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Effect of nitrogen on growth, yield and quality of fodder pearl millet (*Pennisetum glaucum*) cultivars under irrigated condition of North-Western Rajasthan

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In India, the requirement of green fodder was 611.99 Mt against the availability of only 224.08 Mt (Anonymous. 2006). It reflects a wide gap between demand and supply because the regional deficit are more important than the national deficit especially for forages which account only 3.4 m ha and 9.3 m ha area of total cultivable land is utilized for forage production in 1999 in Rajasthan and India, respectively (GOI, 2004). This is because of increasing pressure of human population on land in the country as a result of which top priority is given to only grain crops, preferential use of low-capability land for forages and multiplication ratio is very narrow in most of fodders. The efficiency of milch as well as drought animals largely depends upon the supply of quantity and quality of ration in which green fodder plays a vital role. In the recent years shortage of fodder has remained the burning problem, which calls for the attention of researchers to initiate efforts that can ensure regular fodder supply for development of dairy farming and improvement of the cattle wealth. These are following objectives of study

i. To study the effect of nitrogen on growth, yield and quality of fodder pearl millet cultivars

ii. To identify suitable cultivar of fodder pearl millet

iii. To find out optimum dose of nitrogen for fodder pearl millet

The field experiment was conducted at the Agronomy farm, College of Agriculture, Bikaner during the *kharif* season of 2007. The farm situated at 28.01°N latitude and 73.22°E longitude at an altitude of 234.70 metres above mean sea level. Bikaner falls under Agro-ecological region No. 2 under arid ecosystem (Hot Arid Eco-region with desert and Saline soil). PET in this region ranges between 1500-2000 mm. Bikaner has arid climate and annual rainfall ranges between 200 to 300 mm.

During summers the maximum temperature may go as high as 48°C, while in the winters it may fall as low as 0°C. The periodical mean weekly weather parameters for the period of the experimentation recorded from the meteorological observatory show that lowest and highest maximum temperature of 35.4°C and 39.2°C were recorded in the 39th and 29th standard meteorological week, respectively. Likewise values of minimum temperature (22°C & 27.8°C) were recorded in the 39th and 29th standard meteorological weeks, respectively during the crop growing period. The experimental field was loamy sand in texture, slightly alkaline in reaction (pH 8.36), poor in organic carbon (0.07%), low in available nitrogen (88.25 kg/ha) and medium in P_2O_5 (23.80 kg/ha) and K_2O (169.0 kg/ha). The experiment was laid out in split plot design with three replications assigning twenty treatments consisting of four varieties viz., "Rajasthan Bajra chari-2", "Pusa Bajra-266", "Raj-171" and "Giant Bajra" in main plots and five levels of nitrogen viz., control, 40, 80, 120 and 160 kg/ha in subplots. The seed of different varieties of fodder pearl millet were sown @ 10 kg/ha in lines spaced at 30 cm on 17 July, 2007 by "*kera*" method in open furrows.

Table 1. Effect of varieties and nitrogen levels on growth parameters and yield of fodder pearl millet cultivars

Treatments	Plant height (cm)	Dry matter (g/plant)	Tillers/ plant	Yield (t /ha)	
				Green fodder	Dry fodder
Varieties					
"Rajasthan Bajra chari-2"	178.9	32.0	5.4	39.79	10.07
"Pusa Bajra - 266"	131.6	18.6	3.7	29.44	5.53
"Raj-171"	144.4	21.7	4.1	33.03	6.94
"Giant Bajra"	160.2	26.1	4.8	36.43	8.10
SEm ±	3.66	0.99	0.08	0.767	0.20
CD (P=0.05)	12.7	3.44	0.27	2.65	0.66
Nitrogen level (kg/ha)					
0	134.0	13.6	4.0	29.16	6.68
40	145.3	20.3	4.3	32.09	7.26
80	155.8	25.9	4.6	35.17	7.75
120	165.9	30.7	4.8	37.92	8.22
160	168.0	33.2	4.9	39.01	8.38
SEm ±	3.23	1.09	0.08	0.869	0.161
CD (P=0.05)	9.32	3.13	0.24	2.5	0.465

