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Forage legumes intercropping and nitrogen management effects on performance of guinea grass (*Panicum maximum*) varieties in Bundelkhand region of India

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Introduction

Guinea grass (*Panicum maximum* Jacq.) is one of the important forage grass of the tropics with good yield potential, palatability, persistence and quality fodder (Sukhchain, 2010). The low crude protein productivity of guinea grass can be enhanced through its intercropping with forage legumes to sustain ruminant animals throughout the year. The intercropping of legumes with guinea grass will also optimize forage production per unit area, especially during *rabi* season. Further, its productivity can also be increased through N management as it is heavy feeder due to perennial and multi-cut nature.

Materials and Methods

A field experiment was conducted during 2010-2013 at Indian Grassland and Fodder Research Institute, Jhansi (25^0 27' N latitude, 78^0 33' E longitude and 270 m above mean sea level). The experimental soil was slightly alkaline (pH 7.8), low in organic carbon (4.3 g/kg), available nitrogen (207 kg/ha) and phosphorus (9.3 kg/ha) and high in available potassium (301 kg/ha). There were 16 treatment combinations replicated thrice in a randomized block design. The treatment comprising 4 cropping system [two guinea grass varieties Bundel Guinea-1 (BG-1) and Bundel Guinea-2 (BG-2) was grown sole as well as intercropped with cowpea (*Vigna unguiculata*) - (*Trifolium alexandrinum*)] and four nitrogen schedules (40 and 30 kg N/ha after each cut in one and two splits). In one split, full dose of N was applied just after each cut, whereas in double splits half N at just after each cut and remaining at 12-15 days after cut.
Guinea grass rooted slips was planted in July, 2010 at a spacing of 100 × 50 cm. At the time of plating 60 kg N and 40 kg P_2O_5 were applied. In *kharif*, cowpea *var* Bundel Lobia-2 and during *Rabi* berseem *var* Bundel Berseem-2 was sown in between the rows of guinea as per treatment. Crude protein content was estimated by extracting N with H_2SO_4 and determining the concentration in the digested solution by Kjeldahl analysis and expressed as N × 6.25. The economics was computed using prevailing prices of inputs and outputs. Benefit cost ratio (B:C) ratio was calculated by dividing net returns by cost of cultivation.

Results and Discussion

Fodder yields: Fodder production from guinea grass was less in first year due to establishment and it accelerated tremendously in subsequent years. Green and dry fodder yields were significantly influenced with intercropping and N management (Table 1). Under sole stand, BG-2 produced higher fodder yields than BG-1 and vice-versa in intercropping. However, intercrops (cowpea and berseem) performed better with BG-1 in terms of green and dry fodder yields. This could be ascribed to difference in the growth habit of varieties. BG-1 is erect while BG-2 is spreading type. Fodder yield of guinea grass was less in intercropping as compare to sole stand. This might be due to competitive effect of intercrops on guinea grass (Ram, 2009).
Application of 40 kg N/ha to guinea after each cut in double split produced significantly highest green and dry fodder yields followed by 40 kg N in single split. 30 kg N/ha in single split found at par with 40 kg N in single split. This might be due to reduced loss of nitrogen and extent supply and availability of applied N to plant for longer period under split application of nitrogenous fertilizer. Nitrogen application did not influence the fodder yields of cowpea and berseem in all the years.

Table 1. Effect of cropping system and nitrogen management on green and dry fodder yields of guinea grass and intercrops

Treatment	Green fodder yield (t/ha)					Dry fodder yield (t/ha)				
		Guinea		Cow-pea*	Ber-seem*		Guinea		Cow-pea*	Ber-seem*
	2010-11	2011-12	2012-13			2010-11	2011-12	2012-13		
Cropping system										
BG-1	25.6	76.1	98.2	-	-	6.0	18.6	24.9	-	-
BG-2	27.4	83.8	106.6	-	-	6.6	20.5	26.9	-	-
BG-1 + (C – B)	22.1	68.0	91.7	8.7	56.1	5.2	17.0	23.4	1.4	9.5
BG-2 + (C – B)	23.2	71.6	95.7	8.0	53.4	5.5	17.8	24.0	1.3	8.9
LSD (*P=0.05*)	1.24	2.39	3.05	0.54	2.61	0.30	0.99	1.12	0.09	0.52
N management										
40 kg in single split	24.7	74.9	98.3	8.3	54.9	5.8	18.3	24.9	1.3	9.2
40 kg in double split	26.1	78.3	101.8	8.6	56.0	6.2	19.3	26.4	1.4	9.4
30 kg in single split	23.4	71.8	94.8	8.1	53.5	5.5	17.7	23.6	1.3	9.0
30 kg in double split	24.0	74.4	97.3	8.3	54.6	5.9	18.7	24.5	1.3	9.2
LSD (*P=0.05*)	1.24	2.39	3.05	NS	NS	0.30	0.99	1.12	NS	NS

