

Original Research Article

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## Performance of Different Planting Density, Organic and Inorganic Sources of Nitrogen on Growth and Yield of Pearl millet (*Pennisetum glaucum* L.) in Eastern Region of Uttar Pradesh, India

Kusum Kumari<sup>1\*</sup>, Gautam Ghosh<sup>2</sup> and Amit Masih<sup>3</sup>

<sup>1</sup>SHUATS Allahabad, (U.P)-211007, India

<sup>2</sup>Department of Agronomy, <sup>3</sup>Department of Agriculture Economics,  
SHUATS Allahabad, (U.P)-211007, India

\*Corresponding author

### ABSTRACT

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A field experiment was conducted during the *kharif* season 2016 at the Crop Research farm of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (U.P.) to study the effect of organic and inorganic nutrient under different planting density of *kharif* pearl millet (*Pennisetum glaucum* L.). The experiment consisted of three planting density viz., 30 x 15 cms, 40 x 15 cms, 50 x 15 cms and four combined application of organic and inorganic sources of nitrogen viz., 100% RDN (80 kg ha<sup>-1</sup> N, 40 kg ha<sup>-1</sup> P, 40 kg ha<sup>-1</sup> K), 75 % RDN (80 kg ha<sup>-1</sup> N, 40 kg ha<sup>-1</sup> P, 40 kg ha<sup>-1</sup> K), + 25 % FYM, 50 % RDN (80 kg ha<sup>-1</sup> N, 40 kg ha<sup>-1</sup> P, 40 kg ha<sup>-1</sup> K), + 50% FYM, 25 % RDN (80 kg ha<sup>-1</sup> N, 40 kg ha<sup>-1</sup> P, 40 kg ha<sup>-1</sup> K), + 75 % FYM was laid out in randomized block design with three replications. The result revealed that treatment (T<sub>11</sub>) 50 x 15 cms + 50 % RDN + 50 % FYM produced significantly the highest plant height at 60 DAS (171.59 cm) and 80 DAS (174.62 cm), dry weight at 20 DAS (0.92 g hill<sup>-1</sup>), 40 DAS (13.17 g hill<sup>-1</sup>), 60 DAS (71.35 g hill<sup>-1</sup>) and 80 DAS (81.79 g hill<sup>-1</sup>), grain yield (3.70 t ha<sup>-1</sup>) and significantly higher length of ear (29.37 cm) and test weight (12.11 g) respectively. However significantly higher strover yield (8.99 t ha<sup>-1</sup>) was obtained in treatment (T<sub>1</sub>) 30 x 15 cms + 100 % RDN (80 kg ha<sup>-1</sup> N, 40 kg ha<sup>-1</sup> P, 40 kg ha<sup>-1</sup> K).

### Introduction

Pearl millet (*Pennisetum glaucum* L.) traditionally is an indispensable rainfed cereal crop grown for food and fodder purpose in arid and semi-arid regions. As the crop is hardy can tolerate extreme weather events and changing climatic conditions where other crops generally fail. In India, pearl millet is popularly known as Bajra (bajri), and it is the fifth most important cereal crop after rice, wheat, maize and sorghum. It has the greatest potential of yield among all the millets.

It is staple food for millions of people in the semi arid tropics. Among agronomical management practices, selection of suitable plant density, organic and inorganic sources of fertilizer and manures (FYM) application (Kumar *et al.*, 2009; Diwedi and Diwedi, 2007; Bhagchand and Gautam, 2000; Kumar *et al.*, 2007) is essential to make best use of limited availability level. In present condition intensive cultivation and increased cropping intensity deplete the soil fertility to some

extent. Moreover, chemical fertilizers are quite expensive and the small and marginal farmers are unable to use these in required amount. Therefore it is necessary to explore an alternative so that farmer can use the nutrients more efficiently. In the light of these observations, an experiment was laid out to know the effect of planting density, organic and inorganic sources of nitrogen on growth and yield of pearl millet.

