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PASTURE INVESTIGATIONS IN THE SANDY FOREST COUNTRY OF NORTH-WEST QUEENSLAND

2. Species Evaluation

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SUMMARY

Testing of a number of improved pasture and forage species at two sites over 4 years showed that, in the presence of applied phosphorus, dry matter yields of around 2 000 kg ha^{-1} of *Stylosanthes humilis* (Townsville stylo) and between 1 000 and 3 000 kg ha^{-1} of *Urochloa mozambicensis* (up to 5 000 kg ha^{-1} in establishment year with applied N) can be obtained. Other species to show promise included *Macroptilium atropurpureum* cv. Siratro, *Cenchrus* spp. and *Dactyloctenium giganteum* (Q 10091).

I. INTRODUCTION

Part 1 of this series of three papers (Bishop 1974) discussed nutrient requirements of *Stylosanthes humilis* (Townsville stylo) on the sandy forest soils of north-west Queensland. This paper reports the results of concurrent work on species evaluation from four experiments over 4 years at the same two sites on Glenore Station, south-east of Normanton.

II. MATERIALS AND METHODS

A general description of the climate, vegetation and soils of the region and the two experimental sites has already been given (Bishop 1974). Design, plot size, sowing date and data collection details of the four experiments are shown in table 1.

TABLE 1

DETAILS OF INDIVIDUAL EXPERIMENTS

Experiment	Site	Design	Plot size	Sowing Date	Dates of data collection	Recording areas
1	A	34 x 2 x 2 x 2 RB	5 m x 5 m	6 Jan 67	Population 23 Feb 67 ..	4 m x 0·2 m
					Dry matter 28 Apr 67 ..	4 m x 0·4 m
2	A	8 x 4 RB	5 m x 5 m	5 Dec 67	Dry matter 20 May 71 ..	4 m x 0·4 m
3	B	2 x 2 x 4 RB	5 m x 2·5 m	23 Nov 67	Population 18 Jan 68 and 1 Apr 69	2 m x 0·2 m
					Dry matter 1 Apr 68, 1 Apr 69, 17 Apr 70, 19 May 71	2 m x 0·4 m
4	B	6 x 2 x 4 RB	5 m x 2·5 m	23 Nov 67	Population 18 Jan 68 and 1 Apr 69	2 m x 0·2 m
					Dry matter 1 Apr 68, 1 Apr 69, 17 Apr 70, 19 May 71	2 m x 0·4 m

Experiment 1 (Site A)

Thirty-four species and cultivars (table 2) were evaluated with and without 376 kg ha^{-1} superphosphate and 125 kg ha^{-1} urea. Trees at the site were cut down and removed and the inter-stump area was cultivated with a rotary hoe 2 months prior to planting. Planting rate was 10 kg ha^{-1} for all lines.

Experiment 2 (Site A)

Eight species (two legumes and six grasses) were planted using an establishment fertilizer of 500 kg ha^{-1} superphosphate and 125 kg ha^{-1} urea. Site preparation was the same as for experiment 1 and planting rate was 10 kg ha^{-1}. The species planted were—

Legumes—

Stylosanthes humilis (commercial)
Macroptilium atropurpureum cv. Siratro

Grasses—

Urochloa mozambicensis
Dactyloctenium giganteum (Q 10091)
Cenchrus ciliaris cv. American
C. ciliaris cv. Biloela
C. setigerus (Birdwood grass)
Setaria anceps cv. Kazungula

Experiment 3 (Site B)

Two legumes, *Stylosanthes humilis* (commercial Townsville stylo) and *Macroptilium atropurpureum* cv. Siratro, were planted at 10 kg ha^{-1} with and without 5 kg ha^{-1} *Urochloa mozambicensis*. Superphosphate at 50 kg ha^{-1} and urea at 125 kg ha^{-1} were applied at establishment and 375 kg ha^{-1} of 12:34:12 (NPK) fertilizer was broadcast over the site at the beginning of the third season. Trees at site B were ring-barked 3 months before planting and a seedbed was prepared using a rotary hoe 1 month before planting.

