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COMPETITION AFTER WINDROWING OR SINGLE-ROLLER CHOPPING FOR SITE PREPARATION IN THE SOUTHERN PIEDMONT

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ABSTRACT

For two years, post-treatment regrowth of herbaceous and woody species was sampled on two adjoining areas in the southern Piedmont where they had been either sheared and piled into windrows or chopped by a single pass of a single-drum roller-chopper. Windrowing yielded 55% less total standing crop of woody trees, shrubs, and vines after 2 years than chopping did. But shearing and windrowing with a KG-blade gave no additional control of sweetgum (Liquidambar styraciflua L.) and blackgum (Nyssa sylvatica Marsh.). No differences between treatments were found in the standing crop of grasses and forbs. Legumes were more abundant on the windrowed site. Sheet and rill erosion, resulting in topsoil loss, persisted after 2 years on the windrowed area but not on the chopped area. Windrowing treatments should be restricted to gentle slopes and level sites; for sloping terrain chopping is more advisable.

INTRODUCTION

Mechanical site preparation for pine establishment is applied mainly to reduce hardwood competition and permit machine planting. The most common treatments use either 1) crawler-tractors with root-rakes, straight- or KG-blades that push downed hardwoods into windrows or 2) roller-drum choppers, singly or in pairs, to crush and split hardwood stems and stumps. Other treatments may follow, using disk-harrows, bedding plows, or herbicides applied broadcast or injected in individual stems. Intensive mechanical site preparation treatments were first developed in the Sand Hills and Flatwoods Physiographic Regions and are now being more commonly applied in the Upper Hilly Coastal Plains and Piedmont Regions. Windrowing costs about $75 per hectare more than a single pass of a roller-chopper costs. This extra investment in pine establishment needs to be scrutinized by the manager who should consider how much competition is reduced and soil productivity altered by each of the two treatments. Also, how treatments affect wildlife habitat must be considered. This paper describes hardwood and herbaceous vegetation development during the first 2 years after two mechanical treatments and explores some aspects of forage yield and soil alterations.

STUDY SITE AND TREATMENTS

The study was established on a 124-ha management unit in Mid-Alabama at the southern extreme of the Piedmont Physiographic Region. Numerous intermittant and perennial streams have produced a rolling topography with broad rounded-to-flat ridges, 10 m high. Ridges run mostly north and south. The topography and soil series are uniform across the study area; the soil is a Cecil gravelly sandy-loam (clayey, kaolinitic, thermic Typic Hapludults). The soil profile is a sandy-loam A-horizon over a red clay-loam to clay B-horizon. Sandy-loam surface soils are favorable for mechanical treatments, since they are not prone to excessive compaction. But exposure of the B-horizon can cause compaction and rill erosion. Annual precipitation averages 135 cm (53 in.) with lowest monthly averages in February, April, September, and October.

The uncut adjoining stand was a mixed pine-hardwood forest of about 26 m^2/ha (115 ft^2/a) basal area, mainly loblolly pine (*Pinus taeda* L.), shortleaf pine (*Pinus echinata* Mill.), southern red oak (*Quercus falcata* Michx.), hickory (*Carya* sp.), and sweetgum. Thirty-two hardwood species and four conifer species have been identified on the unit and in adjacent uncut stands.

Harvest was done in summer 1977, and site preparation treatments were applied in fall. About half the unit was site-prepared with a single pass of a roller-drum chopper in August and September. The remaining half was sheared with a KG-blade and windrowed with the same blade in October. Topsoil disturbance or removal was frequent on the steeper slopes of the windrowed area, and debris piled along contours. An adjacent uncut stand with similar species, topography, and soils was sampled as an untreated check.

