EFFECT OF RATE AND FREQUENCY OF NITROGEN APPLICATION ON DRY MATTER YIELD AND NITROGEN CONTENT OF PARA GRASS (*BRACHIARIA MUTICA*)

P. A. CHADHOKAR*

ABSTRACT

The response of para grass to nitrogen applied after each harvest (every six weeks) or after alternate harvests (every 12 weeks) at 200, 400, 600 and 800 kg ha^{-1} yr^{-1} was measured in terms of dry matter yield, protein content and efficiency of nitrogen utilization. The experiment was conducted over a three year period in the Markham Valley of Papua New Guinea.

Dry matter yield and nitrogen content increased with level of nitrogen applied, however response was less at higher rates of nitrogen. While yield of dry matter per kilogram of nitrogen applied decreased with increasing nitrogen rates, the percentage of nitrogen recovered increased.

Frequency of nitrogen application had no effect on total dry matter yield but more frequent application resulted in slightly higher protein content of the grass and also considerably reduced the variation in dry matter production in sequential harvests.

INTRODUCTION

Para grass (*Brachiaria mutica* (Forsk) Stapf) is extensively used for grazing and fodder in most humid tropical and subtropical areas of the world. Its ability to withstand excessive moisture in prolonged floods and waterlogging under high rainfall conditions and its easy establishment from vegetative cuttings makes it an important pasture species in these areas (Whyte *et al.* 1959). Little information is available on its production and management but available information indicates quite high animal production from para grass (Wang and Cheng 1961, Michielin *et al.* 1968, Roberts 1970).

Under very wet soil conditions growth of legumes with para grass is often not satisfactory and hence fertilizer nitrogen has been widely used for intensive animal production (Vincente-Chandler 1966, Roberts 1970). The importance of frequent nitrogen application has also been stressed (Caro Costas *et al.* 1960, Wang and Cheng 1961, Escobar *et al.* 1967) due to heavy losses of nitrogen under these conditions (Vincente-Chandler *et al.* 1959).

Para grass is commonly grown in Papua New Guinea on lowlands under high rainfall conditions but there is no information on rates and frequency of nitrogen application required to maximize returns from para grass pastures. Results on yield of dry matter, protein content, and efficiency of nitrogen utilization as affected by rates and frequency of nitrogen applied are presented in this paper.

METHODS AND MATERIALS

The experiment was conducted over three years at Bubia, about 15 km from Lae. The soils are deep, fertile, heavy loams. Average annual rainfall is about 2800 mm. The experiment was conducted in a split plot randomized block design with five replicates.

---

*Present address: Tropical Pasture Specialist, Sri Lanka/I.D.A., Dairy Development Project, Getambe, Peradeniya, Sri Lanka.

Para grass was established in May 1972 with cuttings planted at 25 × 25 cm spacing. A basal dressing of phosphorus, potash and sulphur at 50, 50 and 20 kg ha^{-1} respectively was applied before planting and again at the beginning of the third season. Nitrogen as urea (46% N) at 200, 400, 600 and 800 kg ha^{-1} yr^{-1} (in main plots) was applied in split doses either at each harvest or at alternate harvests (sub plots). Nitrogen was hand broadcast after harvesting and cleaning the plots. The first application of nitrogen was made in September 1972.

Dry matter yield was estimated by cutting four quadrats (50 × 50 cm) from each plot at 15 cm height. The samples were dried at 80°C for 48 hours and pooled samples over the replicates were analyzed for nitrogen content. In the three years of the experiment harvests were taken each year at six weekly intervals. There was a non-experimental period of about one month at the end of the first and second growing seasons. Efficiency of nitrogen utilization was calculated in terms of yield of dry matter (kg) per kilogram nitrogen applied and percentage recovery of nitrogen in the dry matter yield. Yield of dry matter per kilogram of nitrogen applied was calculated by subtracting control plot yields from fertilized plot yields and dividing this figure by the amount of nitrogen applied. A similar method was used to estimate the percentage nitrogen recovery.

RESULTS

Growing conditions

A uniform stand of para grass was obtained before treatments were imposed. Growth in the first year was very vigorous but in the second year was poor and stunted. Growth improved in the third year with the dressing of phosphorus, potash and sulphur but only for the first few harvests. The rainfall over the 42 weeks growing period was 3094, 2753 and 2319 mm during the first, second and third year respectively.

Dry matter yield

The average total dry matter yield over the three year period and the yields in individual years increased with increase in applied nitrogen except in the second year when yields were low (Table 1).

Total dry matter yield was not influenced by frequency of nitrogen application (Table 1) but in two out of the three years, yields at individual harvests showed great variation when nitrogen was not applied after every harvest (Figures 1 and 2).

