Effect of Burning and Mowing on Composition of Pineland Threeawn

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Highlight: *The object of the experiment was to determine the effect of burning and mowing treatments on the composition of Pineland threeawn (*Aristida stricta *Michx) over a 5-year period. Treatments were control; burning annually; burning in alternate years; and mowing annually and in alternate years both with clippings removed or left on. Annual treatment dates varied from February 20 to March 6. Threeawn samples were analyzed for protein, ether extract, fiber, ash, calcium, magnesium, and phosphorus (P). The grass from all treatments improved in nutritional quality from March to June and decreased from July to the following March. There was a highly significant difference among collection dates in level of all seven nutritional factors, indicating strong seasonal trends. Effect on new growth was greater for protein than for the other factors. Samples collected from all plots 35 days after treatment averaged 5.9% protein, while grass collected 289 days after treatment had 3.8% protein, a reduction of 36%. Forage from threeawn plots either mowed or burned was higher in protein and lower in fiber and P than the control with no differences between the burned or mowed plots. Grass growth after burning approached the recommended minimum protein level for a nursing cow in only a few instances. Ash was lower in grass from the control than from the treated plots. Burning increased P compared to mowing. Threeawn from all treatments lacked sufficient P for good cattle production.*

Pineland threeawn (*Aristida stricta* Michx) (threeawn) commonly known as wiregrass, was the most common grass species on the unimproved flatwoods of central and south Florida in the 1940 decade and provided much of the forage for free-roaming range herds. The usual pasture management practice was the uncontrolled burning of different sections of a native range during the November to March period. The new growth for several weeks after burning was sparse but provided nutritious and palatable forage and all cattle responded with improved production if the range was not too heavily stocked.

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Since 1940 there has been a yearly increase in the establishment of improved grass pastures, thus native forage plays a reduced role in providing grazing for the rapidly expanding beef herds. The Institute of Food and Agricultural Sciences (1965), however, estimated there were over 2 million hectares (ha) of unimproved pasture, much of it in central and south Florda. Cattlemen use the combination of native range and highly developed pastures to provide year-round grazing. Native range frequently is reserved for grade cows after their calves are weaned until they freshen again 4 to 5 months later. By this method some improved pastures can be rested and others can be renovated or used to grow a crop of hay for supplemental winter feed. Pineland threeawn is still an important source of forage for the beef herd in the 1970's.

Yarlett (1965) describes several threeawn grass varieties adapted to the flatwoods of Florida. Pineland threeawn is the most prevalent grass on much of the cut-over pineland of central Florida. It appears to be adapted to low fertility fine sand soils of the Ona Agricultural Research Center (ARC). Moore (1974) reported that threeawn was a desirable forage for 3 to 4 months after burning but as it matured it became less palatable.

Response of a herd of native cows on a threeawn range, sections of which were burned each fall and winter, averaged 541 lb in March, 623 lb in June, 645 lb in September, and 621 lb in December (Kirk et al., 1945). The higher quality native forage from March to September increased carrying capacity, growth rate of calves, and weight of cows and improved the quality of market cattle.

Methods

The site selected to study the yearly composition change of threeawn under different treatments was cut-over pine land of Immokalee fine sand soil, typical of large areas of flatwoods in central Florida. Saw-palmetto [*Serenoa repens* (Bartr.) Small] occurred in abundance with a few second-growth pine trees (*Pinus palustris* Mill.). Palmettos on one half the experimental area were removed by grubbing and the remainder left untouched. Topography of the site was level and drainage was poor, similar to large areas of low fertility flatwoods land.

The treatment plan is shown in Table 1. Treatment date varied each year according to temperature and moisture conditions which affected grass growth. The first forage samples each year were collected from 30 to 43 days after treatment, averaging 35 days for the 5 years. Threeawn blades, approximately 225 grams green weight per sample, were plucked on the same day for all treatments.

Forage samples were obtained at 8 dates in 1945-46 and at 10, 8, 7, and 6 dates in following years. More grass samples were collected from April to June than in the other 3-month periods of the year to facilitate the

Table 1. Treatment plan.

Treatment dates	Treatment[1]						
		Burned		Mowed, clippings removed		Mowed, clippings left on	
	Control	Every year	Alternate years	Alternate years	Every year	Alternate years	Every year
3- 2-45	none	burned	burned	mowed	mowed	mowed	mowed
2-20-46	none	burned	none	none	mowed	none	mowed
3- 5-47	none	burned	burned	mowed	mowed	mowed	mowed
2-29-48	none	burned	none	none	mowed	none	mowed
2-17-49	none	burned	burned	mowed	mowed	mowed	mowed
Number of samples	39	39	31	31	39	31	39

[1] Four treatment areas in 1945 and seven in the following four years.

immediate effects of the treatments on forage composition. A total of 249 samples were analyzed on an air-dry basis for crude protein, ether extract (EE), fiber, ash, calcium, magnesium, and phosphorus at the nutrition laboratory, University of Florida, Gainesville, by the methods outlined by A.O.A.C. (1940).

