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PRODUCTIVITY, ECONOMICS AND QUALITY OF FODDER SORGHUM UNDER VARYING LEVELS OF NITROGEN AND PHOSPHORUS

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ABSTRACT

A field experiment was undertaken at Udaipur (Rajasthan) to study the effect of nitrogen and phosphorus levels on the productivity, quality and economics of forage sorghum. Results showed that application of 80 kg N ha^{-1} increased significantly dry matter accumulation at 60 DAS and harvest, plant height, leaf weight per plant, green and dry fodder yield and crude fibre content over control. The magnitude of increases in fodder yield, net returns and B/C ratio, crude protein, crude fat and N and P uptake were of the order of 28.2, 53.9, 30.9, 17.4, 3.5, 90.2, and 85.2 % over control, respectively. Application of 40 kg P_2O_5 ha^{-1}gave significantly lesser days to bloom, higher dry matter accumulation at 60 DAS and harvest, plant height at harvest, number of green and total leaves and leaf weight per plant, green and dry fodder yield, economics and uptake of nutrients over control and 20 kg P_2O_5 ha^{-1}. Application of 40 kg$P_2O_5ha^{-1}$ recorded 9.9, 7.0, 17.3, 11.2 and 14.7 % higher dry matter accumulation at harvest, plant height, leaf weight per plant, green and dry fodder yield over control. Combined application of 120 kg N and 60 kg P_2O_5 ha^{-1} recorded maximum protein content and 120 kg N and 40 kg P_2O_5 ha^{-1} recoded maximum crude fibre content.
Key words: Nitrogen, phosphorus, nutrient uptake, economics, fodder sorghum

INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the fourth important food grain crops of world. The quick spreading of high yielding genotypes changed the scenario of sorghum production in India. Sorghum is a nutrient exhaustive crop and the importance of nitrogen and phosphorus in its nutrition is well documented. Sorghum contains high biomass in terms of green and dry fodder yield and plays an important role to meet out the huge demand of fodder. Nitrogen and phosphorus have been considered as the most important plant nutrients for enhancing plant growth and development. Nitrogen increases leafiness, crude protein, crude fat and mineral matter contents and their production, but decreases nitrogen free extract and nutritive ratio. While, phosphorus decreases nitrates and HCN contents, but increases protein and fat contents .Thus, proper nutrition is very important to get higher fodder yield. Hence, the present study was undertaken to evaluate the yield and quality of single cut fodder sorghum cv HC 308 under varying nitrogen and phosphorus levels.

MATERIALS AND METHODS

A field investigation was carried out during the *kharif* 2004 at the Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur. The soil of experimental site was clay loam in texture having slightly alkaline pH (7.8) in reaction, organic carbon (5.40 g kg^{-1}), available nitrogen 287.90 kg ha^{-1}, available phosphorus 20.80 kg ha^{-1} and available potassium 341.50 kg ha^{-1}. The experiment consisted of 4 levels each of nitrogen (0, 40, 80 and 120 kg N ha^{-1}) and phosphorus (0, 20, 40 and 60 kg P_2O_5 ha^{-1}) tested in a randomized block design with three replications. Fodder sorghum HC 308 was sown on 7 July 2004 at 30 x 8-10 cm row and plant to plant spacing with a seed rate of about 30 kg ha^{-1}. Half dose of nitrogen and full dose of phosphorus was applied as per treatments at sowing time and rest of the nitrogen was top dressed at 30 days after sowing the crop. Phosphorus was supplied through single superphosphate. The crop received 570 mm rain fall during crop season. Crop was harvested 2-3 days after flowering on 24 September, 2004. Plant height, dry matter accumulation per plant, number og green and dry leaves were recorded at 60 days after sowing. Crop was harvested at 75 DAS and green fodder yield was recorded. The plants samples collected at harvest were analysed for nitrogen by modified Kjeldahl method. Crude protein content was calculated by multiplying the nitrogen percentage with 6.25. Crude fiber content was determined as per method described by Wright (1939). Crude fat was determined by Soxhlet using petroleum ether as an extractant.

RESULTS AND DISCUSSION

Effect of nitrogen: Data (Table 1) indicate that all the growth parameters viz., dry matter accumulation

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plant^{-1} (60 DAS and harvest) and plant height at harvest were significantly influenced by nitrogen. Application of 80 kg N ha^{-1} recorded 42.7, 32.1 and 7.2% higher dry matter accumulation at 60 DAS and at harvest and plant height over control. The enhanced availability of nitrogen favoured the rate of photosynthesis and consequently led to better plant growth. Significant improvement in number of green as well as total leaves and their weight per plant, green as well as dry fodder yield, net returns and B/C ratio was recorded with 80 kg N ha^{-1}. But 80 kg N ha^{-1} was found at par with 120 kg N ha in respect of these parameters. The magnitude of increases with 80 kg N ha^{-1} were 50.0, 28.2, 53.9 and 13.3 % in leaf weight, green and dry fodder yield, net returns and B/C ratio over control. Crude protein, crude fibre and crude fat concentrations were significantly influenced by nitrogen application. Improvement in various yield attributing characters, fodder yield and monetary returns due to N fertilization is in close conformity with the findings of Muhammad *et al.* (2007) and Sumeriya (2009).

