Importance of Species and Seed Source Selection in Great Plains Nurseries[1]

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Abstract.—Increased tree planting, resulting from federal programs and tree planting promotions, has increased the transfer of planting stock among Great Plains states. These transfers increase the probability that poorly-adapted planting stock may be planted. Nursery managers and tree planters are cautioned to use only seed source-identified planting stock. Local seed sources are recommended unless appropriate provenance tests support the use of specific non-local seed sources.

INTRODUCTION

Tree planting in the Great Plains, and in the United States as a whole, has greatly increased in the past five years (USDA 1988). This trend has been driven by several factors. Tree planting has been promoted by The Conservation Reserve Program (CRP), the Centennial tree planting programs in North Dakota and South Dakota, Soil Conservation Districts, the American Forestry Association's Global Releaf program, and the National Arbor Day Foundation. The increased tree planting emphasis developed quickly in the last two years and has left little lead time for nurseries to gear up their production to meet the increased demand for planting stock. Nursery managers are well aware that increased seedling production requires increased seed procurement several years in advance of need for the planting stock. The rapid increase in the demand for planting stock has outstripped the capacity of many nurseries to produce it and shortages of some species have occurred.

In order to avoid shortages, tree planters and nursery managers may attempt to procure stock from non-traditional sources such as public nurseries in other states, or from private nurseries in the same, or other states. Purchasing planting stock from non-traditional sources increases the probability that poorly-adapted seedlings will be planted. This can be the result of several factors:

1) private nursery staff may be uninformed about importance of seed source:
2) out-of-state nurseries may not have appropriate seed sources:
3) tree planting contractors may accept non-adapted stock just to get something to plant;
4) seedlings may be repackaged and lose identity;
5) some planting stock may pass through several vendor's hands with a resulting loss of information at each transaction.

THE PROBLEM

Whenever seed or seedlings are moved to a region where they have not been tested, an element of risk is involved because their performance potential is unknown. They may perform very well, or very poorly. Poor adaptation may result in poor survival. slow growth, damage or losses from insects, diseases, drought and cold. Unfortunately, these impacts may take several years to become evident. In addition, it may be difficult to separate the causes of these impacts. Poor performance may be the result of any combination of the following factors:

1) poor physiological condition of nursery stock;
2) poor planting techniques:
3) poor maintenance practices; or
4) genetically non-adapted or . poorly-adapted seed sources.

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There are several examples of the use of poorly-adapted seed sources in the Great Plains. Siberian elm was planted extensively throughout the Great Plains during the 1920's and 1930's. Several different seed sources had been planted but no trials comparing seed sources had been established. Early autumn freezes that occurred in 1938 and 1942 and the extremely cold winter of 1942 were followed by widespread die-back and mortality of Siberian elm throughout the Great Plains (George 1944. Webb 1948, Maxon 1951). Siberian elm trees grown from unknown seed sources or southern seed sources suffered losses 75-90 percent greater than northern seed sources from the Harbin area of China or farther north.

Many provenance tests have been established in the Great Plains and nearly all of them contain dramatic examples of non-adapted, or poorly-adapted seed sources. The ponderosa pine provenance study established by the Rocky Mountain Forest and Range Experiment Station in 1968 included test sites throughout the Great Plains. The results after 15 years of growth in those tests have been reported by Van Haverbeke (1986). Table 1 shows results from the plantations at Watertown, South Dakota and Hastings, Nebraska. The north-central Nebraska race performed the best at both sites. The percentage loss in survival and total height of five other races is compared to the north-central Nebraska seed source. These results could be interpreted as demonstrating that if one of the five other races were planted at either Watertown or Hastings, their performance would be inferior to that available by planting the north-central Nebraska race. The percentage loss values estimate how inferior those races would be.

Clonal tests of vegetatively propagated species also provide good examples of poorly-adapted clones. Table 2 compares the performance of six Populus clones five years after planting in central North Dakota. The hybrid clone Populus Xeuramericana, (14271) performed best in terms of total height, lack of crown die-back and fewer terminal shoots. If any of the other clones are planted in central North Dakota, they can be expected to be inferior to clone *14271 to the extent shown in the percent loss columns.

Table 1. Relative performance of ponderosa pine races at two locations in the Great Plains.

Watertown, South Dakota				
RACE	SURV	Loss[1]	HT	Loss[1]
	- - - (%) - - -		(ft)	(%)
Southern	18	81	5.5	65
Northwest	38	60	8.7	45
Central Rocky Mtn.	70	26	10.2	35
Foothills-Black Hills	75	20	12.0	24
N. High Plains	92	3	13.9	12
N.C. Nebraska	95	0	15.8	0

Hastings, Nebraska				
RACE	SURV	Loss[1]	HT	Loss[1]
	- - - (%) - - -		(ft)	(%)
Northwest	56	44	9.8	42
Central Rocky Mtn.	99	1	10.3	39
Southern	85	15	10.9	36
Foothills-Black Hills	99	1	11.9	30
N. High Plains	98	2	13.1	22
N.C. Nebraska	100	0	16.9	0

[1]Percent loss compared to north-central Nebraska race.

