COOL SEASON PRODUCTIVITY OF FIVE TROPICAL GRASSES IN A HIGH RAINFALL AREA OF SOUTH-EAST QUEENSLAND

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ABSTRACT

The use of cold tolerant tropical grasses fertilized with nitrogen can reduce the period of feed shortage during the cool season to three and a half months from mid July to late October.

Setaria anceps *cv. Narok fertilized with* 100 *kg N* ha^{-1} *in autumn yielded an average of* 6000 *kg* ha^{-1} *of dry matter in mid winter.* Panicum coloratum *CPI* 16796 *(Kabulabula) produced similar yields but the material was very stemmy in comparison. Yields appeared unaffected by moisture conditions during autumn.* In vitro *digestibility and N content of all matured grasses was low, and some supplementation with high quality feed would be necessary to sustain high animal production, especially from milking cows.*

During the spring, Paspalum wettsteinii *(broadleaf paspalum) and CPI* 16796, *fertilized with* 100 *kg N* ha^{-1}, *produced an average of* 2000 *kg* ha^{-1} *dry matter by the end of October. The former also produced substantial yields with a lower rate of N fertilizer. Nutritional value of all grasses in the spring was satisfactory. Moisture and probably temperature conditions seem to be of paramount importance in early spring yields.*

Pennisetum clandestinum *cv. Whittet and* Panicum maximum *var.* trichoglume *cv. Petrie produced much lower yields in both seasons.*

INTRODUCTION

Environmental conditions of coastal south-east Queensland favour tropical and subtropical pasture species as the main constituents of permanent pastures (Ostrowski 1978). However, production of these species during the cooler part of the year is generally restricted by the low temperatures and low rainfall. This frequently results in a period of critical feed shortage from early June to late October.

Some tropical species, particularly grasses, show reasonable cold tolerance, and if properly managed, may produce high yields that will substantially narrow the cool season feed gap. The most suitable grasses for autumn saved winter grazing appear to be *Setaria anceps* cv. Narok (Hacker 1972, Rees 1972), *Pennisetum clandestinum* (Kemp 1975) and *Panicum coloratum* CPI 16796 (Rees 1972), while *Paspalum wettsteinii* appears suitable for early spring production (Leggett 1967).

Application of nitrogen fertilizer to these grasses can further increase yields and extend their growing season. On the mid north coast of New South Wales the growth period of some grasses was extended from a normal four to six months to up to nine months with added nitrogen (Kemp 1975). This period could be even further extended in the warmer climate of south-east Queensland provided that soil moisture is not limiting.

This paper compares autumn saved and spring yields of five tropical grasses and their nitrogen and phosphorus content, when grown under varying nitrogen regimes.

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MATERIALS AND METHODS

Site

The experiment was located at Mt. Mee in south-east Queensland (27°1′S, 152°8′E) on an acid red leached structured earth (Gn 3.14, Northcote 1971) which previously supported improved pasture for 10 years. Average annual rainfall is 1453 mm mainly of summer incidence. Several (3–4) light frosts occur each winter.

Design and treatments

Five grasses, *Setaria anceps* (setaria) cv. Narok, *Panicum coloratum* CPI 16796 (Kabulabula), *Pennisetum clandestinum* (kikuyu grass) cv. Whittet, *Paspalum wettsteinii* (broadleaf paspalum) and *Panicum maximum* var. *trichoglume* (green panic) cv. Petrie, and three rates of nitrogen (0, 150 and 300 kg ha^{-1} yr^{-1} applied in three equal dressings) were arranged in a randomized block design with three replicates.

Plots were 3 m × 2.4 m with 1.8 m pathways between replicates.

Establishment

The existing grass cover of the area was killed with 2,2-DPA in early October 1973 before cultivation. Basal fertilizer consisting of 6 kg ha^{-1} N, 52 kg ha^{-1} P, and 52 kg ha^{-1} K, with trace elements Cu, Zn and Mo was applied three days before sowing. Grass seeds were sown by hand at 5 kg ha^{-1} and harrowed in, together with the first application of N, on November 29, 1973.

Maintenance and management

Maintenance fertilizer of 30 kg P and 75 kg K ha^{-1} was applied yearly in early summer. Nitrogen was applied in mid-March, in late August and in January. During the second season, in December 1974, the experiment was sprayed with a 50:50 2,4-D : 2,4,5-T mixture to control weeds.

