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Meraj Ahmad

Department of Soil Science and Agricultural Chemistry, Kulbhaskar Ashram Post Graduate College, Prayagraj-211001, Uttar Pradesh, India

S K Tripathi

Department of Soil Science and Agricultural Chemistry, Kulbhaskar Ashram Post Graduate College, Prayagraj-211001, Uttar Pradesh, India

Effect of Integrated use of Vermicompost, FYM and Chemical Fertilizers on Soil Properties and Productivity of Wheat (*Triticum aestivum* L.) in Alluvial Soil

Meraj Ahmad, S K Tripathi

ABSTRACT

A field experiment was conducted during *rabi* season 2020-21 at the Research Farm of Kulbhaskar Ashram Post Graduate College, Prayagraj, UP to study the effect of integrated use of vermicompost, FYM and chemical fertilizers on soil properties and productivity of wheat in alluvial soil. The experiment consisted of eight treatment combinations viz., T1- Absolute control, T2- 25% RDF + 75% N through FYM, T3-50% RDF + 50% N through FYM, T4-75% RDF + 25% N through FYM, T5- 25% RDF + 75% N through vermicompost, T6-50% RDF + 50% N through vermicompost, T7-75% RDF + 25% N through vermicompost, T8-50% N through FYM + 50% N through vermicompost with three replications in Randomized Block Design (RBD). The results of experiment showed higher grain and straw yield obtained with the application of 50% RDF + 50% N through vermicompost. Maximum plant height, number of grains/spike, test weight and protein content was recorded in treatment T6 (50% RDF + 50% N through vermicompost). The data revealed that maximum harvest index (42.97%) was observed in treatment T7 (75% RDF + 25% N through vermicompost). The soil properties in respect of pH, ECe, organic carbon and available N, P & K were noticed with the treatment T6 (50% RDF + 50% N through vermicompost).

Keywords: INM, Vermicompost, FYM, Chemical Fertilizers, Soil Properties, Productivity, Wheat, Alluvial Soil.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is most important cereal crop of family Poaceae. Wheat is chief source of vegetable protein for human food with higher protein content than other cereal grains. Indiscriminate use of chemical fertilizers is harmful for plants as well as soil environment. Continuous use of chemical fertilizers in modern intensive cropping not only adversely affects the crop yield but also deteriorates soil health to a great extent. Therefore, it is the necessary to use of eco-friendly and less expensive chemical fertilizers for sustaining wheat yield and soil health. Fertilizer use especially NPK plays an important role in increasing the yield of wheat but continuous use of micronutrient free NPK fertilizers in intensive cropping system with avoid of organic manures have resulted in the depleting micronutrients from soil reserves. Integration of organic manures with chemical fertilizers has been found to be quite reliable not only in increasing higher productivity but also in providing sustainability in crop production^[1]. Nitrogen is major and primary element and play vital role in increasing productivity of wheat. It is an important constituent of chlorophyll, protoplasm, protein and nucleic acid and increasing the growth and development of all living tissues. Nitrogen also plays an important role in physiological process of plant. Phosphorus is a key element play an important role in energy transfer, biosynthesis of nucleic acid and membranes. It is essential constituent for nucleic acid and phytin and also called energy currency. Phosphorus promotes new cell formation and root development in plants. Potassium is an essential plant nutrient in photosynthesis, regulates the opening and closing of stomata as well as regulates CO₂ uptake. FYM is one of the more valuable organic fertilizers maintaining soil fertility in the system of alternative agriculture. Vermicompost is a kind of organic fertilizers and derived from composting organic waste by using various species of earthworms. Integrated Nutrient Management helps to render and sustain soil fertility, crop productivity and also improves soil health. It may also help to check the emerging deficiency of nutrient other than NPK. Integrated management of the nutrients is required for proper plant growth, as well as effective crop and soil management. It also reduced the need for chemical fertilizers by taking advantages of non-chemical sources of nutrients such as the manures, composts and bio-fertilizers.

