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Role of zinc application from organic and biological sources on wheat (*Triticum aestivum* L.) productivity under semi-arid conditions

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Abstract
The present study was carried out during the Rabi season at the pot house of the Department of Agricultural Sciences and Allied Industries, Rama University, Kanpur, situated in the Central Plain Zone of Uttar Pradesh. The experiment aimed to evaluate the impact of various fertilizer treatments on wheat yield and soil fertility. The treatments included: T_1 - Control, T_2 - Recommended Dose of Fertilizers (RDF; 120:60:40 kg ha^{-1}), T_3 - RDF + 5 kg $ZnSO_4$ ha^{-1}, T_4 - RDF + 10 kg $ZnSO_4$ ha^{-1}, T_5 - RDF + Seed treatment with Zinc Solubilizing Bacteria (ZSB), T_6 - RDF + $ZnSO_4$ ha^{-1} + ZSB seed treatment, T_7 - RDF + 10 kg $ZnSO_4$ ha^{-1} + ZSB seed treatment. The treatments showed significant differences in their effects on soil fertility and the grain and straw yields of wheat. The application of 100% RDF combined with $ZnSO_4$ and ZSB seed treatment resulted in significantly higher growth and yield parameters. These included plant height (cm), dry matter accumulation (g m^{-2}), number of effective tillers (m^{-2}), grains per spike, 1000-grain weight (g), harvest index (%), grain yield (38.40 q ha^{-1}), and straw yield (63.3 q ha^{-1}). The integration of organic and inorganic fertilizers along with biofertilizers notably enhanced the organic carbon content in soil. A combination of 100% NPK with FYM, $ZnSO_4$, Mn, and Fe yielded higher productivity and profitability, and also improved residual soil fertility after wheat cultivation. The highest bioavailable zinc levels were observed with foliar (30%) and soil application (28%). Across both tillage systems, maximum economic returns were achieved through zinc seed priming, with zero tillage (ZT) providing greater net benefits than conventional plough tillage (PT) due to reduced input costs. Overall, zinc application through various methods enhanced wheat productivity, economic returns, and grain biofortification under both PT and ZT conditions.

Keywords: Inorganic, biological zinc, growth, yield, wheat

Introduction
Wheat is cultivated on a larger area than any other food crop, covering approximately 220.6 million hectares as of 2024. It is the most widely traded cereal crop globally. In 2024, global wheat production reached 771.5 million tonnes, while the 2019 forecast estimated 766.8 million tonnes, ranking wheat as the second most-produced grain after maize. Since 1960, the worldwide production of wheat and other cereal crops has tripled and is projected to continue rising through the mid-21st century.
The growing global demand for wheat is largely driven by the unique viscoelastic and adhesive qualities of gluten proteins, which are essential in food processing. This demand is further fueled by industrialization and the adoption of Western dietary patterns, both of which have increased the consumption of processed foods.
Wheat serves as a significant source of carbohydrates and is also regarded as a key provider of plant-based protein in human nutrition, with an average protein content of around 13.5%—relatively high among cereal grains. However, its protein is limited in certain essential amino acids. When consumed as a whole grain, wheat offers a good supply of dietary fiber and various essential nutrients.
Micronutrient deficiencies in soils represent a significant constraint to wheat productivity (Nayyar *et al*., 2001; Kataki *et al*., 2001a) [7,8]. Continuous nutrient extraction by crops has

intensified micronutrient depletion, causing a steady decline in soil reserves. It is estimated that wheat, when producing 2 tonnes of grain, removes approximately 65-210 g of Zn, 231-1220 g of Fe, 140-331 g of Mn, and 35-50 g of Cu from the soil (Narwal *et al*., 2010) [9]. In Punjab, reductions in micronutrient availability were recorded as 22% for Zn, 12% for Fe, 11% for Mn, and 2% for Cu (Bambiwal *et al*., 2011).

Micronutrient malnutrition affects over 3.1 billion people globally (Kakamak *et al*., 2010), with zinc and iron deficiencies being particularly prevalent. In India, approximately 45% of children under five are zinc-deficient (Kapil and Jain, 2011) [10]. Inadequate levels of Zn and Fe are linked to serious health conditions such as growth retardation, increased susceptibility to infections, impaired cognitive function, delayed mental development, and anemia (Fraga, 2005) [11].

Material and Methods

Straw yield (kgha^{-1})

By deducting the grain yield from the total amount of food gathered and converting it to kilograms per hectare, the straw yield from the net-plot area was calculated.

Biological yield (kgha^{-1})

Following harvesting, the wheat crop was allowed to sun-dry for a week before the weight of the net harvested area of wheat in each plot was measured and converted to kilograms per hectare.

