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ADVANCE REPRODUCTION UNDER MATURE OAK STANDS OF THE NEW JERSEY COASTAL PLAIN

In managing hardwood stands, one of the most important tasks is to secure adequate reproduction of desirable species after harvest cuttings. Natural reproduction is usually relied upon. This can be either advance growth (seedlings or seedling sprouts) or reproduction that becomes established after the cutting. Which one the forest manager should mainly rely upon depends on several factors: relative tolerance of desired and undesired species, abundance of desirable stems and their competitors, logging damage, and cost of different methods of tilting succession to favor preferred species.

On many of the better sites in the New Jersey Coastal Plain, the highly desirable species are oaks, yellow-poplar, and sweetgum. But they are less tolerant of shade than the commonly associated red maple, blackgum, beech, and some other species. Foresters have felt that desirable reproduction was more easily obtained here on well-drained sites than on poorly drained ones.[1] But it has not been clear whether the better reproduction observed on well-drained sites was due to more advance growth, to a greater catch of desired species after cutting, or to less competition.

To determine the influence of soil-moisture conditions on both the amount of desirable advance reproduction and the amount of undesirable competitive growth, a survey of hardwood reproduction under mature oak stands was recently made.

Description of Study

Fifteen mature oak stands, scattered throughout the hardwood section of the New Jersey Coastal Plain, were sampled in the survey. Each stand was fairly well stocked, with no large holes in the canopy.

[1] Smith, Glenn E. OBSERVATIONS ON MANAGING HARDWOODS IN THE DELAWARE VALLEY OF SOUTHERN NEW JERSEY. Jour. Forestry 51: 189-191, 1953.

Selected with the help of State foresters, most of the stands were already marked for cutting.

Five stands were located on each of three moisture conditions: (1) dry sites, on well-drained soils, (2) moist sites, on moderately well to somewhat poorly drained soils, and (3) wet sites, on poorly and very poorly drained soils.

On the dry sites, black, chestnut, and white oaks predominated in the overstories. Understories were relatively short and open. Common shrubs were mountain-laurel, low-bush blueberries, and azalea, with lesser amounts of sweet pepperbush and maple-leaved viburnum. Desirable tree reproduction was chiefly black and chestnut oaks, plus some white oak and Virginia pine, and occasional stems of sweetgum and yellow-poplar. Undesirable species were red maple, dogwood, sassafras, blackgum, black cherry, and gray birch.

On the moist sites, overstories were predominantly northern red oak, with some intermixed white oak. Understories were taller and denser than on the dry sites. In nearly all stands, maple-leaved viburnum was the most common shrub, although sweet pepperbush, southern arrowwood, azaleas, and high- and low-bush blueberries also occurred in abundance. Here desirable tree reproduction included northern red oak, black oak, white oak, sweetgum, and yellow-poplar. Undesirable species were red maple, dogwood, sassafras, hickory, blackgum, and holly.

The wet sites included two conditions of wetness associated with minor topographic differences. The higher ground supported most of the tree and shrub growth. Overstories were composed largely of pin, willow, and swamp white oaks. In the depressions, characterized by thick, usually blackened, leaf litter and by standing surface water during wet periods, the vegetation was relatively sparse. Overstory canopies were thin because most trees grew around, but not in, these spots. Some red maple of second-story stature, and scattered plants of high-bush blueberry, poison ivy, and greenbrier, grew in the depressions. Sometimes dense patches of first-year seedlings of sweetgum or red maple were present.

Understories on the higher ground around the depressions were lush. In some places vegetation was over head-high, and occasionally 50 or more stems were found in a single milacre quadrat. Shrubs predominated. Sweet pepperbush, southern arrowwood, blueberries, and azaleas were most common. Tree reproduction included black, northern red, pin, and swamp white oaks, and sweetgum among the desirable species; red maple, blackgum, beech, holly, and sassafras were common undesirable ones.

In each of the 15 stands, transects of 20 contiguous milacre-quadrats were used to sample the small reproduction up to 1.5 inches d.b.h. Two such transects were studied in each of 12 stands; in the other 3 stands only 1 transect met established standards for uniform-

ity in soil drainage and overstory composition. Reproduction tallies included all trees and shrubs on each quadrat by species and by three height classes: (1) less than 0.5 foot tall, (2) 0.6 foot to 4.5 feet tall, and (3) taller than 4.5 feet but less than 1.6 inches d.b.h. Species and height of the dominant stem on each quadrat were recorded.

Trees and shrubs larger than 1.5 inches d.b.h. were tallied on 0.12-acre plots by species and 1-inch diameter classes. The 0.12-acre plots were 0.6- x 2-chain strips centered on the quadrat transects.

