BURNING, THEN RESTING, REDUCES WIREGRASS (*Aristida* spp.) IN BLACK SPEARGRASS PASTURES

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ABSTRACT

Wiregrasses (*Aristida* spp.) are becoming more prevalent, causing reduced productivity, in the black speargrass (*Heterpogon contortus*) pastures of south-east Queensland. Burning a native pasture of poor botanical composition (with a high proportion of wiregrass) in spring, and resting a heavily-grazed pasture also of poor composition, both improved the condition of these pastures. However, burning in late summer did not. Three months after burning in spring, relative density of wiregrass had decreased and that of a desirable species, black speargrass, had increased. However, this effect did not persist under continuous and heavy grazing. Resting increased threefold both the yield of pasture and the proportion of black speargrass, and decreased the proportion of wiregrass by two-thirds. Burning in late summer had no effect on the relative density of black speargrass but relative density of wiregrass increased. Selective grazing after burning in late summer kept this pasture in very poor condition for 14 months.

These results suggest that the best way to increase the proportion of black speargrass and reduce the proportion of wiregrass in a pasture would be to burn in spring and then rest the pasture.

RESUMEN

*El pasto (*Aristida spp.*) se ha venido extendiendo, ocasionando reducción en la productividad en las pasturas black speargrass (*Heteropogogon contortus*) al sureste de Queensland. Quemando la pastura nativa de composicion botánica pobre (alta proporción de pasto wiregrass) en la primavera, y descanzando una pastura sobre-pastoreada con igual composición pobre, ambos tratamientos mejoran las condiciones de dichas pasturas. Sin embargo, quemando al final del verano, no. Tres meses luego de la quema, en la primavera, la densidad relativa del pasto wiregrass es disminuida y las especies deseables, pasto black speargrass, es incrementada. Sin embargo, este efecto no persistió bajo pastoreo continuo y pesado.*

El descanzo igualmente incrementó en tres veces los rendimientos de la pastura y la proporción del pasto speargrass, y disminuyó en dos tercios la proporción del pasto wiregrass. Quemando al final del verano no afectó la densidad relativa en el pasto black speargrass pero la densidad relativa del pasto wiregrass fue incrementada. El pastoreo selectivo luego de la quema al final del verano dejó esta pastura en muy pobres condiciones por 14 meses.

Estos resultados suguieren que la mejor práctica para incrementar la proporción del pasto black speargrass y reducir la proporción del pasto wiregrass en la pastura es quemar en la primavera y luego descanzar la pastura.

INTRODUCTION

Wiregrasses (*Aristida* spp.) are becoming dominant in areas of native pasture in south-east Queensland and a means of control is needed. These grasses are regarded as inferior forage (Lodge and Whalley 1983); and as indicators of pasture deterioration where their incidence increases (Anderson *et al.* 1984; Pressland *et al.* 1988). Weston *et al.* (1981) reported that about 30% of native pasture in the southern coastal and subcoastal regions was in poor condition, owing to the presence of high proportions of wiregrass. Native pastures contribute 90% of the forage for grazing cattle in Queensland and black speargrass (*Heteropogon contortus*) is the dominant species in large areas of sub-coastal Queensland (Weston *et al.* 1981). Encroachment by unpalatable species such as wiregrass may be reducing production from these pastures.

Techniques for improving black speargrass pastures in poor condition include the strategic use of both fire and grazing. Graziers prefer these options as the methods are simple and less costly than using cultivation or herbicides. Evidence confirms the effectiveness of these techniques for controlling some wiregrass species and maintaining dominance by black speargrass (Shaw 1957; Swann 1982; Tothill 1983). In contrast, neither clipping nor burning was able to reduce the proportion of *A. armata* in mulga (*Acacia aneura*) pastures (Brown 1986), and fire and grazing did not control wiregrass in pastures normally dominated by Queensland bluegrass (*Dicanthium* spp.) (Bissett 1960). Also, Shaw (1957) found that exclusion of grazing led to a reduction in the basal area of *A. ramosa* in a black speargrass pasture in south-east Queensland.

The value of burning and grazing as a management option for controlling wiregrass required further testing. We did this on a commercial scale and found that a combination of burning in spring, followed by resting, is the strategy most likely to be successful in restoring a deteriorated pasture to a suitable yield and composition.

