REVISING THE SEED ZONES FOR SOUTHERN PINES

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Early foresters had a sense that using local seed sources was the best for afforestation, although this was often based more on intuition than experience. Non-local planting stock has often been used in the past. In the reforestation carried out by the Civilian Conservation Corps in the 1930's, for instance, an effort was made to use native seed sources, but nursery[2] records show that the source of seed was sometimes disregarded when local stock was not available. A similar situation now exists in the southeastern US, where demand for planting stock has exceeded supply, mainly because of widespread wildfires in the south associated with drought.'

When seedling supplies are short, and non-local sources are available, it is very tempting to use this stock. Indeed, provenance tests have shown that non-local sources may not always be the best. Results from provenance tests (Wells and Wakeley 1966) have been used to justify massive movement of seed sources especially in loblolly pine. Tremendous quantities of seedlings originating in Livingston Parish, Louisiana and east Texas have been planted in Georgia, Alabama, and north Florida because they are resistant to fusiform rust (Wells 1985). In the other direction, great quantities of seedlings from the Coastal Plain of the Carolinas have been planted in Arkansas, because they greatly surpass the local sources in early growth, although there is increased risk for crop failure (Lambeth *et al* 1984).

There is always short-term risk associated with planting trees, but long-term risk should also be considered. This could be especially important in the federal Conservation Reserve Program (CRP), where established plantings may not be intensively managed, and the planted forest stands will be left to develop naturally.

Guidelines for seed transfer of the southern pines have been previously published (Lantz and Kraus 1987). These guidelines need to be up-dated in light of more recent research results.

ANALYSIS

It has often been observed that seed sources of many forest tree species can be moved northward a modest distance, where they will out-perform local sources. If moved too far to the north, however, they suffer cold damage and will not perform as well as the local source. This suggests a curvilinear relationship between temperature, or growing season length at the source and growth. The planting site by seed source interaction usually found in provenance tests is mainly a result of this relationship, and is an important consideration in movement of seed sources.

Results from the Southwide Southern Pine Seed Source Study (SSPSSS) and other provenance tests have been interpreted using regression to relate growth to climatic variables (Schmidtling 1997), to establish seed zones. Analysis of the relationship of growth and survival to climatic variables showed that the most important climatic variable associated with north-south variation in the four major southern pine species, loblolly, slash, longleaf and shortleaf pines, is average yearly minimum temperature at the source. This has been used by horticulturists for many years to determine "plant hardiness zones". Twenty-five year results from the Southwide Southern Pine Seed Source Study were combined in this analysis by expressing growth for each species as a percent deviation from the local source, and expressing minimum temperature at the source as a deviation from that of the planting site.

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[1] USDA Forest Service, Southern Institute of Forest Genetics, Saucier, MS 39574
[2] Nursery records on file at the Ashe Nursery, USDA Forest Service, Brooklyn, MS.
[3] Reforestation News, spring 1999. International Forest Co., Odenville, AL.

The analyses show that moving seed sources northward from areas with minimum temperatures of from 5 to 7 °F warmer than the planting site result in the maximum gain over local sources. Moving seed sources northward more than 10 °F results in growth that is less than that of the local source. This was used to define seed zones that are delineated by 5 °F minimum temperature isotherms. In general, seed sources may be moved anywhere within a zone, or to any adjacent zone. Northward movement will result in a slight gain in growth over local sources, southward movement will result in a slight loss in growth.

East-west differences are unimportant in longleaf and shortleaf pines, and seed sources may be transferred across the Mississippi River Valley within the western limits of the species without restriction.

In loblolly pine, east-west differences are significant and important. Western sources are slower growing, more rust resistant and are more tolerant to drought than eastern sources. Some sources east of the river, i.e., Livingston Parish LA, are also resistant to rust. There is a very steep gradient of fusiform rust susceptibility increasing from west to east in southeast Louisiana and southwest Mississippi, east of the Mississippi River and west of the Pearl River (Wells *et al* 1991). This as well as other evidence indicates that the dividing line between western sources and eastern sources is actually somewhat east of the Mississippi River Valley. In addition, re-analysis of provenance tests that intensively sampled Texas and Louisiana indicates that only sources near the western and northwestern edges of the loblolly distribution appear to be slow growing and adapted to drought (Long 1980). In studies that sampled across southern Louisiana including both sides of the Mississippi River Valley, there was no difference in growth from west to east (Dyer *et al*. 1977).

