CROWN SHAPING IN A SLASH PINE SEED ORCHARD

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Abstract.--A seed orchard of high-gum-yielding slash pines was established for seed production and demonstration purposes in 1957 near Lake City, Florida. A tree shaping (pruning) study was imposed at age 9. Pruning decreased cone production slightly but limited height growth for ease of cone collection. Cone production for the first 10 years was generally curvilinear, rising with age. Good seed crops occurred every other year. Tree shaking removed only about 60 percent of the cones on both pruned and unpruned trees. Insect damage to cones and inbreeding effects are also discussed.

Additional keywords: Seasonal trends, tree shaker efficiency, cone insect impact, inbreeding, Pinus elliottii, pruning.

In 1957, a clonal seed orchard of high-gum-yielding slash pines (Pinus elliottii Engelm.) was established near Lake City, Florida to demonstrate orchard management and to provide seed for commercial production of high-gum-yielding trees. In April of 1966, a tree shaping (pruning) study was implemented at this orchard. The objectives of pruning were: (1) to increase cone production by increasing the number of cone-bearing branches, and (2) to keep the trees at a manageable height for easy cone collection. Pruning results and other observations which may be helpful to orchard managers are presented herein.

MATERIALS AND METHODS

The McColskey Still seed orchard was designed to produce third generation seed and contains only 9 clones, all of which are related as half- or full-sibs. It was established in 1957 after 3 of the best gum producing families growing in a 10-year-old progeny test were evaluated, and 3 high-gum-yielding individuals from each family were selected from them for cloning. Airlayers and grafts were planted at a 30 x 30 foot spacing with ramets of a clone no closer than 90 feet. The orchard was mowed, irrigated, and fertilized to promote flowering and growth. The lower third of the crown was removed in 1963 to facilitate mowing.

The pruning study consisted of 4 blocks, with 4 trees of each of the 9 clones in each block. Each of the 4 trees of a clone in a block received a different treatment. Treatments consisted of:

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1. No pruning.
2. Terminal and lateral branches bud pruned.
3. Terminal and laterals pruned back to established branches (heavy pruning).
4. Visual pruning, a combination of the other two pruning methods as the pruner chose.

When the pruned trees exceeded 30 feet in height the tops were sheared back to 30 feet and allowed to increase in height one whorl per year.

Pruning was started when trees were approximately 20 feet tall. Treatments 2 and 4 were carried on every year for 4 years (1966-1969). Pruning of laterals in treatment 3 occurred in 1966 and 1968. The 1966 pruning shaped the bottom portion of the crown while the 1968 pruning shaped the upper portion. After the trees were shaped, only the tops were cut back for an additional 4 years (1970-1974). The time required for pruning and cone collection was recorded. Cone counts were made for 10 years (1966-1975).

RESULTS

Pruning Study

The cumulative time (in minutes) required to shape the treatment trees over the 4-year pruning period was as follows: control - 0; bud pruning - 32; heavy pruning - 20; pruner's choice - 21. The additional top pruning carried on from 1970 through 1973 required approximately 4.6 minutes per tree per year.

The number of cones collected per minute was basically the same for all treatments, but increased with increasing size of crop (table 1). Clonal effects were strong with values ranging from 2.3 cones/min. to 27.2 cones/min. Before tree height became a critical factor in cone collection time, the timing experiment was completed. The controls are now reaching a height where some cones will be uncollectable with present equipment. However, pruned trees on the average are approximately 15 feet shorter and are more accessible than unpruned trees.

Table 1.--Average number of cones per minute collected with a bucket truck and 3 man crew.

	Year of collection							
Treatment	1966	1967	1968	1969	1970	1971	1972	1973
Control	5	9	10	9	8	16	11	14
Bud pruning	5	12	9	7	7	18	9	13
Heavy pruning	4	10	9	6	7	16	10	13
Pruner's choice	5	9	8	8	7	17	10	13
Average number of cones per tree	3	10	19	44	29	187	85	175

Overall pruning had a negative effect on cone production, but differences were not statistically significant over the 10 years (figure 1). Differences in cone production between pruned treatments were generally very small.

Pruning greatly increased the crown density (figures 2 and 3). The differences in crown development were due to pruning. Note the thin foliage at the base of the crown in figure 2. Natural pruning usually occurs at the base of the crown at an early age even when slash pine is open grown. The greatest change occurred in the unpruned trees when the tops were sheared back.

