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Understory Responses to Fertilization of Eroded Kisatchie Soil in Louisiana

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SUMMARY

Responses of native vegetation growing on highly eroded Kisatchie soil to a May 1982 application of 672 kg/ha of 16-30-13 fertilizer were monitored on two sites through 1985. Herbage increased from 1,133 kg/ha on control plots to 4,956 kg/ha on fertilized plots by August of the first year. Litter accumulations on treated plots provided excellent soil protection through the fourth year but helped to reduce herbage production nearly to pretreatment levels by August 1985. Woody-plant cover had nearly doubled on fertilized plots by May 1985.

INTRODUCTION

The Kisatchie soil series (a fine, montmorillonitic, thermic Typic Hapludalf) has the highest erosion potential of any soil on the 241,900-ha Kisatchie National Forest. This soil covers approximately 11,400 ha of National Forest land in Louisiana, with about 12 percent on slopes less than 5 percent, 65 percent on slopes of 5 to 40 percent, and 23 percent on sites classified as gullies. This soil series is characterized by thin surface horizons, high acidity, low natural fertility, and relatively sparse vegetative cover. Monitoring of erosion on characteristic sites on the Kisatchie District in 1980 revealed natural sheet-erosion losses averaging 186 t/ha (1.3 cm) and gully-erosion losses of 796 t/ha (5.3 cm). Soil losses of twice these levels occurred within the first year after a late-November control burn on a similar site.[1]

In May 1982 five sites totaling 89 ha were fertilized in an attempt to reduce soil losses. This report summarizes vegetative responses on two of these sites through the fourth growing season following treatment.

STUDY AREAS AND METHODS

The two study areas are located on the Kisatchie Ranger District in west-central Louisiana. Area I, consisting of 19 ha, was a 44-year-old sparsely stocked pole-timber stand of primarily longleaf pine (*Pinus palustris*) with some loblolly pines (*P. taeda*). Area II consisted of 20 ha of seedling loblolly pine planted in February 1982. Longleaf pines dominated Area II prior to logging. The 50-year site index for longleaf pine for Areas I and II is 12.2 m and 18.3 m, respectively.

A 16-30-13 granular fertilizer formulation was applied by helicopter at the rate of 672 kg/ha to both sites in May 1982. Area I was treated on May 18 and 19; Area II was treated on May 21. Untreated 3.6-ha strips along the edges of both treated areas served as controls.

Vegetation was measured on eight 30.5-m permanent transects located in each treated and control unit. Transects within fertilized areas were randomly located; those of the control strips were selected to match vegetative conditions along treated transects. Transects were confined to slopes of less than 10 percent. Vegetation within gullies was not measured, but some general observations were made.

The herbaceous standing crop (reported as oven-dry weight) was estimated in late August 1982, 1983, and 1985 by clipping seven 0.14-m^2 quadrats within 2 m of

[1]Unpublished Forest Service report by soil scientist Lynn Schoelerman: "Soil Monitoring Plan for Prescribed Burning on Kisatchie National Forest, Kisatchie Ranger District, Bayou Luce Sub-Watershed", 21 July 1980.

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each transect, for a total of 56 plots in each of the four sampling areas. Other measurements were made in May 1982 just before treatment and again in May 1983 and 1985. Woody-plant cover to a height of 1.52 m was determined over the permanent transects using line intercept methods (Canfield 1941). Bare ground, rock, and vegetative cover (defined as litter plus live vegetation) were ocularly estimated within a 19-mm (3/4-in) diameter circular loop (Parker and Harris 1959) at 100 points along a marked line stretched tightly between transect stakes. These cover measurements were recorded to the nearest 25-percent increment, i.e., 0, 25, 50, 75, and 100 percent. Plants rooted within the loop were tallied and used to compute plant composition by absolute frequency. When more than one plant was rooted within the loop, only the plant nearest the center of the loop was recorded.

RESULTS

Ground Cover

Vegetative cover was comparable within areas before treatment, averaging about 66 percent on Area I and 85 percent on Area II (fig. 1). Recent logging debris accounted for the higher cover on Area II.

Vegetative cover on control plots of Area I increased from 68 to 84 percent from May 1982 to May 1985 but remained nearly constant at about 87 percent on control plots of Area II (fig. 1). Vegetative cover increased to about 96 percent on both treated areas 1 year after fertilizing and averaged 95 percent 3 years after treatment.

