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Effect of Different Doses of Zinc and Vermicompost on Soil Fertility and Productivity of Wheat (*Triticum aestivum* L.) in Sandy Loam Soil

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ABSTRACT

Background: Wheat (*Triticum aestivum* L.) at a world level vital, primitive staple cereal (ranked second after rice) providing essential nutrition to over a billion people. Firstly, used for flour, it contains gluten, which is crucial for bread, pasta and baked goods. India is self-determined in food grain production but with increasing population pressure food grain production as well as quality has to be elongated. Due to increase in cropping density in Indian soil, there is deficiency of primary elements like N, P and K and micronutrients like zinc, which reduces the yield of wheat crop. The deficiency of zinc increase the chlorosis, stunted plant height, reduce the size of leaves, numbers of tillers and dry matter of plants. Therefore a congestive use of zinc and vermicompost may positively improve the crop performance of wheat crop.

Methods: The experiment evaluate the impact of soil application of various levels of zinc and vermicompost on soil fertility and productivity of wheat in sandy loam soil in the *rabi* season 2024-25 at the farming land of IIMT University Meerut. Experiment was conducted on wheat variety PBW-303 in randomized block design with the combinations of 9 treatments and 3 replications and the total plots are 27.

Result: The experimental finding exhibited that the treatment T_9 where recommended NPK and vermicompost @ 3t ha^{-1} used with micronutrients mixture @25 kg ha^{-1} was recorded maximum plant height, number of tillers m^{-2}, dry matter accumulation, yield attributes, grain, straw, biological yield and harvest index among all the other treatments. The maximum availability of N (231.44), P (24.29) and K (249.22) kg ha^{-1} during experimental year was analysed in T_4 where 100% RDF was combined with VC @ 3 t ha^{-1} and it is similar to the treatment T_9 where micronutrients mixture @ 25 kg ha^{-1} was supplied with100% NPK and VC @ 3 t ha^{-1}. The highest value (2.01 ppm) of available zinc was recorded in the treatment T_8 where 20 kg Zn ha^{-1} through $ZnSO_4$ was used with VC.

Kew words: Micronutrients mixture, Productivity, Soil properties, Vermicomposting, Wheat, Zinc.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important food grain crop in India ranking.

Beside rice (*Oryza sativa* L.) In the 2024-25 crop year, Uttar Pradesh is a state of largest wheat production in India with a contribution approximately 35.65 million tonnes. India occupies second position next to china in the world with regard to area 30.96 million hectares and production 117.51 million tonnes in 2025 (PIB 2024-25). The average productivity (yield) of wheat in India is estimated approximately 35.87 to 35.95 q ha^{-1} can be possible due to use of high yielding cultivar and best management activities with balanced fertilization in an integrated manner. In India, main wheat growing state are U.P., Punjab, Haryana, M.P., Rajasthan and Bihar (Kumar *et al.*, 2021; Yadav *et al.*, 2024). The injudicious use of fertilizers and less application of organic materials promote the micronutrients deficiency in soil. The micronutrients deficiency in Indian soils is reach to the value of 47% to the zinc, 25% for copper and 13% for manganese hereby, it is the constitutive to apply natural and less dose of inorganic fertilizers for maintaining and sustaining the yield of wheat crop as well as quality of soil. The application of NPK fertilizers are essential for better productivity of wheat crop but continual use of the fertilizers free from micro elements

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in cropping pattern resulting in depletion of micronutrients in soil. Conjugative use of fertilizers with carbonic materials like vermicompost and FYM was recorded more credible for increasing the yield and also valuable in sustaining the quality of wheat for a longer period. The best texture class for the cultivation of wheat crop is loam (Zulfiqar *et al.,* 2020). Fine texture soil with good drainage facilities is good for wheat cultivation because wheat cannot tolerate the water logging condition. The application of micronutrient mixture in different doses with NPK fertilizers play an important role in crop nutrition and also improve soil fertility and production of wheat crop (Sharma *et al.*, 2016; Ghasal *et al.*, 2015). Hence the supply of micronutrient are necessary to improve crop productivity when NPK fertilizers are not enough for crop nutrition (Mathpal *et al.*, 2015; Groote *et al.*, 2021). The different research trials are being conducted to understand the need of essential element for wheat crop (Anitha and Kadalli, 2019). The soil application of macronutrients with micronutrients in balancing amount play a dominant role in nutrition and yield of food grain crops (Singh *et al.*, 2024). The yield of high fertilizer responsive cultivar is enhances with the application of micronutrients with NPK fertilizers (Faizan *et al.*, 2021).

