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Effect of Organic and Inorganic Sources of Nitrogen on Growth, Yield, Quality and Soil Properties of Wheat (*Triticum aestivum* L.)

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ABSTRACT

Background: The concept of combined use of both organic and inorganic fertilizer should be followed to prevent severe health hazards and to protect the environment. The combined use of organic and inorganic fertilizers is an effective way to maintain nutrient supply, gives organic carbon to soil microbes and mobilizes soil-bound nutrients on decomposition through the release of organic acid. Combined use refers to combining all available nutrient sources, such as organic and inorganic sources with components in a prudent manner to create an environment that is both environmentally sound and economically ideal for farming.

Methods: The experiment was conducted at the research farm of the School of Agriculture, Department of Agronomy, Lovely Professional University, Phagwara (Punjab) during *rabi* season in the year 2021-2022. The objective of the study was to evaluate the "Effect of organic and inorganic source of nitrogen on growth and yield of wheat (*Triticum aestivum* L.)". Data recorded on different aspects of crop *viz*., growth, yield attributes, yield, quality as well as soil chemical properties were recorded and subjected to statistical analysis.

Result: Among various treatments 25% RDN with vermicompost + 75% RDN from inorganic fertilizers showed a significant impact on the growth and yield parameters of wheat crop. Significantly higher growth parameters *viz.,* plant height, number of tillers m^{-2}, dry matter and relative growth rate were observed in T_{12} (25% RDN with vermicompost + 75% RDN from inorganic fertilizers) of crop. It was also showed higher significant impact on yield attributes *i.e.*, number of effective tillers^{-2}, grain yield, straw yield, harvest index, quality parameters as well as soil parameter like available nitrogen, phosphorus and potassium in T_{12} (25% RDN with vermicompost + 75% RDN from inorganic fertilizers).

Key words: Enriched compost, Farmyard manure, Fertilizer, Organic manure, Vermicompost, Wheat.

INTRODUCTION

Wheat (*Triticum aestivum* L.) ranks second among major cereal crops next to rice belongs to *Poaceae* family. Wheat is a major agronomic crop which is well known for making flour, pasta, pastry, semolina, flake, chapatti, cookies, *etc.* It is one of the major sources of energy as it all alone contributes about 20 per cent of total food calories required for human diet (Ram and Kaur, 2024). It is originated in South Western Asia. It has a global annual production of 756.40 million metric tons from 240 million hectares of land (Ashik *et al*., 2023). India is the second largest producer of wheat in the world. Wheat is grown in India on 33.61 m ha and produces of 106.21 mt with national average yield of 3160 kg ha^{-1} during 2019-20 (Anonymous, 2020). It accounts for approximately 12% of world's wheat production and the second largest wheat consumer after China. It is one of the chief sources of diet by providing half of the dietary protein and more than half of the calories to the rising population of India. As a consequence, scientists are always focusing to produce higher yields to feed the nation (Khan *et al.,* 2015). Wheat contains significant amount of protein which constitutes about 12-14%. Apart from protein, whole wheat is also rich in vitamins, minerals and fiber. Wheat grains are comparatively better source of protein consumed in India.

Wheat is a highly nutrient consuming crop and it requires substantial amount of nutrients for higher productivity. Nitrogen is a costly input and a major share of it is used for cereal cultivation. The cost of nitrogen fertilizers is increasing day by day. Nitrogen is an indispensable element for optimum functioning of crops. Despite the fact

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that inorganic fertilizers were resulted in better yield of crop, over dependence on them associated with declined soil properties and degraded soils which in turn decreases yield in subsequent period. Intensive use of inorganic and agrochemical fertilizers leads to the significant decline of soil health and fertility. So, the major strategies that need to be adapted is maintaining soil health and restoring degraded agricultural land (Kumar *et al*., 2023). Use of organic manures like farm yard manure (FYM), goat manure, poultry litter, *etc*., for crop production might be a substitute of the chemical fertilizers. Organic manure increases the nutrient use efficiency and reduces the environmental pollution due to fertilizers. Use of organic manure and organic waste was also found good for crop production. The main disadvantage of using organic fertilizer is that it doesn't contain significant quantities of primary nutrients which are nitrogen, phosphorus and potassium. Manure based fertilizer relying on other beneficial micro-organisms as they slowly convert to nitrogen and feed the plant.

