TREE IMPROVEMENT IN THE GREAT PLAINS

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It was not long ago at Watertown that you gave me an opportunity to speak on this subject. I'm not sure how many new and significant things can happen in the field of tree improvement in just 4 years, but I will try to justify the use of 20 minutes of your time.

First, I'd like to bring you up-to-date on changes in personnel in tree improvement at various locations, so you will know whom to contact for advice. In this connection I'll also give a brief resume' of the species and phases of tree improvement research that are being tackled at each location.

Second, I'll give a status report on two of the major region-wide thrusts in tree improvement. The new region-wide study of two junipers--Eastern and Rocky Mtn.,--and ponderosa pine provenance study which was established 10 years ago in most states of the Plains region.

Third, I'd like to speak about an operational aspect of nursery management that is too often neglected--the documentation of seed origins, as the nurseryman's responsibility in the tree improvement effort.

PERSONNEL AND RESEARCH PROJECTS

Bottineau, North Dakota-- the Forest Service research unit here, lost Rich Cunningham as geneticist, and Jack Stein as entomologist, and neither have been replaced. Dick Tinus, is the project leader at this location, and concentrates his research in greenhouse-container systems for which he is nationally known. He is also involved in mycorrhizal tests of container and nursery stock, with assistance from Jerry Riffle, pathologist at Lincoln.

Jim Van Deusen, research forester is conducting the selection and breeding in Scots pine and green ash; and selection in older (40 year-old) ponderosa pine, Siberian larch and spruce plantations, which are being converted to seed production areas. He also is responsible for maintaining provenance plantations of ponderosa pine, blue spruce and green ash.

Mary Ellen Dix, entomologist is working on the biology of several important insects; in particular a pitch nodule moth (Petrova) which injures branch tip buds of ponderosa; and a cone seedbug (Leptoglossus) which damages seed of Scots pines, and therefore can reduce seed yields in orchards or seed production areas. We at Lincoln are cooperating with her on a study to control this insect in a Scots pine breeding plantation.

Mandan, North Dakota--The Agricultural Research Service has recently added a new position in tree improvement. Richard Cunningham, geneticist, is now on the job there, and beginning research in selection and breeding of elm species. Other trees of high priority at this center are poplars, junipers, ponderosa pine, jack pine and bur oak. In addition, Rich has the responsibility to follow up on the earlier small plot tests of species which were established at the Station over the past 50+ years. Some of the species introductions can now be given long-term evaluation, and this should assist in determining possibilities for future tests.

Bismarck, No. Dakota--The Soil Conservation Service maintains a Plant Materials center here for the Northern Plains. Erling Jacobson is the specialist in charge, and can be consulted on the performance of tree and shrub species selected for special traits for windbreak and wildlife habitat purposes.

Montana and Wyoming--I have no information concerning tree improvement research in the Plains portions of these states. The area is considered to be within the territory of the research center at Mandan, and of course much of it is also covered by research projects related to reclamation of strip mine activity. The Soil Conservation Service at Bridger, Montana has indicated interest in the regional juniper improvement research, and is planning to establish a field test of selected sources for this portion of the Plains.

Brookings and Watertown, So. Dakota--At South Dakota State University, Paul Collins and Norman Baer have projects in tree improvement, and Jack Otta is researching tree diseases.. Research here has developed hybrids of Siberian and slippery elms, which grow faster than progeny of either parent. Provenance tests of green ash and hackberry are well established, as is the ponderosa provenance test at Watertown. Fred Kruger and Jim Suedcamp with State Forestry at Watertown are cooperating with Baer and Collins on the ponderosa pine study.

Lincoln,Nebraska--The Forest Service unit has two scientists on tree improvement research-- Dave Van Haverbeke and myself. Our research is concentrated on improvement of conifers, including introduction of new species from worldwide sources, provenance tests, clonal propagation of selected trees for seed orchards, and selection, breeding and progeny testing of new combinations for adaptability and growth and disease and insect resistance. Ponderosa pine and the junipers are the major thrusts in our research at the present time, but past work has evaluated other conifers, such as red pine, jack pine, limber and southwestern white pine, eastern white pine, Douglas-fir, Japanese larch, pitch pine and blue spruce.

