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Effect of nitrogen and zinc, iron application on growth and yield attributes of rice

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Abstract
A field experiment was conducted to determine the influence of Nitrogen and Zinc, Iron on growth and yield of Rice at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj, UP, during the *Kharif* season of 2023. The experiment was laid out in Randomized Block Design with ten treatment Combinations and three replications in which there were three levels of zinc and iron (10,15 and 20 kg/ha) and three levels of (Nitrogen 80,70, 60 kg/ha) and Nano urea (2, 3, 4 ml/L)) and a control (120-60-60 NPK kg/ha). Among the various treatment combinations Significantly highest plant height (104 cm), number of tillers/hill (16.00), dry weight (52.13 g/hill), number of productive tillers/m^2 (297.48), number of grains/panicle (84.50), test weight (18.07 g) were recorded in treatment-9 with application of Nitrogen 60 kg/ha, Zinc 20 kg/ha and Iron 20 kg/ha along with Nano Urea 2 ml/L in rice crop.

Keywords: Iron, nano urea, zinc, yield

Introduction
Rice (*Oryza sativa* L) is a basic staple food and also main source of carbohydrates which including two-thirds of the world's population of India. Rice is edible starchy cereal grain belong to the family Poaceae, chromosome number (2n = 24). Rice is grown in 46.38 M ha in India with the production level of 130.29 M t and the average productivity is about 2809 kg/ha. Uttar Pradesh is the second largest growing state of rice after West Bengal in the country. Rice crop production in Uttar Pradesh was 15.27 M t from an area of 5.70 M ha and productivity of 2679 kg/ha (Agricultural Statistics at a Glance, 2022).

Micronutrients are involved in metabolism of rice, including chlorophyll synthesis, enzyme activation and membrane integrity major physiological activities like photosynthesis and respiration, which deficiency can inhibit these major physiological activities leads in down fall of yield gain (Afreen *et al*., 2021) [2]. Zinc (Zn) is one of the 17 essential elements necessary for the normal growth and development. Zinc plays major role in enzymes and controls numerous biochemical activities in the plants required. Iron also plays major role synthesis of chlorophyl, respiration, photosynthesis, chlorophyll synthesis, and many other. In Sometimes severe chlorosis caused due to Fe deficiency can lead to rice crop failure (Soumya *et al.*,2022) [8].

Nitrogen owning its major key role in chlorophyll production, which is essential for the photosynthesis process. Nitrogen being a component of amino acids, nucleic acids, nucleotides, chlorophyll, enzymes, and hormones. N promotes rapid plant growth and improves grain yield and grain quality through higher tillering, grain formation and filling, and protein synthesis. Nano-urea (urea in liquid form) has been developed by IFFCO using Nanotechnology for agricultural use. Urea molecules of 20-50 nanometer size provide nitrogen to the crops in a targeted manner. The size of one nano liquid particle has 10,000 times more surface area to volume size compared to the conventional granular urea. Due to ultra-small size and surface properties, the nano-urea liquid gets absorbed by plants more effectively when sprayed on their leaves (Namasharma *et al*., 2023) [6]. Nano-urea has already proved to increase the crop yield by an average of 8% against conventional urea, besides improving the quality of produce. Without compromising soil productivity nano urea decreases the need for urea by half or more while improving crop production, soil health. (Midde *et al.*, 2022; Bhargavi *et al*., 2023) [5, 4].

Keeping in view the importance of zinc, iron and Nano urea application, the present study "Effect of nitrogen and zinc, iron application on growth and yield of Rice" was undertaken.

Material and Methods

At the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.), the experiment was carried out during the kharif season. After being cultivated in a nursery, seedlings of the rice variety Sahbhagi Dhan were transplanted with a 30 cm × 10 cm spacing. After removing two rows from each side of the plot, which measured three meters by three meters, five rice plants were chosen and tagged for measurements of plant height, number of tillers/hill, and yield attributes. Sampling for dry weight was carried out from the border row. Gomez & Gomez's (1984) randomized block design was used to statistically examine the data gathered for various factors. A 5% level of significance (p=0.05) is used to display the results in order to compare the various treatments.

Results and Discussion

Growth parameters

Table 1. Embodies the data regarding growth attributes like plant height, number of tillers/hill and dry weight.

1. Plant height

At 100 DAT, significantly higher plant height (104.00 cm) was recorded in (treatment 9) with application of Nitrogen 60 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 2 ml/L whereas, (treatment 8) was found to be statistically at par with the higher. Nano encapsulated nitrogen effectively releases nutrients, regulating plant development and meristematic activity (Midde *et al*., 2022) [5]. Increase in plant height was mainly due to Zn and Fe application helpful in synthesis of growth promoting hormones (auxin production) which induce rapid cell division in meristematic cells increased plant height (Baishya *et al.*, 2019) [3].

2. Number of tillers/hill

At 100 DAT, Significantly higher number of tillers/hill (12.80) was recorded in (treatment 9) with application of Nitrogen 60 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 2 ml/L whereas, Nitrogen 70 kg /ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 3 ml/L (treatment 5), Nitrogen 70 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 3 ml/L (treatment 6), Nitrogen 60 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha + Nano Urea 2 ml/L (treatment 7) and Nitrogen 60 kg/ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 2 ml/L (treatment 8) were found to be statistically at par with the higher. Increased photosynthetic process, synthesis of chlorophyll and protein and nitrogen fixation due to application of zinc and iron (Rao *et al*., 2019) [7]. Better growth performance was obtained with foliar application of nano-urea in conjunction with inorganic N-fertilizer (urea), which might be due to higher nitrogen use efficiency (NUE) of nano-urea (Namasharma *et al*., 2023) [6].