Autumn and spring production in each of three years was measured for the periods March 14 to July 16 and August 15 to October 30 respectively although no harvest was taken during the first autumn. During the remainder of the year cattle were allowed to graze the experimental area. The plots were mown to 10 cm height with an autoscythe at the commencement of each measured growth period.

Sampling

A sample strip of 0.9 m × 3 m was cut at 10 cm height from the centre of each plot with an autoscythe. The cut material was weighed in the field and a 0.5 kg subsample taken for dry matter determination and N and P analysis. The autumn subsamples were separated into leaf and stem.

In vitro digestibility was determined on separate leaf and stem samples from the first autumn harvest. Samples were oven-dried for 2 hours at 100°C and analysed as described by Tilley and Terry (1963).

RESULTS

Average weather conditions prevailed during the autumn and spring periods of 1974 and 1976. In 1975 the autumn was very dry and the spring was wet and mild. Only one light frost occurred in mid June 1975 and none in 1976 before the July harvest.

Autumn production

Mean yields for the two autumn periods are presented in Table 1. Narok was most productive at both levels of applied N. In the absence of nitrogen fertilizer there were no significant differences between species. All grasses responded well to both rates of applied nitrogen. Average nitrogen recoveries for the two seasons at the highest level of applied nitrogen ranged from 43.5% for Petrie to 53.9% for Kabulabula.

TABLE 1

Total dry matter and leaf yield (kg ha⁻¹) in autumn (March 14 to July 16) of five grasses given three rates of nitrogen (0, 150 and 300 kg ha⁻¹). Mean of two years (1975 and 1976).

Species	Total Yield			Leaf Yield		
	0	150	300	0	150	300
Narok setaria	789	3529	5974	546	2497	3142
Kabulabula panic	354	2640	5810	147	985	1852
Whittet kikuyu	410	2054	4124	270	1055	1984
Broadleaf paspalum	639	2299	4333	222	1117	2310
Petrie green panic	252	1546	4457	89	770	1430
L.S.D. (P=0.05)		856			638	
(P=0.01)		1155			861	
(between any two means)						

The quality of herbage expressed as *in vitro* digestibility percentage and N and P concentration is shown in Table 2. *In vitro* digestibility and P concentration of Whittet were higher than those of the other species. N concentration of broadleaf paspalum was greater than those of the other species, but its leaf digestibility was lowest.

TABLE 2

IN VITRO *digestibility (DMD, 1975) and N and P percentage (means, 1975-76) of five autumn-saved grasses at 300 kg ha⁻¹ N.*

Species	DMD leaf*	N		P	
		whole plant top	leaf	whole plant top	leaf
Narok setaria	51.0	0.98	1.11	0.24	0.24
Kabulabula panic	52.0	0.99	1.36	0.19	0.22
Whittet kikuyu	56.0	1.19	1.46	0.28	0.31
Broadleaf paspalum	47.0	1.22	1.52	0.24	0.25
Petrie green panic	52.0	1.03	1.40	0.24	0.28
L.S.D. (P=0.05)		0.09	0.06	0.02	0.01
(P=0.01)		0.12	0.08	0.03	0.02

*Replicates bulked for analyses.

Spring production

Average spring dry matter yields for three seasons are shown in Table 3. Significant differences were only obtained when N was applied and then Kabulabula and broadleaf paspalum were the most productive.

TABLE 3

Yields (kg ha⁻¹) in spring (August 15 to October 30) of five grasses given three rates of nitrogen (0, 150 and 300 kg ha⁻¹). Mean of three years (1974-1976).

Species	0	150	300
Narok setaria	354	879	1243
Kabulabula panic	203	1065	2181
Whittet kikuyu	179	497	841
Broadleaf paspalum	427	1737	2049
Petrie green panic	182	620	1408
L.S.D. (P=0.05).		388	
(P=0.01)		524	
(between any two means)			

Average nitrogen recoveries in spring, at the highest level of applied nitrogen, were 12.1, 13.9, 21.8, 28.0 and 31.3% of the nitrogen applied to Whittet, Narok, Petrie, broadleaf paspalum and Kabulabula, respectively. Recovery of N reached 43.2% in broadleaf paspalum fertilized with 150 kg N ha^{-1}.

