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Effect of Split Application of Nitrogen Levels in Summer Pearlmillet (*Pennisetum glaucum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at Sardarkrushinagar Dantiwada Agricultural University, Gujarat during summer season of 2022 on loamy sand. The experiment comprised of nine treatment combinations. Significantly higher plant height, earhead/plant, length of earhead, girth of earhead, test weight, grain and straw yield as well as protein content were recorded under 120 kg N/ha and application of nitrogen at 25% as basal + 75% as top dressing. The same level of nitrogen along with split application of nitrogen provided maximum net realization value and BCR. Application of 150 kg N/ha and split application of nitrogen 40% as basal + 60% as top dressing were at par with 120 kg N/ha and 25% as basal + 75% as top dressing, respectively.

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1. INTRODUCTION

"Pearlmillet (*Pennisetum glaucum* L.) is an annual, *kharif* and summer season crop belonging to the *Poaceae* (*Gramineae*) family, commonly known as *Bajra* or *Bajri*. It is drought and heat tolerant and has a considerable ability to grow and yield in poor, sandy and saline soils under arid, hot and dry climates. Pearlmillet is one of the most important food grain cereal crop of India and ranks fourth in area after rice, wheat and sorghum. In India, largest producer of pearlmillet is Rajasthan which is followed by Uttar Pradesh, Maharashtra, Gujarat and Haryana. The nutritive value of pearlmillet crop is fairly high. It contains moisture (12.4%), protein (11.6%), fat (5.0%), carbohydrates (67.0%) and minerals (2.7%)" [1]. Additionally, they are rich in vitamins, thiamine and riboflavin, providing substantial energy to the body and being easily digestible. Pearlmillet also possesses special health benefits for individuals with conditions such as diabetes, cancer and asthma. Nitrogen plays an important role in the synthesis of chlorophyll as well as amino acids, which is the building unit of the protein. As nitrogen is mobile element, the time and rate of nitrogen application or split application of nitrogen at various times with different quantity as per requirement of crop growth stage may be an important factor which can be used for exploitation the yield potential as well as nitrogen use economy. Split nitrogen fertilizer applications can play an important role in a nutrient management strategy that is productive, profitable and environmentally responsible.

2. MATERIALS AND METHODS

A field experiment was conducted during summer season of 2022 at Agronomy Instructional Farm, S. D. Agricultural University, Sardarkrushinagar, Gujarat. The treatment comprised three levels of nitrogen doses (90, 120 and 150 kg N/ha) and three split application of nitrogen (50% as basal + 50% as top dressing, 40% as basal + 60% as top dressing and 25% as basal + 75% as top dressing). The experiment comprised of nine treatment combinations with randomized block design with factorial concept (FRBD) and replicated thrice. Present experiment was conducted in loamy sand soil with light brown in colour, well-drained, fairly retentive of moisture and low in available nitrogen, while medium in available phosphorus and higher in available potassium. Pearlmillet variety, 'GHB 1129' ware sown at 45 cm row spacing with 3.75 kg/ha seed rate. Fertilizer application was done as per respective treatments. In which, full dose of phosphorus (thorough DAP) was applied as basal. While respective dose of nitrogen in different treatment were applied as basal and remaining were top dressed at 20 and 40 DAS in two equal splits.

3. RESULTS AND DISCUSSION

3.1 Effect on Growth Parameters

"Among the different treatments, significantly higher plant height (187.50 cm) at harvest was recorded with the application of 120 kg N/ha and remained at par with 150 kg N/ha. That might be due the fact that nitrogen promotes number of internodes and increase length of internodes which results in progressive increase in plant height. This might have accelerated the meristematic activity, vegetative growth and photosynthetic activity, consequently resulting in to increase plant height". Joshi et al. [2] and Kadam et al. [3]

Application of 25% N as basal + 75% N as top dressing recorded significantly higher plant height at harvest (187.50 cm), which was statistically at par with 40% N as basal + 60% N as top dressing (181.54 cm). Dividing the nitrogen fertilizer into two equal splits application during the later stages of plant growth ensures a consistent supply of nitrogen during critical growth periods. This continuous nitrogen availability supports vigorous growth and elongation, resulting in increased overall plant height in pearlmillet. The results are corroborating with those of Baladaniya [4] Joshi et al. [2] and Kadam et al [3].

The interaction effect between nitrogen levels and their splits application was not significant for growth parameters of summer pearlmillet crop.

