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Growth Characters, Fodder Yield, Quality and Economics of Pearl Millet (*Pennisetum americanum* L.) Genotype as Influenced by Nitrogen Levels

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ABSTRACT

A field experiment was conducted at Agricultural Research station, Bikaner during Kharif season 2015 to study the "Growth characters, fodder yield, quality and economics of pearl millet genotype as influenced by nitrogen levels". Treatments comprising four pearl millet genotypes (PM A2-1, PM A2-2, PM A2-3, PM A2-4) and four nitrogen levels (0, 30, 60 and 90 kg/ha) were laid out in factorial randomized block design with three replication. The growth and fodder yield of pearl millet genotypes were influenced significantly with different nitrogen levels. The genotype Pm2-1 & Pm2-2 significantly show their superiority in plant stand, plant height and tillers compared to Pm2-3 &Pm2-4 and maximum green fodder yield, (689.5q/ha), net returns (Rs 68840/ha) and B: C ratio (1.97) was recorded with PM2-3 closely followed by Pm2-2. The dry matter yield (DMY) and crude protein content (%) was the highest in PM2-4, while fodder productivity was noted the maximum (10.98 q/ha/day) in PM2-2. Among nitrogen levels application of 60 kg N/ha significantly increase green fodder yield (GFY), dry matter yield (DMY), fodder productivity, net returns and B:C ratio. The application of 60 kg N/ha produced 61.32, 18.75 and 8.19 per cent higher green fodder yield and 32.36, 13.61, 4.30 per cent higher dry matter yield over 0, 30 and 90 kg N/ha respectively.

Key words: *Nitrogen, Genotype, Green fodder yield, Crude protein, Fodder productivity.*

INTRODUCTION

Pearl millet (*Pennisetum americanum* L.) is erect, leafy and drought resistant plant, widely used for grain production in arid and semi-arid regions of India. In Rajasthan, pearl millet is one of the most important kharif season cereal crops. Moreover, the stover (karbi) is major source of fodder for animal particularly in winter season. Pearl millet as fodder crop has some additional advantages over sorghum and maize because of firstly, the green fodder of pearl millet has high crude protein content (9.9 to 14 %) and secondly, its green fodder can be safely fed to cattle at all stages of growth because of absence of hydrocyanic acid. It is nutritious and palatable and can be fed as green, dry or as conserved fodder in the form of silage or hay. The more tillers production capacity, rapid growth rate and higher crude protein (CP) contents and short growth period make the pearl millet as strong cereal for fodder purpose[4].

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Efficient fertilizer management plays important role in increasing the crop yield through efficient utilization of limited moisture /water supply. The soils of these areas are deficient in various nutrient elements in general and nitrogen in particular. It is, therefore, imperative to have better understanding of growth, yield and fodder quality of this crop in relation to nitrogen for promoting its adoption by farmers of these regions. Though nitrogen management of pearl millet cultivars has been studied by various researchers[9,13].

Nitrogen is an essential nutrient for plant growth and development. Nitrogen is a very important constituent of cellular components. Alkaloids, amides, amino acids, proteins, DNA, RNA, enzymes, vitamins, hormones and many other cellular compounds contain nitrogen as one of the elements. An adequate supply of nitrogen is associated with vigorous vegetative growth and deep green colour. Also Nitrogen is an integral part of chlorophyll ($C_{35}H_{72}O_5N_4Mg$) and to improve the yield and quality of forage pearl millet. Judicious and appropriate use of fertilizer not only increases yield but also improves quality of forage especially protein contents[2]. Generally, pearl millet has been known for growing under low N management[5] but, several studies showed that N application can increase millet production efficiency[14]. Pearl millet, being a cereal crop, responds well to nitrogen because nitrogen is one of the basic plant nutrients for profuse growth. Information on the relative performance of pearl millet genotypes for high forage production at different nitrogen levels is meagre therefore; the present study was carried out.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif* season 2015 on sandy loam soil at Agricultural Research station, Bikaner and sowing was done on 1st July, 2015 allocating four pearl millet genotypes (PM A2-1, PM A2-2, PM A2-3, PM A2-4) and four nitrogen levels (0, 30, 60 and 90 kg/ha), thus total sixteen treatment combinations in FRBD and replicated thrice. The experimental field soil was poor in fertility status, sandy loam in texture and saline in reaction. Nitrogen fertilizer was applied in three splits *i.e*. one-third dose (as per treatment). The remaining two-third dose of nitrogen was top dressed in two splits equally i.e., *first* at 25 DAS and rest dose after about one week of first cutting (50 DAS) with sprinkler irrigation. Observations for growth characters *viz*., number of plants/m^2, plant height, number of tillers/plant, number of leaves/plant, leaf: stem ratio and fodder yield were recorded at final harvest (full bloom) of pearl millet i.e., 55 DAS in Pm2-1, Pm2-2 and 70 DAS in Pm2-3 &Pm2-4. The forage nutritive value was analyzed in term of crude protein (CP) using standard method[1] (A.O.A.C, 1990). The sub sample of dry matter was well grind and passed through 0.5 mm sieve and was preserved for chemical analysis. For CP, the nitrogen contents of feed sample was determined by Kjeldahl Method and the value recorded for nitrogen was then multiplied with 6.25[7] (Jones, 1931) to determine CP of the sample. Total rainfall of 386.6 mm received in 18 rainy days, two irrigations was given because long dry spell after sowing and early with drawl of monsoon from the second fortnight of August. The data was subjected to statistical analysis to determine the significance using F test (ANOVA).

