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FERTILIZER RESPONSE OF GREEN PANIC ON THE ATHERTON TABLELAND, QUEENSLAND

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SUMMARY

Green panic (*Panicum maximum* var. *trichoglume*) responded linearly to rates of 0, 2, 4 and 6 cwt of sulphate of ammonia per acre. There was no yield response to superphosphate at 1, 2 and 3 cwt/ac.

The maximum annual yield recorded was 10,600 lb dry matter per acre. About 80% of production from all treatments occurred in the warm months of the year.

Efficiency of fertilizer use was best at the lowest rate of sulphate of ammonia, which gave an average increase of 40 lb dry matter per lb of nitrogen applied.

The mean basal area of green panic increased from 9·7% in September 1961 to 13·6% in November 1962.

I. INTRODUCTION

One of the most popular grasses on the Atherton Tableland in northern Queensland is green panic (*Panicum maximum* Jacq. var. *trichoglume* (K. Schum.) Eyles). It is a fine-stemmed, leafy, tufted species, very sensitive to conditions of moisture, temperature and soil nitrogen. Under warm, humid conditions on a fertile soil it will produce a large quantity of green, leafy material in a very short time.

However, on the Atherton Tableland, pastures of this species, when unfertilized, decline after 2 or 3 years under grazing. Little local information on the use of maintenance fertilizers is available. The work described in this paper was designed to study the effects of nitrogenous and phosphatic fertilizers on a green panic sward in the Malanda area of the Tableland.

The average annual rainfall for Malanda (17° 21′S., 145° 35′E.) is 66 in. Of this, 48 in. is received in the warmer 6 months (October–March) and 18 in. in the cooler 6 months (April–September). Monthly rainfalls for Malanda during the course of the experiment are given in Table 1 with the 42-year mean monthly rainfalls. The rainfall is variable from year to year and month to month.

TABLE 1

MONTHLY RAINFALL (in.) AT MALANDA

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total
1961 ..	7·42	5·18	9·63	3·91	3·74	1·10	0·56	0·93	1·20	0·99	4·34	4·67	43·67
1962 ..	11·34	7·83	4·21	7·44	0·66	4·22	2·72	0·26	2·09	0·06	4·99	4·22	50·04
1963 ..	20·39	16·92	6·20	13·07	3·64	2·06	0·46	0·78	0·37	3·37	1·62	5·59	74·47
42—year mean	11·13	13·62	12·53	6·34	3·78	2·98	2·21	1·64	1·50	1·38	3·01	6·20	66·32

Frosts capable of damaging top growth of tropical pasture grasses can be expected from May to September. In 1962, light frosts occurred, three in July and three in August. Frosts occurring in 1963, five in June and six in July, were severe.

Maximum day temperatures in the warm months are over 80°F. Those in the cool months are mild. Relative humidity at 9 a.m. is over 75% from January to August. Hours of bright sunshine are low from January to July, due to the large number of wet or overcast days in these months. The period October to April represents the effective growing season of green panic in this area.

II. MATERIALS AND METHODS

The site lay on a slope of 5%. The soil was a red-brown sandy clay loam derived from Atherton basalt. Soil taken to a depth of 6 in. had a pH of 6·1, a replaceable potassium content of 0·40 m-equiv. % and an available phosphorus content of 41 p.p.m. P_2O_5 as calculated by B.S.E.S. method (Kerr and von Stieglitz 1938). The available nitrogen content at time of sampling was medium.

The green panic sward chosen had been down for several years. It was an open one with a light infestation of weeds, mainly Chinese burr (*Urena lobata* L.) and wild tobacco (*Solanum auriculatum* Ait.). These were hand-pulled to give a relatively pure sward. All manure pats were removed.

The area selected was mown roughly to a height of 4–9 in. at the end of September 1961. Superphosphate (22% P_2O_5) at 4 levels (0, 1, 2 and 3 cwt/ac) and sulphate of ammonia (21·0% N) at 4 levels (0, 2, 4 and 6 cwt/ac) were applied to the sward in three randomized blocks arranged in a 4 x 4 factorial design. A second application was made in November 1962.

