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EFFECTS OF LEGUMES AND FERTILIZER NITROGEN ON PRODUCTIVITY OF GREEN PANIC SWARDS AT GAYNDAH, SOUTH-EASTERN QUEENSLAND

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SUMMARY

Dry-matter and nitrogen yields of a range of mixtures of legumes and green panic (*Panicum maximum* var. *trichoglume*) were compared, under non-grazing, with yields of green panic swards fertilized with nitrogen.

The legumes had little effect on green panic yield, yield of other species, total yield or yield of nitrogen.

There was a marked curvilinear yield response to nitrogen fertilizer in the pure grass swards. The response in terms of yield of nitrogen was linear due to an increase in nitrogen content of the grass with increased levels of nitrogen fertilizer.

In this environment, legumes should be regarded primarily as protein-rich herbage rather than as contributors of nitrogen to the companion grass.

I. INTRODUCTION

Realisation of the importance of nitrogen in the maintenance of productive grasslands in south-eastern Queensland has led to the introduction and testing of many legumes for inclusion in mixed pastures. Little information is available from the sub-coastal areas regarding the nitrogen contribution of these legumes to the associated grass or the grass-legume mixtures, though Christian and Shaw (1952) reported beneficial effects on animal and grass production from the inclusion of lucerne in Rhodes grass pasture in the Lockyer Valley.

The work reported in this paper was designed to compare the growth and nitrogen uptake of a range of legumes in association with green panic (*Panicum maximum* Jacq. var. *trichoglume* (K. Schum.) Eyles) with that of pure grass fertilized with various rates of nitrogen.

II. ENVIRONMENT, MATERIALS AND METHODS

"Brian Pastures" Pasture Research Station (25° 38′ S., 151° 41′ E.) lies in the subtropical sub-coastal region of southern Queensland. The average annual rainfall for the 12-year period 1954-1966 was 28·41 in. Monthly rainfall during the course of the experiment and the average monthly rainfall are given in Figure 1. In this area an average of one-third of the year's rain falls in the cooler 6 months. The rainfall is extremely variable from year to year (Tothill 1966) and from place to place within any one year.

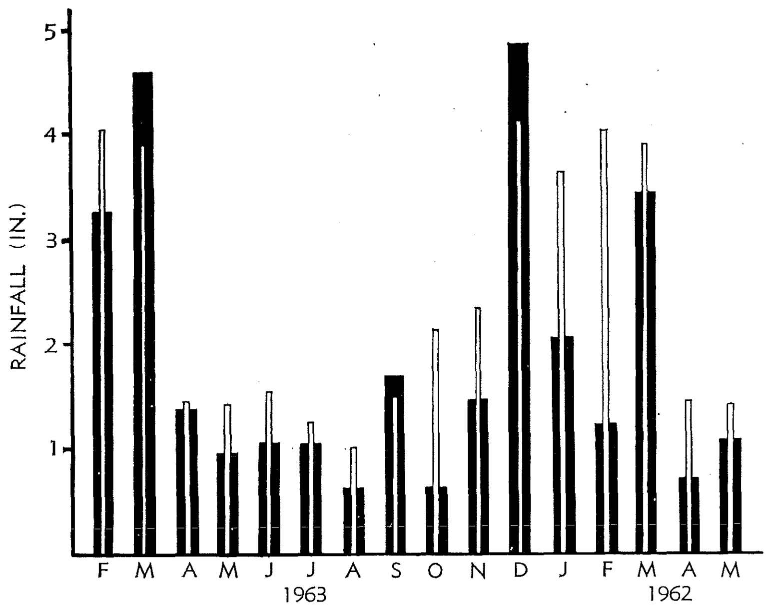

Fig. 1.—Monthly rainfalls at "Brian Pastures" over the experimental period (shaded columns) and average monthly rainfall (open columns).

Temperatures rise rapidly during spring, and maximum day temperatures above 90°F occur between November and March. Frosts occur between May and September, with heavy frosts being experienced during June, July and August, when grass minimum temperatures as low as 12°F are recorded.

A characteristic of the environment is the occurrence of periods during the summer growing season when pastures are subjected to moisture stress.

Sixteen treatments were laid down in a triple lattice design with six replications. Only the following 13 treatments established well enough to warrant observations, and the results of these were analysed as for a randomized block design:

Treatment No.	Treatment
1	Nil nitrogen
2	50 lb nitrogen per acre
3	100 lb nitrogen per acre

4	150 lb nitrogen per acre
5	200 lb nitrogen per acre
6	Cooper glycine (*Glycine javanica* L. C.P.I. 25702)
7	Tinaroo glycine (*Glycine javanica* L. cv. Tinaroo)
8	*Glycine javanica* L. C.P.I. 16830
9	Siratro (*Phaseolus atropurpureus* DC. cv. Siratro)
10	Hunter River lucerne (*Medicago sativa* L.)
11	Hairy Peruvian lucerne (*Medicago sativa* L.)
12	Tinaroo glycine plus Hunter River lucerne
13	Siratro plus Hunter River lucerne.

