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RESEARCH PAPER

Response of nano N, Zn and Cu application on growth and yield of scented rice

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Abstract : The present experiment was conducted at Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *Kharif* season 2020-21. Entitled with " Response of Nano N, Zn and Cu application on growth and yield of scented rice" including nano fertilizer nutrients with recommended dose of fertilizer 60:40:30 NPK kg ha^{-1}. The experiment was presented in Randomized Block Design with three replication . The treatments was consisted of eigth treatments *viz.,* Result revealed that treatment T_8 (100 % PK + 50% N + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP), resulted the highest plant height, number of effective tillers at harvest , number of tillers per meter length at harvest, grain yield (32.83 qha^{-1}), straw yield (66.51 q ha^{-1}). Which was significantly superior over other treatments but was at par with T_6 (100% PK + 50% N + 2 spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP) with (28.91 qha^{-1}) grain yield closely followed by the treatment T_7, T_5,T_3.

Key Words : Response of nano N, Zn, Cu application, Growth, Yield, Scented rice

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INTRODUCTION

Rice (*Oryza sativa* L.) is the world's largest staple food crop. An average productivity of 0.85 tonne ha^{-1}, 5 million tonnes of rice were produced from 0.7 million hectares, accounting for 1.5 per cent of total rice area. The majority of aromatic rice trade is located in India, Pakistan and Thailand. India produces more than 40% of overall production and has more than 30% of total cultivated land. In India rice production for 2015-16 amounts to 104.41 million tonnes, 2400 kg ha^{-1} of production covering an area of 434.99 lakh hectares. The field size decreased to 431.94 lakh hectare in 2016-17 with an increase in 110.15 million tonnes of output and 2500 kg ha^{-1} of productivity (Annual report of 2017-18). Chhattisgarh is historically known as an Indian bowl of rice. In the state, there are more than 23,250 rice varieties. Rice is grown in 3.79 million hectares in Chhattisgarh, which covers 8.58 per cent of India and yields 6.91 million tonnes on average (Anonymous, 2018).

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Norio Taniguchi coined the phrase "nanotechnology" in 1974. The term "nanotechnology" comes from the Greek word "nanos," which meaning "dwarf.". Nanotechnology is described as the study and management of materials with dimensions ranging from 1 to 100 nan ometers, where unique physical features allow for novel applications. Nano particles : Nano particle is defined based on the size at which fundamental properties differ from those of the corresponding bulk material (Banfield and Zhang, 2001). In plants, zinc plays a key role in many important biochemical metabolic pathways as a structural component or regulatory cofactor of various enzymes. They are mainly related to carbohydrate metabolism (photosynthesis and conversion of sugar to starch). Protein metabolism, growth hormone metabolism (growth regulators), pollen production, maintenance of biofilm integrity and resistance to infections by certain pathogens (Alloway, 2004). Copper (Cu) is known as an essential component, which functions in regulating plant growth and development, including chlorophyll formation and seed production (Viera *et al*., 2019). Copper is a micronutrient that is required for normal plant growth. Because it exists in several oxidative states (Cu_2^+, Cu^+) in vivo, it is engaged in a variety of physiological activities (Yruela, 2005).

MATERIAL AND METHODS

A field experiment was conducted at Instructional Farm, The present experiment was conducted at Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *Kharif* season 2020-21. Experiment was laidout in Randomized Block Design (RBD) with the eight treatments and replicated three. The test was variety scented rice 'Vishnubhog'. Crop was sown in first week of August and harvest in first week of December. The soil of the experimental field was neutral in reaction 6.2 and clay loam soil in texture. The soil was categorized as medium inorganic carbon (0.64%), low in available nitrogen (150 kg ha^{-1}) and medium in available phosphorus (13.88 kg ha^{-1}), Potassium content (204.96 kg ha^{-1}) organic carbon (0.64%) and electrical conductivity (0.25 dS m^{-1} at 25°C). there were eight total treatment combinations under study T_1 (Control , 100% PK), T_2 (100% PK + 2 spray of nano N @ 4 ml $liter^{-1}$ water at 25 and 50 DAP), T_3 (100 % PK + 2 spray of nano N + Zn @ 4 + 2 ml $liter^{-1}$ of water at 25 and 50 DAP), T_4 (100% PK+2 spray of nano N + Cu @ 4 + 2 ml $liter^{-1}$ of water at 25 and 50 DAP), T_5 (100% PK + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml $liter^{-1}$ of water at 25 and 50 DAP), T_6 (100% PK + 50% N + 2 spray of nano N + Zn @ 4 + 2 ml $liter^{-1}$ of water at 25 and 50 DAP), T_7 (100 % PK + 50% N + 2 spray of nano N + Cu @ 4 + 2 ml $liter^{-1}$ of water at 25 and 50 DAP), T_8 (100 % PK + 50% N + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml $liter^{-1}$ of water at 25 and 50 DAP). Vishnubhog variety was sown by line transplanting method with a row spacing of 20 cm and plant to plant spacing 10 cm apart and seed rate was 40 kg ha^{-1}. The recommended dose of fertilizers for scented rice are 60: 40: 30 kg of N, P_2O_5, K_2O ha^{-1}, respectively. Full dose of P_2O_5, K_2O and 50% of Nitrogen were applied at the time of transplanting. Plant protection measures and irrigations were provided as and when required for all the treatments. Regular biometric observations were recorded at periodic intervals of 30 DAP, 60 DAP, 90DAP and at harvest stage of selected plants. Growth parameters were recorded just before harvesting of crop. Harvesting was done when the panicle matured and plant was dried up. The threshing of the crop was done by manually by plot wise and grain and straw where conducted separately. The grain yield was recorded as kg $plot^{-1}$ and then conducted into q ha^{-1}. The straw yield was calculated by the subtracting grain yield from the biological yield. Statistical data were analyzed by standard procedure by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Plant height:

A significant effect of nano and non-nano fertilizers was observed on plant height at all the crop growth stages till 90 DAP. Among the applied treatments, T_8 (100 % PK + 50% N + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml $liter^{-1}$ of water at 25 and 50 DAP) recorded significantly higher plant height (158.27 cm) as compare to other treatments at the time of harvest. However, it was at par with treatment T_6 (100% PK + 50% N + 2 spray of nano N + Zn @ 4 + 2 ml $liter^{-1}$ of water at 25 and 50 DAP) were at par with each other. The significantly lowest plant height (110.21cm) was observed in treatment T_1 (control , 100% PK). The similar trend was observed in each duration.

Number of effective tillers per meter length at harvest:

Among the applied treatments, T_8 (100 % PK + 50% N + 2 Spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP) observed significantly higher number of effective tiller per meter square (158.14) as compare to other treatments at the time of harvest. However, it was at par with treatment T_6 (100% PK + 50% N + 2 Spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP). The significantly lowest number of effective tiller per meter square (130.80) was observed in treatment T_1 (control 100% PK). The result are on conformity with the finding of Mehta Swati and Bharat Rajeev (2019) and Lodh Banashri (2016).

Number of tillers per meter length at harvest:

Significant effect of nano and non-nano fertilizers on number of tillers per meter length at all the crop growth stages till harvest. Among the applied treatments, T_8 (100 % PK + 50% N + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP) resulted significantly higher number of tillers per meter length (162.45) as compare to other treatments at the time of harvest. However, it was found at par with treatment T_6 (100% PK + 50% N + 2 spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP) . The significantly lowest number of tillers per meter length (132.51) was observed in treatment T_1 (control , 100% PK). The results are on conformity with the finding of Lodh banashri (2016) and Shivay *et al.* (2016).

Grain yield:

The use of nano and non-nano fertilizers had significant effect on the grain yield (q ha^{-1}). Data

Table 1 : Effect of nano N, Zn and Cu application on plant height (cm) at harvest, no. of tillers per meter length at harvest and no. of effective tillers per meter lenght at harvest

Treatments		Plant height at harvest	No.of tillers per meter length at harvest	No. of effective tillers per meter lenght at harvest
T_1	Control , 100% PK	110.21	132.51	130.80
T_2	100% PK + 2 spray of nano N @ 4 ml liter^{-1} water at 25 and 50 DAP	114.19	138.15	137.82
T_3	100 % PK + 2 spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP	140.40	147.35	144.68
T_4	100% PK + 2 spray of nano N + Cu @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP	139.22	144.36	139.36
T_5	100% PK + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP	146.48	152.76	146.76
T_6	100% PK + 50% N + 2 spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP	154.52	158.55	154.41
T_7	100 % PK + 50% N + 2 spray of nano N + Cu @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP	150.28	154.48	149.95
T_8	100 % PK + 50% N + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP	158.27	162.45	158.14
S.E.±		1.55	1.57	1.34
C.D. (P = 0.05)		4.72	4.76	4.05

Table 2 : Effect of nano N, Zn and Cu application on grain yield and straw yield

Treatments		Grain yield	Straw yield
T_1	Control , 100% PK	21.98	45.72
T_2	100% PK + 2 spray of nano N @ 4 ml liter^{-1} water at 25 and 50 DAP	24.86	50.23
T_3	100 % PK + 2 spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP	26.30	53.63
T_4	100% PK + 2 spray of nano N + Cu @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP	26.76	54.71
T_5	100% PK + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP	27.25	55.76
T_6	100% PK + 50% N + 2 spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP	30.58	62.34
T_7	100 % PK + 50% N + 2 spray of nano N + Cu @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP	29.89	60.30
T_8	100 % PK + 50% N + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP	32.83	66.51
S.E.±		0.96	1.86
C.D. (P = 0.05)		2.91	5.65

pertaining of yield recorded and presented in Table 1. Among the applied treatments, T_8 (100 % PK + 50% N + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP) observed significantly higher grain yield (32.83 q ha^{-1}) as compare to other treatments. However, it was at par with treatment T_6 (100% PK + 50% N + 2 spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP). The significantly lowest grain yield (21.98 q ha^{-1}) was observed in treatment T_1 (control 100% PK). This is on close agreement with finding of Parihar *et al.* (2017); Rathia Neeta (2019) and Lodh Banashri (2016).

Straw yield:

The integrated use of nano and non-nano fertilizers had significant effect on the straw yield (q ha^{-1}). Data recorded and presented in Table 2. Among the applied treatments, T_8 (100 % PK + 50% N + 2 spray of nano N + Cu + Zn @ 4 + 2 + 2 ml liter^{-1} of water at 25 and 50 DAP) resulted in significantly higher straw yield (66.51 q ha^{-1}) as compare to other treatments. However, it was over at par with treatment T_6 (100% PK + 50% N + 2 spray of nano N + Zn @ 4 + 2 ml liter^{-1} of water at 25 and 50 DAP). The significantly lowest straw yield (45.72 q ha^{-1}) was observed in treatment T_1 (control 100% PK). The results are on conformity with the finding of Apoorva *et al.* (2017); Parihar *et al.* (2017); Rathia Neeta (2019) and Lodh Banashri (2016).

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