

FEMALE-STROBILUS PRODUCTION IN A SLASH **PINE**  
**SEED ORCHARD** FOLLOWING BRANCH PRUNING

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INTRODUCTION

The utility of pruning to control the size and shape of seed orchard trees has been studied at our laboratory for a number of years. Our first experiment involved nonclonal material, and was not very informative because of the extreme variation in response among trees. More recently, one of our group began a pruning experiment in a slash pine clonal orchard. Female-strobilus production was studied during the first year following pruning; the results are reported here.

METHODS

The work was done in the Forest Service's demonstration seed orchard of high-gum-yielding slash pine, located near Lake City, Florida. The orchard was established in 1957-1958; and a pruning experiment was installed in 1968. The pruning experiment consisted of an unpruned check treatment and three pruning intensities, each replicated over four ramets in each of the nine clones in the orchard.

In late 1968 we began the study reported here. It was based on two to five sample branch systems in each of three ramets in the check treatment and three ramets in the highest intensity pruning treatment in each clone. Ramets were chosen at random from their respective treatments. In each study tree sample branch systems, beginning with the one nearest the ground on the southeast side of the crown, were selected along a vertical line at intervals of approximately 7 feet.

In the highest intensity pruning treatment, all vigorously growing limbs with two or more healthy lateral branches were pruned back to those laterals in March and April 1968.

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In each sample branch system, secondary and tertiary branches with 1968 shoots at least 10 cm. long were selected for measurement, beginning with those nearest the distal tip of the branch system and proceeding basipetally until either five of each branch type had been selected or the supply had been exhausted, whichever came first. The diameter at the midpoint of the first flush of the shoot elongating in 1968 on each branch was recorded in December 1968.

In January 1969, when the strobili initiated in 1968 were in the large twig-bud stage, we recorded the number of (1) foliated branches, (2) branches bearing female strobili only, and (3) female strobili on each bearing branch.

Most data reported here are expressed as the mean value per branch system, because most items were composed of different numbers of branch systems. Exceptions to this will be obvious.

The reliability of the sample to estimate female-strobilus production trends for the entire tree was confirmed by the correlation between the sample data and a whole-tree count of strobili made in April 1969 ( $r = 0.83$ ,  $df = 52$ ).

## RESULTS AND DISCUSSION

Branch pruning reduced the average number of branches bearing female strobili in 1969 by 40 percent in seven of the nine clones studied (figure 1). This was due simply to the mechanical reduction of the number of bearing branches. The following tabulation indicates that pruning was concentrated on the female-strobilus producing branch tips:

<u>Item</u>	<u>Nonbearing branches</u>	<u>Bearing branches</u>
	(Number per branch system)	
Unpruned trees	26.9	2.5
Pruned trees	27.4	1.5
Difference (percent)	+1.8	-40.0

How long this effect will persist is unknown, but it is important for at least 1 year following pruning.

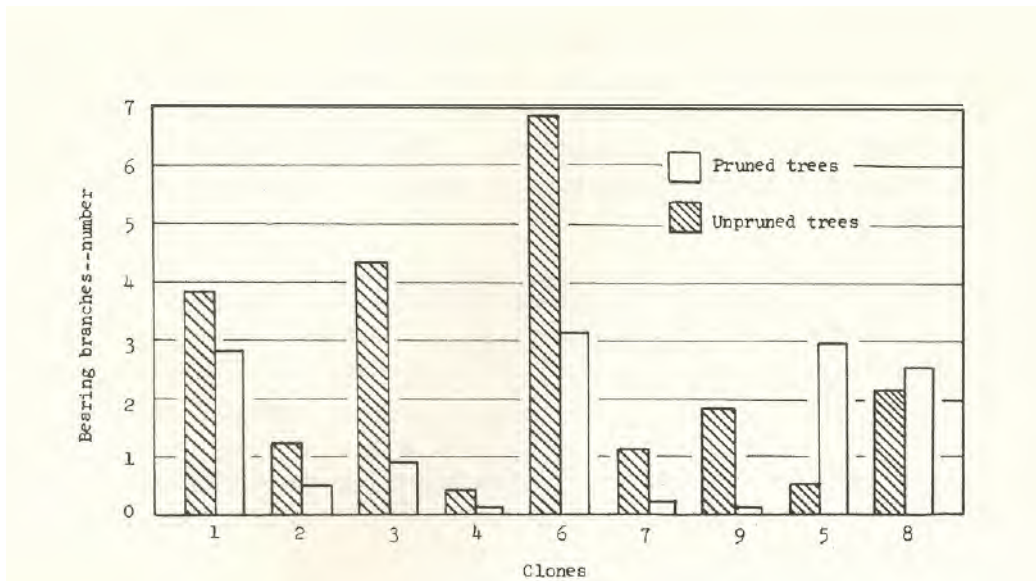


Figure 1.--Effects of pruning on the average number of bearing branches per branch system, in 1969.

