A REVIEW OF PASTURE SPECIES IN FIJI. II. LEGUMES

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ABSTRACT

The performance of introduced and native legumes of pastoral value is discussed. It appears that previous lack of knowledge of requirements of legumes, particularly of nutrients, has caused the potential of some species to be overlooked in the past. Legumes proving valuable or potentially useful are Phaseolus atropurpureus, Centrosema pubescens, Leucaena leucocephala, Desmodium heterophyllum, Desmodium intortum, Stylosanthes guyanensis, Vigna hoseii, Pueraria phaseoloides.

INTRODUCTION

Part I of this review (Roberts 1970) indicated that at the commencement of settlement by immigrants in Fiji few legumes now considered to be of importance to pastoralists existed. Similarly, the information concerning subsequent introductions is scarce, but Parham (1949) has provided valuable introduction lists and comments.

Some of the leguminous plants and shrubs have been and in some cases still are regarded as weeds according to the use to which farmers are putting their land. For instance Vaivai (*Leucaena leucocephala*) forms dense impenetrable thickets in areas favourable to the species and can prove a considerable hazard to the establishment of new coconut plantations.

Not until the mid-forties were serious attempts made to introduce, establish and evaluate papilionate legumes intended for use in mixed pastures.

Of the introduced species few thrive under unamended soil conditions and without care in management. The majority of Fiji's soils are low in available phosphate, especially the latosols which form the basis of large areas of potential grazing land.

Early attempts to obtain persistent pasture legumes were probably hampered by the lack of knowledge concerning nutritional and rhizobium requirements and seed treatment to overcome hard seededness. The first reported fertilizer trials were those by Payne *et al* (1955), who started work at Sigatoka in 1949, and showed beneficial effects from superphosphate. The regular use of *Rhizobium* inoculants is restricted by the lack of a local supply. The nearest source of inoculants is Australia and this makes their economic use difficult. Experimental sowings are now, in most cases, inoculated with cultures air-freighted from Brisbane.

The scope of this review does not allow a discussion of all introductions known. Therefore, those at present of importance or showing promise will be discussed.

MIMOSA PUDICA

Mimosa pudica (sensitive plant) has been regarded as a weed since early days of settlement, but has some enthusiastic proponents who consider that its feeding value outweighs its nuisance value. On the richer alluvial flat lands it is a considerable hindrance to establishment of new pastures. Even in established areas, especially in the Tailevu dairying region, it has been estimated to occupy 20% of the available pasture. McKeown (1921) observed that few cattle ate the plant if grass could be had and that those who did attempt to eat it selected only the tips of the branches. Parham (1958), on the other hand, reported that it is

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highly regarded by dairy farmers and that production is reported to drop markedly if the species is missing from the pasture.

Twyford and Wright (1965) used sensitive plant in some exploratory pot trials and found that it responded to phosphate and potash when grown in a typical humic latosol. This is confirmed by the vigorous growth of the plant when newly planted grass/legume pastures have been sown with superphosphate.

Nodulation of sensitive plant is usually heavy, particularly in the richer alluvial soils, and it is therefore likely that athough in itself it may be of little value as a feed, the indirect benefit to the grass provides an explanation for the dairy-farmers' observations mentioned by Parham (1958).

Although no experimentation has been carried out, observations indicate that, provided the soil nutrient status can be maintained to suit desired species, the proportion of this weed can be kept to a minimum by competition.

No suitable direct control of sensitive plant is yet in use except for 2,4,5-T, which is, of course, detrimental to most cultivated legumes.

LEUCAENA LEUCOCEPHALA

It is not known when this shrub which is locally known as vaivai was introduced to Fiji, but it was observed by Seeman (1860-73). The common Hawaiian type abounds throughout the country especially in coastal areas and in thickets close to outcrops of limestone. At present little use is being made of this valuable fodder and, in coconut growing areas in particular, it is considered to be a serious weed. Its toxicity to non-ruminants also contributes to its unpopularity. This is due in no small measure to the lack of enclosed grazing lands and the great reliance country Fijians place on their horses for transport.

