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EFFECTS OF NITROGEN FERTILIZER ON PRODUCTION OF MIXED SWARDS AT GAYNDAH, SOUTH-EASTERN QUEENSLAND

By W. J. SCATENI, M.Agr.Sc.

SUMMARY

Levels of urea equivalent to 0, 50, 100, 150, and 200 lb nitrogen an acre were applied in September 1962 and January 1964 to three pastures—*Panicum maximum* var. *trichoglume* cv. Petrie with *Medicago sativa* cv. Hunter River, and Petrie with *Phaseolus atropurpureus* cv. Siratro—which were intermittently grazed by cattle.

Yields of dry matter and nitrogen were recorded during two seasons, 1962-63 and 1963-64, and net changes in available dry matter from May to December 1963 are reported.

Nitrogen fertilizer greatly increased the nitrogen content and dry-matter production of Petrie. Legume yield was too low to be a sensitive parameter.

I. INTRODUCTION

The legume component in a mixed sward is important not only because of its nitrogen contribution to the associated grass, but also as a high protein feed for animals. This may be of particular importance during winter and early spring, when the nitrogen content of grass available for grazing is low.

In subtropical subcoastal Queensland, on all except the very fertile scrub soils, a nitrogen source, either legume or fertilizer, is necessary to maintain a productive, introduced sown grass such as Petrie green panic (*Panicum maximum* var. *trichoglume* cv. Petrie). Where legume growth is insufficient to achieve this objective, the only alternative is nitrogen fertilizer.

Scateni (1968) reported the small effect of a range of legumes on total dry-matter and nitrogen yields of mixed swards during the below-average rainfall season of 1962-63. Nitrogen fertilizer, however, produced a marked increase in grass dry-matter yield, nitrogen content and thus total nitrogen yield when applied to grass swards.

The object of the experiment reported here was to further these studies by examining the effects of nitrogen fertilizer on production from swards of Petrie green panic alone, with Hunter River lucerne (*Medicago sativa* cv. Hunter River), or with Siratro (*Phaseolus atropurpureus* cv. Siratro).

II. MATERIALS AND METHODS

The experiment was carried out at "Brian Pastures" Pasture Research Station near Gayndah in subtropical, subcoastal Queensland. The main climatic features of the environment have been described by Scateni (1968). The average annual rainfall for the 16-year period 1954-1969 was 28 in. (Figure 1). The total rainfall for the 28 months was 76% of average. Below-average rainfall was recorded in 20 months. In July 1963, 24 ground frosts were recorded, compared with the average of 15, and the mean monthly minimum screen temperature was 38°F, compared with the 16-year mean of 42°F.

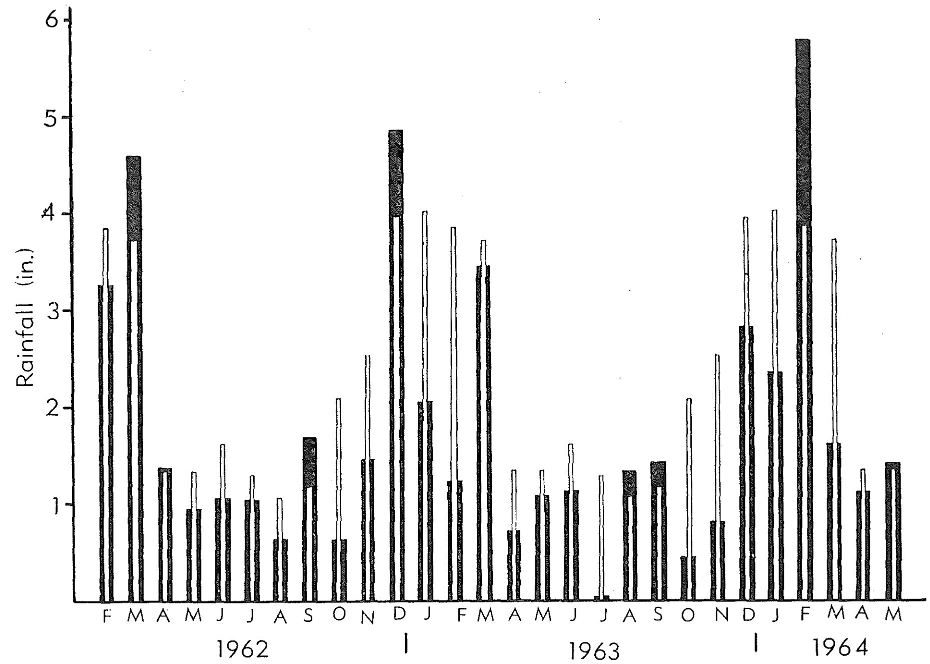

Fig. 1.—Monthly rainfall at "Brian Pastures" for the experimental period (shaded columns) and the average monthly rainfall (open columns).

