Responses of Southern Bluestems to Pine Straw Mulch, Leachate, and Ash

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Highlight

Perennial grass production on southern bluestem range was not significantly affected by pine straw mulch, ash, or leachate. Pine straw mulch and ash significantly reduced the perennial grass basal cover index but increased bluestem flower-stalk density.

To maintain high forage production, southern pine-bluestem ranges are customarily burned in winter or early spring every few years after considerable pine straw has accumulated (Wahlenberg et al., 1939). This paper reports a study of the possible causes for the production decreases that are known to occur when pine straw is allowed to accumulate. No single cause could be identified.

Experimental Area and Procedures

The study area is on the Palustris Experimental Forest in central Louisiana. It is longleaf pine-bluestem range that had been protected from grazing for 15 years and from fire for 7 years prior to study initiation. Herbaceous cover consisted primarily of pinehill bluestem (*Andropogon divergens*) and slender bluestem (*A. tener*) with lesser amounts of panicums (*Panicum* spp.) and paspalums (*Paspalum* spp.). No tree overstory was present on study plots.

Treatments consisted of mulching with pine straw, burning immediately after mulching with pine straw, watering with pine straw leachate, and a nontreated check. The treatments were designated mulch, ash, leachate, and control, respectively. Mulch, ash, and leachate treatments utilizing pine straw at rates of 5, 10, and 15 tons/acre were designated light, moderate, and heavy, respectively. Recently cast longleaf pine (*Pinus palustris*) needles were collected under nearby trees and ovendried 48 hours at 24 C.

[1] Received January 20, 1971.

The 10 treatments replicated four times were randomly assigned to 5- by 5-ft plots. Forage data were collected from 3.1- by 3.1-ft quadrats centered on each plot.

All plots were burned in early March to remove the old herbaceous litter. Pine straw was placed on the ash treatment plots just prior to the March burning to produce the prescribed levels of ash. Pine straw was placed on the mulch treatment plots immediately after burning and remained there until termination of the study. Pine straw for the leachate treatments was soaked with tap water in individual 30-gallon containers. Three gallons of water containing the leachate were applied to plots at approximately 2-week intervals from early April to September. At the same time 3 gallons of tap water were applied to all other plots. Water was replenished in the leachate container after each application.

Basal cover index of perennial grasses, pinehill and slender bluestem flower stalk density, and production of bluestems and other perennial grasses were determined in mid-September. Basal cover index was estimated by averaging 100 ¾-inch-diameter loop readings systematically spaced on each quadrat. Flower stalks were counted on each quadrat and production was determined by clipping to 1-inch stubble and ovendrying for 48 hours.

Results

Grass Production

Although perennial grass production after treatment ranged from less than 2000 to over 2800 pounds per acre, none of the treatment means differed significantly (0.05 level) from the average on control plots (Table 1). Other workers have reported that herbaceous vegetation decreases when pine straw is allowed to accumulate on southern pine-bluestem range (Wahlenberg et al., 1939; Heyward, 1939; and Hilmon and Hughes, 1965). In those studies, however, production was evidently influenced by overstory as well as mulch.

Basal Cover Index

Basal cover of perennial grasses appeared to be less on mulch and ash plots than on leachate-treated and control plots when spring regrowth began. The low basal cover index persisted throughout the growing season on most of the ash and mulch treatments (Table 2). Partial to complete mortality of crowns of perennial grasses was

Table 1. Perennial grass production (lbs./acre) on longleaf pine-bluestem range in September after treatment in March.

Treatment	Bluestems	Other perennial grasses	Total production
Heavy mulch	1878[1]	60[1]	1938[1]
Moderate mulch	2072	24	2096
Light mulch	2026	140	2166
Moderate leachate	2132	74	2206
Light leachate	2105	135	2241
Heavy ash	2266	36	2302
Control	2358	45	2403
Heavy leachate	2507	92	2599
Light ash	2580	44	2624
Moderate ash	2817	32	2849
Average	2274	68	2342

[1] Treatment differences not statistically significant at 0.05 level, according to Duncan's multiple range test.

Table 2. Perennial grass basal cover index on longleaf pine-bluestem range in September after treatment in March.