Zinc help in production of super oxide dismutase and constituent of carbonic anhydrase and alcoholic anhydrase and important in the synthesis of IAA and RNA as well as essential fo water uptake in food grain crops (Farooq *et al.,* 2025). The excess application of major nutrients create a depletion of trace element which responsible for the limiting the yield of crop. Parameters of soil like pH, EC, organic matter, moisture content, texture and structure directly affect the availability and fixation of essential elements in soil. The plant usable zinc in soil is increases with enhance the content of organic matter and clay. Vermicompost is highly nutritive manure with good analytical value of NPK and micronutrients and favourable for increases the solubility of different macro and micronutrients. The current research was carry trough to analyse the effect of recommended NPK, zinc and vermicompost on soil fertility and growth, yields and harvest index of wheat crops in sandy loam soils of western Uttar Pradesh.

MATERIALS AND METHODS

The trial of research is implemented at the cultivated area of IIMT University Meerut (U.P.) during *rabi* season 2024-25. Area received 932 mm average annual rainfall which is 90% of rain period from July to September. The physio- chemical properties of soil of research area was sandy loam in texture with a percentage 52.74, 29.6 and 17.6 in sand, silt and clay, respectively, pH 8.25, electrical conductivity 0.485 dSm^{-1}, mineralizable N 192.86 kg ha^{-1}, Olsen-P 14.38 kg ha^{-1} ammonium acetate extractable K 222.48 kg ha^{-1} and DTPA extractable zinc 0.78 ppm. The experimental trial is composed of 4 levels of zinc @ 5, 10, 15 and 20 kg ha^{-1} and vermicompost @ 1.5 and 3 tha^{-1} with the conjugation of NPK@120:60:60. The experiment site divided in the combination of 9 treatments with 3 replication in a randomized block design (RBD). The size of plot is 5×4 m^{-2} with a spacing of line to line is 22.5 cm. Vermicompost was applied in both the doses like 1.5 and 3 t ha^{-1} at the time of land preparation with the combination of NPK. Treatments combination have a uniform dose of urea, diammonium phosphate (DAP), muriate of potash (MOP), zinc sulphate, micronutrient mixture and vermicompost to provide NPK, Zn, Cu, Fe and Mn. Treatment T_1 used as an control plot where any types of fertilizers was not applied for the comparison with the other plots of experimental site. A full dose of vermicompost and zinc was applied with 60 kg N, 30 kg P and 30 kg K ha^{-1} as in basal dose at the time of land preparation and sowing. The half dose of nitrogen was used in top dressing at the different growing stages of wheat. Observations of growth parameters were noted at 30, 60 days after sowing (DAS) and at harvesting of crop. Grain, straw and biological yield and yield attributing characters were recorded plot wise at time of harvesting and after threshing of crop. The yield of net plot thus convert to q ha^{-1}. The observation of Dry weight of straw collected from net plot was recorded after sun drying for 5-6 days and expressed in qha^{-1} and the grain yield was recorded in kg per plot. The total biological yield was recorded on dry basis after sun drying from net plots and expressed in qha^{-1}. The observations collected from research trial were statistically analyses by using the analysis of variance techniques (ANOVA) for randomized block design. The data recorded during the course of investigation were subjected to statistical analysis using analysis of variance technique (ANOVA) for randomized block designed as assigned by (Cochran and Cox, 1957). Critical difference and standard error of mean in each cases were analyse at 5% levels of significance. The analysis of available nutrients in soil was carefully completed by using the standard methods in soil testing laboratory of agriculture department IIMT University Meerut (U.P.) India.