Analytical results were calculated on a moisture-free basis using the formula Response/1.00-moisture with moisture expressed as a decimal fraction. Results on this basis were studied statistically using the analysis of variance technique. Differences in results of ($P < .05$) or greater reliability were accepted as significant.

Six contrasts among the treatments were studied to maximize the information from the statistical analysis.

1. Treatment vs control.
2. Annual vs alternate year burning.
3. Burning vs mowing.
4. Mowing, clippings removed vs clippings left on.
5. Annual vs alternate year mowing.
6. Interaction between 4 and 5.

Results and Discussion

Rainfall previous to and after burning or mowing affected forage composition. For example, the protein of threeawn obtained from all treatments on April 7, 1947, averaged 8.19% protein after 12.07 inches of rain the previous months, while samples collected April 10, 1950, averaged 3.61% protein when rainfall totaled 1.79 inches January to March (McCaleb and Hodges, 1960). Rainfall had more effect on protein level of threeawn than on the six other nutritional factors studied.

The first collection of grass after treatment was always included in the April to June period. Threeawn forage samples from April to June had higher levels of protein, EE, Ca, Mg, and P and lower levels of ash than for the other periods of the year (Table 2). Fiber and ash percentages were highest in July to September and protein and Mg the lowest in January to March. Analysis of variance showed that there were highly significant seasonal differences for each of the seven nutritional factors in every year except for Ca and P in the first year. The main effect means for all samples of threeawn are given in Table 3.

Crude Protein

The average protein level during the 5-year period ranged from 3.71% (control) to 4.65% (burned every spring). The highest average protein level, 4.65%, furnished only 51% of the protein required for the adequate nutrition of a producing cow according to the National Research Council (1963) (NRC). Protein content of threeawn from all treated areas was significantly greater than grass from the control but differences observed among the burned and mowed areas were not significant.

Sampling date means show that protein level in threeawn was highest in late March and April with the most rapid decrease from June to September. There was a slight increase in protein from January to March 1947 when soil moisture and weather conditions were favorable for grass growth. The greatest increase in level of protein occurred when nursing cows require this element for milk production. The effect of the different treatments on composition of threeawn was more apparent for protein than with the other six factors studied.

Seasonal trends in percentage protein in threeawn from the control and average of six treated areas for 1947-48 are illustrated in Figure 1. The eight samples from the control averaged 3.59% and the 48 from the six treated areas 4.25% protein, an 18% higher yearly level in favor of the treatment areas. The significant facts to be observed from Figure 1 are: protein in the grass from the control generally decreased throughout the year; treated areas showed a rapid increase in protein after treatment, going from 4.1% 13 days before treatment to 8.8% 30 days after treatment, an increase of 115%; after reaching its maximum, protein of treated areas rapidly returned to their pretreated levels, being 4.2% 80 days after treatment; and after 110 days, there was no essential difference between control and treated areas.

The protein level of the 249 threeawn samples collected over a 5-year period ranged from 1.20% (1-20-48, mature grass mowed every year, clippings left on) to 11.46% (4-4-47, burned alternate years and obtained 30 days after treatment). Thus during six short periods after burning treat-

Table 2. Average composition (%, dry matter) of threeawn by 3-month periods, all treatments.

Period	No. of samples	Composition						
		Protein	EE	Fiber	Ash	Ca	Mg	P
Apr. to June	13	5.39	1.96	35.72	3.30	0.53	0.22	0.085
July to Sept.	10	3.77	1.91	36.49	3.52	0.45	0.15	0.076
Oct. to Dec.	8	3.59	1.58	34.66	3.38	0.37	0.14	0.076
Jan. to Mar.	8	3.31	1.80	35.46	3.51	0.37	0.10	0.076