Walt Bagley of the Univ. of Nebraska has concentrated tree improvement research on broadleaf species, such as red oak, hybrid poplars, cottonwood, hackberry, green ash, white ash, bur oak and sycamore.

The tree disease project at Lincoln has two scientists, Glenn Peterson and Jerry Riffle. This project is concerned with diseases of conifers and broadleaves; in studying the biology and control of the most devastating diseases in nurseries and established plantings, over the entire region of the Plains. Peterson's work in connection with the Austrian pine provenance test has revealed evidence of disease resistance, in which the seed origin from Yugoslavia is resistant to Dothistroma needle blight. Work with this blight is also being conducted in ponderosa pine seed sources (a separate planting for this purpose). Ponderosa source plantations are also being studied with reference to spread of western gall rust from previous infection in a nursery. Riffle's work with mycorrhizae is an extremely important aspect in nursery and container production of planting stock for use in Plains grassland soils. His work extends from the Lincoln-Oakes nursery in No. Dakota to Albuquerque, New Mexico.

Bill Lovett, tree improvement specialist with the Nebraska Dept. of Forestry, is carrying out the application of research findings to the action program, and is involved in establishment and maintenance of seed orchards and propagation of selected materials for that purpose.

As mentioned in a previous talk at Watertown, I insist that we give much credit for the wealth of research planting materials available in Nebraska and Kansas, to the organization known as NC-99, the regional Tree Improvement committee of the Northcentral States Agricultural Experiment Stations. This was organized in 1959 under the leadership of Dr. Jonathan Wright, Prof. of forest genetics, Michigan State University. This project continues into its second decade of activity. Jon Wright has written a textbook entitled Introduction to Forest Genetics, which I recommend to you, for a better understanding of this important field. It is a well-illustrated, and well-written, uncomplicated text, and is available from Academic Press, Inc. III Fifth Ave., New York, N.Y. 10003 at $19.00.

Manhattan, Kansas-- Kansas State University is at present without a tree improvement scientist. Fred Deneke formerly in that position is now with the State & Private branch of the Forest Service in Denver. However I understand a new man will be filling the Kansas position by November. Research here includes provenance tests of ponderosa pine, Scots pine and green ash; selection and propagation of black walnut and cottonwood; and some tests of pine species. Hugh Thompson,in the Dept. of Entomology has accomplished very important studes of tipmoth in the ponderosa pine provenance test in Kansas. His research in the last 5 years is the only concentrated work in the Plains dealing with this pest of young pines.

Also at Manhattan is a Plant Materials Center of the Soil Conservation Service, where tests of selected broadleaf trees and many tests of selected shrubs are being conducted, under leadership of John Dickerson.

Stillwater, Oklahoma-- Tree improvement research at Oklahoma State University is under direction of Chas. Tauer, professor of forest genetics in Department of Forestry. Research in the genetics of southern pines--shortleaf and loblolly is of major importance to eastern Oklahoma, but I often wonder why it isn't extended to include the Southern Plains. Provenance tests include ponderosa pine which is located at the Oklahoma State nursery near Norman. Bob Gardner of the State Forester's organization has been very active in keeping up with performance in that plantation. Cottonwood variation and selection are also important research projects at Stillwater.

R. D. Eikenbary, of Entomology Dept. is conducting research on tipmoth and cone and seed insects, mostly in relation to seed orchards of southern pines.

College Station, and Lubbock, Texas--Tree improvement research at Texas A&M and the Texas Forest Service has been a strong program for 20 years but aimed at the timber producing areas of east Texas, not the Plains. In the past 5 years, emphasis has been put on Plains needs, and Bill Lowe at A&M and Bob Fewin at Lubbock are the major contributors to this work. Some testing of pine and broadleaf species has been initiated at Lubbock.