The number of female strobili per bearing branch, on the other hand, did not vary appreciably between pruned and unpruned trees. The clonal means were as follows:

Clones	Unpruned trees	Pruned trees
1	1.5	1.3
2	1.0	1.0
3	1.3	1.3
4	1.0	1.0
5	1.0	1.2
6	1.0	1.5
7	1.2	1.0
8	1.0	1.3
9	1.0	1.0
Means	1.2	1.3

Thus, the net result at this point was that branch pruning in slash pine decreased female- strobilus production by reducing the number of bearing branches.

As a possible out-growth of reduced female-strobilus productivity, the percentage of seeds resulting from natural selfing may increase following pruning (Fowler 1965). The proportion of female strobili in the lower 3/5 of the crown (i.e., in the lower 19 feet) was 75 percent in pruned trees; it was only 64 percent in unpruned trees (figure 2). It is in this part of the crown where natural selfing occurs most frequently (Fowler 1965; Franklin 1968). With the greater proportion of female strobili located here in pruned trees, the percentage of seeds resulting from natural selfing should be slightly higher than in unpruned trees.

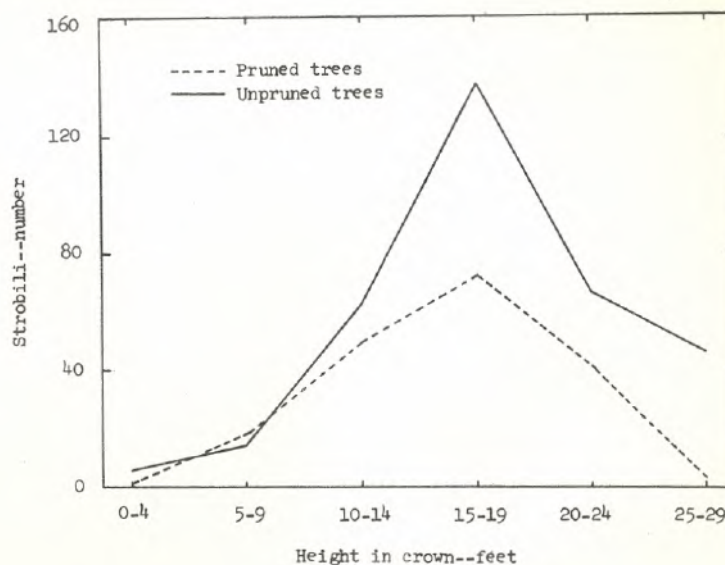


Figure 2. --Effects of pruning on distribution of female strobili within the crown.

Reduced female-strobilus productivity and increased natural selfing may not be lasting effects of branch pruning, however. The increased vigor of branches remaining on pruned trees may eventually compensate for these initial disadvantages.

Branch vigor and the subsequent production of female strobili by both secondary and tertiary branches were correlated in the positive direction in unpruned trees in this study (figure 3). This finding agrees with the relationship documented for many tree species, including slash pine. Comparisons of this relationship for each branch type (figure 4) revealed that nonbearing secondary branches were 10 percent larger and tertiary branches were 25 percent larger in pruned trees than in unpruned ones. The increased shoot diameter placed the nonbearing branches in pruned trees in the same size range as bearing branches, a result which may have important physiological implications for future female-strobilus production.

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<sup>2/</sup> Varnell, R. J. The relationship between vegetative branch growth and subsequent bearing of female strobili in slash pine. 1969. (In preparation for publication. )

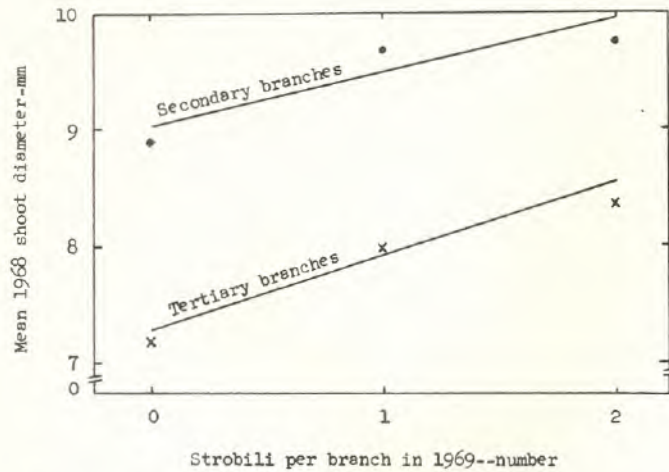


Figure 3.--Relationship between branch vigor and subsequent female-strobilus production in unpruned trees.

First, the larger mean shoot diameters for nonbearing branches in pruned trees suggest that many of these branches may now be vigorous enough to bear female strobili in coming years. Assuming all measured branches in pruned trees will bear female strobili in the future, the productivity from this source could increase as much as eightfold.