TABLE 1

Effect of nitrogen application on dry matter yield and its nitrogen content in para grass

Treatment	Dry matter yield (tonnes ha^{-1})				Nitrogen Content %			
Nitrogen (kg ha^{-1})	Year 1	Year 2	Year 3	Mean	Year 1	Year 2	Year 3	Mean
(a) *Rates*								
0	14.3 a	9.3 a	10.3 a	11.3	1.15	1.13	0.95	1.08
200	19.6 b	11.6 ab	16.5 b	15.9	1.16	1.42	1.08	1.22
400	25.3 c	13.0 b	19.7 c	19.3	1.25	1.82	1.51	1.53
600	31.2 d	11.8 ab	22.6 d	21.9	1.40	2.46	1.88	1.91
800	35.9 e	13.1 b	25.3 d	24.7	1.56	2.71	2.07	2.03
(b) *Frequency*								
at each harvest	25.2 a	11.5 a	18.9 a	18.5 a	1.35	1.96	1.67	1.66
at alternate harvests	25.3 a	12.0 a	18.9 a	18.7 a	1.33	1.82	1.58	1.58

Figures not followed by the same letter differ at $P < 0.05$

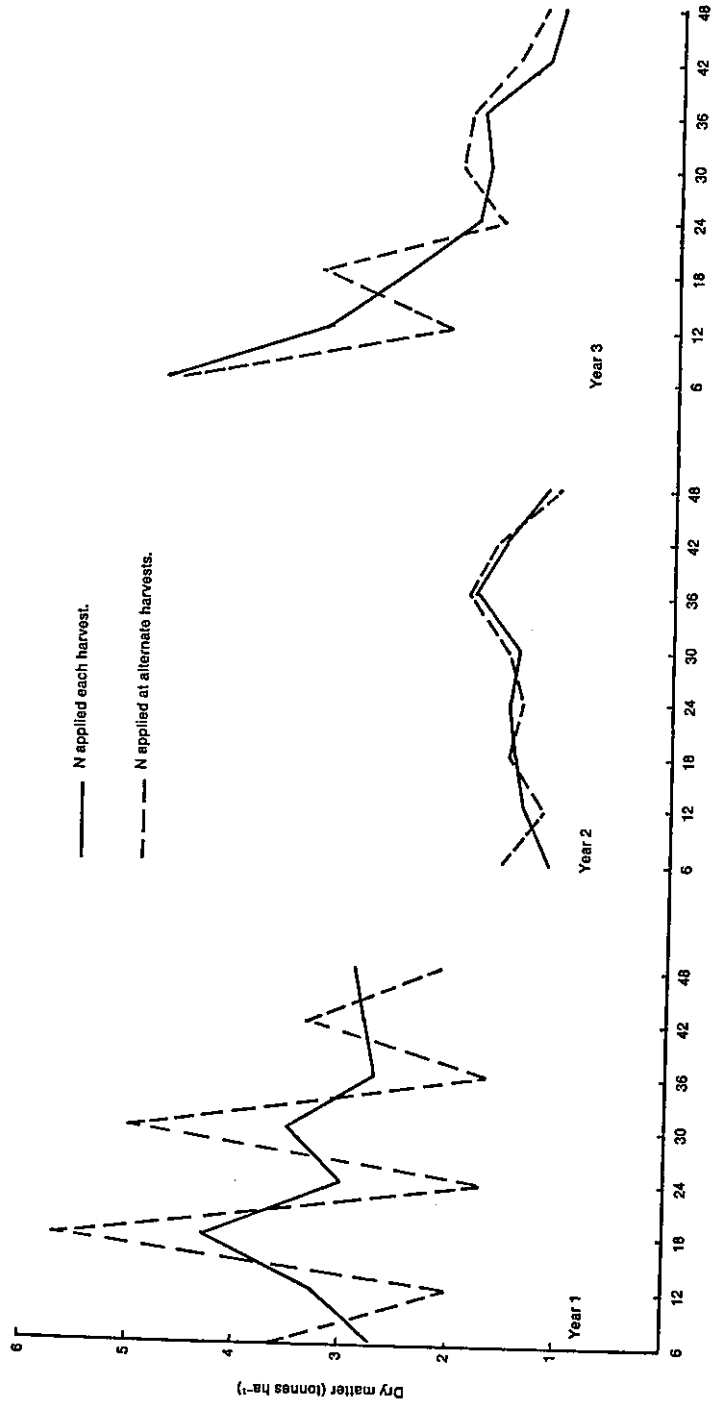

FIGURE 1
Dry matter yield of para grass in response to nitrogen applied after each harvest or alternate harvests (meaned over nitrogen rates).

