E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
www.agronomyjournals.com
2024; 7(6): 231-235
Received: 17-04-2024
Accepted: 30-05-2024

Dusengimana Patrick
M.Sc., Department of Agriculture Maharishi Markandeshwar (DU) Mullana-Ambala, Haryana, India

Ishwar Singh
Faculty, Department of Agriculture, Maharishi Markandeshwar (DU) Mullana-Ambala, Haryana, India

MK Rana
Faculty, Department of Agriculture, Maharishi Markandeshwar (DU) Mullana-Ambala, Haryana, India

Devi Singh
Faculty, Department of Agriculture, Maharishi Markandeshwar (DU) Mullana-Ambala, Haryana, India

RK Behl
Faculty, Department of Agriculture, Maharishi Markandeshwar (DU) Mullana-Ambala, Haryana, India

OP Mehla
Faculty, Department of Agriculture, Maharishi Markandeshwar (DU) Mullana-Ambala, Haryana, India

Corresponding Author:
Dusengimana Patrick
M.Sc., Department of Agriculture Maharishi Markandeshwar (DU) Mullana-Ambala, Haryana, India

Effect of different nutrient management on yield and economics of wheat (*Triticum aestivum* L.)

Dusengimana Patrick, Ishwar Singh, MK Rana, Devi Singh, RK Behl and OP Mehla

DOI: https://doi.org/10.33545/2618060X.2024.v7.i6d.874

Abstract
The experiment was undertaken at the Research Farm of the Agriculture Department, Maharishi Markandeshwar (DU), Mullana-Ambala during *Rabi* season of 2022-23. The experiment used a randomized block design with eight treatments: control (T_1), 100% NPK (T_2), 100% NPK + Zinc at 2.5 kg ha^{-1} (T_3), 100% NPK + Zinc at 5 kg ha^{-1} (T_4), 100% NPK + Vermicompost (VC) at 1 t ha^{-1} (T_5), 100% NPK + VC at 2 t ha^{-1} (T_6), 100% NPK + VC at 1 t ha^{-1} + Zinc at 2.5 kg ha^{-1} (T_7), and 100% NPK + VC at 1 t ha^{-1} + Zinc at 5 kg ha^{-1} (T_8). The seed of wheat cv. HD-3086 (Pusa Gutami) was sown on 16 November 2022 at 22.5 cm row spacing by using a seed rate of 100 kg ha^{-1}. The study's key findings showed that T_6 produced the maximum count of effective tillers (429 m^{-2}), spike length (11.1 cm), count of grains per spike (54.67), grain yield (54.24 q ha^{-1}), straw yield (62.86 q ha^{-1}), and the maximum gross return (Rs. 154,554.8 ha^{-1}) and net return (Rs. 103,737.3 ha^{-1}). Treatment T_8 also demonstrated superior results with significant grain yield (50.50 q ha^{-1}), straw yield (61.70 q ha^{-1}), highest 1000-grain weight (46.7 g) and benefit-cost ratio (2.13). Statistical analysis using OPSTAT software confirmed that integrating vermicompost and chemical fertilizers resulted in higher yields and economic benefits compared to control and solely chemical treatments. The combination of 100% NPK with VC and Zinc also improved wheat crop production highlighting the advantage of integrated nutrient management. Conclusion, the study recommends the application of either T_6 or T_8 for optimal yield and economic returns in wheat cultivation, enhancing productivity and supporting sustainable agriculture by improving soil health and resource use efficiency.

Key words: Wheat, zinc, vermicompost, yield and economics

Introduction
The wheat (*Triticum aestivum* L.) belonging to the family Poaceae is renowned worldwide as one of the foremost cereal crops, excelling in both production and cultivated acreage. A considerable segment of the world's population relies on it since it is a crucial means of nourishment and stands as the most widely traded crop globally by major exporting nations such as India, China, Russia, Canada and the United States. Globally, wheat covers an area of 240 million hectares, contributing approximately 780 million tonnes of grains to the global food supply and productivity of 3.25 tonnes per hectare (Dukhnytskyi, 2023; FAO, 2023) [9, 11]. With an average production of 3371 kilograms per hectare, India produces 99.70 million tonnes of wheat covering an extent of 30 million hectares per year and through a land extent of 2.55 million hectares and aggregate production of 4407 kg per hectare, and Haryana produced 11.24 million tonnes of wheat grains (Ramadas *et al*., 2020) [22].