There were no significant differences in N content between grasses in spring (mean of 1.72%). Whittet had the highest P content (0.27%), the other species ranging from 0.19 to 0.23% P.

Unlike autumn saved growth, spring yields were related to rainfall (Table 4).

TABLE 4

Spring and autumn yields (kg ha^{-1}) as related to rainfall (mm).

Year	Autumn (March-July)		Spring (August-October)	
	Rainfall	DM yield	Rainfall	DM yield
1974	—	—	199	984
1975	161	2814	284	1369
1976	640	2415	172	425
Long term average	568		190	

DISCUSSION

High dry matter yields were obtained in mid winter from autumn saved grasses fertilized with nitrogen. Narok and Kabulabula produced much higher yields than the remaining grasses (Table 1). Their N content, however, at the highest level of applied nitrogen, was somewhat lower than that of the other grasses (Table 2).

Mature stands of tropical grasses contain a large proportion of stem which is not well accepted by grazing animals. Laredo and Minson (1973) have shown that intake of leaf by sheep is much higher than that of stem, even when both fractions have similiar *in vitro* dry matter digestibilities. Consequently, Stobbs (1975) suggested that leaf yields are more important than total dry matter yields. In this experiment, Narok produced much higher yields of leaf than any other grass.

Voluntary intake is restricted by N concentrations below 0.96% (Milford and Minson 1966). As N content of all five grasses grown under the highest level of applied nitrogen exceeded 0.98%, voluntary intake should not be restricted. Similar N contents were also evident at a lower rate of applied nitrogen. These levels, however, were far below the 1.9% N content required to reach the potential milk production of a cow (Glover and Dougall 1961). P concentrations of leaves and whole plants of all grasses would also not be expected to limit intake.

Digestible DM yields of Narok and Kabulabula were higher than those of all other grasses. Narok had the highest yield of digestible leaf dry matter, due to leafiness rather than to a high digestibility percentage. This high leafiness of Narok during the autumn-winter period was also observed at Beerwah, south-east Queensland, by Evans and Hacker (1973).

It is of interest that yields were high even in the dry autumn of 1975, in which drought was further aggravated by preceding dry months. Further work will be necessary to determine the apparent lack of dependence of autumn growth on rainfall.

This experiment showed Narok to be the most suitable grass for deferred winter grazing. Kabulabula was also productive in autumn but when mature this grass was very stemmy and could be difficult to manage (Rees, Jones and Roe 1976). Yields of kikuyu grass, commonly used for deferred autumn grazing, were low. A similar result was recorded from the mid north coast of New South Wales (Kemp 1975). The value of this grass is probably more due to its higher digestibility (Table 2) than to its potential for growth during this period.

Prevailing rainfall conditions in each spring had a strong influence on yields of the grasses. However, mild temperatures in late winter and early spring in the second season (1975) could also have had an influence on high yields obtained in that year.

The spring growth of all grasses had high N contents although the nitrogen recovery in spring was much lower than in autumn.

Of three grasses which performed well in this experiment, *viz.* Narok, broadleaf paspalum and Kabulabula, Narok has already found a place in south-east Queensland, but broadleaf paspalum and Kabulabula are less well known. All three grow well in summer as well as late autumn or early spring (Leggett 1967, Rees 1972, Kemp 1975). However, if any benefit is to be gained from these grasses, they have to be supplied with nitrogen. There were no significant differences in yields of tested grasses without applied nitrogen in this experiment.

The economics of maintaining a pure grass sward with nitrogen fertilizer as a normal practice may be doubtful (Michell, Bryan and Evans 1972). However, the use of some pure grass paddocks for extending production into the cool season seems to be warranted in certain circumstances and has been recommended in the wet tropics (Teitzel, McTaggart and Hibberd 1971). The lower quality of Narok would need to be compensated for by high quality supplements such as grazing oats, irrigated pastures or concentrates if animal production, especially of dairy cows, is to be maintained.

Another alternative is a grass-legume pasture strategically fertilized with nitrogen. Colman (1968) suggested that, with more information on the effect of management, the strategic use of nitrogen fertilizer on tropical grass-legume pastures may extend seasonal production without severely reducing the legume component.

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