The soil on the experimental area was a brown sandy-clay of moderate fertility (Ug6 (Northcote 1965)), which was fallowed for weed control for 4 months prior to sowing.

Four levels of urea equivalent to 50, 100, 150 and 200 lb of nitrogen an acre were applied to each of the pastures in a randomized block design with five complete replications. In addition, a zero treatment was included. Plot size was 30 lk x 30 lk, with a datum area of 40 lk².

In February 1962, Hunter River and Siratro, inoculated with rhizobia cultures CB61 and CB451 respectively, were hand broadcast into a well-prepared seedbed at 2 and 4 lb/ac respectively. Petrie was then oversown at 5 lb/ac using a disc drill.

Plots were mown to a 2 in. stubble and the cut material removed on August 31, 1962. Following mowing, 140 lb/ac superphosphate (9·6%P, 10%S) and 16 lb/ac elemental sulphur were applied to all plots, and urea, providing the appropriate rates of nitrogen, was applied to the nitrogen fertilizer treatments. Urea was again applied at the beginning of January 1964.

Plots were sampled before and after grazing in January and April 1963, before grazing only in December 1963 as the pastures were grazed very low to a uniform height, and finally before grazing in March 1964. Four 5 lk x 2 lk random pasture samples were cut to a stubble height of 0·5 in. from each plot. Samples were separated into Petrie, sown legume, and weed, dried at 200°F in a forced-draught oven for 16 hr, and weighed. Samples of sown legume and Petrie plus weed were bulked for each treatment and analysed for nitrogen in the usual way. Nitrogen analyses for the N150 treatment were not carried out in 1963.

III. RESULTS

Spring–Summer 1962-63.—Results for this period are summarized in Figures 2 and 3. Nitrogen fertilizer increased ($P<0\cdot01$) Petrie and total dry-matter yields and decreased ($P < 0\cdot05$) legume yield. However, legume yield was too low to be a sensitive parameter. Pasture type had no significant effect on dry-matter yield. Nitrogen fertilizer increased Petrie plus weed, and total nitrogen yields at N50 ($P < 0\cdot05$) and greater ($P <0\cdot01$). Nitrogen yield of Petrie plus weed was less ($P < 0\cdot01$) for Petrie with Siratro than for the other pastures, and total nitrogen yield of Petrie with Hunter River was greater than for Petrie alone ($P < 0\cdot05$) and Petrie with Siratro ($P < 0\cdot01$).