Growers' widespread use of fertilizers in recent decades to meet out the entire demand of the incessantly population has resulted in a significant expansion in the global capacity for food production. However, in recent years, various studies emphasize the inefficiency and countries' jaggedness in the application of fertilizers, resulting in environmental concerns, soil nutritional unevenness, crop quality and not ideal food production (Penuelas *et al*., 2023) [21]. The negative impacts of using nutrient-rich fertilizers on soil health and the surroundings have resulted in energy scarcity and an unsustainable agricultural system.

The indiscriminate and persistent utilization of fertilizers has had injurious effects on the attributes of the soil, including physical, chemical and biological aspects, reducing crop productivity while causing secondary and micronutrients deficiencies, especially zinc (Parewa *et al*., 2019) [20], which is vital for maintaining the nutritional health of plants, animals and people, while over one-third of the global population might impose a zinc deficiency. Zinc has been found to be low in Indian soils and it participates in enzymatic and metabolic processes in crop systems. Zinc deficiency can cause sluggish plant development, fewer tillers, chlorosis and tiny leaves, prolonged crop maturation time, spikelet infertility and inferior harvest quality. Zinc threatens to affect the ability of plants to transport and absorb water (Keram, 2014) [14]. Some studies found a significant increase in grain yield from the harvest of wheat upon the use of zinc (Khattak *et al*., 2016) [15].

In this manner, the amalgamation of chemicals, bio-fertilizers, and compost not only delivers all necessary nutrients but also enhances soil properties by fostering desirable soil texture, boosting the ability of the soil to exchange cations, enhancing the amount and accessibility of crop nutrients, increasing humus, supporting microbial growth and function, improving efficiency in applied fertilizers and ultimately increase crop productivity (A. Kumar and Tripathi, 2022) [1]. However, utilizing manure alone resulted in a decrease in wheat production, demonstrating that manure alone cannot meet the nutritional demands of wheat, thus, manure must be blended with fertilizers to maintain optimum levels of crop output (Sheoran *et al*., 2017) [26].

Fulvic and humic acids are the most persistent organic molecules in soil. Both compounds include a huge number of functional groups (OH, COOH) that have tremendous attraction for metal ions like Zn and Fe. Fulvic acid forms chelates with Zn over a wide pH range, increasing Zn solubility and mobility. Organic farming can boost the zinc level in wheat grain (Helfenstein *et al*., 2016) [12].

To maintain soil fertility, crop yield and profitability, vermicompost treatment enhances soil's physical, chemical and biological attributes, including its WHC, allowing for optimal water usage and offering nutrients that are easily available to plants. Combining manure and fertilizers, particularly vermicompost and NPK in a balanced ratio enhances wheat yield and financial profits while also improving soil fertility. For the establishment of environmentally conscious and economically viable agricultural practices, INM emerges as a viable option for wheat cultivation due to its utilization of both manure and fertilizers as sources of plant nutrients. Keeping the preceding facts in view, the present study entitled "Effect of different nutrients management on yield and economics of wheat" was planned.

