Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(5): 2665-2668
Received: 18-07-2020
Accepted: 29-08-2020

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Response of multi-cut fodder pearl millet (*Pennisetum glaucum* L.) genotypes to varied nitrogen levels in southern dry zone of Karnataka

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DOI: https://doi.org/10.22271/phyto.2020.v9.i5ak.12749

Abstract
A field experiment was conducted at zonal agricultural research station, V. C farm, mandya during *summer* 2019 to study the response of multi-cut pearl millet genotypes to varied levels of nitrogen and to identify the optimum and economical level for higher green forage yield and quality. The study revealed that, the variety Giant bajra national check recorded significantly higher green forage and dry matter yield (608.0 and 114.9 q ha^{-1} respectively), net monetary returns (Rs.56,346 ha^{-1}) and agronomic efficiency of nitrogen (632.0 Kg green fodder yield per Kg of N). However the variety HTBH-4902 recorded significantly higher crude protein yield (9.13 q ha^{-1}) and it was on par with variety Giant bajra (8.72 q ha^{-1}). Application of 120 kg N ha^{-1} significantly recorded higher green forage, dry matter and crude protein yield (741.1 q, 143.4 q and 12.57 q ha^{-1} respectively) and net monetary returns (Rs.72,234 ha^{-1}). The application of nitrogen at 40 Kg per hectare recorded higher agronomic efficiency of nitrogen (542.0 Kg green fodder yield per Kg of N).

Keywords: Green forage, dry matter and crude protein yield and agronomic efficiency of nitrogen

Introduction
Agriculture and Animal husbandry in India are interwoven, livestock rearing being integrated to livelihoods. India has vast livestock resources and backbone of Indian agriculture with contribution of 25.6 percent to agriculture Gross domestic product (GDP) and 4 per cent to total GDP of the country (Anon., 2017) [1]. The rapid change in agriculture to achieve the food security of ever increasing population of the country that had substantial impact on existing animal husbandry practices. The Karnataka state is presently facing 30% deficit of green fodder and 40.95 % of dry fodder. The deficit has to be met from either increasing productivity, utilizing untapped feed resources, increasing area under fodder crops or through the adoption of innovative strategies. Hence, there is a big challenge in front of us to utilize the meagre land wisely and adopt potential technologies with high yielding varieties/hybrids for higher green forage yield and quality.
Pearl millet (*Pennisetum glaucum* L.) is an important most widely adopted cereal fodder under rainfed ecosystem and gaining importance in Karnataka state due to tolerance to drought situations and it requires less irrigation water as compared to other cereal fodder, hence it can be cultivated in command area under rice follows, where water is very scarce during summer season. Apart from this it is short duration better palatability and digestibility and free from ant nutritional factors compared to fodder sorghum. Among essential plant nutrient Nitrogen place an pivotal role which is directly involving in vegetative growth, dry matter production and partitioning and crude protein content of the green herbage. The improved genotypes of multi cut pearl millet are being evolved and the response of genotypes to applied nutrients particularly for nitrogen is very meagre. Keeping these things in view the present investigations was undertaken to know the response of multi-cut pearl millet genotypes to varied nitrogen level and to identify the optimum, cost effective level for higher green forage yield and quality.

Materials and Methods
The field experiment was conducted at Zonal Agricultural Research Station, V. C Farm, Mandya during *summer* 2019 to identify the optimum level of nitrogen for higher green forage yield and quality. The soil of the experimental site is red sandy loam in texture having low in available nitrogen (242 kg N ha^{-1}), medium in available phosphorous (37.3 kg ha^{-1}) and potassium (152.0 K_2O kg ha^{-1}) with pH of 7.40.

The experiment consisted of six varieties (V_1: HTBH-4902, V_2: ADV 0061, V_3: AFB-37, V4: Moti Bajra (South zone check), V_5: Raj Bajra -1 (National check) and V_6: Giant Bajra (National check) and four nitrogen levels (0, 40, 80 and 120 N Kg ha^{-1}) was laid out in split plot design with three replications. The crop was sown during the first fortnight of February with recommended spacing of 30 cm between the rows, the cultural practices were followed as per recommended package of practices for establishment of crop. The recommended dose of phosphorous 60 Kg ha^{-1} and potassium 40 Kg ha^{-1} was applied at the time of sowing. The nitrogen was applied as per the treatments i.e 40% as basal + 20% at 40 days after sowing and 20% each after first and second cut. The crop was harvested three times and first harvest at 55 days after sowing, 2nd harvest at 30 days after 1st cut and 3rd harvest at 30 days after 2nd harvest and immediately after each harvest the green fodder yield was recorded. The known quantity of sample was taken and oven dried to attain constant weight in thermo statistically controlled oven at 70 $\pm$ 2 ◦C temperature for the estimation of dry matter content and yield and as well as other quality parameters. The agronomic efficiency of Nitrogen (AEN) was worked out and economics was calculated with prevailing market price and input costs. The statistical analysis of data was done for interpretation of the results and draw conclusion.

