PRIMARY EVALUATION OF GRASSES AND LEGUMES FOR THE NORTHERN WALLUM OF SOUTH-EAST QUEENSLAND

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SUMMARY

This paper describes experiments on initial species evaluation in the northern Wallum, in a 43 in. rainfall area.

Thirty-nine grass and 40 legume species were tested for adaptation to the environment, and production measured by harvesting at 6 week intervals. *Panicum coloratum* gave the highest production among the grasses and exhibited both drought and frost tolerance. The most productive legumes were *Phaseolus atropurpureus* (Siratro), *Lotononis bainesii* cv. Miles, and *Trifolium semipilosum* C.P.I. 27218.

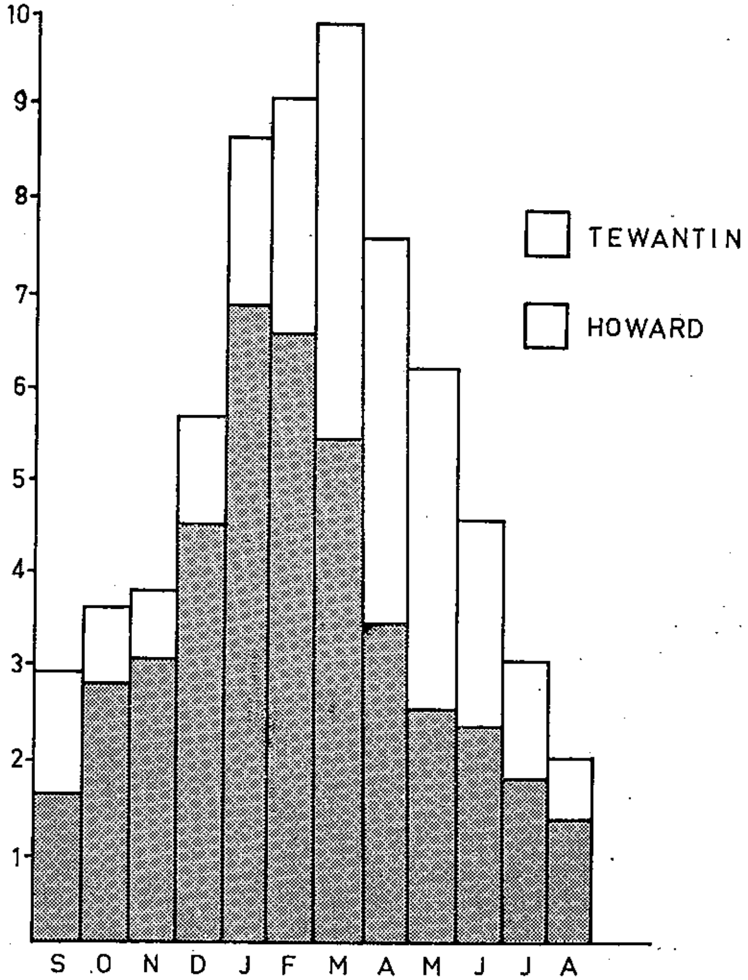

FIGURE 1.
Mean monthly rainfall for Tewantin and Howard.

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INTRODUCTION

The northern wallum of the coastal lowlands of S.E. Queensland extends from Maryborough to Baffle Creek north of Bundaberg and covers an area of some three quarters of a million acres. The general features of climate, vegetation and soils of the region were described by Tommerup (1935) and Coaldrake (1961). These differ from those of the coastal lowlands south from Maryborough mainly in rainfall distribution and soil type. The topography of the northern wallum is generally flat to undulating and has little effect on rainfall. The mean annual rainfall of approximately 43 in. has a winter component of 8-10 in. (May-September). Variability of summer rainfall is high (Coaldrake and Bryan, 1957) and this decreases the effectiveness of the total rainfall. The pattern of monthly mean rainfall (30 year mean) for Tewantin and Howard representing the southern and northern wallum respectively is compared in Figure 1.

There are marked differences in monthly precipitation and the maximum monthly precipitation occurs two months earlier in the northern region. The low incidence of thunderstorm rainfall in spring and early summer markedly reduces the total rainfall in the northern wallum. The coincidence of increasing temperature and radiation with low rainfall at this time of year produces a period of acute moisture shortage for pastures, and is likely to place a restriction on growth and production. The mean daily maximum temperatures are a few degrees higher in the northern wallum and frosts may occur from May to August but are most prevalent in July.