MATERIALS AND METHODS

Site

The site was on a shallow duplex soil (Db 2.43; Northcote 1979) at Brian Pastures Research Station in south-east Queensland (25°39′S; 151°45′E). The experimental area was a native pasture paddock (71 ha) dominated by *H. contortus, Bothriochloa decipiens, A. ramosa* var. *speciosa* and *A. calycina* (Neldner and Paton 1986).

Treatments

Three treatments were imposed: 25% of the paddock burnt in spring (November 1981); 25% of the paddock burnt in late summer (February 1982); and 50% left as an unburnt control. Each treatment area contained 7 fixed sites (10 m x 10 m) that were selected and matched across treatments according to a ranking based on wiregrass presence. Rank 1 contained approximately 90% wiregrass and rank 7 contained 20% wiregrass. Four mesh cages (1.1 m wide, 1.2 m high and 2.4 m long) were placed in the late-summer-burnt area during October 1982 to exclude grazing and enable observations of pasture recovery. The paddock, including the experimental area, was continuously grazed by 25 breeding cows. Only the caged areas were ungrazed.

Measurements

Botanical composition was measured using the point-centred quarter (PCQ) technique (Heyting 1968). The PCQ method is an adapted point technique for measuring pasture composition. A pin was pushed into the ground at regular intervals (40 stations per site) along parallel transects. The pin was marked to define four 90° arcs at each station, and the nearest plant to the pin in each quarter was identified and recorded. The relative density of a species is that percentage of the total number of recordings of a species as a proportion of the total number of recordings. It is not a measure of plants per unit area. Changes in botanical composition are indicated from PCQ data by changes in relative densities of pasture species. Treatment differences are indicated by the change in relative density of one species in a treatment compared with the change that occurs for that species in another treatment over the same time. PCQ measurements were taken in the control and spring-burnt treatments before burning in spring 1981. Subsequent PCQ measurements were taken in all 3 treatments on 4 occasions: February 1982, April 1983, December 1983 and May 1984. Yields of standing pasture and litter were recorded using a visual assessment method (Campbell and Arnold 1973) in December 1982, April 1983 and May

1984. Ground cover was measured using an eye-point method (Cockett 1964) in April 1983, January 1984 and May 1984. PCQ measurements, pasture yield and ground cover were obtained from the 7 fixed sites in each treatment. Three, randomly selected 0.25 m^2 quadrats were cut in each grazing exclosure and 3 from the adjacent grazed area in May 1984. The samples were divided into black speargrass, forest bluegrass (*Bothriochloa bladhii*, a desirable species), wiregrass and others for dry matter yield determination.

Statistical Analyses

Changes in pasture composition were analysed by subjecting changes in PCQ treatment means to analysis of variance, using stratified plots within treatments as replicates.

RESULTS

Rainfall

Following burning in spring 1981, rainfall for the growing period until February 1982 was only slightly less than average (Table 1). However, rainfall for the 12 month period following burning in February 1982 was half the long-term average. During the next 3 seasons (autumn, winter and spring of 1983), rainfall was almost double the long-term average.

TABLE 1

Seasonal rainfall at Brian Pastures from June 1981 to May 1984

Year	Winter (Jun-Aug)	Spring (Sep-Nov)	Summer (Dec-Feb)	Autumn (Mar-May)	Total
			(mm)		
1981/82	124	117	347	103	691
1982/83	25	74	163	440	702
1983/84	107	234	196	100	637
Long-term average	95	166	325	141	727

Relative density

Relative density of wiregrass was similar in all treatments prior to burning (Figure 1a). In spring-burnt plots, relative density of wiregrass decreased from 39% in September 1981 to 28% in February 1982. This change was significantly greater ($P<0.05$) than in the unburnt control. There was a corresponding increase in the relative density of black speargrass from 12% to 22% when pasture was burnt in spring, which was significantly greater ($P<0.05$) than the change for the same period in the control (Figure 1b). However, relative density of wiregrass in spring-burnt pasture subsequently followed a similar trend to that of the control until the trial concluded. Relative density of wiregrass increased to 61%, 14 months after burning in late summer, significantly greater ($P<0.01$) than the change in the control. By May 1984, the proportions of wiregrass in pasture were similar for each treatment.

