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Efficiency of fertilizers and vermicompost on growth and yield attributes of wheat (*Triticum aestivum* l.)

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Abstract
An experiment was conducted during 2020-21 at research farm of University Institute Of Agricultural Sciences, Chandigarh University during the *Rabi* season on sandy loam soil to determine the "Effect of vermicompost and NPK on growth and productivity of wheat (*Triticum aestivum* L.*)*".The experiment conists seven treatments (T1- 100% NPK+100% vermicompost, Treatment 2- 100% NPK + 50% vermicompost, Treatment 3- 75%NPK+ 100% vermicompost, Treatment 4-75%NPK + 50% vermicompost, Treatment 5-50%NPK + 100% vermicompost, Treatment 6- 50% NPK+ 50% vermicompost,T7-Control).Various forms of NPK and vermicompost fertilizer displayed profound consequences on growth characteristics and yield contribute features of wheat. The outcome displayed that application of NPK fertilizers along vermicompost gave optimum level of produce. It was found that number of tillers were influenced under different treatments of vermicompost and NPK. On the whole the results indicated that the improvement in growth, yield parameters and seed yield of wheat was observed with the application doses of 100% NPK + 100%VC. However, application of 100% NPK + 50% VC also showed remarkable progress in the growth and yield of the wheat. The growth and yield factors of the wheat obtained from the treated plots were quite better as compared to plots under control treatment. It is clearly visible from the results that the application of NPK along with vermicompost is to be the most vital agronomic practice for the optimum growth, development and productivity of the wheat crop.

Keywords: nitrogen, phophorous, potassium, vermicompost, wheat

Introduction

Wheat is the essential part of staple Indian diet. It provides 20% of carbohydrates and 19% protein. The wheat variety named (*Triticum aestivum* L.) is mainly grown in India. Agriculture is the main source of livelihood for about 58% of India's population. The share of agriculture and allied sectors in gross value added (GVA) of India at current prices stand at 17.8 %. India is the 7th largest wheat exporter in the world as per global estimates from march to june 2020. Wheat (*Triticum aestivum* L.) is a major rabi crop of north-western zone of India. India is producing about 92.45 million tons of wheat from an area of 29.64 million hectare with an average productivity of 3119 kg/ha (Anonymous, 2013) [1].Punjab was on the forefront during green revolution of 1960 and 1970 and till today it continues to be India's granary and contributes to 12.8% of wheat production. Nitrogen can limit crop yield and its judicious use is essential for sustainable crop production. It represents 28% of the cost of inputs. Mengel *et al.* (2006) [11] reported that optimum Nitrogen rate should be explored as too high rates may cause severe Nitrogen losses and low rates depress the yield. Indiscriminate use of chemical fertilizers like Nitrogen to urge maximum yields results in the depletion of inherent soil fertility (Gupta and Nath, 1998) [4]. Overuse of fertilizers adversely affects the physicochemical properties of the soil resulting in deteriorated rice-wheat production. The declining response to inputs has been received to be the adverse issue affecting the sustainability of wheat based cropping system.

NPK fertilizers had played a significantly vital role since ages on the farm productivity as well as improving the traits like height, weight and all other desirable characteristics of wheat crop. However increased dosage of this combination of synthetic fertilizers had resulted in significant loss of soil fertility. Texture, bulk of the soil had been severely impaired in some cases and wheat productivity had been grossly affected. Wheat needs a selected amount of the essentail nutrients, like nitrogen, phosphorus and potassium along several micro nutrients for its normal growth and development. Once the nutrient doses exceed the optimum limit, the crop growth and yield are affected. The excess nitrogen use over the recommended dose for ideal yield stimulates the vegetative growth, delays ripening and maturity, and causes yield loss. (Suthar S., 2006) [14].
Vermicomposting is a method widely used in the present agricultural industry to produce highly optimum levels of wheat variety and had been proved a better method as compare to other yield enhancing methods. It involves use of earthworms to improve the general outlook of the crop.
Vermicomposting of organic waste can play an essential role in integrated waste management strategies (Sujit Adhikary *et al.,2012*) [13]. The earthworm *Eisenia foetida* is able to change anaerobically digested sewage sludge in different ways. The application of vermicompost and water treatment residuals makes the soil physical property better, promising technology to meet the requirements of high plant growth and cost-effective reclamation. Therefore, the goal of this study was to research the effect of vermicompost and

its mixtures with water treatment residuals on selected physical properties of soil and on wheat yield.

Punjab has wide agriculture with vast production of major crops like as wheat, rice, maize, sugarcane. Punjab is having 1.53% area of India which supply about 46 % wheat and 27% rice during 2015-16 (Kahiluoto *et al.* 2019) [7].Being the great contributor of essential cereals to the central pool, Punjab has entitle with the 'Granary of India'. The Punjab state has divided into three agro-climatic zones on the basis of homogeneity, rainfall distribution, soil texture, cropping pattern etc.

