Wind damage to a yellow-popular seed orchard

Franklin Cech, James Brown, and David Weingartner

Professor, Forest Genetics, West Virginia University, Morgantown, W. Va.; Professor, Ohio Agriculture Experiment Station, Ohio State University, Wooster, Ohio; and Research Assistant, Auburn University, Auburn, Ala.

On June 28, 1974, a local wind of cyclone force hit a yellow-poplar seed stimulation study leaving the area a confusion of broken, uprooted and leaning trees. Sixty percent of the 310 trees in the study were damaged, 40 percent of them seriously, i.e., top broken, major forks destroyed, or the tree uprooted. Only three trees were lost completely, one of these being uprooted and two broken near the base. Several trees were undamaged as far as top breakage was concerned, but were left leaning which indicated there was some root damage.

As a result of the seed orchard management procedures used in the plantation, which consisted of wide spacing, fertilization, herbicide treatment under the trees, and mowing the entire area—large, spreading, heavy -limbed crowns have developed. These crowns can be subject to extensive damage in high winds, glaze and snow storms.

Practically all forest tree seed orchards will be managed using the techniques just mentioned and damage of this type apparently must be expected. Several instances of such damage to southern pine seed orchards have been previously catalogued in the North Carolina State Cooperative Industry Tree Improvement Annual Reports of 1963, 1964, 1966, 1969, 1970, 1971, 1972, and 1973.

Many tree improvement programs now include hardwood seed orchards, among these being members of the North Carolina Cooperative Tree Improvement program, the Tennessee Valley Authority, the U.S. Forest Service and the States of Pennsylvania and West Virginia. There is little information available relative to the proper techniques for managing these orchards.

In order to develop these techniques, a seed stimulation study has been in progress in a sapling plantation of yellow-poplar *(Liriodendron tulipifera)* at Ravenswood, West Virginia. The study was designed to determine the age at which seedling trees will bear commercial amounts of seed, the fertilizer treat. ments required to encourage maximum seed production, the best

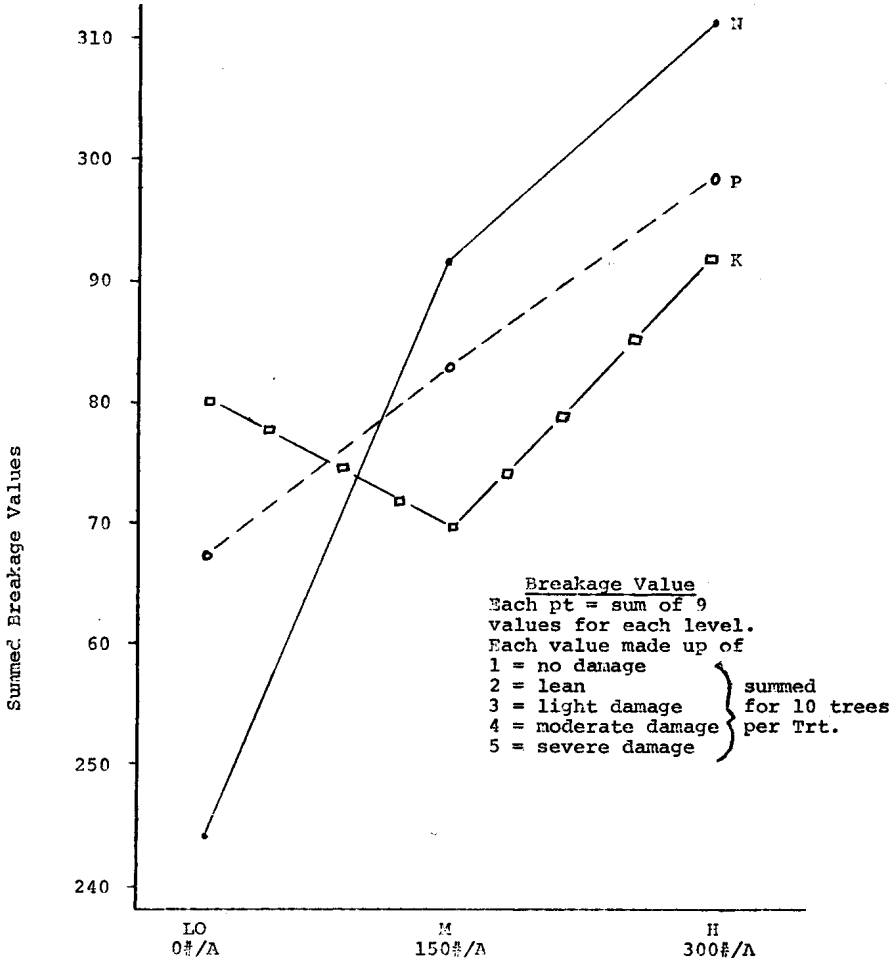

Figure 1.—Breakage associated with fertilizer.

collection techniques, and other management procedures.

