Repeated Fertilization Fails to Stimulate Cone Production in Young Loblolly Pine Stand

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The use of chemical fertilizers to increase cone crops in seed production areas has been the subject of numerous studies. However, a brief review of the literature shows that results of trial applications of fertilizers are still inconclusive and vary widely with species and sites. In fact, under certain conditions, the response to fertilization may produce results contrary to those desired. This proved the case in a 5-year study aimed at increasing cone production in a young loblolly pine *(Pinus taeda L.)* seed production area in southern Illinois.

Study Area

The study area is a loblolly pine plantation located in Pope County, Ill. Prior to machine planting in 1950, it was abandoned farmland. The Illinois Union State Forest Nursery, Jonesboro, Ill. grew the seedlings from seed collected in Maryland. Gilmore and Metcalf (1961) estimated the site quality to be 62 feet at 25 years, above average for this species in the area. The soil belongs to the Wartrace series which has developed in loess and is silty loam in texture grading to silt clay at lower horizons. The study area occupies a middle slope position with a north aspect.

In March, 1963, the entire 13year-old plantation was set aside as a seed production area. The plantation, which had over 900 stems per acre, was thinned to an average of 298 trees per acre. Average d.b.h. was 5.2 inches and height of dominants and codominants was 33 feet.

Herbicides were applied to ground vegetation in 1966 to reduce com petition following opening of the stand and treatment with fertilizer.

A test of a composite soil sample of the area made in 1963 showed a pH of 4.6 in the surface horizon, and deficiencies in phosphorus and potassium as measured for farm crop use. Organic matter was reported as 1.6 percent, the equivalent of approximately 50 lbs. of nitrogen per acre. In 1966, 3 years after thinning, the area received a fertilizer treatment.

Study Design

The plantation was divided into four blocks of nearly equal size and stand density. Blocks I and II received 50 lbs. N, 100 lbs. P_2O_5, and

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50 lbs. K_2O per acre, broadcast over the entire block. Blocks II and III received 1.5 tons of ground agricultural limestone per acre. Block IV was left as a control. There were four treatments; (1) Fertilizer only, (2) fertilizer plus lime, (3) lime only, (4) control.

The limestone was applied only once, at the start of the study. Fertilizer treatments were repeated for 5 consecutive years from May 1966 through April 1970. Within each block, two permanent 0.1 acre circular plots were established. The plot centers within the treatment blocks were located so that plot basal area densities between treatments were nearly equal. Trees in the control plots were shorter but not smaller in diameter than those in the treated plots. Each tree in each plot was numbered. In September, 1965, before treatment, the plots were measured and data recorded. Each year thereafter the plots were remeasured in August or' September. Measurements consisted of total height of each tree to the nearest whole foot, d.b.h. to the nearest 0.1 inch, and the number of mature cones observed using the method described by Hoekstra (1960).

Results and Discussion

Plot means were calculated for height, d.b.h., and number of cones observed per tree. Unfortunately, lack of replication ruled out analysis of variance. Positive effects due to the treatments applied were not apparent. Cone production was not stimulated by the treatments, and height and diameter growth were seemingly unaffected.

In referring to figure 1, it appears that the application of fertilizer, lime, and the combination of both actually depressed cone production when compared to the untreated portion of the plantation.

Several releases of the National Plant Food Institute's Clearing House on forest fertilization and nutrition research (1963) indicate that loblolly pine seedlings respond favorably to complete fertilizer on poor sites, but on good sites there is no significant increase in height or diameter growth. This is probably the case with this study. The site is excellent, one of the better sites for loblolly pine in southern Illinois. There was a slight increase in the range of heights (fig. 2) compared to the control over the duration of the study but this amounted to only 2.00 feet for the greatest contrast (fertilizer plus limestone versus control). The mean diameter growth (fig. 3) shows no response to treatments over the duration of the study. In fact, diameter growth in the control plots paralleled the diameter growth in the fertilizer only and fertilizer plus lime plots. The plots treated with limestone only showed a slower growth rate in diameter.

A second factor contributing to the negative response of cone production to fertilization may have been the age of the study plantation. While it has been producing cones since the beginning of the study when the trees were 16 years old from seed, it was still in the grand period of growth and was therefore possibly more sensitive to those factors affecting vegetative growth than cone production.