Materials and Methods

The experiment was undertaken at the Research Farm of the Agriculture Department, MM (DU) University, Mullana-Ambala during *Rabi* season of 2022-23, which is located at a latitude of 30°17'0"N, longitude of 77˚3'0"E and an altitude of 264 m averaged from sea level. The weather of the area was typified by a semi-arid subtropical climate, with hot and dry summers and cool and moist winters. The rainfall in the region was quite erratic both in terms of total and distribution and it was averaged at 1193.8 mm. The field soil collected from a depth of 15 cm was composed of 55.2% sand, 28.4% silt and 16.4% clay. The pH of the field soil was 7.85, eclectic conductivity 0.86 dS m^{-2}, organic carbon 0.33%, available nitrogen 168 kg ha^{-1}, available phosphorus 11.40 kg ha^{-1}, available potassium 365 kg ha^{-1} and available zinc 2.3 ppm. The treatments, *i.e*., T_1: Control (without manure and fertilizers), T_2: 100% NPK (150:60:60) kg ha^{-1}, T_3: 100% NPK + Zinc @ 2.5 kg ha^{-1}, T_4: 100% NPK + Zn @ 5 kg ha^{-1}, T_5: 100% NPK + VC @1 t ha^{-1}, T_6: 100% NPK + VC @ 2 t ha^{-1}, T_7: 100% NPK + VC @ 1 t ha^{-1} + Zn @2.5 kg ha^{-1}, T_8: 100% NPK + VC @ 1 t ha^{-1} + Zn @ 5 kg ha^{-1}, were laid out in a randomized block design with three repetitions. The seed of wheat cv. HD-3086 was planted on 16 Nov. 2022 at 22.5 cm row space by using a seed rate of 100 kg ha^{-1}. One-third of nitrogen was delivered through urea, the full recommended dose of phosphorus was delivered through DAP, the full recommended dose of potassium through MOP and the full quantity of Zn was incorporated in soil before planting. The remaining ⅓rd. of nitrogen was applied in two equivalent doses, first at the CRI stage and 2nd at the tillers stage. In the case of fertilizers in combination with vermicompost, the vermicompost was spread on top of the soil and then muddled by using harrow mounted tractor. The observations were recorded on the number of effective tillers, spike length, number of grains per spike, grain yield and straw yield at harvesting and then economic analysis for various treatments was computed. All recorded data were analyzed by using OPSTAT software to determine the statistical significance of the results.

Results and Discussions

Effective tillers, Spike length, grains per spike and test weight

Effective tillers

Analysis of data in Table 1. reveals that the greatest effective tillers count per meter square (429.00) was registered with organic management of nutrients through the application of 100% NPK + VC 2 t ha^{-1} (T_6). It was closely followed by T_8 (417.17) and T_7 (415.50) and those two treatments were statistically on par with each other. The combination of fertilizer and manure, *i.e.*, vermicompost increased the tillers' count m^{-2} than the treatment received only fertilizer this must be due to the application of vermicompost that is nutrient-rich with various macro and micronutrients. The minimum tillers number per meter square (197.28) at harvest was observed in the control treatment. Similar findings were reported by (Debbarma *et al*., 2020; Maurya *et al*., 2019) [6, 19].

Spike length

Data from Table 1: shows that the application of vermicompost increased wheat's length of spike remarkably, the highest length of spike 11.1 centimeters was observed in T_6- 100% NPK + VC @ 2 t ha^{-1} and being statistically on par with treatment T_8 (10.3 cm) and T_7 (9.9 cm), while closely followed by treatment T_5- 100% NPK + VC @1 t ha^{-1} with spike length of 9.68 cm. A combination of the fully recommended dose of NPK with Zn at 5 kilograms per hectare recorded maximum wheat spike length (9.4 cm) but performed better when this treatment received an additional 1 tonne per hectare of vermicompost T_8. while the control exhibited the shortest spike length of 8.3 centimeters. This was due to the ability of vermicompost to supplement the plant with macro and micronutrients throughout the growth period, this was in agreement with previous research by Dhaliwal *et al*. (2023) [8] who highlighted the significant impact of organic and inorganic nutrient sources on promoting spike length.

Number of grains per spike

Table 1: reveals that the application of zinc and vermicompost enhanced the count of grains per spike, a greater count of grains

per spike (54.67) was obtained via T_6-100% NPK + VC @ 2 t ha^{-1} and was found to be superior to all treatments, treatment T_6- was closely followed by T_8 with (52.00) and T_7 with (50.67), those two treatment was statistically on par each other. For other managements, utilization of whole recommended amount of NPK in conjunction with Zn at 5 kg per hectare registered a maximum number of grains per spike (45.67), among non-vermicompost treatment and being statistically on par with T_3 and T_2 whereas control exhibited the minimum wheat count of grains per spike (35.00). the same trend was reported by Dawar *et al*. (2022) [5] and El-Habbasha *et al*. (2015) [10].

Test weight

As data was revealed in Table 1: the application of vermicompost and zinc increased 1000 grains weight, maximum test weight (46.70 g) was weighed in the treatment used the whole recommended amount of NPK in conjunction with VC @ 1 tonne per hectare and Zn @ 5 kilogram per hectare (T_8), it was an increase of 13.08% from control. T_8 was statistically on par with all treatments that received vermicompost, *i.e.*, T_7 with (45.50), T_6 with (46.00), and T_5 with (45.00). The amalgamation of the full dose of recommended NPK with Zn @ 5 kg per hectare registered (43.50 g) which was the maximum among non-vermicompost treatments, but it was statistically at par with other treatments that didn't receive any doses of vermicompost. The minimum test weight (41.30 g) was obtained in control. (Aslam *et al*., 2019; Devi *et al*., 2022) [3, 7] illustrated the synergistic effects of combined nutrient management approaches, particularly evident in treatments integrating both organic and inorganic amendments, resulting in superior test weight and grain quality.