3. Dry weight

At 100 DATS, ignificantly higher dry weight (52.13 g) was recorded in (treatment 9) Nitrogen 60 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 2 ml/L whereas, Nitrogen 60 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha Nano Urea 2 ml/L (treatment 7) and Nitrogen 60 kg/ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 2 ml/L (treatment 8) were found to be statistically at par with the higher. The larger surface area, particle size less than the leaves can easily penetrate into the plant and improve nutrient use efficiency leads to high dry matter production (Midde *et al*., 2022) [5]. Nano urea application in their critical stage (tillering and PI), may lead to adequate nitrogen availability leading to cell elongation, activity of meristematic cells and dry matter produce (Bhargavi *et al*., 2023) [4].

Yield attributes

Table 2. Embodies data of yield attributes.

1. Number of productive tillers/ m^2

Significantly higher number of productive tillers/m^2 (297.48) wa s recorded in (treatment 9) Nitrogen 60 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 2 ml/L whereas, treatment 7 and treatment 8 were fo und to be statistically at par with the higher.

2. Number of grains/panicle

Significantly higher number of grains/panicle (84.50) was recorded in (treatment-9) with application of Nitrogen 60 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 2 ml/L whereas, treatment-8 was found to be statistically at par with the higher.

3. Test weight

Higher test weight (18.07 g) was recorded in (treatment-9) with application of Nitrogen 60 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + NanoUrea2 ml/L whereas, Nitrogen 70 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 3 ml/L (treatment 6), Nitrogen 60 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha + Nano Urea 2 ml/L (treatment 7) and Nitrogen 60 kg/ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 2 ml/L (treatment 8) were found to be statistically at par with the higher.

Significant increase in yield attributes and yield might due to the he favourable influence of applied zinc on yield may be due to its catalytic or stimulatory effect on most of the physiological and metabolic process of plant. Zinc and iron plays a major role in biosynthesis of IAA and which promotes the yield (Rao *et al*., 2019) [7]. Increased growth of plant parts and metabolic processes such as photosynthesis that finally led to higher photosynthates accumulation and translocation to the economic plant parts due to application nano urea have accelerated the yield (Namasharma *et al*., 2023) [6].

Table 1: Effect of Nitrogen and Zinc, Iron application on growth parameters of rice crop.

S.no	Treatments	Plant height (cm)	Plant dry weight (g/hill)	Number of tillers/hill
1.	Nitrogen 80 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha + Nano Urea 4 ml/L	91.67	47.70	12.80
2.	Nitrogen 80 kg /ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 4 ml/L	93.00	48.67	13.27
3.	Nitrogen 80 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 4 ml/L	94.50	49.50	13.80
4.	Nitrogen 70 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha + Nano Urea 3 ml/L	95.00	49.97	14.33
5.	Nitrogen 70 kg /ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 3 ml/L	96.33	50.20	14.80
6.	Nitrogen 70 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 3 ml/L	97.67	50.90	15.07
7.	Nitrogen 60 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha + Nano Urea 2 ml/L	99.67	51.20	15.40
8.	Nitrogen 60 kg /ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 2 ml/L	102.00	51.83	15.53
9.	Nitrogen 60 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 2 ml/L	104.00	52.13	16.00
10.	120-60-60 kg NPK/ha (Control)	89.00	46.80	12.77
	F-test	S	S	S
	S.Em (±)	0.77	0.41	0.17
	CD (p=0.05)	2.28	1.23	0.52

Table 2: Effect of Nitrogen and Zinc, Iron application on yield attributes of rice

S.no	Treatments	Number of productive tillers/m^2	Number of grains/panicle	Test weight (g)
1.	Nitrogen 80 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha + Nano Urea 4 ml/L	269.95	73.33	17.27
2.	Nitrogen 80 kg /ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 4 ml/L	273.95	73.67	17.37
3.	Nitrogen 80 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 4 ml/L	276.39	76.40	17.47
4.	Nitrogen 70 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha + Nano Urea 3 ml/L	277.72	78.53	17.50
5.	Nitrogen 70 kg /ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 3 ml/L	279.72	79.93	17.57
6.	Nitrogen 70 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 3 ml/L	281.94	80.73	17.77
7.	Nitrogen 60 kg/ha + Zinc 10 kg/ha + Iron 10 kg/ha + Nano Urea 2 ml/L	290.82	81.57	17.87
8.	Nitrogen 60 kg /ha + Zinc 15 kg/ha + Iron 15 kg/ha + Nano Urea 2 ml/L	293.04	82.80	18.00
9.	Nitrogen 60 kg/ha + Zinc 20 kg/ha + Iron 20 kg/ha + Nano Urea 2 ml/L	297.48	84.50	18.07
10.	120-60-60 kg NPK/ha (Control)	264.40	73.13	17.17
	F-test	S	S	S
	SEm (±)	4.24	0.77	0.16
	CD (p=0.05)	12.61	2.31	0.48

Conclusion

It is concluded that in rice crop (treatment-9) Nitrogen 60 kg/ha, Zinc 20 kg/ha and Iron 20 kg/ha along with Nano Urea 2 ml/L is recommended under Eastern Uttar Pradesh Agro-Climatic conditions for higher growth and yield of rice.

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