Harvest index (HI)

The harvest index, which is determined using Donald's (1962) formula, is economic yield expressed as a percentage of biological yield.

$$HI = \frac{\text{Economic yield}}{\text{Biological yield}} x100$$

Economics of treatments

Accredited marketplace costs for inputs are used to calculate the value of cultivating different treatments. By multiplying the grain yield by the minimal aid price and the straw yield by the current market price of straw, the gross returns sum of revenue from grain and straw yields was determined. The calculation of net return (Rs ha-1) involved deducting the entire cost of growing each remedy from the gross income of that remedy.

Benefit Cost Ratio (B: C.)

Benefit Cost Ratio was calculated by formula given below:

$$\text{Benefit cost ratio} = \frac{\text{Gross return Rs/kg}}{\text{Total cost of preparation Rs/kg}}$$

Experimental Results and Discussion

Table 1: Grain yield (kgha-1)

Treatment	Grain yield (kgha-1)
T_1	2217
T_2	2290
T_3	3133
T_4	3516
T_5	3217
T_6	2916
T_7	3800
C.D	14.65

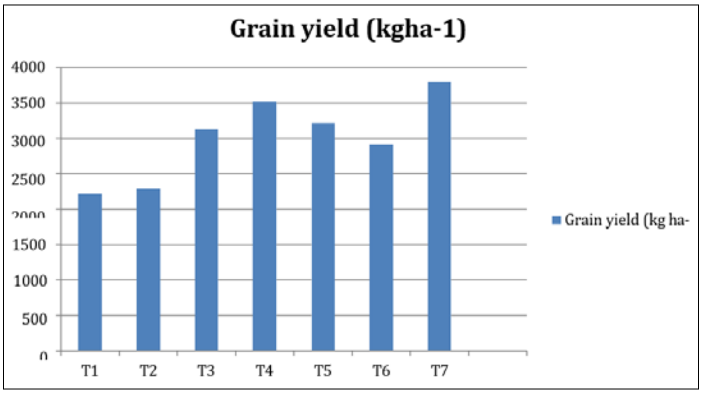

Fig 1: Effect of different treatments of inorganic manure and biofertilizers on plant Grain yield (kg ha-1).

Table 4.7 Treatment 7 recorded the maximum number of effective tillers per hectare (3800)**,** reflecting the most favorable effect on tiller formation. The lowest number of effective tillers was found in the Control (Treatment 1)**,** indicating significant improvement due to treatment application.

Table 2: Straw yield (kg ha-1)

Treatment	Straw yield (kgha-1)
T_1	4872
T_2	5690
T_3	5065
T_4	6243
T_5	6036
T_6	5722
T_7	6336
C.D	17.60

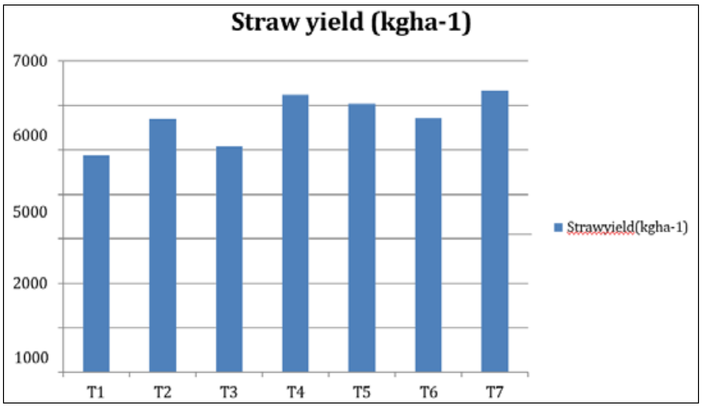

Fig 2: Effect of different treatments of inorganic manure and biofertilizers on plant Straw yield (kg ha-1)

Table 4.8 shows that the maximum value of Straw yield (kg ha-1) shown is treatment 7(6336), Followed by treatment 4, (6243), treatment 5 (6036), treatment 6, (5722), minimum value is recorded in treatment 1 (4872).

Table 3: Harvest Index (%)

Treatment	Harvest index (%)
T_1	0.25
T_2	0.26
T_3	0.35
T_4	0.37
T_5	0.35
T_6	0.34
T_7	0.38
CD.	0.002