The present investigation entitled "Effect of Integrated use of Vermicompost, FYM and Chemical Fertilizers on soil Properties and Productivity of Wheat (*Triticum aestivum* L.) in Alluvial soil" was undertaken to compare integrated use of organic and inorganic sources of nutrients with chemical fertilizers along with following objectives:

Correspondence:

Dr. S K Tripathi

Department of Soil Science and Agricultural Chemistry, Kulbhaskar Ashram Post Graduate College, Prayagraj-211001, Uttar Pradesh, India
Email: sk.kap2017@gmail.com

- To find out the effect of integrated use of vermicompost, FYM and chemical fertilizers on growth, yield attributes, yield and protein content of wheat and
- To find out the effect of integrated use of vermicompost, FYM and chemical fertilizers on properties of soil

MATERIALS AND METHODS

The present experiment was conducted during *Rabi* season of year 2020-21 at the research farm of Kulbhaskar Ashram Post Graduate College, Prayagraj, UP. Prayagraj is located between 24°26' N latitudes and 81°56' E longitudes. Prayagraj lies in the southern part of the state Uttar Pradesh in India at an elevation of 98 meter. The average rainfall of Prayagraj is 1042 mm/annum. The average maximum and minimum temperature lie 42°C and 10°C, respectively and average annual relative humidity is 62%. The eight treatments i.e., T₁- Absolute control, T₂ (25% RDF +75% N through FYM), T₃ (50% RDF +50% N through FYM), T₄ (75% RDF +25% N through FYM), T₅ (25% RDF +75% N through vermicompost), T₆ (50% RDF +50% N through vermicompost), T₇ (75% RDF +25% N through vermicompost), T₈ (50% FYM +50% N through vermicompost), were selected and tested in Randomized Block Design (RBD), with three.

replications. The crop wheat is taken as test crop and variety of PBW-443. The use of organic materials for experiment was calculated on the basis of the percentage of nitrogen present in it. The organic material like FYM and vermicompost was incorporated into soil before two weeks sowing of wheat and allowed to decompose at proper moisture content. Recommended amounts of phosphorus and potassium were applied equally in all the treatments except in control. The fertilizers were applied @120kg N, 60kg P₂O₅ and 40 kg K₂O per ha in the form of urea, di-ammonium phosphate and muriate of potash, respectively. Half dose of nitrogen and full doses of phosphorus and potassium were applied at the time of sowing as per treatment except control. The remaining half dose of nitrogen was top-dressed after first irrigation of wheat crop. The treatment wise doses of farmyard manure FYM were applied on the basis of nitrogen content at the rate of 25, 50, 75% and at the rate of 50, 25, 50, 75% vermicompost in the field 15 days before sowing of crop. The seed rate 120 kg/ha of wheat variety PBW-443 was sown at a row distance of 20 cm on in the experimental plots. Plants parameters like plant height, no. of spikes/m², spike length, no. of grains/spike, yield, soil properties etc. was observed. The protein content was calculated after analyze the N content in grain and value was multiplied with 6.25. The experiment data were analyzed using “Analysis of Variance Techniques” in Randomized Block Design (RBD).

Table 1: Mechanical and Chemical analysis of soil

Components	Percentage	Methods used
Sand	60	Hydrometer method ^[2]
Silt	34	
Clay	21	
Texture	Sandy loam	
Parameters	Value	
pH (1:2.5)	8.20	By pH meter
OC (%)	0.47	Walkley & Black method ^[3]
ECe (dS/m)	0.39	By Electrical Conductivity meter.
Available N (Kg/ha)	236	Alkaline Permanganate method ^[4]
Available P ₂ O ₅ (Kg/ha)	27	0.5M NaHCO ₃ (pH 8.5) extractable P (Olsen’s method) ^[5]
Available K ₂ O (Kg/ha)	220	1N NH ₄ OAc extractable K using Flame Photometer ^[6]

Chemical composition of FYM and vermicompost

Particulars	FYM	Vermicompost
OC (%)	12.20	9.75
N (%)	0.50	1.80
P ₂ O ₅ (%)	0.25	0.65
K ₂ O (%)	0.50	1.20

RESULTS AND DISCUSSIONS

Growth and Yield attributing characters

The plant height was recorded at 30, 60, 90 and 120, days after sowing (DAS) and results of the data and analyzed are depicted in table 2. The data indicated that the effect of integrated nutrient management on plant height is significant. It was observed that height of the plant significantly increases in all treatment at different days over control. The maximum plant height at 30, 60, 90 and 120 DAS was recorded in T₆ (50% RDF + 50% N through vermicompost) which was 11.15, 68.92, 96.45 and 97.27 cm respectively, followed by T₃ (50% RDF + 50% N through FYM) and T₇ (75% RDF + 25% nitrogen through vermicompost). The plant height at maturity was maximum in treatment receiving 50 % NPK through recommended dose of fertilizers in combination with 50% N through vermicompost which was significantly superior over T₁ (Absolute control) and at par with all integrated plots. Vermicompost supplied nutrients to plant