Soil descriptions, cited by Coaldrake (loc. cit.), indicate that the soils are shallow with underlying sandstone at 36-40 in. There is generally a dominance of fine sand over coarse sand and also a high silt content in the A horizon of some soils. This surface structure reduces penetration of rainfall and the soil surface tends to seal after rain. In parts of the region the content of soluble salts in the soil is high enough to affect the establishment and survival of sown pastures (Evans 1967).

Species evaluation was carried out at a site 4½ miles west of the township of Howard. The area is representative of the Burrum landscape described by Coaldrake (loc. cit.) which is the most extensive of the landscapes in the northern wallum.

The natural vegetation of the experimental area was layered woodland with *Eucalyptus intermedia* (red bloodwood) as the dominant species; associated species were *E. acmenioides* (yellow stringy bark) and *Melaleuca quinquenervia* (Ti-tree). The density of trees was approximately 65 per acre. The ground flora was predominantly *Themeda australis* (kangaroo grass) and sedges.

The soil of the experimental area was a gleyed podzolic overlying Burrum coal measures (Hubble, personal communication). The surface 0-9 in. horizon is a fine sandy loam and overlies a dense layer of ferro-manganiferous nodules (⅛-½ in. diameter) in the 9-12 in. horizon. A gradual change to a sandy clay loam occurs from 12-20 in. and texture then changes to a medium clay which continues to the parent material at 40 in. Analytical data for this soil is shown in Table 1.

These analyses indicate a very low level of soil fertility for all major plant nutrients except magnesium. The soil is moderately acid, has a low cation exchange capacity and a base saturation of approximately 25 per cent.

Plant nutrition experiments by the author on this and other soils in the northern wallum showed responses to P, K, Ca, S, Mo, Cu and Zn (unpublished data). The results obtained agreed with those obtained by Andrew and Bryan (1955) for the southern wallum, and confirm the widespread deficiency of these nutrients on the soils of the coastal lowlands.

TABLE 1.
Analyses of soil from the experimental site.

Depth (in.)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	pH*	Total soluble salts (%)	Organic carbon (%)	Nitrogen (%)	Avail.† p'phorus (p.p.m.)	Total‡ p'phorus (%)	Exchangeable cations (m.e. %)						
											Ca	Mg	K	Na	H	Total	Saturation (%)
0-3	4.0	57.0	28.0	10.0	5.6	0.01	1.30	0.081	1	0.006	1.0	0.91	0.06	0.14	6.3	8.4	25
3-9	9.0	52.0	25.0	12.0	5.7	0.01	0.63	0.048	1	0.006	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	
9-12	21.0	39.0	25.0	16.0	5.9	0.01	0.42	0.039	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	
12-20	9.0	32.0	20.0	39.0	6.0	0.01	0.26	0.033	N.S.	0.009	0.05	2.4	0.02	0.54	8.2	11.2	27
20-30	4.0	29.0	20.0	48.0	5.9	0.02	0.15	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	
30-40	5.0	26.0	18.0	51.0	5.5	0.02	0.13	N.S.	N.S.	0.008	<0.02	5.5	0.04	1.60	9.8	17.0	42

N.S.—not sampled
* pH determined in a 1:5 suspension
† determined by B.S.E.S. method
‡ determined as P soluble in boiling HCl

SPECIES EVALUATION

Experiments to compare dry matter production from 39 grass and 40 legume species were planted in January, 1963. Those species for which sufficient seed was available were included in randomised block experiments with two plots and compared in separate experiments. Production was measured by harvesting at (25 x 25 links) of each species. Grasses and legumes were sown in pure stands approximately 6 week intervals and the species were intermittently grazed by cattle in the third year.

