Research note

Response of Shaw creeping vigna and a perennial alyceclover accession to burning

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Introduction

Most grasslands have developed under burning, and the dominant grasses are tolerant of burning (Roberts 1979; Hodgkinson 1986). Roberts (1979) suggested that burning provided advantages to grasses over desirable pasture legumes, whereas Pressland (1982) considered that native legumes in Queensland speargrass were temporarily enhanced by burning. Some desirable pasture legumes including ecotypes of several *Stylosanthes* species, *Zornia latifolia, Centrosema venosum, Galactia glaucescens* and *G. jussiaeana* are tolerant of burning, possibly due to the ability to produce fruits underground (*C. venosum*), extensive development of tuberous roots containing organic reserves and regrowth points (*G. jussiaeana*) (Schultze-Kraft and Giacometti 1979), or the presence of underground buds initiating from root meristems (*Stylosanthes*) (Mott 1982).

Accidental burning of adjacent stands of bahiagrass (*Paspalum notatum*) with either Shaw creeping vigna (*Vigna parkeri*) or a perennial alyceclover (*Alysicarpus vaginalis*) ecotype at Ona, Florida in early spring of 1988 appeared to stimulate the alyceclover but eliminated Shaw vigna. Our study was designed to evaluate the effects of burning on these two legumes.

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Materials and methods

Field plots were laid out in existing pastures of bahiagrass and the legumes, alyceclover (accession IRFL 3240) and Shaw creeping vigna on a Pomona fine sand (sandy, siliceous, hyperthermic Ultic Haplaquod, Spodosol). Burning treatments were applied during late winter or spring as backfires. Burn temperatures were monitored in 1990 with copper/constantan thermocouples placed 2.5 cm below the soil surface. Gravimetric soil moisture to a 7.5-cm depth was determined immediately before burning. Herbage mass, primarily frost-killed herbage from the previous growing season, was determined in each plot for each burn.

The pastures were subjected to periodic grazing by yearling steers throughout the growing season. Presence or absence of legumes was monitored at the end of each growing season at 1.0 m intervals along transects laid out every 3.0 m across each plot. Three separate experiments were conducted.

Experiment 1 evaluated the responses of Shaw creeping vigna to burning at 2 sites in 1989 and 1990 using a randomised block design with a split-plot arrangement of treatments in 4 replications. Main plots were time of burning (early and late March 1989; early March and early April 1990). Subplot treatments were the amount of herbage present at burning. Low herbage subplots were mowed to a 15-cm stubble height immediately before burning, and the mown herbage was spread over the high herbage subplot. Two additional subplots were left undisturbed with one burned as a medium herbage treatment and the other left unburned. Main plots were 4.5 × 36 m (subplots of 4.5 × 9 m) at one site and 6 × 48 m (subplots 6 × 12 m) at the other.

Experiment 2 was conducted on a mixed stand of alyceclover and Shaw creeping vigna in bahiagrass. Six replications of paired plots, 6 × 9 m, were used. Treatments were burned and unburned, with burning in mid-March 1989 and 1990.

In Experiment 3, burning treatments and an unburned control were imposed on alyceclover in early and late March 1990 using a randomised block design with 5 replications. Plots were 9 × 12 m. Frequency of alyceclover occurrence was determined at the end of the 1989 (before burning) and 1990 (after burning) growing seasons.

Results

Experiment 1

Herbage mass at burning was similar for the two sites in 1989, averaging 3.7, 5.5 and 7.3 t/ha for the low, medium and high herbage levels, respectively. In 1990, mean fuel loads at burning were 2.8, 4.2 and 5.6 t/ha for site 1 and 1.8, 2.4 and 3.0 t/ha at site 2. Soil moisture at burning did not differ among treatments and averaged 20 g moisture/100 g dry soil.

Soil temperatures peaked as the flame passed a given observation point in 1990 and decreased within 5 seconds. Temperatures decreased linearly during the following minute to within 10–20 °C of the ambient air temperature. Maximum temperatures were highly variable and a location × time of burning × amount of standing herbage interaction was obtained. Maximum temperatures for the early burn were similar for both sites. For the late burn, site 1 reached higher ($P<0.05$) temperatures in the high fuel treatments than did site 2 (Table 1).

