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Effect of nitrogen and phosphorus levels on yield and quality of summer pearlmillet

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Abstract
A field experiment was carried out during summer season 2019 to find out the effect of nitrogen and phosphorus levels on yield and quality of summer pearlmillet at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. Total nine treatments of different levels of nitrogen and phosphorus were tested randomized complet block design with factorial concept. Among different levels, an application of 160 kg N/ha and 90 kg P_2O_5/ha recorded significantly higher number of effective tiller per plant, length of earhead, test weight and grain and straw yield compared to other treatment.

Keywords: Nutrient, peralmillet, yield, quality

Introduction
Pearl millet [*Pennisetum glaucum* (L.) R. Br.] Commonly known as Bajra or Bajari belongs to family Poaceae. Pearl millet is the most drought tolerant warm season cereal grown in arid and dry-semi-arid tropical environments of South Asia and sub-Saharan Africa, where low precipitation and high temperatures and low soil fertility limit the cultivation of other major food crops. The major constraint limiting the growth and development of this crop is the poor fertility status of Indian soils. Nitrogen to some extent enhances the utilization of phosphorus and potassium. Nitrogen is most commonly deficient nutrient in Indian soil and gives considerable response in pearl millet crop (Jadav *et al.*, 2011). Phosphorus is a major and important plant nutrient involved in a wide range of plant processes from permitting cell division to the development of a good root system and for ensuring timely and uniform ripening of the crop. To know the effect of optimum dose of nitrogen and phosphorus requirement for higher grain yield and quality in summer pearlmillet, this exaperiment was formulated.

Materials and Methods
A field was conducted during summer season of 2019 to findout the effect of nitrogen and phosphorus levels on growth, yield and quality of pearlmillet at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. Nine treatment combinations comprising of three levels of nitrogen *viz*., 80 kg N/ha (N1), 120 kg N/ha (N2) and 160 kg N/ha (N3) and three levels of phosphorus *viz*., 30 kg P_2O_5/ha (P1), 60 kg P_2O_5/ha (P2) and 90 kg P_2O_5/ha (P3) were laid out under randomized block design (RBD) with factorial concept with four replications. The soil of experimental field was loamy sand in texture, slightly alkaline in reaction and soluble salt content under safe limit. It was low in organic carbon, available N, medium in available P_2O_5 and high in K_2O content. The experimental field was cultivated by tractor drawn cultivator and it was followed by harrowing and planking to obtain fine seedbed. The experiment was laid out as per layout plan and plots were levelled manually. Half dose of nitrogen and full dose of phosphorus were applied as basal dose in furrows in the form of urea and DAP as per treatment. The remaining half dose of nitrogen was applied as top dressing at 35 DAS in the form of urea at proper moisture. The first irrigation was given after sowing. Second light irrigation was applied after two days to first irrigation to facilitate germination and establishment of seedlings. Subsequent irrigations were applied at an interval of 8 to 10 days.
The data on number of effective tiller per plant, length of earhead, test weight and grain and straw yield and economics was recorded.

Result and Discussion
(A) Effect of nitrogen levels on yield and quality of pearlmillet
The effect of different levels of nitrogen play significant role on number of effective tillers per plant, length of earhead, test weight, grain yield, straw yield and protein content of summer pearl millet.

On an average, the application of 160 kg N/ha (N3) and 120 kg N/ha (N2) increased effective tiller per plant to turn of 39.63 and 31.15 per cent over 80 kg N/ha (N1), respectively. This might be owing to the role of increasing the available rate of nitrogen through higher rate of application resulted into cytokinin synthesis, which increases cell division and elongation, thereby resulting in higher number of tillers per plant. This resultis closely corroborated with the findings of Barad *et al.* (2017) [2] and Thakor *et al*. (2018) [18] in pearl millet crop.