## Materials and Methods

A field experiment was conducted at Crop Research Farm, Department of Agronomy, Naini School of Agriculture, SHUATS, Allahabad (U.P.) India (latitude 25° 24' 42" N, longitude 81° 50' 56" E and 98 m altitude above the mean sea level) on sandy loam soil during *kharif* season of 2016 to study the effect of planting density, organic and inorganic sources of nitrogen on growth and yield of pearl millet under U.P. east condition. The climate of the area is semiarid and subtropical. Summers are very hot and winters are very cool. Temperature is high as 40-45 °C (May-June) and as low as 6 °C are experienced. The average rainfall is 550 mm.

The treatment combinations consist of T<sub>1</sub> (30 x 15 cms + 100 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup>), T<sub>2</sub> (30 x 15 cms + 75 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 25 % FYM), T<sub>3</sub> (30 x 15 cms + 50 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50 % FYM), T<sub>4</sub> (30 x 15 cms + 25 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 75 % FYM), T<sub>5</sub> (40 x 15 cms + 100 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup>), T<sub>6</sub> (40 x 15 cms + 75 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 25 % FYM), T<sub>7</sub> (40 x 15 cms + 50 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50 % FYM), T<sub>8</sub> (40 x 15 cms + 25 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 75 % FYM), T<sub>9</sub> (50 x 15 cms + 100 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup>), T<sub>10</sub> (50 x 15 cms + 75 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 25 % FYM), T<sub>11</sub> (50 x 15 cms + 50 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50 % FYM), T<sub>12</sub> (50 x 15 cms + 25 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 75

% FYM). The experiment was laid out in randomized block design and replicated thrice. Full dose of farm yard manure (FYM) was applied 11 days before sowing. Half dose of nitrogen through urea as a basal and remaining was top dressed at 30-35 days after sowing. Full dose of phosphorus and potash was applied as diammonium phosphate and muriate of potash at the time of sowing. Pearl millet was sown in first week of September (due to heavy rainfall) by applying ridge and furrow planting pattern and harvested in second week of December when the crop reached its physiological maturity. The other crop management practices were followed as per standard recommendations. The growth yield attributing character and yield were recorded at harvest.

## Statistical analysis

The data recorded during the course of investigation was subjected to statistical analysis by “Analysis of variance technique”. The significant and non-significant treatment effects were judged with the help of ‘F’ (variance ratio) table. The significant differences between the means were tested against the critical difference at 5% probability level. Statistical analysis was performed for randomized block design (Gomez *et al.*, 1983). The data generated for one season and analysed statistically.

## Results and Discussion

### Effect of growth parameter on pearl millet

Data presented in (Table 1) plant height at 60 and 80 DAS, though the significantly higher value recorded was 171.29 and 174.62 cm in treatment T<sub>11</sub> 50 cm x 15 cm + 50% RDN + 50% FYM respectively. The increase in the plant height might be due to optimum plant population attributed to minimum intra-species competition which might help in proper utilization of natural resources *i.e.*

space, light, moisture, nutrient uptake and translocation, which ultimately linked with the plant growth and development in terms of plant height. Combined effect of organic (FYM) and inorganic sources of nitrogen released the nutrients probably at faster rate which enriched the soil and providing judicious amount of nutrients that are required to various metabolic processes facilitating faster vegetative growth and leads to higher internodal elongation and finally enhance the plant height (Amgain *et al.*, 2013).

At 60 DAS, higher number of tillers hill<sup>-1</sup> was recorded in treatment T<sub>11</sub> 50 cm x 15 cm + 50% RDN + 50% FYM (4.20). However, number of tillers hill<sup>-1</sup> recorded under the treatment T<sub>10</sub> 50 cm x 15 cm + 75% RDN + 25% FYM was statistically at par to the higher number of tillers hill<sup>-1</sup>. The higher number of tillers hill<sup>-1</sup> might be attributed to the fact that narrow row spacing intercept more radiation than wider row spacing owing to proper utilization of nutrients as well as moisture under optimum plant population. This may have enabled better vegetative growth leading to higher number of productive tillers hill<sup>-1</sup> reported by Satyajeet and Nanwal (2007). Application of organic manure with inorganic fertilizer provides greater and prolonged availability of nutrients to crop helps in enhancement of root growth and various biological activity of crop which stimulate rapid cell division and cell elongation for the productive growth of tillers (Amgain *et al.*, 2013).