Plots were 13 ft x 6 ft, with 6-ft laneways between blocks. To estimate yields, a 10 ft x 3 ft strip was mown at 4–6 in. through the centre of each plot. The cut green material was weighed in the field and subsampled for dry-matter determination. The subsamples were dried in a forced-draught oven at 60°C for 24 hr. Three cuts were made in the warm period of the first year and two in that of the second year. One cut was made in the cool period of each year.

There was a suggestion that almost complete defoliation by mowing at harvest time might be deleterious to stand survival. The measurement of the basal area of all sward components was regarded as the best way to study any permanent changes in botanical composition due to this and/or fertilizer treatments. Thus, in the week following establishment of the trial, initial basal cover was estimated by means of a 5-point quadrat with points 4 in. apart; 100 points were recorded per plot. Two more estimations were made, one in November 1962 and the other in March 1964. Percentage species composition was derived from the equation $\dfrac{\text{Hits on species}}{\text{Total hits on all species}} \times 100$.

III. RESULTS

Dry-matter yield.—Throughout the 2 years of yield measurement no significant dry-matter response to superphosphate occurred, nor did there appear to be any consistent interaction of superphosphate with rate of nitrogen application.

There was a linear response to nitrogen in both years at the 1% level of significance. The regressions of annual dry-matter yields on nitrogen rate are shown in Figure 1. The response declined rapidly with time and disappeared at the 1% level of significance after the first two cuttings following nitrogen application.

Warm-season yields were on average four times as great as those in the cool season, when the response was not evident (Figure 2). The highest rate of nitrogen (141 lb/ac) gave approximately twice the yield of the control during the warm season.

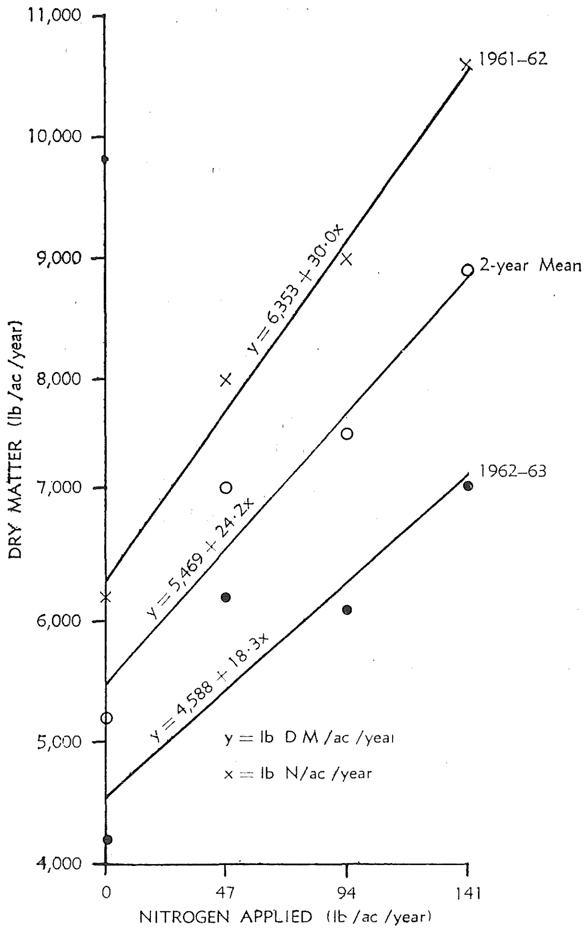

Fig. 1.—Annual dry-matter response to nitrogen fertilizer by green panic.

Sward composition.—The mean basal area of green panic over the whole trial area increased from 9·7% in September 1961 to 13·6% in November 1962 and remained stable (Table 2). However, growth was often slow after cutting and then appeared to speed up if defoliation had occurred early in the growing season but continued slowly if the cut had been made late in the season.

At the commencement of the trial, the phosphate plots were so distributed by randomization that the basal area of green panic in plots receiving 3 cwt superphosphate per acre was significantly less, at the 1% level, than plots receiving 2 cwt/ac, and at the 5% level significantly less than the plots receiving 1 cwt/ac and no superphosphate. These differences disappeared after the first year. There was also a non-significant suggestion that nitrogen fertilization at the higher rates contributed to the overall increase and maintenance of mean basal area over the period of the trial.

