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GROWING OF *GLIRICIDIA* AS GREEN MANURE CROP IN COCONUT GARDEN UNDER LITTORAL SANDY SOIL

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ABSTRACT

Coastal sandy soil which is widespread along the west coast region of India has poor physico-chemical properties limiting coconut productivity. To mitigate this problem, investigations were conducted on the feasibility of growing *Gliricidia* as a green manure crop under littoral sandy soil conditions at CPCRI, Kasaragod. *Gliricidia sepium* was established in two and three rows at 1 x 1m spacing in a four year old coconut garden with a spacing of 7.5 m x 7.5 m The treatment, three rows of *Gliricidia* in between two rows of coconut palms with three prunings per year (February, June and October) resulted in higher biomass yield of 7970 kg/ha. Coconut growth characters were not affected by intercropping of *Gliricidia*. Application of the *Gliricidia* prunings from interspace of one hectare coconut garden to the coconut palms could meet a major portion of nitrogen (90%), part of phosphorous (25%) and potassium (15%) requirement of coconut palms.

Key words: Coconut, *Gliricidia,* Intercrop, Prunings, Plant density

INTRODUCTION

The weather parameters prevailing along the coastal area are conducive for growing coconut economically. However, coconut productivity is very low in the coastal sandy soils. The reasons for the low productivity are mainly poor physico-chemical characters viz., high bulk density, poor aggregate stability, poor water holding capacity, high soil temperature and poor soil fertility status. Under these conditions soil management practices that improve the soil fertility status apart from increasing the water holding capacity, hold the key for increasing the productivity. The organic matter status of the soil can be maintained by the addition of green leaves, compost or farm yard manure (FYM). Addition of blended organic sources, like forest leaves and cattle manure markedly enhanced the growth and vigour of coconut palms as compared to palms treated with NPK fertilizers alone (Nambiar *et al.* 1983). However, in many coconut gardens, farmers are unable to apply the required quantity of compost or FYM because of inadequate supply.

Coastal sandy soils are mainly skeletal soils, consisting of 99.1% sand particle. Even though coconut is a widely spaced crop, the interspace cannot be utilised economically for growing intercrops in sandy soils. Permanent coconut tree - legume intercropping has been considered for the coastal sandy soils in south east Ivory Coast during the eighties (Pomier *et al.* 1986). Studies carried out on intercropping in coconut in coastal sandy soils in south east Ivory Coast have found that *Casurina equestifolia* and the two legumes *Acacia mangium* and *Acacia auriculiformis* maintained soil fertility (De Taffin *et al.* 1991). Similarly *Gliricidia sepium* when intercropped with coconut played a major role in improving the physical characters of infertile gravelly soils of Srilanka (Vidhana Arachachi and Liyanage, 1996). *Gliricidia* has a great potential as a multipurpose tree in agroforestry systems and could be useful in improving the productivity of coconut. Keeping the above points in mind, investigations on the feasibility of growing *Gliricidia* in coconut gardens and the optimum management practices i.e planting densities and pruning frequency were carried out at CPCRI, Kasaragod.

MATERIALS AND METHODS

A field experiment was conducted in a four year old coconut garden at Central Plantation Crops Research Institute, Kerala. The mean annual rainfall (Table 1) of the area is around 3500 mm out of which 86 percent is received during the four monsoon months (June-September). The pan evaporation exceeds precipitation throughout the year except during monsoon period. The littoral sandy soil (Quartzipsamments) has 99.1 per cent sand, 0.2 per cent silt and 0.7 per cent clay. The pre-experimental nutrient status of the soil is given in Table 2. The experiment was laid out in randomized block design with four replications and five treatments viz., T1: Control (coconut monocropping) T2: Two rows of *Gliricidia* (1x1m spacing) in between the two rows of coconut palms with three prunings per year (February, June and October). T3: Two rows of *Gliricidia* (1x1m spacin) in between two rows of coconut palms with 4 prunings per year (March, June, September and December). T4: Three rows of *Gliricidia* (1x1m spacing) in between two rows of coconut palms with 3 prunings per year. (February, June and October). T5: Three rows of *Gliricidia* in between two rows of