We expected the pruning of the lateral branch tips to increase the number of cone bearing branches, and the top pruning to cause the smaller branches to become larger and better able to bear cones. Branches with a larger diameter tend to have more cones per branch. Tertiary branches were 25 percent larger in pruned trees than in unpruned trees (Varnell 1969).

There was no insect control in the orchard. An insect impact study in the orchard indicated that over half of the flower buds are lost before harvest due to cone aborting insects mainly thrips (Fatzinger, et al. 1975). There is a strong indication that pruning of branch ends attracts these insects. In the upper portion of the crown of pruned trees, 55% of the conelets matured into cones, while 71% matured on the unpruned trees. Pruning results might have been different if insects had been controlled.

Other observations

Cone production cycles.--Cone production in the orchard began in 1966 and followed a rising curvilinear pattern as the orchard became older. The pattern of overall cone production is illustrated by the control (figure 1). Cone production fluctuated annually with relatively good cone crops produced every other year.

Tree shaker collection.--In 1974 and 1975 a shockwave tree shaker was used to remove the cones. The shaker was as efficient with pruned trees as with unpruned ones, but it harvested only 60 percent of the cones in both cases. The efficiency of the harvest varied strongly by clones; the clonal means varied from 37% to 80%.

Insect damage.-- The cones from 2 unpruned ramets per clone were analyzed from 1971-1975. Generally, cone deforming insect infestations follow cycles. In this orchard, cone infestation from 1971-1974 was on a downward trend, but 1975 brought on a large increase (table 2).

Overall, insect infestations of cones by cone moth (Dioryctria) have been relatively low (7.4%) in this orchard compared to other orchards (16%) with no insect control. Seed orchard sanitation may have something to do with low infestation, as all cones have been removed from the area for the past 10 years. High-gum-yielding clones in a clone bank where the cones were not removed had much lower sound seed counts (11 vs. 46) in 1976.

Figure 1.--Average number of cones per tree for various pruning treatments.