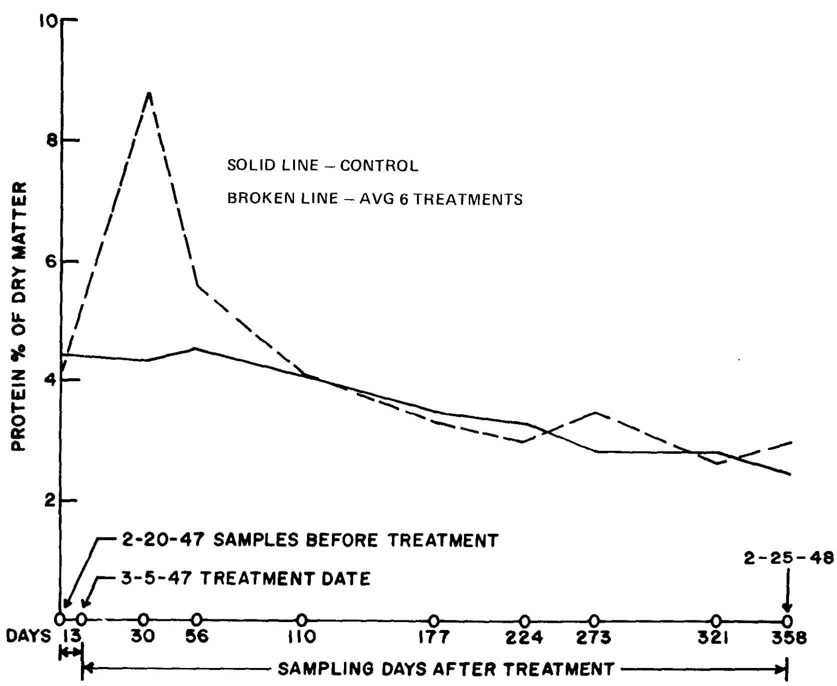

Fig. 1. *Percentage protein in pineland threeawn grass from control and average of six treated areas for nine collection dates in a year.*

ment did protein content of threeawn meet optimum requirements of 9.2% for good animal production (NRC, 1970), while for most periods of the year the grass is inadequate in protein.

Ether Extract

Average ether extract of threeawn from all treatments ranged from 1.67% (mowed alternate years, clippings left on) to 1.86% (burned every year) with a mean of 1.71% for the 249 samples. The extreme levels in single samples were from 0.83% (8-3-49, burned alternate years) to 5.54% (8-1-45, mowed alternate years, clippings left on). There was a significant difference in level of ether extract in threeawn between sampling dates in each of the 5 years. An analysis of variance showed a highly significant difference between dates with years but no detectable difference among the six contrasts.

Fiber

Average fiber content of threeawn from all treatments varied from 35.19% (mowed alternate years, clippings left on) to 36.05% (control) with a mean of 35.58% for all samples. Level of fiber in single samples ranged from 24.73% (8-29-47, mowed alternate years, clippings removed to 42.20% (9-12-45, mowed alternate years, clippings left on). Davis and Kirk (1952) obtained similar values, 23.24% for very young to 36% to 40% fiber for mature forage. There was a significant difference in fiber content between collection dates in each of the 5 years and between years, with the lowest in year 3 (33.25%) and the highest in year 2 (37.90%). A suggested reason for the variation in fiber level is in the difference in total rainfall, 69.91 inches in year 3 and 52.67 inches in year 2 (McCaleb and Hodges, 1960).

Frequency of mowing had some influence on the fiber level, but this was not consistent over the 5 years of the experiment. The observed differences favoring alternate year mowing were not significant except for year 3, when fiber was higher in plots mowed annually.

Ash

Average ash content of threeawn ranged from 3.17% (control) to 3.63% (burned alternate years). Single samples of forage varied from 2.25% (6-2-48, burned alternate years) to 7.3% (4-4-47, burned alternate years) with an average of 3.43% for all samples. Ca, Mg and P made up 12.8%, 5.5% and 2.2%, respectively, or 20.5% of the total ash. Forage analysis revealed a greater percentage of ash from all treated areas than from the control.

There was a highly significant difference in ash of grass between sampling dates in each of the 5 years. Except for year 1 there was a significant difference between the control and treated areas, with treated areas having a higher level of ash. The plot which was burned alternate years had a higher ash content than the plot burned annually. Leaving clippings on after alternate-year mowing reduced forage ash below that of the clipping removal treatment. Clipping removal and non-removal had no effect on forage ash under annual mowing.

Ash level was found to significantly interact with years X treatments between treatment vs control, annual

Table 3. Average composition (%, dry matter) of threeawn from the six treatments and the control plots.

No.	Treatment	No. of samples	Composition						
			Protein	EE	Fiber	Ash	Ca	Mg	P
1	Control	39	3.71	1.80	36.05	3.17	0.43	0.19	0.083
	Burned:								
2	Every year	39	4.65*	1.86	35.44	3.57	0.44	0.18	0.091
3	Alternate years	31	4.09*	1.79	35.34	3.63	0.42	0.19	0.086
	Mowed, clippings removed:								
4	Alternate years	31	4.07*	1.68	35.19	3.46	0.40	0.17	0.069
5	Every year	39	4.47*	1.79	35.52	3.36	0.46	0.20	0.076
	Mowed, clippings left on:								
6	Alternate years	31	3.93*	1.67	35.43	3.31	0.44	0.19	0.068
7	Every year	39	4.22*	1.78	35.92	3.51	0.45	0.19	0.067

*Significantly higher than control.

vs alternate year burning, burning vs mowing, and removal of clippings vs clippings left on. Interaction showed that removal of clippings reduced the ash if alternate year mowing was employed but increased the response if grass was mowed annually. Similarly, alternate year mowing increased ash when clippings were removed and decreased the response if left on the area.

