Effect of nano potassium and nano zinc on growth and yield enhancement in wheat (*Triticum aestivum* .L)

ABSTRACT

The field experiment was conducted during *Rabi* season 2022 at experimental field of Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, Uttar Pradesh, India. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), low in organic carbon (0.48%), available nitrogen (230 kg/ha), available phosphorus (13.60 kg/ha) and available potassium (215.4 kg/ha). The treatment consists of 3 levels of Nano potassium 25, 40, 55 ppm and Nano zinc 60, 80, 120 ppm along with control. The experiment was layout in Randomized Block Design with ten treatments each replicated thrice. Higher plant height (93.43 cm), plant dry weight (26.99 g), tillers/running row meter (73.57) and the yield attributes namely spike length (11.93 cm), grains/spike (51.67), spikes/running row meter (62.90), effective tillers/running row meter (60.10), grain yield (6.61 t/ha) and straw yield (8.90 t/ha were obtained highest in the treatment 9 [Nano potassium 55ppm + Nano zinc 120ppm].

Keywords: *Wheat, Nano-potassium, Nano-Zinc, Growth and Yield.*

INTRODUCTION

"Wheat (*Triticum aestivum* L.) is a major source of diet for India's growing population, providing half of the dietary protein and more than half of the calories. As a result, scientists are constantly striving to increase yields in order to feed the nation". (**Khan *et al.*, 2015**). It is estimated that annual cereal production should be increased by 1 billion tonnes to feed the 9.1 billion people expected by 2050. To meet the increased food supply requirements, crop productivity must be increased in the current scenario. Wheat is grown in tropical and subtropical regions that are subject to a great deal of stress. The yield is reduced as a result of these stresses. Cold, salinity, heat, and drought are among the major environmental stresses affecting its yield. However, water and heat are regarded as the primary environmental stresses that have resulted in a reduction in wheat yield globally. To increase wheat production, genetic improvements in yield and stress tolerance are required.

According to FAO estimates, "the world will need approximately 840 million tonnes of wheat by 2050, up from the current production level of 642 million tonnes". "This demand does not include animal feed requirements or the negative effects of climate change on wheat production. To meet this demand, developing countries should increase wheat production by 77%, with vertical expansion accounting for more than 80% of demand". (**FAO, 2009**).

"Wheat is a staple crop in many countries and hence its consumption is directly proportional to the population growth. Consumption of wheat in rural India has increased apparently due to the availability of nutritious cereal. The share of wheat in total cereals consumption has increased from 25.43 per cent (3.88 kg/ month) in 1972-73 to 37.36 per cent (4.24 kg/ month) in 2009-10 (rural India) while a marginal increase from 42.88 per cent (4.82 kg/ month) to 43.54 per cent (4.08 kg/ month) was observed in urban India" (**Sendhil *et al.* 2012**).

Nanotechnology is a new frontier for the scientific community, and it can be used as an alternative strategy in a variety of fields, including agriculture (**Bhattacharyay *et al.* 2020**). In this context, nanotechnology, such as the use of nanoscale fertilizers, suggests novel crop management strategies (**Hossain *et al.* 2021; Seyed *et al.* 2021).** In recent years, there has been a lot of focus on using nanotechnologies and plant biotechnology in agriculture to increase plant production, improve plant tolerance to environmental stress, improve nutrient use efficiency, and mitigate hazardous environmental effects, as opposed to traditional bulk materials methods (**Abdel *et al.*, 2022**). The nano particles have the potential to make plants use fertilizers more efficiently and environmentally benign since their nano-scales enable for uptake through stomata and the base of trichomes, increasing fertilizer use efficiency. The most important use of nanotechnology in agricultural crop production is the field of nano fertilizers, which, unlike traditional fertilizers, can feed plants gradually and in a controlled manner. These nano fertilizers have the potential to be more effective, reducing soil pollution and other environmental problems associated with chemical fertilizers (**Salhy *et al.*, 2021**).

The nutritional value of 100 g of raw whole-grain wheat (bran, endosperms, germ) :340-360 kcal 10.3 g protein (gluten), 1 g total fat, 73.6 g carbohydrates, 2.7 g fiber, 15 mg Calcium, 1.2 mg Iron, 22 mg Magnesium, 108 mg Phosphorus, 107 mg Potassium, 2 mg Sodium, 0.7 mg Zinc, 0.1 mg Thiamin (B1), 0.04 mg Riboflavin (B2), 1.3 mg Niacin (B3), 0.04 mg Vit. B6, 26 DFE Folate. It has "gluten" protein that is higher than other cereals which is essential for bread making. The crop has been cultivated near about 216.6 million hectares with a production of 674.88 million tonnes of grain with 3115 kg/ha productivity (2012-13). India (29.90 million ha) ranks first in area coverage followed by China (24.13 million ha), while in production China stands first (120.50 million tonnes) and India ranks second (94.8 million tonnes). As regard the average yield of wheat in the world per hectare, France (75 q/ha) ranks first followed by Germany (73 q/ha).