root in balanced amount and stimulate growth, increased organic matter content in soil including the humic substance that affected nutrients accumulation and promoted root growth which led to better growth of plants. The increased in plant height was observed with integrated use of organic and inorganic sources of nutrients have also been reported by ^[7, 8]. The data presented in table-2 in respect of no. of grains/spike showed that all the treatments FYM and vermicompost with chemical fertilizers were significantly higher over control maximum number of grains per spike (56.49) was recorded in treatments 50% RDF + 50% N through vermicompost (T₆) which was significantly higher over T₁ (control), T₂ (25%RDF +75% N through FYM), T₅ (25% RDF + 75 % N through vermicompost), T₈ (50% FYM +50% N through). Observations on number of spikes per meter square, spike length and number of grains per spike increased significantly by integrated use of chemical fertilizers with FYM or vermicompost. However, the treatment receiving 50% RDF + 50% N through vermicompost increased significantly the number of spikes/m², spike length and number of grains/spike over the control

and recommended dose of chemical fertilizers. The important property of organic matter provides a steady supply of nutrients to the plants for better growth. It also increased availability of phosphorus and potassium in addition of micronutrients which may increase yield attributing characters of wheat. This corroborates the findings of [9, 10]. Data presented in above revealed that the highest value of test weight (43.69 g) was observed in the treatment T₆ (50% RDF +50%N through vermicompost) which was significantly superior over T₁ (Absolute control), T₂ (25% RDF +75 % N through FYM), T₅ (25%RDF + 75% N through vermicompost T₈ (50% FYM + 50 % N through vermicompost) and at par with rest of the treatments. The increase in test weight may be ascribed to the balanced and steady supply of nitrogen, increased photosynthetic activity in leaves, better translocation of photosynthates from source to sink. Vermicompost was more effective in this respect because of better nutrient supply than FYM [9, 10].

Yield and Harvest Index

Integrated nutrient management on grain and straw yield of wheat was found better over control. The maximum grain and straw yield were recorded in treatment T₆ (50 % RDF+ 50% N through vermicompost), which was significantly higher over the treatments T₁ (Absolute control), T₂ (25%RDF + 75% N through FYM), T₅ (25% RDF + 75% N through vermicompost), T₈ (50% FYM + 50% N through vermicompost) and at par with treatments T₃ (50% RDF + 50 % N through FYM), T₄ (75% RDF + 25 N % through FYM) and T₇ (50% RDF + 50% N through vermicompost). The grain yield of wheat is a resulted product of number of spike/m², no. of grains spike, spike

length and test weight. The application of 50% RDF+ 50% N through vermicompost resulted in more yield attributing characters of wheat. Therefore, highest grain and straw yield produced by treatment receiving 50% RDF + 50% N through vermicompost. This may be due to considerable impact on physical, chemical and biological properties of soil. Vermicompost contains rich nutrients especially nitrogen, which gradually makes them available to plants compared to other organic sources. Macro nutrients in vermicompost such as N, P, and K which have critical roles in plant life activities. It also contains micronutrients such as Fe, Cu, Zn and Mn. [7, 8, 11].

A perusal of data computed in table-2. The harvest index responded by different treatments did not show much variation. Maximum value of harvest index was calculated (42.97%) in treatment T₆ (50% RDF + 50% N through vermicompost). However, the minimum harvest index value (41.41%) was calculated in control. The harvest index did not show much variation within the treatments. However, the maximum harvest index was recorded with treatment T₆ (50 % RDF + 50% N through vermicompost). Similar finding was also observed by [8].

Protein content (%)

The data presented in table-2 on protein content in clearly indicated that maximum protein content was obtained with treatment T₆ (50% RDF +50% N through vermicompost) which was significantly superior over the treatments T₂ (25% + 75% N through vermicompost, T₄ (75% RDF +25% N through FYM), T₅ (25% RDF +75% N through vermicompost) and T₈ (50% FYM +50% N through vermicompost) [7, 12].

