FORAGE AND LEGUMES AS PROTEIN SUPPLEMENTS FOR PASTURE BASED SYSTEMS

by

F.A. Moog

INTRODUCTION

Major emphasis for pasture improvement in the tropics has been placed on grass-legume pastures. The grass-legume approach in pasture development is based on the knowledge that tropical soils often lack nitrogen and on the general philosophy that the legume-*Rhizobium* symbiosis can provide a more economical source of N. The ability of legumes to fix nitrogen from the atmosphere, in association with the *Rhizobium* bacteria, gives the plants a dual-role of providing an improved diet to growing animals and of increasing soil fertility through release of nitrogen.

Legumes provide high-quality protein and energy, often critical during the dry season when animals, feeding solely on grass, lose much of the weight they gained during the wet season. Pasture scientists in the tropics had shown the potential and value of grass-legume pasture and an increasing number of cattle raisers are appreciating it.

CHARACTERISTICS OF TROPICAL PASTURES

Most of the native pastures in the tropics are dominated by grasses like *Imperata*, *Themeda*, *Chrysopogon* and *Aristida* which have a short growing period or mature very quickly compared to the temperate pasture species. Protein deficiency is very common in tropical grasses, particularly the native species (Humphreys, 1972). Crude protein of native pastures is usually below 3%, particularly during the dry season and, when crude protein levels fall below 7 to 8%, animal production would be limited by protein deficiency (Evans, 1968). In addition, most of the grasslands in the tropics are found in marginal areas with low fertility status and are invaded by non-palatable species which dominate the area with increasing grazing pressure.

The value of legumes in pasture

The nutritive value and digestibility of tropical legumes is higher than that of tropical grasses and the quality of herbage from grasses rapidly declines with increasing maturity. In contrast, herbage from the legumes remains good throughout the growing period, except for the fodder trees which become woody as they mature, although such a situation is easily overcome by regular lopping of the plants.

In addition most of the tropical legumes are more productive than the grasses during the dry season, making them more valuable as sources of additional high quality feed during this period, thus increasing the year-round carrying capacity of pasture.

Legumes in native pasture

A number of studies showing the value of tropical legumes to grazing animals has been done in Australia and recently several results have been reported from numerous grazing trials conducted in Thailand, Malaysia and the Philippines, with most of the studies done on liveweight gain of beef cattle. Most of the studies however are on beef production from legume-based pastures involving Centrosema (*Centrosema pubescens*), Townsville Stylo (*Stylosanthese humilis*), Siratro (*Macroptilim atropurpureum*), Schofield and Cook Stylo (*S. guianensi*), Seca Stylo (*S. scatia*),, Verpuo Stylo (*S. hamata*) and Ipil-ipil (*Leucaena leucocephala*).

Table 1 shows the summary of liveweight gain data obtained from various studies in the Philippines. The data indicated that animal production from native pastures can be increased two- to four-fold by incorporating suitable pasture legumes, particularly with the Stylos which thrive well in dry acidic conditions. In Mabate, *Imperata* pastures overseeded with Centro or Stylo can easily support 1 animal unit per hectare with more or less 100 kg liveweight gain per hectare per year, while pure *Imperata* pasture stocked at 0.5 and 1.0 animal unit per hectare produced only 22 to 25 kg LWG per year, coupled with the animal loss in weight during the dry season.

Table 2 shows beef production on improved grass/legume pastures in the Philippines. Napier/Centro pasture fertilized with 65-45-45 NPK produced 128-148 tons of fresh herbage per year in a study conducted at ANSA farms. This pasture safely carried three animals per hectare with beef production of 475 kg liveweight gain per hectare per year. With four animals, the pasture had 806 kg liveweight gain per hectare but ran out of grass for 37 days and corn-stover supplementation was carried out.