In 1962 further strains were introduced and compared in observations with the local vaivai. The Peruvian strain in particular proved superior in leafiness and vigour.

Some interest in recent years has been shown by a local stockfeed firm in the inclusion of dried vaivai meal in poultry rations. A small area of Peruvian vaivai was used at the Sigatoka Agricultural Station for the production of trial lots and was cut at approximately six week intervals. Cuts were carried out with a forage harvester and drying in a commercial grain drier. Initially a small area of the local strain was also harvested but yields were extremely low under the cutting regime followed and weed invasion became so heavy that it was abandoned at an early stage. The Peruvian strain maintained production for 3½ years before it too opened up and the dried produce became unacceptable to the feed processor due to excessive stalk (P. G. Thompson-personal communication). Production for the first three years averaged 6000 lb dried meal per acre and 2000 lb for the last six months.

Crude protein averaged between 20 and 23% of the dry matter, but upon investigation of the roots of this crop it was found that nodulation had not taken place, in spite of the existence of the local strain nearby. It is therefore likely that persistence would have been extended had seed inoculation been carried out initially. Defoliation using a set cutting height was severe in that the amount of woody material taken at each cut became progressively greater. It is possible that a suitable regime would be to cut non-woody growth only, and prune back periodically when necessary. This approach is now being tested in a comparison of six varieties, five of which have been supplied by Dr. J. L. Brewbaker of the Hawaii Agricultural Experimental Station. Of these, four are erect and one sub-erect in growth habit, while the Peruvian strain is classified as a shrub.

Vaivai could best be used in Fiji as a grazing supplement and a trial has been commenced to compare its usefulness on set-stocked hill country with the grass commonly used. In this trial the treatments are: grass alone, 10% vaivai by area

and 20% vaivai by area. Quite apart from its nutritive value, in the dry areas of the country the commonly used grass species *Dichanthium caricosum* makes no growth for up to six months of the year. Vaivai with its deep rooting habit is extremely resistant to drought and is likely to be doubly valuable at such times.

ALYSICARPUS VAGINALIS

The date of introduction of *Alysicarpus vaginalis* (one-leafed clover) is not known. It is not mentioned by Seeman, but Parham (1949) indicated that it was widespread, especially in the dry zone. It is not at present considered to be of much value, but like *Desmodium heterophyllum* is well-adapted to unamended soils in both main climatic zones, but more especially to the dry sides of the two main islands. Whyte *et al* (1953) stated that the encouragement of this legume together with sensitive plant and *Desmodium* species was practised in Fiji. It is the present author's experience that such attempts at encouragement do not take place.

CALOPOGONIUM SPP.

Calopogonium mucunoides (Calopo) was introduced in 1945, and has not proved popular and it is not utilised by local farmers. At Sigatoka, which is in the intermediate climatic zone and has a marked dry season, Payne *et al* (1955) found that of seven legumes grown with Kavirondo perennial sorghum (*Sorghum verticelliflorum*), only calopo survived after six months. Its rapid germinating qualities obviously gave calopo advantages over the others tried, namely centro, stylo, vaivai, *Desmanthus virgatus*, pigeon pea and puero. On the other hand, they considered that this species was a weed in the field. It is likely that this opinion has precluded further use of calopo, but the fears expressed have been unfounded. A reasonable pasture of calopo and para grass has existed at another intermediate zone station for a number of years, but the legume has not encroached beyond the boundaries of this field.

Recent observation with this legume on alluvial clays in the wet zone indicate that it could well prove useful as a companion to the slower establishing centro during the establishment year when weeds are a problem. Similarly, together with puero it appears that calopo could be usefully employed as a ground cover during the establishment years of new coconut plantations, when livestock must be excluded and nitrogen requirements of the trees are heavy.

Calopogonium caeruleum is a recent introduction from Malaysia where it is used as a cover crop under rubber. Initial establishment and cover was satisfactory in the wet zone but seed was set in the dry zone only in 1968, and both dry and intermediate zones in 1969, a year of severe drought. It is now considered that for seed production purposes the dry zone with a well-defined and sometimes prolonged dry season is to be preferred for this and for most pasture species.