Table 2: Effect of integrated use of vermicompost, FYM and chemical fertilizers on growth, yields attributing characters, protein content and yield of wheat

Treatments	Plant height (cm)	No. of Grains Spike ⁻¹	Test Weight (g)	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Protein content(%)
T ₁	87.25	50.65	40.05	40.60	54.75	10.26
T ₂	94.55	54.04	42.44	41.99	57.52	11.88
T ₃	96.62	56.11	43.35	46.75	62.58	12.86
T ₄	95.16	55.27	43.17	46.00	61.35	12.10
T ₅	94.66	54.14	42.45	42.95	60.60	11.23
T ₆	97.27	56.49	43.69	47.50	67.20	13.18
T ₇	95.27	55.35	43.69	46.15	61.25	12.54
T ₈	93.74	54.12	42.06	41.80	55.75	11.10
SEm±	1.47	0.74	0.21	0.53	2.02	0.32
CD at 5%	4.46	2.25	0.62	1.60	6.14	0.98

Soil properties

Soil pH, ECe & OC

The data presented in table-3 revealed that soil pH was found non-significant between the treatments, but it was observed that improved over control. The maximum pH was recorded in treatment T₁ was 7.95 and minimum in treatment T₅ was 7.61. There was improvement in soil pH was noticed in all integrated plots as well as only organic manures applied over control. The minimum reduction in electrical conductivity (0.19) was observed in T₆ and maximum was recorded in control. EC was reduced in all the integrated plots over control. The soil pH and EC declined slightly in all the treatments receiving organic and inorganic sources of nutrients. This may be due to release of various organic acids during decomposition of organic manures. In general, more the organic substances incorporated in soil results more reduction in pH and EC of soil. The results closely corroborate with the findings of [13, 14]. An examination of data presented in table-2 revealed that organic carbon content in soil

increased significantly over control during crop year. However maximum organic carbon content recorded in T₆ (0.69) in which 50% RDF + 50% N through vermicompost which was significantly over the treatment T₁ (control), T₂ (25% RDF +75%N through FYM), T₅ (25 % RDF+75% N through vermicompost). Organic carbon increased in all the treatments in which chemical fertilizers replaced either through FYM or vermicompost. The organic carbon was higher in T₈ over control. This may be increase in microbial population and better decomposition of organic wastes which increased organic carbon content in soil [13, 14, 15].

Table 3: Effect of Integrated use of Vermicompost, FYM and Chemical Fertilizers on Soil Properties

Treatments	Soil pH (1:2.5)	Soil EC _e (dSm ⁻¹)	OC (%)	Available N (kg/ha)	Available P ₂ O ₅ (kg/ha)	Available K ₂ O (kg/ha)
T ₁	7.95	0.25	0.51	282.45	15.05	124.45
T ₂	7.63	0.20	0.66	289.35	15.63	160.60
T ₃	7.49	0.21	0.69	298.68	17.33	210.18
T ₄	7.58	0.22	0.66	292.15	17.00	183.30
T ₅	7.61	0.23	0.65	293.35	16.17	165.63
T ₆	7.46	0.19	0.68	299.37	18.50	215.35
T ₇	7.50	0.20	0.66	291.40	17.00	196.80
T ₈	7.76	0.19	0.66	288.65	15.89	139.85
SEm±	0.71	0.02	0.03	2.05	0.41	2.08
CD at 5%	2.13	0.06	0.08	6.20	1.22	6.27