MATERIALS AND METHODS

During the 2021-2022 *rabi* season, the field trial was conducted at Research Farm of Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab. The experiment was laid out in randomized block design (RBD) consist of 12 treatments which was replicated thrice. The treatments were T_1: 100% Recommended dose of nitrogen (RDN) from farm yard manure, T_2: 75% RDN from farm yard manure + 25% from inorganic fertilizer, T_3: 50% RDN from farm yard manure + 50% from inorganic fertilizer, T_4: 25% from farm yard manure + 75% from inorganic fertilizer, T_5: 100% RDN from enriched compost, T_6: 75% RDN from enriched compost + 25% from inorganic fertilizer, T_7: 50% RDN from enriched compost + 50% from inorganic, T_8: 25% RDN from enriched compost + 75% from inorganic fertilizer, T_9: 100% from vermicompost, T_{10}: 75% RDN from vermicompost + 25% from inorganic fertilizer, T_{11}: 50% RDN from vermicompost + 50% from inorganic fertilizer and T_{12}: 25% RDN from vermicompost + 75% from inorganic fertilizer. The source of inorganic nitrogen fertilizer is urea. Data recorded on different aspects of crop, *viz*., growth, yield attributes, yield, quality as soil chemical properties were tabulated and subjected to statistical analysis as per Gomez and Gomez, (1984). Relative growth rate was described by Blackman, (1919) and it was calculated by the equation:

$$\text{Relative growth rate (RGR) } (g\ g^{-1}\ day^{-1}) = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1}$$

Where:

W_1 = Initial dry weight of plant (g).

W_2 = Final dry weight of plant (g).

t_1 = Initial time period.

t_2 = Final time period.

It is also called efficiency index (y) and can be expressed in g g^{-1} day^{-1}.

Harvest index was obtained by formula given by Donald and Hamblin, (1962).

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (t ha}^{-1})}{\text{Biological yield (t ha}^{-1})} \times 100$$

RESULTS AND DISCUSSION

Growth attributes

Plant height

A perusal of the Table 1 reveals that highest plant height of 88.6 (cm) were recorded in treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer), whereas treatment T_8 (25% RDN from enriched compost + 75% from inorganic fertilizer) and T_{11} (50% RDN from vermicompost + 50% from inorganic fertilizer) were found to be statistically at par to the treatment T_{12} whereas the lowest height of 83.5 (cm) were observed in treatment T_1 (100% RDN from farm yard manure). Thus, the application of 75% of the prescribed fertilizer dose and the addition of vermicompost led to an increase in plant height.

Table 1: Effect of organic and inorganic fertilizers on growth parameters of wheat (*Triticum aestivum* L.).

Treatments	Plant height (cm)	No. of tillers m^{-2}	Dry weight (g $plant^{-1}$)	Relative growth rate (g g^{-1} day^{-1})
T_1	83.5	401.3	67.3	0.003
T_2	85.3	406.2	68.3	0.004
T_3	86.7	408	69.1	0.003
T_4	87.6	409.7	69.9	0.004
T_5	84.1	403.2	67.5	0.003
T_6	85.9	407	68.5	0.004
T_7	87.4	408.4	69.2	0.003
T_8	88.3	410	70.1	0.003
T_9	84.8	405.6	68.1	0.004
T_{10}	87.2	407.8	68.9	0.004
T_{11}	87.4	408.9	69.5	0.006
T_{12}	88.6	410.4	70.2	0.007
S.E m (±)	0.31	0.18	0.07	0.0004
CD (P= 0.5)	0.92	0.53	0.20	0.0012

The outcomes were also in agreement with those of Kumar *et al.* (2017) and Hadis *et al.* (2018).

Number of tillers (m^{-2})

The highest number of tillers m^{-2} of 410.4 was recorded in treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) which was found to be statistically at par to treatment T_8 (25% RDN from enriched compost + 75% from inorganic fertilizer) while the lowest number of tillers m^{-2} of 401.3 were observed in treatment T_1 (100% RDN from farm yard manure). Sufficient nitrogen availability has a stimulatory effect on wheat tillering, resulting in a greater number of productive tillers. This can be achieved through the production of cytokines and the quick conversion of synthesized carbohydrates, which causes rapid multiplication and an increase in the size and number of growing cells. The outcomes are consistent with observations of Patel *et al.* (2018).

Dry weight

It was evident from the Table 1 that the highest dry weight of 70.2 g $plant^{-1}$ was recorded in treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) which was found to be statistically at par to treatment T_8 (25% RDN from Enriched compost + 75% from inorganic fertilizer) and the lowest dry weight of 67.3 (g $plant^{-1}$) was observed in treatment T_1 (100% RDN from farm yard manure). When nutrients, particularly nitrogen, are more easily accessible to crops, there is an increased transfer of photosynthates from source to sink. As a result of the accumulation of photosynthates in various plant parts, the wheat crop produces more dry matter. Increased dry weight may be a result of applying the necessary amount of fertilizers in both organic and inorganic forms. The results reported correspond with Patel *et al.* (2018); Singh *et al.* (2017).