$$\text{Agronomic Efficiency of Nitrogen (Kg GFY/Kg N)} = \frac{\text{“Green forage yield in Nitrogen applied plot - green forage yield in No Nitrogen plot” (Kg)}}{\text{Amount of Nitrogen applied (Kg)}}$$

$$\text{Dry matter yield (q/ha)} = \frac{\text{Dry matter \% X Green forage yield (q/ha)}}{100}$$

$$\text{Crude protein yield (q/ha)} = \frac{\text{Crude protein \% X Dry matter yield (q/ha)}}{100}$$

Results and Discussion

Green forage yield

Varieties differed significantly under varied levels of nitrogen with respect to green forage yield recorded at harvest (Table 1), Among varieties Giant Bajra (National check) reordered significantly higher green forage yield (608 q/ha), which was on par with the varieties HTBH-4902 and Raja Bajra-1 (566.2 q & 539.8 q/ha respectively). The lower green forage yield was recorded with variety ADV-0061 (474.4 q/ha). Application of nitrogen at 120 Kg/ha recorded significantly higher green forage yield (741.1 q/ha) followed by 80 N Kg/ha (668.6 q/ha). The interaction between varieties and nitrogen levels found non-significant. This is due to nitrogen place a pivotal role in cell division, cell elongation and differentiation, there by leads to better root proliferation and luxuriant growth which is evidenced by higher plant height and leaf stem ratio, which resulted higher green forage yield. The similar results were reported by Rana *et al.*, 2013 [7], Rasendez *et al.*, 2017 [8] and Shekar *et al.*, 2019) [9]

Dry matter yield

Dry matter yield was significantly influenced by varieties and nitrogen levels recorded at harvest (Table 1), Among varieties Giant Bajra recorded higher dry matter accumulation (114.9 q/ha), which was on par with variety HTBH-4902 (106.1 q/ha) and Raja Bajra-1 (102.6 q/ha). The lowest dry matter yield was observed with variety ADV-0061 (85.5 q/ha). Application of nitrogen at 120 Kg/ha recorded significantly higher dry matter yield (143.4 q/ha), this is due to better partitioning of photosynthates with application of nitrogen which, resulted high dry matter content and green forage yield that led to increased dry matter yield. This is in accordance with the results of Damame *et al.*, 2013 [5], Kumar *et al.*, 2018 [6] and Yadav *et al.*, 2019 [4].

Crude Protein yield

Crude Protein yield of varieties was significantly influenced by nitrogen levels recorded at harvest (Table 2). Among varieties, HTBH-4902 recorded significantly higher crude protein yield (9.13 q/ha) and it was on par with variety Giant Bajra (8.72 q/ha). The lower crude protein yield was observed with variety ADV-0061 (7.17 q/ha). Application of nitrogen at 120 Kg/ha recorded significantly higher crude protein yield (12.57 q/ha). The increase in crude protein yield is mainly due to increased crude protein content and dry matter yield and better translocation within plant system with higher level of nitrogen. The similar results were reported by Bhatt *et al*., 2012 [3], Uwah *et al.*, 2014 [10] and Dabhi *et al.*, 2017 [4].

Nitrogen use efficiency

The nitrogen use efficiency of varieties was significantly influenced by nitrogen levels recorded at harvest (Table 2). Among varieties Giant Bajra reordered significantly higher agronomic efficiency of nitrogen (632 Kg green fodder yield per Kg of N) which was on par with variety HTBH-4902 (575 Kg GFY per Kg N). The lower agronomic efficiency was observed with variety Moti-Bajra (411 Kg GFY per Kg of N applied). The lower level of nitrogen at 40 Kg/ha recorded higher agronomic efficiency of nitrogen (542 Kg green fodder yield per Kg of N applied) and it was on par with Nitrogen at 80 Kg/ha (521 Kg green fodder yield per Kg of N applied) and superior over 120 Kg N/ha (408 Kg GFY per Kg N). The nitrogen use efficiency was higher at lower level of nitrogen and decreased with incremental nitrogen levels, this might be due to higher amount of nitrogen loss through leaching, runoff with higher N levels might have resulted lower utilization of applied nitrogen and there by decreased nitrogen use efficiency. This is in accordance with the findings of Sharma *et al*., 1999.

