15. SOUTHERN PINE HYBRIDS, NATURAL AND ARTIFICIAL

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When the Chairman of this meeting asked me to talk to this group of Southern Pine men about Southern Pine Hybrids, my first reaction was distinctly negative. Why, I asked myself (and you will probably join me in this question), should anyone not working with Southern Pines be so presumptuous as to try to talk to you about them? However, after some soul-searching bearing largely upon Boston's weather at this time of the year compared to that of New Orleans, I decided to accept.

According to Webster's New International dictionary, unabridged, a hybrid is:

"1. The offspring of the union of a male of one race, variety, species, genus, etc., with the female of another; a crossbred animal or plant. By many plant and animal breeders the term hybrid is limited to a cross between different species, crossbred being used for a cross between races or varieties of the same species.

"2. In genetics, however, the term hybrid is commonly applied to any offspring of parents of different genetic makeup."

According to Knight's Dictionary of Genetics, "A hybrid is the product of a cross between individuals of unlike genetic construction."

Since with the exception of a few special cases progeny in nature result from coatings, whether animal or plant, between individuals of more or less different genetic makeup, it follows that virtually all sexually reproduced progeny, even if differing in but one gene, are by definition hybrids.

Nonetheless, while accepting this more general usage for practical purposes, we should keep in mind that in the fullest sense of the word nearly all trees met with in our day to day work are literally hybrids in a greater or lesser degree. No population of trees is so static genetically that it lacks some variability. This variability is, moreover, both blessing and curse to the forester and breeder. On one hand he has found through bitter and too often repeated errors that he cannot promiscuously use a seed stock of a

given origin in a new and unselected site far removed from the source with any assurance of the success of the planting. It may or may not succeed, or its success may be of a limited degree according to the degree of adaptability inherent in the seed lot and the sum total effect of the new environment on the planting. In the final analysis, each seed source represents a continuum in time of a more or less narrowly plastic composite of the genotypes of the area resulting from all the selective forces acting at the source of the seed. These forces, in the course of evolutionary history, may well have screened out certain adaptive features originally present in the species when it first moved into its present location. In this way the adaptability range of a species or variety may be progressively narrowed down until we reach a point of local, sometimes edaphic, races of limited adaptive capacity. On the other hand, inherent variability gives the breeder a chance to select individual progeny of potential merit or value to him. For example, by this means we have been able to grow many pine species in the Boston area which are generally not hardy there. The technique is the simplest. Plant a lot of seed from various sources and let winter do the selecting. By this method we have some slash pine of unknown origin, spruce pine from Alabama, Pinus pseudostrobus and some other Mexican hard pines, P. ayacahuite a white pine also from Mexico), P. massoniana from Southern China, and a number of others. A good hard winter might finish most of them, but for the present they are prospering.

What can be expected from hybrid pines? On what bases do we expect them to be useful? From experience it is natural to draw comparisons with other plants in which hybrids have proved of value. It is easy, by analogy, to expect of hybrid pines what we realize from hybrid corn, for instance, but in the case of corn the breeder has had to be content with increases in yield of 15, 20, or sometimes 30 percent on an overall average. These relatively modest increases have resulted from an intensive and painstaking selection for vigor, disease and insect resistance, adaptability to soils, growing seasons, and numbers of other factors. These carefully inbred selected qualities have been brought together usually in a two generation double cross to endow the hybrid with values transcending those of its parental lines and creating a truly plastic and widely adaptable organism. One acceptable definition of hybrid vigor can be simply stated to be better adaptability to given environmental conditions than that shown by the parental lines. However, an organism displaying hybrid vigor under certain conditions may not do so under others. Every organism is capable of existing within a given range of conditions. Within this total range a narrower band of more nearly optimum conditions prevail, where the organism truly flourishes. On either side

of these optimal limits lie belts where existence is possible, but life grows less tolerable as the limits are approached. Hybridization may expand this band or belt of available optimum conditions but will not necessarily have a similar effect on the limits of conditions tolerated by the hybrid organism. On the contrary, a narrowing of the extremes of this marginal survival range on both ends of the optimum range might more likely be expected, thus actually further limiting rather than increasing the overall tolerance of the hybrid organism. If we expose our best corn hybrids to untenable conditions, we cannot expect other than disappointing results. Without the necessary environment the best of heredity is meaningless. One cannot exist without the other, and arguments as to which force is the more important are largely pedantic.