RESULTS AND DISCUSSION

The current investigation was conducted during *Rabi* 2024-25 to evaluate the effect of different doses of zinc and vermicompost on soil fertility and productivity of wheat in sandy loam soils. The area of study was under the research farm IIMT University Meerut. The observation on different growth stages, tillers number, wheat dry weight, yield contributing characters were recorded and study on soil chemical properties like pH, EC, available nitrogen, phosphorus, potassium and DTPA extractable zinc also done after harvesting of wheat crop.

Impact of different doses of zinc and vermicomposting on growth parameters of wheat crop plant height (cm).

Data present in the Table 1 indicated that the wheat plant height at various growth stages significantly affected by different treatments combinations. Plant height at 30 DAS

ranges from 14.68 to 23.70 cm was noticed in the various plots. The highest value of plant height 23.70 cm was observed in the treatment T_9 while minimum plant height 14.68 cm was noticed in the treatment plot T_1 control. The treatments from T_4 to T_8 possess the highest plant height because vermicomposting was applied with NPK and zinc and these treatments also significantly at par with the treatment T_9. The lowest rate of plant growth was noticed in the treatment T_1 in which no fertilizers was applied. The similar trends in plant height was also observed at 60 DAS and at harvesting of wheat crop. The greatest plant height (49.70 cm) at 60 DAS was observed in the treatment T_9 while the lowest plant height 29.56 cm was recorded in the treatment T_1 (control). Plant height at 60 DAS in the treatments T_5, T_6 T_7 and T_8 also find tallest and followed the plant height like T_9. At harvest treatment T_9 exhibited the highest plant height 94.20 cm because of application of vermicompost with NPK and micronutrients fertilization. The treatments T_6 (89.90), T_7 (90.80) and T_8 (92.30) also followed the plant height like T_9. While the control plot T_1 recorded the shortest plant height (68.97 cm) in which any types of manures and fertilizers was not use. The differences in plant height may be due to decomposition of vermicompost release macro and micronutrients with organic acids and growth hormones throughout the life period of wheat crop. Similar finding was observed by Yadav *et al.* (2024). The application of zinc @10 kg ha^{-1} promote the crop growth and leaf area index. The application of micronutrients have significant impact on physiological and yield attributing characters including numbers of tiller, leaf area index (LAI), crop growth rate (CGR), net assimilation rate (NAR) and grain yield. Nadim *et al.* (2012). Similar result also exhibited by Araganji *et al.* (2026).

Number of tillers (m^{-2}) and dry weight (g m^{-2})

Table 1 data exhibited that the highest number of tillers 500 m^{-2} was recorded in T_9 treatment. Soil application of vermicomposting along with RDF and zinc also improve the number of tillers and followed treatment T_9. The performance of number of tillers was improved significantly with increase the level of zinc with vermicompost and NPK fertilizers. Similar results have been noted by Sharma *et al.* (2008). Dry weight of wheat at 30, 60 DAS and at harvest shown in Table 1. Different combinations of treatments significantly affected dry matter of wheat crop. The highest values of dry weight 59.40, 200.50 and 529.20 g m^{-2} at 30, 60 and 90 DAS was noted in the treatment T_9 respectively. Dry weight of wheat in treatment T_7 also shows a good performance and significantly followed the treatment T_9. Lowest weight of dry materials 47.65, 118.54 and 226.85 g m^{-2} at 30, 60 and 90 DAS was observed in the treatment T_1 (control). The application of zinc with NPK and vermicomposting meet the requirement of nutrient and paly a main role in increment of straw yield, plant growth and biomass production. Similar finding also exhibited by Singh *et al.* (2015).

Table 1: Effect of different doses of zinc and vermicompost on growth parameters at different stages.