Significantly higher length of earhead recorded with application of 160 kg N/ha (24.07 cm) over 80 kg N/ha (21.14) but it was statistically on par with 120 kg N/ha (23.11 cm). With increase in nitrogen supply, the process of tissue diffrentiative from somatic to reproductive meristemic activity and development of floral primordial might have increased which resulted in longer ear head. Present finding further confirmed the earlier reports of Chaudhary *et al*. (2018) [4], Barad *et al.* (2017) [2] and Thakor *et al*. (2018) [18]

Significantly highest test weight recorded 12.79 g with the application of 160 kg N/ha (N3) over 80 kg N/ha (N1) with recorded (10.69 g) but it was statistically at par with the application 120 kg N/ha (N2) with figures of 12.49 g. Test weight due to highest level of nitrogen might be attributed to the better filling of grains resulting into bold sized grains and consequently highest test weight. This line is closely corroborated with the findings of Sakarvadia *et al.* (2012) [15], Patel *et al.* (2014) [11] in pearl millet crop.

An application of nitrogen 160 kg N/ha (N3) recorded maximum grain yield of 4026 kg/ha as compared to the application of 80 kg N/ha (N1) with figure of 3583 kg/ha. While, it was statistically at par with the application of 120 kg N/ha (N2) with recorded 3996 kg/ha. Highest grain yield of summer pearl millet could be due to cumulative effect of improvement in yield attributes *viz*., number of effective tillers per plant, length of ear head and test weight. In case of summer pearl millet, linear response to nitrogen has been reported by Chaudhary *et al*. (2018) [4], Barad *et al.* (2017) [2], Thakor *et al*. (2018) [18], Sakarvadia *et al.* (2012) [15], Patel *et al.* (2014) [11] in pearl millet, Reddy *et al*. (2018) [13], Daroga *et al*. (2017) [8] in maize crop.

Increase in straw yield with successive doses of nitrogen ranges from 7535 to 6685 kg/ha. Significantly highest straw yield with the application of 160 kg N/ha (N3) over 80 kg N/ha (N1) application but it was statistically at par with the application 120 kg N/ha (N2). The better effect of nitrogen levels might be attributed to rapid expansion of dark green foliage, which could intercept and utilized were incident light energy in the production of carbohydrate through the process of photosynthesis.Earlier workers have also reported such positive response on straw yield due to nitrogen application to summer pearl millet. These results are also in agreement with the findings of Chaudhary *et al*. (2018) [4], Barad *et al.* (2017) [2], Thakor *et al*. (2018) [18], Sakarvadia *et al.* (2012) [15], Patel *et al.* (2014) [11] in pearl millet, Reddy *et al*. (2018) [13], Daroga *et al*. (2017) [8] in maize crop

(B) Effect of phosphorus levels on yield and quality of pearlmillet

Effect of different levels of phosphoruson effective tillers per plant, length of earhead, test weight, grain yield, straw yield and protein content of summer pearl millet found significant.

An application of 90 kg P_2O_5/ha (P3) produced the significantly highest number of effective tillers per plant (3.31) and it remain statistically at par with the application of 60 kg P_2O_5/ha (P2) which recorded (3.21). The overall improvement in crop growth under the influence of nitrogen and phosphorus fertilization could possibly be attributed to better result into improving the crop production.The present findings are in accordance with the findings of Chaurasiya *et al.* (2006) [5], Bhuva *et al*. (2018) [3], Singh *et al.* (2019) [17] in pearl millet and Ahmad *et al.* (2007) [1], Masood *et al*. (2011) [10] in maize.

Highest length of earhead (23.91cm) recorded significantly with the application of 90 kg P_2O_5/ha (P3) and it was at par with the application of 60 kg P_2O_5/ha (P2) with recorded (22.91 cm). This might be due to phosphorus has also been recognized as an essential constituent of all living organisms which plays a very important role in the conservation and transfer of energy in the metabolic reactions of living cells including biological energy transformation. These findings corroborate the results of Chaudhary *et al*. (2017) [6] in maize and Bhuva *et al*. (2018) [3] in pearl millet.