TABLE 2

EFFECT OF NITROGEN AND PHOSPHATE ON THE PERCENTAGE BASAL AREA OF GREEN PANIC

Sulphate of Ammonia (lb N/ac)	Year of Estimate			Superphosphate (cwt/ac)	Year of Estimate		
	1961	1962	1964		1961	1962	1964
0	10·0	13·0	13·3	0	10·0	13·2	14·1
47	9·1	13·1	13·0	1	9·9	14·2	13·5
94	9·9	14·2	15·0	2	11·0	13·5	14·2
141	9·7	14·1	15·0	3	7·8	13·5	14·5
Mean	9·7	13·6	14·1	Mean	9·7	13·6	14·1
L.S.D. 5%	N.S.	N.S.	N.S.		1·8	N.S.	N.S.
1%					2·5		

During each summer, a variety of other species invaded the trial area, particularly in the weakest plots. This was characteristic of surrounding green panic and paspalum pastures. At the end of summer in 1962 and 1963, Paramatta grass (*Sporobolus capensis* (Willd.) Kunth) was prominent, while in 1964 fleabane (*Erigeron bonariensis* L.) and a small-leaved, creeping native Desmodium dominated the sward. Other invaders were blue-top (*Ageratum houstonianum* Mill.) and paspalum (*Paspalum dilatatum* Poir.).

TABLE 3

EFFECT OF NITROGEN AND PHOSPHATE ON THE BOTANICAL COMPOSITION OF THE SWARD

Percentage Green Panic

Treatment (cwt/ac)	Year of Estimate			Treatment (cwt/ac)	Year of Estimate		
	1961	1962	1964		1961	1962	1964
N0	92·7	95·7	84·9	P0	92·4	97·8	89·9
N2	88·2	95·4	89·8	P1	93·6	97·7	90·4
N4	95·7	98·4	90·3	P2	94·4	95·2	90·6
N6	93·5	97·0	94·1	P3	89·8	95·9	88·1
Mean	92·5	96·6	89·8	Mean	92·5	96·6	89·8

The variation in sward composition due to this annual invasion is shown in Table 3. Of particular interest are the results for nitrogen treatments in 1964. The analysis was made in March, at the end of summer, when mature invaders are most evident. Despite the fact that no significant differences in yields were recorded in July 1963, at the end of the following summer other species represented 15% of plants in plots receiving no nitrogen and only 6% in plots receiving 141 lb of nitrogen per acre.

IV. DISCUSSION

(a) Dry-matter Production

The maximum annual yield recorded was 10,600 lb dry matter per acre. However, as the response was linear, it is probable that suboptimal quantities of nitrogen had been used and maximum potential yields had not been reached. Henzell (1963) reported an approximately linear response to nitrogen by *Chloris gayana, Paspalum dilatatum* and *P. commersonii* in south-eastern Queensland up to 400 lb nitrogen per acre and claimed that maximum potential yields from these grasses at high levels of nitrogen and from three cuts per season would be at least 20,000 lb of dry matter per acre per year. Such high plant production has been reported from other parts of the tropical world and is attributed to a generally satisfactory rainfall and a high light intensity (Donald 1960).

