Influence of nano potassium and nano zinc on yield and economic enhancement on 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. 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), straw yield (8.90 t/ha), maximum gross return (140462.50 INR/ha), net return (99555.93 INR/ha) and B C ratio (2.43) were obtained highest in the treatment 9 [Nano-potassium 55ppm + Nano-zinc 120ppm].

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

INTRODUCTION

Wheat (Triticum aestivum) is the most important staple food grain crop, grown in a variety of environments across 221.6 million hectares (M ha), with annual production expected to exceed 750.4 million metric tonnes in 2016-17 (Foreign Agricultural Service, USDA, 2018). Despite this significant growth, some parts of the world's population are still facing famine due to a lack of food grains. To meet the future food demands imposed by an ever-increasing population, which is expected to reach nine billion by 2050, global wheat production must increase by 2% per year. The challenge of increasing wheat production is daunting because the wheat cropping system is currently constrained by climatic fluctuations, poor soil health, and an increased risk of disease and insect-pest epidemic outbreaks. To address these challenges, innovative technologies that have the potential to increase the sustainability of current cropping systems must be introduced into modern agriculture.

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**).

Potassium (K) is a nutrient that is required for plant growth. Following nitrogen (N) and phosphorus (P), potassium (K) is the third most likely nutrient to limit crop productivity. Using nano potash fertiliser as a potassium source in rice resulted in an increased number of grains per panicle and a lower amount of potash compared to muriate. They discovered that coating wheat and maize with nano and slow release fertilisers increased grain yield as well as effective N fertiliser recovery (Subbarao *et al.*, 2013).

Zinc is a mineral that is required for normal plant growth and development. It is important in enzyme activation and also in the biosynthesis of some enzymes and growth hormones (Marschner, 1995). Zinc deficiency is a significant nutrient issue in Indian soils. Although total Zn concentrations are adequate in many agricultural areas, available Zn concentrations are deficient due to differences in soil and climatic conditions. The available Zn concentration in soil is affected by soil pH, lime content, organic matter amount, clay type and amount, and the amount of phosphorus fertiliser applied.

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 DISCUSSION

YIELD ATTRIBUTES AND YIELD

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).**

ECONOMICS

Gross return (INR/ha)

Gross return (140462.50 INR/ha) was found to be highest in treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm] and minimum gross return (108800.00.00 INR/ha) was found to be in control.

Net return (INR/ha)

Net return (99555.93 INR/ha) was found to be highest in treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm] and minimum net return (67375.00.00 INR/ha) was found to be in control.

Benefit Cost ratio (B:C)

The maximum Benefit cost ratio (2.43) was recorded in treatment no.9 [Nano-potassium 55 ppm + Nano-zinc 120 ppm] which was superior to rest of all treatment combinations.

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), stover yield (8.90 t/ha), maximum gross return (140462.50 INR/ha), net return (99555.93 INR/ha) and B C ratio (2.43) 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 yield attributes and yield 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

Table 2: Effect of nano potassium and nano zinc on economics of wheat.

S. No.	Treatment combinations	Gross return (INR/ha)	Net returns (INR/ha)	B C ratio (B:C)
1.	Nano potassium 25ppm + Nano zinc 60p	111350.00	70486.09	1.72
2.	Nano potassium 25ppm + Nano zinc 80ppm	116025.00	75154.37	1.83
3.	Nano potassium 25ppm + Nano zinc 120ppm	120912.50	80028.43	1.95
4.	Nano potassium 40ppm + Nano zinc 60ppm	125800.00	84924.84	2.07
5.	Nano potassium 40ppm + Nano zinc 80ppm	130475.00	89593.12	2.19
6.	Nano potassium 40ppm + Nano zinc 120ppm	131962.50	91067.18	2.22
7.	Nano potassium 55ppm + Nano zinc 60ppm	135575.00	94688.59	2.31
8.	Nano potassium 55ppm + Nano zinc 80ppm	138762.50	97869.37	2.39
9.	Nano potassium 55ppm + Nano zinc 120ppm	140462.50	99555.93	2.43
10.	Control (RDF 150:60:40 NPK kg/ha)	108800.00	67375.00	1.62