Highest test weight (12.76 g) recorded significantly with the application of 90 kgP_2O_5/ha (P3) and it was statistically at par with the application of 60 kg P_2O_5/ha (P2) with recorded (12.63 g). The increase in the test weight by the phosphorus application can be ascribed to a vital role of phosphorus in energy transformation making ADP and ATP molecules through various metabolic processes and thus, probably resulted in more synthesis and translocation of photosynthates of better filling and development of more as well as bold grains. These findings in close conformity with those of Bhuva *et al*. (2018) [3] and Singh *et al.* (2019) [17] in pearl millet and Chaudhary *et al.* (2017) [6] in maize

Among different phosphorus levels,application of 90 kg P_2O_5/ha (P3) recorded significantly the highest grain yield (4001 kg/ha) and it was statisticallyat par with the 60 kg P_2O_5/ha (P2) with the grain yield of 3982 kg/ha. Thus the increased grain yield due to phosphorus was a result of combined effect of improvement in growth as well as yield components. Significant increased productivity due to phosphorus fertilization has alsothese results are in agreement with the findings of Jakhar *et al.* (2006) [9] and Singh *et al.* (2019) [17] in pearl millet.

Significantly the highest straw yield (7577 kg/ha) was recorded under the application of phosphorus 90 kgP_2O_5/ha (P3) and lowest straw yield (6635 kg/ha) was observed under the application of 30 kg P_2O_5/ha (P1). This result is in line with the findings of Rathod *et al.* (2002) [12] and Roy *et al.* (2015) [14] in sorghum, Bhuva *et al*. (2018) [3] and Singh *et al.* (2019) [17] in pearl millet

Significantly maximum protein content (11.01 %) observed with the application of 90 kg P_2O_5/ha (P3) and it wasstatistically at par with the application of phosphorus 60 kg P_2O_5/ha (P2) with figures of 10.90 %. While significantly lowest protein content (10.38 %) of summer pearl millet with the application of phosphorus 30 kg P_2O_5/ha (P1).The magnitude of increase in proteincontent in grain of summer pearl millet due to P3 and P2 over P1 was to extend 6.12 and 5.07 per cent, respectively. These present findings are in close conformity with the observations made by Singh *et al.* (2017) [16] in pearl millet, Roy *et al.* (2015) [14] in sorghum and Chaudhary *et al.* (2017) [6] in maize.

(C) Effect of interaction

The interaction of nitrogen and phosphorus levels was found non-significant for number of effective tillers per plant, length of earhed, test weight, grain yield, straw yield and protein content of summer pearl millet.

Table 1: Effect of nitrogen and phosphorus levels on number of effective tillers per plant, length of earhead, test weight, protein content, grain yield and straw yield of summer pearl

Treatments	Number of effective tillers per plant	Length of earhead (cm)	Test weight (gm)	Protein content (%)	Grain yield (kg/ha)	Straw yiled (kg/ha)
Nitrogen levels (N)						
N1 : 80 kg/ha	2.41	21.14	10.69	10.40	3583	6685
N2 : 120 kg/ha	3.16	23.11	12.49	10.79	3996	7486
N3 : 160 kg/ha	3.37	24.07	12.79	11.10	4026	7535
S. Em.±	0.08	0.57	0.21	0.15	102	227
C.D. at 5 %	0.23	1.68	0.63	0.45	299	664
Phosphorus levels (P)						
P1 : 30 kg/ha	2.42	21.49	10.58	10.38	3622	6635
P2 : 60 kg/ha	3.21	22.91	12.63	10.90	3982	7494
P3 : 90 kg/ha	3.31	23.91	12.76	11.01	4001	7577
S. Em.±	0.08	0.57	0.21	0.15	102	227
C.D. at 5 %	0.23	1.68	0.63	0.45	299	664
Interaction (NXP)						
S. Em.±	0.14	1.0	0.37	0.26	177	394
C.D. at 5 %	NS	NS	NS	NS	NS	NS
CV%	9.33	8.74	6.20	4.92	9.16	10.89

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