be obtained for any clone from the Department of Forestry or from Dr. Pauley at the University of Minnesota.