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

By R. E. Schonike, J. D. Hart and M. D. Gibson

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Sonderegger pine (Pinus X sondereggeri H. H. Chapman – P. palustris Mill. × 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 Louisiana. 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 (Namkong, 1966).

One parent, longleaf pine, normally 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. F1 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.

Most 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 loblolly pine at age 10 in some of the Southwilde 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 loblolly pine in some South African plantations (Anon., 1947). Schmitt (1968) found that most Sonderegger plantations 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 × 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 observations 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 116 cm dbh (range 4–48 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 29 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 F1 hybrids, although Schmieder and Scarborough (1968) and Namkong (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
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 F₁ hybrids as a commercial possibility. A long-term program aimed at finding suitable mass production techniques could be justified only if the F₁'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 Hyeon et al. (1973) in Korea. Hyeon has obtained F₂ 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 F₂, or even F₃, generations. On this point, the data are equivocal. F₁ 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 F₁'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 F₁ generation to have about the same range of variability as in the parental types, and the F₂ generation to be much more variable. Our F₁ 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 F₁ 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 F₂ generation. To stimulate cone production in the F₁, 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 F₂ would then be obtained as soon as sufficient numbers of F₁ 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. Chap-
man — Pinus palustris Mill. × Pinus taeda L.), hybrid — vigor, rust — resistance.

**Zusammenfassung**

Sämlinge von Hybrid-Kiefern, Pinus × sondereggeri, (Pi-

nus palustris Mill. × Pinus taeda L.), die nach der Aussaat von Pinus palustris im Saatbeet gefunden wurden, gelang-
ten auf einem Standort in Süd-Carolina Piedmont zur Aus-
pflanzung. Im Alter 9 zeigte die Kultur mit den Hybrid-

Kiefern etwa 80% mehr an Gesamtwachstumslastung ge-
genüber normalen Kulturen mit Pinus taeda. In Stamm-

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