Cowan (1986) summarised the levels of milk production that have been obtained from tropical pastures in Table 3. The grass and legume mixed pastures gave higher production per cow than nitrogen fertilized grass pastures. However, they cannot carry as heavy stocking rates as nitrogen fertilized grass and production per hectare is lower. Average production per cow is of the order of 10 to 12 kg/day for Friesian cows, 7 to 9 kg/day for Jersey and 6 to 10 kg/day for crossbred cattle. Production per hectare varies from 2,600 to 8,300 kg/year. Grass and legume systems have produced up to 8,000 kg/ha/yr, but loss of legume was observed at high stocking rates (Cowan *et al.*, 1975)

Table 1. Live weight gains on Imperata and Imperata/legume pasture.

Location/ animal	Pasture	Stocking rate (a.u./ha)	ADG (kg)	LWG/hd (kg)	LWG/ha (kg)
Masbate (cattle)	Imperata	0.5	0.12	43.2	21.6
	Imperata	1.0	0.07	26.6	26.6
	Imperata/Stylo	1.0	0.32	116.6	116.6
	Imperata/Centro	1.0	0.25	91.8	91.8
Bukidnon (cattle)	Imperata	1.0	0.21	77.4	77.4
	Imperata/Centro	1.0	0.26	94.1	94.1
Bohol (Carabao)	Imperata-Themeda	0.5	0.24	85.4	42.7
	Imperata-Themeda	1.0	0.22	78.9	78.9
	Imperata-Themeda/ Stylo	0.5	0.35	127.0	63.0
	Imperata-Themeda/ Stylo	1.0	0.25	92.2	92.2
Bohol (Carabao)	Imperata	0.75	0.22	68.1	51.1
	Imperata/Leucaena	1.5	0.35	111.9	167.9
	Imperata/Leucaena	2.0	0.28	87.4	174.8

Table 2. Liveweight gain production on improved grass/legume pastures.

Location	Pasture	Fertilizer rate (kg/ha/yr N-P-K)	Stock-ing rate (au/ha)	ADG kg	LWG/hd kg	LWG/ha kg
Bukidnon	Para grass /Centro	0-50-0	2.0	0.423	155.9	311.8
	Para grass /Centro	0-50-0	2.0	0.419	150.9	305.8
ANSA Farm (South Cotabato)	Napier/ Centro	65-45-45	2.0	0.428	156.5	313.0
	Napier/ Centro	65-45-45	3.0	0.431	158.0	474.0
Bohol	Guinea/ Cook Stylo	24-24-24	2.0	0.240	86.4	172.8
	Guinea/ Cook Stylo	24-24-24	2.5	0.280	100.8	252.0
	Guinea/ Cook Stylo	24-24-24	3.0	0.220	79.2	237.6

Table 3. A Summary of milk production per cow and per hectare from cows grazing tropical pastures.

	Breed	Stocking rate (cows/ha)	Milk yield (kg/cow/day)	Milk yield (kg/ha/yr)
Unimproved pastures	Jersey	1.1	6.8	2660
	Guernsey	1.5	6.9	2670
	Jersey/Criollo	1.0	6.9	2660
	Friesian/Zebu	1.5	6.9	2760
Improved grass-legume pastures	Jersey	1.0	8.5	-
	Guernsey	1.8	9.3	4700
	Friesian	1.6	12.4	5350
	Friesian/Zebu	1.7	7.3	3720
	A.F.S.	1.6	8.0	3840
Improved nitrogen fertilized pastures	Jersey	2.5	6.8	5250
	Guernsey	2.5	7.8	5350
	Friesian	2.5	11.0	8250
	Friesian/Zebu	2.2	8.7	5200
	Jersey/Criollo	2.6	6.7	4100
	A.F.S.	2.5	7.0	4800

TREE LEGUMES

Shrub and tree legumes are a good source of protein and have been gaining importance for livestock production in S.E. Asia and other tropical countries. Fodder tree legumes have several attributes that make their potential use in the tropics very high. The legumes have deep root system and can withstand drought and often serve as the main source of forage during the dry season. Some of the tree legumes are multiple purpose plants and are often grown for fuel wood, timber, poles and even a source of food, in addition to fodder. Tree legumes, once established, are easier to maintain in association with tropical grass compared to conventional creeping legumes and they can be grown as an upper story on land used for growing crops at lower levels.