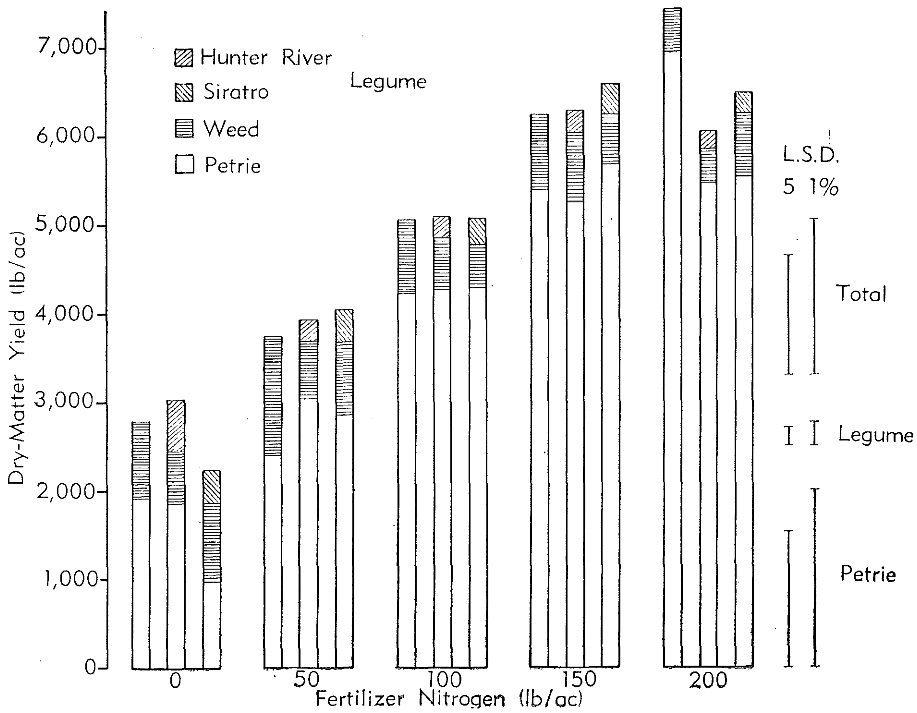

Fig. 2.—Effect of nitrogen fertilizer on dry-matter yield from August 31, 1962, to April 22, 1963.

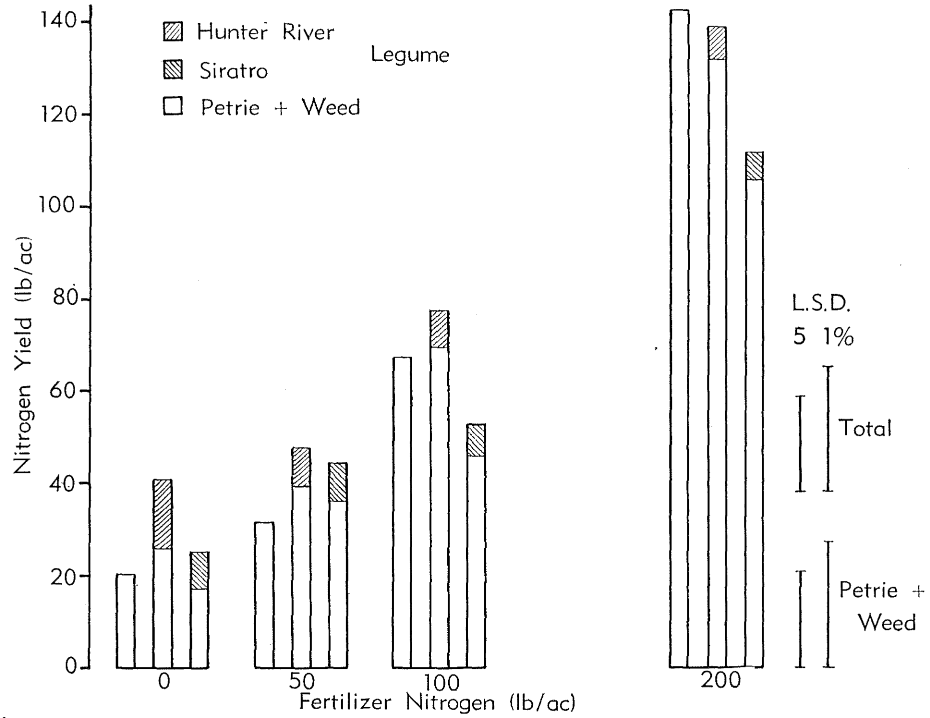

Fig. 3.—Effect of nitrogen fertilizer on nitrogen yield from August 31, 1962, to April 22, 1963.