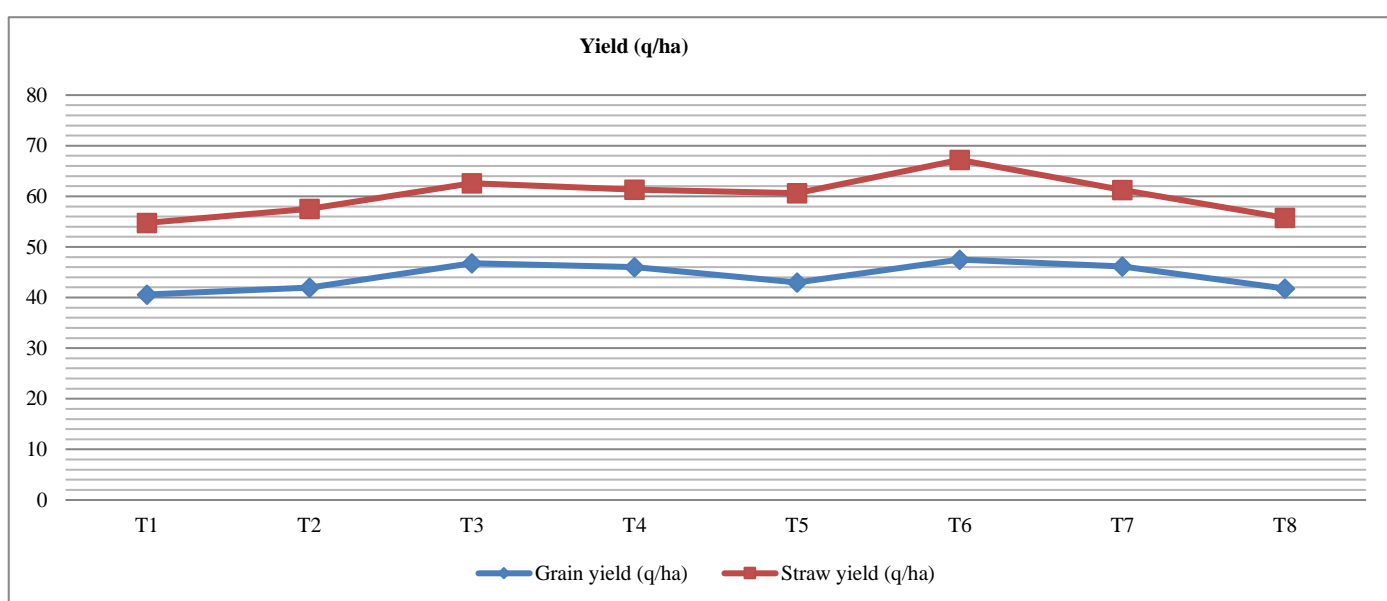


Figure 1: Effect of integrated use of vermicompost, FYM and chemical fertilizers on grain and straw yield

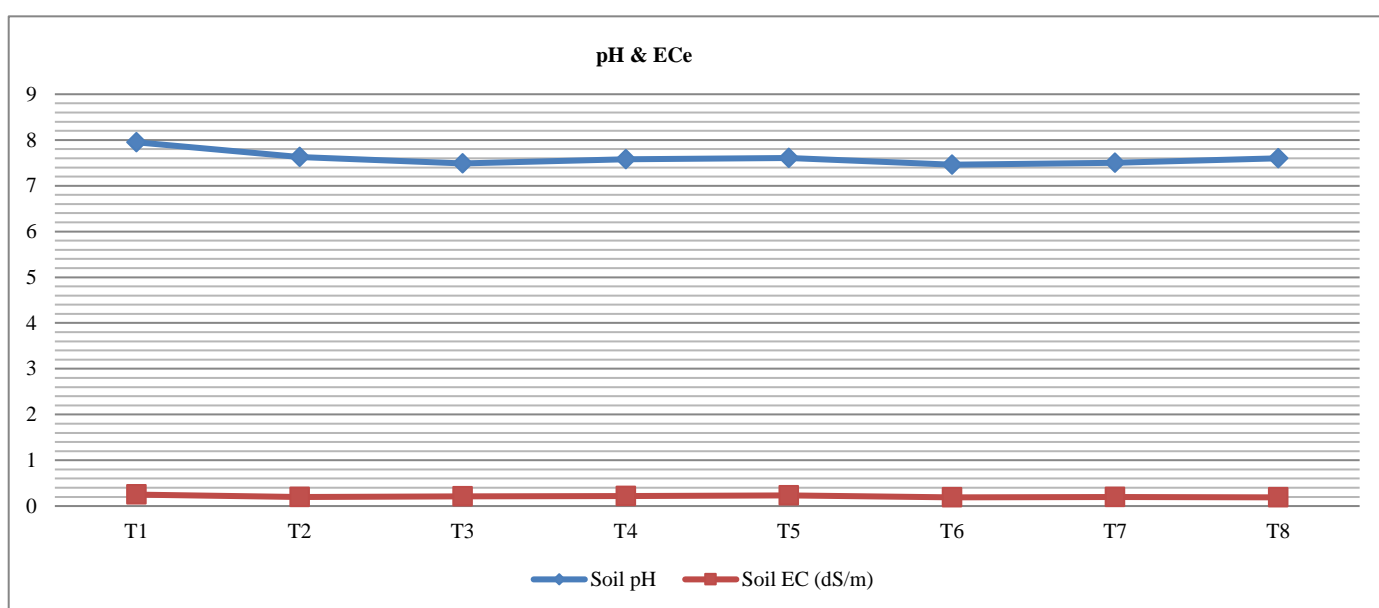


Figure 2: Effect of Integrated use of Vermicompost, FYM and Chemical Fertilizers on Soil pH & ECe