Woody Plants

Woody-plant cover was similar among all four sampling areas just before treatment in May 1982, averaging 5.8 percent on Area I and 4.8 percent on Area II (fig. 2). Carolina jessamine (*Gelsemium sempervirens*), yaupon (*Ilex vomitoria*), southern waxmyrtle (*Myrica cerifera*), and blackjack oak (*Quercus marilandica*) were principal species on Area I; yaupon, winter huckleberry (*Vaccinium arboreum*), and blueberries (primarily *Vaccinium elliottii* and some *V. corymbosum*) were most prevalent on Area II (table 1).

By May 1983, cover on fertilized plots had increased 129 percent on Area I and 156 percent on Area II, compared to increases on control plots of 22 percent on Area I and 6 percent on Area II (fig. 2). By May 1985, woody-plant cover on fertilized plots averaged twice that of controls on Area II and was nearly as great on Area I. These

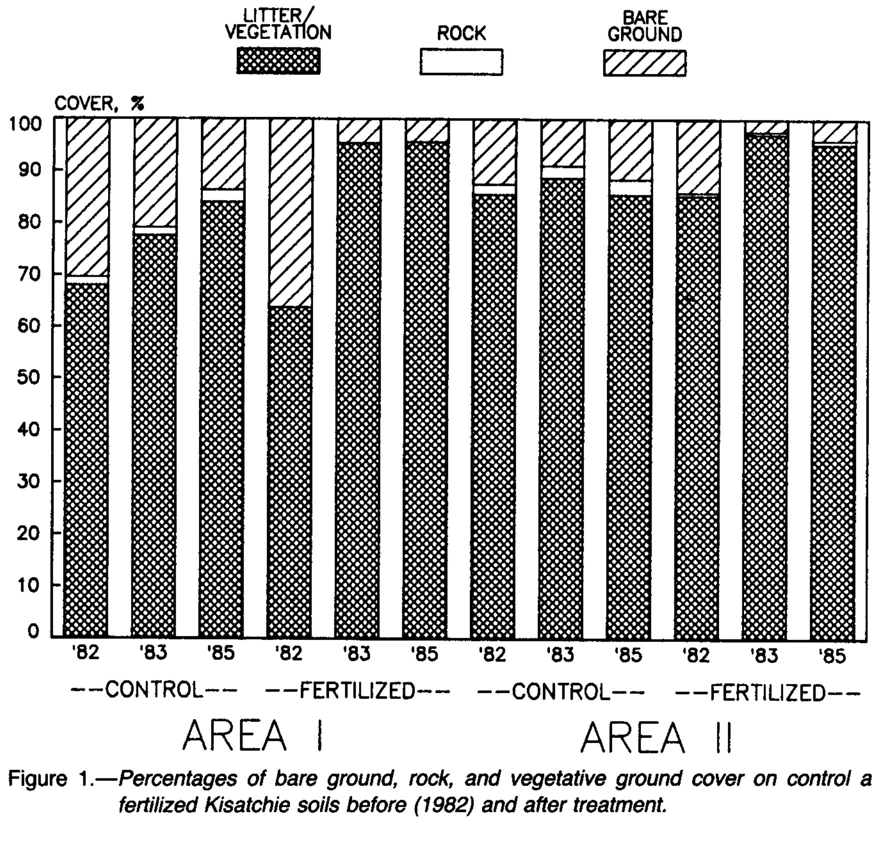

Figure 1.—*Percentages of bare ground, rock, and vegetative ground cover on control and fertilized Kisatchie soils before (1982) and after treatment.*

