Effects of Cutting or Grazing in the Wet Season on Seed Production in *Andropogon Gayanus* Var. *Bisquamulatus* (Hochst.) Stapf.[1]

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ABSTRACT

The effects of time of cutting or grazing in the wet season on seed production in the tropical grass *Andropogon gayanus* var. *bisquamulatus* (Hochst.) Stapf. were investigated in two experi-ments over three seasons. The work was conducted in the tropical savanna region of Brazil at latitude 15° 36' S and longitude 47° 42' W. Cutting in mid-January gave the highest seed yields while cutting in mid-March reduced seed yields by 63 percent compared to the uncut control. Tillering was increased by cutting but inflorescence density was unaffected. Cutting reduced the proportion of fertile tillers but did not influence seed size. The highest seed yields under grazing were obtained when animals were excluded in mid-February. The application of the results to seed production practice is discussed briefly.

Additional index words: **_Andropogon gayanus_ var. _bisquamulatus_ (Hochst.) Stapf., tropical savanna, Brazil, cutting, time of grazing, lodging, tillering, seed yield.**

INTRODUCTION

Andropogon gayanus var. *bisquamulatus* (Hochst.) Stapf. cv. Planaltina (CIAT 621 = BRA 19) was released in Brazil in 1980 by the Brazilian Agricultural Research Organization (EMBRAPA) as a suitable grass for the tropical savanna region, known locally as "cerrados" (Thomas et al. 1981). Aspects of seed production in the species have been discussed by Ferguson (1981). *Andropogon gayanus* is a short-day plant with a critical day-length for flowering of between 12 and 14 hours (Tompsett, 1976). At latitude 15° S in Brazil flowering commences in late April (towards the end of the wet season) and harvesting of seed takes place at the start of June (in the early dry season).

In an earlier experiment reported by Andrade, Thomas and Ferguson (1983) pure seed yield in cv. Planaltina was reduced in the second season by lodging. N fertilizer had been supplied at the commencement of the wet season so plants realized their full height potential of 3 m, and lodged in the pre-flowering period. In the following season a cut in early January prevented lodging and pure seed yield was increased dramatically.

In addition to fertilizing effects seed production of pasture plants may be influenced strongly by the time of cutting or, in dual purpose systems, the exclusion of livestock from the area. Defoliation too late in the wet season may reduce seed yields (Humphreys, 1979). To investigate this more precisely two experiments were initiated in the 1980-81 wet season. One examined the effects of time of cutting and the other the effects of time of termination of grazing on seed production.

MATERIALS AND METHODS

Both experiments were conducted concurrently over three seasons at the Centro de Pesquisa Agropecuaria dos Cerrados (CPAC), 35 km north-east of the capital city Brasilia, Brazil at latitude 15° 36' S, longitude 47° 42' W and altitude 1010 m. The average rainfall (35 years) is 1573 mm, of which 90 percent is distributed between October and March inclusive. Average year-round temperature is 21 C. The soil was a well-drained dark-red latosol (Oxisol), pH 5.0 (in water), 1 to 3 mg available P per kg soil and 0.58 m equiv. Al per 100 ml.

Two uniform blocks of cv. Planaltina, established in the 1979-80 wet season, were utilized in the experiments. In the establishment year the areas had received 2000 kg ha^{-1} lime, 70 kg ha^{-1} P (as single superphosphate), 80 kg ha^{-1} K (as potassium chloride), 4 kg ha^{-1} Zn (as zinc sulfate) and 0.25 kg ha^{-1} Mo (as ammonium molybdate), consistent with local knowledge and practice. During the subsequent three seasons of the experiments 13 kg ha^{-1} P and 25 kg ha^{-1} K were broadcast annually.

In the cutting experiment four treatments were employed; no defoliation, defoliation on 15 January, 15 February or 15 March in each season. Treatments were replicated three times in a randomized complete block design. Plots were 16 × 10 m in size and the defoliation treatments were cut with a mower to 20 cm. After cutting, 50 kg ha^{-1} N (as ammonium sulfate) was applied; the uncut treatments received N at the start of each wet season. The area was burned to remove accumulated dry matter at the end of each dry season.

In the grazing experiment there were also four treatments; no grazing, animals excluded on 15 January, 15 February or 15 March in each season. Four equal areas of 80 × 10 m were designated within the paddock of cv. Planaltina. At the beginning of the experiment, before the animals entered, the first area was fenced off from the other three as the ungrazed control treatment. On 15 January the sub-division fence was moved forward to exclude the animals from the second area. This was repeated on 15 February and 15 March respectively to exclude animals from the remaining two areas. Within

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each treatment area three plots of 20 × 10 m were marked out from which the samples were taken. The methodology employed enabled a relatively small area to be used without the need for complete sub-division fencing. Animals were able to graze each area continuously until removal, which would have been impossible in similar sized fenced plots.

Yearling Gir *(Bos indicus)* steers were utilized to maintain the height of the grass 30 to 40 cm above ground level in the grazed treatments. Following the removal of the cattle, paddocks were clipped to 20 cm. N was applied as in the cutting trial. At the end of each dry season the experiment was burned to remove excess dry matter. Unfortunately, in the second season (1981-82), following the successful burning of the cutting trial, early rain delayed the burning of the grazing experiment. The effects of eventual burning were very variable because of the growth of new shoots. Consequently, it was decided to disregard these data and present results only for the first and third seasons.

Seed was hand harvested once per season when the crop matured. Seed heads were cut, heaped in the field and threshed one week later. Seed was hand cleaned and the weight of clean, dry seed recorded followed by a purity analysis to derive pure seed yield. Pure seed was defined as those sessile spikelets containing a caryopsis and purity was estimated by an indirect technique reported by CIAT (1980). At harvest maturity in the cutting experiment total tiller number, total inflorescence number and percent fertile tillers (defined as the proportion of tillers bearing inflorescences at this time) were counted.

