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Effect of levels and scheduling of nitrogen on economic, quality, nutrient content, uptake and soil status of pearl millet

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Abstract

A field experiment entitled "Response of pearl millet (*Pennisetum glaucum* L.) to levels and scheduling of nitrogen under south Gujarat condition was conducted on heavy black soil at the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat) during the summer season 2016. The experiment comprising twelve treatment combinations were laid out in factorial randomized block design and replicated three times. The treatment consisted combinations of four levels of nitrogen viz. 60 kg N/ha (N₁), 80 kg N/ha (N₂), 100 kg N/ha (N₃) and 120 kg N/ha (N₄) and three scheduling of nitrogen viz. 50% at basal + 50% top dressing at 30 DAS (M₁), 50% at basal + 50% top dressing at 45 DAS (M₂) and 50% at basal + 25% top dressing at 30 DAS + 25% top dressing at 45 DAS (M₃). The recommended dose of phosphorus @ 40 kg/ha was applied uniformly to all the treatment as basal in form of single super phosphate. Nitrogen was applied as per treatment in form of urea. The result of the experiment showed that maximum gross return and net return obtained with 120 kg N/ha followed by 100 kg N/ha and 80 kg N/ha. NPK content in grain and straw found non significant with respect to nitrogen level. However uptake of NPK were significantly higher with 120 kg N/ha which was at par with 100 kg N/ha. Nutrient status of soil were not affected significantly with respect to N and P₂O₅, but K₂O status significantly increased with 120 kg N/ha followed by 100 kg N/ha

In case of scheduling of nitrogen, maximum gross return and net return secured with 50% at basal + 25% top dressing at 30 DAS + 25% top dressing at 45 DAS (M₃) followed by 50% at basal + 50% top dressing at 45 DAS (M₂). NPK content in grain and straw found non significant with respect to nitrogen. Significantly higher uptake of NPK reported with 50% at basal + 25% top dressing at 30 DAS + 25% top dressing at 45 DAS (M₃) followed by 50% at basal + 50% top dressing at 45 DAS (M₂). Nutrient status of soil was not affected significantly with respect to N and P₂O₅, but K₂O status significantly increased with splitting.

Thus based on one year field experimentation, it is concluded that higher quality, nutrient uptake, soil status and better economic returns of summer pearl millet can be obtained by fertilizing the crop with 80 kg N/ha and scheduling at 50% at basal + 50% top dressing at 45 DAS along with recommended fertilizer dose of 40 kg P₂O₅/ha.

Keywords: Pearl millet, nitrogen levels, nitrogen scheduling, nutrient uptake, quality

Introduction

Pearl millet belongs to family gramineae (poaceae). It is the most drought tolerant crop among cereals and millets and water requirement is low. The nutritive value of pearl millet is fairly high and it is fairly rich in fat content as compared to other cereals. In India, it is annually grown on 7.95 million ha area producing nearly 8.79 million tonnes of grains with productivity of 1,106 kg/ha. (Anon., 2014) ^[1]. The major production factor to boost up the yield of pearl millet is fertilizer management, which has contributed to the extent of 27 per cent. Nitrogen and phosphorus are major elements required to increase the crop production. Among these elements, nitrogen is one of the decisive as well as expensive inputs which govern the cereal crops production. It has the quickest and the pronounced effect on plant growth. Insufficient nitrogen may reduce yield drastically and deteriorates the quality of produce. Split application of N fertilizers commensurate with crop growth stage is an useful approach for increasing the efficiency of applied N in Pearl millet. it is therefore necessary to judiciously manage the inflow of the nitrogen. Therefore, levels and scheduling of nitrogen are crucial. Considering the above fact and views, the present experiment was planned and conducted.

Materials and methods

The present experiment was conducted on the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during summer season of 2016. The experiment comprising twelve treatment combinations were laid out in factorial randomized block design and replicated three times. The treatment consisted of four levels of nitrogen viz. 60 kg N/ha (N₁), 80 kg N/ha (N₂), 100 kg N/ha (N₃) and 120 kg N/ha (N₄) and three scheduling of nitrogen viz. 50% at basal + 50 top dressing at 30 DAS (M₁), 50% at basal + 50% top dressing at 45 DAS (M₂) and 50% at basal + 25% top dressing at 30 DAS + 25% top dressing at 45 DAS (M₃). The recommended dose of phosphorus @ 40 kg/ha was applied uniformly to all the treatment as basal in form of single super phosphate. Nitrogen was applied as per treatment in form of urea. The present investigation carried out with pearl millet hybrid variety GHB 558.