The plant dry weight (Table 1) at 20, 40, 60 and 80 DAS, observed plant dry weight (0.92, 13.17, 71.35 and 81.79 g) showed statistically significantly the highest among treatments under T<sub>11</sub> 50 cm x 15 cm + 50% RDN + 50% FYM respectively. The increase in dry matter accumulation resulted in greater contribution of photosynthates synthesis to increase in

number of tillers and other plant growth attributes (Singh *et al.*, 2014).

### **Yield attributes and yield of pearl millet**

The data revealed that (Table 2) there was an increase in grain yield. Treatment T<sub>11</sub> (50 x 15 cms + 50 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50% FYM), recorded significantly highest value (3.70 t ha<sup>-1</sup>) of grain yield, which was 51.64% higher than lowest grain yield (2.44 t ha<sup>-1</sup>) observed in T<sub>4</sub> (50 x 15 cms + 25 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 75 % FYM). Application of organic and inorganic nutrient sources with optimum spacing of plants significantly enhanced the grain yield might be due to improvement in yield attributes (ear length, test weight etc.) which also necessary for sustaining higher productivity of pearl millet (Priyadarshani *et al.*, 2012; Jat *et al.*, 2013).

The data revealed that (Table 2) there was an increase in stover yield. Treatment T<sub>1</sub> (30 x 15 cms + 100 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup>), recorded significantly higher value (8.99 t ha<sup>-1</sup>) of stover yield, which was 36.00% higher than the lowest stover yield (6.61 t ha<sup>-1</sup>) observed in T<sub>12</sub> (50 x 15 cms + 50 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50% FYM). However, Treatment T<sub>5</sub> (40 x 15 cms + 100 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup>) was found statistically to be on a par with T<sub>1</sub> (30 x 15 cms + 100 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup>).

An increase in stover yield owing to fertilizer application through organic and inorganic sources of nutrients might be because of increased plant height and profuse tillering (Jat *et al.*, 2013). Data pertaining to earhead length showed that significantly higher value (29.37 cm) of ear length was observed in treatment T<sub>11</sub> (50 x 15 cms + 50 % RDN *i.e.* N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50% FYM) which was found 12.70% higher than the lowest value observed.

**Table.1** Effect of different planting density, organic and inorganic sources of nitrogen on growth attributes of Pearl millet (*Pennisetum glaucum* L.)

Treatment Combinations		Plant height (cm)		Number of tillers (hill <sup>-1</sup> )	Dry weight of plant (g hill <sup>-1</sup> )			
		60 DAS	80 DAS		20 DAS	40 DAS	60 DAS	80 DAS
T <sub>1</sub>	30cm x 15 cm + 100% RDN	160.20	165.86	2.53	0.85	10.55	66.14	76.43
T <sub>2</sub>	30 cm x 15 cm + 75% RDN + 25% FYM	165.17	171.18	2.73	0.79	11.69	69.33	78.18
T <sub>3</sub>	30 cm x 15 cm + 50% RDN + 50% FYM	168.37	157.77	3.27	0.83	12.73	70.01	79.53
T <sub>4</sub>	30 cm x 15 cm + 25% RDN + 75% FYM	156.51	157.10	2.33	0.72	10.00	62.38	75.17
T <sub>5</sub>	40cm x 15 cm + 100% RDN	163.71	167.48	2.60	0.78	10.86	67.11	77.08
T <sub>6</sub>	40 cm x 15 cm + 75% RDN + 25% FYM	166.39	172.96	3.07	0.86	11.84	69.67	78.29
T <sub>7</sub>	40 cm x 15 cm + 50% RDN + 50% FYM	169.23	159.25	3.47	0.91	12.79	70.34	80.24
T <sub>8</sub>	40 cm x 15 cm + 25% RDN + 75% FYM	159.36	164.86	2.40	0.71	10.00	64.72	76.38
T <sub>9</sub>	50cm x 15 cm + 100% RDN	166.54	173.21	2.73	0.79	11.39	67.76	77.42
T <sub>10</sub>	50 cm x 15 cm + 75% RDN + 25% FYM	171.12	171.29	3.60	0.89	12.95	70.78	81.34
T <sub>11</sub>	50 cm x 15 cm + 50% RDN + 50% FYM	171.59	174.62	4.20	0.92	13.17	71.35	81.79
T <sub>12</sub>	50 cm x 15 cm + 25% RDN + 75% FYM	166.77	167.88	3.13	0.89	12.19	69.72	76.43
F – test		S	S	S	S	S	S	S
S. Ed. (±)		0.87	0.80	0.36	0.04	0.21	0.92	0.96
CD (0.05%)		1.81	1.66	0.74	0.09	0.43	1.90	2.00

**Table.2** Effect of different planting density, organic and inorganic sources of nitrogen on yield and yield attributes of pearl millet (*Pennisetum glaucum* L.)

