Growth of a Nine-Year-Old Sonderegger Pine Plantation in South Carolina

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(Received November 1974 / January 1975)

Sonderegger pine (Pinus X sondereggeri H. H. CHAPMAN = P. *palustris* MILL. X P. taeda L.) is a naturally occurring hybrid between longleaf and loblolly pines. It was originally described in 1922 by H. H. CHAPMAN, who named it after its discoverer, V. H. SONDEREGGER the state forester of Lousiana. It usually occurs as single specimens or small hybrid swarms in stands where both parental species grow in close proximity. Large hybrid swarms consisting of several generations of hybrids are rare, although a study involving one such swarm in Louisiana has recently been made (NAMKOONG, 1966).

One parent, longleaf pine, norrnally possesses a seedling grass stage. This means that seedlings usually need several years to start rapid height growth. Loblolly pine seedlings start rapid height growth their first year. F, hybrids resemble loblolly pine in this respect, so are easily detected in a longleaf pine seedbed. They can also be identified by intermediacy in morphological traits (BROWN, 1964). Planters wishing pure longleaf pine plantations usually cull and discard the hybrid seedlings at the time of removal from the seedbed.

Mast data on the growth of the hybrids are from mixed plantations established with longleaf pine seedlings which were not culled. CHAPMAN (1922) found that the hybrids possessed a growth advantage over pure longleaf pine for several years. WELLS and WAKELEY (1970) reported hybrids to be 1.7 m taller than pure longleaf pine at age 10 in some of the Southwide Pine Seed Source Study plots. At age 5, hybrids were 50 percent taller (6.2 m vs. 4.1 m) and correspondingly greater in diameter (13 cm vs. 8 cm) than pure longleaf pine in some South African plantations (ANON., 1947). SCHMITT (1968) found that most Sonderegger plantings were intermediate in height growth between loblolly pine and longleaf pine, although some individuals were superior to both.

P. C. WAKELEY (personal communication) considered this hybrid less desirable than the pure species because of susceptibility to several pests and extra large branches. The branchiness may have been due to the fact that most Sonderegger pines were in pure longleaf pine plantations and had grown faster than the surrounding trees. Among the pure plantations of Sonderegger pine are a 30-year-old planting on the Kisatchie National Forest in Louisiana (WAKELEY, personal communication) and two 20-year-old plantations on the Savannah River Project of the Atomic Energy Commission in South Carolina (J. HATCHER and W. E. HOWELL, personal communication).

Procedure

This is an account of an 8—10 year-old plantation established on the Clemson Forest, 13 km south of Clemson, South Carolina. The plantation was established with 1-year-old seedlings selected from longleaf pine seedbeds in three South Carolina nurseries. The planting site was an eroded old field with a clay loam soil and a light weed cover. The trees were planted in January or February, 1964, 1965, and 1966. Spacing was 2.6 m X 2.6 m. In all, about 800 trees were planted. At the end of the 1972 growing season, measurements were made of height, diameter breast high, bole form, branch angle, live crown length, and damage by fusiform rust (Cronartium fusiforme).

Results

At the end of 1972, average survival was 430/800 (54%). This survival is considered about average for longleaf Pine but low for loblolly pine. The relatively poor survival confirms previous obsexvations that Sonderegger pine is difficult to plant because of the comparative lack of fine lateral roots on seedlings.

Although the trees were planted in three different years, the effects of year of planting were masked by differences in soil fertility and weed cover. Therefore, it is sufficient to consider all trees as 9 years old at the time of measurement.

The trees averaged 7.5 m tall (range 5—11 m) and 11.6 cm dbh (range 4—18 cm), exceeding the growth rate of 80 percent of similar-aged loblolly pine plantations sampled by GOEBEL and WARNER (1969) on similar sites in the South Carolina Piedmont region.

Bole form was similar to that of loblolly pine. Of the 430 live trees in 1972, 63 (15%) had straight stems; and 264 (61%) had slight crooks such as are typical of loblolly pine. Of the remaining 24%, about equal numbers had forks, sweep, or serious crook which would reduce their merchantability.

The angle which the branches made with the trunk was variable, ranging from 45—90°, with an average for the plantation of 70°. The percent of the total bole clothed with a live crown varied from 15—95 because of variations in spacing due to the mortality and because of the variation in height among adjacent trees. The average length of live crown was 59 percent of the total height. These values are believed to be generally closer to loblolly pine averages than to those of longleaf pine of a similar age.

