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Effect of Levels of Nitrogen and Potassium on Growth and Yield of Rainfed Pearl millet (*Pennisetum glaucum* L.)

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A B S T R A C T

The experiment comprising nine treatment combinations were laid out in randomized block design and replicated thrice. The treatment consisted combination of 3 levels of nitrogen *viz*. 75kg/ha, 60 kg/ha and 45 kg/ha, and 3 levels of potassium *viz*. 20 kg/ha, 30 kg/ha and 40 kg/ha along with Phosphorus at 40 kg/ha. The Yield parameters *viz.* Number of Heads/hill, Number of Grains/head, Grain yield, and maximum Gross return, Net return and B:C ratio were recorded with the application of 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 40 kg/ha Potassium.

Introduction

Pearl millet [*Pennisetum glaucum* (L.)] is the fifth most important cereal crop in the world after rice, wheat, maize and sorghum. Pearl millet is commonly known as bajra, cattail, spiked or bulrush millet. Pearl millet excels all other cereals due to its unique features – C_4 plant with high photosynthetic efficiency, high dry matter production capacity and is grown under the most adverse agro-climatic conditions where other crops like sorghum and maize fail to produce economic yields. It is widely grown rainfed cereal crop in the arid and semi- arid regions of Africa and southern Asia, and can be grown in areas where rainfall is not sufficient (200 to 600 mm/yr) for the cultivation of maize and sorghum. Pearl millet is rightly termed as "nutricereal" as it is a good source of energy, carbohydrate, protein, fat, ash, dietary fiber, iron and zinc. Its grain is more nutritious and the protein content is not only high but it is also of good quality. The grain contains 11-19% protein, 60-78% carbohydrates and 3.0-4.6% fat and also has good amount of phosphorous and iron. India is the largest producer of pearl millet, both in terms of area and production. In India, it is annually grown on 7.5 million ha area producing nearly 9.73 million tonnes of grains with productivity of 1305 kg/ha during 2016-17 (Directorate of Millet Development, 2018).

Materials and Methods

The experiment was conducted during the *Kharif* season 2019, at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), low in organic carbon (0.42%), available Nitrogen (219 kg/ha), available Phosphorus (13.50 kg/ha) and available Potassium (257 kg/ha). The experiment was laid out in randomized block design with three replications and nine treatments.

The treatment consisted combinations of 3 levels of nitrogen viz. 75 kg/ha, 60 kg/ha and 45 kg/ha and 3 levels of potassium viz. 20 kg/ha, 30 kg/ha and 40 kg/ha.

The recommended dose of phosphorus at 40 kg/ha was applied uniformly to all the treatments. The crop was sown with at a spacing of 45 cm × 15 cm on 21st July 2019 using a variety SHB-152 with a seed rate of 4 kg/ha.

Results and Discussion

The data pertaining to effect of nitrogen and potassium on different growth parameters, yield and yield attributes are presented and discussed here under

Growth parameters

The analysed data presented in Table 1 shown significant variations among all treatments. At 90 DAS significantly maximum plant dry weight (54.11 g) was recorded in (T_7) 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 40 kg/ha Potassium, which was statistically at par with (T_2) 60 kg/ha Nitrogen + 40 kg/ha Phosphorus + 20 kg/ha Potassium. Similar results of increased dry matter production with increased levels of nitrogen at all the growth stages of Pearl millet crop was reported by Kumar *et al.,* (2004) and Reddy (2009). Better accumulation of dry matter in the form of shoot and root development has led to more uptake of potassium. Increased content and / or uptake of K due to increased nitrogen and potassium has been reported by Yadav *et al.,* (2011).