3.2 Effect on Yield Attributes and Yield

Significantly higher number of earhead, length of earhead, girth of earhead, test weight, grain and straw yield were found under 120 kg N/ha. Which was not differ significantly with 150 kg N/ha. A sufficient nitrogen supply encourages vigorous vegetative growth, which increases cell division and elongation. This results in development of

Table 1. Effect of different nitrogen levels and their split application on growth, yield attributes, yield and quality of summer pearlmillet

Treatment	Plant height (cm)	Earhead/plant	Length of earhead (cm)	Girth of Earhead (cm)	Test weight (g)	Yield (kg/ha)		Harvest index (%)	Protein content (%)
						Grain	Straw		
Nitrogen level (N)									
N_1 : 90 kg N/ha	170.12	3.59	22.98	8.88	8.69	3406	6071	35.90	10.74
N_2 : 120 kg N/ha	187.50	4.02	25.52	9.85	9.62	4169	7332	36.70	11.30
N_3 : 150 kg N/ha	181.61	3.76	23.91	9.41	9.33	3891	6838	36.21	11.06
S.Em.±	4.61	0.11	0.67	0.25	0.25	155.02	255.25	0.55	0.13
C.D. (P=0.05)	13.83	0.34	2.02	0.76	0.74	464	765	NS	0.39
Splits of nitrogen (S)									
S_1 : 50% as basal + 50% as top dressing	170.19	3.55	22.75	8.88	8.72	3518	6229	36.06	10.74
S_2 : 40% as basal + 60% as top dressing	181.54	3.84	24.18	9.43	9.25	3838	6804	36.09	11.06
S_3 : 25% as basal + 75% as top dressing	187.50	3.98	25.48	9.84	9.67	4110	7207	36.34	11.31
S.Em.±	4.61	0.11	0.67	0.25	0.25	155.02	255.25	0.55	0.13
C.D. (P=0.05)	13.83	0.34	2.02	0.76	0.74	464	765	NS	0.39
Interaction (N × P)									
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	7.70	9.08	8.38	8.13	8.06	12.17	11.35	4.55	3.55

Table 2. Effect of different nitrogen levels and split application on the economics of summer pearlmillet

Treatment	Gross realization (₹/ha)	Cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR
Nitrogen level (N)				
N_1 : 90 kg N/ha	86333	42044	44289	2.05
N_2 : 120 kg N/ha	105367	42430	62937	2.48
N_3 : 150 kg N/ha	98334	42816	55518	2.30
Split of nitrogen (S)				
S_1 : 50% as basal + 50% as top dressing	89040	42430	46610	2.10
S_2 : 40% as basal + 60% as top dressing	97181	42430	54751	2.29
S_3 : 25% as basal + 75% as top dressing	103813	42430	61383	2.45