Some of the legumes with known use and potential as a source of fodder are species belonging to the genera of *Albizzia*, *Callandra*, *Gliricidia*, *Mimosa*, *Leucaena*, *Samanea* and *Acacia*. Among the legumes, *Leucaena leucocephela* is most well studied while the value of *Gliricidia maculata* is now being recognised, along with other species as a source of fodder.

In the Philippines, Ipil-ipil or *Leucaena* is the most popular legume and has been given a great deal of attention since the early seventies, with people in the livestock sector looking at it almost on a 'cure-all' for the growing animal industry. This bias worked against the sector because, in 1985, *Leucaena* was infested by a 'jumping lice' or psyllid (*Heteropsylla cubana*) and we were not prepared with an alternative species. Currently, the infestation is still around but not as destructive as in 1985-1987 when the intensive cattle-fattening, smallholder farms were badly affected, forcing them to reduce animal holdings or stopped operations.

The infestation also affected the feed milling industry which utilized *Leucaena* as a source of xanthophyll and carotene in mixed feeds. Likewise, it also affected the smallholder farmer who grew, harvested and sold the leaves to the feed merchants and feedmills.

Smallholder dairy farmers raising Sahiwal-Holstein Friesian feed their animals with 5 to 19 kg fresh Ipil-ipil leaves in combination with fresh grass fodder and obtain 4 to 7 kg milk per cow per day. Ipil-ipil is planted in hedges around the home-lots and farmlots, and in evenly spaced rows (1m to 2m) under coconuts.

Liyanage and Jayasundera (1988) reported that several trials conducted by the Coconut Research Institute in Sri-Lanka have demonstrated the value of *Gliricidia* as an animal feed. *Gliricidia* loppings mixed with *Brachiaria milliformis* in 50-50 ratio and fed to crossbred heifers resulted in an average live weight gain of 700 g/head/day. In another trial, a mixture of *Gliricidia* and *Leucaena* was planted alternately 1.5 m apart along the fence in a pasture/ cattle/coconut integrated system and produced more than 2 MT/ha/year of fresh green matter. This, when fed to heifers at the rate of 6 kg along with a pasture during the dry season, produced average live weigh gains of 300 g/head/day. Freshly chopped *Gliricidia* leaves can also reduce the duration of urea-treated straw from 21 to less than 6 days.

Gliricidia leaves are succulent but may not be very palatable to animals when first introduced. However, livestock freely eat when they become accustomed to the taste. Table 4 shows that *Gliricidia*, when fed with Siguaue (*Brachiaria brizantha*) grass from 0 to 100% for one month to Jersey milch cows, had no adverse effect on their health or milk production and was very palatable (Chadhokar and Lecamwasam, 1982). However, tainting of milk when *Gliricidia* is fed above 50% supplementation level has been reported but this may be avoided if feeding of this material is stopped a few hours before milking.

Table 4. Effect of *Gliricidia maculata* in a mixture with *Brachiaria brizantha* on milk yield and its composition

Treatment	Average Milk Yield (litres/cow/day)		Average Milk Composition (Percentage)		
Percentage *Gliricidia*	Pre-exptl.	Exptl.	Fat Pre-exptl.	Fat Exptl.	Solids not-fat
0	5.5	5.8	4.8	4.7	8.3
25	5.2	5.8	5.2	5.1	8.6
50	6.5	5.7	5.7	5.8	8.8
75	3.8	4.6	5.1	5.3	8.4
100	6.7	7.6	5.3	5.8	8.6

SUMMARY AND CONCLUSIONS

Vine and tree legumes are very valuable components in livestock feeding systems in the tropics. Increasing population trends indicate that more of the grassland areas will be diverted to crop production and will limit the use of pasture legumes to marginal areas where crop production is economically less or not feasible. Smallholder livestock production will increase in proportion and fodder trees will be socially and economically viable.

Livestock research and development programmes should focus on utilisation of tree legumes relevant to existing farming systems in smallholder farms in the tropics.

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