



Forage Productivity, Quality and Soil Nutrients Status of Guinea Grass (*Panicum maximum* Jacq.) based Pasture as Influenced by Legumes Intercropping and Weed Control

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Abstract: An experiment was conducted during 2007-2011 under rainfed conditions on sandy loam soil at Central Research Farm of Indian Grassland and Fodder Research Institute, Jhansi to study the effect of legumes intercropping and weed control on forage productivity, quality and soil nutrients status of Guinea grass based pasture in semi-arid conditions. The treatment comprised four legumes (*Stylosanthes hamata*, *S. seabrana*, *Clitoria ternatea* and *Macroptillium atropurpureum*) and four weed management practices (weedy check, hand weeding, weeding with weeder cum mulcher and pre-emergence application of pendimethalin @ 0.75 kg a.i. ha⁻¹). Intercropping of *Stylosanthes seabrana* with Guinea grass produced significantly higher total dry forage yields (6.68 t ha⁻¹) than *Clitoria ternatea* (5.41 t ha⁻¹), *Macroptillium atropurpureum* (5.60 t ha⁻¹) and *S. hamata* (6.29 t ha⁻¹). Intercropping of *S. seabrana* with Guinea grass also recorded significantly higher total crude protein yield (582.0 kg ha⁻¹) as compared to *C. ternatea* (457.7 kg ha⁻¹) and *M. atropurpureum* (474.9 kg ha⁻¹). In weed management practices, hand weeding 35 days after sowing in 1st year and 25 days after onset of monsoon rain from 2nd year onwards recorded significantly higher dry forage and crude protein yields of both Guinea grass (5.02 t ha⁻¹ and 344.0 kg ha⁻¹) and legumes (2.0 t ha⁻¹ and 271.8 kg ha⁻¹) than weedy check, pre-emergence application of pendimethalin @ 0.75 kg a.i. ha⁻¹ and weeding with weeder cum mulcher. The intercropping of *S. seabrana* with Guinea grass recorded significant improvement in organic carbon (0.48%) and available nitrogen (228 kg ha⁻¹) than *C. ternatea* and *M. atropurpureum*. Available nitrogen (226.2 kg ha⁻¹), phosphorus (9.91 kg ha⁻¹) and potash (195.8 kg ha⁻¹) were also increased significantly in hand weeding plots than weedy check (211.3, 9.05 and 179.1 kg ha⁻¹).

Key words: *Clitoria ternatea*, *Macroptillium atropurpureum*, *Panicum maximum*, *Stylosanthes hamata*, *S. seabrana*, weed control.

The perennial forage legumes provides cheaper source of quality fodder and enhances animal productivity when grown with grasses (Thomas *et al.*, 1997). However, when legumes are grown with grasses their establishment and growth are often poor because of faster growth of weeds and their smothering effect during early stage of legume growth. Presence of weeds in pasture field generally reduce the forage quality on account of low crude protein content and dry matter digestibility and high fibre content. They also reduce quality of livestock products and affects animal health. Most of the forages are grown under rainfed and dryland, where, weeds compete with fodder species for space, soil moisture and nutrients and causes 30-40% reduction in

forage production (Reddy and Reddy, 1994). In such situations weed management practices can provide best opportunity to legumes to establish and grow vigorously upto the time of harvest for quality forage production. In view of these points, the present experiment was undertaken to study the effect of legumes intercropping and weed control on forage productivity, quality and soil nutrients status of Guinea grass based pasture under rainfed conditions.

Materials and Methods

A field experiment was conducted during 2007-2011 at Central Research Farm (25°27' N latitude, 78°37' E longitude and 275 m altitude, Indian Grassland and Fodder Research Institute, Jhansi to examine the effect of legumes intercropping and weed control on

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Table 1. Effect of legume and weed management practices on dry forage yield, number of weeds and weed dry weight in Guinea grass based pasture (pooled data of 4 years)

Treatment	Dry forage yield (t ha ⁻¹)			No. of weeds m ²	Weed DW (g m ⁻²)
	G	L	T		
Guinea + Legumes					
G + <i>S. hamata</i>	4.37	1.92	6.29	50.97	85.91
G + <i>S. seabrana</i>	4.26	2.42	6.68	48.18	82.45
G + <i>M. atropurpureum</i>	4.29	1.31	5.60	53.01	90.47
G + <i>C. ternatea</i>	4.32	1.09	5.41	60.49	96.36
SEm±	0.11	0.04	0.15	2.18	3.98
CD (P=0.05)	NS	0.12	0.42	6.28	11.45
Weed control					
Weedy check	3.76	1.43	5.18	69.49	117.68
Pendimethalin (0.75 kg a.i. ha ⁻¹)	4.08	1.58	5.66	59.96	101.13
Weeder cum mulcher	4.39	1.72	6.11	51.26	87.12
Hand weeding	5.02	2.00	7.02	31.81	49.56
SEm±	0.11	0.04	0.15	2.18	3.98
CD (P=0.05)	0.31	0.12	0.42	6.28	11.45