METHODS

Vegetation was sampled in August 1978 and 1979, 1st and 2nd years after treatment, from 2 x 2 m plots (milacre). Plots were located with baselines and sample lines. Baselines were located lengthwise on each ridge and the length divided into numbered points 20 m apart. Five points were randomly selected in each treatment area for locations of sample lines at right angles to the baselines. Eight plots were randomly selected from drawn numbers, placed along 100-m sampling lines, and permanently marked with wooden stakes and flagged pins. Two temporary plots per sampling line were also established each year, in a spacial relationship to randomly drawn permanent plots. Each treatment area had 40 permanent and 10 temporary plots. The sampled area did not include streamside leave-strips, ridgetop logging roads, or windrow interiors.

For each plot, tree, shrub, and vine species were recorded, as were maximum heights, number of stems, and whether woody stems were seedlings or sprouts. Repeated measurements were needed on permanent plots. And, because of financial and manpower limitations, a modified Double-Sampling Method (5) was used to estimate standing crop in metric tons per hectare of both woody and herbaceous vegetation. This modified procedure uses regression relationships calculated for a particular estimator between the *ocularly-estimated oven-dry weight* and the *actual oven-dry weight* of vegetation components. The regression equations are then used to adjust estimates made on other plots.

Data from the 20 temporary plots were used to calculate the regressions. On both permanent and temporary plots, I estimated standing crop (aboveground biomass) of the vegetation components and individual woody species. Then I clipped vegetation on temporary plots and oven-dried (75°C for 24 h) and weighed it. From the weight estimates and actual weights, the linear regressions were calculated for each component, forcing the line through the origin (4). The best procedure was to consistently underestimate so a straight line passing through the origin could be approximated. Finally, the regression coefficients were used to adjust the estimates from the permanent plots. Before the line was forced through the origin, the r^2's averaged 0.77 for herbaceous groups and 0.95 for woody species in the 1st year and 0.87 for herbaceous and 0.97 for woody in the 2nd.

The vegetation components--modified from Blair (1)--are:

1. Grass and grass-like
2. Composites
3. Legumes
4. Other forbs
5. Vines (unfavored by wildlife)
6. Shrubs, tree reproduction, and preferred vines (by species)

Groups are defined by chemical control differences (for examples grasses vs broadleaves), forage benefits (legumes vs other forbs) and life form (vines vs composites).

RESULTS AND DISCUSSION

The standing crop of trees, shrubs, and vines was 55% smaller on the windrowed area than on the single-chopped area after 2 years (Table 1). Rates of regrowth of these components were greater on the windrowed area, with vines alone increasing 15-fold (they increased only 3-fold on the chopped area) between the 1st and 2nd years. Other competitive components such as composites, grasses, and other forbs, did not differ between treatments. Ragweed (Ambrosia artemisiifolia L.), horseweed (Erigeron canadensis L.), goldenrods (Solidago sp.), sunflowers (Helianthus sp.), dogfennel and thoroughworts (Eupatorium sp.) were the main composites. These species can commonly reach 2 m tall at full development in September-October, overtopping pine seedlings within dense clumps. The most abundant and frequent grasses were broomsedge (Andropogon virginicus L.) and many species of panicum (Panicum sp.). A total of 118 herbaceous and 15 grass species were identified on the treated areas, with no differences in species composition evidently caused by treatment.

Legumes, important game food, appeared to be slightly encouraged by windrowing (Table 1). Legume species occurring often on both areas were partridge pea (Cassis fasciculata Michx.) and several desmodiums (Desmodium sp.). Other species browsed by wildlife included the composite, wild lettuce (Lactuca sp.), and a forb, Lobelia puberula Michx. Two vine species that are favored forage, honeysuckle (Lonicera sp.) and greenbrier (Smilax sp.), were present on both areas but were more abundant on the chopped area. Both vine species and the abundantly occurring muscadine (Vitis rotundifolia Michx.) compete with pine seedlings; the competition becomes more severe when herbaceous vegetation on which the vines can climb is also present.