The soil was a heavy brown basaltic clay of moderate fertility. The area prior to a 4-month presowing fallow period carried a mixed pasture of native grasses and green panic with a small legume component of lucerne and *Phaseolus lathyroides*. Green panic and the legumes were sown in February 1962 into a well-prepared, moist seedbed. The legume seed, inoculated with appropriate rhizobia, was broadcast by hand and the green panic was drilled in, using a disc drill. Green panic was sown at 3 lb/ac, lucerne 2 lb/ac, and glycine and siratro 3 lb/ac. Plot size was 40 lk x 30 lk.

Plots were hand-weeded to remove volunteer *Phaseolus lathyroides* which emerged soon after sowing. Following an establishment period, plots were mown and raked at the end of August 1962. After mowing, superphosphate (140 lb/ac) and sulphur (16 lb/ac) were applied to all treatments and nitrogen as urea was applied to the nitrogen fertilizer treatments.

Plots were sampled before and after mowing in February 1963 and at the end of the summer growing period in May 1963. Four rectangular frames 5 lk x 2 lk were cut at predetermined random positions within the plots on each sampling occasion and different positions were used for each cut. Plants were cut at approximately $\frac{1}{2}$ in. above ground-level and dried at 90°C in a forced-draught oven for 16 hr. Nitrogen determination was done on ground material, bulked by treatments, by routine Kjeldahl digestion. Composition of the pasture was estimated by hand separation and weighing of green panic, legume and "other species" components.

Nitrogen analyses were carried out on one representative treatment where two or more strains of a legume species were studied. Nitrogen analyses were not made for treatments 6, 8 and 11.

III. RESULTS

The dry-matter yield for the 1962-63 growing period (Figure 2) increased curvilinearly with increasing units of nitrogen, with an efficiency ranging from 33 to 15 lb dry matter per pound of applied nitrogen for 50 and 200 lb nitrogen per acre, respectively. The presence of legumes resulted in a small non-significant reduction in yield of the green panic+other species component. There were no significant differences between the total yield of pasture in legume treatments and in the nil-nitrogen treatment. The total yield of pasture at the 50-lb level of nitrogen was significantly greater ($P < 0{\cdot}01$) than that from the legume-grass swards. The highest nitrogen treatment had the least other species.

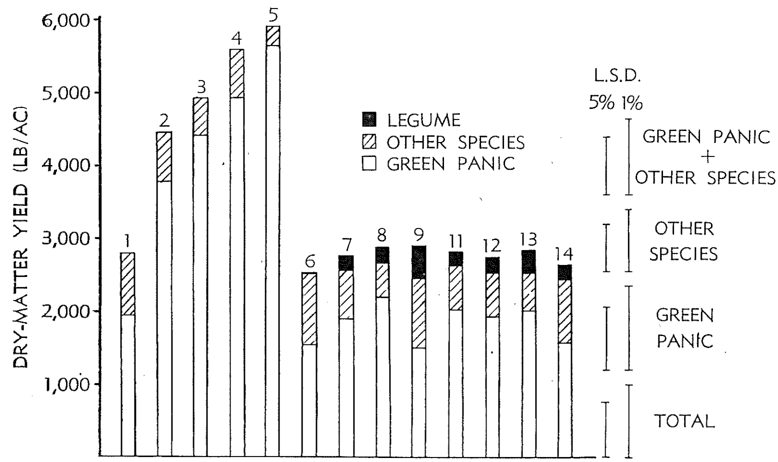

Fig. 2.—Dry-matter yields for the period August 30, 1962 to May 14, 1963. Differences between legumes were not significant. (Numbers above columns refer to treatments).

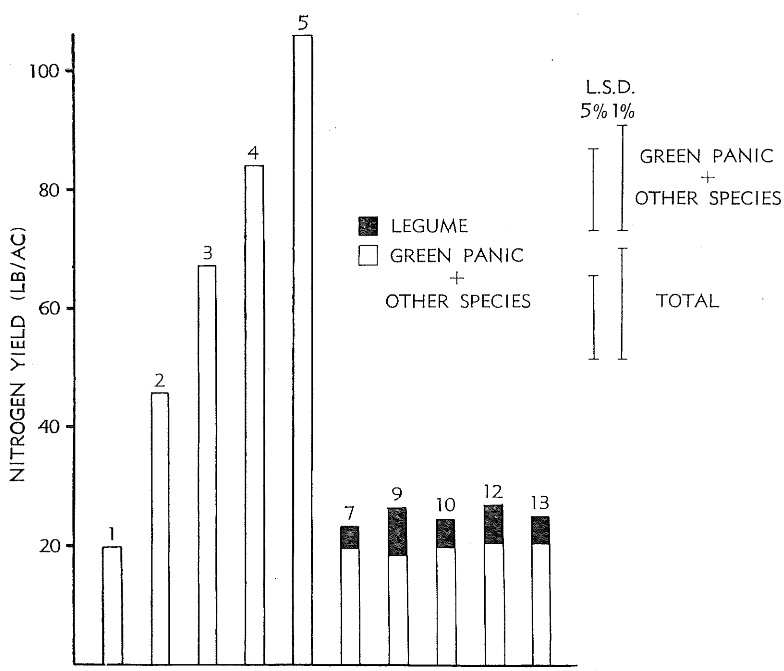

Fig. 3.—Nitrogen yields for the period August 30, 1962 to May 14, 1963. Differences between legumes were not significant. (Numbers above columns refer to treatments).

