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EFFECTS OF SOWING RATE ON YIELD AND COMPOSITION OF A SIRATRO-NANDI SETARIA PASTURE

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SUMMARY

The effect of sowing rates of *Setaria sphacelata* cv. Nandi and *Macroptilium atropurpureum* cv. Siratro on the yield and composition of established pasture was examined in a field experiment on a podzolic soil at Pimpama, south-eastern Queensland. Siratro at 3·3, 9·9 and 29·7 kg/ha was sown with Nandi setaria at 2·2 and 6·6 kg/ha, with sowing rates based on pure live seed. Pasture production and composition were measured three times each year for 3 years subsequent to the establishment phase.

Increased Siratro sowing rates resulted in higher legume yields, a higher nitrogen content of the associated grass and a greater proportion of legume in total pasture. The responses to Siratro sowing rate were more pronounced at the low Nandi setaria sowing rate, where the effects persisted for up to 33 months (legume yield) and 21 months (grass nitrogen content and grass/legume proportion) after sowing. At the end of the third productive season all effects of sowing rate had disappeared.

I. INTRODUCTION

Minson and Milford (1967) and Evans (1970) reported that efficiency of utilization and animal performance were directly related to the legume content of a tropical grass-legume pasture. This can be influenced by stocking rate and maintenance phosphorus application (Evans 1970; Bryan 1970; Mears and Barkus 1970), soil moisture status, drainage and companion species (Bryan 1970), applied nitrogen (Jones 1970), and frequency and height of defoliation (Ebersohn 1969). Adjustment of sowing rates of the legume and grass components would also be expected to influence their relative proportions in a pasture, at least in the early stages.

This paper reports the effects of variable sowing rates of *Setaria sphacelata* cv. Nandi and *Macroptilium atropurpureum* cv. Siratro on yield and composition of a pasture during a 3-year period subsequent to the establishment phase. Results from the establishment phase have been published (Middleton 1970).

II. MATERIALS AND METHODS

Details of the site, experimental design and treatments were presented by Middleton (1970). The soil was a shallow red podzolic, consistent with the red-yellow podzolics and Dr 3.41 soils mapped by Beckmann (1967) and Isbell *et al.* (1967), respectively. Treatments sown February 12, 1968, were in factorial combinations with three replications. Owing to the elimination of Greenleaf desmodium by *Amnemus* weevil in the summer of 1968-69 the results presented are restricted to the effects of Siratro sown at 3·3, 9·9 and 29·7 kg/ha live seed with Nandi setaria sown at 2·2 or 6·6 kg/ha live seed. Plot size was 4·5 x 3·6 m with a 1·8 m buffer zone between plots.

In addition to the basal fertilizer applied at planting (Middleton 1970), a maintenance application of superphosphate (372 kg/ha) was applied each spring (September). An application of potassium chloride (236 kg/ha) was applied in September 1969.

Dry-matter yields of the various components of the pasture were determined three times each growing season using an Autoscythe. The dates are shown in Figure 1. Subsamples of sown grass and legume were analysed for nitrogen and phosphorus content on each occasion. After each harvest the area was heavily grazed and then mown at 10 cm height.

Rainfall recorded for the growing season (September to April) each year was 425 mm, 1100 mm and 1225 mm for 1968-69, 1969-70 and 1970-71 respectively. Severe drought conditions extended through the 1968-69 season. The average annual rainfall is 1250 mm. Light to moderate frosts occurred in all winters.

III. RESULTS

Dry-matter and nitrogen yields.—The most significant feature of the results was the effect of Siratro sowing rate on pasture dry-matter and nitrogen yield. Thus the highest Siratro sowing rate produced significantly higher Siratro dry-matter yields than did the lowest Siratro sowing rate at all harvests up to February 1970, 24 months after sowing (Figure 1). However, the degree and the duration of this response were influenced by setaria sowing rate in that at the low setaria sowing rate the Siratro yield response was more marked and persisted until November 1970, 33 months after sowing (Table 1).