SOLUTIONS

There are several strategies that can be utilized to reduce the use of poorly adapted seed sources. They range from simple and low cost to complex and costly. The most elementary of these strategies is to always use seed sources of known origin. Knowledge of seed source origin is critical for documenting performance, either bad or good. Performance records can then be linked to individual seed sources, and will serve as valuable bases for deciding whether to use that seed source again in the future.

Knowledge of the geographic location of the trees from which the seed was harvested gives you some information about the potential adaptation of those trees to your planting site. If the trees are native to the area, they are likely well adapted in terms of survival. If the trees are planted and their origin is unknown, their performance may provide an acceptable demonstration of their adaptation, particularly if they are at least one-half the normal rotation age for that species and intended use. If seed sources of known origin are not available, it is better to postpone planting for a year rather than risk the problems of planting ill-adapted stock. Remember, a landowner has to live with his, or your, choice of planting stock for the life of the plantation. If he chooses not to live with poorly performing planting stock, then he must bear the expense of removing them and starting over again.

Table 2. Relative performance of *Populus* clones at Mandan, North Dakota.

CLONE	MORT[1]	LOSS[2]	TERM[3]	LOSS	HT	LOSS
	- - % - -		(no)	(%)	(ft)	(%)
NE-259	74.0	74	4.2	162	11.7	29
Nor'Easter (NE-237)	34.5	34	3.6	125	14.6	14
Northwest Poplar	2.0	2	1.4	+12	12.7	23
Siouxland	2.5	3	4.6	188	15.5	7
Imperial Poplar	3.0	3	3.5	119	15.7	6
Euramericana (14271)	0	0	1.6	0	16.7	0

[1] MORT = percentage of the crown that is dead.

[2] Percentage loss compared to Euramericana (14271) clone.

[3] TERM = the number of terminal shoots in the top one-third of crown.

Fortunately many state forestry agencies have recognized the importance of using planting stock grown from well-adapted seed sources. One state, Arkansas, has even gone so far as to adopt a policy that prohibits the planting of Atlantic coastal seed sources of loblolly pine in Arkansas if the plantings are to be cost-shared by that agency. Acceptable, local seed sources are identified on a map of Arkansas. This policy was prompted by the poor survival and growth of Atlantic coastal sources in some plantations that had been planted by forest industries 20 years previously.

The second strategy to use in a sound seed procurement program is to use local seed sources whenever possible, unless you have reliable information documenting specific non-local seed sources that may perform better than your local seed sources. Populations of native species will have become adapted to the local environment through the process of natural selection. They should survive well and perform satisfactorily. If the results of provenance tests have identified superior non-local seed sources, then they should be used if available. However, don't try to "stretch" the area of adaptation too far. If your planting site differs significantly from the site upon which the provenance test was conducted, the results may not apply to your site. Seed zoning systems can provide guidelines useful in determining whether a particular seed source can be considered "local" for a particular planting site (Cunningham, 1975). Seed may not be available from local seed sources as a result of poor seed years. It is a good practice to build up an inventory of seed in "good" seed years, to help carry you through the "bad" seed years.

Another strategy to consider in seed procurement is the use of seed from seed increase blocks or seed production areas. These areas can provide reliable sources of large quantities of seed that have the potential for genetic superiority. Seed production areas can be relatively inexpensive to establish and can be managed for increased seed production. Phenotypic selection can be followed by roguing to eliminate undesirable trees. Good performance through at least one-half the rotation age usually is a reliable predictor of performance at maturity. Planting stock grown from the seed harvested in seed production areas can be monitored to provide performance records and document seed sources of known performance potential.

One of the most intensive, and costly seed procurement strategies, is the use of seed from seed orchards. Seed orchards are normally developed only for high priority species. They are expensive to establish and maintain and usually require many years before they produce useful quantities of seed. The advantage they offer is the high level of genetic superiority their progeny should possess, particularly if the trees in the orchard have been progeny tested and the orchard has been subsequently rogued of poor performing clones. Even untested seed orchards generally have a high potential for genetic superiority and are usually superior to other available seed sources.

Genetically superior clones of vegetatively propagated species can be quickly integrated into the production programs of most nurseries. Cuttings from superior clones can be established in stooling blocks that will provide thousands of cuttings for rooting in production beds. Superior Populus clones have been propagated this way for years. Generally, clones are propagated and distributed separately, but there is increasing interest in distributing clonal mixes of several compatible clones. The idea is that several clones will provide some buffering capacity against pest outbreaks and help prevent complete plantation mortality.

Finally, officially named and released cultivars should be used when they are available and appropriate for the intended use. Cultivars are the culmination of a tree breeder's efforts to improve a particular species. Cultivars are tested over a variety of sites for several years to insure that they perform above average for that species and are worthy of release. They may be propagated from seed or vegetative parts. The area of adaptation is usually specified and its recommendations should be followed. Once again, don't try to "stretch" the area of adaptation. Lists of cultivars that have been released for use in conservation plantings have been published (Cunningham 1988).

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