G - Guinea grass, L - Legumes, T - Total (Guinea grass+Legumes).

forage productivity, quality and soil nutrients status of Guinea grass based pasture under rainfed conditions. The total rainfall received was 553.8, 1267.1, 544.9 and 684.1 mm in 38, 52, 33 and 32 rainy days during 2007, 2008, 2009 and 2010 respectively. There were 16 treatment combinations replicated thrice in randomized block design. The treatment comprised four legumes viz., *Stylosanthes hamata*, *S. seabrana*, *Clitoria ternatea* and *Macroptillium atropurpureum* and four weed management practices viz., weedy check, hand weeding with weeder cum mulcher and pre-emergence application of pendimethalin @ 0.75 kg a.i. ha⁻¹. Hand weeding and weeding with weeder cum mulcher was done at 35 days after sowing in first year and 25 days after onset of monsoon rain from 2nd year onwards and application of pendimethalin @ 0.75 kg a.i. ha⁻¹ was done pre-emergence in first year and from 2nd year onwards just after one day of onset of monsoon rain. The seedlings of Guinea grass were transplanted in the month of July 1 m apart and legumes were sown in between two rows of grasses. Dry matter content was estimated by drying 500 g plant sample of each treatment and replication in hot-air oven at 70°C, which led to computation of dry matter yield. The plant samples were analysed for crude protein content (AOAC, 1995).

Results and Discussion

Dry forage yield

Intercropping of *Stylosanthes seabrana* with Guinea grass produced significantly higher total dry forage yields (6.68 t ha⁻¹) than *Clitoria ternatea* (5.41 t ha⁻¹), *Macroptillium atropurpureum* (5.60 t ha⁻¹) and *S. hamata* (6.29 t ha⁻¹). This was due to better survival and growth of *S. seabrana* over the years as compared to *S. hamata*, *Macroptillium atropurpureum* and *C. ternatea*. Edye *et al.* (1998) and Basak *et al.* (2003) also reported that *Stylosanthes seabrana* had the best overall yield performance compared to other *Stylosanthes* species. In total dry forage yield (6.68 t ha⁻¹), per cent contribution of *S. seabrana* were maximum (36.23). Clem *et al.* (2001) found that *S. seabrana* was best adapted for use in permanent pastures as compared to various other legumes.

In weed management practices, hand weeding 35 days after sowing in 1st year and 25 days after onset of monsoon rain from 2nd year onwards recorded significantly higher dry forage yield of both Guinea grass (5.02 t ha⁻¹) and legumes (2.0 t ha⁻¹) than weedy check, pre-emergence application of pendimethalin @ 0.75 kg a.i. ha⁻¹ and weeding with weeder cum mulcher (Table 1). Liu and Revell (2002)

Table 2. Effect of legume intercropping and weed management practices on crude protein content and yield of Guinea grass based pasture

Treatment	Crude protein content (%)		Total crude protein yield of system (kg ha ⁻¹)
	Guinea grass	Legumes	
Guinea + Legumes			
G + <i>S. hamata</i>	7.84	12.70	547.0
G + <i>S. seabrana</i>	7.86	12.27	582.0
G + <i>M. atropurpureum</i>	7.81	13.81	474.9
G + <i>C. ternatea</i>	7.78	15.49	457.7
SEm±	0.04	0.06	16.8
CD (P=0.05)	NS	0.18	48.5
Weed control			
Weedy check	7.74	13.46	437.7
Pendimethalin (0.75 kg a.i. ha ⁻¹)	7.80	13.53	476.4
Weeder cum mulcher	7.85	13.61	531.8
Hand weeding	7.91	13.67	615.8
SEm±	0.04	0.06	16.8
CD (P=0.05)	0.11	0.18	48.5

G - Guinea grass.

indicated that after removal of weeds, the legume component had the ability to grow better than weedy check.