Ft. Collins, Colorado-- Tree improvement at Colorado State University is under the guidance of Gil Fechner, prof. of forest genetics. Research here includes studies of genetic variation and morphology of flowering in blue spruce, and in flowering and pollination of junipers. Some tests of Northeastern Station (Schreiner's) hybrid poplars have also been conducted.

Los Lunas, New Mexico--A Plant Materials Center of the Soil Conservation Service is active at this location, and is under leadership of Larry Hamilton. Work is mostly with shrubs, three-leaf sumac, Euonymous and Russian-olive.

STATUS OF JUNIPER AND PONDEROSA STUDIES

Juniper Improvement for the Great Plains

In fall 1973 a Technical Committee known as GP-13, and composed of tree improvement people from each of the 10 states in the Great Plains, organized to initiate a regional project. After getting the opinions of all forestry people in each of the states, this committee concluded that the junipers--eastern and Rocky Mountain--represented the high priority concensus on research that was needed. Reasons were: (1) the extensive use of these species in practically all states, (2) the fact that genetic variation and selection has not adequately been exploited in these species, and (3) the fact that only one and the same seed source has been used for over 20 years in the action program.

Dave Van Haverbeke, tree improvement scientist at Lincoln who studied the taxonomy of these species, agreed to write a Study Plan for regional use. This plan, approved by the committee after considerable discussion, provided for seed collections from individual trees of specially good form and other traits, in various zones throughout the Plains region. The zoning system used was that developed by Richard Cunningham, as another part of the GP-13 Technical Committee's work for the Great Plains Council. ReferenceisProvisional Tree and Shrub Seed Zones for the Great Plains, U. S. Forest Service Research Paper, RM-150 available from the Rocky Mtn. Forest Expt. Stn. in Ft. Collins, Colo.

Objective of the study is to identify the best adapted individual tree seed sources for planting over a wide and diverse range of sites in the Plains. Seed were collected 1974 through 1976, from 5 of the best trees in each of about 40 zones; collections were made by many different cooperators, and all seed sent to Lincoln. Quite a few of the seed lots of Rocky Mountain juniper had to be recollected because of low seed quality and insect damage. Even after recollection, there are a number of seed lots which will not yield enough seedlings for field testing.

All Rocky Mountain juniper seed are being stratified 6 months. Eastern juniper seed are frozen and with the Rocky Mountain, will all be sowed at the same time this August, at Bessey Nursery. Over 3000 linear feet of bed space is being provided by the Forest Service for this purpose.

Ponderosa pine provenances in the Great Plains.

This study which contains progeny of 79 seed sources, 71 of which are east of the Continental Divide in Montana, No. Dakota, So. Dakota, Wyoming, Nebraska, Colorado and New Mexico, was established in field plantings in 1968. It is one of the largest established studies in content of natural stand seed sources of the scopulorum variety (east side) of ponderosa pine, anywhere in the country. Plantations are located at the State Nursery near Norman, Oklahoma; at Milford, Kansas; at Plattsmouth, Hastings, Halsey and Alliance, Nebraska; at Watertown (Big Sioux Nursery) So. Dakota; at Towner Nursery in No. Dakota; at Morris and Lamberton,Minn.; at Indianhead Nursery, Saskatchewan; at Drumheller, Alberta; at Columbia and Springfield, Missouri; and in Michigan and Pennsylvania.

Seed were collected for this study in 1962 to 1964, and the stock was grown at Bessey and Towner nurseries 1965 through 1967. Performance and various other seedling traits were measured for 3 years in the nursery. Analysis of those data has indicated certain patterns of geographic clustering, which provides new information on the genetic variation to be expected in the eastside populations of ponderosa. This analysis confirmed the existence of var. scopulorum eastside, as distinct from var. ponderosa west of the Continental Divide in Montana. It also confirmed a distinct genetic difference between the southwestern ponderosa of New Mexico and Arizona, and all other ponderosa to the north. The clustering pattern will be tested in the analysis of field performance.