MATERIALS AND METHODS

The methodology, materials, and the techniques adopted in this present experiment entitled, "Effect of nano potassium and nano zinc on growth and yield of wheat", was carried out at Crop Research Farm of the Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during *Rabi* season of 2022. In order to study the two nutrients, nano potassium and nano zinc are taken. The experiment was conducted at during *Rabi* 2022, at Crop Research Farm, Naini Agricultural Institute, SHUATS, Prayagraj. The experimental site of the study is geographically located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level (MSL). The soil of the experimental field constituting a part of central Gangetic alluvium is neutral and deep. Pre- sowing soil samples were taken from a depth of 15 cm with the help of an auger. The composite samples were used for the chemical and mechanical analysis. The soil was sandy loam in texture, low in organic carbon (0.36%) and medium in available nitrogen (171.48 kg/ha), phosphorous (15.2 kg/ha) and low in potassium (232.5 kg/ha). Growth characteristics namely plant height (cm), plant dry weight (g), tillers/running row meter were recorded. The crop was completely harvested at physiological maturity stage and their post-harvest observations such as number of grains/spike, spikes/running row meter, effective tillers/running row meter, grain yield (t/ha) and straw yield (t/ha) were recorded. "The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described" by **Gomez (1984).**

RESULTS AND DISCUSSIONS

GROWTH PARAMETERS

At 120 DAS, significantly higher plant height (93.43 cm) was recorded in the treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm]. However, treatment no.8 [Nano-potassium 120 ppm + Nano-zinc 80 ppm] was found to be statistically at far with treatment no. 9. Maximum plant dry weight (26.99 g) was recorded in the treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm]. However, treatment no.8 [Nano-potassium 55 ppm + Nano-zinc 80 ppm] was found to be statistically at far with treatment no. 9. Higher tillers/Running row meter (10.53) was recorded in the treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm]. However, treatment no.8 [Nano-potassium 55 ppm + Nano-zinc 80 ppm] was found to be statistically at far with treatment no. 9.

"Potassium is involved in number of physiological processes, protein synthesis and activation of enzymes. Recent studies showed declining status of K in Indian soils in most of the states from high to medium or medium to low status" **Bras *et al.*, (2011). "**Potassium aggregating agent which is known to have positive effect on soil physical properties such as plant height, healthy growth etc and subsequently crop yields". **Reddy S and Singh S.**

"Zinc have played a vital role in the vegetative growth especially under low temperature ambient and rhizosphere regime and adequate availability of zinc to young and developing plants resulting in sufficient growth and development" **(Singh et al., 2012).** "Continuous and balanced supply of nutrients right from the early stage of growth result in vigorous plant growth which eventually may have resulted in increased dry-matter accumulation" **(Pooniya and Shivay, 2011)**

"Zn application to crops on nutrient metabolism, biological activity and growth parameters and hence, applied zinc resulted in taller and higher enzyme activity which in turn encourage more tillers/plant". **Naik *et al.*, (2020).**

YIELD ATTRIBUTES

At harvest, the data recorded higher grains/spike (51.67) in treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm]. However, treatment no.8 [Nano-potassium 55 ppm + Nano-zinc 80 ppm] was statistically at par with treatment no.9. Higher tillers/row meter (60.10) in treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm]. However, treatment no. 7 [Nano-potassium 55 ppm + Nano-zinc 60 ppm] and treatment no.8 [Nano-potassium 55 ppm + Nano-zinc 80 ppm] was statistically at par with treatment no.9. Higher spikes/running row meter (62.90) in treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm]. However, treatment no. 7 [Nano-potassium 55 ppm + Nano-zinc 60 ppm] and treatment no.8 [Nano-potassium 55 ppm + Nano-zinc 80 ppm] was statistically at par with treatment no.9. Higher grain yield (6.61 t/ha) in treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm]. However, treatment no.7 [Nano-potassium 55 ppm + Nano-zinc 60 ppm] and treatment no.8 [Nano-potassium 55 ppm + Nano-zinc 80 ppm] was statistically at par with treatment no.9. Higher stover yield (8.51 t/ha) in treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm]. However, treatment no.7 [Nano-potassium 55 ppm + Nano-zinc 60 ppm] and treatment no.8 [Nano-potassium 55 ppm + Nano-zinc 80 ppm] was statistically at par with treatment no.9.