Cooley (1970) recommended that the effectiveness of fertilization should be determined for each prospective stand before extensive programs to increase cone production are initiated. He further stressed

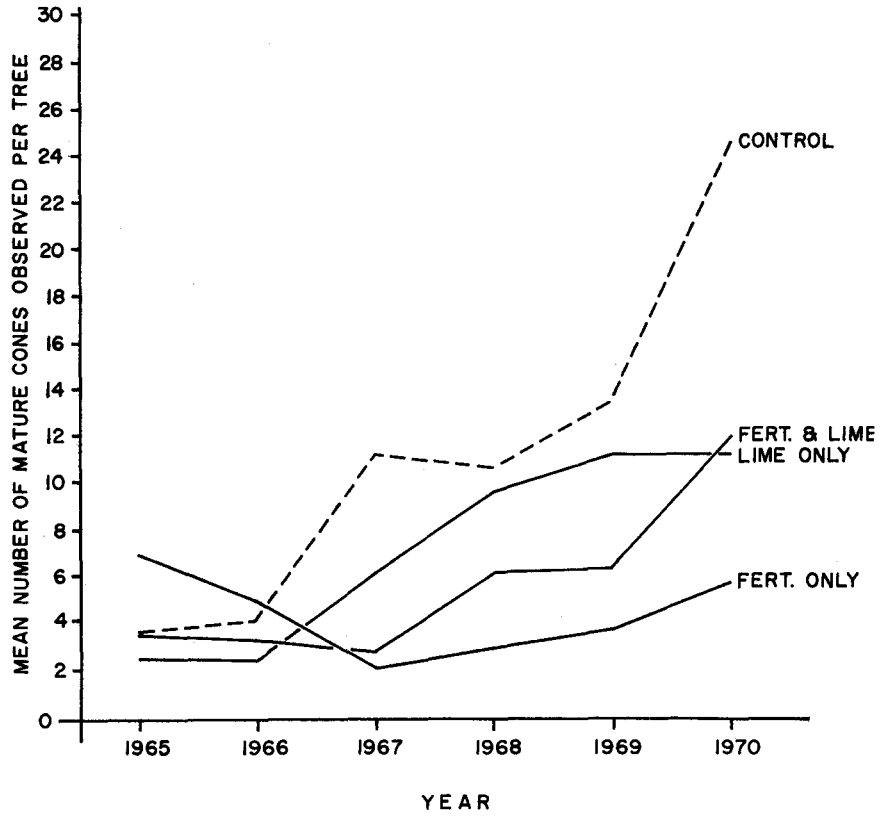

Figure 1.-Mean annual cone production following treatments of young loblolly pine in Southern Illinois.

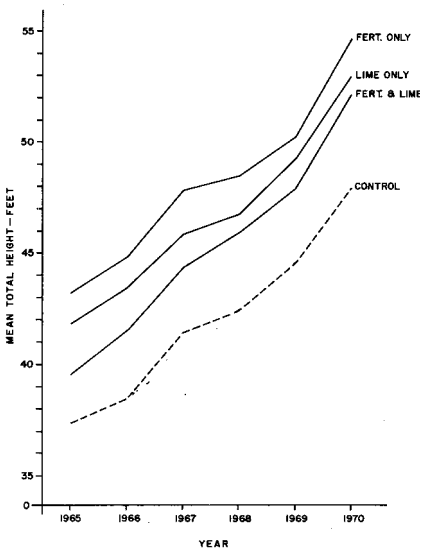

Figure 2.-Mean height growth response following treatments of young loblolly pine in Southern Illinois.

that such determinations cannot be based on a single year's observation. The results in this study bear out this recommendation and point up the need for extensive research to develop fertilization guides.

Foresters, nurserymen, and seed orchard managers should be aware that fertilization is not always effective in increasing growth and cone production. It is important to know the species requirements, the age of the tree treated, and especially the fertility of the site. In addition, the density of the stand, the composition of understory vegetation, the water regime of the soil itself, and the climate of the area are critical factors in arriving at a fertilizer prescription. Even if all these factors are known, the response may be less than desired. Plant materials have certain limitations for growth, and treatments can only be effective within these as yet undefined limits.

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Figure 3.—Mean diameter growth response following treatments of young loblolly pine in Southern Illinois.