Treatment	Plant height (cm.)			Dry matter accumulation (gm.m^{-2})			Tillers (m^{-2})
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1: Control	14.68	29.56	68.97	36.40	114.00	355.60	305
T_2: RDF (NPK @ 120:60:60 kg ha^{-1})	19.50	35.70	80.50	39.80	129.30	386.70	356
T_3: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @1.5 t ha^{-1}	19.80	38.60	83.80	42.60	140.10	401.50	367
T_4: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1}	20.80	40.60	86.70	45.40	149.60	405.00	403
T_5: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1}+Zinc @ 5 kg ha^{-1}	21.80	43.80	88.50	47.10	163.40	452.10	406
T_6: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1}+Zinc @ 10 kg ha^{-1}	21.90	44.60	89.90	50.90	168.30	482.20	444
T_7: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1}+Zinc @ 15 kg ha^{-1}	22.90	46.00	90.80	53.80	180.50	492.70	461
T_8: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1}+Zinc @ 20 kg ha^{-1}	23.00	47.00	92.30	56.60	190.00	515.30	483
T_9: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1}+micronutrients mixture @ 25 kg ha^{-1}	23.70	49.70	94.20	59.40	200.50	529.20	500
CD (P≤0.05)	3.34	5.51	4.82	4.17	7.29	6.17	7.88
SEm ±	1.11	1.82	1.59	1.38	2.41	2.04	2.61

Table 2: Effect of different doses of zinc and vermicompost on yield attributing characters, yields and harvest index of wheat.

Treatment	Spike length (cm)	Test weight (gm.)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
T_1: Control	9.68	40.31	26.85	42.68	69.53	38.62
T_2: RDF (NPK @ 120:60:60 kg ha^{-1})	11.62	41.40	34.86	53.36	88.22	39.51
T_3: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC@1.5 t ha^{-1}	11.65	41.48	36.39	53.44	90.24	40.32
T_4: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1}	11.81	41.65	37.82	53.85	94.30	40.11
T_5: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + Zinc @ 5 kg ha^{-1}	12.15	42.12	40.86	58.64	96.46	42.36
T_6: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + Zinc @ 10 kg ha^{-1}	12.57	42.65	42.58	59.56	102.90	41.37
T_7: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + Zinc @ 15 kg ha^{-1}	13.00	42.97	43.46	60.32	103.02	42.18
T_8: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + Zinc @ 20 kg ha^{-1}	13.37	43.15	45.74	60.82	107.59	42.51
T_9: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + micronutrients mixture @ 25 kg ha^{-1}	14.22	43.41	47.58	61.85	108.40	43.90
CD (P≤0.05)	2.23	N/A	6.91	7.12	8.39	N/A
SEm ±	0.74	1.48	2.28	2.36	2.78	1.90

Effect of different doses of zinc and vermicomposting on yield attributes and yield and harvest index of wheat

Yield attributes

Data found in Table 2 showed that the maximum length of spike 14.22 cm was recorded in the T_9 treatment which was significantly superior among the all treatments and followed by treatments T_8 (13.37 cm), T_7 (13.00 cm) and T_6 (12.57 cm). Treatment T_1 control where no fertilizer was used recorded the lowest spike length with a value of 9.68 cm. The highest panicle length may be due to increased transportation of photosynthates from source to sink due to application of zinc (Jena *et al.*, 2006). Table 2 data noticed that the supreme test weight (43.41 g) of wheat after harvesting was recorded in the treatment T_9 where micronutrients mixture@ 25 kg ha^{-1} was applied with NPK and vermicompost @ 3 t ha^{-1}. The treatment T_1 control exhibited lowest test weight (40.31 g) due no application of manure and fertilizers plot survive only on natural condition (Gueins *et al.*, 2003) also reported that the soil application of zinc with vermicompost have dominant effect on number of grains, spikes and test weight of wheat crop.