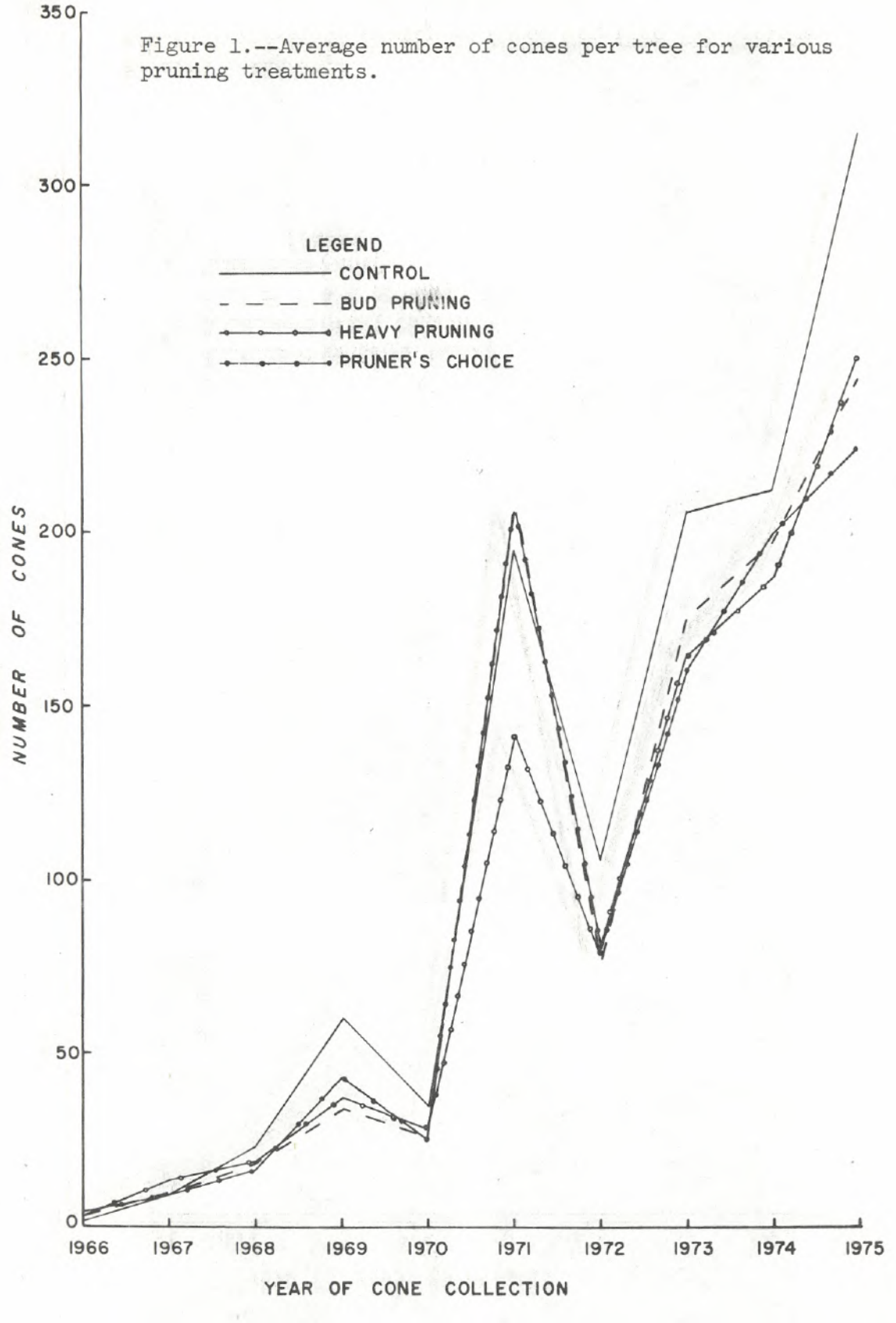

Figure 2.- Normal Development of Narrow-Crowned Tree in Seed Orchard