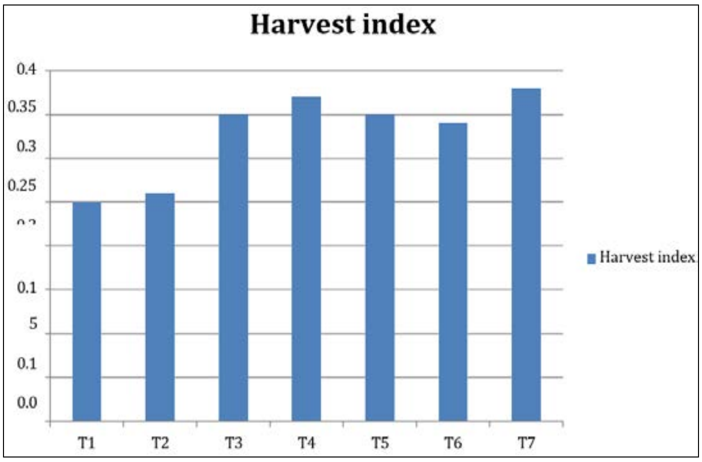

Fig 3: Effect of different treatments of inorganic manure and biofertilizers on plant of Harvest Index (%).

Table 4.9 shows that the maximum value of Harvest index (%) shown is treatment 7 (0.38), Followed by treatment 4(0.37), treatment 5(0.35), treatment 6,(0.34), minimum value is recorded in treatment 1(0.25).

Table 4: Economic

Treatment	Cost of cultivation (RS/ha)	Gross returns (RS/ha)	Net returns (RS/ha)	B:C ratio
T_1	8000	28850	20850	2.61
T_2	7000	18192	11192	1.60
T_3	10500	19104	8604	0.82
T_4	9200	33631	24431	2.65
T_5	8650	30957	22307	2.58
T_6	8100	28250	20100	2,48
T_7	12700	36101	23401	1.84

Summary and Conclusion

Summary

1. Grain yield (tha-1)

The maximum value is shown in treatment 7 (3800).

2. Straw yield (tha-1)

The maximum value is shown in treatment 7(6336).

3. Harvest Index (%)

The maximum value is shown in treatment 7(0.38).

Conclusion

Based on one years of experiment it maybe inferred that application of treatments T_7 (10Kg Znso4/ha + Seed treatment ZSB) gave the highest grain yield value of wheat crop showed good potential for sustainable production and proved to be quite remunerative in alluvial tract of Uttar Pradesh.

References

1. Akhi Paul Chowdhury, Mrityunjoy Biswas, P Mandal, Bonani Bhattacharjee Tithi, M Kadir (2018) Effects of Nitrogen and Zinc Fertilization Levels on Growth and Yield of Late Sown Wheat.
2. B Kumssa, D. B., Joy, E. J., Ander, E. L., Watts, M. J., Young, S. D., Romanoff, A., & Broadley, M. R. (2016). Global magnesium supply in the food chain. Crop and Pasture Science, *66*(12),1278-1289.
3. Farhad Sadeghi, Abbas Rezeizad, and Mehdi Rahimi (2021) Effect of Zinc and Magnesium Fertilizers on the Yield and Some Characteristics of Wheat (*Triticum aestivum* L.) Seeds in Two Years.
4. Fulpagare, D.D., Patil, T.D. and Thakare, Ritu S. (2018). Effect of different treatments of iron and zinc on soil fertility status soil available micro nutrients at harvest and grain and Stover yield of Pearl millet. Int. J. Che. Stud. 6 (6) : 2647-2650.
5. L. G. Ramanandan, Narendra Swaroop, Arun Alferd David and Tarence Thomas (2020) Influence of Integrated Nutrients on Growth and Yield Attributes of Wheat (*Triticum aestivum* L.) Crop [Cv.PBW-343] in Inseptisol. International Journal of Current Microbiology and Applied Sciences
6. Min Wang, Fanmei Kong, RuiLiu, QingqiFan, and Xiaocun Zhang (2020) Zincin Wheat Grain, Processing, and Food.
7. Nayyar VK, Arora CL, Kataki PK. Management of soil micronutrient deficiencies in the rice-wheat cropping system. Journal of Crop Production. 2001 Mar 1;4(1):87-131.
8. Kataki R, Konwer D. Fuelwood characteristics of some indigenous woody species of north-east India. Biomass and Bioenergy. 2001 Jan 1;20(1):17-23.
9. Narwal RP, Malik RS, Dahiya RR. Addressing variations in status of a few nutritionally important micronutrients in wheat crop. In19th World Congress of Soil Science, Soil Solutions for a Changing World 2010 Aug 1 (Vol. 3, pp. 1-6).
10. Kapil U, Jain K. Magnitude of zinc deficiency amongst under five children in India. The Indian Journal of Pediatrics. 2011 Sep;78(9):1069-72.
11. Fraga MF, Ballestar E, Paz MF, Ropero S, Setien F, Ballestar ML, Heine-Suñer D, Cigudosa JC, Urioste M, Benitez J, Boix-Chornet M. Epigenetic differences arise during the lifetime of monozygotic twins. Proceedings of the National Academy of Sciences. 2005 Jul 26;102(30):10604-9.