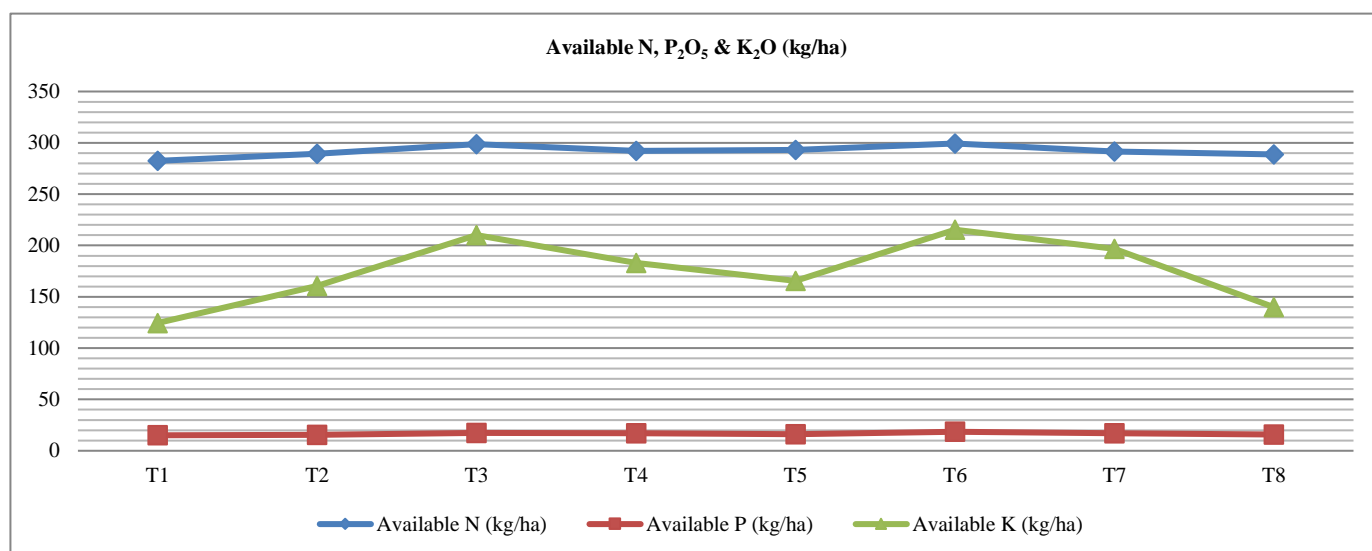


Figure 3: Effect of integrated use of vermicompost, FYM and chemical fertilizers on available N, P₂O₅ & K₂O (kg/ha)

Available N, P & K

The maximum available nitrogen at 0-15 cm soil depth recorded in T₆ which was 299.37 kg/ha and was at par with T₃ (298.68 kg/ha) and minimum nitrogen at 0-15 was recorded in control (T₁) which was 282.45 kg/ha. The enhancement in available nitrogen was increased 5.65 % over control. The application of vermicompost increase nitrogen content. The similar findings are in line with [16, 17]. The maximum available phosphorous content was recorded in 50% RDF +50% N through vermicompost (T₆) which was significantly higher over the treatments T₁ (control), T₂ (50% RDF +50% N through FYM), T₅ (25% RDF +75% N through vermicompost) and T₈ (50% FYM + 50% N through vermicompost) and at par with T₃ (50% +50% N through vermicompost) T₄ (75% RDF +25% N through vermicompost) T₇ (75% RDF + 25% N through vermicompost). The treatments T₈ have been 15.89 kg/ha of available phosphorous content which was higher over control. Vermicompost and FYM are capable to reduce phosphorus fixation in soil. The results are in agreements by [13, 15]. Effect integrated of vermicompost, FYM and chemical fertilizers enhanced available K content in soil. The result further showed that maximum available K content was recorded in treatment T₆ (50% RDF +50% N through vermicompost) which was significantly higher over treatments T₁ (control), T₂(25% RDF + 75% N through vermicompost), T₅ (25% RDF +75% N through vermicompost) and T₈. The use of 1:1 ratio of chemical fertilizers combined with FYM or vermicompost found better in respect of available K in soil. This may be due to organic acid produced during decomposition of organic manures reduces the K-fixation in soil. These findings are in agreement with those of [8, 15].