Table 1. ***Weather parameters of CPCRI, Kasaragod (Mean of 10 years)***

Parameters	Temperature °C		Relative humidity (%)			Evaporation	Sunshine	Rainfall
Month	Max.	Min.	7.30 hrs	14.30 hrs	Mean	(mm/day)	(h/day)	(mm)
JAN	32.3	18.7	92	51	72	4.1	9.3	0.2
FEB	31.9	19.7	87	57	72	4.8	10.0	0.0
MAR	32.5	21.8	87	60	74	5.2	9.0	9.7
APR	33.2	23.5	82	61	72	5.7	8.6	32.0
MAY	33.2	23.5	82	64	73	5.3	8.1	165.1
JUNE	30.1	22.4	91	80	86	3.6	3.4	1036.4
JULY	28.8	22.0	92	83	88	2.9	2.6	1010.8
AUG	28.9	21.6	94	82	88	3.1	3.7	678.3
SEPT	29.9	21.4	92	75	84	3.6	5.8	214.6
OCT	31.1	21.3	91	71	81	3.6	6.4	166.4
NOV	32.3	20.4	78	61	70	3.7	7.9	112.6
DEC	33.0	18.7	81	50	66	4.1	9.3	10.3

Table 2. ***Soil characteristrics of the experimental site (pre experimental)***

Depth (cm)	Organic C (%)	Available N (ppm)	Available P (ppm)	Available K (ppm)
0-25	0.173	38.0	24.5	15
25-50	0.105	31.6	21.6	10
50-75	0.103	30.8	20.2	10

coconut palms with 4 prunings per year (March, June, September and December), *Gliricidia* cutting (1 m long) were planted in an upright position during June 1995. The prunings yield data from Feb. 1997 onwards was considered for this paper. The schematic representation of *Gliricidia* planting pattern is given in Fig 1. Coconut was planted at the spacing of 7.5 x 7.5 m (175 palms/ha) and the *Gliricidia* population of 2054 plants/ha and 3081 plants/ha was maintained for two rows and three rows respectively. Uniform

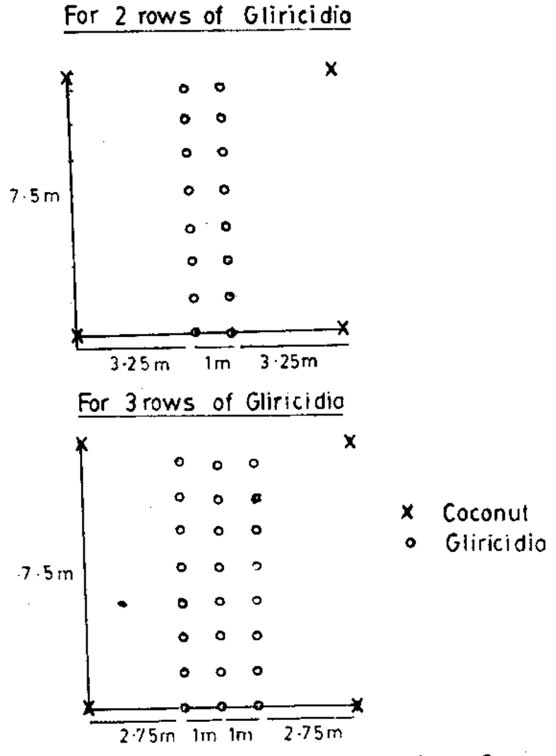

Fig. 1. Schematic representation of gliricidia planting in coconut gardens.

dose of 500g N, 320 g P_2O_5 and 1200g K_2O was applied to all the coconut palms. *Gliricidia* prunings was applied uniformly to the coconut palms except coconut monocrop (control) as and when pruning was done. Twelve *Gliricidia* plants per treatment were randomly selected for above ground biomass assessment. Pruning was done according to the treatment schedule at 100 cm above the ground. Dry matter yield of prunings (biomass yield) was determined by drying sub sample at 60°C in a hot air oven. Sub samples of prunings were ground and analysed for N, P and K content by adopting the standard procedures (Jackson, 1973).