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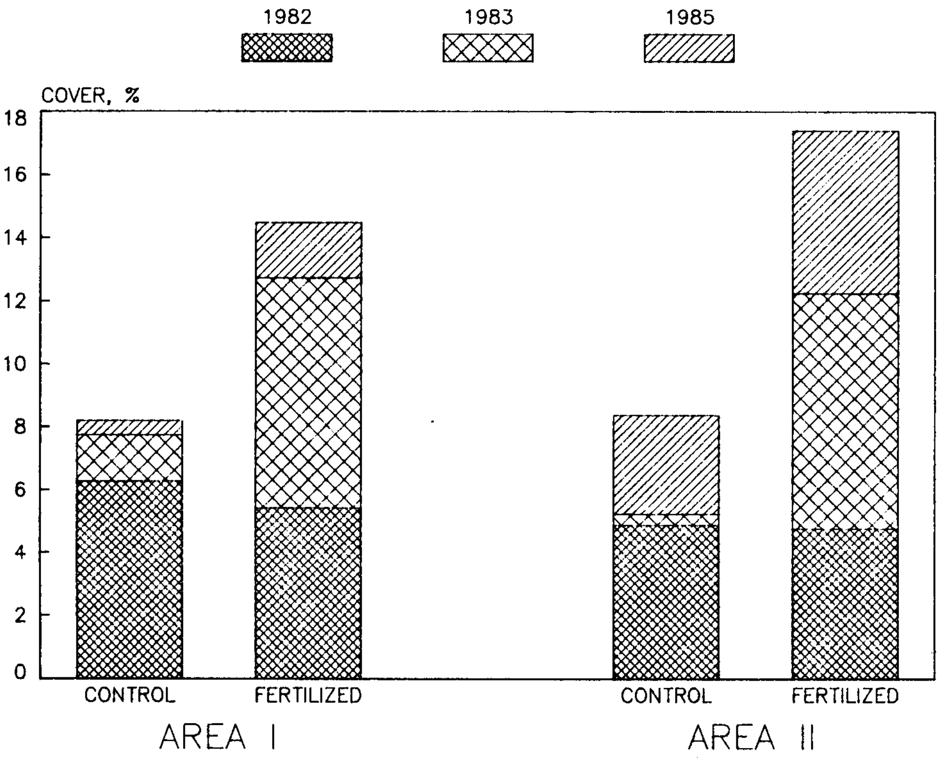

Figure 2.—*Accumulative percentages of woody-plant cover on control and fertilized plots in May before treatment (1982) and during 1983 and 1985.*

increases were attributed mostly to yaupon and southern waxmyrtle on Area I and to southern waxmyrtle, yaupon, blueberries, and blackberries (*Rubus,* spp.) on Area II (table 1).

Herbaceous Plants

The herbaceous standing crop on control plots varied substantially among years. Production on Area I control plots in 1985 (2,208 kg/ha) was more than double that of 1982 (863 kg/ha) and 1983 (952 kg/ha), and 1983 production on Area II (2,098 kg/ha) was nearly double the average (1,200 kg/ha) for 1982 and 1985 (fig. 3).

Fertilized plots produced an average of 4,956 kg/ha of herbage in August 1983 compared to 1,133 kg/ha on control plots (fig. 3). Area I received an estimated 7–13 mm of rain immediately after treatment, but Area II received no rain for 26 days after treatment. Consequently, treated plots on Area I responded more rapidly to treatment, and by August 1983 the herbaceous standing crop on Area I was 14.1 percent greater (5,281 vs. 4,630 kg/ha) than that on Area II.

Herbage composition values summarized in table 2 are based on absolute frequencies, i.e., the number of rooted-plant occurrences/800 sampling points. Low panicum grasses (*Dicanthelium* spp.) and pinehill bluestem (*Schizachyrium scoparium* var. *divergens*) were the most abundant taxa on both sites, together with beakrushes (*Rhynchospora* spp.) and rayless goldenrod (*Biglowia nuttallii*) on Area I before treatment.

Following treatment, pinehill bluestem formed dense stands 1- to 1.5-m tall over much of both treated areas and accounted for most of the increase in herbage during the first year. As this herbage died over winter, a thick mat of litter accumulated that had a smothering effect on subsequent herbage production. Compared to 1982, the herbaceous standing crop on fertilized plots had decreased 52.5 percent on Area I and 26.7 percent on Area II by 1983 (fig. 3). By August 1985, the standing crop on fertilized plots had nearly declined to control plot pretreatment levels. However, despite decreases in standing live herbage, ground cover remained at 95 percent in May 1985 (fig. 1).

Low panicum grasses showed initial increases in frequency following treatment but declined to below pretreatment level by 1985, presumably because of dense litter accumulations. Rayless goldenrod and beakrushes also decreased substantially on Area I following treatment. Twofold and threefold increases in pinehill bluestem composition on fertilized plots of Areas II and I, respectively, persisted through 1985 (table 2).

