EVALUATION OF PASTURE GRASSES UNDER COCONUTS IN WESTERN SAMOA

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ABSTRACT

Production levels of sixteen grasses were compared under coconuts allowing approximately 50% light transmission. Production was shown to be seasonal and four production classes were identified. All grass species produced significantly higher yields than the local pasture except for Brachiaria mutica *and* Digitaria decumbens, *which demonstrated low shade tolerance, and local* Pennisetum purpureum. *A grazing experiment showed marked animal preference for hybrid* P. purpureum, B. mutica *and the legume* Leucaena leucocephala, *but species most suited to the coconut environment in Western Samoa were identified as* B. brizantha, B. decumbens, B. humidicola, B. miliiformis, Ischaemum murinum *and* Panicum maximum *var. Embu.*

INTRODUCTION

Traditionally, cattle have been run under coconuts as 'sweepers' or 'brushers' to keep the grass and weeds short, so preventing excessive nutrient and moisture competition with the coconut palms and ensuring easy location and collection of fallen nuts (Carrad 1977, Ohler 1969, Osborne 1972, Plucknett 1972, Thomas 1978). More recently attempts have been made to intercrop coconut areas by establishing improved grasses and using fertilizer to increase both forage yields and animal carrying capacity, and also nut yields (Guzman 1975, Whiteman 1977).

Work in a number of countries has indicated the problems of competition and shade (Ferdinandez 1972, Santhirasegaram 1966), the relative degree of shade tolerance of different grasses and legumes (Guzman and Allo 1975, Javier 1974, Santhirasegaram and Ferdinandez 1967) with, more recently, detailed studies of plant growth and light intensity relationships (Eriksen and Whitney 1977, Ludlow *et al.* 1974). However, there are relatively few studies reporting actual forage yields, and usually these have compared only a narrow range of species (Boonklinkajorn and Duriyaprapan 1977, Rajaratnam and Santhirasegaram 1963, Santhirasegarem and Ferdinandez 1967). The present paper describes an experiment under coconuts comparing the yields of sixteen different grasses and the species preference of grazing cattle.

METHODS

The experiment was located at Vailele on the WSTEC[1] plantations (lat. 13° 51'S, long. 171° 43'W) seven km from Apia, the capital of Western Samoa on a 0.5 ha site. The environment is humid and moist with annual rainfall averaging 2929 mm, with small diurnal and seasonal fluctuations in temperature; the average maximum and minimum being 30/23°C. The mean relative humidity is 83.2%. Coconut palms of approximately 20–23 years of age spaced at 9.1 m on the square gave light transmission values of about 50% of open conditions.

A randomized block design was used with sixteen different grasses. All were replicated four times with the exception of the last three grasses which were only replicated twice because of space limitations. Species used were:—

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Species	*Common or cultivar name*
Brachiaria brizantha	Palisade
Brachiaria humidicola	Koronivia
Brachiaria miliiformis	Cori
Brachiaria mutica	Para
Ischaemum murinum	Batiki
Digitaria decumbens	Pangola (Samoa)
Pennisetum purpureum	Napier or elephant—hybrid Napier 3418
Panicum maximum	Common
Panicum maximum var *trichoglume*	Green Panic
Mixture of *Ruellia prostrata, Mimosa pudica, Blechum pyramidatum, Axonopus compressus, Cyrtoccoccus trigonum, Cyperus ryllingia* and others	Local
Pennisetum purpureum	Napier or elephant—local
Panicum maximum	Embu-Creeping guinea
Paspalum plicatulum	Rodd's Bay
Paspalum conjugatum	Ti or Sour
Panicum maximum var A.	Tall Guinea var. A
Panicum maximum var B.	Tall Guinea var. B

Plots were 4 m × 4 m in size with a cut area of 5 m^2, the rest being border discard. Plots were separated by 0.5 m cultivated strips. All grasses were established from cuttings or pieces between late August and early October 1974 except for *P. plicatulum* which was seeded at about 11.2 kg ha^{-1}. (Some legume and grass-legume plots were included in the trial but poor establishment resulted in their being excluded from evaluation.) A broadcast dressing of 50 kg ha^{-1} Urea and 300 kg ha^{-1} 15 % potassic superphosphate was applied to the area in November 1974.

First recorded forage cuts were made on 4 February 1975 and thereafter at approximately 6 week intervals until 22 January 1976, a total of nine cuts. Forage was harvested by hand using a bush knife and a cutting height of approximately 15–20 cm, with the exception of the low growing batiki and local at 10 cm.