Grain yield

Data from Table 1. revealed that a combination of fertilizers, manure, Zinc micronutrient or a combination of all increased wheat grain yield, maximum grain yield (54.24 q ha^{-1}) was registered by treatment T_6 and being found to be superior to remaining treatments, it increased grain yield by 31.4% from application of 100% NPK and 112.79% from control, it was succeeded by T_8 and T_7 with produce of 50.50 and 48.54 q ha^{-1}, respectively. T_8 and T_7 were statistically comparable, It was in line with the findings of previous research by Ahmad and Tripathi (2022) [1] and Shamseldinrawia *et al*. (2022) [25]. Furthermore, the treatments that included zinc in addition to fertilizers showed substantial increases in grain produce, emphasizing the necessity of micronutrient management in enhancing wheat grain yield, utilizing the whole recommended NPK in conjunction with Zn @ 5 kg per hectare registered maximum wheat grain produce (44.27 q ha^{-1}). This treatment increased grain yield by 7.24% from treatment of 100% NPK and 45.5% from control, it was statistically at par with treatment T_3 and T_5. Minimum wheat grain yield (25.49 q ha^{-1}) was recorded in the control and it remained with trends of previous research by Cuesta *et al*., 2021; D Kumar *et al*., (2017 and Saikia *et al*., (2022) [4, 17, 24].

Straw yield

Application of fertilizer, vermicompost and zinc or a combination of all increased wheat straw yield significantly as it is revealed in Table 1. maximum straw yield (62.86 q ha^{-1}) was observed in T_6- 100% NPK + VC @ 2 t ha^{-1} and being quantitatively on par T_8 with (61.70 q ha^{-1}). T_8 was also quantitatively on par T_7 with (59.72 q ha^{-1}). Within only fertilizers treatments, maximum wheat straw yield (55.10 q ha^{-1}) was registered by the combination of the full dose of NPK and Zn @ 5 kilograms per hectare (T_4) and being quantitatively on par with T_5 and T_3. The minimum wheat straw yield (35.61 q ha^{-1}) was registered in the control. Those results were per prior research results of Kumar *et al*. (2021) [18] and Verma *et al*. (2022) [28] shading lights on the incorporation of fertilizers, vermicompost and zinc supplementation elicited a substantial rise in wheat straw production.

Harvest index

Results from Table 1. Show that the harvest index ranged from 41.71% recorded in control up to 46.32% recorded in T_6- 100% NPK + VC @ 2 t ha^{-1}. There was no big difference between treatments that received either fertilizer, manure, or a combination of both manure and fertilizers. Conversely, higher rates of vermicompost combined with fertilizers showed positive effects on the harvest index. This aligned with a previous study by Debbarma *et al*. (2020) [6] and Jackson *et al*. (2019) [13], the use of the complete recommended NPK plus VC @ 2 tonnes per hectare and full recommended dose of NPK plus VC @ 1 tonne per hectare and Zn @ 5 kilograms per hectare had a positive influence as they recorded maximum harvest index (46.322 and 45.01%, respectively) followed by 100% NPK with harvest index of 44.92%. it was aligned with previous studies by Zubairu *et al*. (2022) [29] have demonstrated significant impacts of different nutrient sources on the harvest index.

Table 1: Effect of different nutrient management on wheat's yield attribute and yield

Treatment	Effective tillers m^{-2}	Spike length (cm)	Number of grains/spike	Test weight (g)	Yield (q ha^{-1})		Harvest index (%)
					Grain	Straw	
T_1	197.28	8.30	35.00	41.30	25.49	35.61	41.71
T_2	338.50	9.10	43.00	42.40	41.28	50.62	44.92
T_3	358.83	9.30	44.00	43.50	43.13	53.07	44.84
T_4	369.50	9.40	45.67	43.60	44.27	55.10	44.55
T_5	383.83	9.68	47.00	45.00	46.20	57.94	44.36
T_6	429.00	11.10	54.67	46.00	54.24	62.86	46.32
T_7	415.50	9.90	50.67	45.50	48.54	59.72	44.84
T_8	417.17	10.30	52.00	46.70	50.50	61.70	45.01
CD 5%	5.72	1.24	2.10	2.23	2.34	2.84	
SEM ±	1.87	0.41	0.69	0.73	0.76	0.93	