RESULTS AND DISCUSSION

Genotypes

The growth and fodder yield of pearl millet were influenced significantly with genotypes (Tables 1). The results showed that the maximum number of plants/M^2 (38) was recorded in Pm2-1 & Pm2-2 both being at par and were significantly higher compared to Pm2-3 &Pm2-4 (31). Further, number of tiller/ plant and plant height significantly differ due to genotypes. The pearl millet genotypes Pm2-1 and Pm2-2 registered their superiority in tiller and plant height both over Pm2-3 & Pm2-4. Number of leaves / plant and L:S ratio did not vary due to different pearl millet genotypes (Table-1 Pm). The crude protein

(%) was also influenced significantly by different genotypes. The highest crude protein content (8.53%) and crude protein yield was recorded in Pm2-4. This may be due to higher dry matter yield of Pm2-4.

The maximum green fodder yield (689.5q / ha), net returns (Rs 68840 / ha) and B: C ratio (1.97) was recorded with PM2-3 closely followed by Pm2-2 and these were significantly higher by 39.6&22.3, 48.8&27.4 and 19.4 & 10.0 per cent over PM2-1 and PM2-4, respectively. The dry matter yield (DMY) was the highest in PM2-4(109.08 q/ha) while per day fodder productivity was noted the maximum (10.98 q/ha/day) in PM2-2 and both these significantly higher over rest genotypes (Table-2 Pm). This was due to the superiority of the genotype to produce more values of growth characters like plant height and number of tillers. Similar results were also reported by Singh *et al*[12].

Nitrogen

Data (Table-1) show that increasing nitrogen level up to 60 kg/ha significantly increased plant stand but further increase in N dose to 90 kg/ha result in significant reduction over preceding dose but was found at par with 30 kg N/ha and registered statistical superiority over control. Growth characters *viz*, number of tillers/plant leaves/plant and plant height increased with increasing N levels up to 90 kg/ha. But L: s ratio remains unaffected due to nitrogen levels, though the highest value (0.80) was noted with 60 kg N /ha dose significantly increased. The crude protein (%) was also significantly increased with increasing nitrogen level up to 60 kg/ha which was at par with nitrogen level of 90 kg/ha. Further, increasing N fertilization in fodder pearl millet increased the availability of nitrogen in the rhizosphere and since nitrogen is main constituent of amino acids, it ultimately increased crude protein contents of plants. Nitrogen has essential functions in plant life *viz.*, its role in rapid multiplication of tissues and increase in amount of growth substances such as naturally occurring phyto-harmone, photosynthesis rate, increase level of auxin supply with higher level of nitrogen might have brought about a significant increase in plant height, and number of tillers per plant, number of leaves per plant and leaf: stem ratio in the present investigation. Gasim[6] also indicated that increase in plant height with nitrogen fertilizer is due to the fact that nitrogen promotes number of internodes and increase length of the internodes which results in progressive increase in plant height. Further, he reported that the increase in leaf to stem ratio with nitrogen application is probably due to the increase in number of leaves and leaf area under nitrogen treatments, producing more and heavy leaves. The result of present investigation is also in conformity with the finding of research work done by Meena *et al*[8]., Ratan and Singh[11] and Pathan *et al*[10].

Data presented in Table-2 reveal that green fodder yield (GFY), dry matter yield (DMY), fodder productivity, net returns and B:C ratio improved significantly by increasing N dose up to 60 kg/ha. However, further increase in N dose to 90 kg/ha showed declining trend in above cited yield and economical parameters over preceding dose but significantly superiority over 30 kg N /ha (except GFY and B:C ratio) and control. The application of 60 kg N/ha produced 61.32, 18.75 and 8.19 per cent higher green fodder yield and 32.36, 13.61, 4.30 per cent higher dry matter yield over 0, 30 and 90 kg N/ha respectively. The vegetative growth of plant was positively correlated for higher forage yield and dry matter accumulation. Similar results were also reported by Singh *et al*[12]., and Bhilare *et al*[3].

Interaction (Genotype X Nitrogen)

Interaction data related to plant stand, GFY, DMY, fodder productivity and net returns are given in Table-3 and Table-4. The highest values of all these parameters were recorded in PM2-2 and Pm2-3 with 60 kg n/ha dose, closely at par to one another which were significantly higher over rest treatments. Almost similar net returns (79580 and 59700 Rs / ha) were accrued under these treatment combinations.