The decline in relative density of wiregrass from April 1983 to December 1983 coincided with an increase in the proportion of broadleaf weed species (Figure 1) for all treatments. In the pasture burnt in late summer, relative density of annual weeds (mainly *Conyza* spp., *Vittadinia* spp. and *Lepidium africanum*) had increased to 57% by December 1983.

Pasture yields

Pasture DM yields in December 1982 were 26% and 14% of the control for pastures burnt in spring and late summer respectively (Figure 2). Pasture and litter yields of both burnt pastures remained less than the control during the experiment. Pasture yields were low (100 kg/ha) in the late-summer-burnt treatment in April 1983. Yields in both burnt treatments increased subsequently to 62% and 58% of the control yield by May 1984 for pastures burnt in spring and late summer, respectively.

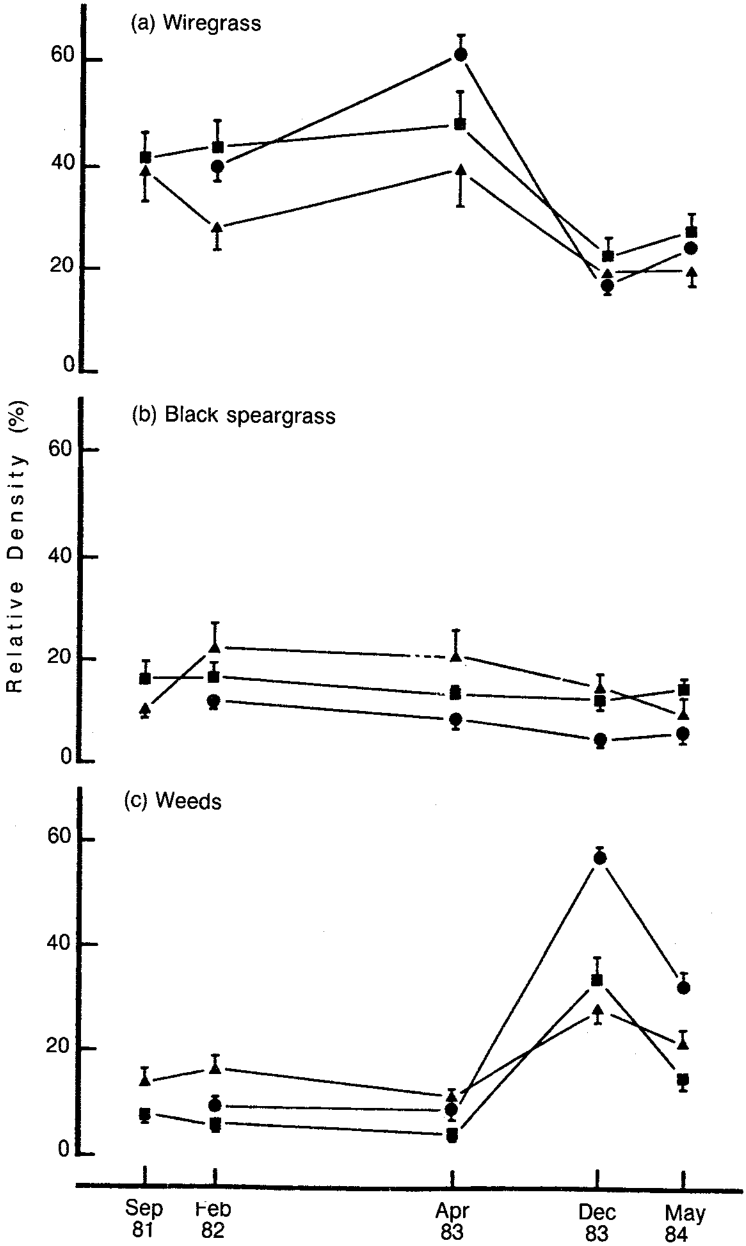

FIGURE 1

Relative density of (a) wiregrass, (b) black speargrass and (c) weeds, in control (■—■), spring burnt (▲—▲) and late summer burnt (●—●) treatments. (Vertical bars represent standard errors of means).