Plant height and dry matter accumulation at different growth stages was significantly higher in "Rajasthan Bajra chari-2" than other varieties. This may be due to inherent genetic character of variety. These findings are in concurrence with AICRP-Forage Crops (2006). Application of nitrogen @ 120 kg/ha which was statistically at par with the 160 kg N/ ha significantly increased plant height and dry matter accumulation at different growth stages over control, 40 and 80 kg N/ha. It might be due to that nitrogen has in plant life, its role in rapid multiplication of tissues and increase in amount of growth substances such as naturally occurring photo hormones, photosynthesis rate, increase in auxin supply and with higher level of nitrogen might have brought about a significant increase in plant height, dry matter accumulation and number of tillers per plant. The response of nitrogen fertilization in terms of improved growth is further supported by the fact that the soil of experiment field was low in available nitrogen (90.25 kg/ha). As a principle, a soil deficient in plant nutrient improves crop growth when supplied with a particular nutrient in question. These results are in conformity with those of Babu *et al.* (1995). "Rajasthan Bajra chari-2" also produced significantly higher number of tillers per plant than other varieties. In case of nitrogen @ 120 kg/ha which was at par with 160 kg N/ha, significantly increased number of tillers per plant over control, 40 and 80 kg N/ha.

Dry matter accumulation was significantly higher in "Rajasthan Bajra chari-2" than other varieties. Application of nitrogen @ 120 kg/ha was statistically at par with 160 kg N/ha, significantly increased dry matter accumulation over control, 40 and 80 kg N/ha at all growth stages.

Green and dry fodder yield were significantly higher in "Rajasthan Bajra chari-2" than "Pusa Bajra-266", "Raj-171" and "Giant Bajra". Application of nitrogen @ 120 kg/ha significantly increased green and dry fodder yields of pearl millet over control, 40 and 80 kg N/ha which was at par with 160 kg N/ha. The fodder yield, being a function of the cumulative effect of growth parameters such as plant height, number of tillers per plant and dry matter accumulation per plant which were higher with 120 kg N/ha, resulting in higher forage yield under this treatment. The increase in fodder yield with increasing level of nitrogen could also be explained by better nutritional condition of the crop as supported by higher nitrogen uptake when fertilized with 120 kg N/ha. More uptake of nutrients by application of nitrogen probably favored better growth and development of crops, resulting into increased fodder yield. These findings corroborate the results of Tiwana *et al.* (2004) and Hooda *et al.* (2004) who found a significant increase in fodder yield with increased levels of nitrogen.

"Rajasthan Bajra chari-2" not only produced maximum yield of pearl millet fodder but also good quality of fodder than other varieties. Crude protein content (%) in dry fodder of variety "Rajasthan Bajra chari-2" was significantly higher than other varieties. This might be due to that higher nitrogen content in this variety. Nitrogen is an integral part of protein as a result higher crude protein found in dry fodder of "Rajasthan Bajra chari-2" than other varieties. The similar results were also obtained by AICRP-Forage Crops (2006) who reported significantly higher crude protein in variety "Rajasthan Bajra chari-2" than rest of varieties. The results are also in agreement with those obtained by AICRP-Forage Crops (2005). "Rajasthan Bajra chari-2" contains significantly higher ether extract (6.73%), mineral matter (12.58%) and significantly lower crude fibre (24.50%) as well as nitrogen free extract (44.74%) proving its better palatability and acceptability for animals as compared to other varieties. This may be due to inherent genetic characters of varieties and higher content of nitrogen which is the major constituent of amino acids and protein (Randawa *et al.* 1989) and decreased the pectin, cellulose, hemicellulose and proportion of carbohydrates and hence decreased crude fibre and nitrogen free extract. These findings are in accordance to the findings of Babu *et al.* (1995), Jakhar *et al.* (2003), Tiwana and Puri (2005). In case of nitrogen @ 120 kg/ha was at par with 160 kg N/ ha, significantly increased crude protein content over control, 40 and 80 kg N/ha.