Table 1.—*Line-intercept coverage (%) of principal woody plants on control and fertilized plots before fertilization (1982) and during 1983 and 1985*

	Area I						Area II					
	Control			Fertilized			Control			Fertilized		
Taxa	1982	1983	1985	1982	1983	1985	1982	1983	1985	1982	1983	1985
Gelsemium sempervirens Carolina jessamine	0.6	1.0	1.6	0.6	1.7	1.9	0.3	0.4	1.3	0.1	0.2	0.3
Ilex vomitoria Yaupon	2.9	3.4	3.6	2.8	6.7	6.9	1.8	1.8	2.4	0.6	1.8	2.1
Myrica cerifera Southern waxmyrtle	0.7	1.3	1.0	1.0	2.3	3.2	0.5	0.2	0.9	0.4	2.0	3.5
Pinus palustris Longleaf pine	0.5	0.5	0.4	0.1	0.0	<0.1	0.1	0.0	0.0	0.0	0.1	0.2
P. taeda Loblolly pine	0.1	<0.1	0.1	0.1	0.3	0.8	0.1	0.1	1.0	0.1	0.5	1.2
Quercus marilandica Blackjack oak	1.4	1.3	1.4	0.6	0.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Rubus spp. Blackberry	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.1	<0.1	0.1	0.7	0.9
Vaccinium arboreum Winter huckleberry	0.0	0.0	<0.1	0.1	0.3	0.2	0.8	0.8	1.1	0.9	2.6	2.9
V. spp.[1] Blueberries	<0.1	0.0	0.0	0.1	0.2	0.4	1.1	1.6	1.4	1.2	3.3	4.4
Others[2]	<0.1	0.2	0.1	0.2	0.2	0.5	0.4	0.3	0.2	0.4	1.1	1.9
Total	6.3	7.7	8.2	5.6	12.6	14.4	5.2	5.3	8.3	3.8	12.3	17.4

[1] *Vaccinium elliottii* and *V. corymbosum.*

[2] Consisted of trace amounts of *Acer rubrum, Ascyrum hypericoides, Berchemia scandens, Callicarpa americana, Chionanthus virginicus, Crataegus crus-galli, C. marshallii, Diospyros virginiana, Pinus echinata, Quercus nigra, Smilax glauca,* and *Vaccinium stamineum.*

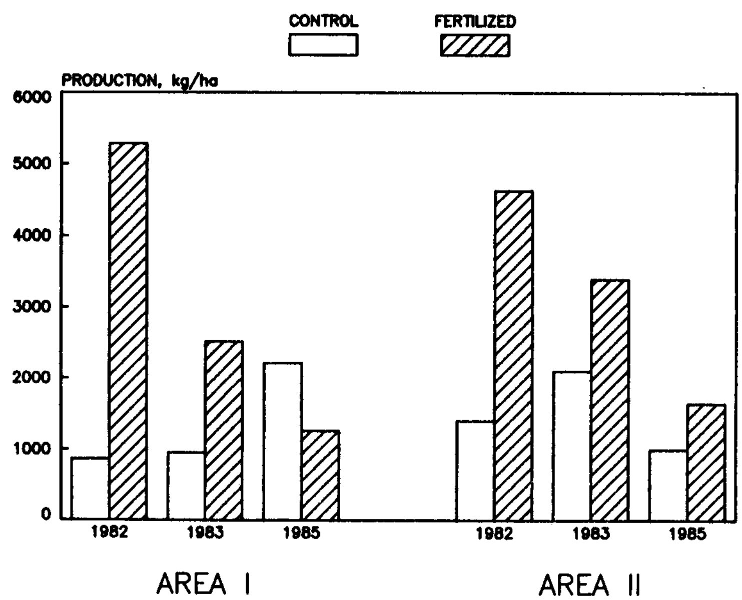

Figure 3.—*Herbaceous standing crop on control and fertilized plots during August of the treatment year (1982) and during August of 1983 and 1985.*

Table 2.—*Herbaceous botanical composition (%) on control and fertilized plots before fertilization (1982) and during 1983 and 1985*