CENTROSEMA PUBESCENS

Centro was introduced in 1936 (Parham 1949), and was reported as being naturalised and spreading in the provinces of Naitasiri, Tailevu, and Ra thirteen years later.

Payne *et al* (1955) considered centro to be undoubtedly one of the most useful legumes grown, both on alluvial flats and on the hills. In the same area, with an intermediate zone climate, a field sown to centro and guinea grass in January 1951 was ploughed in 1952 and planted to maize. In 1953 it was possible to locate the area originally sown to the legumes on account of the visibly greener leaves of the crop.

On alluvial soils which are commonly regarded as being fertile, some excellent para/centro pastures have been established and maintained at Navuso for a

number of years with use of regular dressings of superphosphate. (G. Bamford-personal communication) At Koronivia Research Station also a useful balance of centro with both para and Koronivia grass (*Brachiaria dictyoneura*) has been maintained over the years 1967-70, partly by the use of adequate phosphate top-dressing.

A further factor limiting more general use of centro is its rather slow germination and early growth even when the seed has been carefully pre-treated with sulphuric acid. It is at this stage that weed incursion is a danger and it has also been noted that when vigorous grass species such as para are the companions in the sward, careful grazing management is essential.

Parham (1953) reported that during 1952 at Adi Cakobau School twenty three acres of land were sown to a mixed pasture of Batiki blue grass (*Ischaemum indicum*) at 8 lb and centro at 20 lb per acre. Even such a heavy seeding rate appears to have failed to establish this legume successfully in the area. Again no details as to pre-treatment and fertilisation are given.

In 1953 a trial at Sigatoka to investigate the yields of fodder from plots of elephant grass (*Pennisetum purpureum*) with the legumes centro and creeping indigo (*Indigofera spicata*) was laid down. The latter legume was quickly smothered by the grass and centro. The grass was cut at 2 ft, 3 ft 6 in, and 5 ft levels and pig manure added at 10 tons and 20 tons per acre. A summary of the results is given in Table 1.

At Koronivia in 1962, a year's milk recording for pasture on the same soil type, using the same cows in rotation after the necessary spell on a common pasture before testing, gave a comparison between para with centro and para with two rates of nitrogen fertilisation (Table 2). On the basis of milk production, the legume was at least equal to 175 lb N/ac. and seasonal variation in milk yield was less.

TABLE 1

Effect of cutting height, and pig manure on yield of elephant grass in tons per acre of green grass

	Cutting height		
	2′ 6″	3′ 6″	5′
Increase due to legume	9.2	10.3	14.8
Increase due to 10 tons manure + legume	12.4	20.0	15.8
Increase due to 20 tons manure + legume	13.0	23.0	21.0

Trials comparing various legumes in association with grasses have been in progress on intermediate zone stations since 1967. These are sampled regularly, each sampling being followed immediately by a grazing and each plot receives an annual maintenance dressing of 2 cwt superphosphate per acre. One example from Dobuilevu is given in Table 3.

TABLE 2

A comparison of para grass with centro and with two rates of nitrogen (as urea) under grazing

Treatments	para/centro		para + 175 lb N/ac.		para + 345 lb N/ac.	
Season	milk lb/ac	cow days	milk lb/ac	cow days	milk lb/ac	cow days
Spring	2521	146	2952	161	3594	200
Summer	1676	119	1327	94	1556	115
Autumn	1913	103	1713	97	2250	117
Winter	2286	119	2149	101	3141	135
Totals	8396	487	8141	453	10541	567

TABLE 3

Hay production of grass/legume mixtures at Dobuilevu (*Grass* = Ischaemum indicum (I.i.) & Cenchrus ciliaris (C.c.))