* Mean data of three years C- Cowpea; B-Berseem

Crude protein

Crude protein content was higher in BG-2 than BG-1 variety of guinea grass (Figure 1). Integration of forage legumes did not significantly influenced the crude protein content of guinea grass. Among N management treatments, maximum crude protein content was found with 40 kg N/ha in double split. This might be due to increased availability of nitrogen resulted to higher crude protein content.

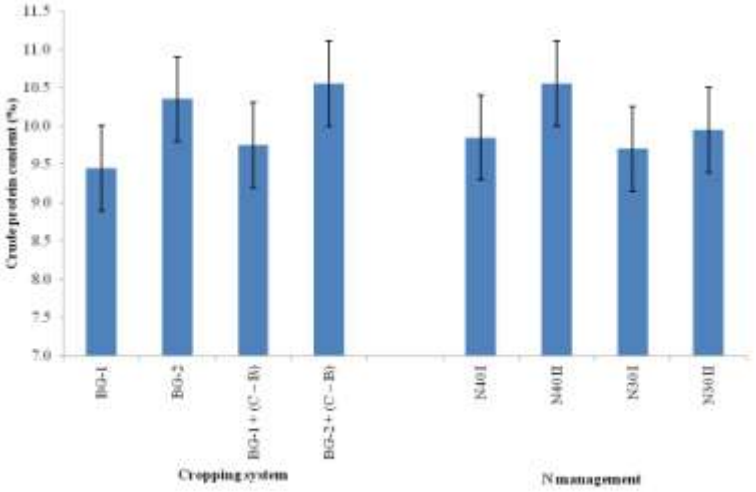

Figure 1. Effect of cropping system and nitrogen management on crude protein content of guinea grass (mean data of two years). Bars indicates LSD (P=0.05) values

Economics

In sole guinea grass negative net returns and B:C ratio were obtained in first year (Table 2). This was attributed to additional cost involved in planting of guinea grass and very low productivity in establishment year of grass. Thereafter gradual increase in net returns and B:C ratio was recorded. The highest net returns and B:C ratio was realized in intercropping of cowpea-berseem with guinea grass and was in accordance with results of Verma *et al.* (2011). Among N management, highest net returns and B: C ratio were achieved with the application of 40 kg N/ha in two split.

Table 2: Effect of cropping system and nitrogen management on economics

Treatment	Net returns (× 10^3 Rs/ha)			B:C ratio		
	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13
Cropping system						
BG-1	-17.5	37.4	53.8	-0.46	1.59	2.17
BG-2	-16.0	43.6	60.5	-0.42	1.85	2.44
BG-1 + (C– B)	28.0	66.6	80.3	0.47	1.33	1.48
BG-2 + (C– B)	25.4	66.0	80.1	0.42	1.32	1.48
N management						
40 kg N/ha in single split	39.3	84.2	99.0	0.80	2.29	2.51
40 kg N/ha in double split	41.8	87.6	102.3	0.85	2.34	2.55
30 kg N/ha in single split	37.3	80.1	95.0	0.76	2.22	2.45
30 kg N/ha in double split	39.0	82.9	97.7	0.79	2.25	2.47

Selling price of green fodder: Guinea Rs 800 /t; Cowpea/Berseem Rs 1000 /t C- Cowpea; B-Berseem

Conclusion

It can be concluded that integration of forage legume (cowpea-berseem) in guinea grass and application of 40 kg N/ha after each cut of guinea grass in double split holds great promise for increased fodder productivity and profitability.

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