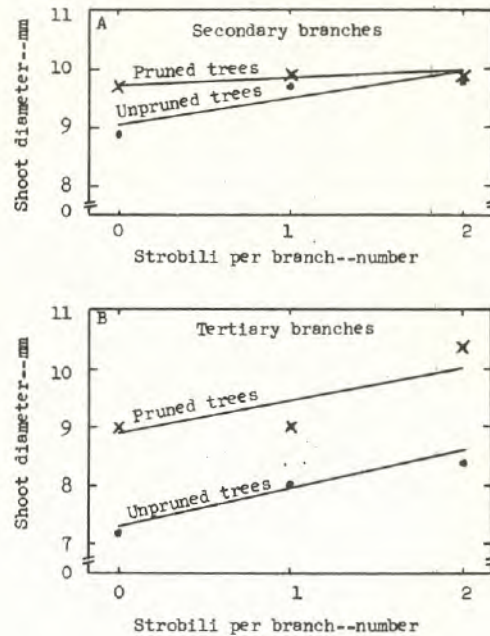


Figure 4.--Relationship of branch vigor and subsequent production of female strobili in pruned and unpruned trees. (Regressions for unpruned trees were significant at the 95 percent level; regressions for pruned trees were not significant at that level.)

<u>Branch type</u>	<u>Number of measured branches</u>	<u>Number of branches which produced female strobili in 1969</u>
Secondary	276	32
Tertiary	295	39
Sums	571	71

$$\text{Maximum increase} = 571/71 = 8.0$$

Although an increase of this magnitude is not expected, a twofold or threefold increase would be appreciable and would more than compensate for the removal of productive branch tips during pruning.



Second, increased branch vigor following pruning may enhance female-strobilus production by increasing the number of strobili borne per bearing branch. Based on the regressions for unpruned trees as standard relationships between branch vigor and female-strobilus production, secondary branches in pruned trees would be expected to yield  $1.6 + 0.7$  and tertiary branches  $3.0 + 1.2$  strobili per bearing branch (figure 5). The predicted numbers of strobili per bearing branch were not larger statistically than the observed value of 1.3 for secondary and tertiary branches separately in pruned trees. However, they are suggestive of future increased productivity of female strobili by bearing branches.

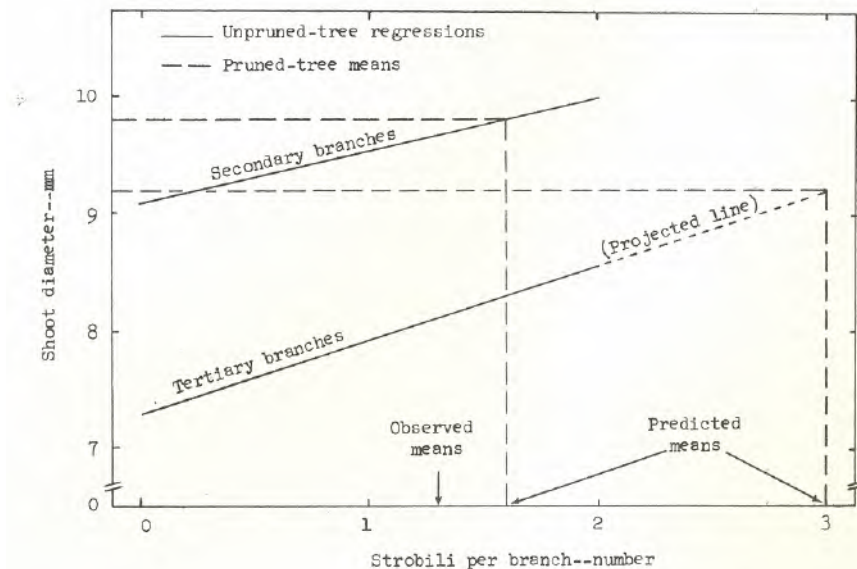


Figure 5.--Predicted mean numbers of 1969 female strobili per bearing secondary and tertiary branches following pruning, based on 1968 mean shoot diameters.

The suggested increases in the number of bearing branches and the number of strobili per bearing branch are speculative. They are discussed merely to illustrate that increased production of female strobili may be expected from increased branch vigor following pruning in slash pine.

Why the vigorous branch development in pruned trees in 1968 did not lead immediately to enhanced production of female strobili is unknown. But, the pattern of branch development from year-to-year in slash pine (see footnote 2) indicates that the vigorous branches in pruned trees probably will maintain their vigor for several years; during this time they can be expected to bear several crops of female strobili.

The possibility of increased female-strobilus production following pruning in slash pine appears to dispute the results of pruning in loblolly pine (van Buijtenen and Brown 1962). The experiments were different: major limbs of loblolly pine were pruned back annually; first growth shoots were pruned one time only in our study with slash pine. Increased production following pruning will be possible only if, after initial treatment, the pruning is discontinued and the potential bearing branches that remain are allowed to develop unmolested.

#### SUMMARY

The results of this study show that:

1. Branch pruning mechanically reduces the number of branches which subsequently bear female strobili, at least for 1 year.
2. The percentage of seeds resulting from natural selfing may increase following pruning.
3. It is possible that the initial disadvantages of branch pruning may eventually be offset by increased female-strobilus production associated with the increased branch vigor observed following pruning.

#### LITERATURE CITED

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