QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 511

CONTROL OF GRADER GRASS (THEMEDA QUADRIVALVIS)

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SUMMARY

Regeneration of grader grass was suppressed by pasture spelling and enhanced by prewet season heavy defoliation and burning.

Spraying with a plant desiccant greatly reduced the density of young plants of grader grass.

Cutting at flowering reduced density of grader grass more than cutting at the late vegetative stage. Survival was not affected by the degree of shade imposed on stubble after cutting.

I. INTRODUCTION

Themeda quadrivalvis, known as grader grass or Habana oat grass, is a tall-growing annual, native to India. It was first recorded in Queensland in 1935 at Habana near Mackay (S. L. Everist personal communication). Grader grass has now become a conspicuous and often dominant component of roadside vegetation in parts of Queensland. As it is a comparative newcomer, the magnitude and extent of its weed potential have not had time to be fully expressed. Assessment of the weed potential of grader grass before it becomes widely distributed is necessary.

Distribution in Queensland is mainly confined to higher rainfall areas, and plants have been collected along the coast between latitudes 17°S. (Cairns) and 27°S. (near Brisbane). An isolated colony of grader grass has been observed where the average annual rainfall is as low as 26 in. on grey-brown soils of heavy texture in the Central Highlands (W. J. Bisset personal communication).

In India, grader grass is a major component of grassland composed of perennial grasses such as *Sehima nervosum, Chrysopogon montanus, Themeda triandra, Eremopogon foveolatus, Heteropogon contortus* and *Cymbopogon* sp. These grasslands extend throughout tropical India to latitude 28°N., with a rainfall range of 15 to 80 in. Best development is observed in areas receiving between 20 and 35 in. per annum (Dabadghao 1960).

Grader grass is not yet a weed of great economic significance in the pastoral industry. At a few sites it has spread into native pastures. It is also causing concern where pastures were sown with Townsville stylo (*Stylosanthes humilis*). Since stock do not favour matured grader grass, pastures dominated by this species are less productive than pastures consisting of perennials.

Grader grass is often prominent where cattle concentrate, such as on stock routes and in railway holding paddocks. Sometimes it occurs abundantly on headlands in canefields, in neglected cane and on road shoulders.

The purpose of the experiments to be described was to determine factors responsible for the invasion of pasture by grader grass and to work out a system of management which could prevent such invasion and/or reduce the amount of grader grass already present.

II. REDUCTION IN DENSITY FROM CUTTING AND SHADING

In earlier investigations it was found that grader grass plants grown in partial shade (one-third of full sunlight) suffered some mortality and reduced seeding after cutting (Sillar 1963, unpublished). The combination of cutting and the resulting shading was therefore considered to be directly responsible for the observed elimination of grader grass achieved by late-summer mowing of infested native pastures.

The object of the first experiment was to study the effect of cutting grader grass at different stages of growth and of shading after cutting.

(a) Method

The experiment was located at Walkerston, near Mackay, on a native grass pasture invaded by grader grass. Perennial grasses included black spear grass (*Heteropogon contortus*), *Sporobolus indicus,* mat grass (*Axonopus compressus*) and blady grass (*Imperata cylindrica* var. *major*). Prominent forbs and legumes included spiny-head sida (*Sida acuta*), common sensitive plant (*Mimosa pudica*) and coffee senna (*Cassia occidentalis*). The area has a 60 in. average annual rainfall and the soil is a well-drained friable clay loam of moderate fertility. The site had been heavily grazed until early summer (November). It was then fenced off.

The experimental treatments were (*a*) 24% sunlight; (*b*) 36% sunlight; and (*c*) 100% sunlight, with cutting at (i) preflowering and (ii) full-flowering, with four replications in a fully randomized block design. Plots measured 3 ft x 6 ft and were laid out end-to-end on a north-south axis.

The preflowering cut was made on February 10, 1965, and the flowering cut on March 8, 1965. A reciprocating mower cutting 3 in. above ground was used. Canopies to shade the stubble, measuring 2 ft x 3 ft x 6 ft, were then erected with their long sides on the east and west closed in. The different degrees of shading were obtained by using black shade cloth of different light transmission capacities. Density of grader grass was recorded in three 1 lk x 1 lk fixed quadrats when shade and cutting treatments commenced.

(b) Results

Irrespective of light treatment, reduction in density of grader grass was greater following cutting at the full-flowering stage. After the preflowering cut, grass density tended to be inversely related to the degree of shading.

Data for density are given in Table 1.