Forage samples were analyzed for total nitrogen (crude protein, N × 6.25), phosphorus, potassium, calcium, magnesium, sulphur, iron, zinc, copper and manganese using methods described by Cable and Reynolds (1972). No further forage cuts were made after 22 February 1976, but the trial was lightly grazed from time to time before steers were used to assess palatability, animal preference and species ability to withstand heavy grazing, in August and September 1976. For the latter experiment demonstration plantings of leucaena (*Leucaena leucocephala*—a local tall variety, probably cv. Peru) were included. Four steers of 220–270 kg liveweight were introduced into the experimental area on 24 August, 1976. Over the following ten day period ratings were made of apparent animal preference for species on eleven occasions based on plot observations of forage consumption. The trial was discontinued on 8 September 1976 when most species were fully grazed. Water was supplied daily throughout the grazing period.

Ratings were made for grass species only: legumes were not rated, with the exception of leucaena. Details of rainfall during the period of the experiment are given in Table 1. Soil analysis details from the Vailele clay, a Ustic/Typic Dystropept, are shown in Table 2.

TABLE 1

Monthly rainfall (mm) at experimental site 1974 1976

	(mean[1])	1974	1975	1976
January	(432)	—	984	607
February	(362)	—	304	520
March	(353)	—	319	194
April	(248)	—	275	284
May	(178)	—	324	245
June	(138)	—	113	147
July	(105)	—	323	242
August	(107)	8	101	35
September	(144)	113	165	10
October	(209)	391	249	—
November	(268)	685	198	—
December	(385)	504	360	—

[1]Based on 75 year records at Mulinu'u station, Apia.

TABLE 2

Soil analysis details from experimental area[1]

pH	C %	N %	P.Truog %	P.Retention %	C.E.C. m.e. %	T.E.B. m.e. %	B.S. %	Ca m.e. %	Mg m.e. %	K m.e. %
5.9	2.9	0.73	1.2	81	33.3	3.3	10	2.0	0.91	0.37

[1]Composite soil sample 0-15cm depth analyzed using methods described by Blakemore (1971).

RESULTS

Growth and dry matter yield

Details of forage dry matter production are given in Table 3 and species are classified on the basis of level of production into four groups.

TABLE 3

Annual dry matter yield data grouped on the basis of level of production

Group Production Level	Yield Range (Kg ha^{-1})	Name	Dry matter production (Kg ha^{-1})†
A Very High	14–16,000	Tall guinea var. B	15887 a
		Tall guinea var. A	14128 a
B High	10–14,000	Creeping guinea	10597 b
		B. humidicola	10540 b
C Medium	7,500–10,000	*P. plicatulum*	9678 b c
		B. brizantha	8871 b c d
		Napier-hybrid	8596 b c d e
		Guinea	8589 b c d e
		P. conjugatum	8578 b c d e
		Green Panic	8459 b c d e
		B. miliiformis	8209 c d e
		Batiki	8021 c d e
		Napier-local	7873 c d e f
D Low	<7,500	Pangola (Weeds)	7295 d e f
		B. mutica	6752 e f
		Local	5984 f

†Mean values with one or more common letter(s) are not significantly different at the 5% lev e (Duncan's New Multiple Range Test).

The two unknown tall guinea grasses were ranked first and second and the local pasture ranked sixteenth. Although, for example, the tall guinea var. B outyielded local pasture by 157%, differences between many of the species were not significant. All species produced significantly higher yields than local except for *B. mutica, D. decumbens* and local Napier.

Dry matter production was seasonal with growth rate in the dry season approximately half that in the wet season.

Forage analysis

Details of mean forage analysis are given in Table 4. Although the range for some elements was wide most mean values indicate an adequate level except for phosphorous which was a little low and iron and manganese which were high.

TABLE 4

Mean forage analysis results on dry matter basis

	N%	Crude Protein	P%	K%	Ca %	Mg %	Mn ppm	Fe ppm	Zn ppm	Cu ppm	S ppm
Mean[1]	1.58	9.87	0.26	0.86	0.57	0.84	167	115	37	8.5	1773
Range	1.29— 1.68	8.19— 10.50	0.21— 0.31	0.56— 1.30	0.38— 0.96	0.62— 1.03	124— 201	86— 200	31— 48	7— 10	856— 3662

[1]Mean of all harvesting dates and species.

