Range Mgmt. & Agroforestry 34 (1) : 69-72, 2013
ISSN 0971-2070

Response of Guinea grass (*Panicum maximum*) to fertility levels and harvest intervals

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Received: 26th June, 2012 Accepted: 21st January, 2013

Abstract
A field experiment was conducted during 2006-2010 on sandy loam soil at Indian Grassland and Fodder Research Institute, Jhansi to find out the response of Guinea grass (*Panicum maximum*) to fertility levels and harvest intervals under semiarid rainfed conditions. Harvesting of Guinea grass at 60 days interval along with application of 80 kg N/ha in combination with 10 t FYM/ha recorded maximum dry forage yield (6.31, 11.59 and 8.17 t/ha) which were significantly higher as compared to 40 and 60 days harvest intervals + lower levels of fertility treatments. Dry forage yield of Guinea grass recorded during 1st, 2nd and 3rd years were 4.25, 8.61 and 5.22 t/ha, respectively. During second year 102.59 % increase in dry forage yield was recorded as compared to 1st year. During third year, 39.37 % decrease in yield was observed as compared to second year. Application of 80 kg N/ha recorded highest net return (Rs 9913 and 2399/ha) during 2nd and 3rd years respectively.

Key words: Fodder crops, Fertility levels, Forage, Harvest intervals, *Panicum maximum*

Introduction

Guinea grass (*Panicum maximum* Jacq.) is one of the important pasture species suitable for higher forage production from community lands, village grazing lands and marginal lands owned by the farmers. It is a high yielding perennial forage grass that performs well in 900 to 1500 mm rainfall range but can survive even when rainfall is less than 400 mm. It has profuse tillers, quick regeneration, high leaf-stem ratio and provides highly nutritious, digestible and palatable forage. It can be easily propagated both by seeds and vegetative means and performs well under shade of trees and in saline-sodic soils. Low productivity of Guinea grass under semiarid rainfed condition is mainly due to poor status of soil fertility and lack of cutting management. Harvesting of grasses at an appropriate growth stage resulted in higher green forage with acceptable dry matter content and nutrient, particularly protein (Ramamurthy and Vinod Shankar, 1998). Incorporation of farmyard manure in combination with inorganic fertilizer in grasses reduced the requirement of inorganic fertilizer and also maintained the productivity with soil health (Rai and Pahwa, 1996). Therefore, the present experiment was under taken to study the effect of fertility levels and harvest intervals on growth, productivity and economics of Guinea grass pasture under semiarid rainfed conditions.

Materials and Methods

A field experiment was conducted during 2006-2010 at Central Research Farm (25^0 27' N latitude, 78^0 37' E longitude and 275 m above mean sea level) of Indian Grassland and Fodder Research Institute, Jhansi to find out the response of Guinea grass pasture to fertility levels and harvest intervals under semiarid rainfed conditions. The soil of the experimental field was sandy loam, low in organic carbon (0.470) and available nitrogen (212.14 kg/ha) and medium in available phosphorus (10.16 kg/ha) and potash (157.42 kg/ha) in initial years. The total rainfall received was 553.8, 1267.1 and 544.9 mm in 38, 52 and 33 rainy days during 2007, 2008 and 2009 respectively. There were 18 treatment combinations replicated thrice in split plot design. The treatments comprised of two cutting intervals (40 and 60 days), three levels of farmyard manure (0, 5 and 10 t/ha) and three levels of nitrogen (0, 40 and 80 kg/ha). Cutting intervals and FYM were imposed in main plot and nitrogen in sub plots. At 40 days harvest interval, first cut was taken on 20th August while at 60 days harvest interval first cut was taken on 10th September. Total two cuts were taken at both the harvest intervals (40 and 60 days). Nitrogen was applied as per treatment and recommended dose of phosphorus (30 kg/ha) and potash 30 kg/ha was applied. 2/3rd amount of nitrogen and full amount of phosphorus and potash were applied as basal dose and remaining 1/3rd amount of nitrogen was applied just after first cut. The seedlings of Guinea grass (*var* Bundel Guinea grass 1) were transplanted on 12th July, 2006. Dry matter content was estimated by drying 500

g plant sample of each treatment and replication in hot-air oven at 70^{0}C, which led to computation of dry matter yield. The crude protein content of the fresh samples was estimated by the procedure of AOAC (1995).