RESULTS AND DISCUSSION

Effect of frequency of pruning and planting density on biomass yield

The effect of planting density and frequency of pruning on biomass production is shown in Table 3. The

Table 3. ***Effect of pruning regimes and planting density on biomass yield of Gliricidia***

Treatment	Fresh leaf matter (kg/ha) (Mean of 2 years, 1996-98)
T2:2 rows, 3 prunings	6194
T3:2 rows, 4 prunings	5479
T4:3 rows, 3 prunings	7970
T5:3 rows, 4 prunings	7211
SEd±	196
CD(5%)	445

biomass yield significantly increased with increasing planting density. Three rows of gliricidia (T4 and T5) in between two rows of coconut palms resulted in significatly higher biomass yield when compared to two rows of *Gliricidia* (T2 and T3) in between the coconut palms. Jha and Chaturvedi (1995) observed a similar trend in biomass production with varying densities of *Leucaena leucocephala*. Regarding pruning inensities, three prunings per year (February, June and October) recorded higher biomass yield compared to four prunings per year (March, June, September and December). The biomass yield associated with more frequent pruning was probably related to the increased number of recovery phases during which the rate of biomass production become very low. Similarly Liyanage (1994) observed that *Gliricidia* intercropping with coconut resulted in 10 t/ha fresh loppings from three prunings per year.

Seasonal effects on biomass production

The results summarized in Fig. 2 revealed that the highest production of biomass was recorded during the months of June, September and October as pruning coincided with south west monsoon in which more than 80% of the total rainfall is received. The climatic factors are very conducive for higher biomass production. On the contrary, pruning in the month of February, March and December *i.e.,* wet/dry transition period recorded low biomass yield. This is mainly due to non-conducive weather and moisture deficit. Similarly Dugumba *et al.,* (1988) also found that two thirds of the annual production of *Leucaena* occurred in the six month wet season and only one-third in the dry period. Green manure/FYM application is recommended for coconut in the month of September along with 2/3rd-fertilizer dose. However, the green leaf manure has to be procured from forest area, which may be from a far

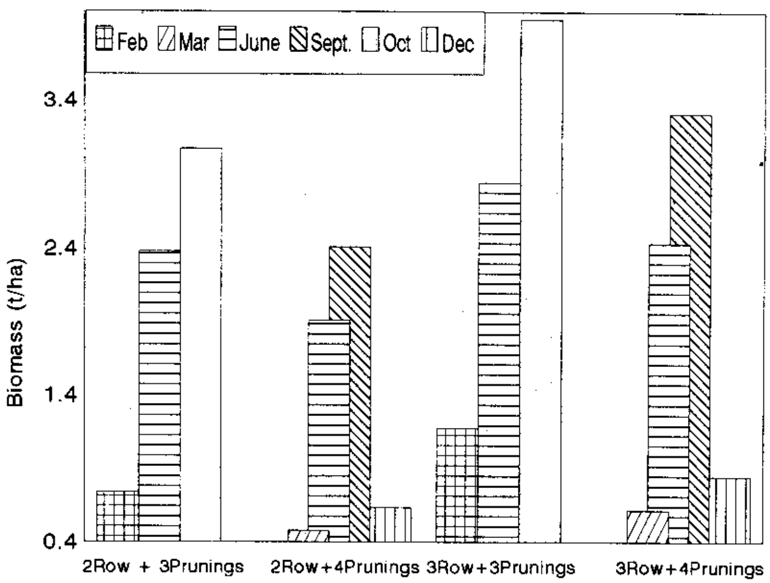

Fig. 2. Seasonal effect on *Gliricidia* biomass production

off place If we consider FYM, the availability in coastal area is less due to less cattle population/fodder availability whereas by growing *Gliricidia*, better quality of green manure is obtained from the coconut garden itself with the advantage that cost of green manure is less, and the leguminous green manure is rich in NPK. Further *Gliricidia* is very succulent and easily decomposable and establishment of any other green manure crop is difficult. Because of all these reasons *Gliricidia* has an upper hand as green manure for coconut garden in coastal sandy soils.