	Area I						Area II					
	Control			Fertilized			Control			Fertilized		
Taxa	1982	1983	1985	1982	1983	1985	1982	1983	1985	1982	1983	1985
Grasses												
Aristida purpurascens Arrowfeather threeawn	0.0	0.1	0.0	0.0	1.9	0.0	0.0	0.1	0.0	0.0	0.1	0.0
A. spp. Threeawns	0.2	0.9	0.8	0.2	0.1	0.0	0.8	1.0	0.0	0.0	2.3	0.0
Dicanthelium spp. Low panicum grasses	6.4	5.4	6.1	3.1	4.3	1.1	11.0	10.2	6.1	9.6	11.1	3.0
Muhlenbergia expansa Cutover muhly	1.8	1.1	1.9	0.8	1.2	1.6	0.0	0.1	0.0	0.3	0.8	0.5
Schizachyrium scoparium var. *divergens* Pinehill bluestem	3.8	6.4	7.6	7.4	23.0	22.8	7.2	6.6	7.7	5.6	11.9	10.1
S. tenerum Slender bluestem	0.0	0.3	0.6	0.0	0.1	0.5	0.4	0.4	1.6	0.1	0.6	0.4
Others	0.2	0.1	0.0	0.0	0.5	0.6	0.0	0.0	0.0	0.0	0.1	0.1
Subtotal	12.4	14.3	17.0	11.5	31.1	26.6	19.4	18.4	15.4	15.6	26.9	14.1
Grasslike Plants												
Rhynchospora spp. Beakrushes	5.5	6.8	5.8	3.8	2.3	1.3	1.3	0.8	1.5	1.8	4.4	3.0
Scleria ciliata Fringe razorsedge	1.0	1.6	1.6	1.4	2.1	1.2	1.4	1.4	0.5	2.3	3.2	1.5
Others	0.4	0.2	0.0	1.0	0.2	0.0	0.2	0.6	0.0	0.2	0.0	0.1
Subtotal	6.9	8.6	7.4	6.2	4.6	2.5	2.9	2.8	2.0	4.3	7.6	4.6
Other Herbs												
Aletris spp. Stargrasses	0.4	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aster dumosa Bushy aster	0.8	0.4	0.1	0.2	0.0	0.8	0.0	0.1	0.1	0.1	0.4	0.0
Biglowia nuttallii Rayless goldenrod	9.0	10.3	10.9	12.6	7.3	4.0	4.0	4.2	4.5	0.2	0.0	0.1
Helianthus angustifolius Swamp sunflower	0.9	1.1	0.4	0.5	0.9	0.9	0.9	1.8	3.1	0.9	3.2	3.5
Liatris spp. Gayfeathers	0.1	1.4	1.8	0.1	0.5	0.1	1.4	0.8	2.6	0.6	0.9	1.0
Lichens	1.9	2.8	3.6	2.8	0.4	0.1	1.8	2.1	1.6	0.0	0.0	0.0
Selaginella spp. Spikemosses	0.9	0.4	1.2	0.6	0.6	1.8	0.8	1.9	2.9	0.6	0.8	2.1
Others	1.7	1.4	1.6	1.3	1.3	1.4	1.4	1.7	1.7	2.7	1.7	1.4
Subtotal	15.7	18.2	19.8	18.2	11.0	9.1	10.3	12.6	16.5	5.1	7.0	8.1
Total	35.0	41.1	44.2	35.9	46.7	38.2	32.6	33.8	33.9	25.0	41.5	26.8

DISCUSSION

The fertilizer used in this study was a custom formulation designed to meet pine nutrient deficiencies. As such, this formulation was not necessarily optimum for native herbage growing on these sites. Consequently, it was probably not the most cost-effective formulation for reducing soil erosion losses.

Pine responses to this treatment were not measured, but Shoulders and Tiarks (1984) indicated that fertilization of young pines without subsequent control of competing vegetation may result in limited pine response. On these erosion-prone sites, soil protection should initially take precedence over timber production. Thus, additional research could yield a more cost-effective fertilizer formulation for herbaceous vegetation growing on these sites.

We did not monitor vegetation changes in gullies but did observe substantial grass (primarily pinehill bluestem) establishment on the more level, lower portions of several adjacent gullies. The excellent vegetation cover that developed on the adjoining uplands following treatment should reduce overland flow and thereby reduce gully erosion substantially.

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