Effect of different nutrient management on the economics of numerous treatments on wheat crop

Cost of cultivation

Table 2. illustrates a high cultivation cost (Rs. 50817.50 ha^{-1}) was registered in (T_6) 100% NPK in conjunction with VC at 2 tonnes per hectare, which was due to higher quantities of vermicompost applied. It was followed by T_8 and T_7, this was also caused by the effect of the price of vermicompost, and the

expansiveness of zinc micronutrient fertilizer and the least cost of cultivation (35400.00 Rs. ha^{-1}) was recorded in control.

Gross return

Data demonstrated in Table 2. shows that treatment using 100% NPK in conjunction with VC at 2 tonnes per hectare (T_6) had great gross net return (154554.8 Rs. ha^{-1}), this is because vermicompost was applied in this treatment and yielded higher grain and straw of wheat and resulted in good gross net return. It was followed by T_8 and T_7, this was also caused by the effect of vermicompost, and the addition of zinc micronutrient that enhanced wheat straw and grain yield and the least gross net return (75661.40 Rs. ha^{-1}) was registered in non-fertilizers and manure treatment. This highlights the potential economic benefits of organic supplementation in increasing wheat production and profitability, it was aligned with the studies of Aslam *et al*. (2019) [3].

Net return

Table 2. shows that the treatment applied with a full recommended amount of NPK in conjunction with VC @ 2 tonnes per hectare ha^{-1} had a high net return (103737.30 Rs. ha^{-1}), which is due to the application of vermicompost in this treatment, which increased wheat grain and straw yield and resulted in a positive net return. It was succeeded by T_8 with 99042.50 Rs. ha^{-1} and T_7 with (93915.80 Rs. ha^{-1}), which was also caused by the effect of vermicompost and the addition of zinc micronutrient that enhanced wheat straw and grain yield, the least net return (Rs. ha^{-1} 40261.40) was registered in control.

Benefit-cost ratio

The data in Table 2: reveals treatment used full recommended NPK in conjunction with VC @ 2 tonnes per hectare and Zn @ 5 kg per hectare yielded a high benefit-cost ratio compared to other treatments which were (2.13), which is due to the combination of vermicompost and chemical fertilizer in this treatment, which increased wheat grain and straw yield and resulted in high B:C it was followed by T_4. Treatment T_6 and T_7 got the same B:C ratio (2.04), and closely followed by T_3 with (2.03). The control had a minimum B:C (1.14). combining organic, micronutrients and fertilizers boosting crop productivity and economic efficiency, Kumar *et al*. (2017) [17], the addition of zinc micronutrients to fertilizers improves benefit-to-cost ratios, highlighting the importance of micronutrient management for resource optimization and farm profitability (Devi *et al*., 2022) [7].

Table 2: Effect of different nutrient management on the economics of cv. HD 3086 for various treatments

Treatments	Rs.ha^{-1}			
	Cultivation cost	Gross return	Profit	B: C
T_1	35400	75661.4	40261.4	1.14
T_2	40817.5	119021.5	78204	1.92
T_3	41130	124440.1	83310.1	2.03
T_4	41442.5	128041.23	86598.73	2.09
T_5	45817.5	133844	88026.5	1.92
T_6	50817.5	154554.8	103737.3	2.04
T_7	46130	140045.8	93915.8	2.04
T_8	46442.5	145485	99042.5	2.13

Conclusion and Recommendation

The mix of 100% RDF + 2 t ha^{-1} Vermicompost outperformed all other treatments about effective tillers, produce, straw and grains quality, and economics due to the various distribution of macro and micronutrients in vermicompost coupled with fertilizer. The use of micronutrient zinc fertilizer over 100% NPK improved grain quality and production, despite it performing best when combined with 1 t ha^{-1} vermicompost. The treatment used complete recommended NPK combined with VC @ 1 tonne per hectare and Zn @ 5 kg per hectare registered the great B: C (2.13) and hence considered economically efficient, whereas the full recommended NPK in conjunction with VC at 2 tonnes per hectare (T_6) had the highest net return followed by (**T_8**). Briefly, regarding the present finding from this research experiment, we recommend farmers use either NPK at a ratio of 150:60:60 combined with VC at 2 tonnes per hectare (T_6) or NPK at a ratio of 150:60:60 combined with VC 2 tonnes per hectare and Zn @ 5 kg per hectare (T_8).