Grain yield (q ha^{-1})

Table 2 indicated that the zinc application in soil with NPK and vermicompost significantly influence the grain yield of wheat. Treatment T_9 was showed the maximum grain yield (47.58 q ha^{-1}) where NPK was used along with micronutrients and vermicompost. The highest increment in grain yield was noticed in the treatment T_9 and the lowest value of grain yield was noticed in the treatment T_1 control (26.85 q ha^{-1}) in which manures and fertilizers are not used. T_8, T_7, T_6 and T_5 treatments significantly followed the T_9 treatment with a values of grain yield (45.74 q ha^{-1}), (43.46 q ha^{-1}), (42.58 q ha^{-1}) and (40.86 q ha^{-1}) respectively. The application of micronutrient positively affect the growth and yield parameters like plant height, number of tillers m^{-2}, seed yield, 1000 grain weight, germination percent *etc.* similar finding also noticed by Shukla *et al.* (2018). The application of urea fertilizer with FYM and Vermicompost shows the good impact to increases the grain yield according to Akhter *et al.* (2017). These finding of grain yield also associated with the research by Arumugam *et al.* (2025).

Straw yield (q ha^{-1})

Table 2 data showed that the application of different levels of zinc with vermicompost and NPK recorded higher impact on the straw yield. The straw yield 61.85 qha^{-1} was noticed highest in the treatment T_9 while lowest straw yield (42.68 q ha^{-1}) in T_1 control. Treatments T_5, T_6, T_7 and T_8 also recorded the good yield and significantly followed the treatment T_9. Lowest straw yield in T_1 plot may be due to any of fertilizers and manure was not applied. This increment in straw yield due to efficient nutrient management in soil which is very crucial for increases the overall performances of wheat crop. Similar finding was also noticed by Nadim *et al.* (2012).

Biological yield (kg ha^{-1}) and harvest index (%)

Table 2 indicated that the best improvement in biological yield (108.40 q ha^{-1}) and harvest index (43.90%) was recoded in T_9 treatment in which NPK and mixture of micronutrients was used. The treatments T_8, T_7 and T_6 also exhibited the best increment in biological yield and significantly followed the treatment T_9. However, control plot recorded the lowest biological yield (69.53 qha^{-1}) and harvest index (38.62%). Biological yield is the sum of grain and straw yield. Hereby micronutrients application with NPK and vermicompost could be enhanced the grain and straw yield resultant increment in biological yield. This results also similar with the finding of Gill and Walia (2014).

Soil properties

Data found in Table 3 are exhibited that soil pH was recorded non-significant among the all treatments. The highest pH 8.07 was noticed in the treatment T_2 (Recommended NPK) and followed by the treatment T_1 (control) with a value of 7.56. The minimum pH 7.05 was noticed in T_4 treatment in which NPK was used with vermicomposting. Decrement in soil pH was observed the treatments where inorganic fertilizers was applied with organic materials. Data present in Table 3 recorded that the significant difference in electrical conductivity was noticed in the all treatments combinations. The minimum value of electrical conductivity 0.314 dSm^{-1} was observed in T_4 and maximum 0.428 dSm^{-1} in control. Treatment received vermicompost with micconutrient and NPK recorded lowest electrical conductivity over the control. Treatments received vermicompost with NPK and trace elements reduced the pH and Electrical conductivity of soil similar result also recorded by Prikshit *et al.* (2025). This effect on pH and EC may be due to release of organic acids, carbon di oxide, sulphur and calcium during the decomposition of vermicompost which temporarily lower the pH level of soil and also improve the leaching of salts by dissolving soluble salts. The similar finding also reported by Bhatt *et al.* (2019) and Meena *et al.* (2018). Data prevailing in Table 3 revealed that the maximum availability of nitrogen 231.44 kg ha^{-1} was recorded in T_4 treatment where RDF was used with organic manure (VC)@3 t ha^{-1}. The lowest available nitrogen 185.89 kg ha^{-1} was noticed in the treatment T_1 control. The control plot is significantly inferior in available nitrogen due to no application of manures and fertilizers. The enhancement in available nitrogen was 19.68% over control. The use of vermicompost in soil increases the content of nitrogen in soil due to mineralization. The similar results also exhibited by Singh *et al.* (2017) and Reddy *et al.* (2018). The strongest value of soil available phosphorus 24.29 kg ha^{-1} among the various treatment combinations was recorded in the treatment T_4 because vermicompost @ 3 t ha^{-1} was used with NPK fertilizers. The content of available phosphorus in zinc received treatments are less because the antagonistic effect in between phosphorus and zinc. The lowest value of available phosphorus was recorded in control treatment T_1. Fixation of phosphorus in soil may be reduces with the

Table 3: Effect of different doses of zinc and vermicompost on soil parameters.