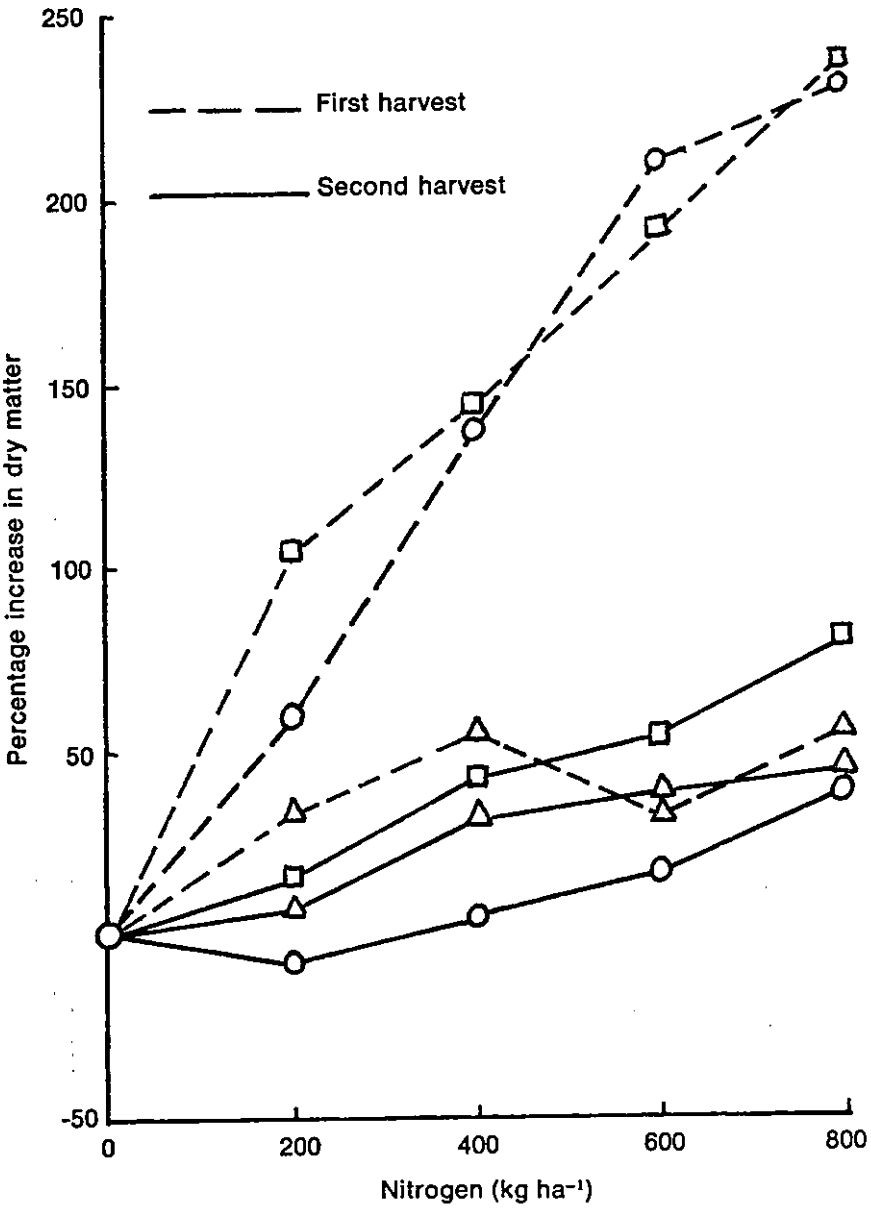

FIGURE 2

Percentage increase in yield in first and second harvest after application of nitrogen applied after alternate harvests. (O—year 1; △—year 2; □—year 3)

Nitrogen content

Mean nitrogen content increased substantially with increase in nitrogen applied. A small increase in nitrogen content was noted with more frequent application of nitrogen (Table 1).

Efficiency of nitrogen utilization

Dry matter per kilogram of nitrogen applied decreased with increasing levels of nitrogen except in the first year when it showed a small increase (Table 2). Frequency of nitrogen application showed no effect.

Percentage recovery of nitrogen in the dry matter increased with increasing nitrogen rates (Table 2) but the increase was highest when nitrogen level was raised from the 200 to 400 kg ha^{-1} level. Frequency of nitrogen application had little effect and more frequent application gave a slightly higher recovery of nitrogen.