Treatment	Basal cover index
Heavy mulch	9.25a[1]
Moderate mulch	14.50ab
Heavy ash	18.50abc
Light mulch	24.25abcd
Moderate ash	24.75abcd
Light leachate	29.50bcd
Heavy leachate	30.75cd
Control	31.75cd
Light ash	34.50d
Moderate leachate	36.00d

[1] Means followed by the same letter do not differ significantly at the 5% level.

apparent in mid-June on the moderate and heavy ash treatments (Fig. 1). Evidently, burning high quantities of pine straw produced sufficient heat to kill some of the grasses. Earlier studies have reported similar effects (Wahlenberg et al., 1939; Duvall and Linnartz, 1967). Since the light ash treatment did not reduce the basal cover index, burning apparently is not significantly detrimental to the plants until the heat exceeds a certain amount.

Moderate and heavy mulching delayed spring

FIG. 1. Pinehill bluestem range in mid-June. Light ash (*upper right*), moderate ash (*upper left*), heavy ash (*lower left*), and control (*lower right*) treatments were applied during late winter.

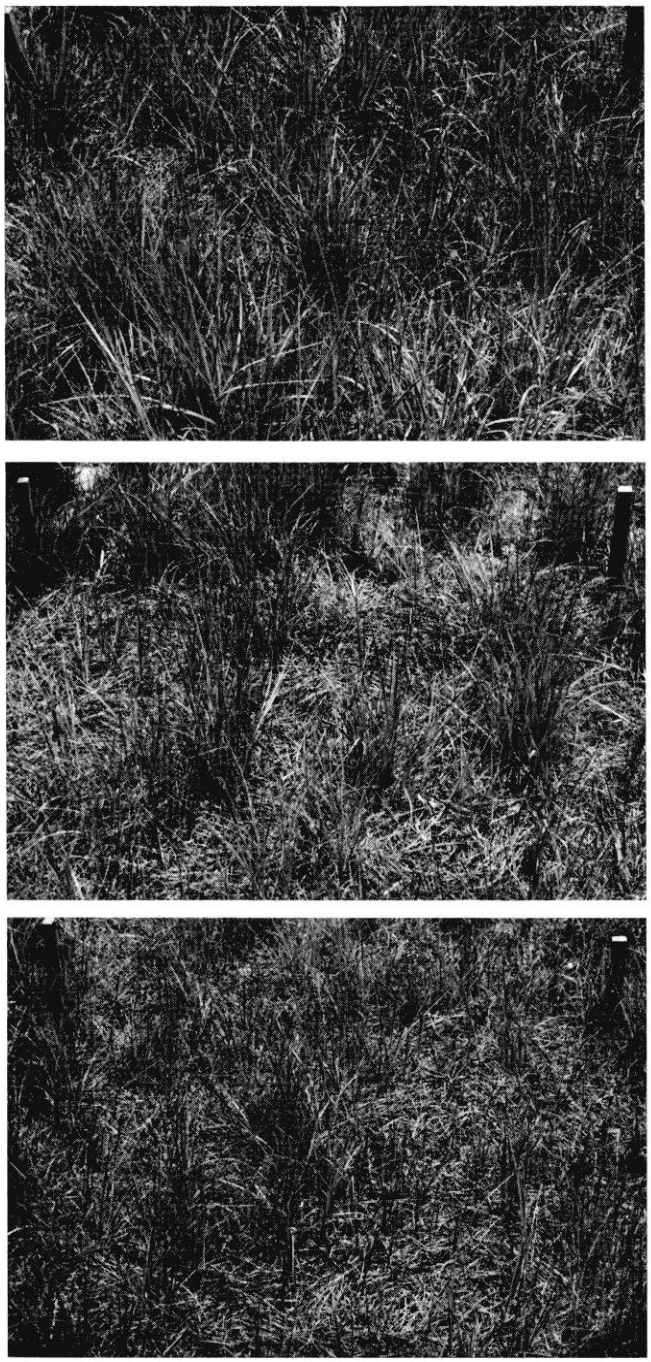

FIG. 2. Pinehill bluestem range in mid-June after light (*upper*), moderate (*middle*), and heavy (*lower*) mulching with pine straw.

regrowth (Fig. 2), and low herbage density persisted throughout the growing season. Delayed regrowth on deeply mulched plots was probably due to low soil temperatures as monitored by other workers (Weaver and Rowland, 1952; Ehrenreich, 1959). Furthermore, deep mulching apparently inhibited tiller development. Sparse herbage density was the result of only a few tillers initiating growth under heavy mulch; observations indicated that all tillers which initiated growth successfully penetrated the pine straw layers. Similar effects were observed with herbaceous litter (Hulbert, 1969).

Table 3. Bluestem flower-stalk density on longleaf pine-bluestem range in September after treatment in March.