The effects of Siratro sowing rate on the nitrogen yield of the legume and indeed total pasture nitrogen yield were closely related to the dry-matter yield responses of Siratro. Thus Siratro and total pasture nitrogen yield responses occurred at the low setaria rate only (except in November 1969) and persisted until November 1970 (Figure 2).

TABLE 1

EFFECT OF SOWING RATE ON THE DRY-MATTER YIELD (kg/ha) OF SIRATRO

Sample Date	Setaria 2·2 kg/ha			Setaria 6·6 kg/ha			L.S.D.
	Siratro Sowing Rate (kg/ha)			Siratro Sowing Rate (kg/ha)			
	3·3	9·9	29·7	3·3	9·9	29·7	5%
19.iii.69 ..	42	67	136	29	72	103	73
24.xi.69 ..	91	195	648	129	213	415	177
9.ii.70 ..	386	524	1,156	473	407	672	326
8.iv.70 ..	993	1,276	1,399	635	690	591	434
24.xi.70 ..	227	390	473	108	77	173	235
9.ii.71 ..	1,367	1,421	1,491	1,323	1,394	1,130	N.S.

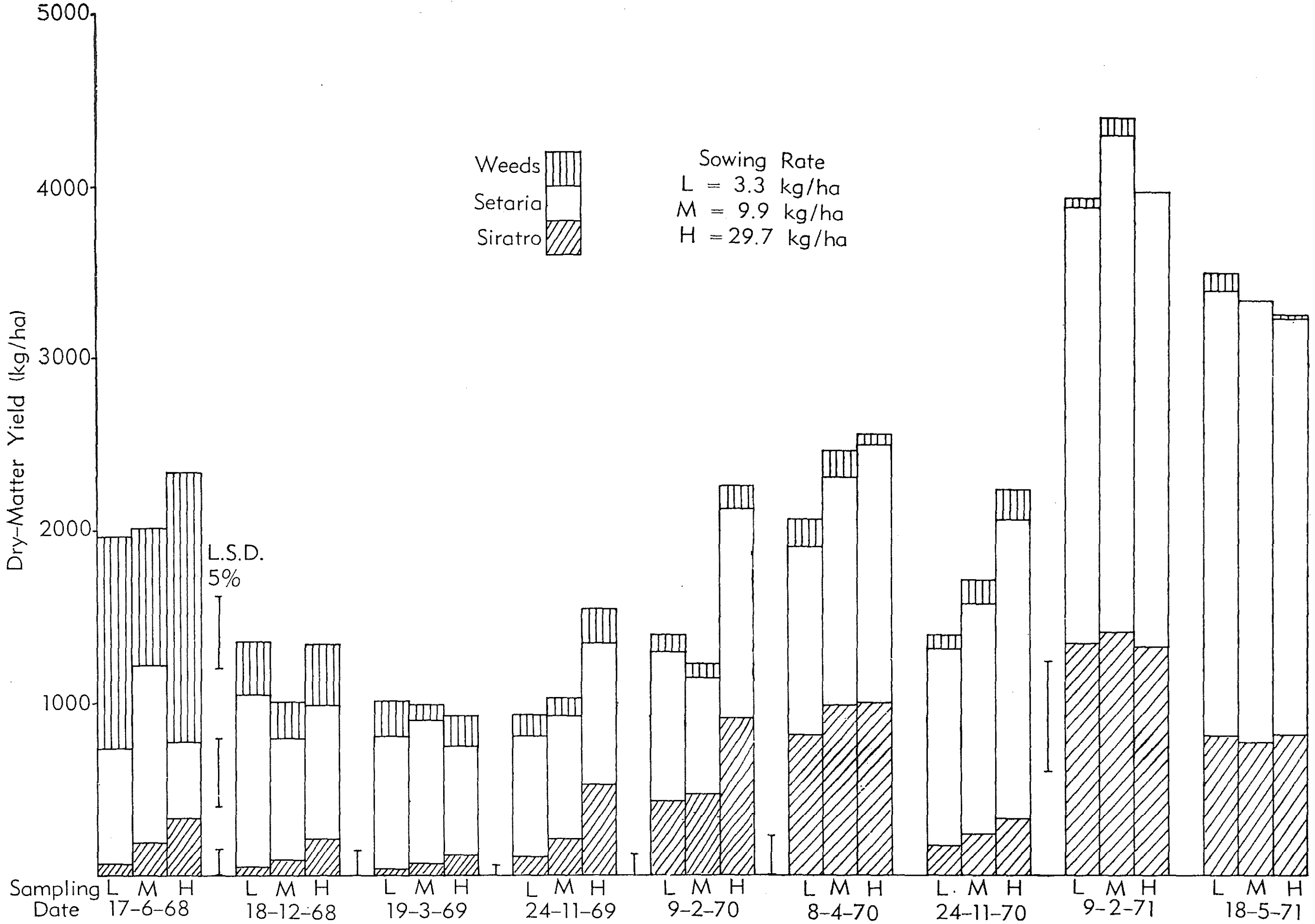

Fig. 1.—Effect of Siratro sowing rate on dry-matter yield of pasture components.