Blackberry (*Rubus* sp.) made up about one-tenth the weight of the tree-and-shrub standing crop shown in Table 1 and competed fiercely with pine seedlings in the first 2 years; scattered pine mortality resulted. Though blackberry provides game food and is presumably controlled some by game, blackberry overtopped pine seedlings more often than any other competitor did. It remains competitive in height on both treatments even after 2 years (Table 2). On windrowed areas blackberry standing crop was 110 kg/ha in the 2nd year and on the chopped area 310 kg/ha. Blackberry develops fast. On the chopped area in the 1st and 2nd years after harvest, the standing crop of blackberry was 140- and 620-fold over the amounts on the uncut area. Blackberry control is probably necessary on some roller-chopped areas in the 2nd and 3rd years. Once pine has overtopped blackberry, pines will prevail because blackberry does not usually exceed 3 m tall.

Hardwood sprout-control is one of the main reasons for shearing and windrowing treatments. Table 2 shows that windrowing inhibits seedling and sprout heights more than chopping does. At the end of two growing seasons 25% fewer sprouts developed in windrowed sites than in chopped areas (Table 3). Sweetgum and blackgum, however, 30% to 40% of the hardwood sprouts, were exceptions. Sweetgum regenerates by producing many sprouts, and sweetgum and blackgum both regenerate from sprouted saplings. Piling the windrows with a KG-blade apparently did not dis-lodge either sweetgum or blackgum from the soil. Only two other species were unaffected by windrowing treatments--white oak (*Quercus alba* L.) and black cherry (*Prunus serotina* Ehrh.); neither competes with pine in height growth.

Windrowing on sloping terrain minimizes competition but results in areas of rapid erosion (Figure 1). Dark-brown humus in the A-l horizons on both treated sites disappeared. Scarification from windrowing and active erosion further decreased the A-horizon. Dissmeyer and Stump (2) have predicted that windrowing forest land in the Piedmont will cause eight times more erosion that chopping would, an average soil loss of 4.9 metric tons/ha per year for windrowing and 0.6 metric tons/ha per year for chopping. Hewlett (3), studying a Piedmont watershed, reported that a double pass with a roller chopper did not significantly affect sediment and dissolved nutrients in streamwater.

On the windrowed area, bare ground amounted to 48% in the 1st year and 16% in the 2nd. On the chopped area, bare ground was 32% the 1st year and 7% the 2nd. Sheet and rill erosion were both more evident on the windrowed treatment, because scarified slopes between windrows remained unstable after 2 years (Figure 1). Bare ground on the chopped area resulted mostly from scattered distribution of hardwood trees over-thrown during chopping. Overthrowing causes a mound and depression where the roots have come out of the ground. These mounds and depressions are slow to revegetate, but rills do not develop. So, to protect the future productivity of intensively managed sites, restrict windrowing treatments to gentle slopes and level terrain.

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Table 1. Standing crop (oven-dry weight) after mechanical treatments.

Vegetation Components	Uncut Stand	First Year Chopped	First Year Windrowed	Second Year Chopped	Second Year Windrowed
	metric tons/hectare				
Trees & shrubs	.61[1]	0.95	0.37	2.29	0.99
Vines	.07	.09	.01	.27	.15
Grass and Grass-likes	.05	.40	.37	.74	1.02
Composites	.01	.a9	.70	.63	.61
Legumes	.002	.02	.06	.18	.22
Other forbs	.001	.10	.04	.07	.07
	0.74	2.45	1.55	4.18	3.06

[1]Understory trees only

Table 2. Average maximum height (cm) per plot and standard deviations of woody stems after mechanical treatments. Species above the dash lines have height advantage over pine.

Woody Species	First Year Chopped		First Year Windrowed		Second Year Chopped		Second Year Windrowed	
	x	s	x	s	x	s	x	s
Crop tree:								
Loblolly pine	26	13	21	10	75	42	65	34
Competitors:								
Sweetgum	67	45	48	24	87	62	107	55
Blackgum[1]	54	33	38	29	83	45	80	45
Blackberry[2]	69	35	21	15	93	44	74	87
Dogwood	51	26	27	13	83	50	56	41
Sumac	37	31	31	28	77	52	52	33
Hickory	37	26	26	17	61	48	47	31
Red oaks	35	24	15	10	58	46	31	21

[1] Includes persimmon
[2] Includes raspberry and dewberry

Tabel 3. Number of sprouts (stems/hectare) after mechanical treatments.