TABLE 2

Efficiency of nitrogen utilization as affected by rate and frequency of application to para grass

Treatment	Dry matter (kg) per kilogram of nitrogen applied				Nitrogen recovery %			
Nitrogen (kg ha^{-1})	Year 1	Year 2	Year 3	Mean	Year 1	Year 2	Year 3	Mean
(a) *Rates*								
200	26.4	11.7	30.8	23.0	27.2	26.2	37.7	30.3
400	27.4	9.3	23.5	20.1	37.3	34.0	46.0	38.4
600	28.1	4.2	20.5	17.6	45.4	31.5	48.8	41.9
800	26.9	4.8	18.7	16.8	48.3	31.6	48.3	42.7
(b) *Frequency*								
at each harvest	28.1	7.3	23.4	19.6	38.4	32.1	47.7	39.4
at alternate harvests	26.3	7.7	23.4	19.1	40.6	29.5	42.6	37.6

DISCUSSION

Except in the second year, an almost linear increase in dry matter yield of para grass was obtained. An even greater response could be expected if the harvesting interval was increased to more than six weeks as shown by Caro Costas *et al.* 1960. Although dry matter yields are increased with delayed harvesting intervals feeding value is greatly reduced, especially the nitrogen content (Vincente-Chandler *et al.* 1959, Miller and Nobbs 1976).

The lower response in the second year in the present trial was probably due to a deficiency of other nutrients. This was confirmed in the third year when again a higher response to nitrogen was obtained following application of phosphorus, potash and sulphur. Evidence from extra plots of the same stand suggested that sulphur was the limiting factor (unpublished data). This indicates the necessity of balancing other plant nutrients if the maximum benefits from the applied nitrogen are to be obtained.

In the present trial efficiency of nitrogen utilization was comparatively low. This is probably due to the high initial fertility of the soil and possibly to losses due to leaching. Recovery of nitrogen, however, showed an increasing trend with increasing nitrogen rates. Caro-Costas *et al.* (1960) reported a decrease in both these attributes, but Miller and Nobbs (1976) reported a small increase of 3 to 18 per cent in nitrogen recovery with nitrogen rates increasing from 100 to 800 kg ha^{-1}.

Although frequency of nitrogen application had no significant effect on total dry matter yield, application at each harvest resulted in less harvest to harvest variation in yield of dry matter and protein content than when nitrogen was applied at alternate harvests. The effect of applied nitrogen appeared to be very short lived as a very small residual effect was obtained at the second harvest following its application. Similar results were obtained elsewhere when nitrogen was applied to para grass at alternate

harvests under lower rainfall (1500 mm) conditions (Chadhokar and Charles, unpublished data). Vincente-Chandler *et al.* (1964) in Puerto Rico recommended six annual applications immediately after harvesting the grass. However, cost of application should be weighed against the gains in constancy of dry matter production.

ACKNOWLEDGEMENTS

The author is grateful to S. Mears for assistance and the Chief Chemist for nitrogen analysis.

REFERENCES

CARO COSTAS, R., VINCENTE-CHANDLER, J., and FIGERELLA, J. (1960)—The yield and composition of five grasses growing in the humid mountains of Puerto Rico as affected by nitrogen fertilization, season and harvest procedures. *Journal of the Agricultural University of Puerto Rico* **44**: 107-20.

ESCOBAR, R. L., RAMIREZ, P. A., and LOTERO, C. J. (1967)—Rate and frequency of Nitrogen application to three tropical grasses. *Agricultura Tropical* **23**: 726-37.

MICHIELIN, A., RAMIREZ, P. A., LOTERO, C. J., and CHAVERRA, G. H. (1968)—Cutting frequency and N application for Coastal Bermuda grass, Pangola and Para grass. *Agricultura Tropical* **24**: 689-709.

MILLER, I. L., and NOBBS, R. C. (1976)—Early wet season fertilisation of para grass for use as saved fodder in the Northern Territory, Australia. *Tropical Agriculture (Trinidad)* **53**: 217-24.

ROBERTS, O. T. (1970)—A review of pasture species in Fiji. I. Grasses. *Tropical Grasslands* **4**: 129-37.

VINCENTE-CHANDLER, J. (1966)—The role of fertilizer in hot humid tropical pastures. *Soil and Crop Science Society of Florida.* **26**: 328-60.

VINCENTE-CHANDLER, J., SILVA, S., and FIGERELLA, J. (1959)—The effect of nitrogen fertilization and frequency of cutting on yield and composition of three tropical grasses. *Agronomy Journal* **51**: 202-6.

VINCENTE-CHANDLER, J., CARO COSTAS, R., PEARSON, R. W., ABRUNA, F., FIGERELLA, J., and SILVA, S. (1964)—the intensive management of tropical forages in Puerto Rico. *University of Puerto Rico Agricultural Experiment Station Bulletin* 187, 152 pp.

WHYTE, R. O., MOIR, T. R. G., and COOPER, J. P. (1959)—"Grasses in Agriculture", F.A.O. Agricultural Studies No. 42: 319-20.

WANG, C. -C., and CHENG, C. -P. (1961)—Effect of different methods of nitrogen top dressing on growth and forage production of para grass. *Journal of the Agricultural Association, China,* **35**: 1-14.

(Accepted for publication May 1, 1978)