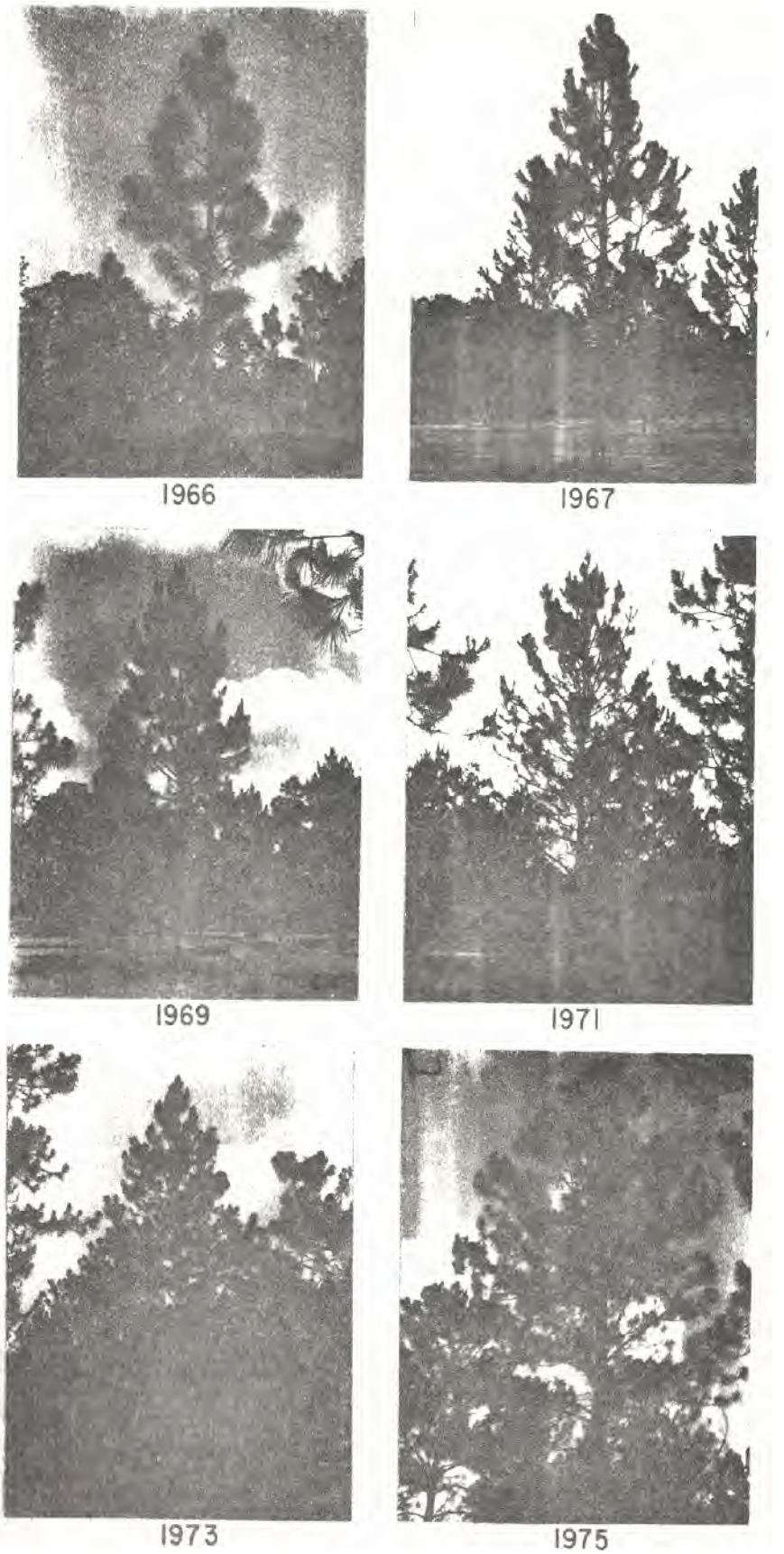

Figure 3.-- Development of Narrow-Crowned Tree with Heavy Pruning in Seed Orchard