A portion of an existing yellow-poplar plantation was thinned at the age of 9 years to an average spacing of 30 by 30 feet. After soil analyses, fertilizer was added at rates of 0, 150, and 300 pounds each of N, P_2O_5 and K_2O in a completely randomized factorial design. Paired trees were treated with all combinations of N, P, and K at the three levels. Granulated fertilizer was broadcast in an area equal to the crown radius of each tree. In addition, lime was added to raise the pH to approximately 7.0. This required approximately 3 tons of lime per acre. Herbicide was applied in the zone of fertilization to eradicate herbaceous competition. Untreated controls were left in the unthinned area adjacent to and surrounding the study on three sides. Additional controls were: thinned, untreated; thinned, lime only; and thinned, herbicide only.

As a result of thinning, there has been virtually no natural pruning, most of the trees have large crowns and lush foliage with limbs starting at 4 to 5 feet above ground level.

The area is subject to occasional high winds and there was a small amount of limb damage during the 5 years since the first fertilization.

Tree heights before the storm varied from 36 to 61 feet. Top loss during the storm varied from 11 to 27 feet, averaging about 40 percent of the tree height. Where destruction was not complete, the greatest loss for an individual tree was 85 percent of the bole; this left a 10-foot stub with three to four side branches. Diameters at breast height averaged 10.0 inches.

Damage was coded and results subjected to an analysis of variance. There was greater damage to trees with the high nitrogen treatment, statistically significant at the .05 level ($P = .02$). Nitrogen at any level in all combinations appears to be associated with breakage, with a probability level of .07. Although not quite statistically significant ($P = .10$), the trend was for damage to be greater in plots with heavier fertilizer application (figure 1) .

Figure 2.—Major fork destroyed by wind. Note discoloration at union.

Much of the damage occurred in crowns which had two or three large forks and where one or more of the forks were broken at the bole. Although many tops broke out and a few of the branches broke a distance from the bole, of special interest was the fact that 95 percent of the limbs were broken at the bole. Of these, nearly 99 percent were weak because of partial breaks which had occurred at an earlier date. Evidence for this was wood stain, callus around the upper portion of the branch union, and dampness apparently associated with a bacterial flux at the old fracture (figure 2, 3) . We suggest that this was the result of ice accumulation during glaze storms, causing branches to bend almost to the breaking point and leaving a wound which later healed superficially. Under average conditions these branches continue to develop normally, but they break under severe stress.

Seed heads had practically reached full size at the time of the storm and those on broken portions of the crowns were counted. The highest number counted on one tree (1,603) was from a highly damaged individual where a 16-foot-long top branch had broken. The number of seed

(Continued on Page 20)

(Continued from Page 4)

heads counted ranged from 1,603 to 0. Apparently seed production was not related to breakage.

In summary, the wind damage severely reduced the seed bearing portion of 40 percent of the trees in the study, and by actual count destroyed 30,900 seed heads (approximately 3 million seeds). Three trees were destroyed completely and an additional 20 percent of the remaining trees were damaged to some extent.

If a yellow-poplar orchard is to be successful, it should be placed in a location where high winds are not likely to be a problem and glaze storms minimal. Some technique is needed to discourage the development of large forks. Perhaps a pruning treatment which would retain the most vigorous upper limb is indicated when top forks begin to develop. Orchards might be protected by shelterbelts on the windward side, or preferably, surrounding the orchard. Such shelterbelts should be of a different species from that in the orchard, and while giving wind protection, would occupy the isolation zone and help to minimize the amount of non-superior pollen reaching the selected trees.

Figure 3.—Two-inch diameter branch broken at bole of tree. Note discoloration and callus tissue indicating previous partial breakage.