TABLE 2.
Grass species sown and notes on evaluation

Botanical name	C.P.I. or cultivar	Common Name	Seeding Rate lb/ac	Evaluation
Brachiaria dictyoneura	16707	—	vegetative	productive
Cenchrus ciliaris	cv. Biloela	Buffel grass	10	productive
Chloris gayana	Commercial	Rhodes grass	5	productive
Chloris gayana	28708	Mbarara Rhodes	5	productive
Chloris gayana	16144	Samford Rhodes	5	productive
Digitaria decumbens		Pangola grass	vegetative	productive
Panicum coloratum	13371	—	10	productive
Panicum coloratum	14375	—	10	productive
Panicum coloratum	16796	—	10	productive
Panicum coloratum	16789	—	10	productive
Panicum maximum	27630	Coloniao guinea grass	10	productive
Panicum maximum	14374	—	10	productive
Paspalum commersonii	Paltridge	Scrobic	10	productive
Paspalum notatum	11816	—	10	productive
Paspalum plicatulum	21378	—	10	productive
Paspalum plicatulum var. glabrum	cv. Hartley	Hartley Plicatulum	10	productive
Paspalum plicatulum	cv. Rodd's Bay	Rodd's Bay plicatulum	10	productive
Setaria sphacelata	cv. Nandi	Nandi Setaria	10	productive
Setaria splendida	15899	—	vegetative	productive
Acrocerus macrum	16701	Nile grass	vegetative	unproductive
Brachiaria brizantha	15890	—	10	unproductive
Brachiaria ruziziensis	33465	—	5	unproductive
Cenchrus ciliaris	cv. Gayndah	Buffel grass	10	unproductive
Cynodon dactylon	17765	Star grass	vegetative	unproductive
Panicum coloratum	18747	—	10	unproductive
Panicum coloratum	16326	—	10	unproductive
Panicum maximum	16003	—	10	unproductive
Panicum maximum	16793	—	10	unproductive
Paspalum dilatatum	Commercial	Paspalum	10	unproductive
Paspalum pauciciliatum	11824	—	10	unproductive
Paspalum notatum	9073	—	10	unproductive
Paspalum notatum	11864	—	10	unproductive
Brachiaria mutica	cv. Para	Para grass	vegetative	not persistent
Eragrostis curvula	Ermelo	—	5	not persistent
Panicum coloratum	16788	—	10	not persistent
Panicum coloratum	13372	—	10	not persistent
Panicum maximum	16721	—	10	not persistent
Pennisetum clandestinum		Kikuyu grass	vegetative	not persistent
Phalaris arundinacea x Phalaris tuberosa var. *stenoptera*		— Ronfa grass	vegetative	not persistent

The area received an initial fertilizer dressing as follows:

5 cwt superphosphate/acre
5 cwt lime/acre
1 cwt potassium chloride/acre
7 lb copper sulphate/acre
7 lb zinc sulphate/acre
2 oz elemental molybdenum/acre

Annual maintenance dressings of 2 cwt/acre superphosphate and 1 cwt/acre potassium chloride were applied in October. The grass species received 200 lb N/acre/annum in the form of calcium ammonium nitrate applied in equal quantities in March, May, October and December. The species used and notes on their evaluation are shown in Tables 2 and 3.

The three years over which the experiments were conducted were abnormally dry with total annual rainfalls of 25.68, 15.24 and 28.45 in. compared with a mean annual rainfall of 43in. Of the 39 grasses sown 32 persisted, but there were marked differences between species in dry matter production. *Panicum* spp. were particularly productive and the Kabulabula type viz. *P. coloratum* C.P.I. 16796, 13371 and 14375 showed both frost and drought tolerance. Within the genus *Paspalum* the highest production was from *P. plicatulum* 21378, which is of particular interest because it remained undamaged by frost when the other cultivars of this species were severely frosted.

In the third year the experiments were grazed every 12 weeks with cattle at a stocking rate of 5 beasts/acre. This resulted in a total of 140 grazing days/acre for the year. Plots were sampled prior to grazing and mown when stock were removed after one week's grazing. All species were well grazed with the exception of *Panicum coloratum* C.P.I. 16796 and 14375 which appear to have a degree of unpalatability. Both showed rapid regrowth after cutting and the interval between harvests was probably too great to allow these plants to be grazed at the most palatable stage of growth. The only legume species that was not consistently heavily grazed was *Dolichos axillaris,* but this was grazed in the winter period.

Only 50 per cent of the legumes persisted over three years. The outstanding legumes were *Phaseolus atropurpureus* (Siratro), *Lotononis bainesii*, *Dolichos axillaris* and *Trifolium semipilosum.* The latter two were frost tolerant and gave good winter production. Both species of *Lotononis* and *Teramnus uncinatus* were also frost tolerant. *Desmodium uncinatum* died out in the first year and *D. intortum* after two years, probably due to drought. Dalrymple vigna grew particularly well in the first year but declined in productivity thereafter. Dry matter yields for the most productive grasses and legumes are shown in Tables 4 and 5.