Species rating based on animal preference

Overall rankings are shown in Table 5. Napier was the grass most preferred by the steers, followed closely by the legume leucaena and para grass. *B. miliiformis* was preferred to *B. brizantha* and creeping guinea. *B. humidicola* proved not to be as unacceptable as previous reports had indicated, being preferred even to green panic, followed by guinea, batiki and the two tall guinea varieties. The local pasture, dominated by *M. pudica*, was largely ignored until other more palatable species were eaten.

TABLE 5

Ranking of forage species based on animal preference

Species	Mean score[1]	Ranking
Napier	1.00	1
Leucaena	2.00	2
B. mutica	2.00	2
B. miliiformis	2.64	4
B. brizantha	3.36	5
Creeping guinea	3.50	6
B. humidicola	4.20	7
Green Panic	4.33	8
Guinea	5.22	9
Batiki	5.33	10
Tall guinea	5.75	11
Local	6.75	12

[1]Score is mean of assessment on eleven occasions

DISCUSSION

It is probable that guinea yield is underestimated in this experiment possibly because of a low cutting height. Data collected by Reynolds and Lovang (1977) suggest that guinea pastures under coconuts of the same age should lie in the high

rather than the medium production category. It was noticeable that batiki also may have been affected by the low cutting height, especially in the dry period August-September 1975.

If forage growth in 1975 is representative of an average year in Western Samoa (rainfall totals suggest that it was slightly wetter than average) then forage production in the drier period (i.e. during all or part of the months June to October), may be 30–50% less than in the wetter months. Experience in the very dry periods in 1976 and 1977 suggests that conditions can be even more extreme with yields $< 50\%$ of wet season production. This has important implications for stocking rate, carrying capacity and general management strategies. In order to maintain reasonable liveweight gains year-round, cattle owners should look at various conservation techniques.

Although napier was shown to be the grass most preferred by the steers, no distinction was made in the ranking between the local and hybrid varieties. Other work has shown that animals have a distinct preference for the hybrid (Reynolds and Sini 1976). The grasses *P. plicatulum* and *P. conjugatum* were not included in the ranking assessment because both had been invaded by batiki and were no longer pure stands. In fact, both had virtually disappeared when checks were made after the grazing experiment. Para grass, although ranked high in terms of animal preference, performed poorly in terms of yield as mentioned above and also was slow to come back after the heavy grazing. Pangola grass had already virtually disappeared at the time of the grazing trial and was therefore not ranked; it went out completely under grazing.

CONCLUSIONS

The experiment demonstrates clearly that certain grasses perform much better than others under the relatively low light transmission conditions of the coconut plantation environment. Ranking of species into four classes indicates the considerable contrast between the local pasture species and the high yielding tall guinea varieties.

Although napier and para grass ranked high in terms of animal preference, selection of species suitable for large scale planting under similar conditions would have to take into account practical factors such as grass competition with the coconut palm and the problem of locating fallen nuts in tall grasses, in addition to the actual forage yield.

While pangola, para, *P. plicatulum, P. conjugatum,* local napier, and local pastures could be eliminated on the basis of poor performance or inability to stand up to heavy grazing pressure, and hybrid napier and the tall guinea grass varieties could be recommended for intensive forage production areas under high fertilizer regimes (Ferdinandez 1972), the species most suitable for coconut environments with about 50% light transmission appear to be creeping guinea, *B. humidicola,* green panic, *B. brizantha,* guinea, *B. miliiformis* and batiki. *B. decumbens* could probably be added to this list because of its similarity to *B. brizantha* (Loch 1977). Because of the cost of producing or obtaining seed and the fact that guinea competes strongly with coconut palms, reducing yields by as much as 20% in the absence of fertilizer use (Reynolds and Uati 1976), guinea and green panic are regarded as less suitable in the Western Samoan context. The remaining grasses all fall within the high and medium production classes and selection would depend on individual characteristics and personal preference with creeping guinea and *B. miliiformis* probably less able to tolerate prolonged heavy grazing and strong weed competition than the other species. Tentative suggestions for accompanying legumes would include centro, Siratro, puero, *Desmodium heterophyllum* (widespread locally) or double row hedges of leucaena between the coconut palms. Grazing trials in progress will provide liveweight gain information for some of the grass species.

ACKNOWLEDGEMENTS

Acknowledgement is made of field and laboratory assistance received in particular from Messrs O. Sini and T. Lovang, and also from L. Isaako, A. Salesa, F. Uati and Mrs S. Robertson. The cooperation of the General Manager and staff of the Western Samoan Trust Estates Corporation, the use of facilities at the Alafua School of Agriculture of the University of the South Pacific, and the support of the Director of the Department of Agriculture are greatly appreciated.

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(Accepted for publication August 2, 1978)