Experiment 4 (Site B)

Six grasses were planted with and without 5 kg ha^{-1} *Stylosanthes humilis* (Townsville stylo). Fertilizer application and site preparation were the same as for experiment 3. Planting rate was 10 kg ha^{-1} and the cultivars used were—

Urochloa mozambicensis
Dactyloctenium giganteum (Q 10091)
C. ciliaris cv. American
C. ciliaris cv. Biloela
C. setigerus (Birdwood grass)
Setaria anceps cv. Kazungula

In each experiment, seed and fertilizers were hand broadcast onto a dry seedbed (legume seed was not inoculated) and the plots were then hand raked.

RAINFALL. Rainfall was below average for the duration of the experiments with very dry periods during January and February 1970 and January 1971. Rainfall data have been presented in the first paper of this series (Bishop 1974).

III. RESULTS

Experiment 1

Only Townsville stylo recorded a measurable dry matter yield (270 kg ha^{-1}) without fertilizer, while with fertilizer, 10 of the 34 lines planted produced growth during the first season (table 2). The forage crops Zulu sorghum and Katherine Pearl millet recorded the highest yields. *U. mozambicensis* was the highest yielding grass and Townsville stylo the highest yielding legume.

Experiment 2

Siratro and Kazungula setaria failed to establish, and Townsville stylo and *D. giganteum* failed to regenerate in the second year. The mean dry matter yields for the remaining four grasses in the second and fourth years were *U. mozambicensis,* 1 640 and 371 kg ha^{-1}; American buffel, 778 and 1 277 kg ha^{-1}; Biloela buffel, 109 and 375 kg ha^{-1}; and Birdwood grass, 363 and 475 kg ha^{-1}.

Experiment 3

POPULATION. Townsville stylo established well (83 plants m^{-2}) with a massive regeneration of single-stemmed plants (97 500 m^{-2}) in the second year. Siratro had 7 plants m^{-2} in the first year and this fell to less than 1 plant m^{-2} in the second year. Fewer plants established in the presence of *U. mozambicensis* (68 compared with 98 plants m^{-2} for Townsville stylo alone and 4 compared with 10 plants m^{-2} for Siratro alone) but this reduction was not significant.

DRY MATTER YIELD. Townsville stylo greatly outyielded Siratro, and in the presence of *U. mozambicensis* first-year yields of both legumes were reduced (table 3). In most instances, the yield of native species was greatly reduced by the presence of *U. mozambicensis.*

Experiment 4

DRY MATTER YIELD. Apart from Kazungula *setaria,* all species established successfully. *U. mozambicensis* gave high dry matter yields during all 4 years and the *Cenchrus* species also yielded well (table 4). *D. giganteum* yield varied each year depending on the amount of regeneration of the species.

TABLE 2

PLANT POPULATION, O.D.M. YIELD AND CHEMICAL COMPOSITION (WHOLE PLANT) FOR SPECIES PERSISTING TO HARVEST (28 APR 67) IN EXPERIMENT 1 (FERTILIZED PLOTS ONLY)

Species	Population of sown plants (m^{-2})	O.D.M. yield of sown spp. (kg ha^{-1})	Chemical composition	
			N%	P%
Stylosanthes humilis (commercial)	106	1 254	2·20	0·17
Macroptilium atropurpureum cv. Siratro	7	225	1·65	0·09
Vigna sp. (CPI 25380)	6	216	1·95	0·15
Urochloa mozambicensis	22	1 526	1·04	0·09
Cenchrus ciliaris cv. Biloela	30	1 161	0·84	0·06
Cenchrus ciliaris cv. Tarewinnabar	3	674	1·00	0·08
Cenchrus ciliaris cv. Molopo	6	244	0·78	0·09
Cenchrus setigerus (Birdwood grass)	30	853	0·90	0·05
Sorghum spp. hybrid*	6	1 777	0·55	0·12
Pennisetum typhoides cv. Katherine Pearl†	50	1 921	0·50	0·04