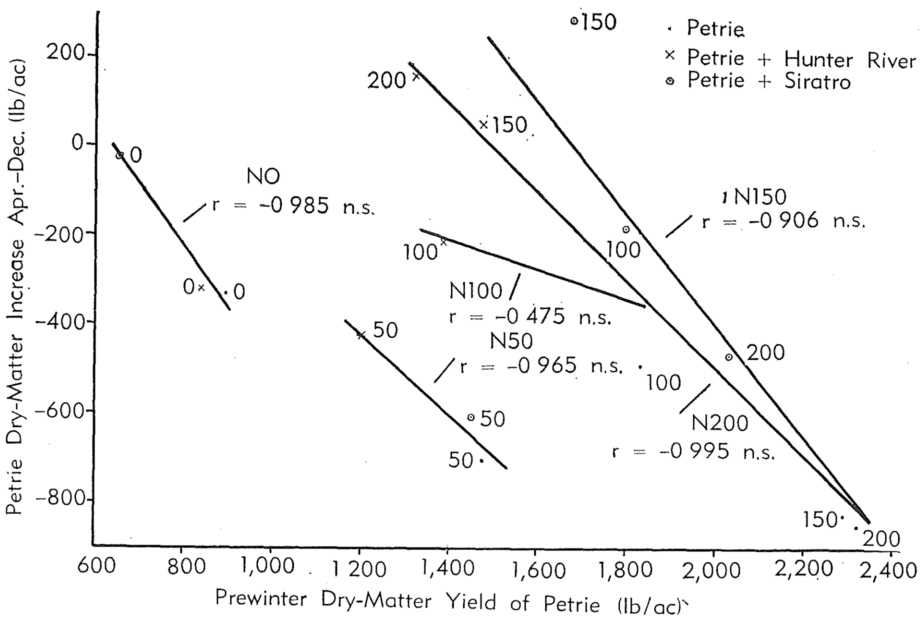

Fig. 4.—Relation between prewinter dry-matter yield and dry-matter increase of Petrie for each level of nitrogen fertilizer from April 24 to December 17, 1963.

Winter–Spring 1963.—The results for this period are summarized in Figures 4 and 5. The data for Petrie show that with the exception of the N100 level there were high but non-significant negative correlations between prewinter yields and net dry-matter increase during April to December. The linear regression coefficients of these lines did not differ significantly. A significant ($P < 0 \cdot 01$) negative correlation occurred between the mean prewinter dry-matter yields and the mean net dry-matter increase of weed from April to December. Dry-matter yields of legume were low and changes were small.

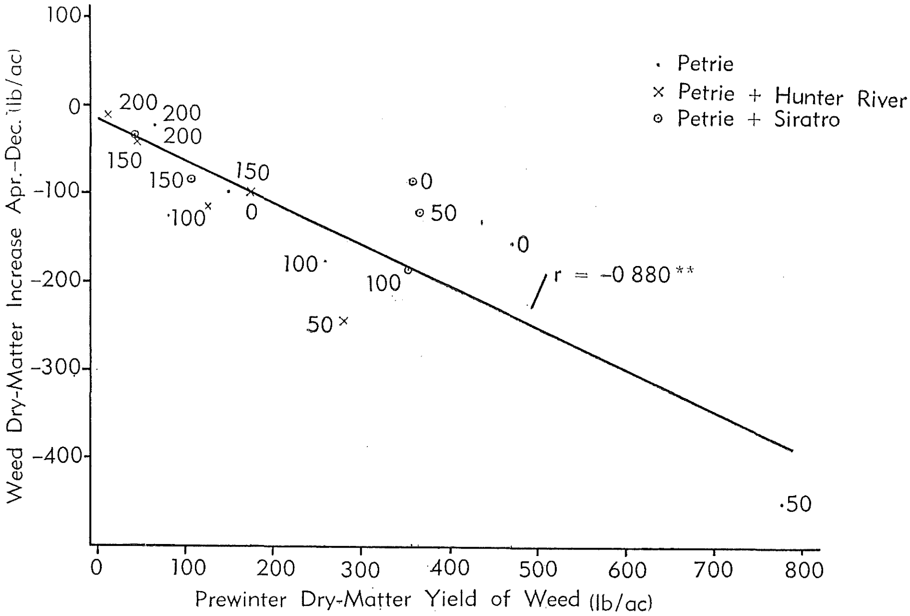

Fig. 5.—Relation between prewinter dry-matter yield and dry-matter increase of weed from April 24 to December 17, 1963.

Summer 1963-64.—Figures 6 and 7 and Tables 1 and 2 summarize the results for this period. Nitrogen fertilizer increased ($P < 0 \cdot 01$) Petrie and total dry-matter yields and decreased ($P < 0 \cdot 01$) the dry-matter yields of weeds at N100 and above. Petrie with Hunter River reduced weed growth more than Petrie alone ($P < 0 \cdot 01$) or Petrie with Siratro ($P < 0 \cdot 05$). Hunter River yield was lower ($P < 0 \cdot 01$) than Siratro yield and Hunter River depressed ($P < 0 \cdot 05$) total dry-matter yield. A significant interaction ($P < 0 \cdot 05$) between nitrogen fertilizer and pasture type occurred for Petrie dry-matter yield due to the higher yield when associated with Hunter River at N0 and lower yield response to nitrogen fertilizer in this pasture.