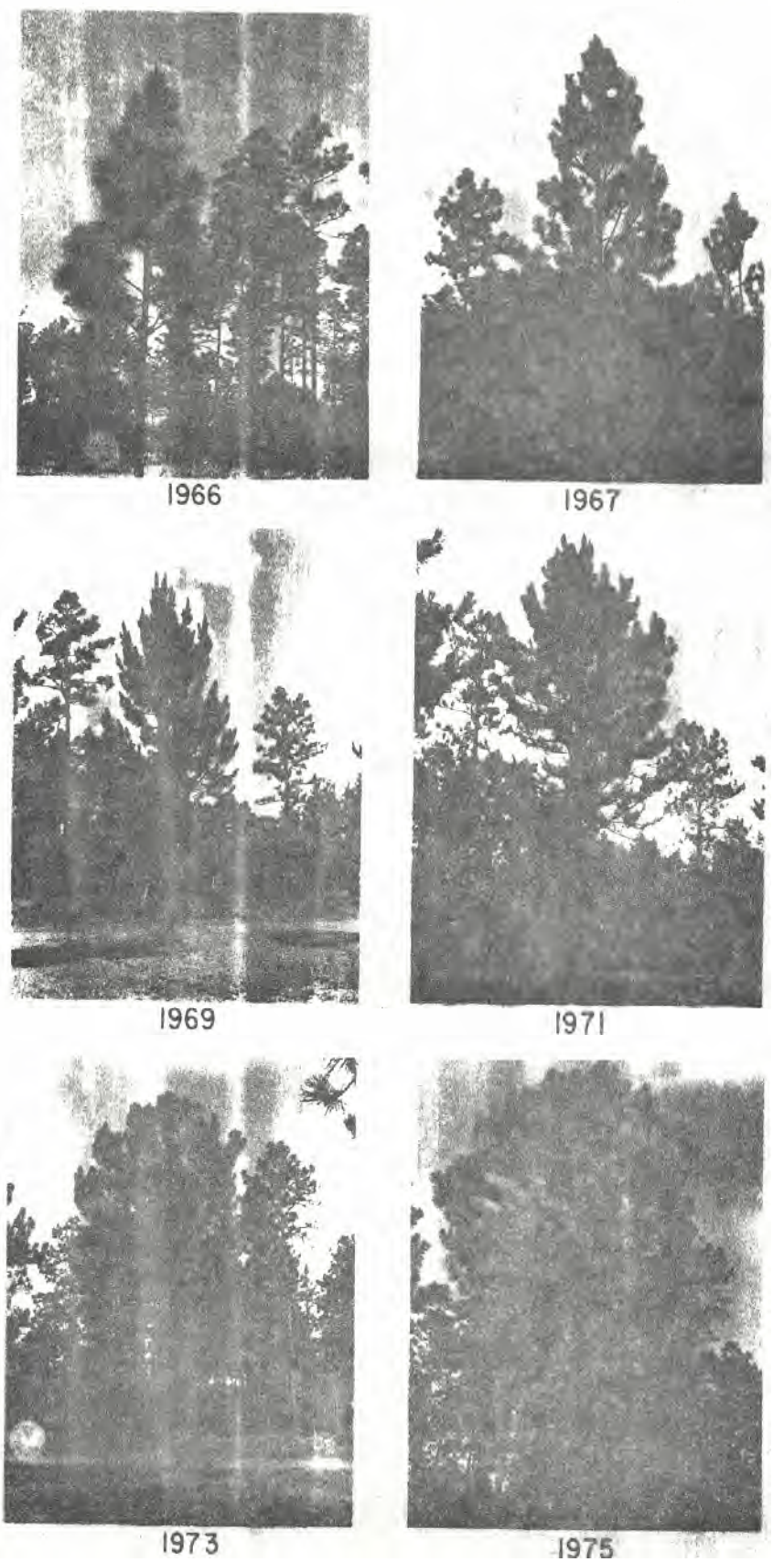

Table 2.--Percent of cones infested with insects on sample trees in McColskey Still seed orchard.

Year	Cones infested
1971	7.5
1972	4.9
1973	4.3
1974	3.8
1975	14.6

Apparent lack of inbreeding effect on cone production.--Surprisingly, inbreeding seemed to have little effect on this orchard. According to an Eastern Tree Seed Laboratory (SOS) report, the McColskey Still seed orchard produced 23 thousand viable seed per tree in 1971, as compared with an average of 11 thousand for 29 southern orchards tested that year. In short term progeny tests, seedlings grown from seed of this orchard grew to an average height of 10.5 feet in three years; 6% taller than the controls. When tested a second time they averaged 10.9 feet, 20% taller than controls.

Normally inbreeding causes a depression in the growth rate. Yet, the growth data for this orchard indicates that little inbreeding occurred, possibly due to high pollen contamination (Squillace 1967, 1977). An estimate of the inbreeding coefficient (F) for the F_2 progenies would be 0.167 in this orchard, assuming random mating among clones, equal ramets per clone, no selfing, and no outside pollen contamination. Inbreeding depression for height growth should be about 8% for this degree of inbreeding..

CONCLUSIONS

In this study, pruning reduced cone production slightly, but facilitated cone collection by limiting the height of trees. If seed orchard insects had been controlled, the effect of pruning on cone production might have been quite different.

Cone production increased sharply after the 14th year. Three clones did not start significant cone production until their 15th year. The overall trend of cone production, shouldbe of value to tree improvement program managers for projecting orchard yields.

The efficiency of the tree shaker leaves much to be desired. We observed no difference in "shakeability" of pruned or unpruned trees. The timing of the shaking seems to be important. When it is necessary to collect all the cones in the seed orchard, a bucket truck and punch poles should follow the tree shaker. Top pruning then becomes an important factor in seed orchard management, as it can extend the period of efficient cone collection in the orchard.

The fact that only 9 clones were used in the orchard and that they were all related did not seem to decrease seed production or growth of their progeny. However, use of a few clones and/or many highly related clones is not recommended because of the restriction on the genetic base, which in turn may greatly decrease possibilities for future genetic improvement.

LITERATURE CITED

Fatzinger, Carl W., Hertel, Gerard D., Merkel, Edward P. and Lloyd, F. Thomas. 1975. Developing a sampling method to determine effects of insects on yields in southern pine seed orchards. Proc. 13th South. For. Tree Improv. Conf. pp. 127-128.

Squillace, A. E. 1967. Effectiveness of 400-foot isolation around a slash pine seed orchard. J. For. 65(11); 823-824.

Squillace, A. E. 1977. Monoterpene composition of cortical oleoresin in Pinus elliottii and its utility in genetics research. Paper presented at EEC Symposium on Forest Biochemistry, Brussels, Belgium. Jan. 1977.

Varnell, R. J. 1969. Female strobilus production in a slash pine seed orchard following branch pruning. Proc. 10th South. For. Tree Improv. Conf. pp. 222-228.