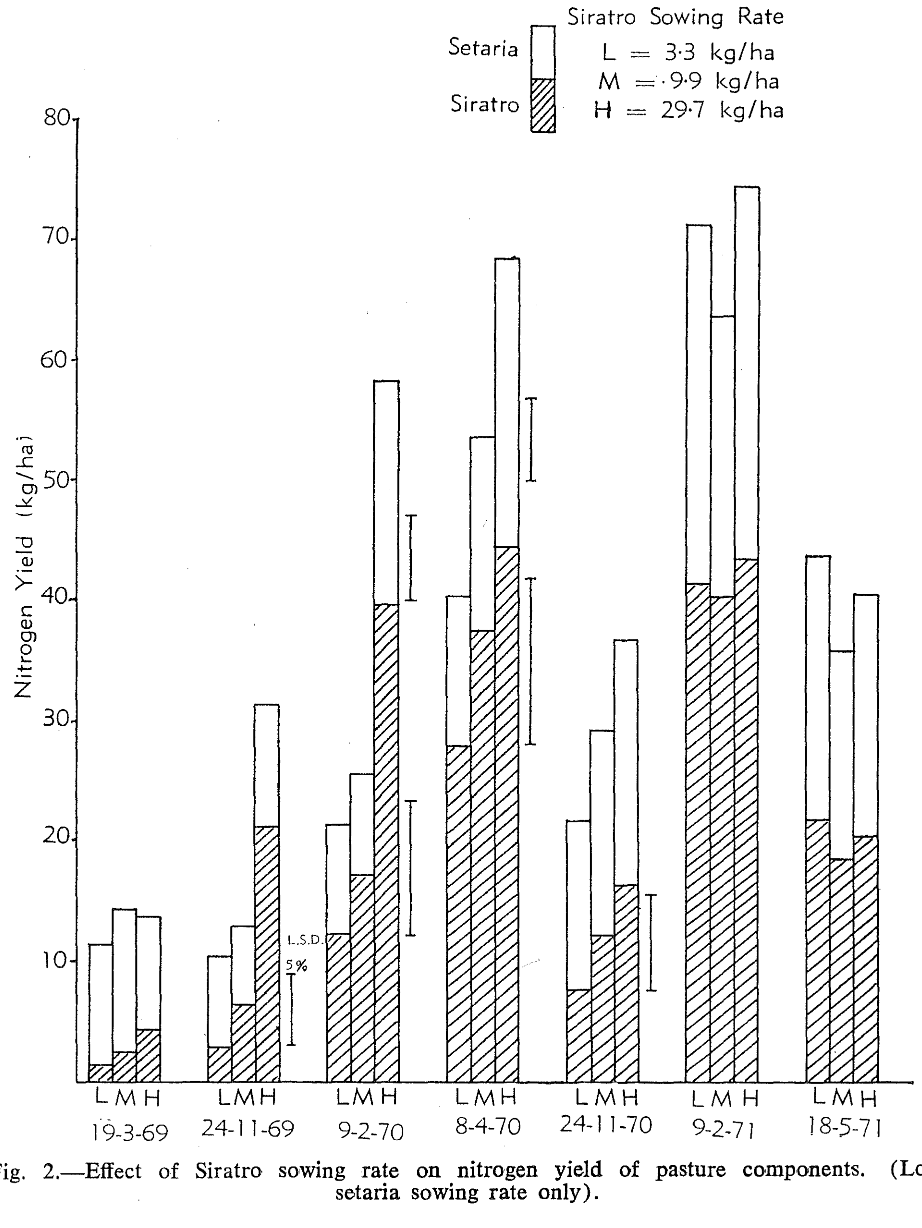

Fig. 2.—Effect of Siratro sowing rate on nitrogen yield of pasture components. (Low setaria sowing rate only).

Nandi setaria sowing rate alone had little effect on the yield of pasture components. However, in February and April 1970 setaria dry-matter yield (Table 2) and nitrogen yield (Figure 2) were significantly greater for the high (29·7 kg/ha) Siratro/low setaria than for the low (3·3 kg/ha) Siratro/low setaria treatment. This pattern was similar in total pasture nitrogen yield being significant in April and November 1970 (Figure 2).

TABLE 2

EFFECT OF SETARIA AND SIRATRO SOWING RATE ON THE DRY-MATTER YIELD (kg/ha) OF SETARIA AND TOTAL PASTURE (SETARIA + SIRATRO)

Sample Date	Component	Setaria 2·2 kg/ha			Setaria 6·6 kg/ha			L.S.D. 5%	Means of Siratro Rates		
		Siratro Sowing Rate (kg/ha)			Siratro Sowing Rate (kg/ha)						
		3·3	9·9	29·7	3·3	9·9	29·7		Setaria 2·2	Setaria 6·6	L.S.D. 5%
24.xi.69	Setaria	574	551	756	806	891	873	N.S.	627	857	N.S.
	Total pasture	666	746	1,404	851	936	1,104	582	938	964	N.S.
9.ii.70	Setaria	849	635	1,546	880	726	870	737	1,010	825	N.S.
	Total pasture	1,235	1,161	2,703	1,352	1,133	1,542	838	1,699	1,342	N.S.