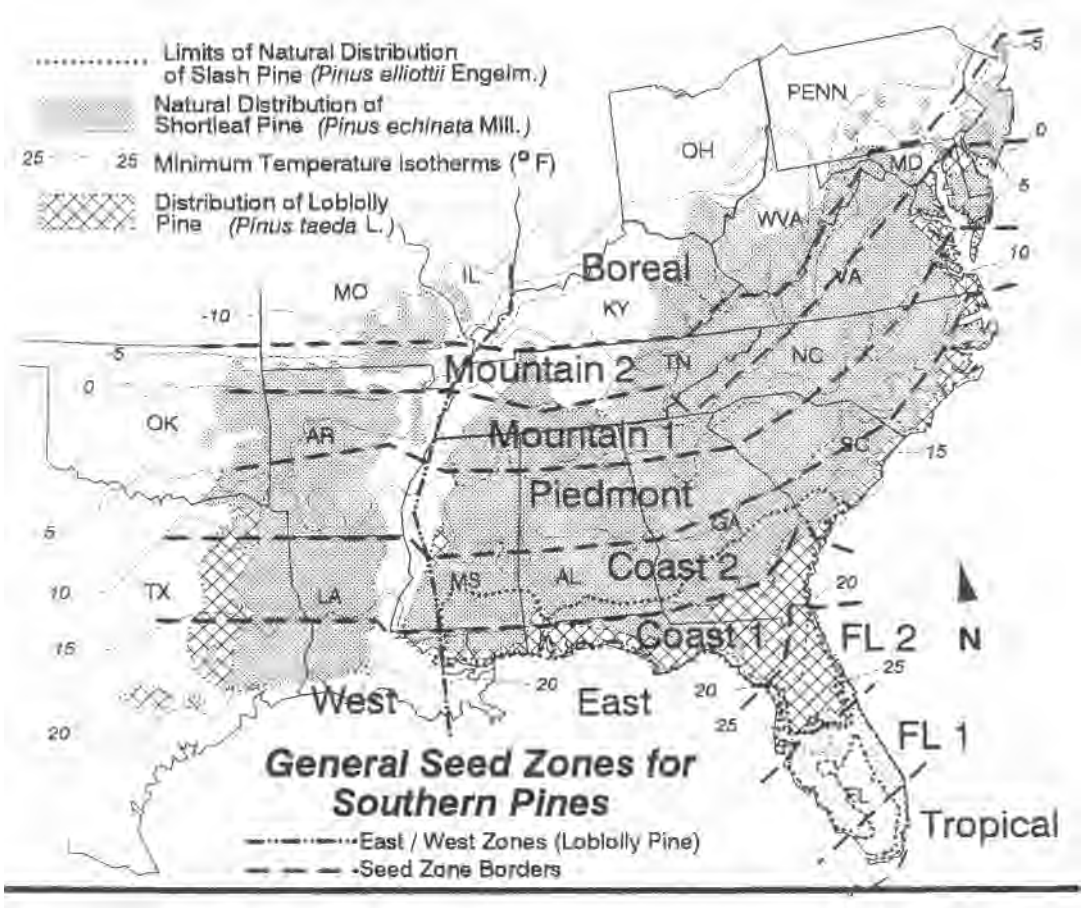
Transfers of western seed sources to the east has often been done to take advantage of the fusiform rust resistance of the western sources. This transfer may result in stands that could be somewhat slower growing than local stands, but has little long-term risk.

Forest managers must be prepared to assume some risk in transfers of seed sources in the opposite direction, that is, transfers of eastern sources to western sites, since these sources in general have little resistance to fusiform rust. These sources are not as drought tolerant as western sources, which would entail some risk in Arkansas and east Texas at the edge of the natural distribution. Indeed, these transfers may be very successful for a pulpwood rotation, but fail in the long-term (Lambeth *et al*. 1984).

RECOMMENDATIONS

Recommended seed zones based on Plant Hardiness Zones are shown in the figure. For the southern pines except loblolly pine, east-west movement within a zone and movement to adjacent zones should be unrestricted within the western limits of the natural distribution of the species. Movement from a zone from a warmer climate will result in a slight gain in growth, movement from a zone with a colder climate will result in a slight loss in growth.

For loblolly pine, movement of eastern sources to west of the Mississippi River is not recommended unless the stock has substantial fusiform rust disease resistance. Movement of eastern sources westward beyond the natural distribution of longleaf pine, or to Arkansas is not recommended except for intensively managed pulpwood rotations on mesic sites. Movement of western sources eastward should not be restricted, except that planting sources from Texas west of the natural longleaf pine distribution or Arkansas will result in slower growth.



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