Table.1 Effect of levels of Nitrogen and Potassium on dry weight, no. of heads/hill, no. of grains/head, grain yield and B:C ratio of Pearl millet

TREATMENTS	Dry weight (g/plant) at 80 DAS	Heads/hill (No.)	Grains/head (No.)	Grain yield (t/ha)	B:C ratio
1. 75 kg/ha Nitrogen + 20 kg/ha Potassium	43.18	2.56	1948.11	4.62	2.84
2. 60 kg/ha Nitrogen + 20 kg/ha Potassium	48.78	2.44	1910.11	4.22	2.52
3. 45 kg/ha Nitrogen + 20 kg/ha Potassium	45.52	1.67	1897.33	3.72	2.11
4. 75 kg/ha Nitrogen + 30 kg/ha Potassium	44.29	2.33	1971.89	4.79	2.87
5. 60 kg/ha Nitrogen + 30 kg/ha Potassium	45.56	2.22	1859.78	4.53	2.76
6. 45 kg/ha Nitrogen + 30 kg/ha Potassium	43.22	2.00	1877.78	4.02	2.34
7. 75 kg/ha Nitrogen + 40 kg/ha Potassium	49.66	2.67	1996.67	4.91	2.95
8. 60 kg/ha Nitrogen + 40 kg/ha Potassium	46.33	2.22	1918.60	4.48	2.67
9. 45 kg/ha Nitrogen + 40 kg/ha Potassium	45.33	1.89	1866.67	3.93	2.24
F test	S	S	S	S	S
SEm (±)	1.38	0.15	21.18	0.25	0.14
CD(p=0.05)	4.15	0.44	63.49	0.53	0.41

Yield and yield attributes

Significantly higher number of heads/hill (2.67) was recorded in (T_7)75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 40 kg/ha Potassium, which was statistically at par with (T_1)75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 20 kg/ha Potassium, (T_2) 60 kg/ha Nitrogen + 40 kg/ha Phosphorus + 20 kg/ha Potassium and (T_4) 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 30 kg/ha Potassium. Significantly higher number of grains/head (1996.67) was recorded in (T_7)75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 40 kg/ha Potassium, which was statistically at par with (T_1) 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 20 kg/ha Potassium and (T_4) 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 30 kg/ha Potassium. Application of potassium improved the number of grains per head which might be due to the favourable effects of potassium on nutrient uptake, photosynthetic activity, improving its mobilization reported by Yadav *et al.,* (2011). Significantly superior grain yield (4.19 t/ha) was recorded in (T_7) 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 40 kg/ha Potassium, which was statistically at par with (T_1) 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 20 kg/ha Potassium, (T_4) 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 30 kg/ha Potassium,(T_5) 60 kg/ha Nitrogen + 40 kg/ha Phosphorus + 30 kg/ha Potassium and (T_8) 60 kg/ha Nitrogen + 40 kg/ha Phosphorus + 40 kg/ha Potassium. Increased grain yield due to varying levels of nutrients have also been reported by Munirathnam and Gautam, 2002 (90 kg N), Yadav and Yadav, 2004 (30 kg K), Guggari and Kalaghatagi, (2005) (60 kg N + 40 kg P), Singh *et al.*, 2010 (120 kg N).Nitrogen application increases the activity of cytokinins in plant which leads to the increased cell-division and elongation. Nitrogen is a component of porphyrins of chloroplasts and hence, increased nitrogen fertilization increased the growth and yield of crop due to increased photosynthates production. Varied responses in straw yield due to varied levels of nutrients have also been reported by Munirathnam and Gautam, 2002 (90 kg N), Yadav and Yadav, 2004 (30 kg K), Yadav *et al.*, 2011 (60 kg K), Jadav *et al.*, 2011 (120 kg N), Reddy *et al.*, 2016 (100 kg N).

Economics

Economic viability of crop management is the foremost criteria in transforming new investigations to farmers' field. The results pertaining to the cost: benefit analysis of the crop as influenced by nitrogen and potassium levels indicated that application of (T_7) 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 40 kg/ha Potassium recorded the highest gross, net returns and B:C ratio (2.95). The highest net return was obtained by application of nitrogen and potassium fertilization may have been due to the supply of their nutrients which synchronized with the peak period of nitrogen and potassium requirement that had produced higher yield by Reddy *et al.*, (2016).

In conclusion on the basis of one season experiment, application of 75 kg/ha Nitrogen + 40 kg/ha Phosphorus + 40 kg/ha Potassium is more productive and economically effective under rainfed conditions than the remaining treatment combinations.

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