Result and Discussion

Effect of nitrogen levels

Effect on economics

The data on economics of different nitrogen levels are presented in Table 1. Treatment N₄ (120 kg N/ha) was found superior by recording maximum value of net returns (₹ 68,437 /ha) and BCR (3.20) and followed by treatment N₃ (100 kg N/ha) with net realization (₹ 62,940 /ha) and BCR (2.99) and 80 kg N/ha (N₂) with net realization (₹ 60243 /ha) and BCR (2.90).

The treatment N₁ (60 kg N/ha) showed the lowest value of net realization (₹ 54,502 /ha) and BCR (2.65). It is obvious that higher net returns and benefit: cost (B: C) ratio was the result of higher productivity. These results are in agreement with finding of Choudhary and Prabhu, (2014) [4] and Meena and Jain (2013) [9].

Table 1: Economics of pearl millet as influenced by levels and scheduling of nitrogen

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross realization (₹/ha)	Total cost of cultivation (₹/ha)	Net realization (₹/ha)	B: C Ratio
Nitrogen levels						
N ₁	3770	7356	75032	20530	54502	2.65
N ₂	4055	8084	81048	20805	60243	2.90
N ₃	4211	8322	84020	21080	62940	2.99
N ₄	4505	8856	89792	21355	68437	3.20
S.Em. ±	156.40	306.60	-	-	-	-
C.D. at 5%	458.60	899.30	-	-	-	-
Nitrogen scheduling						
M ₁	3823	7646	76460	21843	54617	2.50
M ₂	4262	8157	84506	21843	62663	2.87
M ₃	4319	8661	86426	22743	63683	2.80
S.Em. ±	135.40	265.60	-	-	-	-
C.D. at 5%	397.10	778.90	-	-	-	-
Interaction						
S.Em. ±	270.80	531.12	-	-	-	-
C.D. at 5%	NS	NS	-	-	-	-
C.V.%	11.34	11.28	-	-	-	-

Effect on quality, nutrient content, uptake and soil status

The data on nutrient content, uptake and soil status are illustrated in Table 2,3 and 4. An application of nitrogen (60 to 120 kg N/ha) to summer pearl millet crop do not produced significant effect on protein content in grain, While, protein yield was significantly increase with increasing rate of nitrogen (Table 2 and 3).

NPK content were not affected significantly by various levels of nitrogen, but NPK uptake by grain and straw of pearl millet (Table 3) increase significantly with increasing rate of nitrogen (60 to 120 kg N/ha) and maximum with 120 kg N/ha which was at par with 100 kg N/ha. There are no significant effect produced by nitrogen levels on available N and P₂O₅ in the soil after harvest, while in case of K₂O in the soil after harvest significantly increase with increasing levels of nitrogen up to 120 kg N/ha (N₄) (Table 4). This might be due to favorable effects of nitrogen on growth parameters and yield attributes which ultimately resulted in highest grain and straw yields and consequently more nitrogen uptake by the crop. The findings are in accordance with those of Jadhav *et al.*, (2011) [6], Sakarvadia *et al.*, (2012) [11].and (Patel 2014) [11].

Effect of nitrogen scheduling

Effect on economics:

The data on economics of nitrogen scheduling are presented in Table 1. Treatment M₃ (50% at basal + 25% top dressing at

30 DAS + 25% top dressing at 45 DAS) was found superior by recording maximum value of net returns (₹ 63,686 /ha) and BCR (2.80) followed by treatment M₂ (50% at basal + 50% top dressing at 45 DAS) with net realization (₹ 62,663/ha) and B: C ratio (2.87). The treatment M₁ (50% at basal + 50% top dressing at 30 DAS) showed the lowest value of net realization (₹ 54,617 /ha) and B: C ratio (2.50). This was probably due to split applications of nitrogen provide nutrient at right time. Similar finding were also reported by Choudhary and Prabhu, (2014) [4].

Effect on quality, nutrient content, uptake and soil status

Scheduling of nitrogen in different treatments M₁ (50% at basal + 50 at 30 DAS), M₂ (50% at basal + 50 top dressing at 45 DAS) and M₃ (50% at basal + 25% top dressing at 30 DAS + 25% top dressing at 45 DAS) to summer pearl millet crop do not produced significant increase in protein content in grain, While, protein yield was significantly higher in treatment M₂ (50% at basal + 50 top dressing at 45 DAS) and remain at par with treatment M₃ (50% at basal + 25% top dressing at 30 DAS + 25% top dressing at 45 DAS) (Table 2). Similar result reported by Kharub and Chander (2010) [7].