Economics

Among varieties Giant bajra recorded higher gross returns (91196 Rs. /ha), Net returns (56346 Rs. /ha) and B:C ratio (2.6) followed by variety HTBH-4902 (84915 Rs. /ha, 49918 Rs./ha and 2.4 respectively). Application of Nitrogen at 120 Kg/ha recorded higher gross returns (111168 Rs. /ha), Net returns (72234 Rs. /ha) and B:C ratio (2.5). The increase in net monetary returns with application of higher level of Nitrogen is due to higher green forage yield and marginal increase in cost of production as compared to lower level of Nitrogen. This is in accordance with observations of Bama *et al.* (2013) [2].

Based on the results it can be inferred that, variety Giant Bajra or HTBH-4902 with nitrogen level of 120 Kg/ha found economical and sustainable, which recorded higher green forage, dry matter and crude protein yield and net monetary returns in southern part of Karnataka.

Table 1: Green forage and dry matter yield of multi-cut pearl millet varieties as influenced by nitrogen levels

Treatments	GFY (q/ha)		DMY (q/ha)		DM (%)	
Varieties						
HTBH-4902	566.2		106.1		18.5	
ADV 0061	474.4		85.5		17.7	
AFB-37	510.5		91.2		17.5	
Moti Bajra (NC)	496.7		87.3		16.9	
Raj Bajra-1 (NC)	539.8		102.0		18.6	
Giant Bajra (NC)	608.0		114.9		18.8	
S. Em±	22.3		3.86		0.54	
C.D (p=0.05)	71.2		12.32		NS	
Nitrogen levels (Kg/ha)						
0	251.9		40.8		16.1	
40	468.6		85.0		18.1	
80	668.6		122.0		18.3	
120	741.1		143.4		19.4	
S. Em±	15.3		3.14		0.45	
C.D (p=0.05)	44.2		9.04		1.28	
Interaction	S. Em±	C.D (p=0.05)	S. Em±	C.D (p=0.05)	S. Em±	C.D (p=0.05)
Varieties x Nitrogen	44.6	NS	-	NS	1.08	1.54
Nitrogen x Varieties	39.5	NS	-	NS	1.09	NS

Table 2: Crude protein yield and agronomic efficiency of nitrogen as influenced by multi-cut pearl millet varieties as influenced by nitrogen levels

Treatments	Crude protein yield (q/ha)		Crude protein (%)		Agronomic efficiency of Nitrogen (Kg GFY /kg N)	
Varieties						
HTBH-4902	9.13		8.40		575	
ADV 0061	7.17		8.06		448	
AFB-37	7.20		7.68		470	
Moti Bajra (NC)	7.83		8.70		411	
Raj Bajra-1 (NC)	8.03		7.69		405	
Giant Bajra (NC)	8.72		7.46		632	
S. Em±	0.30		0.11		41.0	
C.D (p=0.05)	0.96		0.36		132	
Nitrogen levels (Kg/ha)						
0	2.96		7.26		-	
40	6.60		7.76		542	
80	6.93		8.19		521	
120	12.57		8.79		408	
S. Em±	0.27		0.07		26	
C.D (p=0.05)	0.79		0.19		78	
Interaction	S. Em±	C.D (p=0.05)	S. Em±	C.D (p=0.05)	S. Em±	C.D (p=0.05)
Varieties x Nitrogen	0.60	NS	0.26	0.50	72	NS
Nitrogen x Varieties	0.65	NS	0.18	0.55	67	NS

Table 3: Economics of multi-cut pearl millet genotypes as influenced by nitrogen levels

Treatments	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Varieties			
HTBH-4902	84915	46460	2.38
ADV 0061	71153	37186	2.03
AFB-37	76571	42284	2.19
Moti Bajra (NC)	74483	40181	2.11
Raj Bajra-1 (NC)	80963	46460	2.30
Giant Bajra (NC)	91196	56346	2.55
Nitrogen levels (Kg/ha)			
0	37770	7143	1.23
40	70293	37613	2.15
80	100290	64594	2.81
120	111168	72234	2.85

Acknowledgement
Authors are grateful to University of agricultural Sciences, Bangalore and AICRP on Forage crops, IGFRI, Jhansi for financial support and facilities for conducting of experiment at Zonal Agricultural Research station, V C Farm, Mandya, UAS, Bangalore.

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