Number of weeds and weed dry weight

Intercropping of *S. seabrana* with Guinea grass recorded significantly less number of weeds (48.18 m⁻²) and lower weed dry weight (82.45 g m⁻²) as compared to *C. ternatea* (number of weeds 60.49 m⁻² and weed dry weight 96.36 g m⁻²). This was due to better survival and growth of *S. seabrana* over the years and its suppressing effect on weeds. Hand weeding resulted in significantly lesser number of weeds (31.81 m⁻²) and lower weed dry weight (49.56 g m⁻²) than weedy check, pre-emergence application of pendimethalin and weeding with weeder cum mulcher (Table 1). Decrease in weed count and weed dry weight by hand weeding were also reported by Sharma and Gill (2005). The common weeds found and removed from the experimental field were *Cynotis* sp., *Commelina benghalensis*, *Leucas aspera*, *Cassia tora*, *Phyllanthus niruri*, *Borreria hispida*, *Fimbristylis diphylla*, *Parthenium hysterophorus*, *Celosia argentea*, *Ipomea pestigridis*, *Digera arvensis*, *Tridax procumbence*, *Sida acuta*, *Cyperus rotundus*, *Coculus* sp., *Miremia emarginata*, *M. triandra* and *Borreria stricta*.

Crude protein yield

Crude protein yield (582.0 kg ha⁻¹) was also increased significantly when guinea grass intercropped with *S. seabrana* than intercropping with *C. ternatea* (457.7 kg ha⁻¹) and *Macroptillium atropurpureum* (474.9 kg ha⁻¹). This was due to higher dry matter yield obtained by intercropping of *S. seabrana* with Guinea grass than *Macroptillium atropurpureum* and *C. ternatea*. Crude protein yield (615.8 kg ha⁻¹) was also increased significantly when hand weeding was done at 35 days after sowing in 1st year and 25 days after onset of monsoon rain from 2nd year onwards than weedy check, pre-emergence application of pendimethalin and weeding with weeder cum mulcher (Table 2). Moyer *et al.* (2003) also reported that removal weeds resulted in higher protein yield than weed infested plots.

Forage quality

Intercropping of legumes did not affect significantly the crude protein content of Guinea grass (Table 2). However, *C. ternatea* recorded significantly higher crude protein content (15.49%) as compared to *M. atropurpureum* (13.81%), *S. hamata* (12.70%) and *S. seabrana* (12.27%) among the legumes (Table 2). Thomas *et al.* (1997) also reported that establishment of

Table 3. Effect of legume intercropping and weed management practices on soil organic carbon and available nutrients of soil of Guinea grass based pasture (pooled data of 4 years)

Treatment	Organic carbon (%)	Available N (kg ha ⁻¹)	Available P (kg ha ⁻¹)	Available K (kg ha ⁻¹)
Guinea + Legumes				
G + <i>S. hamata</i>	0.46	222.8	9.26	183.3
G + <i>S. seabrana</i>	0.48	228.0	9.22	179.6
G + <i>M. atropurpureum</i>	0.44	213.9	9.58	189.1
G + <i>C. ternatea</i>	0.42	208.9	9.75	194.8
SEm±	0.01	4.8	0.18	3.7
CD (P=0.05)	0.02	13.86	0.52	10.68
Weed control				
Weedy check	0.51	211.3	9.05	179.1
Pendimethalin (0.75 kg a.i. ha ⁻¹)	0.45	215.9	9.09	183.5
Weeder cum mulcher	0.44	220.2	9.76	188.4
Hand weeding	0.41	226.2	9.91	195.8
SEm±	0.01	4.8	0.18	3.7
CD (P=0.05)	0.02	13.86	0.52	10.68

G - Guinea grass.

legumes in association with grasses resulted in improvement in quality of forage.

Among weed management practices, hand weeding resulted in significantly higher crude protein content in both Guinea grass (7.91%) and legumes (13.67%) as compared to weedy check (grass-7.74% and legumes-13.46%). Moyer *et al.* (2003) also reported that removal weeds resulted in higher protein yield than weed infested plots.

Soil nutrients status

Intercropping of *S. seabrana* with Guinea grass recorded maximum organic carbon (0.48%) and available nitrogen (228.0 kg ha⁻¹) in soil. Thomas *et al.* (1997) also reported that establishment of legumes with grasses resulted in improvement in soil nutrients status. However, available phosphorus (9.75 kg ha⁻¹) and potash (194.8 kg ha⁻¹) were higher in plots where *C. ternatea* was intercropped with Guinea grass. Among weed management practices, hand weeding recorded maximum available nitrogen (226.2 kg ha⁻¹), phosphorus (9.91 kg ha⁻¹) and potash (195.8 kg ha⁻¹). While organic carbon (0.51%) was highest in weedy check plots. This may be due to decomposition of annual weeds in the weedy check plots.

It is concluded that intercropping of Guinea grass with *S. seabrana* along with hand weeding

at 25 days after onset of monsoon in sandy loam soil increased forage production and quality and improved soil nutrients status under semiarid rainfed conditions. *S. seabrana* had better ability to withstand weed competitions as compared to other legumes and performed well in association with Guinea grass under semiarid rainfed conditions.

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