Although Sonderegger pine has been reported as susceptible to fusiform rust, this disease was not a major problem in our plantation. Only 4 percent of the trees had stem cankers, and only 31 percent had branch cankers. Altogether, 8 percent of the trees had cankers serious enough to affect their growth. This is no greater, and may be less, than most loblolly pine plantations of similar age in the South Carolina Piedmont.

Breeding Possibilities with Sonderegger Pine

Sonderegger pine occurs in many places (WAKELEY, 1954) where the two parental species grow together, but never is the frequency of hybrids very great. Apparently, most of these occurrences are of F, hybrids, although SCHMIDTLING and SCARBOROUGH (1968) and NAMKOONG (1966) presented data for hybrid swarms indicating the presence of some later generation segregates. Presumably, hybridization occurs constantly at a low frequency; but in relatively few

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cases do the hybrid swarms last long enough to indicate that the two parental species might ultimately merge into a single species.

Available controlled pollination data indicate that the seed sets are too low to warrant considering mass production of F_1 hybrids as a commercial possibility. A long-term program aimed at finding suitable mass production techniques could be justified only if the F_1's possessed such an outstanding growth advantage over pure species that they could then be planted on the same sites.

On the other hand, it is possible to visualize a multi-generation breeding project such as has been undertaken by HYUN *et al.* (1973) in Korea. HYUN has obtained F_2 loblolly × pitch pine (*Pinus rigida* MILL.) hybrids which are easily mass produced and seem to show high vigor. Therefore, our primary interest in this and other pure Sonderegger pine plantations is in determining whether the hybrids possess enough growth superiority to warrant growing and selecting in the F_2, or even F_3, generations. On this point, the data are equivocal. F_1 Sonderegger pines have grown faster in this one plantation near Clemson than most other loblolly pine plantations on similar sites, but may not have grown as well as the best of these. Of course the trees are still young, and their growth superiority may increase as the trees age. Judging from older trees, seed production in F_1's appears to be quite adequate. However, this particular plantation has, so far, produced few cones.

We were also interested in determining when selection should start if a multi-generation breeding project were undertaken. Theoretically, one expects the F_1 generation to have about the same range of variability as in the parental types, and the F_2 generation to be much more variable. Our F_1 generation was relatively uniform in rust resistance and bole form and moderately variable in growth rate, percent live crown, and branch angle. Due to the methods used to obtain seedlings, we do not know the extent to which that variation is associated with individual longleaf or loblolly pine parents. It would take considerable effort to determine that, and so determine whether the correct starting point for selection would be prior to production of F_1 hybrids. On the other hand, the variability in our plantation was about the same as in most pure loblolly pine plantations in the area. That being the case, it would be just as well to delay the start of any selection work until the F_2 generation. To stimulate cone production in the F_1, we recommend thinning to half the present basal area. Stunted and diseased trees, and trees with severe forks and crooks would be removed. A mass produced F_2 would then be obtained as soon as sufficient numbers of F_1 cones are produced. This could probably be attained in five or six years, when the trees are 14—15 years of age.

Summary

Seedlings of the hybrid, *Pinus* × *sondereggeri*, taken from *Pinus palustris* seedbeds were planted on an old field site in the South Carolina Piedmont. At age 9, the plantation had grown faster than 80 percent of similar-aged loblolly pine plantations. Bole form and branch angle were found to be similar to loblolly pine. Only 8 percent of the trees had serious fusiform rust cankers. The possibilities of breeding Sonderegger pine for rapid growth are discussed.

Key words: Sonderegger pine (*Pinus* × *sondereggeri* H. H. CHAPMAN = *Pinus palustris* MILL. × *Pinus taeda* L.), hybrid — vigor, rust — resistance.

Zusammenfassung

Sämlinge von Hybrid-Kiefern, *Pinus* × *sondereggeri*, (*Pinus palustris* MILL. × *Pinus taeda* L.), die nach der Aussaat von *Pinus palustris* im Saatbeet gefunden wurden, gelangten auf einem Standort in Süd-Carolina Piedmont zur Auspflanzung. Im Alter 9 zeigte die Kultur mit den Hybrid-Kiefern etwa 80% mehr an Gesamtwachstumsleistung gegenüber normalen Kulturen mit *Pinus taeda*. In Stammform und Aststellung ähnelten die Hybriden *Pinus taeda*. Nur 8% der Hybrid-Kiefern zeigten stärkeren Befall durch *Cronartium fusiforme*. Die Möglichkeiten zur Erstellung von schnellwüchsigen „Sonderegger-Kiefern" werden diskutiert.

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