TABLE 1

Grader Grass Density After Shading and Cutting from an Initial Density of 54 Stems Per Square Link

Light Transmission (Percentage of full light)	Preflowering Cut		Full-flowering Cut	
	Stems per sq lk	log (x + 3) transformation	Stems per sq lk	log (x + 3) transformation
24	11·9	1·1724	3·2	0·7917
36	20·0	1·3614	5·4	0·9220
100	25·2	1·4507	3·0	0·7809

L.S.D. 5%, 0·2876; 1%, 0·3976

III. REGENERATION AFTER BURNING, MOWING AND PASTURE SPELLING

Based on theoretical considerations, Grieg-Smith (1957) postulated that for most species the limits of tolerance for establishment are much narrower than those for survival of existing plants. When applied to control of grader grass, the more rewarding approach appears to be grassland management aimed at the prevention of establishment.

Edwards (1942) and Coetzee (1942) recorded the disappearance of *Themeda triandra* under pasture resting in the absence of fire. Coetzee (1942) also recorded tolerance to winter burning in *Themeda,* while Edwards (1942) recognized fire-avoiding mechanisms in seed of *Themeda triandra* as contributing to its dominance under periodic burning. In grader grass a similar seed morphology suggests tolerance to fire. Annuals are frequently abundant on overgrazed areas and under cultivation. This suggests that, where seed is already present, grader grass could become firmly established when native pastures are regularly burned and overgrazed and also in cultivation.

Three experiments were conducted to study (*a*) the effect on degraded pasture of spelling, prewet season defoliation, and burning; (*b*) regeneration of grader grass following antecedent wet season mowing and spelling; and (*c*) viability of seed under pasture when spelled during the wet season.

(a) Method

Experiment 1.—This comprised five treatments in a latin square design with a plot size of 10 lk x 9 lk. The treatments were: (*a*) pasture resting; (*b*) prewet burn (November 30, 1965); (*c*) prewet mowing (November 30, 1965; (*d*) prewet burn and desiccant applied to the new shoots (January 15, 1966); (*e*) prewet mowing and desiccant as applied in (*d*) (January 15, 1966). The pasture was rested from the beginning of the previous wet season. A large bulk of dead litter from grader grass provided a clean burn on November 30, 1965. A rotary lawn mower was used to cut the grass to ground level in the mowing treatments; cut material was raked off the plots. Seedling counts were made in

10 quadrats of 2 in. diam. per plot on February 2, 1966. For the desiccant treatment, "Gramoxone" was used at $1\frac{1}{2}$ fl oz plus $\frac{1}{2}$ oz of non-ionic wetting agent in $3\frac{1}{2}$ gal of water. This was applied with a knapsack spray until the grass was visibly wet.

Experiment 2.—This consisted of three blocks each 1/40 ac. The site was purposely denuded by extremely heavy grazing up until November 1964, when stock were excluded. On February 11, 1965, grader grass had reached a later preflowering growth stage. After recording its density in five 1 lk x 1 lk permanent quadrats, block A was mown to 3 in. height with a reciprocating mower. By March 22, grader grass had flowered and density was recorded in blocks B and C. Block B was then mown to 3 in. and block C left uncut. The pasture was subsequently rested for 20 months until it was burnt in November 1966.

Experiment 3.—This was conducted on block B of experiment 2, in which grader grass density amounted to 44 plants per sq lk in the previous wet season. The pasture was mown on March 22, and rested throughout the sampling period. The site was divided into three blocks from which 20 soil cores were collected at random from each block at each of three sampling dates, viz. November 1, 1965, February 1, 1966, and May 4, 1966. Cores measured 1 in. in diameter and 1 in. deep. Seeds were recovered from the soil cores by means of sieving and hand separation. Seeds for laboratory storage investigation were harvested in May 1965 by mowing whole plants and threshing.

(b) Results

Table 2 shows the number of grader grass plants after various treatments.

TABLE 2

NUMBER OF GRADER GRASS PLANTS PER FIXED QUADRAT OF 1 SQUARE LINK

Quadrat No.	Block A: Preflowering Cut				Block B: Full-flowering Cut				Block C: No Cutting			
	Feb. 1965	Feb. 1966	Nov. 1966	% Decrease by Nov. 1966	Mar. 1965	Feb. 1966	Nov. 1966	% Decrease by Nov. 1966	Feb. 1965	Feb. 1966	Nov. 1966	% Decrease by Nov. 1966
1	69	..	..	100	63	..	1	98	59	..	3	95
2	159	..	14	91	46	..	10	79	39	..	39	..
3	76	..	2	94	1	..	..	100	40	..	1	98
4	6	..	..	100	61	..	2	97	1	..	..	100
5	141	..	1	99	50	..	19	62	52	..	6	88

Pasture resting prevented germination of grader grass. Mass regeneration occurred when matured grader grass was rested during the dry season and then burned or closely mown before the onset of the wet season. Differences between burning or mowing were not proven.