	Annual total	% legume by dry weight	
	(000 lb)	*Nov. 1968*	*Nov. 1969*
I.i. + *Centrosema pubescens*	26.1	22.5	47.4
C.c. + „ „	28.6	58.1	34.5
I.i. + *Desmodium intortum*	28.1	25.6	57.1
C.c. + „ „	25.1	29.0	10.8
I.i. + *Dolichos axillaris*	26.7	54.5	0.0
C.c. + „ „	29.2	47.0	4.4
I.i. + *Pheseolus atropurpureus*	22.8	55.0	56.5
C.c. + „ „	24.5	57.3	31.7
I.i. + *Stylosanthes guyanensis*	26.9	16.0	0.0
C.c. + „ „	24.1	27.7	6.4
S.E. ±	3.2		

Indications are that in this situation centro is as persistent as siratro which has proved vigorous in association with most grasses used. Persistence is clearly associated with the companion grass, *Cenchrus* being more competitive than *Ischaemum* at this site.

DESMODIUM SPP.

Fiji has a wide range of desmodiums ranging from shrubs to the low growing *D. heterophyllum*. Most have been introduced but three were mentioned by Seeman (1860-73) as being common throughout the group. Introductions in more recent years have been as follows:

1925	*D. multiflorum*	Solomon Island clover
1925	*D. polycarpum*	
1932	*D. tortuosum*	Florida beggar weed
1944	*D. discolor*	giant beggar weed
1947	*D. canum*	kaimi clover
1947	*D. uncinatum*	silver leaf
1962	*D. intortum*	green leaf
1962	*D. distortum*	
1962	*D. gyroides* (*Codariocalyx gyroides*)	
1962	*D. ovalifolium*	

Introductions with unrecorded dates:

D. triflorum	
D. heterophyllum	three flowered desmodium
D. supinum	trefoil, tropical clover

The most commonly occurring species are *D. heterophyllum* and *D. triflorum*, while *D. intortum* has shown promise. *D. uncinatum* has been discarded since it failed to persist with any vigour even under controlled conditions.

The shrub *D. gyroides* was first introduced as a shade tree to assist the establishment of young cocoa, but recently it has been observed to establish better in acid lowland conditions than *L. leucocephala*. Provided that recovery is possible after each grazing, the species could well be used as a solution to the legume establishment problems encountered in para grass pastures.

Whyte *et al* (1953) cited *D. heterophyllum* together with *D. triflorum*, *D. tortuosum* and *Mimosa pudica* in Fijian pastures as replacing the clovers and

medics of temperate zones. The species is certainly widespread, but is at present not regarded as being of much importance by farmers.

Advice from overseas visitors (P. D. Sears 1959—Dept. archives) and workers in other countries (B. Grof-personal communication), together with fragmentary evidence in Fiji over the past two decades, suggests that Fiji may well have neglected to realise the value of *D. heterophyllum*. Nodulation occurs naturally throughout the region and the *Rhizobium* strain is reported to be effective (D. O. Norris—personal communication). P. G. Thompson (1966) carried out a simple trial to determine the effectiveness of nodulation and nitrogen fixation, but the results were inconclusive. Further work is required.

Twyford and Wright (1965) used *D. heterophyllum* in pot trials in their survey of Fiji soils, primarily to test the effects of lime on humic latosols. They concluded that this *Desmodium* is probably not sensitive to lime deficiency or low pH. Molybdenum gave no direct effect at ½ lb or 2 lb per acre. Mixed phosphate and potash fertilisers improved yields consistently.

Payne *et al* (1955), when discussing legumes suitable for hill grazing, concluded that contrary to the usual consensus of opinion there was no lack of legumes for rough grazings, and cite *D. heterophyllum, D. triflorum, Alysicarpus vaginalis,* and *Atylosia scarabeoides* for this purpose. They also quoted the response of *D. heterophyllum* to phosphatic fertilisers and the greener condition of grass in association with this legume.

Desmodium canum is sparsely distributed, but along the southern coast of Vanua Levu the sandy coastal soils are well populated with it. Nodulation does not, however, appear to be prolific in this situation.