8.iv.70	Setaria	1,273	1,426	2,147	894	1,215	838	713	1,615	982	412
	Total pasture	2,268	2,703	3,545	1,531	1,906	1,430	1,010	2,838	1,622	583
24.xi.70	Setaria	1,240	1,331	1,897	1,020	1,347	1,762	N.S.	1,489	1,379	N.S.
	Total pasture	1,458	1,722	2,371	1,136	1,424	1,930	904	1,853	1,499	N.S.

Chemical composition.—The nitrogen content of Nandi setaria was influenced by Siratro sowing rate (Table 3). At the harvests in March and November 1969, the highest Siratro sowing rate produced higher setaria nitrogen percentages than did the low and/or intermediate Siratro sowing rate. This effect was significant at the lower grass rate only.

TABLE 3

EFFECT OF SIRATRO SOWING RATE ON THE NITROGEN CONTENT (% N) OF NANDI SETARIA

Sample Date	Setaria 2·2 kg/ha			Setaria 6·6 kg/ha			L.S.D.	Means of Setaria Rates			L.S.D.
	Siratro Sowing Rate (kg/ha)			Siratro Sowing Rate (kg/ha)							
	3·3	9·9	29·7	3·3	9·9	29·7	5%	Siratro 3·3	Siratro 9·9	Siratro 29·7	5%
19.iii.69 ..	1·50	1·68	1·88	1·57	1·62	1·65	0·28	1·53	1·65	1·77	0·20
24.xi.69 ..	1·28	1·20	1·45	1·22	1·17	1·28	0·20	1·25	1·18	1·36	0·14
9.ii.70	1·18	1·36	1·25	1·13	1·26	1·24	N.S.	1·15	1·31	1·26	N.S.
8.iv.70	1·05	1·16	1·17	1·15	1·01	0·99	N.S.	1·09	1·08	1·08	N.S.