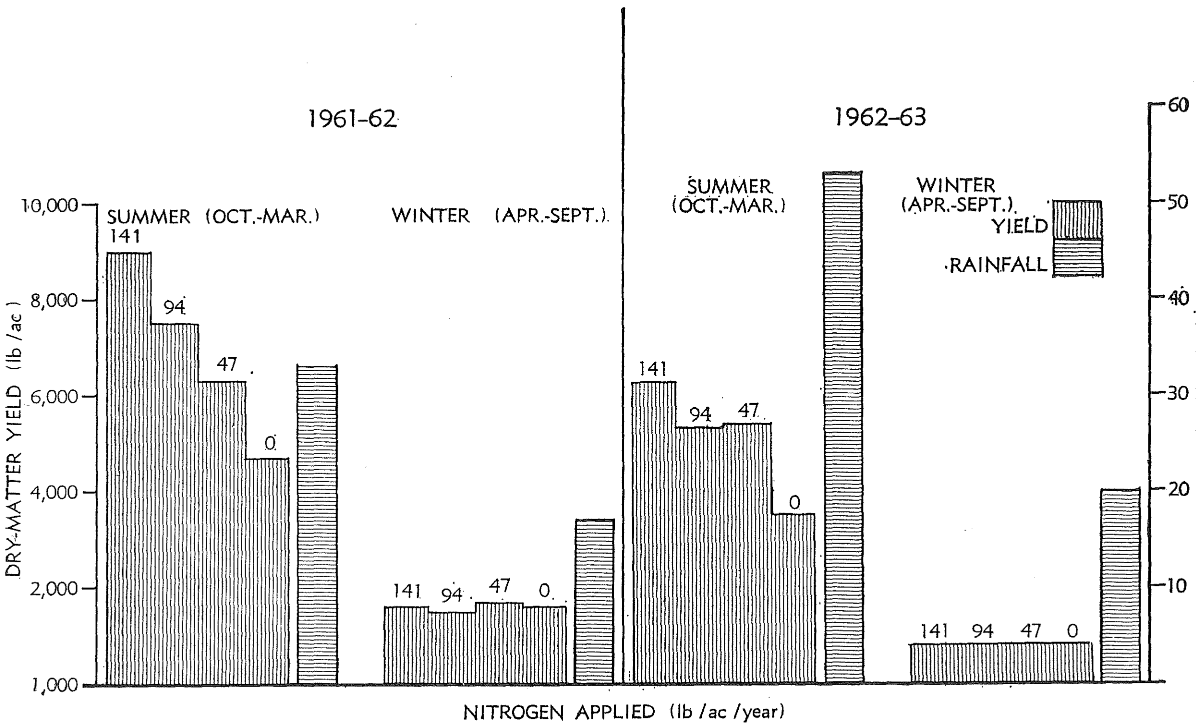

Fig. 2.—Dry-matter yields of green panic and rainfall during the summer and winter periods of the years 1961-1962 and 1962-1963.

The yield in the second year of the experiment was much lower than in the first year, but the ratio of response to 141 lb nitrogen per acre over the control remained about the same. The high rainfall in the summer period (Figure 2) and the following severe frosts are suggested as the cause of the lowered response, since defoliation had not caused any deleterious change in the basal area of the sward. Hours of bright sunshine during the wet season were equivalent to those in the previous year. The 2-year mean yields at the three nitrogen levels (Figure 1) compare with those reported by Henzell from *Chloris gayana* in south-eastern Queensland.

Although the response was linear, there is a suggestion in the data that the most efficient dry-matter response occurred at 47 lb nitrogen per acre. At this level, green panic yielded 38 and 43 lb of extra dry matter per lb of nitrogen applied in the first and second years respectively. These figures compare favourably with results reported for other high-producing tropical pastures. At the levels 94 and 141 lb nitrogen per acre, efficiency in dry-matter production was lower, being respectively in the first year 29 and 31 lb and in the second year 20 and 21 lb.

The essentially seasonal nature of growth in this species and the rapidity and short-lived nature of its response to nitrogen under warm, moist conditions suggest that the use of higher rates of nitrogen in split applications during the summer season might be further explored.

(b) Effect of Treatment on the Behaviour of the Sward

Humphreys and Robinson (1966) found that defoliation of green panic almost invariably stimulated rate of tiller differentiation. Since in the present experiment the increase in the mean basal area occurred in all treatments, the almost complete defoliation by mowing at harvest time is suggested as the principal reason for this increase. However, there is non-significant evidence that fertilizing with phosphate, in particular, and nitrogen had some effect in stimulating an increase in the mean basal area of the grass in the sward.

The shade provided by the denser vegetative cover in high-nitrogen treatments is suggested as the reason for the lower percentage of other species invasion in these plots.

Humphreys and Robinson (1966) also reported that current leaf area was a more important determinant of regrowth after defoliation of green panic than the reduction in the accumulation of non-structural carbohydrate in the roots and crown of the plants caused by frequent defoliation. This explains the slow growth after harvest and acceleration with time if defoliation had been made early in the growing season. This would have been the first cut after fertilization.

Regrowth from successive cuts after fertilization and made later in the growing season remained slow, while for 8 weeks after the spring cut made in September 1962, growth was insufficient to harvest before the annual fertilizer application was made in November. These observations are attributed to the limiting effects of nitrogen and moisture supply.

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