RESULTS

Effects of cutting

The effects of cutting on tillering and seed production are presented in Table 1. As anticipated, plant height at seed harvest was progressively and significantly reduced by the cutting treatments. More tillers were produced in the cut treatments than in the uncut control, but differences between times of defoliation were not statistically significant. Inflorescence density was unaffected but the percentage of fertile tillers was reduced by cutting.

The caryopsis content of the uncut control did not differ markedly from that of treatments cut on 15 January or 15 February. However, cutting on 15 March reduced significantly the caryopsis content. Seed size, as indicated by pure seed unit weight, was reduced by cutting on 15 March, but this decrease was not statistically significant. Cutting on 15 January increased pure seed yield by 49% over that of the uncut control. There was no significant difference in seed yield between the control and the treatment cut on 15 February. However, pure seed yield was 63% lower than the uncut control in plots cut on 15 March.

Effects of grazing

The effects of time of removal of animals appear in Table 2. Plant height at harvest followed the same trend as in the cutting experiment; the reduction in height was positively related to the date of animal exclusion from the treatments.

Table 2. The effect of time of exclusion of animals on seed production (mean of 1981 and 1983).

Grazing schedule	Plant height at harvest m	Caryopsis content %	Pure Seed weight (mg)	Pure Seed yield (kg ha^{-1})
No grazing	3.10	51	3.09	95
Until 15 January	2.36	50	3.15	140
Until 15 February	1.81	52	3.33	152
Unitl 15 March	1.39	54	3.41	112
L.S.D. 0.05	0.01	NS	NS	20
S.E. mean	0.04***	—	—	8***
C.V. %	3.0	—	—	8

No significant differences between treatments in caryopsis content or seed size were noted. Cessation of grazing on 15 January gave a similar relative increase in pure seed yield to the cutting experiment. However, excluding animals on 15 February gave a further increase in seed yield of 8.5%. Exclusion of animals on 15 March gave seed yields that were not significantly different from the ungrazed control.

DISCUSSION

An appropriate defoliation management is necessary with cv. Planaltina to reduce the risk of lodging. However, these data have shown that time of cutting or grazing can influence markedly the production of seed. Cutting after mid-January is likely to decrease seed yield. Under grazing

Table 1. The effect of cutting time on tillering and seed production (mean of 1981 to 1983).

Cutting time	Plant height at harvest m	Tiller No. m^{-2}	Inflorescence No. m^{-2}	Fertile tillers %	Caryopsis content %	Pure Seed weight (mg)	Pure Seed yield (kg ha^{-1})
No cut	2.81	210	174	83	49	3.44	111
15 January	1.73	333	166	55	52	3.45	165
15 February	1.55	417	174	55	50	3.58	118
15 March	1.28	412	166	48	38	3.08	41
L.S.D. 0.05	0.07	115	NS	8	5	NS	9
S.E. mean	0.03***	47*	—	3***	2**	—	4***
C.V. %	2.0	18	—	7	5	—	4

conditions, however, animals need not be excluded until mid-February. This difference between the two experiments in the optimum time of defoliation is probably related to the effects of cutting versus grazing. In the grazing experiment the canopy was never more than 40 cm in height, and plants were continuously defoliated. In the cutting experiment, before defoliation, plants were considerably taller and the canopy more closed. This may have created a less favorable environment for tiller development in the cutting experiment through increased shading. In addition, continuous defoliation by grazing may have stimulated more tillers to form earlier by removal of apical dominance. Although tillering was not monitored in the grazing experiment for comparison, tillers arising at successively earlier dates would have a proportionately greater chance of becoming reproductive (Haggar, 1966). The reduction in seed yield by defoliation in mid-March may have been the result of delayed flowering (Humphreys, 1979). In this treatment first flowering was observed at the end of May, approximately one month later than in the other treatments.

In Colombia, crops of *Andropogon gayanus* more than 2.2 m in height have made combine harvesting difficult and diminished harvesting efficiency (CIAT, 1981). In the present experiments the highest seed yields were associated with plant heights of 1.7 to 1.8 m. Harvesting and post-harvesting labor requirements were greatly reduced by defoliation of the crop. In a comparison of the ungrazed control treatment and that where grazing was stopped on 15 February, defoliation reduced cutting time by 60%, carrying time and time required for making the heaps for field drying by 43%, and threshing and cleaning time by 66%.

In the cutting trial there was no apparent relationship between inflorescence density, the percentage of fertile tillers and changes in seed production. Cutting increased tillering but this did not provide for greater inflorescence density and the percentage of fertile tillers declined. Mishra and Chatterjee (1968), working with *Pennisetum polystachyon* and *Andropogon gayanus,* also reported that cutting increased tillering and reduced the percentage of fertile tillers. However, in their study the decline in fertile tillers was highly correlated with a reduction in seed yield. In other studies (e.g. Cameron and Humphreys, 1976) increases in seed yield have been associated with an increase in both tiller density and fertile tillers.

CONCLUSIONS

Significant areas of *Andropogon gayanus* are now being grown in the "cerrados" of Brazil for seed production and/or grazing. Farmers can avoid seed losses due to lodging by defoliating the crop at the appropriate time. Cutting later than mid-January or allowing cattle to graze beyond mid-February will reduce seed yields. In addition to reducing lodging, defoliation results in a more even crop and, therefore, facilitates mechanical harvesting. This is of importance in Brazil where *Andropogon gayanus* seed is often collected by combine harvester.

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