Results and Discussion

Effect of harvest intervals: Harvesting of Guinea grass at 60 days interval recorded significantly more plant height (128.2, 174.4 and 162.6 cm), number of tillers/ plant (19.0, 30.5 and 24.6) and tussock diameter (11.2, 19.4 and 17.2 cm) as compared to 40 days harvest interval during first, second and third years respectively. Leaf stem ratios (0.93, 0.76 and 0.68) were increased significantly by harvesting of Guinea grass at 40 days interval as compared to 60 days interval (0.65, 0.58 and 0.52). Green forage (19.11, 33.52 and 21.02 t/ha), dry forage (5.27, 9.64 and 6.38 t/ha) and crude protein yields (253.9, 608.8 and 464.5 kg/ha) were also increased significantly when harvesting was done at 60 days interval than 40 days harvest interval. The higher yield with harvest at 60 days interval could be ascribed to optimum period available for the growth of Guinea grass under moisture stress-conditions. Protein contents in Guinea grass recorded at 40 and 60 days harvest intervals were 7.14, 7.00 and 6.82 and 6.72, 6.39 and 6.11 % during first, second and third years respectively. During second year, 90.84 per cent increase in green forage yield was recorded as compared to 1st year (16.81 t/ha). During 3rd year, 43.61 per cent decrease in green forage yield was observed as compared to second year (32.08 t/ha) due to low rainfall. During 1st year, net return obtained was less than establishment cost of the pasture. However, during 2nd year, maximum net return (Rs 8309/ha) and net return/ Rupee invested (0.81) were obtained by harvesting of Guinea grass at 40 days interval. This was due to good rainfall during 2nd year which resulted in higher yield at 40 days harvest interval. While during 3rd year, highest net return (Rs 2432/ha) and net return/ Rupee invested (0.28) were achieved by harvesting of Guinea grass at 60 days interval, because of yield obtained with 60 days harvest interval was more than 40 days harvest interval. Choubey *et al*., (1999) also reported highest net return and forage yield from perennial grass with 60 days harvest interval.

Effect of nitrogen levels: Application of 80 kg nitrogen/ ha recorded significantly better height (125.0, 173.8 and 162.5 cm), number of tillers/ plant (20.3, 31.2 and 25.5), tussock diameter (10.8, 18.5 and 18.3 cm) and leaf stem ratio (0.84, 0.69 and 0.64) as compared to control treatment (without nitrogen) during first, second and third years respectively. The difference between 80 and 40 kg nitrogen/ha was also found significant (Table 1). The green and dry forage yields of Guinea grass also differed significantly due to application of different levels of nitrogen. Increasing levels of nitrogen from control to 40 and further to 80 kg/ha significantly increased the green forage yield 33.68 and 8.19, 29.14 and 7.22 and 42.67 and 9.55 per cent and dry forage yield by 25.35 and 6.97, 31.12 and 7.47 and 48.29 and 8.85 per cent during first, second and third years respectively. The higher green and dry forage yields of Guinea grass were due to better growth attributes of Guinea grass with the application of nitrogen. Similar, result was also reported by Meera Bai *et al*. (1992) in congosignal grass. Net return (Rs 9913 and Rs 2399/ha) and net return/ Rupee invested (0.87 and 0.27) were also maximum when 80 kg nitrogen/ha was applied during second and third years respectively mainly due to higher forage yield.