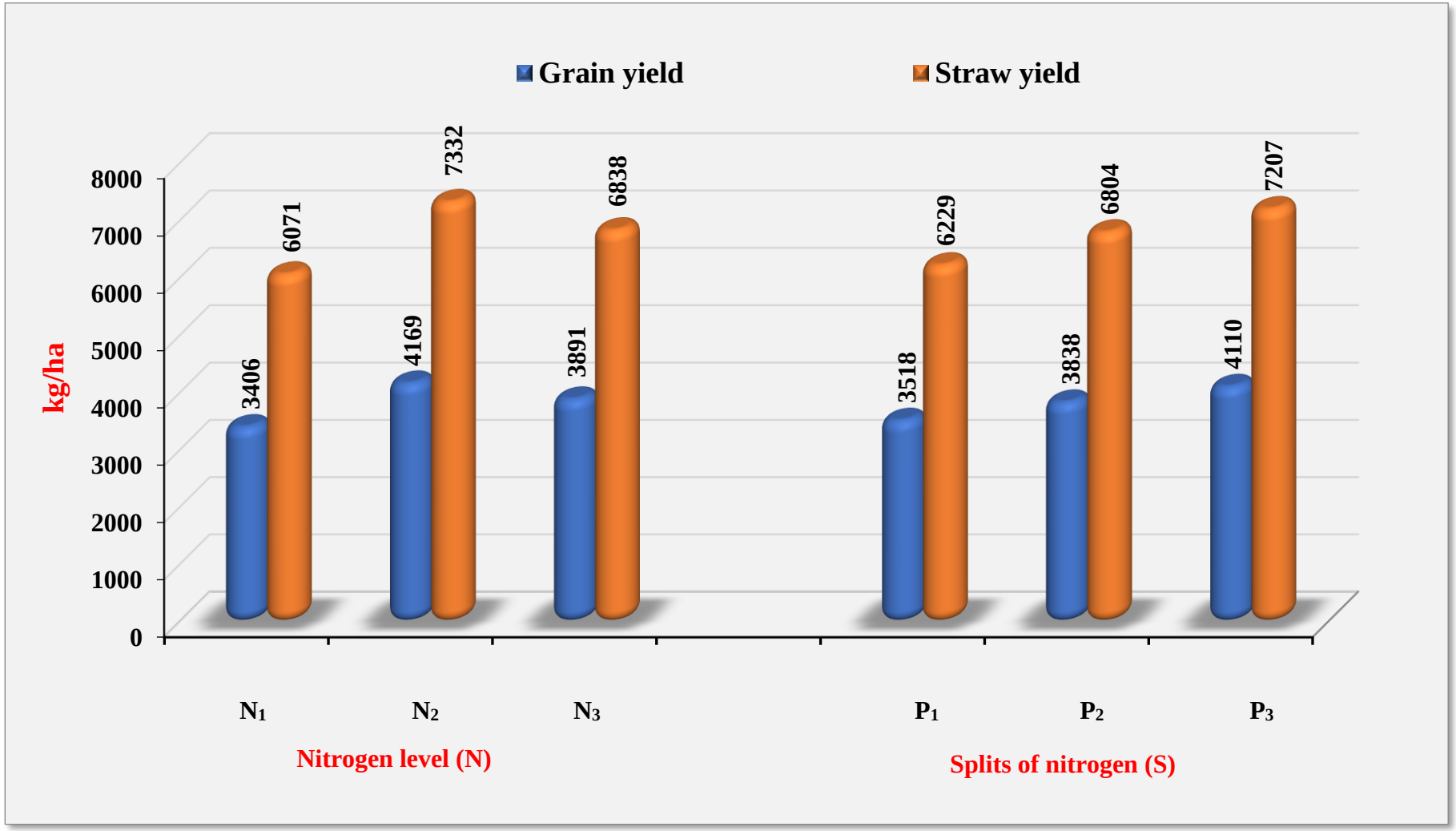

Fig. 1. Effect of different levels of nitrogen and their split application on grain and straw yields of summer pearlmillet

more earheads, maximizing girth as well as length, higher grain filling and ultimately contributing to improved yields (grain and straw) and productivity of pearlmillet. These findings were corroborate the results reported by Baladaniya [4] Joshi et al. [2] Kadam et al. [3] and Gojariya et al. [5] The harvest index did not affected significantly due to different levels of nitrogen.

Among different splits of nitrogen, significantly higher number of earhead, length of earhead, girth of earhead, test weight, grain and straw yield were recorded with the application of nitrogen, 25% as basal + 75% as top dressing and that ware did not differ significantly with 40% as basal + 60% as top dressing. Adequate nitrogen availability throughout the growth period supports the balanced utilization of nutrients in plant parts, further promoting number of earhead. Moreover, the splits application of nitrogen plays a critical role in maximizing earhead length and girth as well as better grain filling in pearlmillet crops. Which ultimately resulted in higher grain and straw yield of pearlmillet crop. Similar response trend was also observed by Jakhar et al. [6] Baladaniya [4] Joshi et al. [2] and Kadam et al. [3]

Different combinations of nitrogen levels and their split application tested in this experiment failed to show its significant effect on yield attributes and yield of pearlmillet.

3.3 Effect on Quality Parameters

Application of 120 kg N/ha recorded significantly higher protein content which remained at par with 150 kg N/ha. Nitrogen plays a crucial role in promoting protein synthesis as it is an essential component of amino acids, which are the building blocks of proteins. Due to balance nitrogen fertilization lead to more content of nitrogen in grain resulted in overall increase in protein content in summer pearlmillet. This finding were confirms to those reported by Jakhar et al. [6] and Prasad et al. [7]

Among different split application of nitrogen, 25% as basal + 75% as top dressing recorded significantly higher protein content (11.31%). Which remained at par with application of 40% N as basal + 60% N as top dressing. Splits application provides nitrogen at specific intervals, ensuring continuous supply of nitrogen during critical growth stages. This enhances the plant's ability to assimilate nitrogen and synthesize proteins, resulting in higher protein content in pearlmillet. The results are in close conformity with the findings of Jakhar et al. [3]

The interaction effect of different levels of nitrogen and their splits did not bring any perceptible increase in protein content of pearl millet.

3.4 Effect on Economics

Gross and net realizations were increased with increase in nitrogen levels from 90 to 120 kg N/ha, but decrease towards 120 kg N/ha to 150 kg N/ha. The highest gross (₹1,05,367/ha) and net realizations (₹62,937/ha) were recorded with application of 120 kg N/ha, which were closely followed by application of 150 kg N/ha with ₹98,334/ha and ₹55,518/ha, respectively. The magnitude of increase in net profit under 120 and 150 kg N/ha were 42.10 and 25.35 per cent, respectively over 90 kg N/ha. The increase in profitability was mainly due to increase in grain and straw yield due to adequate supply of nitrogen as discussed earlier. These finding were agreements with results reported by Jakhar et al. [3] Baladaniya [4] Joshi et al. [2] and Thakor et al. [8]

The maximum gross (₹1,03,813/ha) and net realizations (₹61,383/ha) were observed under splits application of 25% N as basal + 75% N as top dressing in pearlmillet, respectively. These were closely followed by fertilizer application of 40% N as basal + 60% N as top dressing (₹97,181/ha and ₹54,751/ha, respectively). This result match with the finding of Jakhar et al. Bamboriya et al. '[9] Baladaniya [4] and Joshi et al. [2]

4. CONCLUSION

Based on results of experiment, it can be concluded that, for securing higher growth, yield, quality and net realization of summer pearlmillet, crop should be fertilized with 120 kg N/ha of which, 25% N as basal and remaining 75% N in two equal splits at 20 and 40 days after of sowing along with the recommended dose of phosphorus (60 kg P_2O_5/ha) as basal application.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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