* Planted at 22 kg ha^{-1}; † Planted at 34 kg ha^{-1}

Species with some plants establishing but no yield recorded

Macrotyloma uniflorum cv. Leichhardt
Macrotyloma axillare cv. Archer
Macroptilium bracteatum
Centrosema pubescens cv. Belalto
Pueraria phaseoloides
Clitoria ternatea (CPI 28110)
Stylosanthes guyanensis cv. Schofield
Arachis hypogaea (peanut)
Panicum coloratum var. *makarikariense* cv. Bambatsi
Cenchrus ciliaris cv. Gayndah
Sorghum almum cv. Crooble

Species which failed to establish

Lablab purpureus cv. Rongai
Vigna mungo (CPI 27076)
Glycine javanica cv. Tinaroo
Desmodium intortum cv. Greenleaf
Stylosanthes guyanensis cv. Oxley
Glycine max (soybean)
Cyamopsis tetrogonoloba (guar bean)
Panicum maximum var. *trichoglume* cv. Petrie
Panicum maximum (Coloniao)
Panicum maximum cv. Hamil
Setaria anceps cv. Nandi
Setaria anceps cv. Kazungula
Brachiaria ruziziensis (CPI 30623)

The presence of Townsville stylo did not significantly alter the relative yielding ability of the grasses but there was a trend in the first year for the higher-yielding grasses to reduce the yield of Townsville stylo.

IV. DISCUSSION

All sown species grew better at site B than at site A. Site A has a higher sand and lower clay content at depth and, as rainfall for the region was below average over the period of the experiments, soil moisture conditions were probably less favourable at site A.

It proved impossible to grow improved species at either site without addition of phosphate fertilizer. (Townsville stylo did grow without fertilizer in experiment 1 but failed to persist into the second year.) Legume seed was not inoculated because all sowings were into a dry seedbed. It was not known whether Townsville stylo nodulates in these soils and, as soil nitrogen status is very low, urea was

TABLE 3

DRY MATTER YIELDS (kg ha^{-1}) OF LEGUME, LEGUME PLUS COMPANION GRASS AND NATIVE SPECIES FOR THE LEGUME ALONE AND LEGUME WITH *Urochloa mozambicensis* TREATMENTS IN EXPERIMENT 3

Treatments	1968			1969			1970			1971		
	Leg.	Legume plus comp. grass	Native species	Leg.	Legume plus comp. grass	Native species	Leg.	Legume plus comp. grass	Native species	Leg.	Legume plus comp. grass	Native species
S. humilis alone	2 270	2 270	2 749	2 203	2 203	88	2 187	2 187	1 353	*	..	..
S. humilis with *Urochloa* ..	340	5 923	93	1 812	2 548	314	2 119	3 475	0	2	3 264	152
Siratro alone	502	502	4 193	1 035	1 035	736	22	22	2 709	*	..	..
Siratro with *Urochloa* ..	270	4 618	602	1 071	1 858	221	3	2 653	763	457	2 978	0
L.S.D. 5%	832	2 229	1 327	968	655	n.s.	1 181	1 517	1 024	n.s.	n.s.	n.s.

* *Urochloa mozambicensis* had spread throughout the legume-alone treatments by the fourth year.
n.s. F. test not significant.