The dry matter yields for both grasses and legumes show highly significant differences between species. In the grasses, members of the *Panicum coloratum* group were particularly high yielding whilst the lowest production came from the *Paspalum* group. *Paspalum plicatulum* C.P.I. 21378 was an exception owing to greater winter growth which increased its overall production above that of the other *Paspalum* species.

Siratro produced significantly more dry matter than other legumes except in the second year, when its production was affected by drought to a greater extent than that of *Dolichos axillaris. Vigna luteola, Desmodium intortum* and *Centrosema*

TABLE 3.

Legume species sown and notes on evaluation.

Botanical Name	C.P.I. or cultivar	Common Name	Seeding Rate lb/ac	Evaluation	*Rhizobium* Strain
Glycine javanica	27834	—	4	productive	CB 453
Leucaena leucocephala	cv. Peru	Leucaena	10	productive	NGR 8
Lotononis bainesii	cv. Miles	Lotononis	2	productive	CB 376
Phaseolus atropurpureus	cv. Siratro	Siratro	4	productive	CB 756
Trifolium semipilosum	27218	—	4	productive	CB 782
Centrosema pubescens	Commercial	Centro	4	unproductive	CB 421
Desmodium ovalifolium	30151	—	4	unproductive	CB 627
Desmodium sandwicense	11740	—	4	unproductive	CB 627
Desmodium sandwicense	18236	—	4	unproductive	CB 627
Dolichos axillaris	17814	—	4	unproductive	CB 756
Glycine javanica	cv. Tinaroo	Glycine	4	unproductive	CB 453
Glycine javanica	17185	—	4	unproductive	CB 453
Leucaena leucocephala	cv. Bald Hills	Leucaena	10	unproductive	NGR 8
Leucaena leucocephala	cv. El Salvador	Leucaena	10	unproductive	NGR 8
Leucaena leucocephala	cv. Hawaii	Leucaena	10	unproductive	NGR 8
Leucaena leucocephala	cv. Guatemala	Leucaena	10	unproductive	NGR 8
Lotononis angolensis	26293	—	3	unproductive	CB 376
Stylosanthes gracilis	Commercial	Stylo	4	unproductive	CB 756
Trifolium burchellianum	24133	—	4	unproductive	CB 728

Botanical Name	C.P.I. or cultivar	Common Name	Seeding Rate lb/ac	Evaluation	*Rhizobium* Strain
Arachis prostrata	12121	—	vegetative	unproductive	
Aeschynomene americana	15287	—	10	not persistent	CB 1100
Alysicarpus vaginalis	25255	—	4	not persistent	CB 627
Cajanus cajan		Pigeon pea	10	not persistent	CB 756
Desmodium adscendens	7856	—	4	not persistent	CB 756
Desmodium distortum	23189	—	4	not persistent	CB 627
Desmodium intortum	18009	Greenleaf desmodium	4	not persistent	CB 627
Desmodium intortum	28324	Greenleaf desmodium	4	not persistent	CB 627
Desmodium intortum	17916	Greenleaf desmodium	4	not persistent	CB 627
Desmodium intortum	18383	Greenleaf desmodium	2	not persistent	CB 627
Desmodium uncinatum	cv. Silver leaf	—	4	not persistent	CB 627
Desmodium tortuosum	17612	—	2	not persistent	CB 627
Desmodium purpureum	2653	—	2	not persistent	
Dolichos biflorus	cv. Leichhardt	—	4	not persistent	CB 756
Medicago sativa	cv. Hunter River	Lucerne	4	not persistent	Roth RH2
Stylosanthes humilis	Commercial	Townsville lucerne	4	not persistent	
Teramnus uncinatus	25937	—	4	not persistent	CB 761
Trifolium repens	cv. New Zealand	White clover	4	not persistent	CB 165
Trifolium usamberense	25350	—	4	not persistent	CB 775
Listia heterophylla		—	vegetative	not persistent	N fertilizer
Vigna luteola	21347	Dalrymple vigna	4	not persistent	CB 786

TABLE 4.

Mean Annual dry matter production (lb/ac) of grass species sown in evaluation experiment.