Relative growth rate ($g^{-1}g^{-1}day^{-1}$)

The treatment of T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer recorded highest relative growth rate of (0.007 g^{-1} m^2 day^{-1}) as shown in Table 1. The larger canopy development and plant height caused by the application of a higher dose of integrated nutrient management may have increased solar energy interception, absorption and utilization. This, in turn, increased overall growth, photosynthesis and finally the accumulation of dry matter $plant^{-1}$, which increased the relative growth rate (Choudhary *et al.,* 2017).

Yield attributes

Number of effective tillers (m^{-2})

The treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) recorded significantly maximum number of effective tillers m^{-2} *i.e.* 312.6 which was found to be statistically at par to the treatment T_{11} (50% RDN from vermicompost + 50% from inorganic fertilizer) and the treatment T_1 (100% RDN from farm yard manure) recorded lowest number of effective tillers running row $metre^{-1}$ *i.e.* 234.7 as shown in Table 2. With the generation of cytokines and the quick conversion of produced carbohydrates, it results in rapid multiplication and an increase in the size and number of developing cells. This in turn leads to a sufficient supply of nitrogen which accelerates wheat tillering and produces more productive tillers m^{-2}. These findings have been reported by Reddy *et al.* (2018); Fazily *et al.* (2021); Singh *et al.* (2017).

Number of grains $spike^{-1}$

The perusal of the Table 2 shows that the treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) recorded significantly maximum number of grains $spike^{-1}$ of 43.7 which was found to be statistically at par to the treatment T_{11} (50% RDN from vermicompost + 50% from inorganic fertilizer) while the treatment T_1 (100% RDN from farm yard manure) recorded lowest number of grains $spike^{-1}$ of 40.0. By integrating organic manure with chemical fertilizers, crops were better able to absorb essential nutrients including N, P and K. The physical characteristics

Table 2: Effect of organic and inorganic fertilizers on yield attributes of wheat (*Triticum aestivum* L.).

Treatment	Number of effective tillers $metre^{-2}$	Number of grains $spike^{-1}$	Test weight (g)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)
T_1	234.7	40.0	41.1	36.7	66.0	35.7
T_2	256.7	41.3	41.5	40.7	67.8	37.5
T_3	269.3	42.0	42.9	46.4	69.1	40.2
T_4	294.5	43.1	43.9	51.1	69.9	42.2
T_5	242.2	40.4	41.1	37.6	67.3	35.9
T_6	266.1	41.6	42.0	42.6	68.2	38.4
T_7	279.3	42.3	43.1	47.9	69.2	40.9
T_8	299.8	43.3	44.0	53.1	70.1	43.1
T_9	243.7	41.0	41.3	39.6	67.5	37.0
T_{10}	268.0	41.8	42.7	44.2	68.7	39.1
T_{11}	281.4	42.8	43.4	50.0	69.3	41.9
T_{12}	312.6	43.7	44.6	56.2	71.0	44.2
S.E m (±)	4.31	0.19	0.10	0.49	0.17	0.24
CD (P= 0.5)	12.64	0.57	0.30	1.45	0.53	0.71

of the soil and plant growth hormones were also improved. Similar results were found by Singh *et al.* (2017); Reddy *et al.* (2018); Fazily *et al.* (2021).

Test weight (g)

It was evident from the Table 2 that the treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) recorded significantly maximum test weight of 44.6 g which was found to be statistically at par to the treatment T_{11} (50% RDN from vermicompost + 50% from inorganic fertilizer) whereas the treatment T_1 (100% RDN from farm yard manure) recorded lowest test weight of 41.1 g. Reddy *et al.* (2018) and Fazily *et al.* (2021) also reported similar outcomes.

Grain yield (q ha^{-1})

The treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) recorded significantly maximum grain yield (56.2 q ha^{-1}) which was found to be statistically at par to the treatment T_{11} (50% RDN from vermicompost + 50% from inorganic fertilizer) while the treatment (T_1: 100% RDN from Farm yard manure) recorded lowest grain yield (36.7 q ha^{-1}) as shown in Table 2. This might be due to the increase in yield attributes. Singh *et al.* (2017); Reddy *et al.* (2018); Fazily *et al.* (2021) also reported the increase in grain and stover yields of wheat with integrated use of inorganic fertilizers and organic manures.