Spring burning had no effect on Shaw creeping vigna stands at either site in 1989 or at site 2 in 1990. However at site 1 in 1990, the unburned control contained more legume than did plots burned at the two higher fuel levels (Table 2).

Table 1. Maximum temperatures (°C) recorded for fires in Experiment 1 as affected by site, time of burning and fuel load when burned.

	Site 1		Site 2	
Fuel load	Early burn	Late burn	Early burn	Late burn
Low	41	46	40	36
Medium	71	118	78	63
High	88	168	104	52

LSD ($P<0.05$) = 72

Experiment 2

Patterns of temperature elevation were similar to those in Experiment 1 with an average maximum temperature of 140 °C. Shaw creeping vigna stands were sparser ($P=0.10$) and alyceclover stands denser ($P=0.03$) in burned plots than in unburned plots in 1989 (Table 3). However, no responses to burning were detected in 1990. At the end of the 1990 growing season, all alyceclover stands were similar to the best treatments from the previous year, while Shaw creeping vigna had almost disappeared from all plots.

Experiment 3

Maximum temperature of burns averaged 90 °C with patterns of temperature elevation similar to those in Experiments 1 and 2. Frequency of occurrence of alyceclover increased from 1989 to 1990 on burned treatments but decreased on the unburned treatments (Table 4).

Table 2. Frequency of occurrence[1] of Shaw creeping vigna at the end of the growing season following early spring burning treatments (Experiment 1).

		Herbage level (fuel load)			
Year	Site	Low	Medium	High	Unburned
1989	Both	17 a[2]	19 a	18 a	20 a
1990	1	22 ab	17 b	11 b	33 a
1990	2	14 a	23 a	21 a	15 a

[1]Number of observations with the legume present per 100 observations.
[2]Means in a row followed by a common letter do not differ ($P>0.05$).

Table 3. Frequency of occurrence[1] of a perennial alyceclover ecotype and Shaw creeping vigna at the end of the growing season following burning in early spring (Experiment 2).

Legume	Year	Treatment		Probability of difference
		Burned	Unburned	
Alyceclover	1989	32	7	0.029
Alyceclover	1990	31	31	0.998
Shaw	1989	5	25	0.098
Shaw	1990	0	3	0.363

[1]Number of observations with the legume present per 100 observations.

Table 4. Frequency of occurrence[1] of a perennial alyceclover ecotype at the end of the growing seasons in 1989 (before burning) and in 1990 (following a spring burn) (Experiment 3).

Treatment	1989	1990	Change
Early burn	29 a[2]	43 a	+14 a
Late burn	23 a	29 a	+ 6 b
Unburned	33 a	27 a	− 6 c

[1]Number of observations with the legume present per 100 observations.
[2]Means in a column followed by a common letter do not differ ($P>0.05$).

Discussion

Due to the variability in responses, these experiments provide few conclusions. Several factors including plant vigour, intensity of burning and conditions after burning apparently affected plant responses. Although burning did not consistently affect legume stands, when it did, Shaw creeping vigna stands were reduced and alyceclover stands were enhanced. These responses may be associated with differences in plant morphology. Shaw creeping vigna produced succulent stolons which typically extended about 0.3 m from the original plant. Although rooting occurred at nodes along the stolons, plant crowns developed only at the original plant, and this was rather minimal. Crowns typically occurred immediately at the soil surface with a diameter of approximately 2 mm. Both stems and roots were succulent with little periderm development. The alyceclover sward appeared similar to that of Shaw creeping vigna. However, individual plants consisted of distinct plant crowns, often 5 mm or greater in diameter and extending 10 mm or more below the soil surface with distinct periderm development of both roots and stems.

Although further experimentation would be required to determine when responses to burning could be expected from either legume, current information suggests that burning under some conditions can be detrimental to Shaw creeping vigna stands but may be beneficial to stands of the perennial alyceclover.

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