Dry matter yield, NPK content and NPK yield

Planting density and pruning intensities did not influence the N, P and K contents (Table 4). Dry matter production and N, P, K yield are presented in Table 5. The annual nitrogen, phosphorus and potassium yield were estimated from the total dry matter yield and the N, P and K percentage of various prunings. From the data (Table 5), 78 kg N, 6 kg P and 27 kg K were produced by the treatment T4 and it significantly differed from all other treatments. Intensive pruning caused reduction in leaf area resulting in low interception of photosynthetically active radiation and ultimately in low photosynthesis which affected subsequent growth. Dry matter production and N, P, K, yields were directly proportional to planting densities and inversely proportional to pruning intensities. This N, P and K yield will meet 90% nitrogen, 25% phosphorous and 15% potassium of annual requirement of the coconut palms in one hectare.

Table 4: ***N P and K content (%) of Gliricidia prunings under different management practices***

Treatment	N	P	K
T3:2 rows, 3 prunings	3.49	0.251	1.123
T3:2 rows, 4 prunings	3.45	0.251	1.147
T4:3 rows, 3 prunings	3.38	0.247	1.165
T5:3 rows, 4 prunings	3.39	0.249	1.171
SED±	0.048	0.003	0.022
CD (5%)	NS	NS	NS

Table 5: ***Dry matter yield and N, P, K contribution of Gliricidia under different management practices (kg/ha) (Mean of two years)***

Treatment	Dry matter	N	P	K
T2:2 rows, 3 prunings	1816	61.5	4.6	20.4
T3:2 rows, 4 prunings	1594	54.8	4.0	18.4
T4:3 rows, 3 prunings	2296	77.6	5.7	26.8
T5:3 rows, 4 prunings	2051	69.5	5.1	24.0
SED±	65	2.499	0.18	0.817
CD (5%)	148	5.65	0.42	1.849

Table 6. ***Coconut growth characters (1998)***

Treatment	Height (cm)	Girth (cm)	Total no. of leaves	Annual leaf production
T1: Coconut monocrop	484	110	27	7.4
T2: 2 rows, 3 prunings	581	115	30	8.1
T3: 2 rows, 4 prunings	526	106	28	7.9
T4:3 rows, 3 prunings	560	108	29	8.3
T5:3 rows, 4 prunings	546	113	31	8.8

Effect of *Gliricidia* intercropping on coconut growth

Growing *Gliricidia* in the inter-spaces of coconut did not significantly affect the growth characters of coconut (Table 6). De Taffin et al. (1991) observed that when coconut was intercropped with tree legumes and casuarina, coconut growth characters viz., girth, number of leaves, leaf nutrient content and flowering precocity were not affected. Liyanage *et al.* (1989) also found that integration of pasture/fodder (multipurpose trees/animal system) did not affect the coconut productivity compared to monocropping.

Results obtained from this study showed *Gliricidia* can be successfully grown as intercrop in the coconut garden in litoral sandy soil, where no other green manure can establish, thrive and supply green manure permanently especially the annual green manure crops. Among the treatments, the best growth and biomass yields were obtained in the treatment of three rows of *Gliricidia* with three prunings per year obtained in the treatment of three rows of *Gliricidia* with three prunings per year (T4). From the annual N, P and K yield data it is possible to replace 90% N, 25% P and 15% K yield data it is possible to replace 90% N, 25% P and 15% K requirement of the coconut palm. Further *in situ* availability, easy decomposability and low cost green manure are the added advantages.

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