CONCLUSION

On the basis of experimental study, it was concluded that integrated use of chemical fertilizers in combination with vermicompost found better in respect to growth, yield attributing characters and yields of wheat crop. However, the treatment receiving 1:1 ratio of chemical fertilizers with vermicompost T₆ (50% RDF + 50% N through vermicompost) proved better in respect to grain yield of wheat. The integrated use of chemical fertilizers either with FYM or vermicompost enhanced the soil fertility status in respect of pH, EC, Organic Carbon, Available Nitrogen, Phosphorus and Potassium in the soil. The maximum improvement in soil fertility was noticed where vermicompost was applied with chemical fertilizers. Therefore, the treatment 50% RDF+50% N through vermicompost proved better for production of wheat crop and may be recommended to the farmers.

Conflict of Interest

None declared.

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None declared.

REFERENCES

- Nambiar KK, Abrol IP. Long-term fertilizer experiments in India: An overview. *Fertilizer News*. 1989;34(4):11-20.
- Bouyoucos GJ. Directions for making mechanical analyses of soils by the hydrometer method. *Soil Science*. 1936;42(3):225-30.
- Walkley A, Black IA. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Science*. 1934;37:29-38.
- Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soils. *Current Science*. 1956;25:259-60.
- Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. United State Department of Agriculture Circular. 1954;10:939.
- Jackson ML. Soil chemical analysis. Prentice Hall of India Pvt. Ltd. New Delhi. 1973;1958-98.
- Singh S, Singh JP. Effect of organic and inorganic nutrient sources on some soil properties and wheat yield. *Journal of the Indian Society of Soil Science*. 2012;60(3):219-25.
- Kumar V, Raghuvanshi N, Singh RA. Effect of different combination of fym & urea on growth & yield of wheat (*Triticum aestivum* L.). *Bulletin of Environment, Pharmacology and Life Sciences*. 2017;6(2):395-98.
- Maurya RN, Shivbahadur, Yadav RA, Kumar A. Growth, yield & quality of wheat as influenced by integrated nutrient management. *Journal Pure & Applied Microbiology*. 2016;10(2):1619-22.
- Rathwa PG, Mevada K, Ombase KC, Dodiya CJ, Bhadu V, Purabiya VS, Saiyad MM, et al. Integrated nutrient management through different sources on growth and yield of wheat (*Triticum aestivum* L.). *Journal of Pure and Applied Microbiology*. 2018;12(2):905-11.
- Mohan B, Kumar P, Yadav RA. Effect of integrated nutrient management on yield attributes and yields of wheat (*Triticum aestivum* L.). *Journal of Pharmacognosy and Phytochemistry*. 2018;7(1):1545-47.
- Singh SP. Productivity, quality and uptake of nutrients in wheat (*Triticum aestivum*) as influenced by integrated nutrient management. *Annals of Plant and Soil Research*. 2017;19(1):12-16.
- Bhatt MK, Labanya R, Joshi Hem C. Influence of long term chemical fertilizers and organic manures on soil fertility-A Review. *Universal Journal of Agricultural Research*. 2019;7(5):177-88.
- Meena KB, Alam MS, Singh H, Bhat MA, Singh AK, Mishra AK, et al. Thomas T. Influence of farmyard manure and chemical fertilizers on soil properties and yield and nutrients of wheat. *International Journal of Chemical Science*. 2018;6(3):386-90.
- Nayak B, Rath BS, Shahid M, Jena SN, Bagchi TB, Roy PS, et al. Organic Nutrient Management in Aromatic Rice-Rice Sequence: A

Critical Review. International Journal of Chemical Studies. 2020;8:1435-44.

16. Singh H, Singh AK, Alam S, Singh T, Singh VP, Parihar AK, Singh R, *et al.* Effect of various integrated nutrient management models on growth and yield of wheat in partially reclaimed sodic soil. *Int. J. Curr. Microbiol. App. Sci.* 2017;6(3):803-8.
17. Reddy TK, Pawar RB, Patil DS. Effect of integrated nutrient management on growth, yield and economics of wheat (*Triticum aestivum* L.) in inceptisol. *International Journal of Current Microbiology and Applied Science.* 2018;7(10):1892-02.

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