Table 1: Effect of nitrogen and phosphorus on growth, yield and economics of forage sorghum

Treatments	Days to 50 % flowering	DMA at 60 DAS (g/plant)	DMA at harvest (g/plant)	Plant height (cm)	Leaves /plant		Fodder yield (q ha^{-1})		Net returns (Rs ha^{-1})	B/C ratio
					Green	Total	green	dry		
Nitrogen (kg ha^{-1})										
0	70.4	124.5	138.0	249.4	9.12	10.21	349.28	119.44	25901	4.680
40	69.0	145.2	161.9	255.4	9.88	10.88	403.30	147.92	30331	5.045
80	68.4	177.7	182.2	267.3	10.29	11.62	447.70	183.83	33896	5.308
120	67.7	183.4	194.5	267.9	11.04	12.54	442.52	181.74	32999	4.881
CD (P=0.05)	0.46	10.12	14.18	4.34	0.54	0.43	14.04	5.01	1009.0	0.16
Phosphorus (kg ha^{-1})										
0	69.5	147.0	158.0	250.0	9.00	10.33	385.17	145.29	29018	5.039
20	68.9	153.2	166.6	257.5	10.25	11.42	402.56	153.77	30227	5.058
40	68.8	161.1	173.5	267.6	10.42	11.58	428.46	166.64	32202	5.129
60	68.4	169.4	178.5	264.6	10.61	11.92	426.61	167.24	31679	4.691
CD (P=0.05)	0.46	10.12	14.18	4.34	0.54	0.43	14.04	5.01	1009.0	0.16

Effect of phosphorus: Data in Table 1 indicated that application of 40 kg P_20_5 ha^{-1} recorded significantly higher dry matter accumulation plant^{-1} at 60 DAS and harvest, plant height over control. However, application of 60 kg P_20_5 ha-^{1} was found at par with. 40 kg P_20_5 ha-^{1} in respect of these attributes. Application of 60 kg P_20_5 ha^{-1} recorded 9.6, 9.8 and 7.0 % higher dry matter at 60 DAS and at harvest and plant height, respectively over control. Increase in phosphorus levels tended to increase the number of green and total leaves and their weight per plant, green as well as dry fodder yields, net returns and B/C ratio and 40 kg P_2O_5 ha^{-1} addition resulted 17.3% increase in leaf weight, 11.2% in grain yield, 14.7% in fodder yield, 11.0% in net returns and 1.8% in B/C ratio over control. Data further reported that application of 60 kg P_2O_5 ha^{-1} recorded minimum crude protein and crude fat content and found significantly higher over control. These results confirm the findings of Singh *et al.* (2009), Sumeriya (2009) and Sumeriya (2010).

Interaction

The combined application of 120 kg N + 60 kg P_2O_5 ha^{-1} resulted in maximum protein content over rest of the combinations of phosphorus and nitrogen (Table 3). While, use of 40 and 60 kg P_2O_5 ha^{-1} combined with 80 and 120 kg N ha^{-1} gave protein content at par with 40 kg N + 40 kg P_2O_5 ha^{-1}. The lowest value of protein content was recorded under no nitrogen and no phosphorus treatment.

Table 2: Effect of nitrogen and phosphorus levels on quality parameters of forage sorghum

Treatments	Crude protein (%)	Crude fibre (%)	Crude fat (%)
Nitrogen (kg ha^{-1})			
0	5.45	33.14	1.701
40	6.27	32.25	1.73
80	6.80	31.83	1.76
120	7.23	31.52	1.77
CD (p=0.05)	0.24	0.23	0.05
Phosphorus (kg ha^{-1})			
0	5.21	33.41	1.69
20	6.31	32.73	1.73
40	6.98	31.52	1.76
60	7.25	31.08	1.78
CD (p=0.05)	0.24	0.23	0.05

Table 3: Combined effect of nitrogen and phosphorus on quality of sorghum

Phosphorus (kg ha^{-1})	Nitrogen (kgha^{-1})			
	0	40	80	120
Nitrogen content (%)				
0	0.73	0.80	0.83	0.93
20	0.83	0.90	1.13	1.20
40	0.87	1.20	1.17	1.23
60	1.07	1.13	1.20	1.27
CD (P=0.05)	0.08			
Protein content (%)				
0	4.56	5.00	5.19	5.81
20	5.19	5.63	7.06	7.50
40	5.44	7.50	7.31	7.69
60	6.69	7.06	7.50	7.94
CD (P=0.05)	0.50			
Protein yield (kg ha^{-1})				
0	513.3	647.9	903.0	1007.2
20	603.4	793.0	1296.9	1284.0
40	665.6	1160.0	1421.7	1500.2
60	836.7	1661.1	1409.2	1491.37
CD (P=0.05)	114.4			
Crude fibre content (%)				
0	34.30	33.37	33.03	32.93
20	33.57	32.90	32.50	31.93
40	32.97	31.43	31.03	30.63
60	31.73	31.30	30.73	30.53
CD (P=0.05)	0.46			

Application of 40 kg N + 60 kg P_2O_5 ha^{-1} produced significantly higher protein yield over rest of the N and P combinations and it was 223.60 per cent higher over absolute control. Application of 80 kg N alongwith 40 kg and 60 kg P_2O_5 ha^{-1} were the next best combinations for protein production and proved significantly superior over rest of the combinations of fertilizers and produced 176.93 and 174.52 % higher protein yield over absolute control.

Data (Table 3) revealed that application of 80 kg N + 60 kg P_2O_5 ha^{-1} produced significantly minimum crude fibre content. This was found at par with 80 kg N + 40 kg P_2O_5, 120 kg N + 40 kg P_2O_5 and 120 kg N + 60 kg P_2O_5 ha^{-1} in respect of crude fibre content. The lowest amount (34.30%) was recorded under no nitrogen and no phosphorus treatment.

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