Broadcast and spot-seeded pines grow equally well in central Tennessee

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On Tennessee's western Highland Rim, crop trees grew as well in height and diameter on closely clustered seedspots as where they were more widely dispersed in broadcast-seeded stands. Thus, expensive thinning of spot-seeded loblolly and Virginia pines is not needed and growth of the dominant stand should be satisfactory with either seeding alternative.

Direct seeding is a versatile and economical means of forest regeneration that has established pine on thousands of acres throughout the South. It may be more feasible than planting on much of Tennessee's dissected Highland Rim where steep slopes and stony soil restrict machine operation and make hand planting even more costly than usual.

Seeding in spots. the simplest of direct-seeding techniques, is especially suitable for small or irregularly shaped tracts. It is also useful for larger operations where sites cannot be prepared for broadcast seeding, or to fill in failed and missed spots. Currently recommended sowing rates of five or six seeds per spot assure adequate stocking under normal conditions. When weather is unusually favorable, most spots produce two or more seedlings. Doubts that pines can develop normally and express dominance when grown in such tight clusters have discouraged the acceptance of seedspotting in this region.

Research with slash and loblolly pines in Louisiana. and with shortleaf pine in Missouri. indicates that clustering may not be as detrimental as commonly believed (1.2.4). In these studies, height growth of the tallest seedling per spot was not reduced at densities usually obtained with direct-seeding. Excess seedspot stocking caused eccentric crowns in a series of pine seeding trials in Illinois and Ohio, but it was not indicated whether growth was also affected (3). Little is known about the role of seedspot density in diameter growth-a more important determinant of age of merchantability. Nor is there much information on the performance of southern pines established by different methods of direct seeding.

The study reported here evaluated spot and broadcast seeding on steep, rocky slopes with loblolly *(Pinus taeda L.)* and Virginia pines *P. virginiana Mill.)*. It also provided an opportunity to compare growth in stands established by two seeding techniques and to obtain locally applicable information on the effects of seedspot density.

Methods

The study was done near Centerville. Tenn., at an elevation of about 850 feet. Here the low, limestone plateau forming the Highland Rim is dissected into steep-sided hollows separated by long, narrow ridges. Plots were located just below a ridge crest on northwest slopes averaging about 50 percent. The soils are Mount-view and Bodine silt loams containing a high proportion of chert and are the most characteristic series

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on ridges and upper slopes in this region. Sites range from poor to fair for upland oaks: they are believed to be fair to good for pine. Before conversion, an unbroken stand of low-grade oaks and hickories-mostly pole-sized-dominated the area.

The site was prepared by burning in August. following an extended dry period. The fire top-killed brush. saplings, and small poles and consumed the hardwood litter. When plots were seeded the next April, about 20 percent of the area was covered with scattered windrows of leaves from surviving hardwoods. Seedspots were spaced an average distance of 6.6 feet, avoiding deep patches of leaves, and five seeds were sown on each spot to give a sowing rate of 5.000 seeds per acre. Broadcast sowing was done at the rate of 10.000 seeds per acre. All seed was stratified and treated to repel rodents and birds.

Hardwoods that survived the fire were deadened by injection about 1 month after seeding; during the second summer, sprouts were lopped wherever they crowded pine seedlings. Most pines would have outgrown invading hardwoods without follow up weeding, but this allowed us to examine the relation of seeding methods to pine growth. uncomplicated by excessive hardwood competition.

Treatments were replicated three times in randomized, complete blocks on 0.1-acre, square plots. Results expressed as initial tree percents, stocking, or growth after 5 years were tested by analysis of variance.

Figure 1.—Cluster of 5-year-old loblolly pines in a spot-seeded stand on Tennessee's western Highland Rim.

Results

Both methods established acceptable stands of loblolly and Virginia pine (fig. 1). Spot-seeding was significantly (0.01 level) more effective. however, yielding over 50 percent more seedlings per acre from 5,000 seeds than broadcast sowing at twice this rate. Differences between species were riot statistically significant. Additional details concerning these aspects of the study are reported elsewhere (5).