Desmodium intortum (greenleaf desmodium) has only recently shown some promise (Table 3). At Koronivia between 1967 and 1969, in a trial to compare the effect of two types of grass on companion legumes on a humic latosol under wet humid tropical conditions, at the end of the two-year period, greenleaf desmodium was the only one of four to survive. The others in this case were siratro, stylo, and *Vigna luteola.* It does, however, appear extremely sensitive to nutrient deficiencies and attempts to establish greenleaf on a red-yellow podzolic soil have so far proved unsuccessful at Koronivia.

Desmodium distortum and *D. ovalifolium* have survived reasonably well in introduction plots, and warrant further investigation, particularly the latter in relation to pastures under tree crops such as coconuts. Whyte *et al* (1953) mention its effectiveness in the dense shade of rubber plantations. The close spacing of dwarf coconut varieties which are popular with some planters provides similar shade conditions.

INDIGOFERA SPICATA

Introduced in 1950, work on creeping indigo was commenced at Sigatoka, but toxicity to livestock was proved by Yelf (1959). It was therefore considered advisable to discontinue work with this species. Payne *et al* (1955) had previously reported creeping indigo as a promising legume.

DOLICHOS SPP.

A number of varieties of *D. lablab* were introduced in 1962 and have shown remarkably vigorous growth even under adverse conditions. Weevil infestation of the seed at an early stage (within the pod while maturing in the field) has precluded the availability of adequate quantities of viable seed.

Dolichos uniflorus on the other hand is a very satisfactory seed producer, though the foliage produced is not as abundant as *D. lablab*. Neither species is in general use at this stage.

Dolichos hoseii (*Vigna hoseii*). The introduction to Fiji of this species is a mystery. Parham (1949) quoted the origin as Malaya, and said that it is "reported as being successfully introduced." *D. hoseii* is to be found in isolated pockets in the wet zone where it is vigorous and appears to have useful properties, in particular its ability to compete with the heavy growth of Koronivia grass (*B. dictyoneura*).

A further small quantity of seed was introduced in 1968 and compared with the local strain. There were no apparent differences. Earlier, rooted cuttings were transplanted into an existing field of Koronivia grass and later spread and thrived. In view of similarity in conditions between the coastal tropical lowlands of northern Queensland and some wet zone areas of Fiji, the multiplication of *D. hoseii* is indicated. The chief limitation to its spread is its sparse seed production and the manner in which pods are held relative to the leaf canopy. The flowering season also is rather prolonged in Fiji, lasting from October through to January.

PHASEOLUS SPP.

Phaseolus lathyroides (phasey bean, wild pea bean). There appears to be no record of the first introduction of phasey bean into Fiji and Parham (1949) recorded it as being widespread in dry areas. It is chiefly found on roadsides in the dry areas, particularly on Viti Levu, and has not been sown in commercial pastures. Experimental use of the species has been confined to fertiliser pot trials, but its susceptibility to powdery mildew in the glasshouse environment has now restricted its use for this purpose. Commercial plantings of siratro often have a small proportion of phasey bean as a contaminant.

Phaseolus atropurpureus (siratro) is one legume which has captured the enthusiasm of farmers, extension workers and research staff, but to date only one farm contains appreciable acreages of it. This area on the northern coast of Viti Levu is inherently fertile and plantings have been confined to alluvial soils of high phosphate status. The cultivar used was at first thought to differ from the commercial siratro but E. M. Hutton (personal communication) confirms that this is not the case.

In all situations in Fiji, siratro exhibits outstanding seedling vigour, but in the wet zone persistence is generally poor because of *Rhizoctonia solani*. This disease also affects the plant in intermediate and dry zones but recovery is usually rapid. 'Little leaf' is also common in the dry zone, but its severity would appear to be connected with poor nutrition, as it is more prevalent on the poor bauxitic soils of the northern coasts of the main islands.

Various attempts to disseminate siratro have reinforced the view that it is unsuited to a humid tropical climate. On the other hand, the borders between suitable and unsuitable areas are not clear cut, as some planters on Taveuni, which enjoys a well-distributed rainfall and fertile soil, have had considerable success with small pilot plantings.

