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# Influence of planting density and zinc on growth and yield of pearl millet (*Pennisetum glaucum* L.)

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**Abstract**
The field experiment titled "Influence of Planting density and Zinc on Growth and Yield of Pearl millet" was conducted during *kharif* season of 2023 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. The experiment was done under Randomized Block Design with ten treatments and replicated thrice. In treatment combination T6 (35 cm × 15 cm + 25 kg $ZnSO_4$/ha) results obtained that the higher plant height (155.8cm), plant dry weight (43.90 g/plant), length of ear head (27.5 cm), maximum number of grains / ear head (1986.0) were found to be significant.

**Keywords:** Planting density, zinc, pearl millet, growth parameters and yield attribute

## Introduction
After rice, wheat, and maize, pearl millet (*Pennisetum glaucum* L.) is the fourth-most significant cereal food crop in India and the sixth in the world. It is referred to locally as Bajra and popularly known as pearl millet, cat tail, spiked or bulrush millet. Not only is pearl millet a crop with the highest potential for grain production under challenging circumstances. Pearl millet accounts for 10.7% of the total amount of food grains produced. (Areshwar *et al*., 2016) [1]. In India, Pearl millet occupies an area of 7.8 million hectares with production of 9.25 million tones and productivity of 1270 kg/ha.

It is scarcely necessary to repeat that the only way to enhance the resource base in a country like India, where land is a limited resource and soil fertility is a limiting factor, is through greater productivity and the utilization of external inputs for this purpose. Therefore, it is essential to make the best use possible of inorganic fertilizers combined with crop residues, farm manures, green manures, and biological N2 fixation. Low level of nutrient utilization for selecting the right crop combination to use nutrients efficiently for long-term sustainability and to maximize profit from fertilizers. Among the causes of the low grain yields are nitrogen losses from wind erosion. (Virat and Singh 2021) [14].

An initial partial tackle to the fodder scarcity issue might be found in high density planting followed by alternating row harvesting for fodder at different growth stages. Significant improvements in planting density and seed rate result in higher plant heights, higher yields of green and dry matter, and higher dry matter contents. (Talasila *et al*., 2019) [13].

Zinc is a divalent cation that plays a significant part in human health as well as the many physiological and metabolic processes that plants go through. Zinc is a necessary component for crop production and plant growth and development. (Singh *et al*., 2017, 2000) [9].

Keeping in view the above fact, the experiment was conducted to find out the "Influence of Planting density and Zinc on growth and yield of Pearl millet".

## Material and Methods
The experiment was conducted during *kharif* season of 2023, at the Crop Research Farm (CRF), Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P) which is located at 25° 39' 42"N latitude, 81° 67 56" E longitude, and 98 m altitude above mean sea level. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.4)

with low level of organic carbon (0.28%), available N (219 Kg/ha), P (11.6 kg/ha) and K (217.2 kg/ha). This field experiment was selected to study the Influence of planting density and zinc on growth and yield of pearl millet, variety *Jaigrow* during 2023 with three different planting density (25 cm x 20 cm, 35 cm x 15 cm, 40 cm x 10 cm) and three levels of Zinc (15 Kg $ZnSO_4$/ha,20 Kg $ZnSO_4$/ha,25 Kg $ZnSO_4$/ha). The observations were recorded to know the Influence of planting density and zinc on growth parameters have been recorded is plant height, Dry weight and yield attributing characters such as length of ear head, number of grains per ear head. RDF was applied as basal at the time of sowing.

## Results and Discussion

### 1. Growth Parameters

Higher plant height (155.8cm) was observed in treatment-6 (35cm x 15cm + 25kg $znso_4$/ha), at 60 DAS, which was significantly superior over rest of the treatments. However, treatment 5 (35 cm x 15 cm + 20 kg $ZnS0_4$/ha) and treatment 8 (40 cm x 10 cm + 20 kg $ZnSO_4$/ha) and treatment 9 (40 cm x 10 cm + 25 kg $ZnSO_4$/ha) were found to be statistically at par with treatment 6 (35 cm x 15 cm + 20 kg $ZnS0_4$/ha).The significant and higher plant height was recorded with intra row spacing 35 cm x 15 cm might be due to increased growth in wide row spacing treatment was due to higher soil moisture conservation and better growth of plants. effective utilization of nutrients through the extensive root system. Similar results were reported by Subha *et al*. (2021) [16]. There was progressive increase in plant height, number of tillers and dry matter accumulation with zinc fertilizer. Similar results were reported by Ganapati and Savalagi (2006).

Higher plant dry weight (43.90 g/plant) was observed in in treatment 6 [35 cm x 15 cm + 25 kg $ZnSO_4$/ha] However, treatment 2(25 cm x 20 cm + 20 kg $ZnSO_4$/ha), treatment 3(25 cm x 20 cm + 25 kg $ZnSO_4$/ha), treatment 5 (35 cm x 15 cm + 20 kg $ZnS0_4$/ha) and treatment 9 (40 cm x 10 cm + 25 kg $ZnSO_4$/ha) were found to be statistically at par with treatment 6 (35 cm x 15 cm + 20 kg $ZnS0_4$/ha). Significantly showed effect on maximum diameter might be due to rapid photosynthetic rate by more leaf area exposed to sunlight that helped accumulation of dry matter in plant crop geometry. Similar results were reported by Ghuraiya *et al.,* (2021) [5]. Further, increase in plant dry weight with application Zinc might be due to it is essential for promoting certain metabolic reactions.it necessary for the production of chlorophyll and carbohydrates. Zinc is directly or indirectly required by several enzymes, auxin and protein synthesis. The nutrients applied in one crop or not fully utilized which leads to their residual effect on succeeding crop. Similar results were reported by Yadav and Singh (2021) [17].

