Effects of nitrogen and defoliation on the productivity and feeding value of Brachiaria ruziziensis (Germain and Everard) in the mid-country wet zone of Sri Lanka

R. R. APPADURAI AND L. A. GOONEWARDENA

University of Sri Lanka, Peradeniya, Sri Lanka

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Brachiaria ruziziensis Germain and Everard (Ruzi grass) is a native of the Congo, and is among the newer introductions into Sri Lanka. Its growth habit is similar to that of its forerunner *Brachiaria brizantha* (Hoscht) Stapf, but it is somewhat leafier and sends out runners which help it to form a dense mass. Earlier observation trials, had indicated that the grass was ideally suited to areas of higher rainfall, but no systematic evaluation of its potential value had been made in the mid-country situation. The high priority assigned to dairy development in the mid-country, however, highlighted the need for a good grazing grass for the gentler slopes and rolling lands, in addition to the focus already being placed on fodder grasses, for intensive systems of grassland management on the steeper hill sides. This paper describes the results of a one year experiment in which ruzi grass was evaluated under high levels of nitrogen application, and under different systems of defoliation in order to assess its productivity and feeding value under such management in the mid-country wet zone. The experiment was conducted in the Department of Animal Husbandry, at the Peradeniya Campus of the University of Sri Lanka.

MATERIALS AND METHODS

The experiment was laid out as a randomized block with three replications. The area of each plot was 15′ × 15′ (457.2 cm × 457.2 cm). The experiment commenced on April 9, 1971, and was concluded on March 9, 1972. The experimental plots were established about three months prior to the commencement of the trial, and at commencement a basal dressing of 50 lb P_2O_5 (56.1 kg/ha) and 100 lb K_2O (112. 2 kg/ha) was applied over the experimental area.

Nitrogen treatments

Nitrogen was applied in the form of ammonium sulphate. Three rates of application namely 100, 200 and 300 lb (112.2 kg/ha, 224.4 kg/ha and 336.6 kg/ha) of nitrogen per acre per year were used. The nitrogen fertilizer was applied in equal split dressings after each cut every month, and in all 12 cuts were taken for the whole year, under the higher frequency, and 6 cuts were taken under the lower frequency of cutting. The first dressing of nitrogen was applied after an initial control cut on March 9, 1971.

Defoliation treatments

The defoliation treatments imposed included two heights of cutting a close cut to 1″ (2.54 cm) above ground level and a lax cut to about 3″ (7.62 cm) above ground level, and two frequencies of cutting, a grazing cut taken monthly, and a silage cut taken bimonthly. All defoliation treatments were imposed, with an allen autoscythe, set to the required height of cutting.

Sampling procedure

At each sampling, a swath 3′ (91.44 cm) in diameter and 15′ (457.2 cm) in length was cut using the autoscythe. The cut swath was used for dry matter determination, by drying the entire herbage in a Unitherm drying oven at 96 °C for 24 hours. In the middle of each season a sub-sample was used for crude protein analysis. For this purpose dried sub-samples weighing 2 gms each were digested and distilled. The distillate was collected into 0.1 N sulphuric acid and titrated against 0.1 N sodium hydroxide using bromo-cresol green as indicator. The crude protein was estimated by multiplying the N content by 6.25. Every other month a further sub-sample of 250 g of fresh herbage was hand separated into leaf and stem, and the individual dry weights of each component recorded. Soon after each sampling the entire experimental plot was cut uniformly as that of the sampling area.

RESULTS

Total herbage dry matter yields in kg/ha per year for the nitrogen and defoliation treatments are shown in Table 1. Increased rates of nitrogen application resulted in quantitative increases in herbage dry matter yields per hectare. The highest yields were obtained with the highest rates of nitrogen application. Nitrogen caused a highly significant, linear response, in terms of herbage production. The nitrogen utilization efficiency was evaluated by regression analysis and was found to be of the order of 1 : 39. Defoliation treatments caused highly significant differences in herbage dry matter yields. Extending the frequency of cutting to bimonthly intervals (silage cut) resulted in significantly greater yields of herbage. ($P = 0.01$). Close cutting was superior to lax cutting ($P = 0.05$) particularly when it was combined with an extended cutting frequency. Thus the highest yields were obtained in the silage plots that had been closely cut each time.

Mean herbage dry matter yields for each individual cut during the year are shown in Tables 2 and 3.

The highest yields per individual cut were obtained with the initial cut at the silage stage, and by the second cut at the grazing stage, both during the month of May, at the beginning of the south-west monsoon season. Thereafter, the pattern of production of the herbage followed more or less the seasonal advance, with the lowest yields for the year being recorded in the final cuts in February of the following year, which was also the driest month of the year. Table 4 shows the rations of weights of green leaf to stem under the different nitrogen and defoliation treatments.