Nitrogen fertilizer increased ($P < 0 \cdot 01$) Petrie plus weed and total nitrogen yields. Hunter River ($P < 0 \cdot 01$) and Siratro ($P < 0 \cdot 05$) each increased the nitrogen yield of Petrie plus weed and total nitrogen yield ($P < 0 \cdot 05$). The yield of nitrogen from Siratro was greater ($P < 0 \cdot 01$) than that from Hunter River.

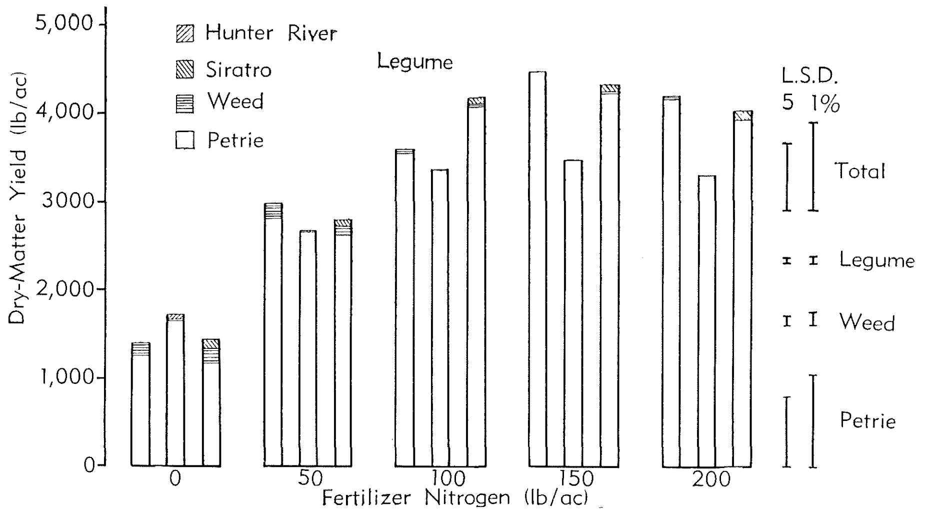

Fig. 6.—Effect of nitrogen fertilizer of dry-matter yield from December 18, 1963, to March 11, 1964.

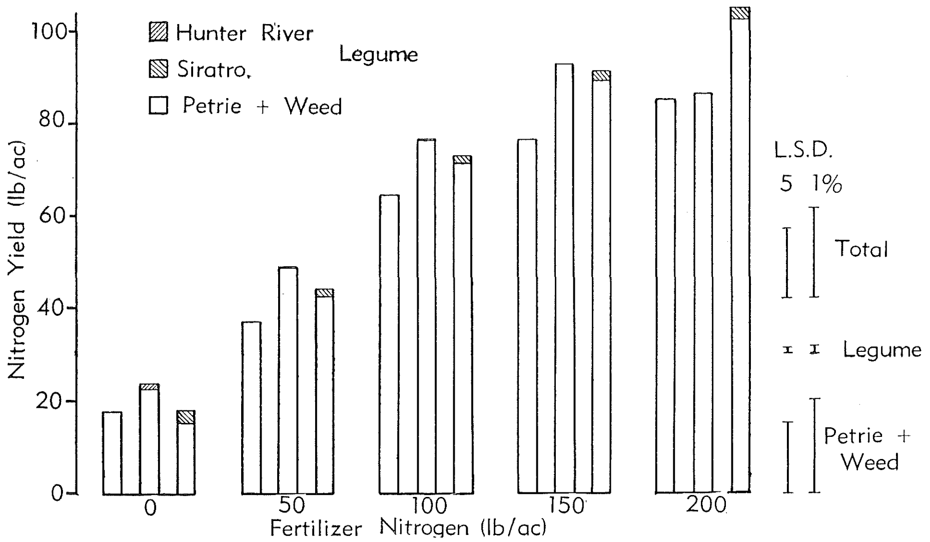

Fig. 7.—Effect of nitrogen fertilizer on nitrogen yield from December 18, 1963, to March 11, 1964.