Stover yield (q ha^{-1})

The treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) recorded significantly maximum stover yield of (71.0 q ha^{-1}) which was found to be statistically at par to the treatment T_{11} (50% RDN from vermicompost + 50% from inorganic fertilizer) was and the treatment T_1 (100% RDN from farm yard manure) recorded lowest stover yield (66.0 q ha^{-1}) as shown in Table 2. Increased photosynthates and nutrient availability to the crop's developing reproductive structures boosted all yield-related traits, which eventually raised wheat's final output. Singh *et al.* (2017); Reddy *et al.* (2018) and Fazily *et al.* (2021) discovered similar outcomes.

Harvest index (%)

The treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) recorded significantly maximum harvest index (%) *i.e.*, 44.2 which was found to be statistically at par to the treatment T_{11} (50% RDN from vermicompost + 50% from inorganic fertilizer) and the treatment T_1 (100% RDN from farm yard manure) recorded lowest harvest Index (%) *i.e.*, 35.7 as shown in Table 2. The similar findings were obtained by Singh *et al.,* (2017); Patel *et al.* (2018); Reddy *et al.* (2018); Fazily *et al.* (2021).

Qualitative observations

Protein content and carbohydrate content (%)

It was evident from the Table 3 that the treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) recorded significantly maximum protein content and carbohydrate content of 12.23% and 68.98% respectively as compared to the other treatments as shown in Table 3. The elevated amounts of protein and carbohydrates may be the result of enhanced nutrient absorption brought about by improved nutrient availability in the soil following the application of vermicompost and 75% RDF. Choudhary *et al.* (2005) provided comparable results.

Soil properties

Available nitrogen, phosphorus and potassium in soil (kg ha^{-1})

The perusal of the Table 3 shows that the maximum available nitrogen, phosphorus and potassium in soil (kg ha^{-1}) was recorded in the treatment T_{12} (25% RDN from vermicompost + 75% from inorganic fertilizer) which were found to be significantly highest (153.6, 24.3 and 149.7 respectively).

Table 3: Effect of organic and inorganic fertilizers on quality parameters of wheat (*Triticum aestivum* L.) as well as soil available nitrogen, phosphorus and potassium.

Treatments	Grain crude protein content (%)	Grain carbohydrate content (%)	Soil available N (kg ha^{-1})	Soil available P (kg ha^{-1})	Soil available K (kg ha^{-1})
T_1	11.39	56.89	146.9	16.7	136.0
T_2	11.66	59.92	148.7	18.4	141.2
T_3	12.04	62.15	150.5	21.6	144.1
T_4	12.21	66.89	152.1	23.2	147.2
T_5	11.46	57.81	147.0	17.2	136.1
T_6	11.82	60.67	149.7	19.3	142.2
T_7	12.09	63.53	151.3	21.9	145.2
T_8	12.25	67.52	152.8	24.2	149.4
T_9	11.68	58.99	148.2	18.5	139.2
T_{10}	11.91	61.13	150.1	21.1	143.1
T_{11}	12.19	64.49	151.4	22.5	146.4
T_{12}	12.23	68.98	153.6	24.3	149.7
S.E m (±)	0.049	0.22	0.93	0.78	0.22
CD (P= 0.5)	0.15	0.65	0.31	0.26	0.27

Significantly lowest available nitrogen, phosphorus and potassium in soil (kg ha^{-1}) was observed treatment T_1: 100% RDN from farm yard manure (146.9, 16.7 and 136.0 respectively). Thind *et al.* (2007) also showed increased available N and P with the conjoint use of inorganic and organic fertilizers. According to Kumar *et al.* (2007) the addition of inorganic, organic manure and biofertilizer treatments enhanced the amount of K build up in the soil; however, the value of these treatments diminished when fertilizer K, organics and biofertilizers were not applied.

CONCLUSION

It was concluded that growth parameters increased with the increase in inorganic fertilizer doses. Application of 25% RDN from vermicompost and 75% from inorganic fertilizer directly influence the growth and development of wheat. Different parameters such as plant height, number of tillers m^{-2}, dry weight, relative growth rate, number of effective tillers m^{-2}, number of grains $spike^{-1}$, grain yield, stover yield, harvest index, protein content, carbohydrate content, available nitrogen, phosphorus and potassium in soil were found maximum in of 25% RDN from vermicompost and 75% from inorganic fertilizer. So, the combined application of organic manure and inorganic fertilizer leads to the better growth, yield and quality of wheat as well as the soil chemical properties.

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Conflict of interest

All authors declare that they have no conflict of interest.

REFERENCES

Anonymous. (2020). Progress Report All India Coordinated Wheat and Barley Improvement Project. Directorate of Wheat Research, Karnal, 14.