Mean leaf stem ratios were higher under close cutting than under lax cutting, but this was significantly more so in the more frequently defoliated grazing plots than the less frequently defoliated silage plots. The leaf stem ratios tended to increase with successive defoliations and were higher towards the end of the season. Increasing the level of Nitrogen application resulted in proportionate increases in mean leaf stem ratios, the higher levels resulting in greater leaf production,

The mean percentage crude protein in the herbage dry matter in respect of two single cuts, each taken in the middle of the main Yala season (s.w. monsoon) and the Maha season (n.e. monsoon) is indicated in Table 5. Mean percentage crude protein content of the dry matter increased significantly with increasing applications of fertilizer nitrogen and was highest under the highest nitrogen application. Frequent defoliations (Grazing cuts) increased the crude protein content of herbage compared to the less frequent defoliations (Silage cuts). Close cutting tended to be superior to lax cutting in enhancing the crude protein content of herbage particularly under the less frequent defoliations (Silage cuts). The differences were more pronounced at the lower levels of N fertilization.

DISCUSSION

Earlier experiments on the use of high levels of applied N, particularly with fodder grasses in the mid-country situation, had clearly established that tremendous increases in dry matter yields could be obtained by high N use. (Appadurai & Goonewardene 1971, Appadurai & Arasaratnam 1969.) The linearity of the response following the application of N upto 300 lb (336.6 kg/ha/year) per acre per year has been conclusively demonstrated earlier, and this has again been confirmed in this experiment. N not only increased herbage yields significantly in ruzi grass, but also increased significantly its feeding value, and leaf stem ratio. Further, it is necessary to recognize that in the context of natural grazing conditions, the frequency and intensity of defoliation, by the grazing animal must be of considerable importance in determining yields and quality in pasture herbage. Although the effects of defoliation have been the subject of intensive study in temperate regions very few organized experiments in this field have been undertaken under tropical situations. The results obtained in temperate experiments have been conflicting, depending on the habit of growth of the species concerned, and the variations in each environment. Several workers have found that cutting close to ground level increased herbage yields from mixed swards compared to lax cutting. (Reid and McLusky 1960, Burger, Jacobs and Hittle 1958.) Others have concluded that lax cutting is preferable to close cutting (Hunt 1952 and Brougham 1956). Still others have examined the relationship between closeness of defoliation and frequency of defoliation, but here again the results have not been conclusive. In the present study, close cutting increased yields by 8% over lax cutting. The explanation for this result, probably lies in the habit of growth of ruzi grass. Ruzi grass is a spreading type of grass, and very much like Pangola, sends its shoots upwards only after a full and closely knit cover has been obtained. Close defoliation, in the case of ruzi still leaves behind a high residual herbage capable of actively photosynthesising till sufficient foliage is developed in the course of time. Pangola behaves in a similar fashion. Total herbage dry matter yields over the entire year were significantly greater by 34% when cutting was carried out at the silage stage, than at the grazing stage. These results are in close agreement with the findings of Sprague and

Garber (1950) and Walker, Adams and Orchiston (1959) who observed that greater yields can be obtained when pasture plants are allowed to grow to a greater degree of maturity between cuts. Thus the longer spellings between cuts at the silage stage could have influenced herbage yields. Throughout the experimental period, the effects of "Stage of growth" at cutting on dry matter yields did not vary with the "height of cutting" treatment imposed. In the presence of N and adequate moisture, recovery growth is quicker and the sward is ready for full exploitation again within four to eight weeks. The potential of such grasses for sheep grazing, where sheep tend to graze close to ground level as against the higher grazing by cattle, must be established by further grazing trials. The fact remains however, that ruzi is a highly valuable grazing grass for the mid-country wet zone, and that under adequate N fertilization and close but less frequent defoliation it is capable of giving high yields of herbage dry matter, of reasonably good feeding value.