At each harvest the mean nitrogen content of Petrie increased as the level of nitrogen fertilizer increased. In 1962-63 there was little change in the mean dry-matter response as the nitrogen level increased. In 1963-64 the response decreased as the level of nitrogen fertilizer increased. In both seasons Petrie with Hunter River had the lowest dry-matter response.

TABLE 1

EFFECT OF NITROGEN FERTILIZER ON MEAN NITROGEN CONTENT (%) OF PETRIE PLUS WEED AT EACH PREGRAZED HARVEST

Nitrogen (lb/ac)	0	50	100	150	200
14.i.63 *	0·97	1·10	1·54	n.d.	2·42
22.iv.63 †	0·80	0·86	0·92	n.d.	1·36
17.xii.63 †	1·18	1·19	1·13	1·30	1·43
11.iii.64 *	1·24	1·53	1·77	2·15	2·42

* < 5 months after nitrogen application.

† > 7 months after nitrogen application.

TABLE 2

EFFECT OF NITROGEN FERTILIZER ON TOTAL DRY-MATTER RESPONSE PER LB OF NITROGEN APPLIED (CALCULATED FROM YIELD AT EACH NITROGEN LEVEL MINUS YIELD AT N0)

lb dry matter/lb N

Nitrogen (lb/ac)	50	100	150	200	Mean
1962–63—					
Petrie	19	23	23	23	22
Petrie with Hunter River	18	21	22	15	19
Petrie with Siratro ..	36	28	29	21	29
Nitrogen means ..	24	24	25	20	
1963–64—					
Petrie	32	22	15	14	21
Petrie with Hunter River	19	16	12	8	14
Petrie with Siratro ..	27	27	19	13	22
Nitrogen means ..	26	22	15	12	

IV. DISCUSSION

In both summer periods nitrogen fertilizer greatly increased Petrie dry-matter production and nitrogen content. Legume yields were too low to be sensitive measurements. The effects of nitrogen fertilizer on Petrie alone were similar to those already reported (Scateni 1968). In 1962-63 the mean yields of legume were 18% and 4% of the total yields of mixed pastures at N0 and N200 respectively, and in 1963-64 were 5% and 2% respectively. Jones, Davies and Waite (1967) found a close correlation between effective rainfall (September to May) and tropical legume dry-matter yield. The total rainfalls from September to May in 1962-63 and 1963-64 were 17 and 18 in. respectively, compared with the average of 24 in. Assuming an effective rainfall of 15 in. in each of these years from September to May, the predicted dry-matter yield of Siratro using the regresson equation of Jones, Davies and Waite (1967) was 240 lb/ac. High yields of tropical herbaceous legumes cannot be expected in grass-legume swards in this environment. The legume component of the mixed pastures had almost disappeared after 2 years because of low rainfall.

Jones (1967) reported that the dry-matter changes of *Paspalum plicatulum* CPI 11826 during winter were small, whereas the losses from the weed component, mainly *Digitaria didactyla,* were high. The higher losses, however, were associated with a mean prewinter yield about four times that of sown grass.

Changes in dry-matter yield of Petrie during a period of protection from cattle grazing, from April to December 1963, showed that net dry-matter increase was inversely related to prewinter yield and was influenced by level of nitrogen fertilizer. This result may be explained in terms of an equal percentage loss of old growth for the different fertilizer levels due to senescence, frost damage and weathering and small herbivore grazing (hares, birds, insects, etc.), and an increase in spring dry-matter production as the level of nitrogen fertilizer increased.

Net dry-matter increase of weed from April to December 1963 was inversely related to prewinter yield and was not influenced by level of nitrogen fertilizer. The weed component was predominantly native grass and because there was no growth response to the August and September rainfall only old growth was involved during the period April to December.

The results indicate that the herbaceous legume component of mixed swards, particularly on the sandy-clay soils in this environment, should be disregarded when consideration is given to the requirement of the grass for nitrogen fertilizer where the aim is to maintain a productive sown pasture.

V. ACKNOWLEDGEMENTS

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The author is an officer of Agriculture Branch, Queensland Department of Primary Industries, stationed at "Brian Pastures" Pasture Research Station, Gayndah.