Setaria sowing rate alone had no effect on the nitrogen content of pasture components, nor did any sowing rate treatment influence the phosphorus content of pasture components during this phase of the experiment.

IV. DISCUSSION

The management system used in the current experiment involved periodic heavy grazing and mowing. Since management factors are known to affect pasture yield and composition, the results are discussed only in terms of the system adopted.

The role of the legume in tropical grass/legume pasture has been defined in terms of nitrogen fixation (Bryan 1962; Henzell 1962; Henzell and Norris 1962; Henzell 1968), their higher nutritive value than tropical grasses (Milford and Haydock 1965; Milford 1967; Milford and Minson 1968; Hamilton *et al.* 1970) and higher animal production as the legume content increases (Evans 1970). Thus any factor which increases the legume content is likely to benefit animal production.

Middleton (1970) showed that increasing Siratro sowing rates increased its population and yield during the establishment phase. The current experiment showed that the Siratro sowing rate was the most important single factor affecting the yield and composition of a Siratro/Nandi setaria pasture in the post-establishment period. As the Siratro sowing rate was increased, significant responses in legume yield, grass yield and grass nitrogen content were recorded. The effects of increasing Siratro rate on its yield and content continued for almost 3 years after sowing. As a consequence of the Siratro yield response to increased sowing rate the proportion of legume to grass in total pasture increased (Figure 1). Thus in March 1969 the Siratro content was 4·4% and 16·0% at the lowest and highest Siratro sowing rate respectively. Corresponding figures for November 1969 were 13·9% (lowest Siratro rate) and 39·5% (highest Siratro sowing rate) and for February 1970 they were 33·2% (lowest Siratro rate) and 43·1% (highest Siratro rate).

Siratro sowing rate responses were always more pronounced and persistent at the low Nandi setaria sowing rate where, presumably, competition from the grass was less. Jones, Davies and Waite (1969) found Nandi setaria a most aggressive and competitive grass. Also Tow (1967) with Tinaroo glycine/Petrie panic and Middleton (1970) with Siratro/Nandi setaria and Greenleaf desmodium/Nandi setaria showed that during establishment, increasing grass sowing rates reduced the yield of the legume component.

Evidence of the value of Siratro in terms of nitrogen fixation was evident at the low setaria rate, firstly in the nitrogen content of Nandi setaria (March and November 1969) and secondly in the dry-matter and nitrogen yield of Nandi setaria (February, April and November 1970). A higher legume content was associated with these responses, which disappeared by the 1970-71 season when the legume content between treatments evened out. Further evidence of the role of high legume contents in nitrogen fixation was indicated in the early part of 1970 when the setaria dry-matter yields were higher at the low compared with the high setaria rate.

While the high Nandi setaria sowing rate increased the dry-matter yield of the grass during the establishment period (Middleton 1970), sowing rate alone rarely had any effect on its yield in the post-establishment period. However, significant interactions with Siratro sowing rate occurred in several instances, the general effect being a suppression of the Siratro sowing rate effect at the higher Nandi setaria sowing rate, indicating higher competitive stress.

Except for a small reduction in yield at the higher Nandi setaria sowing rate early in the experimental period, sowing rates had little lasting effect on weed yield and content. Weed content was high during establishment (Middleton 1970), but weeds rapidly declined to a minor pasture component thereafter, irrespective of treatment (Figure 1). The small benefit in weed suppression by the high grass rate was outweighed by its suppressing effect on Siratro. This was supported by the results, which showed that Siratro yield, grass yield and grass nitrogen content responses to increasing Siratro sowing rates were more pronounced at the lower Nandi setaria sowing rate.

It is concluded from the results that a high Siratro sowing rate relative to that of the companion grass is a useful means of achieving a high legume content and enhanced pasture yield and quality. This advantage may be even more pronounced with tropical legumes which do not set seed as readily as Siratro or whose seed set is limited by factors like premature frosting.

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