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Table 1.—Total Herbage dry matter yields in kg/ha

	Grazing (4)		Silage		
	Lax	Close	Lax	Close	Mean
N_1	13,845	14,070	18,866	20,504	16,821
N_2	19,716	19,017	23,759	25,703	22,049
N_3	21,320	22,192	26,457	32,467	25,609
Mean	18,294	18,426	23,027	26,225	21,493

Co-efficient of variation—11.10%

L.S.D. 5% — For general treatment means = 4,036kg/ha

L.S.D. 1% — For general treatment means = 5,486 kg/ha

L.S.D. 5% — For N means = 2,018 kg/ha

L.S.D. 1% — For N means = 2,743 kg/ha

Table 2.—Mean herbage dry matter yields in g per plot for each individual cut at the grazing stage of growth (Monthly)

Cut No.	1	2	3	4	5	6	7	8	9	10	11	12		
Date of cutting	9.4·71	10.5.71	9·6.71	9.7.71	10.8.71	9.9.71	9.10.71	9.11.71	8.12.71	9.1.72	8.2.72	9.3.72	Total	Kg/ha
Lax	247·0	2,130·0	508·0	451·0	289·0	404·0	682·0	454·0	259·0	198·0	110·0	56·0	5,788·0	13,845·0
N_1Close	494·0	1,107·0	641·0	630·0	546·0	548·0	846·0	362·0	274·0	245·0	120·0	69·0	5,882.0	14,070.0
N_1Lax	456·0	2,447·0	554·0	748·0	617·0	790·0	1,058·0	651·0	389·0	345·0	134·0	54·0	8,243·0	19,716·0
N_2Close	603·0	1,655·0	703·0	674·0	776·0	813·0	1,076·0	611·0	380·0	455·0	140·0	64·0	7,950·0	19,017·0
N_2Lax	353·0	2,245·0	636·0	875·0	908·0	904·0	1,212·0	776·0	417·0	365·0	155·0	67·0	8,913·0	21,320·0
N_3Close	622·0	1,902·0	730·0	979·0	993·0	897·0	1,257·0	683·0	444·0	461·0	204·0	106·0	9,278·0	22,192·0

Table 3. Mean herbage dry matter yields in g for each individual cut at the silage of stage of growth (Bimonthly)

Cut Number		1	2	3	4	5	6		
Date of Cutting		10. 5.71	9. 7.71	9. 9.71	9.11.71	9. 1.72	9. 3.72	Total	Kg/ha
N_1	Lax	3,010·0	1,544·0	1,191·0	1499·0	536·0	107·0	7,887·0	18,866.0
	Close	3,205·0	1,266·0	1,760·0	1,493·0	627·0	221·0	8,572·0	20,504.0
N_2	Lax	3,200·0	2,008·0	1,635·0	2,110·0	840·0	140·0	9,933·0	23,759.0
	Close	3,898·0	1,616·0	2,368·0	1,741·0	900·0	223·0	10,746·0	25,703.0
N_3	Lax	3,463·0	2,169·0	1,697·0	2,539·0	1,058·0	135·0	11,061·0	26,457.0
	Close	4,347·0	2,451·0	2,537·0	2,663·0	1,364·0	211·0	13,573·0	32,467.0

Table 4. Mean Leaf Stem Ratios under the different nitrogen and cutting treatments

			10. 5.71	9. 7.71	9.9.71	9.11.71	Mean
N_1	Grazing	Lax	0·95	3·54	3·55	1·36	2·35
		Close	2·16	3·37	5·00	2·28	3·20
	Silage	Lax	0·80	1·72	2·37	0·95	1·46
		Close	0·67	2·38	1·41	1·39	1·46
N_2	Grazing	Lax	1·12	2·92	3·30	3·82	2·79
		Close	1·58	3·03	3·95	4·09	3·16
	Silage	Lax	0·88	1·01	1·34	1·28	1·13
		Close	0·81	1·27	1·05	1·76	1·22
N_3	Grazing	Lax	1·12	3·26	5·17	2·85	3·10
		Close	1·47	2·06	4·64	6·39	3·64
	Silage	Lax	0·98	1·22	1·94	0·88	1·26
		Close	0·98	1·14	1·27	0·85	1·06

Co-efficient of variation = 22.60%
L. S. D. 5% to compare any two treatment (w) means = 0. 83
L. S. D. 1% to compare any two treatment (w) means = 1. 13

Table 5. Crude protein percentage in herbage dry matter during the middle of each season

Date	9.7.71 (Yala)				9.1.72 (Maha)			
	Grazing		Silage		Grazing		Silage	
	Lax	Close	Lax	Close	Lax	Close	Lax	Close
N_1	9·81	8.24	5.93	7.90	7.78	8.93	7.31	7.61
N_2	9.81	9.61	6.62	8.13	10.73	10.15	9.61	10.25
N_3	13.10	9.33	10.89	8.63	11.48	10.96	10.52	10.39

Co-efficient of variation= 16·54%

L.S.D. 5% to compare any two treatments (W) means —2·61

L.S.D. 5% to compare any two (N) means= 1·30

L.S.D. 1% to compare any two (N) means= 1·77