The species seeds profusely and the flowering season often lasts for three months during the dry winter season. All seed to date has been hand harvested and therefore pre-sowing seed treatment is necessary. On a small scale, acid treatment has been found to be most satisfactory. There appears to be no dormancy with freshly harvested seed. Proper storage is essential, as weevil infestation occurs at an early stage when seed is stored in open containers.

It has not been possible to carry out any grazing experiments with siratro to date, but the advantages of its presence in *Dichanthium* pastures in the dry zone during the 1969 drought were obvious. The *Dichanthium caricosum* growing season is strictly limited in most years, but the presence of siratro maintains the greenness of the grass longer, and later in the season provides the only green keep

available. With *Dichanthium caricosum*, siratro tends to become dominant. Table 4 indicates the position at Sigatoka in a trial situated on an alluvial site.

TABLE 4
The mean proportion of legumes grown with Dichanthium caricosum *at Sigatoka*

Legume	percentage of total dry matter	
	January 1969	*October 1969*
Siratro (ex Yaqara)	71	82
Siratro	82	83
Townsville stylo	15	0
Centro	21	37
Dolichos axillaris	25	0
Glycine javanica	37	48
Stylo	13	4

Table 5 indicates that at Dobuilevu on a latosolic soil, siratro tends to dominate the less vigorous species, but Koronivia grass provides some competition even under conditions of adequate phosphate.

TABLE 5
The mean proportion of siratro grown in association with eight grasses at Dobuilevu from June 1968-December 1969

Grass	*Legume as % of dry matter*	
	June 1968	*December 1969*
Koronivia (*B. dictyoneura*)	52.5	35.1
Batiki (*I. indicum*)	50.2	60.1
Plicatulum (*P. plicatulum*)	5.70	60.1
Kabulabula (*P. maximum* var. *kabulabula*)	71.4	37.5
Green Panic (*P. maximum* var. *trichoglume*)	57.8	71.1
Guinea (*P. maximum*)	63.2	55.5
Buffel (*C. ciliaris*)	54.7	45.3
Nadi (*D. caricosum*)	60.3	73.0

Table 3 shows that where conditions are most suitable for the grass species used, the balance between grass and the siratro is likely to be more even.

As none of the more recent trials include grass-only treatments, it is not possible to indicate what effect siratro has on grass yield. Nitrogen content of the grass is generally raised. Where *Dichanthium* at Sigatoka had a low proportion of companion legume (Table 4) crude protein averaged 5% of the dry matter, while the same grass with siratro averaged 11-12%.

Weed competition in the drier areas of the Colony is generally less severe, especially from *Mimosa pudica*. *Cassia tora* in one instance was successfully suppressed by the use of siratro. This weed is a common woody annual which has hitherto resisted efforts to control it.

PUERARIA SPP.

Parham (1949) indicated that *P. hirsuta* (*P. thunbergiana*) was widespread throughout the Colony, particularly in reed-covered hill country in dry areas. The Fijians have named it "Wa yaka" and have eaten the roots as a vegetable. Probably an aboriginal introduction, recent investigations show that it is also prevalent in hilly reed-dominated country in the wet zone. After clearing and burning such country, this type of "Kudzu" is one of the first species to regenerate.

Pueraria phaseoloides (puero) was introduced in 1943 and distributed widely as a fodder, (Parham 1949). The prevailing opinion is, however, that stock do not relish it. On the other hand the species has not spread greatly.

Puero is quite severely attacked by leaf-eating insects, especially in the dry zone. There is some indication that, provided seeding rates are adequate, puero may prove a useful companion legume to para grass (*B. mutica*) on the wet lowlands of Rewa and Navua. Field scale plantings have been carried out at Koronivia to study this.

The value of puero would appear to be as a soil cover beneath developing tree crops such as coconuts and oil palms. At Wainigata in the wet zone of the island of Vanua Levu, dwarf palms planted on hillsides have come into bearing earlier with a puero ground cover than those palms with a ground cover of natural regeneration of reeds and weeds.