Table 2. Effect of varieties and nitrogen levels on different quality parameters in fodder pearl millet

Treatments	Crude protein (%)	Ether extract (%)	Crude fibre (%)	Ash (%)	Nitrogen free extract (%)	Total digestible nutrient (%)
Varieties						
"Rajasthan Bajra chari-2"	11.4	6.7	24.5	12.6	44.74	62.8
"Pusa Bajra - 266"	8.6	5.5	28.8	8.0	49.09	64.8
"Raj-171"	9.6	5.9	26.7	9.6	48.2	64.2
"Giant Bajra"	10.5	6.3	27.5	10.7	45.02	63.6
SEm ±	0.22	0.09	0.15	0.18	0.379	0.13
CD (P=0.05)	0.77	0.31	0.51	0.61	1.31	0.46
Nitrogen level (kg/ha)						
0	8.3	5.5	29.3	7.5	49.4	65.1
40	9.2	5.8	27.8	9.1	48.0	64.3
80	10.3	6.2	26.5	10.5	46.4	63.7
120	11.1	6.5	25.4	11.8	45.1	63.1
160	11.3	6.6	25.2	12.1	44.8	62.9
SEm ±	0.21	0.08	0.23	0.34	0.44	0.27
CD (P=0.05)	0.6	0.24	0.65	0.98	1.25	0.78

Ether extract and mineral matter were significantly higher in "Rajasthan Bajra chari-2" than other varieties. In case of nitrogen @ 120 kg/ha significantly increased ether extract and mineral matter over control, 40 and 80 kg N/ha which was at par with 160 kg N/ha Nitrogen fertilization not only improved the growth and yield of pearl millet fodder but also quality of fodder by increasing the crude protein content. The crude protein increased significantly due to the application of nitrogen up to 120 kg/ha. Application of nitrogen increased the availability of nitrogen, which resulted in significant increase in nitrogen content in fodder and ultimately the crude protein content. These results are in cognizance with the findings of Shivran and Pareek (2001). Significant increase in ether extract of fodder pearl millet was observed up to 120 kg N/ha. Application of nitrogen significantly decreased the crude fiber. This might be due to the fact that nitrogen application increased the uptake of nitrogen which is the constituent of amino acids and protein and decreased the pectin, cellulose and hemicellulose content which are major constituents of fibre (Babu *et al*. 1995). Application of nitrogen up to 120 kg/ha significantly decreased the NFE content of fodder pearl millet. This could be attributed to the fact that nitrogen application at higher doses had significant effect on crude protein content thereby reducing the proportion of carbohydrates and hence decreased NFE content which is in accordance with findings of Jakhar *et al.* (2003). Crude fibre, nitrogen free extract and total digestible nitrogen were significantly lower in "Rajasthan Bajra chari-2" than other varieties. Application of nitrogen @ 120 kg/ha significantly decreased crude fibre, nitrogen free extract and total digestible nutrient over control, 40 and 80 kg N/ha which was at par with 160 kg N/ha. On the basis of one years results of the present investigation, it may be concluded that the cultivar "Raj Bajra Chari-2" along with 120 Kg N/ha application resulted significant increase in growth parameter, yield attributes, green fodder, dry fodder yield. However, these results are only indicative and further experimentation is required at more consistent and definite conclusion for recommendation to the farmers.

Results of the field experiment that "Rajasthan Bajra chari-2" cultivar of pearl millet significantly higher plant height, total numbers of tillers per plant, dry matter accumulation per plant, green and dry fodder yield, crude protein content and ether extract was recorded. However, "Pusa Bajra-266" recorded significantly higher total digestible nutrient, nitrogen free extract and crude fibre. Application of nitrogen up to 120 kg/ha significantly increased the plant height, dry matter accumulation, tillers per plant, green, and dry fodder yield, crude protein, and ether extract which was at par with 160 N kg/ha. However, the crude fibre content, nitrogen free extract and total digestible nutrient were significantly decreased with application of 120 N kg/ha.

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