IMPROVED SEED - WHAT DOES IT MEAN?

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Tree improvement, the art of applying genetic principles to upgrade the quality of forest stands, has rapidly come of age in the southern states. Whereas a scant 20 years ago tree improvement *was* but a philosophy being proposed by a small number of far-sighted, optimistic individuals, it has in the interim become an integral part of sound silvicultural practice. It has its greatest value under systems of artificial regeneration, nearly universal in the pine forests of the region, with less intensive application in naturally regenerated stands.

1/ Panel presentation. Papers of panel participants are included.

Among the earliest adherents of tree improvement on a commercial scale were large corporate ownerships, principally pulp and paper companies, interested in upgrading timber quality on fee lands. Along with several universities, the U. S. Forest Service, and a small number of state forestry agencies, they established the first orchards for production of improved seed. From this beginning the value of large investments in tree improvement has been accepted to the extent that improved seed will soon be available to virtually every woodland owner desiring to plant trees
. Industries have greatly increased their acreage in seed orchards, the U, S. Forest Service works with several organizations, and it also developed orchards for the national forests. Many land grant colleges include forest genetic activities in both their teaching and research programs, and every southern and southeastern state forestry agency is developing improved seed for production and sale to the public.

The application of genetic principles to enhance tree quality connotes much more than the establishment of seed orchards. To gain the full benefits possible through tree improvement, one must be cognizant of using the proper seed source, the inherent variation existing within the species for the characteristics being improved, the mode of inheritance of desired features, the interaction of species and site, and the silvicultural and management techniques required for the species, to name but a few. To the practitioner, however, tree improvement and seed orchards are nearly synonymous.

In a typical instance many of the above named facets of tree improvement are factually, if not consciously, incorporated into the development of a seed orchard. The awareness of using proper seed sources is satisfied when separate seed orchards are established for major physiographic or geographic regions such as Piedmont or Coastal Plain, organic soils, or other recognized physiographic regions. Existing variation in at least some important characteristics is acknowledged in the selection procedures, whereby only those individuals having desired features are chosen for propagation into the seed orchard. Although the exact mode of inheritance and interactions with site may not be well understood, they are under constant observation to enable greater genetic gains in succeeding orchards while progeny tests under varying site manipulation and management regimes will isolate those families best suited genotypically to perform satisfactorily under given conditions of site preparation and management.

First generation seed orchards, as they now exist, satisfy the requisites for genetic improvement. Desirable phenotypes of the proper seed source are propagated into seed orchards where they are isolated and allowed to interbreed freely among themselves. While the orchards are producing seed commercially, individual families

are progeny tested to identify desired genotypes and eliminate undesired ones.

Amount of genetic gain, or improvement, to be realized from the first generation orchards is dependent upon the inheritance pattern for each characteristic being improved and is estimated overall to lie in the range of 5 to 15 percent for total increased volume production from stands planted with open-pollinated orchard seed. These estimates are based on the amount of improvement expected in individual characteristics of growth, form, wood quality, and pest resistance. Indications from the earliest plantations derived from orchard seed are that these expectations will be realized if not surpassed. For instance, data from our own work with loblolly pine have shown volume production of 2.5 to 3.0 cords per acre per year at age These are early estimates, but growth to date has far surpassed nursery-run seedling check material, and there is no reason to suspect that growth superiority of the orchard material will not be maintained. Outstanding improvement is indicated in the area of disease resistance. Both progeny test results and those of a large Heritability Study under way between International Paper Company, the National Science Foundation, the National Institute of Health, and our Cooperative Program indicate that resistance to Cronartium fusiforme is strongly controlled genetically. In test outplantings and artificial inoculation studies, we find individual families completely resistant to Cronartium while other families planted alongside of them are 100 percent susceptible. These data are sufficiently convincing that we now have Cronartium resistant orchards of loblolly pine being established to furnish material for planting in areas of high disease incidence.

First generation orchards in southern pines at the moment are in all stages of development. In our own Cooperative Program consisting of 27 organizations engaged in tree improvement and orchard development, individual orchards range in age from those newly established to 12 years of age. Many are reaching full commercial production. The ultimate goal from these orchards is sufficient seed to have 300 million plants annually. Nearly 40 million seedlings will be available for planting in 1970-71 from orchard seed produced by these organizations. Similar developmental progress is found in other programs throughout the South.

While first generation orchards are yet in the stage of initiation and development, thought is being given to more advanced orchards for the future. The 5 to 15 percent gain achieved by the first orchards more than offset their costs while increasing the supply of timber available to meet increased demands. Gains equal to or exceeding those of the first generation orchards can be expected from the more advanced ones. Material for future orchards is being derived in several ways other than selection from natural

stands and plantations which were looked to for the bulk of the parents in the first generation orchards. These include outstanding individuals from the best performing control-pollinated families in first generation progeny tests, families in current orchards which have shown themselves to be good general combiners, families having outstanding adaptation to particular environments such as deep sands, organic soils, or pest resistance, and wide-cross material derived from range-wide crosses which may be particularly suited to particular habitats.

Second generation orchard material must satisfy several requisites to be used as parental material. In addition to phenotypic expression of desired characteristics, it must have demonstrated the capacity to impart desired traits into progeny derived from it. In addition, it will have demonstrated the capacity to "flower" in phase with other orchard material, thus, encouraging panmitic crossing of all orchard material instead of a series of "specific" crosses as found in first generation orchards unselected for coincident phenology.

The status of seed orchards in the South in 1970 can best be described as producing commercial quantities of improved seed to satisfy 15 to 20 percent of the present seed needs. This percentage will increase for the next decade or longer before a majority of seed needs will be available from genetically improved sources. Coincident with increasing the quantity of improved material from first generation orchards, additional gains in production will be realized as additional orchards are established for specialty purposes and for second generation improvement.