It follows that with hybrid pines we cannot expect exceptional results unless we are willing to provide exceptional conditions. True, we may be able to, in, all probability will, increase the growth capacity and broaden the adaptability and tolerance of our pines through proper breeding techniques, but we cannot expect miracles where no basis for such exists. Most of our species have inherent growth capacity exceeding that realized under existing management practices, so in a sense we are in the position of trying to improve on something which we haven't yet fully exploited.

From the available literature and from personal communication kindly sent by several of you, I totaled up eight hybrid southern pines, not including reciprocal and backcrosses. This certainly just scratches the surface of the possibilities of hybridization within the several species existing in the southern part of the country. Certainly some of the five or six so-called minor species have characters of potential value which sound exciting to an outsider. What about the competitive capacity of spruce pine teamed with the qualities of the more virtuous species? Such a combination might help solve to some degree the hardwood weeding problem.

Some, perhaps many, of the possible hybrids may prove worthless. Certainly Sonderegger pine does not lack for detractors, in spite of the fact that it eliminates the grass stage of longleaf. In a region largely lacking sharp geographic and climatic barriers and containing many interfertile species it is quite probable that many of the theoretically possible combinations have occurred from time to time but have proved to have low survival value and have been lost in the evolutionary mill. The hybrid between Pinus nigra of Europe and P. densiflora of Japan, for example, first produced in this country by Blakeslee, is dying off now at an age of about forty years. Whether or not this early death is due to hybrid unbalance we have too few trees to determine. Progeny from the hybrids show a remarkable variation in stature, ranging from extreme dwarfs, suggestive of transgressive segregation, to plants of normal stature and growth rate. Incidentally, this hybrid simulates to a remarkable degree the common and most polymorphic of the Eurasian pines, P. sylvestris, and suggests possible ancestral lines of that important timber species.

Another important outgrowth of the study of pine hybrids will be the possibility of discovering something of the phylogeny of our species. To be sure, obvious relationships are recognizable in certain pines, but precisely how these relationships came about we do not yet understand in any profound sense. We clearly see characters in common such as sproutability in pitch and shortleaf pine, and pruinose branchlets and other minor characters are common to shortleaf and scrub pine. How many of our present day species represent in a sense a stabilized hybrid swarm resulting from the fusion of species upon their coming together geographically in the great plant migrations following the retreat of the Pleistocene ice? The Apache Pine, P. engelmanni, of Mexico, Arizona, and New Mexico shows in its long leaves and grass-like juvenile stage a certain phylogenetic affinity to longleaf. How far back does this relationship go? Are the two pines survivors of a single ancient stock separated now by desiccation of the Mexican plateau and further modified by the introgressive effects of sympatric species?

Up to the present time our approach to hybridization has been largely empirical. We know the capabilities of our existing pines only in a general way and can see possibilities for certain improvements, but we lack almost entirely any soundly developed theoretical understanding of these existing species as biological systems. To reduce the role of empiricism should be one of our major initial tasks in any tree improvement program, and to achieve this goal we need fuller knowledge of the basic biology and relationships of our pines. As such knowledge accumulates through the efforts of groups such as this, empiricism will drop into the background and with the confidence born of sure understanding breeders will be able to deliver trees tailored to specifications.

To comment further upon the role of natural hybridization, it is curious indeed. that so few natural hybrids have been reported in this group of highly interfertile species. Sonderegger is, of course, well known, and a few others are reported or suspected. Current evolutionary throught emphasizes the role of hybridization and tends to minimize, without dismissing, mutation as the principle source of variation. The tremendous impact of man upon the plant communities of this region has certainly, in the sense of Anderson, hybridized the habitat and created situations where hybrids can be expected. I suspect we are only now beginning to know where and when to look for them. The pines with their diversity of requirements and ready crossability seem likely to be peculiarly adept at this sort of evolution. Shaw in 191+ in The Genus Pinus comments: "As the botanical horizon enlarges the varietal limits of the species broaden and many restrictions imposed by earlier systems are gradually disappearing. The cause of the bewildering host of varietal forms connecting widely contrasted extremes seems

to be the facile adaptability of these pines." Loock in 1950, commenting on the bewildering complex of Mexican pines says: "It must, however, be added that: many intermediate forms, which are ascribable either to evolution or hybridization, still exist and are extremely difficult to classify, when closely related species are concerned."

To very briefly sum up, it seems likely that hybrids, both interspecific and intraspecific, will have a definite place in the planted forest of the future. They can be expected to show wider adaptive tolerance within reasonable limits than their parental types. They can be made to incorporate resistance to various adverse conditions and under proper conditions may outyield their parents in certain cases. They cannot be expected to compensate for poor conditions of site or water supply nor can they replace sound intelligent management.