Treatment	Seedstalks per 9.6 ft²
Moderate leachate	9a
Heavy leachate	18ab
Light mulch	28ab
Light leachate	30ab
Light ash	35ab
Control	35ab
Heavy ash	63ab
Heavy mulch	58b
Moderate mulch	71b
Moderate ash	74b

[1] Values followed by the same letter do not differ significantly at the 5% level according to Duncan's multiple range test.

Perennial grasses on the control and leachate-treated plots resumed growth soon after the herbaceous rough was burned. Differences in rate of growth and change in basal cover index were not observed within these treatments.

Flower-Stalk Density

On moderately and heavily ashed or mulched plots mature bluestems had two to eight times more flower stalks than on other plots (Table 3). Dix and Butler (1954) and Ehrenreich (1959) reported that bluestem flower-stalk density increased following fire. Increased flower-stalk density on mulched plots is contrary to earlier findings (Curtis and Partch, 1950; Weaver and Rowland, 1952).

Bluestem flower-stalk density (Y) was inversely related to the perennial grass basal cover index (X). However, the equation relating the two,

$$Y = 85.67 + 1.68\ X,$$

explained only 34% of the variation in stalk density. Reduction of perennial grass basal cover index probably reduced plant competition and the surviving more vigorous grasses utilized solar energy, available moisture, and essential plant nutrients for flower-stalk production. Flower-stalk density, stature, and coarseness increased after moderate and heavy ashing or mulching, while basal cover index decreased. Mulching and burning to remove the mulch were equally effective in decreasing basal cover and improving conditions for flower-stalk growth. Flower-stalk density and basal cover were not influenced by other treatments.

Since there was no significant difference in forage production due to treatment, the increased size

and number of flower stalks on plots with low basal area index apparently offset the greater amount of vegetative growth on treatments with higher basal area index. Similar changes from vegetative to reproductive growth following fire were cited by Burton (1944) and Ehrenreich (1959), and the latter author reported no significant effect of burning on total production.

Discussion

In previous studies, herbage production was shown to be increased equally by burning or close grazing (Duvall, 1962) and burning or mowing and raking (Grelen and Epps, 1967). The one common factor in the earlier studies was that all treatments removed the old accumulation of herbaceous material. In the present study burning to remove the herbaceous mulch on all plots apparently influenced production more than pine straw mulch, ash, or leachate.

Under natural conditions herbage production diminishes when pine straw is allowed to accumulate. However, the accumulation is a slow but continuous process as is the accompanying change in vegetation; duration of the present study may have been inadequate to allow measurable changes in vegetation to occur. Furthermore, the present study was conducted on a treeless range. In practical application an overstory canopy in combination with pine straw mulch would probably reduce herbage production and cover at a more rapid rate than mulch alone.

The study results indicate that longleaf pine straw is a physical barrier to southern bluestem growth. Apparently, straw prevents initiation of some tillers and heat from burning destroys some plants.

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Statement of Ownership, Management and Circulation
(Act of August 12, 1970: Section 3685. Title 39. United States Code)

1. *Title of Publication*: Journal of Range Management
2. *Date of Filing*: September 20, 1971 3. *Frequency of Issue*: Bimonthly
4. *Location of Known Office of Publication*: 2120 S. Birch St., Denver, Colo. 80222
5. *Location of General Business Offices*: 2120 S. Birch St., Denver, Colo. 80222
6. *Names and Addresses of*— *Publisher*: Society for Range Management, 2120 S. Birch St., Denver, Colo. 80222
   Editor: Elbert H. Reid, 624 S. Shields St., Fort Collins, Colo. 80521
   Managing Editor: Francis T. Colbert, 2120 S. Birch St., Denver, Colo. 80222
7. *Owner*: Society for Range Management, 2120 S. Birch St., Denver, Colo. 80222
   A nonprofit corporation with no capital stock authorized.
8. *Known Bondholders, Mortgagees, etc.*: None 9. (Not applicable).
10. *The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes have not changed during preceding 12 months.*
11. *Extent and Nature of Circulation*:

	Ave. for Preceding 12 Months	Actual for Issue Nearest Filing Date
A. Total No. copies printed	4966	4800
B. Paid circulation		
1. Dealers, vendors, counter sales	0	0
2. Mail subscriptions	4634	4671
C. Total paid circulation	4634	4671
D. Free distribution		
1. Samples, complimentary	32	35
2. To news agents, not sold	0	0
E. Total distribution	4666	4703
F. Office use, leftover	300	97
G. Total	4966	4800

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