STYLOSANTHES SPP.

Parham (1949) reported that *Stylosanthes guyanensis* was introduced in 1943 but that *S. guyanensis* var. *subviscosa* ("creeping stylo") was well-established in Ra province at that time. Since then there have been many introductions of *S. guyanensis* and *S. humilis*, particularly in 1962.

Townsville stylo (*S. humilis*) has not as yet proved successful though growth in introduction plots in the dry zone has been promising. The vigorous wet season growth of the grass *Dichanthium caricosum* and the general inability of graziers to manage swards to encourage further development of the legume has doubtlessly contributed to the apparent failure.

S. guyanensis (stylo) on the other hand has proved to be a legume adapted to various conditions throughout the Colony. On bauxitic soils in the dry zone it has proved capable of establishing itself without fertiliser treatment. These soils are extremely phosphate deficient and highly acidic. At Sigatoka on calcareous hill soils it has also established reasonably well.

In the wet zone stylo has given variable performance. Currently the best establishment has been on red-yellow podzolic soils with adequate phosphate top-dressings where centro and siratro do not thrive. The performance of stylo on humic latosols, which comprise the highest proportion of wet zone hill country, has to date not been encouraging.

The common hill country grass of the wet zone, *Ischaemum indicum*, must be kept closely grazed to maintain its palatability and this would appear to favour the persistence of stylo grown in association. The poor performance of stylo indicated by the results quoted in table 3 was due to the heavy grass competition occasioned by the eight week cutting cycle.

The greatest benefit from stylo would appear to be on the hills of the dry zone where funds for intensive development are unavailable, topography is difficult and means of obtaining and applying adequate fertiliser are not practicable at the present time. Such areas are frequently swept by fire towards the end of the dry season so that the application of seed as a means of re-establishing cover and improving the pasture appears attractive.

VIGNA SPP.

Seeman (1860-73) indicated that *Vigna luteola* (*V. marina*) was present throughout Fiji in seaside locations. This situation remains today but only where cattle have little or infrequent access. The species is extremely palatable both to grazing animals and insects. A trial at Koronivia which included this species was dominated by it until after the second grazing, by which time it had virtually disappeared from the sward.

Although *V. luteola* occurs naturally on coastal sands it establishes from seed successfully on quite a range of soils. This has been observed at Koronivia on humic latosols and on partially drained peat with a water table two feet below the surface.

Vigna unguiculata (Cowpea) is widely grown in Fiji as a green manure and a vegetable, particularly the latter. The use of cowpea as a fodder is not common and there is no record of it having been used in pasture establishment. Susceptibility of the seed to weevil infestation is a limiting factor to storage of any quantity on the farm.

Vigna hoseii has been discussed as *Dolichos hoseii.*

CONCLUSIONS

Fiji now possesses a range of legumes, enough to form the basis of a definite pasture improvement programme. The apparent lack of success in maintaining an adequate balance with companion grasses, and indeed in maintaining adequate growth of any recently introduced legume species, is in part due to the lack of knowledge of the nutritional requirements of these species and of Fijian soils.

The almost universal presence of *Desmodium heterophyllum* and its ability to combine with densely growing grasses such as *B. dictyoneura* indicate that further work is required on this species, particularly fertiliser trials and on the efficiency of nodulation and nitrogen fixation.

Also, the widespread distribution of *L. leucocephala* indicates that in addition to its use as a vigorous legume of high nutritional value, it should be in more general use as a drought feed. Further investigational work and demonstration by Government agencies is essential.

The *Stylosanthes* group, particularly for dry areas, appears to offer a solution to the reclothing of burnt hill country without a great deal of capital input.

The incidence of prolific weed growth, particularly on more fertile alluvial soils, hinders the successful establishment of many slowly establishing legumes. In view of the successful suppression of *Cassia tora* by siratro in a dry zone situation, greater use of vigorous species in establishment mixtures should be considered, even though these may later fail to persist.

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