TABLE 4

DRY MATTER YIELDS OF GRASS AND *S. humilis* IN EXPERIMENT 4 (kg ha^{-1})

Treatments	1968			1969			1970			1971		
	Grass alone	Grass with *S. humilis*		Grass alone	Grass with *S. humilis*		Grass alone	Grass with *S. humilis*		Grass alone	Grass with *S. humilis*	
	Sown grass	Sown grass	*S. humilis*	Sown grass	Sown grass	*S. humilis**	Sown grass	Sown grass	*S. humilis**	Sown grass	Sown grass	*S. humilis*
Urochloa	5 220	5 645	216	1 282	1 349	1 081	568	1 526	1 940	**	3 280	0
Dactyloctenium	5 490	5 220	232	23	72	1 514	905	924	2 412	Not	295	237
American buffel	3 390	2 849	548	1 076	669	2 224	853	235	2 397	har-	2 529	117
Biloela buffel	3 328	1 761	1 344	2 106	1 452	1 668	621	235	1 819	vested	3 608	115
Birdwood grass	2 031	1 012	1 923	628	458	1 611	293	90	2 032		1 145	187
L.S.D. 5%	2 436			657			875			1 338		

* The *S. humilis* yields were obtained by subtraction and have not been analysed separately.
** *S. humilis* had spread throughout the grass alone treatments by the fourth year.

included in all fertilizer applications at planting. Earlier nursery plantings had indicated that nitrogen as well as phosphorus was required for establishment of grasses. Results of concurrent work had shown that these soils are also deficient in potassium, and the trace element Zn (Bishop 1974). These deficiencies could have been a factor in poor legume performance in experiment 1.

Townsville stylo performed well at site B and was greatly superior to Siratro. The Townsville stylo population in experiment 3 was very high. The phenomenon of very high populations of single-stemmed Townsville stylo plants has been observed in other plantings at site B where no additional dressings of superphosphate were made following initial establishment.

The low Townsville stylo yields in the fourth year for experiments 3 and 4 are attributed to competition from *U. mozambicensis* which had spread throughout all treatments by the beginning of the fourth season. The plots were ungrazed but were defoliated by mowing with a rotary lawn mower at the end of each dry season. The mowing treatment was not applied at the end of the 1970 dry season and this together with good February and March rainfall in 1971 could account for the stronger competition in that year. However, visual observations indicated a good regeneration of Townsville stylo in the fifth year in the absence of prior mowing.

U. mozambicensis gave the best performance of the grasses tested in experiment 4 in terms of dry matter yield and stand persistence. It showed ability to regenerate and spread naturally from seed as well as perennating from original plants.

In experiment 3, *U. mozambicensis* as a companion grass with Townsville stylo considerably reduced the native species component of the pasture. This characteristic would be an advantage on those soils prone to strong invasion by weeds as noted in parts of this region by Bishop (1972).

Gillard (1971), working in northern Queensland, obtained successful establishment of *U. mozambicensis* oversown into pure stands of Townsville stylo accompanied by displacement of native grasses. Fisher (1971) recorded that, in the Northern Territory, *U. mozambicensis* was more effective than Birdwood grass in replacing native species. This supports the results obtained in experiment 4 of this paper where *U. mozambicensis* was more effective than the *Cenchrus* species in displacing the native species.

In the grass-plus-Townsville stylo treatments in experiment 4, the native species yields in the *U. mozambicensis* plots, expressed as a percentage of the mean yields of the native species in the *Cenchrus* plots, were 38% in 1968; 73% in 1969; 25% in 1970 and 28% in 1971. Under certain conditions, *U. mozambicensis* also reduced the yield of Townsville stylo (tables 3 and 4). However, the results in the second and third years of experiment 4 (table 4) indicate good compatibility with Townsville stylo.

Competition from *U. mozambicensis* in the establishment year could probably be controlled by reducing the nitrogen application at planting. In subsequent years, defoliation by grazing animals should check its potential for dominance of the legume component.

American buffel was not as coarse and stemmy as Biloela buffel and gave higher yields in experiment 2 at site A. Birdwood grass gave low yields and appeared to be inferior to American buffel. *D. giganteum* with its very quick flush of growth maturing about mid to late February holds little prospect as a companion for Townsville stylo.

The results obtained indicate that Townsville stylo is a suitable legume for improved pasture planting in this sandy forest country and that *U. mozambicensis* is a more suitable companion grass than the *Cenchrus* species tested.

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