Potassium aggregating agent which is known to have positive effect on soil physical properties such as plant height, healthy growth etc and subsequently crop yields. Similar results reported by **Reddy S and Singh S.** Potassium aggregating agent which is known to have positive effect on soil physical properties such as plant height, healthy growth etc and subsequently crop yields. Similar results reported by **Mownika *et al.* (2021).**

Zinc plays a significant role in enzyme activation, chlorophyll biosynthesis, pollen tube formation and pollen viability, starch utilization ensuing in greater seed set. Similar results were reported by **Arif *et al.* (2017).** Zn application to crops on nutrient metabolism, biological activity and growth parameters and hence, applied zinc resulted in taller and higher enzyme activity which in turn encourage more tillers/plant. Similar findings have been reported earlier by **Naik *et al.*, (2020).** Zinc plays a vital role in increasing straw yield because zinc takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization and biomass accumulation which enhanced haulm yield. Zinc also converts ammonia to nitrate in crops which contribute to yield. The similar findings were reported by **Pradhan *et al.* (2016). "**The increase in the grain yield is attributable to the improved physiology of plants with the added Zn consequently correcting the efficiency of different enzymes, chlorophyll content, IAA hormone and improvement in nitrate conversion to ammonia in plant leading to higher yield" **Hacisalihoglu *et al.*, 2003.** Zinc plays a vital role in increasing straw yield because zinc takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization and biomass accumulation which enhanced haulm yield. Zinc also converts ammonia to nitrate in crops which contribute to yield. The similar findings were reported by **Pradhan *et al.* (2016).**

CONCLUSION

From the observations, it was concluded that with the application of Nano-potassium 55 ppm along with Nano-zinc 120 ppm (treatment 9) in wheat was recorded significantly higher plant height (93.43 cm), plant dry weight (26.99 g), tillers/running row meter (73.57) and the yield attributes namely spike length (11.93 cm), grains/spike (51.67), spikes/running row meter (62.90), effective tillers/running row meter (60.10), grain yield (6.61 t/ha) and stover yield (8.90 t/ha) was with the treatment 9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm].

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Table 1: Effect of nano potassium and nano zinc on growth attributes of wheat.

S. No.	Treatment combinations	Plant height (cm)	Plant dry weight (g)	Tillers/running row meter
1.	Nano potassium 25ppm + Nano zinc 60p	88.40	25.25	70.03
2.	Nano potassium 25ppm + Nano zinc 80ppm	88.60	25.67	70.50
3.	Nano potassium 25ppm + Nano zinc 120ppm	89.07	25.71	71.07
4.	Nano potassium 40ppm + Nano zinc 60ppm	89.47	26.39	71.13
5.	Nano potassium 40ppm + Nano zinc 80ppm	90.13	26.57	71.57
6.	Nano potassium 40ppm + Nano zinc 120ppm	91.37	26.63	72.30
7.	Nano potassium 55ppm + Nano zinc 60ppm	92.07	26.67	72.57
8.	Nano potassium 55ppm + Nano zinc 80ppm	92.50	26.82	73.40
9.	Nano potassium 55ppm + Nano zinc 120ppm	93.43	26.99	73.57
10.	Control (RDF 150:60:40 NPK kg/ha)	88.30	25.19	69.80
	F-test	S	S	S
	SEm(±)	0.35	0.10	0.36
	CD (p = 0.05)	1.03	0.29	1.07

Table 2: Effect of nano potassium and nano zinc on yield attributes and field of wheat.

S. No.	Treatment combinations	Grains/ spike	Spikes/ row meter	Tillers/running row meter	Grain yield (t/ha)	Straw yield (t/ha)	Harvest Index
1.	Nano potassium 25 ppm + Nano zinc 60 ppm	45.00	8.53	70.03	5.24	7.83	40.10
2.	Nano potassium 25 ppm + Nano zinc 80 ppm	46.00	8.67	70.50	5.46	7.93	40.77
3.	Nano potassium 25 ppm + Nano zinc 120 ppm	46.33	8.73	71.07	5.69	8.05	41.40
4.	Nano potassium 40 ppm + Nano zinc 60 ppm	46.67	8.80	71.13	5.92	8.15	41.90
5.	Nano potassium 40 ppm + Nano zinc 80 ppm	48.67	9.53	71.57	6.14	8.26	42.60
6.	Nano potassium 40 ppm + Nano zinc 120 ppm	49.67	9.73	72.30	6.21	8.41	42.47
7.	Nano potassium 55 ppm + Nano zinc 60 ppm	50.33	9.80	72.57	6.38	8.67	42.39
8.	Nano potassium 55 ppm + Nano zinc 80 ppm	51.00	10.07	73.40	6.53	8.74	42.75
9.	Nano potassium 55 ppm + Nano zinc 120 ppm	51.67	10.13	73.57	6.61	8.90	42.62
10.	Control (RDF 150:60:40 NPK kg/ha)	43.33	8.33	39.80	5.12	7.82	39.49
	F-test	S	S	S	S	S	S
	SEm(±)	0.44	0.12	0.36	0.13	0.07	0.60

CD (p = 0.05)	1.32	0.37	1.07	0.39	0.22	1.78