References

1. Ahmad M, Tripathi SK. Effect of Integrated Use of Vermicompost, FYM and Chemical Fertilizers on Soil Properties and Productivity of Wheat (*Triticum aestivum* L.) in Alluvial Soil. Journal of Phytopharmacology. 2022;11(2):101-106.
2. Akaram SSM, Memon HUR, Baloch SK, A. O. K. A. S. Effect of bio-organic and inorganic Fertilizers On The growth And yield Of wheat (*Triticum aestivum* L.). Persian Gulf Crop Protection. 2022;2(4):15-24.
3. Aslam Z, Bashir S, Hassan W, Bellitürk K, Ahmad N, Niazi NK, *et al*. Unveiling the Efficiency of Vermicompost Derived from Different Biowastes on Wheat (*Triticum aestivum* L.) Plant Growth and Soil Health. Agronomy. 2019;9(12).
4. Cuesta NM, Rozas HS, Barbieri P, Wyngaard N, Salvagiotti F, Sabando ML. DTPA-extractable zinc threshold for wheat grain yield response to zinc fertilization in Mollisols. Soil Sci. Soc. Am J. 2021;1-5. DOI: 10.1002/saj2.20295.
5. Dawar K, Ali W, Bibi H, Mian IA, Ahmad MA, Hussain MB, Ali M, Ali S, Fahad S, Ur Rehman S, Datta R, Syed A, Danish S. Effect of Different Levels of Zinc and Compost on Yield and Yield Components of Wheat. Agronomy. 2022;12(7):1-15. DOI: 10.3390/agronomy12071562.
6. Debbarma A, Pandey PG, Tripathi LK. Study the combined effect of organic manure and inorganic fertilizers on the growth and yield of late-sown wheat (*Triticum aestivum* L.). International Journal of Chemical Studies. 2020;8(3):1669-1672.
7. Devi M, Singh SP, Dhyani BP, Kumar S, Kumar Y. Effect of Zinc enriched and organic sources on Productivity and Profitability of Wheat (*Triticum aestivum* L.). The Pharma Innovation Journal. 2022;11(7):985-990.
8. Dhaliwal SS, Sharma V, Shukla AK, Gupta RK, Verma V, Kaur M, *et al*. Residual Effect of Organic and Inorganic Fertilizers on Growth, Yield and Nutrient Uptake in Wheat under a Basmati Rice–Wheat Cropping System in North-