After 5 years, stands established by seedspotting had 2,442 pines per acre. Eighty-seven percent of the spots were stocked with one or more saplings. The average was 2.8 per stocked spot. On broadcast-seeded plots, there were 1.565 pines per acre; milacre stocking averaged 71 percent with 2.2 saplings per stocked milacre. About one-third of these seedspots. but only 19 percent of the milacres. supported four or more saplings each (table 1). Conversely. 35 percent of the milacres had a single pine while only 19 percent of the spots were as lightly stocked. Except for increasing

TABLE 1.—Proportion of stocked seedspots or milacres supporting various numbers of 5-year-old saplings (data for loblolly and Virginia pine combined)

Number of saplings per stocked unit	Seedspots	Milacres
	Percent	
1	19	35
2	25	32
3	24	14
4	18	13
5	14	6

size ofseedlings, the structure ofthese stands had remained relatively constant during the second through fifth years after seeding. Survival over this period averaged 94 percent, so there was little change in either numbers or relative densities of pines on spots or milacres.

Fifth-year total heights were 7.8 feet in broadcast and 8.6 feet in spotseeded stands, based on the tallest sapling per milacre or seedspot. Both loblolly and Virginia pines averaged 8.2 feet. while diameters at breast height-averaging 0.87 inch for both seeding methods-were slightly larger for loblolly. None of the 5-year growth differences were significant. On stocked spots, pines were concentrated on much less than one square foot, while on milacres they had almost 20 square feet of growing space each. Considering this disparity in density, any effects of seeding method on growth of dominant saplings should have been apparent by now-particularly in respect to diameter.

TABLE 2.—Mean diameters of the tallest pines on seedspots of varying densities and heights of the tallest, second ranking, and third ranking sapling, at 5 years of age

Number of pines per seedspot	D.b.h. of tallest sapling	Total height		
		Tallest sapling	Second tallest	Third tallest
	Inches	*Feet*		
1	1.05	8.7		
2	.86	8.6	6.5	
3	.87	8.5	7.4	6.0
4	.76	8.6	7.4	6.3
5	.74	8.0	6.9	6.2

Examination of growth within spots further shows that clustering had no serious effects (table 2). Among spots ranging from one to four saplings each, fifth-year heights of the tallest sapling differed by only 0.2 foot. They were appreciably shorter on spots with five trees, but these occurred too infrequently to seriously affect overall height of the dominant stand. On spots with two or three trees each, d.b.h. was equal to that of the stand as a whole. Diameters of about 0.1 inch less on spots supporting four or five trees were compensated by the considerably larger pines on spots with a single sapling.

Also, for all spot densities, the largest tree was 1 foot or more taller than the next ranking sapling (table 2). In Louisiana, after the tallest loblolly or slash pines on multiplestocked seedspots attained a superiority of at least 1 foot, they always maintained their lead (2). By this standard, these spot-seeded pines in Tennessee have expressed dominance.

Discussion

This study shows that clustering will not adversely affect development of spot-seeded loblolly or Virginia pine stands in central Tennessee. Height of the tallest tree per spot varied little with up to four trees per spot. Although diameter growth slowed somewhat at densities of four or more trees, clustering had little effect on average size of dominant stems. Moreover, seedling establishment in this study was exceptionally good-four or five tree clusters should occur less frequently in most operational seedings. The largest sapling per spot expressed dominance by 5 years of age, and competition from smaller pines will become less intense as crowns close and shade out trees of low vigor. Expensive, noncommercial thinning should seldom be needed to prevent stagnation of spot-seeded loblolly or Virginia pines on Tennessee's western Highland Rim.

The main point, however, is that potential crop trees grew as well on closely clustered seedspots as where they were more widely dispersed in stands established by broadcast sowing.

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