Species	1963/64	1964/65	1965/66	3 year mean
Panicum coloratum C.P.I. 16796	18210	21220	22320	20580
Chloris gayana cv. Samford	13010	11580	13150	12580
Panicum coloratum C.P.I. 16789	11600	9950	13900	11820
Panicum coloratum C.P.I. 14375	5880	11830	17490	11730
Paspalum plicatulum C.P.I. 21378	8020	9980	12350	10120
Chloris gayana C.P.I. 28708	7950	10910	10570	9810
Setaria sphacelata cv. Nandi	8790	8870	10650	9440
Paspalum plicatulum cv. Hartley	9650	7470	11130	9420
Digitaria decumbens — Pangola	7410	8210	12420	9350
Chloris gayana — commercial	10190	9050	8745	9330
Paspalum commersonii cv. Scrobic	10580	6070	10190	8950
Paspalum plicatulum cv. Rodd's Bay	8820	7600	8930	8450
Cenchrus ciliaris cv. Biloela	6850	8610	9540	8330
Paspalum notatum C.P.I. 9073	6030	5550	6630	6070
Paspalum notatum C.P.I. 11864	4520	6320	6200	5680
Paspalum dilatatum — commercial	5320	3580	6280	5060
Cenchrus ciliaris cv. Gayndah	4390	4032	5050	4460
Least significant differences 5%	1332	948	734	
1%	1835	1306	1011	

TABLE 5.

Mean annual dry matter production (lb/ac) for legume species in evaluation experiment.

Species	1963/64	1964/65	1965/66	3 year mean
Phaseolus atropurpureus "Siratro"	8000	6210	8820	7670
Dolichos axillaris C.P.I. 17814	2820	6270	6050	5050
Lotononis bainesii cv. Miles	2680	3110	8230	4670
Stylosanthes gracilis cv. Stylo	2010	4790	5770	4190
Glycine javanica C.P.I. 27834	3010	2300	4650	3320
Teramnus uncinatus C.P.I. 25937	3140	3380	760	2430
Vigna luteola C.P.I. 21347	4910	2300	—	3600*
Desmodium intortum cv. Greenleaf	2490	3220	—	2860*
Centrosema pubescens centro	2930	2520	—	2730*
Least significant differences 5%	610	422	576	* mean of 2 years
1%	888	614	838	

pubescens all died in the second year and *Teramnus uncinatus* decreased markedly in production.

Of the species not included in the experiment but planted in unreplicated plots, very high production was obtained from *Panicum maximum* C.P.I. 27630 (Coloniao guinea) with a mean of 14,600lb dry matter/acre/annum. Although a very coarse species it was readily grazed by cattle. *Setaria splendida* produced a mean of 10,150lb dry matter/acre/annum and showed drought and cold tolerance. In the unreplicated legume plots *Trifolium semipilosum* was of particular interest. It was slow to establish and required reapplication of inoculum but increased in production over the three year period, with a maximum dry matter yield of 8,440 lb/ac in the third year.

The results obtained in this initial species testing have enabled selection to be made of the more productive species for further evaluation. Those species selected include the grasses *Panicum coloratum* C.P.I. 16796 and 14375, *Setaria sphacelata* cv. Nandi, *Digitaria decumbens* (Pangola grass) and *Paspalum plicatulum* C.P.I. 21378. Legumes selected were Siratro, *Lotononis bainesii, Desmodium intortum, Teramnus uncinatus* and *Trifolium semipilosum*.

DISCUSSION

These experiments have shown approximately four fold differences in dry matter production between species in this environment. The highest production was obtained from species generally regarded as more suitable for a dry environment, and moderately high levels of production have been attained over periods of drought. The initial poor soil surface structure reduces penetration and the effectiveness of rainfall, but over a three-year period surface organic matter has increased and observations suggest that rainfall penetration has improved.

The maintenance dressing of fertiliser used has maintained production and the percentage of phosphate and potash in plant material has approximated the levels for optimum growth. The arbitrary selection of 200lb N/acre/annum as a suitable level of nitrogen application to the grasses was probably adequate for optimum dry matter production. Data from a nitrogen fertiliser experiment with Samford Rhodes grass, which will be published separately, showed that this level of application was close to the optimum.

This initial phase of pasture evaluation has shown conclusively that high levels of pasture production can be obtained in the northern Wallum. The next stage in the evaluation of the most promising species is to determine persistence and productivity under grazing. This work has been started at a site near Isis Junction, approximately 10 miles north-east of the Howard site.

It is still necessary, however, to continue the search for other species that may provide higher levels of production in spring and early summer. There is a particular need for legumes with higher winter production, i.e. that possess frost tolerance and also grow actively during this period. Species have yet to be found that fill the early summer gap in production. Alternatively some form of conservation may be required to maintain animal production through this period.

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