NPK content and uptake by straw were not affected significantly by scheduling of nitrogen, but NPK uptake by grain (Table 3) increased significantly with scheduling of nitrogen. Significantly higher uptake of NPK were reported with M₃ (50% at basal + 25% top dressing at 30 DAS + 25%

top dressing at 45 DAS) but it was at par with M₂(50% at basal + 50 top dressing at 45 DAS). The increase of nutrients uptake by grain might be due to favorable effects of nitrogen scheduling on growth parameters and yield attributes which ultimately resulted in higher uptake. Similar results were noted by Kharub and Chander (2010)^[7] and Chaudhary *et al.*, (2013)^[3]. There are no significant effect produced by nitrogen scheduling on available N and P₂O₅ in the soil after harvest, while in case of K₂O in the soil after harvest significantly higher in treatment (50% at basal + 25% top dressing at 30 DAS + 25% top dressing at 45 DAS) and remain at par with M₂ (50% at basal + 50 top dressing at 45 DAS) (Table 4). Similar result obtained by Chaudhary *et al.*, (2013)^[3].

Table 2: Protein content and nutrient content of pearl millet as influenced by levels and scheduling of nitrogen

Treatments	Protein content (%)	Nutrient content in grain (%)			Nutrient content in straw (%)		
		N	P	K	N	P	K
Nitrogen levels							
N ₁	10.55	1.69	0.332	0.679	0.68	0.082	0.838
N ₂	10.49	1.68	0.336	0.689	0.70	0.083	0.850
N ₃	10.67	1.71	0.337	0.695	0.71	0.086	0.860
N ₄	10.76	1.72	0.344	0.708	0.72	0.088	0.870
S.Em. ±	0.162	0.026	0.007	0.012	0.02	0.002	0.020
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS
Nitrogen scheduling							
M ₁	10.54	1.69	0.336	0.689	0.69	0.085	0.851
M ₂	10.76	1.72	0.337	0.691	0.70	0.086	0.855
M ₃	10.56	1.69	0.338	0.698	0.71	0.084	0.857
S.Em. ±	0.14	0.023	0.006	0.01	0.017	0.002	0.017
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS
Interaction							
S.Em. ±	0.80	0.045	0.011	0.020	0.035	0.004	0.035
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS
C.V.%	4.58	4.58	5.88	5.11	8.77	8.70	7.10

Table 3: Protein yield and nutrient uptake by pearl millet as influenced by levels and scheduling of nitrogen

Treatments	Protein yield (kg/ha)	Nutrient uptake by grain (kg/ha)			Nutrient uptake by straw (kg/ha)		
		N	P	K	N	P	K
Nitrogen levels							
N ₁	397.60	63.62	12.52	25.64	50.28	6.06	61.54
N ₂	426.10	68.17	13.61	27.95	56.67	6.75	68.54
N ₃	448.00	71.68	14.17	29.14	59.69	7.15	71.81
N ₄	485.60	77.69	15.50	31.89	69.79	7.81	77.03
S.Em. ±	17.50	2.80	0.57	1.04	3.01	0.33	3.00
C.D. at 5%	51.34	8.21	1.68	3.06	8.84	0.99	8.81
Nitrogen scheduling							
M ₁	402.60	64.42	12.87	26.38	53.29	6.50	65.11
M ₂	458.50	73.36	14.37	29.38	57.77	7.03	69.94
M ₃	456.90	73.10	14.62	30.21	61.76	7.30	74.15
S.Em. ±	15.16	2.42	0.49	0.90	2.61	0.29	2.60
C.D. at 5%	44.47	7.11	1.45	2.65	NS	NS	NS
Interaction							
S.Em. ±	30.32	4.85	0.99	1.80	5.22	0.58	5.20
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS
C.V.%	11.95	11.95	12.31	10.92	15.70	14.64	12.93

Conclusion

Thus based on one year field experimentation, it is concluded that higher quality, nutrient uptake, soil status and better economic returns of summer pearl millet can be obtained by fertilizing the crop with 80 kg N/ha and scheduling at 50% at basal + 50% top dressing at 45 DAS along with recommended fertilizer dose of 40 kg P₂O₅/ha.

Table 4: Nutrient status of soil after harvest of pearl millet as influenced by levels and scheduling of nitrogen

Treatments	Available nutrients in soil after harvesting		
	N(kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (kg/ha)
Nitrogen levels			
N ₁	170.60	31.45	314.90
N ₂	175.70	31.72	323.70
N ₃	177.90	32.25	336.30
N ₄	179.10	32.38	347.30
S.Em. ±	6.01	1.09	6.70
C.D. at 5%	NS	NS	19.66
Nitrogen scheduling			
M ₁	176.90	31.86	319.20
M ₂	175.70	31.87	329.40
M ₃	175.00	32.12	343.00
S.Em. ±	5.20	0.94	5.08
C.D. at 5%	NS	NS	17.03
Interaction			
S.Em. ±	10.41	1.89	11.61
C.D. at 5%	NS	NS	NS
C.V.%	10.26	10.25	6.08
Initial value	180.24	35.30	352.20

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