Woody Species	First Year Chopped	First Year Windrowed	Second Year Chopped	Second Year Windrowed
Not controlled by windrowing				
Sweetgum	4188	4500	4375	7250
Blackgum	7313	8813	8813	7875
White oak	312	1250	624	1625
Black cherry	250	1500	187	562
Controlled by windrowing				
Hickory	6250	4875	7125	4875
Red oak	3812	1125	6813	2187
Dogwood	3000	1437	5312	1250
Tulip poplar	2563	312	3813	250
Red maple	1813	1125	3063	1438
Others[1]	7625	2000	7312	8188
Total	37126	26937	47437	35500

[1] Includes 12 species of trees and shrubs

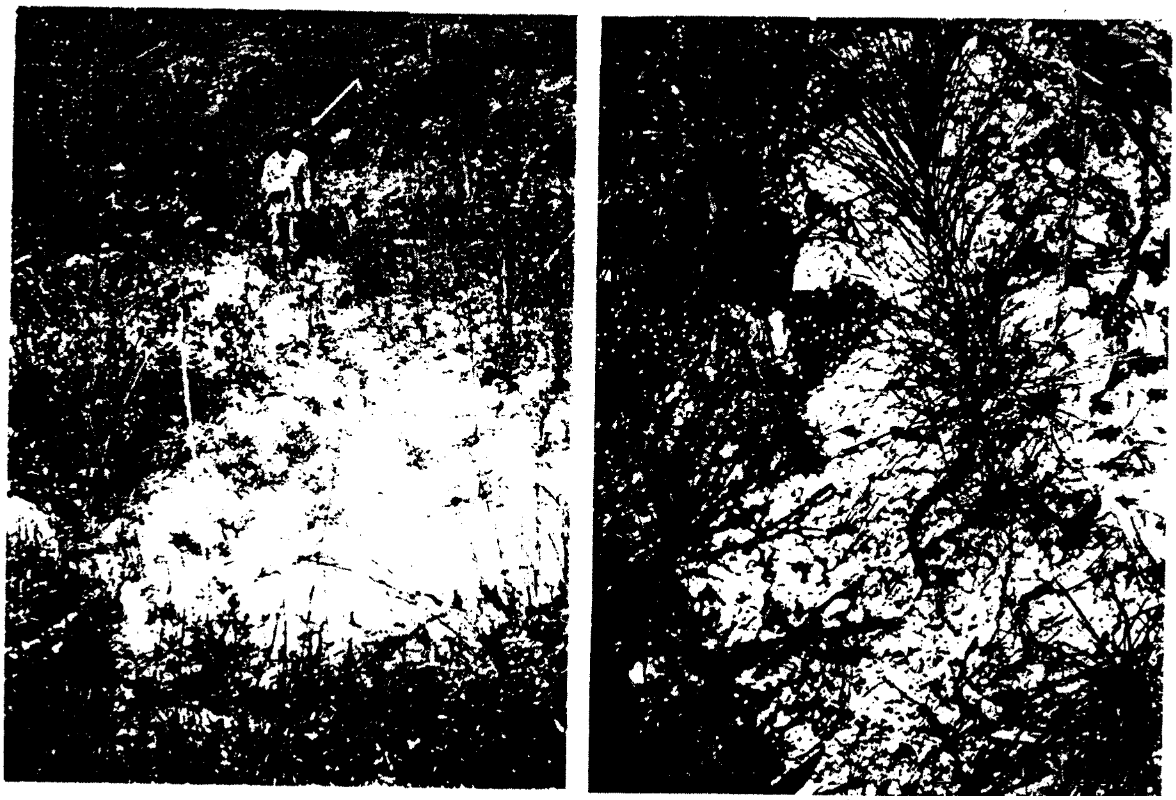

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Figure 1. a) Sheet and rill erosion on the windrowed area 2 years after treatment; b) curved stem on pine seedling caused by erosion.