Ashik, T., Islam, M.M., Rana, M.S., Jahan, K., Urmi, T.A., Jahan, N.A. and Rahman, M.M. (2023). Evaluation of salinity tolerant wheat (*Triticum aestivum* L.) genotypes through multivariate analysis of agronomic traits. *Agricultural Science Digest.* **43(4):** 417-423. doi: 10.18805/ag.D-365.

Blackman, V.H. (1919). The compound interest law and plant growth. *Annals of Botany.* **33:** 353-360.

Choudhary, A.K., Thakur, R.C. and Kumar, N. (2005). Effect of integrated nutrient management on grain yield, protein content and protein yield in wheat-rice crop sequence in North-Western Himalayas. *Himachal Journal of Agricultural Research*. **31(2):** 9-16.

Choudhary, R.R., Yadav, H.L., Choudhary, S.L., Prajapat, A.L. and Choudhary, R. (2017). Effect of integrated nutrient management on growth of wheat (*Triticum aestivum*) cultivars. *International Journal of Current Microbiology and Applied Sciences*. **6(8):** 2369-2374.

Donald, C.M. and Hamblin. (1962). In search of yield. *Journal of the Australian Institute of Agricultural Science.* **28:** 171-178.

Fazily, T., Thakral, S.K. and Dhaka, A.K. (2021). Effect of integrated nutrient management on growth, yield attributes and yield of wheat. *International Journal of Advances in Agricultural Science and Technology.* **8(1):** 106-118.

Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons, New York. pp 105-114.

Hadis, M., Meteke, G. and Haile, W. (2018). Response of bread wheat to integrated application of vermicompost and NPK fertilizers. *African Journal of Agricultural Research.* **13(1):** 14-20.

Khan, S., Memon, A.N., Deverajani, B.R. and Baloch, S. (2015). Physicochemical characteristics of wheat grain and their relation with proteins in different varieties cultivated in Sindh. *Sindh University Research Journal-SURJ* (Science Series). **47(4):** 839-842.

Kumar, D., Prakash, V., Singh, P., Kumar, S., Kumar, A. and Kumar, C. (2017). Effect of nutrient management modules on growth, yield attributes and yield of wheat. *International Journal of Current Microbiology and Applied Science*. **6(12):** 366-369.

Kumar, P., Yadav, S.K., Kumar, M., Rinwa, R.S. and Singh, K.P. (2007). Breaking yield barriers in pearlmillet (*Pennisetum glaucum*)-wheat (*Triticum aestivum*) cropping system through agronomic operations in semi-arid Haryana. *The Indian Journal of Agricultural Sciences*. **77(8):** 479-482.

Kumar, Y.S.S., Reddy, P.V.R., Babu, D.V., Nayak, S.B., Vishnuvardhan, K.M., Rao, E.S.V.N. and Raghavendra, T. (2023). Effect of fourteen years of long term organic and inorganic fertilization on productivity, soil quality and grain quality of rice (*Oryza sativa* L.). *Indian Journal of Agricultural Research.* **57(2):** 178-183. doi: 10.18805/IJARe.A-5954.

Patel, G.G., Sadhu, A.C., Patel, H.K., Shan, S.N. and Lakum, Y.C. (2018). Effect of organic and inorganic fertilizers in comparison with humic acid on growth and yield of wheat (*Triticum aestivum* L.). *International Journal of Agriculture Sciences.* **10:** 6524-6527.

Ram, H. and Kaur, M. (2024). Grain Yield, Heat use efficiency and water use efficiency of diverse wheat (*Tritcum aetivum* L.) varieties under different sowing environments in North-Western India. *Indian Journal of Agricultural Research.* **58(1):** 77-82. doi: 10.18805/IJARe.A-5655.

Reddy Tummala, K., Pawar, R.B. and Patil, D.S. (2018). Effect of integrated nutrient management on growth, yield and economics of Wheat (*Triticum aestivum* L.) in Inceptisol. *International Journal of Current Microbiology and Applied Sciences.* **7(10):** 1892-1902.

Singh, H., Singh, A.K., Alam, S., Singh, T., Singh, V.P., Parihar, A.K.S. and Singh, R. (2017). Effect of various integrated nutrient management models on growth and yield of wheat in partially reclaimed sodic soil. *International Journal of Current Microbiology and Applied Sciences.* **6(3):** 803-808.

Thind, S.S., Sidhu, A.S., Sekhon, N.K. and Hira, G.S. (2007). Integrated nutrient management for sustainable crop production in potato-sunflower sequence. *Journal of Sustainable Agriculture.* **29(4):** 173-188.