Effect of farmyard manure: Plant height (123.5, 170.7 and 157.6 cm), number of tillers/ plant (19.8, 30.7 and 25.0), tussock diameter (10.7, 18.2 and 17.9 cm) and leaf stem ratio (0.83, 0.69 and 0.62) increased significantly with the application of 10 t FYM/ha as compared to control treatment and 5 t FYM/ha during first, second and third years respectively. Application of 5 t FYM/ha was also recorded significantly higher growth parameters of Guinea grass as compared to control treatment (Table 1). The green forage, dry forage and crude protein yields of Guinea grass increased significantly with successive increase in farmyard manure (Table 2). The application of 10 t FYM/ ha gave 34.52 and 8.12, 24.27 and 8.32 and 24.27 and 9.54 per cent higher green forage yield and 26.56 and 6.14, 24.02 and 8.00 and 32.58 and 9.94 per cent dry forage yield as compared to control and 5 t FYM/ha in first, second and third years respectively. The beneficial effects of organic manure in terms of sustained production could be related to the enhanced biological activities in the rhizosphere, improved soil structure and increased nutrient availability. Similar, result was also reported by Ramamurthy (2002) in napier bajra hybrid. Farmyard manure application resulted in slightly lower net return and net return/ Rupee invested as compared to control treatment because of cost incurred on FYM (Table 3).

Interaction effect: Harvesting of Guinea grass at 60 days interval along with application of 80 kg N/ha in combination with 10 t FYM/ha recorded maximum dry forage yield (6.31, 11.59 and 8.17 t/ha) which were significantly higher as compared to 40 and 60 days harvest intervals + lower levels of fertility treatments and at par with 60 days harvest

interval + 80 kg N + 5 t FYM and 40 kg N + 10 t FYM/ha during first, second and third year respectively (Table 4). Ramamurthy and Vinod Shankar (1998) also found higher forage yield of *Pennisetum* trispecific hybrid by harvesting at 75 days interval along with application of 75 kg nitrogen/ ha under semiarid rainfed condition. Dry forage yield of Guinea grass recorded during first, second and third years were 4.25, 8.61 and 5.22 t/ha, respectively. During second year, 102.59 % increase in dry forage yield was recorded as compared to 1st year. While during third year 39.37 % decrease in yield was observed as compared to second year. During 3rd year, rainfall was less than average; therefore, the yield obtained with shorter harvest interval (40 days) was less than longer harvest interval (60 days).

Conclusion

Harvesting of Guinea grass at 60 days interval along with application of 80 kg N in combination with 5 t FYM/ ha in sandy loam low fertile soil was found adequate for higher growth, productivity and monetary return under semiarid rainfed conditions.

Table 1. Effect of harvest intervals, farmyard manure and nitrogen levels on growth parameters of Guinea grass.

Treatment	Height (cm)			Tillers/ plant			T D (cm)			L:S		
	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3
Cutting intervals (days)												
40	102.0	145.3	130.4	15.6	26.2	22.1	8.6	14.4	15.4	0.93	0.76	0.68
60	128.2	174.4	162.6	19.0	30.5	24.6	11.2	19.4	17.2	0.65	0.58	0.52
CD (P=0.05)	5.8	6.40	7.6	1.4	1.8	1.2	0.6	0.88	0.98	0.02	0.01	0.01
Farmyard manure (t/ha)												
0	105.0	147.0	133.5	14.3	25.8	21.5	9.0	15.4	14.5	0.74	0.66	0.57
5	116.9	161.9	148.4	17.8	28.5	23.5	10.0	17.0	16.3	0.80	0.68	0.61
10	123.5	170.7	157.6	19.8	30.7	25.0	10.7	18.2	17.9	0.83	0.69	0.62
CD (P=0.05)	6.2	6.9	8.3	1.5	2.0	1.3	0.6	0.95	1.06	0.02	0.01	0.01
Nitrogen levels (kg/ha)												
0	101.8	139.9	124.4	13.0	24.6	20.4	8.6	14.7	13.8	0.71	0.65	0.55
40	118.5	165.8	152.5	18.6	29.3	24.1	10.3	17.4	16.8	0.82	0.68	0.61
80	125.0	173.8	162.5	20.3	31.2	25.5	10.8	18.5	18.3	0.84	0.69	0.64
CD (P=0.05)	6.2	6.9	8.3	1.5	2.0	1.3	0.6	0.95	1.06	0.02	0.01	0.01

Table 2. Effect of harvest intervals, farmyard manure and nitrogen levels on green forage and crude protein yield of Guinea grass.