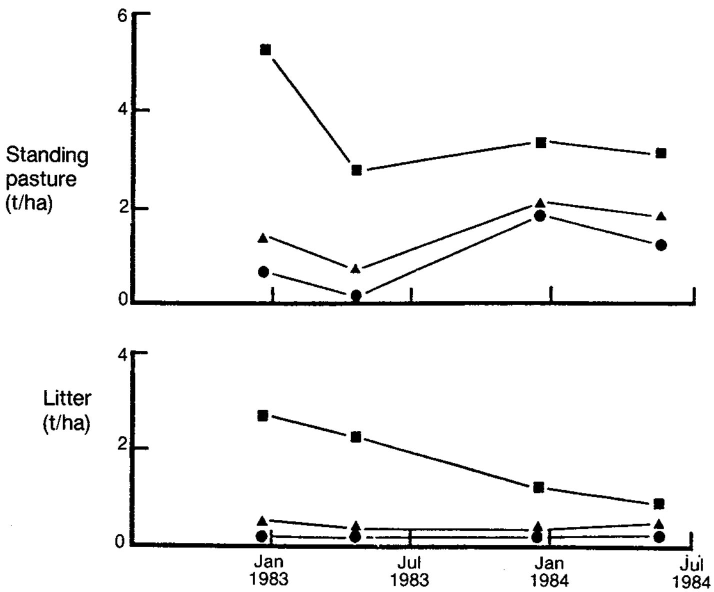

FIGURE 2

Average DM yields of standing pasture and litter at four harvests in control (■—■), spring burnt (▲—▲) and late summer burnt (●—●) treatments.

Ground Cover

In April 1983, the plant canopy (green and dead standing pasture combined) contributed 37%, 18% and 13% to ground cover in the control, spring-burnt and late-summer-burnt treatments respectively (Figure 3). Litter provided almost no ground cover in the late-summer-burnt pasture and only half as much litter was present in spring-burnt pasture as in the unburnt control. Total ground cover (canopy and litter) gradually increased in burnt treatments and by May 1984 only about 10% of soil was exposed to elements of erosion in all treatments.

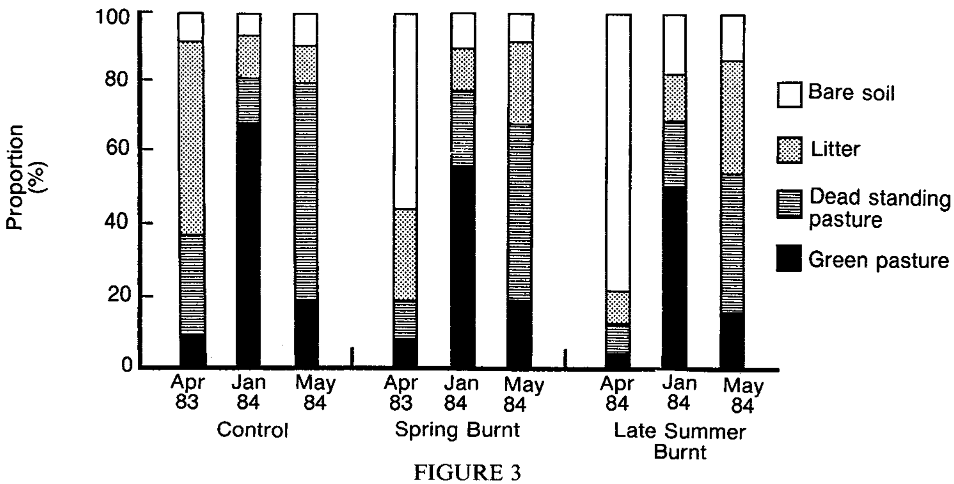

FIGURE 3

Proportions of recordings that were either bare soil or ground cover (green and dead standing pasture, and litter) in control, spring burnt and late summer burnt treatments.

Grazing Exclosures

Exclusion of grazing for 19 months in the late-summer-burnt pasture had a marked effect on pasture dry matter yield and composition (Table 2). Grazed pasture only yielded 32% of ungrazed pasture in May 1984 and yield of the desirable species black speargrass and forest bluegrass was 10 times greater in ungrazed pasture. In contrast, wiregrass formed a much higher proportion in grazed than ungrazed pastures.

TABLE 2

Average DM yields of pasture components and their respective proportions of total yield, from grazed and ungrazed areas in May 1984, following burning in February 1982.

Pasture species	Grazing			
	Nil since Oct 82		Continuous	
	Yield	Composition	Yield	Composition
	(kg/ha)	(%)	(kg/ha)	(%)
Black speargrass	3630	47	350	14
Forest bluegrass	1950	25	200	8
Wiregrass	600	8	800	32
Others	1570	20	1160	46
Total	7750		2510	

DISCUSSION

Burning in spring and resting both improved the species composition of the pasture, whereas burning in late summer was detrimental.