Table 1: Effect of Pearl millet genotype and nitrogen on plant stand, growth characters and fodder quality

Treatment	Plants/m^2 (No)	Tillers/plant (No)	Leaves/plant (No)	L:S ratio	Plant height (cm)	Crude protein (%)	Crude protein yield (q/ha)
Genotypes							
PM A2-1	37.68	6.75	11.67	0.57	193.3	7.58	6.05
PM A2-2	38.23	6.83	11.33	0.59	199.7	7.08	6.75
PM A2-3	31.04	6.25	11.50	0.96	183.3	7.54	7.30
PM A2-4	31.83	5.75	11.92	0.88	180.5	8.53	9.37
SEm±	0.34	0.32	0.35	0.04	3.44	0.22	0.26
CD at 5%	0.99	0.94	NS	NS	9.94	0.63	0.74
Nitrogen							
No	32.44	5.08	10.75	0.76	165.3	6.30	5.04
N30	34.92	6.33	11.33	0.71	194.1	7.51	6.98
N60	36.79	6.67	11.92	0.80	198.8	8.47	8.88
N90	34.63	7.50	12.42	0.75	198.7	8.46	8.56
SEm±	0.34	0.32	0.35	0.04	3.44	0.22	0.26
CD at 5%	0.99	0.94	1.01	NS	9.94	0.22	0.74
VXN	Sig.	-	-	-	-	-	-

Table 2: Effect of Pearl millet genotype and nitrogen on fodder yields and economics

Treatment	GFY (q/ha)	DMY (q/ha)	Fodder productivity (q/ha/day)	Net returns (Rs/ha)	B:C ratio
Variety					
PM A2-1	493.9	78.75	8.98	46270	1.65
PM A2-2	603.8	94.00	10.98	58950	1.82
PM A2-3	689.5	95.58	9.85	68840	1.97
PM A2-4	573.3	109.08	8.19	54500	1.71
SEm±	10.67	2.05	0.17	1601	0.05
CD at 5%	30.83	5.92	0.48	4624	0.15
Nitrogen					
No	432.1	79.33	6.93	38175	1.42
N30	587.0	92.42	9.37	56765	1.80
N60	697.1	105.00	11.29	69975	2.01
N90	644.3	100.67	10.41	63645	1.92
SEm±	10.67	2.05	0.17	1601	0.05
CD at 5%	30.83	5.92	0.48	4624	0.15
VXN	Sig.	Sig.	Sig.	Sig.	-

Table 3: Pearl millet genotype and nitrogen on interactions effect for plant stand and yield parameters

Plants/m2 (No)						Dry matter yield (q/ha)				
Treatment	**N_0**	**N_{30}**	**N_{60}**	**N_{90}**		Treatment	**N_0**	**N_{30}**	**N_{60}**	**N_{90}**
PM A2-1	36.67	38.00	38.53	37.50		**PM A2-1**	69.67	73.33	87.33	84.67
PM A2-2	36.27	38.33	39.30	39.00		**PM A2-2**	67.00	98.33	111.00	99.67
PM A2-3	28.83	31.67	33.33	30.33		**PM A2-3**	80.00	94.00	107.00	101.33
PM A2-4	28.00	31.67	36.00	31.67		**PM A2-4**	100.67	104.00	114.67	117.00
	SEm±	0.68					SEm±	4.10		
	CD at 5%	1.97					CD at5%	11.85		
Green Fodder Yield (q/ha)						Fodder productivity (q/ha/day)				
Treatment	**N_0**	**N_{30}**	**N_{60}**	**N_{90}**		Treatment	**N_0**	**N_{30}**	**N_{60}**	**N_{90}**
PM A2-1	398.33	458.00	591.00	528.33		**PM A2-1**	7.24	8.33	10.75	9.61
PM A2-2	377.00	556.00	775.67	706.33		**PM A2-2**	6.85	10.11	14.10	12.84
PM A2-3	520.67	736.67	780.00	720.67		**PM A2-3**	7.44	10.52	11.14	10.30
PM A2-4	432.33	597.33	641.67	622.00		**PM A2-4**	6.18	8.53	9.17	8.89
	SEm±	21.35					SEm±	0.34		
	CD at 5%	61.65					CD at 5%	0.97		

Table 4: Pearl millet genotype and nitrogen interaction effect on net returns

Net returns (Rs/ha)				
Treatment	**N_0**	**N_{30}**	**N_{60}**	**N_{90}**
PM A2-1	34800	41960	57920	50400
PM A2-2	31740	53220	79580	71260
PM A2-3	48580	74500	79700	72580
PM A2-4	37580	57380	62700	60340
	S.EM±	3202.0		
	CD at 5%	9248.0		

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