Treatment	Green forage yield (t/ha)			Dry forage yield (t/ha)			Crude protein yield (kg/ha)		
	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3
Cutting intervals (days)									
40	14.50	30.64	15.15	3.23	7.58	4.06	230.2	525.03	274.35
60	19.11	33.52	21.02	5.27	9.64	6.38	353.9	608.78	464.47
CD (P=0.05)	1.16	1.56	1.06	0.24	0.41	0.30	16.82	32.00	21.46
Farmyard manure (t/ha)									
0	14.05	28.39	16.07	3.69	7.62	4.42	248.4	490.40	271.78
5	17.48	32.57	18.23	4.40	8.75	5.33	303.4	579.37	336.71
10	18.90	35.28	19.97	4.67	9.45	5.86	324.2	630.95	378.68
CD (P=0.05)	1.24	1.69	1.15	0.26	0.44	0.33	18.22	34.68	23.24
Nitrogen levels (kg/ha)									
0	13.33	26.18	15.04	3.55	6.94	3.81	237.9	439.77	230.01
40	17.82	33.81	18.75	4.45	9.10	5.65	306.7	601.02	355.93
80	19.28	36.25	20.54	4.76	9.78	6.15	331.6	659.94	401.22
CD (P=0.05)	1.24	1.69	1.15	0.26	0.44	0.33	18.22	34.68	23.24

Table 3. Effect of harvest intervals, farmyard manure and nitrogen levels on economics of Guinea grass

Treatment	Net return (Rs/ha)			Net return per Rupee invested		
	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3
Cutting intervals (days)						
40	-2234	8309	430	-0.19	0.81	0.07
60	-1144	7269	2432	-0.09	0.69	0.28
Farmyard manure (t/ha)						
0	-834	8549	2901	-0.10	1.01	0.39
5	-1300	7644	1524	-0.12	0.73	0.15
10	-2933	7175	-132	-0.21	0.51	-0.01
Nitrogen levels (kg/ha)						
0	-3291	5068	35	-0.29	0.53	0.05
40	-1090	8386	1859	-0.10	0.85	0.22
80	-686	9913	2399	-0.04	0.87	0.27

Table 4. Interaction effect of harvest intervals, farmyard manure and nitrogen levels on dry forage yield of Guinea grass (t/ha)

Treatments	Year 1			Year 2			Year 3		
Cutting intervals	Nitrogen levels (kg/ha)			Nitrogen levels (kg/ha)			Nitrogen levels (kg/ha)		
(days) and FYM (t/ha)	N_0	N_{40}	N_{80}	N_0	N_{40}	N_{80}	N_0	N_{40}	N_{80}
$C_{40}FYM_0$	2.33	2.77	3.29	5.58	6.75	7.55	2.33	3.63	4.22
$C_{40}FYM_5$	2.70	3.53	3.72	5.92	8.06	9.22	2.90	4.46	5.12
$C_{40}FYM_{10}$	2.99	3.82	3.92	6.30	9.37	9.47	3.39	5.20	5.32
$C_{60}FYM_0$	3.97	4.60	5.14	7.44	8.85	9.57	4.01	5.77	6.57
$C_{60}FYM_5$	4.49	5.81	6.15	7.86	10.12	11.30	4.77	6.88	7.82
$C_{60}FYM_{10}$	4.83	6.15	6.31	8.51	11.47	11.59	5.47	7.97	8.17
CD (P=0.05)		0.60				1.02		0.75	

Acknowledgements

We gratefully acknowledge the support, encouragement and facilities provided by Director, Indian Grassland and Fodder Research Institute, Jhansi for carrying out the experiments.

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