Treatment	pH	EC (dSm^{-1})	Available N (Kg ha^{-1})	Available P (Kg ha^{-1})	Available K (Kg ha^{-1})	Available Zn (ppm)
T_1: Control	7.56	0.364	185.89	12.28	218.30	0.77
T_2: RDF (NPK @ 120:60:60 kg ha^{-1})	8.07	0.428	203.01	15.28	222.33	0.79
T_3: RDF (NPK @ 120:60:60 kg ha^{-1}) +VC@1.5 t ha^{-1}	7.06	0.342	206.68	15.71	227.70	0.80
T_4: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1}	7.05	0.314	231.44	24.29	249.22	0.86
T_5: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + Zinc @ 5 kg ha^{-1}	7.19	0.369	210.08	18.70	230.10	1.08
T_6: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + Zinc @ 10 kg ha^{-1}	7.22	0.365	213.05	17.37	230.63	1.14
T_7: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + Zinc @ 15 kg ha^{-1}	7.25	0.364	215.01	16.93	232.85	1.76
T_8: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + Zinc @ 20 kg ha^{-1}	7.34	0.377	216.36	16.49	238.77	2.01
T_9: RDF (NPK @ 120:60:60 kg ha^{-1}) + VC @3 t ha^{-1} + micronutrients mixture @ 25 kg ha^{-1}	7.34	0.362	217.26	19.02	241.14	0.92
CD (P≤0.05)	N/A	0.052	6.00	4.59	6.31	0.29
SEm±	0.27	0.017	1.98	1.52	2.09	0.10

application of vermicompost and FYM. The result are in agreements by Bhatt *et al.* (2019) and Nayak *et al.* (2020). The combination of of vermicompost and NPK fertilizers application increases the availability of K in soil. Maximum K availability 249.22 kg ha^{-1} was observed in the treatment T_4 (NPK@ 120:60:60 kg ha^{-1}+VC@ 3 t ha^{-1}) which was significantly superior among all the other treatment but followed by treatment T_8 (241.14 kg ha^{-1}). This effect might be due to degradation of organic matter provided different organic acid and carbon di oxide in soil which responsible for reducing the fixation of potassium in soil due to solubilise effect. These finding also comparable with Kumar *et al.* (2017) and Nayak *et al.* (2020). It is clear from the Table 3 that the availability of zinc in soil affected by different treatment combination. The content of DTPA extractable zinc soil at harvesting of crop was significantly affected by zinc and vermicompost application. It is apparent from the data that the highest value of available zinc was noticed in the treatment T_8 (2.01 ppm) where zinc was used @ 20 kg ha^{-1} with NPK and vermicompost and significantly followed by the treatment T_7 (1.76 ppm). It became clear from the experimental finding the soil application of zinc in various doses with vermicompost significantly increases the available zinc in soil due to vermicompost supplies organic matter that naturally complexes with zinc, preventing it from binding into insoluble forms, while also lowering soil pH, which drastically improves overall zinc solubility and crop uptake of zinc. Similar finding was also recorded by Keram *et al.* (2012).

CONCULSION

The research finding shoed that the use of organic and inorganic sources of nutrients significantly improved wheat growth, yield and soil fertility. The combined application of recommended fertilizers with vermicompost and zinc enhanced soil nutrient status and crop performance. The soil application of zinc at @ 20 kg ha^{-1} with vermicompost and NPK improve the content of zinc in soil. Overall, the treatment combining 100% RDF, vermicompost @ 3 t ha^{-1} and micronutrient mixture @ 25 kg ha^{-1} proved most effective and is recommended for improving wheat productivity.

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The views provided in research manuscript are purely originated by authors and not shoed the opinions of their affiliated institutions. The authors are fully responsible for the he information given in article.

Informed consent

Not applicable, as this study did not involve human or animal subjects.

Conflict of interest

The research manuscript of authors are not involve in any conflict of interest.

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