### 2. Yield Parameters

#### 2.1. Length of ear head (cm)

The significant and maximum length of ear head/plant (27.5 cm) was observed in treatment 6 [35 cm x 15 cm + 25 kg $ZnSO_4$]. However, treatment 5[35 cm x 15 cm + 20 kg $ZnSO_4$/ha], and treatment 9 [40 cm x 10 cm + 25 kg $ZnSO_4$/ha] was found to be statistically at par with the treatment 6 [35 cm x 15 cm + 25 kg $ZnSO_4$/ha]. Significant and higher ear head length was recorded with the35 cm x 15 cm may be due to wider spacing allows for more lateral growth and can result in longer ear heads. Similar results were reported by Sangeeta and Surakod (2018) [10]. Yield attributing characters were recorded under application of phosphorous and Zinc @15 and 10 kg/ha and it was significantly higher over control. Similar results were reported by Girish *et al.* (2023) [3].

#### 2.2. Number of grains / ear head

Significantly maximum number of grains/ear head (1986.0) was observed in treatment 6 [35 cm x 15 cm + 25 kg $ZnSO_4$/ha]. However, treatment 5[35 cm x 15 cm + 20 kg $ZnSO_4$/ha] and treatment 9 [40 cm x 10 cm + 25 kg $ZnSO_4$/ha] were found to be statistically at par with the treatment 6 [35 cm x 15 cm + 25 kg $ZnSO_4$/ha]. significant and maximum number of grains /ear head was recorded with the 35 cm x 15 cm might be due to wider spacing tends to promote more extensive lateral branching and larger ear heads which can result in higher number of grains per ear head. Similar results were reported by Reddy *et al.* (2022) [15]. Further, increase in number of grains/ear head with the application of Zinc might be due to it plays a crucial role in plant growth and development and its deficiency can adversely affect grain yield in crops. Adequate zinc levels can positively influence the number of grains per ear head by supporting various physiological processes, including pollen development, fertilization and grain filling. Similar results were reported by Reddy *et al.* (2022) [15].

**Table 1:** Influence of Planting density and Zinc on growth parameters of Pearl millet

| Treatment No | Treatments | Plant height (cm) At 60 DAS | Plant dry weight (g/plant) At 60 DAS |
|---|---|---|---|
| 1 | 25 cm x 20 cm + 15 kg $ZnSO_4$/ha | 136.5 | 32.51 |
| 2 | 25 cm x 20 cm + 20 kg $ZnSO_4$/ha | 144.2 | 34.22 |
| 3 | 25 cm x 20 cm + 25 kg $ZnSO_4$/ha | 147.1 | 39.96 |
| 4 | 35 cm x 15 cm + 15 kg $ZnSO_4$/ha | 148.5 | 34.31 |
| 5 | 35 cm x 15 cm + 20 kg $ZnSO_4$/ha | 150.2 | 42.39 |
| 6 | 35 cm x 15 cm + 25 kg $ZnSO_4$/ha | 155.8 | 43.90 |
| 7 | 40 cm x 10 cm + 15 kg $ZnSO_4$/ha | 138.7 | 34.23 |
| 8 | 40 cm x 10 cm + 20 kg $ZnSO_4$/ha | 146.8 | 36.53 |
| 9 | 40 cm x 10 cm + 25 kg $ZnSO_4$/ha | 152.6 | 41.08 |
| 10 | 45 cm x 15 cm + $ZnSo_4$ (Control) | 136.5 | 31.79 |
| | SEm(±) | 4.26 | 2.25 |
| | CD (P=0.05) | 12.67 | 6.67 |

**Table 2:** Influence of Planting density and Zinc on yield attributes of Pearl millet

| S. No. | Treatments | Length of ear head/plant | Number of grains/ ear head |
|---|---|---|---|
| 1. | 25 cm x 20 cm + 15 kg $ZnSO_4$/ha | 23.9 | 1715.9 |
| 2. | 25 cm x 20 cm + 20 kg $ZnSO_4$/ha | 24.8 | 1707.8 |
| 3. | 25 cm x 20 cm + 25 kg $ZnSO_4$/ha | 25.5 | 1892.3 |
| 4. | 35 cm x 15 cm + 15 kg $ZnSO_4$/ha | 25.2 | 1816.5 |
| 5. | 35 cm x 15 cm + 20 kg $ZnSO_4$/ha | 26.4 | 1955.0 |
| 6. | 35 cm x 15 cm + 25 kg $ZnSO_4$/ha | 27.5 | 1986.0 |
| 7. | 40 cm x 10 cm + 15 kg $ZnSO_4$/ha | 24.5 | 1833.2 |
| 8. | 40 cm x 10 cm + 20 kg $ZnSO_4$/ha | 24.2 | 1871.0 |
| 9. | 40 cm x 10 cm + 25 kg $ZnSO_4$/ha | 26.1 | 1920.0 |
| 10. | 45 cm x 15 cm + $ZnSo_4$ (Control) | 22.1 | 1739.3 |
| | SEm(±) | 0.65 | 55.88 |
| | CD (p=0.05) | 1.94 | 166.04 |

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**Conclusion**
It is concluded that in pearl millet with the combination of 35 cm plant to plant and 15 cm Row to row and along with 25 kg $ZnSO_4$/ha (treatment 6) was observed highest grain yield and benefit cost ratio.

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