Spring burning

The proportion of black speargrass increased and that of wiregrass decreased in the 3 to 4 months after burning in spring. The increase in black speargrass reflected the number of seedlings that germinated after burning. It is well known that fire stimulates speargrass germination (Shaw 1957; Tothill 1969; Tothill 1983), but little is known of the survival of seedlings under grazing. Bissett (1962) found that heavy grazing after a fire can eliminate black speargrass, but he did not give reasons for this. Although speargrass was not eliminated in our experiment it was subsequently reduced by grazing cattle concentrating on burnt areas. Burning is a strategy used to maintain the monsoon tallgrass pastures of far-northern Australia in a healthy state. It reduces "patch" grazing of preferred species and attracts cattle to graze burnt areas, thereby reducing stocking pressure on unburnt areas of a paddock (Andrew 1986). In contrast, the increased grazing pressure on burnt areas in our experiment resulted in cattle pulling young droughted speargrass plants from the ground.

We applied the treatment in this experiment only once and the heavy grazing and drought that followed probably did not allow the long term benefits of spring burning to be expressed. In less adverse seasons we could expect the initial benefits to be even greater and last longer.

Despite heavy grazing and low rainfall, wiregrass recovered to its original proportion of pasture, 14 months after an initial reduction. This suggests *A. ramosa* var. *speciosa* and *A. calycina* are highly resistant to heavy grazing. A recent report by Brown (1986) documented similar results. He found that clipping did not reduce the proportion of *A. armata* in a deteriorated mulga pasture. In contrast, Brown found that burning failed to reduce the incidence of this species, emphasizing the need to test control measures for different wiregrass species.

Pasture yields after burning did not recover to equal those in the control during the experiment, a consequence of increased grazing pressure due to cattle selecting 'green pick' after burning. Ground cover was also low for 14 months after burning. However, pasture burnt in spring recovered more quickly than did pasture burnt in late summer.

Resting improves composition

Excluding cattle from a pasture in poor condition allowed recovery to a better yield and composition. After 19 months of resting, including 2 summers, yields in exclosures were three times those in adjacent, continuously grazed areas. Also, pasture composition improved dramatically. Resting for such an extended period is not always a practical option for graziers. However, it is possible to lightly stock or rest degraded pastures during summer when other pastures in good condition are more productive. Stock can be concentrated on pasture in good condition for short periods to allow existing speargrass plants in the deteriorated areas to set seed and to allow seedlings to develop.

The shift to speargrass dominance due to resting was slow. Had the pasture been burnt again, 12 months after exclosure, the shift might have been faster. The speargrass set seed in the first summer after exclosure, and burning this treatment in the following spring would have favoured establishment of more speargrass plants, accelerating the recovery process.

Late summer burning increases wiregrass

Burning in late summer was detrimental to pasture, and the effects were long lasting where pasture was continuously grazed. Heavy grazing after burning, coupled with dry conditions, kept pasture yields exceptionally low and kept ground cover sparse (100 kg/ha DM and 22% ground cover 14 months after burning). Also, the proportion of wiregrass increased by about 50% during this period despite the heavy grazing referred to above. This confirms our belief that wiregrass can withstand heavy grazing pressure. In contrast, the proportion of speargrass in this treatment remained low during the experiment. Burning in February did not stimulate speargrass to germinate and any seedlings that germinated in the next summer were subjected to heavy grazing and most likely did not survive.

This experiment has shown that burning in late summer may be ineffective in controlling wiregrass and also detrimental to pasture condition.

Plant processes: influence of burning and resting

Speargrass is influenced by burning and resting in 3 ways. Firstly, burning in spring favours the establishment of speargrass seedlings (Tothill 1969). Secondly, it accelerates the onset of seeding (Lazarides *et al.* 1965). Thirdly, resting burnt pastures enables seedlings to establish and existing plants to set seed.

Taking these processes and our results into account led us to devise what we think is the best strategy for controlling wiregrass and encouraging speargrass.

The best strategy: spring burn followed by resting

Our results show that burning in spring and resting both improve pasture condition. Although we did not combine them into a single treatment, we believe that spring burning, followed by resting, is the strategy most likely to reduce the amount of wiregrass in a degraded pasture and improve pasture condition.

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