THE MISSOURI TREE IMPROVEMENT PROJECT

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The Missouri Tree Improvement Project was initiated in 1967 with the avowed purpose of improving the quality of forest trees, and stands of trees, grown in Missouri, on all lands, through the application of known genetic principles and techniques.

This project is a cooperative program between the Forestry Division of the Missouri Department of Conservation and the Forest Service of the U.S. Department of Agriculture. The authority for this cooperation is contained in Title IV of the Agricultural Act of 1956. We have one forester assigned to this project on a full-time basis.

The primary emphasis of the program has been the improvement of black walnut (*Juglans nigra* L.). Our nursery people feel that we have a demand for 500,000 black walnut seedlings per year, and we would like to meet this demand with improved strains of the species selected for fast growth, good timber form, and quality nut production in volume. We are attempting to do this through the single-tree selection approach.

So far we have located 120 superior walnut phenotypes in Missouri, 12 in Kansas, 3 in Nebraska, and 1 in Illinois. In addition, we have seedlings outplanted from two trees in North Carolina and from one in Tennessee. We eventually hope to have offspring from superior walnut trees throughout the entire range of the species. Superior tree candidates are selected, located, and cataloged very carefully.

We have outplanted offspring from over 30 of our selected phenotypes, and from several of the improved nut varieties of black walnut, in three half-sib progeny test areas. In addition, we have 22 more selected trees propagated for future outplanting in progeny test areas. These progeny test areas total nine acres so far, and they are located in three different geographic zones of the State. We are adding three more progeny test areas of 8 acres each, in two additional geographic zones, and we hope to eventually have a minimum of 60 acres in 5 different zones.

Our second-year measurements of total tree height and survival have been summarized, but they have not been analyzed sufficiently to be definitive. General observations indicate that southern sources have been erratic in their height growth performances at the three different sites, and northwestern sources seem to have performed well when moved south and east. Survival of all sources has been satisfactory at all the test sites.

As these test trees mature, they should indicate which individuals and families of walnuts are indeed superior. We will rogue the inferior trees from the stands and will eventually have converted these test areas to seed orchards of superior trees for seed production.

The single-tree-selection, progeny-test, seed-orchard-development approach is a long-term program. In order to effect some immediate improvement with walnut, we have taken several temporary steps which we hope will help. These steps are summarized as follows:

1. We currently collect seed by geographic zone, grow the seedlings separately, and ship seedlings back to the local zone whence the seed came.

Concurrently, we have established 6 provenance tests which should help us determine if geographic races of walnut exist within the State. These data will aid us in deciding whether or not gains in growth can be attained by shipping seedlings out of their local zones. These tests are currently three years old, and have yielded some second-year data, but none that is reliable enough for long-range predictions.

Our data do indicate, however, that survival at all tests was adequate to fully stock the site. Local seed survived best in only three of the six tests, poorest in two of the tests, and was average in the remaining test.

Total tree heights were quite variable, and some statistically significant differences were found. We are hesitant, however, to put a lot of reliability in differences among these two-year-old trees. For the characters measured thus far, no definite north-south clinal growth pattern has emerged. There is some suggestion of an east-west clinal pattern and the southwest prairie area seems to produce shorter trees in all zones. We will have to wait for the trees to grow some more in order to obtain more reliable data.

2. We have distributed some improved walnut stock, although we don't know just how much better it is, because heritabilities of traits under study are not known. We have developed three seed production areas (SPA's) in existing walnut stands. These total 20 acres, and we collect seed from them whenever there is a crop. In addition, we grade-out the largest 0.1 to 1.0 percent of the regular nursery seedlings and call them super-sized seedlings. These larger seedlings do seem to grow better than smaller seedlings, and there is some improvement. However, we do not purport these "supers" to be genetically superior; rather, they are just significantly larger after one year in the nursery. We usually have 5,000 to 10,000 "super-sized" seedlings and about the same number of SPA seedlings available for distribution each year. We hope to increase these amounts in the next few years.

The second most important activity conducted by the tree improvement forester is to help the nursery supervisor procure seed for all species grown at the nursery. The objective is to get seed from as good a source as possible for each species, and it helps to have

two heads working on these decisions when you are trying to grow about 40 different species among an annual production total of 12 to 14 million seedlings. We feel that our seed procurement program has been greatly improved since the Missouri Tree Improvement Project was initiated.

We are trying to improve our native shortleaf pine *(Pinus echinata* Mill.) by establishing SPA's throughout its range in Missouri. We have over 200 acres of SPA's in various stages of development, but we have not collected cones from any of them yet.

We have established eight shortleaf pine provenance tests throughout the Missouri range of pine in order to see if any racial variations exist. These tests are being measured and analyzed, but we don't have data old enough to be completely reliable. Most of the tests are only two years old, but we do have fourth-year results available from one test. The second-year results are not very definitive. Survival appears to be adequate, and total height has been quite variable between provenances. Some were found to be statistically significant.

The fourth-year results indicate that there are definite geographic differences in total tree height at this time. Also, good phenotypes continue to produce the tallest progenies. The southern provenances seem to be doing better than other sources, but not significantly better than a northern source that came from a U.S. Forest Service SPA. Although we can make some recommendations for the area represented by this test, we are not making complete recommendations for seed collection and seedling distribution zones for Missouri until we have reliable data from all the provenance tests.

In another major activity, we are attempting to gather material from proven clones of eastern cottonwood *(Populus deltoides* Bartr.) for production and distribution of cuttings. To date, we have selected 78 Missouri trees of this species for clonal testing. We have established two such tests in the last two years, but have lost both plantings—one to drouth and weeds, one to a flood. Most of our cottonwood work is done in cooperation with the Southern Hardwoods Laboratory of the U.S. Forest Service at Stoneville, Mississippi. We are hoping eventually to have 15 to 20 good clones for planting in Missouri, with selection based on tests of several thousand clones from Missouri, Stoneville, and elsewhere.

There are a host of minor activities in our total tree improvement efforts. For example, we have developed SPA's for several minor (i.e., to our program) species such as eastern redcedar *(Juniperus virginiana* L.), European black alder *(Alnus glutinosa* [L.] Gaertn.), jack pine *(Pinus banksiana* Lamb.), Virginia pine *(Pinus virginiana* Mill.), and autumn olive *(Elaeagnus umbellata* Thunb.). Other minor activities of some substance are the location and cataloging of superior phenotypes of all native species, seed-source improvement of stands which are to be naturally regenerated, suggesting ways of improving the nursery handling of seedlings, and the development of vegetative propagation techniques for walnut.

In the near future, we hope to initiate projects in (1) pecan *(Carya dlinoenth* [Wangenh.] K. Koch) provenance testing and SPA establishment and (2) development of anthracnose-resistant strains of American sycamore *(Platanus occidentalis* L.).

In our tree improvement activities, we always attempt to cooperate fully with other states, universities, and federal agencies who might be doing similar work.