Results

All sites had 800 to 1,100 stems per acre of desirable species in sizes smaller than 1.6 inches d.b.h. (table 1).

Although not differing greatly in numbers per acre, desirable species dominated the understory considerably more on dry sites than on wet ones. On 12 percent of the quadrats on dry sites, 8 percent

Table 1.—*Average number of stems per acre of different types of woody vegetation, by sites*[1]

Type of understory vegetation	Wet sites	Moist sites	Dry sites
Desirable tree species	863	1,071	861
Undesirable tree species	2,274	3,834	3,191
Shrubs (approximate)	25,000	28,000	6,000

[1] Includes all stems less than 1.6 inches d.b.h. With stems 1.6 to 5.5 inches in diameter, values become:

Desirable trees	910	1,104	893
Undesirable trees	2,390	3,965	3,306

Table 2.—*Dominance of different types of woody vegetation in the understory, by sites*[1]

Type of dominant understory vegetation	Wet sites	Moist sites	Dry sites
	Percent	*Percent*	*Percent*
Desirable tree species[2]	3	8	12
Undesirable tree species	17	25	34
Shrubs	72	66	39
None (no woody plants)	8	1	15

[1] Restricted to stems less than 1.6 inches d.b.h.

[2] Seedlings and sprouts.

of those on moist sites, but only 3 percent of those on wet sites, the dominant stem was of a desirable species (table 2). In part, differences in dominance were due to differences among sites in the size of the desirable seedlings: 73 percent of them were taller than 0.5 foot on dry sites, 34 percent on moist sites, and 27 percent on wet sites.

As is obvious from the stand descriptions, species composition in the desirable category varied with moisture conditions. On wet sites sweetgum predominated; on moist sites oaks (as a group) and yellow-poplar were somewhat more common than sweetgum; while on dry sites oaks were most abundant. A percentage breakdown of the desirable species, by sites, is tabulated below for stems less than 1.6 inches d.b.h.

	Wet sites	*Moist sites*	*Dry sites*
Oak species	30	37	69
Yellow-poplar	2	36	11
Sweetgum	68	27	15
Virginia pine	..	..	5

Reproduction of undesirable tree species was more abundant than desirable reproduction on all sites. The undesirable group averaged 2,300 to 3,800 stems per acre (table 1), and dominated 3 to 5 times as many quadrats as the desirable species (table 2). As with the desirable species, the proportion of quadrats dominated by undesirable trees increased with increasing dryness of sites.

Inclusion of stems 1.6 to 5.5 inches in diameter made little difference in numbers per acre (table 1). In that size class undesirable species were still 2 to 4 times as numerous as desirable ones.

Shrubs were much more numerous than tree reproduction on all sites, and usually dominated much larger proportions of the quadrats (tables 1 and 2). Shrubs were taller and denser, and dominated more quadrats on the wet and moist sites than on the dry sites. Fifteen percent of the dry-site quadrats contained no woody plants (table 2). Elsewhere non-stocked quadrats were rare except in the depressions on wet sites.

Shrub competition probably accounts in large part for the small size and infrequent dominance of desirable tree seedlings on the moist and wet soils. As noted earlier, only on the dry sites were a majority of these seedlings taller than 0.5 foot. Here the shrubs were both fewer and shorter, and the tree seedlings had attained greater height despite the less favorable conditions.

Undesirable species were less handicapped by the intense shrub competition on the moister sites, probably because most of them are more tolerant than the desirable species. On the poorly and very poorly drained soils 13 per cent of these undesirables were taller than 4.5 feet, as compared to 11 percent in this size class on the dry sites.

For all sites, the ratio of undesirable to desirable stems in all size classes smaller than 1.5 inches d.b.h. was 3.3 to 1; and the ratio was essentially the same (3.2 to 1) for larger understory trees. These ratios indicate the greater tolerance of the undesirable species and the trend in succession. Unless controlled by cutting and cultural measures to favor preferred species, succeeding overstories in these stands will contain few desirable stems. On dry sites, individual-stem herbicide treatments of undesirable trees larger than 2 inches d.b.h. may be an adequate supplement to harvest cutting.

On the moister sites, more drastic measures will be required to bring through well-stocked stands of desirable species after harvest cuttings. Judicious mistblower applications of herbicide to the low growth and injector treatments of larger stems would seem to be the most feasible method for controlling shrub and weed-tree competition while desirable species are getting established. This may mean that much of the advance reproduction of desirable species may have to be sacrificed. Under these circumstances, new stands would have to be established from seed either just before or just after a harvest cutting is made.

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