The application of nitrogen fertilizer resulted in a large increase in the nitrogen content of grass plus other species at the first harvest and a smaller increase at the second harvest (Table 1).

Nitrogen yields responded linearly to increasing levels of nitrogen fertilizer. There was no significant increase in total yield of nitrogen for the legume treatments. The total nitrogen yield for the 50 lb nitrogen per acre treatment was significantly greater ($P < 0 \cdot 01$) than that for the legume treatments.

Nitrogen recovery in the harvested material varied from 52·6% to 43·1% for 50 to 200 lb treatments respectively.

TABLE 1

PERCENTAGE NITROGEN CONTENT OF PASTURE COMPONENTS

Treatment No.	Sampled 12.ii.63		Sampled 14.v.63	
	Green Panic and Other Species	Legume	Green Panic and Other Species	Legume
1	0·77	..	0·62	..
2	1·18	..	0·70	..
3	1·60	..	0·88	..
4	1·78	..	1·09	..
5	2·38	..	1·18	..
7	0·80	1·81	0·69	1·74
9	0·78	2·03	0·67	1·57
10	0·83	1·95	0·66	2·21
12	0·86	1·87	0·70	1·97
13	0·91	2·13	0·74	2·06

IV. DISCUSSION

The results show that green panic is capable of large yield response to nitrogen fertilizer even during periods of low summer rainfall, as only 70% of the average rainfall for the period September to April was received during this period in 1962-63.

The large increase recorded in nitrogen content, with increasing levels of nitrogen fertilizer, in green panic harvested 5 months after the application of nitrogen, is in contrast to the results of Henzell (1963). In a higher rainfall region when nitrogen fertilizer was applied at rates up to 400 lb nitrogen per acre per annum, he obtained little effect on the percentage nitrogen of paspalum and Rhodes grass cut 8–12 weeks apart.

The results for yield and nitrogen content responses in green panic obtained at "Brian Pastures" are of importance in the subcoastal environment, since by applying nitrogen fertilizer to green panic pasture, high yields of good quality pasture or grass hay are produced during summer. More standing feed of improved quality is also provided for the autumn period.

The recovery of fertilizer nitrogen obtained was comparable with that reported by Henzell (1963).

The results obtained in the absence of grazing indicate that the herbaceous perennial tropical legumes offer little promise of contributing sufficient nitrogen to an associated adapted tropical grass to maintain a vigorous productive mixed pasture. The use of nitrogenous fertilizer to achieve this is indicated.

The often less emphasized role of the legume component in a mixed pasture, namely provision of a high-protein supplement, is probably best filled by lucerne on the heavy clay soils in this environment. Lucerne is frost-tolerant and is capable of winter and spring growth provided soil moisture is available. At these times it provides a high quality protein supplement when animals need it. The ability of the tropical legumes, most of which are frost-susceptible and winter dormant, to provide a protein supplement for animals as standover feed has not been determined in this area. It is likely that the greatest benefit from legumes when regarded as protein supplements for animals on mixed pastures will be derived from their inclusion in the native pastures, which are of much lower quality than the sown grasses in winter and spring. Legumes when used as protein supplements for animals may also prove to be important in sown pastures fertilized with nitrogen.

The legumes which were not included in the experimental observations because of poor initial establishment were *Lotononis bainesii* Baker (C.P.I. 16833), Oxley stylo (*Stylosanthes* sp.) and centro (*Centrosema pubescens* Benth.).

By February 1967, following a series of years of below-average summer rainfall, all the legumes except lucerne, siratro and *Lotononis* had disappeared. Siratro remained as sparse plants which made moderate growth during the midsummer to autumn period before being frosted back to the crowns. *Lotononis* survived from an extremely poor establishment of 2 or 3 plants per plot and the area covered increased each year. The stoloniferous habit was well expressed and strong rooting-down occurred at the nodes. Spring growth was vigorous when soil moisture was adequate. Lucerne in all plots was at a low density. The green panic in all legume plots was suffering from severe nitrogen deficiency and native grass species were well established and have increased in density.

According to Bryan (1961), neither the rainfall nor the heavy soil type at "Brian Pastures" is conducive to persistence of *Lotononis* under grazing. The survival and rapid spread of this legume over the past 5 years calls for a re-evaluation of its potential.

V. ACKNOWLEDGEMENTS

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The years in Fig. 1 should read "1962" and "1963".

The figures at the heads of the columns in Fig. 2 should read from 1 to 13.