Treatment Combinations		Length of earhead (cm)	Test weight (g)	Grain yield (t ha <sup>-1</sup> )	Stover yield (t ha <sup>-1</sup> )
T <sub>1</sub>	30cm x 15 cm + 100% RDN	26.06	2.68	2.68	8.99
T <sub>2</sub>	30 cm x 15 cm + 75% RDN + 25% FYM	27.65	2.79	2.79	8.77
T <sub>3</sub>	30 cm x 15 cm + 50% RDN + 50% FYM	28.49	2.85	2.85	8.06
T <sub>4</sub>	30 cm x 15 cm + 25% RDN + 75% FYM	27.21	2.44	2.44	7.14
T <sub>5</sub>	40cm x 15 cm + 100% RDN	26.66	2.92	2.92	8.90
T <sub>6</sub>	40 cm x 15 cm + 75% RDN + 25% FYM	28.23	2.98	2.98	8.25
T <sub>7</sub>	40 cm x 15 cm + 50% RDN + 50% FYM	28.53	3.15	3.15	7.95
T <sub>8</sub>	40 cm x 15 cm + 25% RDN + 75% FYM	27.43	2.51	2.51	7.08
T <sub>9</sub>	50cm x 15 cm + 100% RDN	27.41	3.30	3.30	7.38
T <sub>10</sub>	50 cm x 15 cm + 75% RDN + 25% FYM	29.15	3.28	3.28	7.07
T <sub>11</sub>	50 cm x 15 cm + 50% RDN + 50% FYM	29.37	3.70	3.70	6.61
T <sub>12</sub>	50 cm x 15 cm + 25% RDN + 75% FYM	28.29	2.55	2.55	2.55
F – test		S	S	S	S
S. Ed. (±)		0.20	0.10	0.13	0.09
CD (0.05%)		0.41	0.22	0.27	0.18

However treatment T<sub>10</sub> (50 x 15 cms + 75 % RDN i.e. N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 25% FYM) was at par with treatment T<sub>11</sub> (50 x 15 cms + 50 % RDN i.e. N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50% FYM).

The probable reason for increases length of ear might be due to cumulative effect of growth and vigour of plants leads to increase supply of metabolites which have significant effect on growth character and yield attributes and also higher rate of photosynthesis as well as higher translocation of photosynthates from various plant organs to the development of ear length (Kumar *et al.*, 2015).

Treatment T<sub>11</sub> (50 x 15 cms + 50 % RDN i.e. N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50% FYM) registered maximum value (12.11 g) of test weight which was 22.81% higher than the lowest test weight (9.86 g) recorded in treatment T<sub>4</sub> (30 x 15 cms + 25 % RDN i.e. N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 75 % FYM). However, treatment T<sub>10</sub> (50 x 15 cms + 75 % RDN i.e. N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 25 % FYM) was found statistically at par with T<sub>11</sub> (50 x 15 cms + 50 % RDN i.e. N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50 % FYM) (Table 2).

An increase in test weight might be due to significant improvement in growth character and better mobilization of nutrients throughout the growth period which might have provided stability in higher supply of photosynthates towards the sink (grain/ear) revealed by Jat *et al.*, (2013).

It may be concluded that amongst all the treatments, treatment T<sub>11</sub> (50 x 15 cms + 50 % RDN i.e. N<sub>80</sub>P<sub>40</sub>K<sub>40</sub> kg ha<sup>-1</sup> + 50% FYM) has been found to be the best for obtaining the highest growth attributes, yield attributes and yield of pearl millet (*Pennisetum glaucum* L.). Since the findings are based on the research done in one season, it may be repeated for confirmation.

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