Calcium

The five-year average of calcium in threeawn from the seven treatments ranged from 0.40% (mowed alternate years, clippings removed) to 0.46% (mowed every year, clippings removed). Single samples of grass had 0.11% (4-30-47, control) to 1.28% (4-1-49, burned alternate years) Ca with an average of 0.44% for all samples. Thus the medium value provided more than sufficient Ca to meet the needs of all classes of beef cattle (0.30% of ration, Cunha et al., 1964) although 33% of the samples were deficient in this essential nutrient element. There was a difference between collection dates each year in level of Ca. In the third year, 1947-48, level of Ca was higher when clippings were left on compared to when they were removed. Analysis of the 5-year data detected a highly significant difference between dates with years but no difference between treatments and years × treatments.

Magnesium

Average magnesium content of threeawn ranged from 0.17% (mowed alternate years, clippings removed) to 0.20% (mowed every year, clippings removed) for the seven treatments, with a mean of 0.19% for all samples. Variation in level of Mg in individual samples was from 0.01% (1-15-46, burned every year) to 0.64% (8-29-47, mowed every year, clippings left on), with 88% being above the 0.06% level requirements of Florida beef cattle (Cunha et al., 1964). As with all factors studied there was a significant difference in level of Mg between collection dates for each year.

There was a difference between burning vs mowing in year 3, with level of Mg being higher in forage from plots which had been mowed. Magnesium was increased in year 1 when clippings were removed. Frequency of mowing interacting with years affected the level of Mg, and this interaction was found to be significant because the magnitude of the difference was not consistent from year to year.

Phosphorus

Phosphorus level in threeawn from seven treatments varied from 0.067% (mowed every year, clippings left on) to 0.091% (burned every year), with a mean of 0.077% for all samples. Variation in single samples of grass was from 0.044% (6-2-48, control to 0.16% (burned alternate years).

Becker et al. (1953) recommended 0.13% P in dry ration, but only 11% of the 249 grass samples equalled or excelled this level. Cunha et al. (1965) stated that the Florida cow ration should have 0.25% P and NRC (1970) that the ration of a nursing cow contain 0.22% P.

Significant differences in level of P were detected among sampling dates except in year 1. Annual vs alternate-year burning increased P in the threeawn in year 4. Except in year 1, threeawn from burned areas had more P than grass from areas that were moved. Only in year 4 did removal of clippings increase P.

Analysis of data showed that variation among sampling dates within years was highly significant. Threeawn from treated plots had lower P level than grass from the control. Burning threeawn increased the amount of P compared to mowing.

Summary

The data has historical and current value as there is little information in the literature showing the effect of season and management treatment on the composition of threeawn. Burning grass every second or third year is fully as applicable in 1974 as 30 to 40 years earlier on the over 2 million ha of Florida range. Camp (1932) found that burning mature threeawn grass stimulated new forage growth, removed unpalatable mature grass of low nutritional value, and reduced ground cover of saw-palmetto and brush. Other advantages of systematic controlled burning include the reduction of insects which annoy cattle and the lessening of danager of wild fire which could destroy ranch buildings and forage on adjacent improved pastures. Controlled burning an area of the native range in the late fall and a similar area in the winter months will provide the herd with palatable feed over a longer period of the year. Mowing of native range is not considered practical in 1974. Chopping with a medium weight machine controls brush growth and reduces the ground area shaded by saw-palmetto with little injury to a stand of threeawn if the operation is performed when soil moisture is adequate.

Frequent observation showed no observable change in density of stand of threeawn over the 5-year treatment period, although there were more threeawn plants where saw-palmetto had been removed. There was no intrusion of carpet grass (*Axonopus affines* Chase) and creeping bluestem (*Andropogon stonifer* Nash), which would indicate a slight improvement in soil fertility.

Cows grazing threeawn with an average of 4.18% protein and 0.077% P would not produce up to their potential and might develop deficiency diseases. Kirk et al. (1974) found that factors which permitted the maintenance of a herd on the adjoining 324 ha native range to the plots of this experiment during the same period in a moderately productive state were: separate areas of each pasture were burned each fall and winter; herd had access to a large area; soil types varied from flatwoods to lower sites which were more fertile and produced more nutritious forage; herd had free access to a mineral mixture containing Ca, P, common salt, iron, copper, and cobalt; four of the five lots in this trial were given limited feed from November to March, which supplied a minimum of protein and energy nutrients.

All seven treatments of threeawn coupled with new spring growth improved in nutritional quality from March to June. Forage growth was sparse after treatment, but it was not mixed with mature grass except on the control plot. There was a decrease in feeding value as the threeawn matured from July to the following March. Extremes of moisture and frost in late winter and early spring affected quality of new threeawn growth.

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