Following burning or cutting, spraying with Gramoxone significantly reduced the number of young grader grass plants (Table 3).

TABLE 3

NUMBER OF GRADER GRASS PLANTS PER CORE AFTER TREATMENT

a Pasture resting	0·5
b Prewet burning	68·8
c Prewet mowing	58·8
d Prewet burning + desiccant ..	2·2
e Prewet mowing + desiccant ..	4·0

Significance at 1% level: a, d, e < b, c

On areas neither burnt nor mown, no germination occurred after 12 months. On areas left undisturbed for 20 months and then burnt, the density of grader grass was greatly reduced on all plots, more so where a preflowering or full flowering cut was done previously.

Germination of grader grass seed in soil cores taken from pasture rested for 20 months fell from 8% in November 1965 to 3% in February 1966 (Table 4). Samples taken in May 1966 yielded insufficient seed (12 seeds from 60 cores) to allow quantitative germination testing. Seeds stored in the laboratory during the same period maintained a high germination.

TABLE 4

MEAN PERCENTAGE GERMINATION OF GRADER GRASS AFTER MOWING TO 3 IN. AND RESTED FOR 20 MONTHS

Core Sampling Date	No. of Caryopses per 60 in. cores	Germination (%)		Pasture Condition at Core Sampling
		Seed from Soil Core under Pasture*	Seed from Laboratory-stored Control	
Nov. 1, 1965	>600	8	70	Collected 6 months after formation of mature seed; a large bulk of dead grader grass; perennials with green shoots; seed conspicuous on soil surface
Feb. 1, 1966	>600	3	59	Small groups of grader grass only in trial area; perennial grasses and forbs dominate; pasture vegetative and soil moist; seed still viable on soil surface
May 4, 1966	43†	‡	74	Most perennial grasses seeded but pasture generally green; seed not visible at soil surface

* Seed bulked from 20 cores within each block and percentage germination determined under alternating temperature of 20°–35°C in light.

† Out of 43 caryopses only 12 complete seeds were counted.

‡ Greatly reduced population precluded an estimate of germination.

IV. DISCUSSION

Increased degrees of stubble shading after cutting did not significantly reduce the density of grader grass. This does not support previous results (Sillar 1963, unpublished), although a tendency towards reduced density with increasing shade was indicated following mowing at the preflowering stage. In previous work, shading was imposed at germination. This provided greater overall light stress than delaying shading until after cutting, as in this experiment.

The ineffectiveness of shading proves that it is not a practical method for controlling grader grass in the field. A flowering stem containing mature seed is produced even under three-quarters shade.

Reduced density following cutting at full flowering is considered to be a direct function of plant age—the older the population the more susceptible it is to defoliation. In the field, exact timing to reduce the population before seeding occurs would be difficult to achieve. However, cutting at full flowering or even after mature seed is formed has indirect benefits. More light for the growth of other perennial grasses is provided. Seed-heads produced after such a cut are borne closer to the ground. This minimizes their being caught up and spread by farm and other machinery.

Burning and severe defoliation encouraged germination of grader grass seeds. Allowing the grass to remain undisturbed suppressed germination. Management systems which denude the soil will encourage grader grass; increased soil cover will reduce grader grass. Reduction is permanent because seed degenerates in the soil. In lower rainfall areas with sparser vegetation it may be difficult to maintain adequate cover to suppress grader grass.

Provided seed is present, grader grass is a potential weed in many areas where soil denudation occurs. Early wet-season grazing of native pastures improved with Townsville stylo was shown to give the highest cattle productivity (Norman 1965). This also provides favourable conditions for invasion of grader grass. For this reason, Townsville stylo pastures could be particularly susceptible. Excessive burning would dispose native grassland to invasion, while moderate grazing of improved pastures in the wet tropics would preclude regeneration of grader grass.

V. ACKNOWLEDGEMENTS

Acknowledgements are due to the Standards Branch of the Department of Primary Industries for carrying out germination tests, to the Biometry Branch for statistical analyses and to the Australian Meat Research Fund for provision of facilities.

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(Received for publication September 13, 1967)

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