At 5 years age (1972) the tree heights in most all plantations were measured and analyzed. We found that certain seed sources showed superior height growth, in nearly all plantations. They grew as well or better in all plantations, as some other seed sources even closer to the planting site. These results however must be considered tentative until they can be substantiated by the 10-year performance which is being measured this fall. If the results indicated by the 5-year data hold up through the 10 years, I think we will be in good position to recommend very specific seed collection locations, to obtain better planting materials than we now use, for faster growth and even for improved ability to tolerate tipmoth insects.

DOCUMENTING SEED ORIGIN

"Recognizing that trees and shrubs vary in branch habit, rate of growth, resistance to cold, drought, insects, diseases, and in other attributes which influence their usefulness and local adaptation for various planting uses, and that such differences are largely of a genetic nature,---it is the policy----:

1. To use only seed of known locality of origin and nursery stock grown from such seed.
2. To require from the vendor, adequate evidence verifying place and Year of origin of all lots of seed or nursery stock purchased.
3. To require an accurate record of the origin of all lots of seed and nursery stock used in forest, shelterbelt and erosion-control and other plantings. Minimum required record for each lot is:
   1) a lot number- year of collection
   2) species name
   3) place of origin: State, County, Locality, Elevation range".

What I have just quoted was written in 1936, and is part of a Handbook prepared by the Forest Service and used on the Prairie States Forestry Project (The Shelterbelt). The reason I've quoted this is to emphasize that Plains tree planters recognized the importance of documenting seed origin 40 years ago. This policy of course is as valid today as then.

This documenting of seed origin, is every bit as important a part of the nurseryman's responsibility, as is the labelling with the correct species name. Many of you have heard me expound on this before, and I do not intend to let up. Research is showing time and again that the place of seed collection is important--that survival and performance capability depend to a large extent on seed origin. The inescapable .conclusion is that in order to improve tree planting success, we must know what seed origins we're dealing with. Without that information we are back in the dark ages, doing things without knowing why-- just guessing. That's not good enough.

A case in point--not too long ago I observed nursery beds of 2+0 blue spruce seedlings. All were the same age, yet some of the beds averaged at least twice and maybe triple the height of the other beds. The difference was that these were 2 different lots of blue spruce seed. What was the seed source of these faster growing spruce? No one knows where they were collected--? The slow growing spruce was known only that it came from a certain State--a State containing 104 thousand square miles: This is not only a frustration to tree improvement people, but also should be an embarrassment to nurserymen.

How are we going to find and continue to produce new and better plant materials without keeping records of where the seed originates? And of course it works both ways. We'd like to know where the best materials come from in order to perpetuate and use them. But we'd also like to know where the slow growing or pest susceptible materials come from, in order to avoid using them again.

We can and must do a better job of maintaining seed origin identification records of planting stock. This is an operational aspect of nursery management which ought to be as automatic a procedure as listing the species name. In fact, the origin designation can be as simple as you wish to make it. It can be your own code number based on a grid you have devised; it can be a zone number; or better yet it can be 7 digits added to the species name. The first 3 digits stand for latitude 42.8; the second 4 digits are the longitude 101.7. Thus, the location of such a seed-collection translated to a map, is 8 miles south of Merriman, Nebraska along the Niobrara River.

My suggestion is to use latitude and longitude. This is the simplest grid anyone could devise; you can read it from any Rand-McNally atlas. If latitude and longitude are not given, find out where seed were collected--near what town, in what part of a ranger district, along what river etc. and spot it on your atlas map. Then read off the latitude and longitude. Keep it simple and read it in degrees and 10th of degrees; not minutes. Seed origin information should also indicate whether from natural stands or from a planting. There's nothing wrong about using seed from plantation trees. It just needs to be known, in case the progeny turn out to be exceptionally good or exceptionally bad.

What I am suggesting is not a complicated system, nor does it have to be in the tree by tree detail such as we often use in research. In simple, straight-forward terms, we need only to know enough about the origin of seed, to enable someone to return to the place to collect more seed, or to avoid the place. One more suggestion. Whenever you acquire seed, request the place of origin. If seed supplier can't or won't furnish that information, tell him you do not want the seed at any price. He'll get the message.