Western India. Agriculture (Switzerland). 2023;13(3):556. DOI: 10.3390/agriculture13030556.
9. Dukhnytskyi B. World agricultural production. United States Department of Agriculture, WAP 9-23, 1-46. 2023. DOI: 10.32317/2221-1055.201907059.
10. El Habbasha SF, Badr EA, Latef E. Effect of Zinc foliar application on growth characteristics and grain yield of some wheat varieties under Zn deficient sandy soil condition. International Journal of Chem Tech Research. 2015;8(6):452-458.
11. FAO. Crop prospects and food situation #2. In Crop Prospects and Food Situation (Issue 2); c2023. http://www.fao.org/documents/card/en/c/ca5327en.
12. Helfenstein J, Müller I, Grüter R, Bhullar G, Mandloi L. Organic Wheat Farming Improves Grain Zinc Concentration. PLOS ONE. 2016;11(8):1-20. DOI: 10.1371/journal.pone.0160729.
13. Jackson K, Changade NM, Sukul P, Meetei T, Bijilaxmi Y. Efficacy of organic and inorganic fertilizer on soil properties, growth and yield attributes of wheat crop. International Journal of Chemical Studies. 2019;7(6):2942-2947.
14. Keram KS. Response of zinc fertilization to wheat on yield, quality, nutrients uptake and soil fertility grown in a zinc deficient soil. European Journal of Academic Essays. 2014;1(1):22-26.
15. Khattak SG, Dominy PJ, Ahmad W. Effect of Zn as soil addition and foliar application on yield and protein content of wheat in alkaline soil. Journal of the National Science Foundation of Sri Lanka. 2016;43(4):303-312. DOI: 10.4038/jnsfsr.v43i4.7965.
16. Kumar A, Tripathi SK. Effect of integrated use of organic, inorganic and bio-fertilizers on soil fertility and productivity of wheat (*Triticum aestivum* L.) in alluvial soil. The Journal of Phytopharmacology. 2022;11(2):92-96. DOI: 10.31254/phyto.2022.11207.
17. Kumar D, Prakash V, Singh P, Ahamad A. Effect of integrated nutrient management modules on yield, quality and economics of wheat. Journal of Pharmacognosy and Phytochemistry. 2017;6(6):709-711.
18. Kumar H, Dhyani BP, Shahi UP, Kumar A, Tomar VA, Singh A. Effect of zinc and vermicompost application on zinc content, uptake and yield of late sown wheat (*Triticum aestivum* L.). Journal of the Indian Society of Soil Science. 2021;69(3):339-343. DOI: 10.5958/0974-0228.2021.00046.3.
19. Maurya RN, Singh UP, Kumar S, Yadav AC, Yadav RA. Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.). International Journal of Chemical Studies. 2019;7(1):770-773.
20. Parewa HP, Ram M, Jain LK, Choudhary A, Ratnoo SD. Impact of Organic Nutrient Management Practices on Yield Attributes, Yield and Economics of Wheat (*Triticum aestivum* L.). International Journal of Bio-Resource and Stress Management. 2019;10(3):257-260. DOI: 10.23910/ijbsm/2019.10.3.1981.
21. Penuelas J, Coello F, Sardans J. A better use of fertilizers is needed for global food security and environmental sustainability. Agriculture and Food Security. 2023;12(1):1-9. DOI: 10.1186/s40066-023-00409-5.
22. Ramadas S, Kiran Kumar TM, Pratap Singh G. Wheat Production in India: Trends and Prospects. Recent Advances in Grain Crops Research. 2020;July 2019. DOI: 10.5772/intechopen.86341.
23. Yadav SK, Sharma SK, Choudhary R, Jat RK, Jat GK. Yield performance and economics of wheat varieties under organic farming. Indian Journal of Agricultural Sciences. 2020;90(11):2225-2232.
24. Saikia TP, Zaman ASN, Bordoloi PK, Borah N. Zinc uptake and yield of wheat as influenced by zinc fertilizer in Central Brahmaputra Valley Zone of Assam, India. Journal of Soil and Water Conservation. 2022;21(2):215-218. DOI: 10.5958/2455-7145.2022.00028.5.
25. Shamseldinrawia O, AEA A, Box PO. Improve wheat productivity by using a combination of mineral nitrogen, organic and biological fertilizers under new sandy soil conditions. Pak. J. Biotechnol. 2022;19(1):13-22.
26. Sheoran S, Raj D, Antil SA, Mor VS, Dahiya DS. Productivity, seed quality and nutrient use efficiency of wheat (*Triticum aestivum* L.) under organic, inorganic and integrated nutrient management practices after twenty years of fertilization. Cereal Research Communications. 2017;45(2):315-325.
27. Tiwari A, Kumar A, Pathak RK, Sharma S, Prasad H. Impact of Organic Manure, Inorganic Fertilizers and Bioinoculants on Production and Economics of Wheat (*Triticum aestivum* L.). International Journal of Environment and Climate Change. 2023;13(9):3534-3544. DOI: 10.9734/IJECC/2023/v13i92643.
28. Verma SK, Yadav AS, Singh R, Tiwari AK, Yadav A. Productivity, Nutrient Content and Uptake of Wheat (*Triticum aestivum* L.) as Influenced by Integration of Organic, Inorganic and Biofertilizers Nutrient Sources. Ecology, Environment and Conservation. 2022;28. DOI: 10.53550/eec.2022.v28i04s.028.
29. Zubairu AM, Sandabe MK, Abdullahi R. Effect of Farmyard Manure (FYM) and Zinc Fertilizer Application on Yield Parameters of Common Wheat (*Triticum aestivum* L.) Grown on Sandy-clay Loam of Borno State, Nigeria. International Journal of Plant & Soil Science. 2022;34(24):544-550. DOI: 10.9734/IJPSS/2022/v34i242671.