These zones are sub mountainous zone, central zone and wheat-maize, wheat-paddy and wheat-cotton zones. In view of the primary position of the agricultural sector in the country, collection and maintenance of agricultural statistics assumes have a great importance (Fischer *et al*. 2012) [3].

Material and Methods

The experiment was conducted in 2020-21 in the season of *rabi* at research area of University Institute of Agricultural Sciences, Chandigarh University, Gharuan located at 30.7691° N latitude and 76.5759° E longitude at an elevation of about 296.86 meters above mean sea level and falls under the trans-gangetic plain of the agro-climatic zones of India. The experimental site was sandy loam with a pH of 8.1 and was determined by the initial fertility status of the soil. The composite soil samples from 0-15 and 15- 30 cm depth of the soil were taken from the experimental field after the field preparation.

The soil was air dried ground and sieved through 2 mm sieve and subjected to mechanical and chemical analysis to determine the native-fertility and texture of the experimental field.

The results of physio-chemical analysis of soil are given in the table below. The soil of the experimental field tested low in organic carbon and available nitrogen, medium in available P, K and mechanical properties. An experiment was implemented in Randomized Block Design with seven treatments and three replications in 21 plots. The seven treatments were under taken *viz*.,T1- 100% NPK+100% Vermicompost, T2- 100% NPK + 50% Vermicompost, T3- 75%NPK+ 100% Vermicompost, T4-75%NPK + 50% Vermicompost, T5-50%NPK + 100% Vermicompost, T6- 50% NPK+ 50% Vermicompost, T7- Control. Region of the experimental site comes under humid subtropics with cool weather in winter, hot weather in summers and distant rainfall period in the months of July- September.

The Southwest monsoon is the leading source of rainfall. The temperature variation can be from -1 ºC - 46 ºC.

The city receives winter rains occasionally.

The study of the experimental site cropping scheme of the previous year will give an idea regarding the general fertility and crop production trend of the field and in the previous 2 years Rice and Wheat cropping system was done.

Result and Discussion

The results obtained with effect of vermicompost and NPK on growth and productivity of wheat carried out at Research Farm of University institute of agricultural sciences, Chandigarh University have been presented in this chapter with the help of data tables and depicted through suitable diagrams and also interpreted simultaneously in the light of available evidences.

Effect on Growth and Development Attributes of Wheat

The data was recorded in table 1 on the effect of vermicompost and NPK on plant height have been seen, the plant height was significantly influenced by the application of different treatments. The plant height was highest in T1 and was lowest in T7 Higher dry matter accumulation (24.5 g m^{-2}) at 30 DAS was observed in 100% NPK + 100% VC (T1). The lowest dry matter accumulation (14.9 g m^{-2}) was recorded in control. Maximum amount of dry matter accumulation which was found in T1 at 90 DAS (120.5 g m^{-2}), 120 DAS (167.4 g m^{-2}) and at harvest (195.3 g m^{-2}). The lowest among all the treatments at all the different stages were recorded in control. Kaur *et al*. (2018) [9] also found similar results where plant growth parameters such as dry matter accumulation were highest with the application of 100% RDF and vermicompost. The result showed that number of tillers was influenced under different treatments of vermicompost and NPK. The maximum number of tillers at 30 DAS was found in T1 (80.7) and the lowest was recorded in (108.4). The same pattern was followed at 90 DAS, 120 DAS and at harvest. At 90 DAS the maximum number of tillers were found in T1 (150.9) and at 120 DAS (176.2) and at harvest (180.2). The lowest number of tillers was reported in T7. The application of 100% NPK and 100% vermicompost produced maximum number of tillers as the nutrients released from them were easily absorbed by the plants and was in required quantity. Kumar *et al*. (2017) [10] also reported the effect of 100% NPK and vermicompost in number of tillers in wheat.

Effect on Yield and Yield attributes of Wheat

These all results are presented in table 2. Maximum number of effective tillers (305) were record in T1 (100% NPK + 100% VC) and T2 (301) with the application of 100% NPK + 50% VC. The lowest number of effective tillers was recorded in control (252). The result revealed that 100% NPK and 100% vermicompost had significant effect on the number of tillers in wheat. This might because of the optimal application of required dose of fertilizers to the crop. The immediate effect of the chemical fertilizers lead to the plant cell increment and thus the photosynthetic rate increased so the plant height. The results are in accordance with the findings of Devi *et al.* (2011) [2] where they found 100% of recommended dose of fertilizers would affect yield attributes of wheat crop. The different treatments on effect of vermicompost and NPK had significance over 1000 seed weight. The maximum 1000 seed weight was found in T1 (44 g) with the application of 100% NPK + 100% VC and the lowest 1000 seed weight was found in control (38.5). Similarly, Jiang *et al.* (2006) [6] found increase in 1000 seed weight in wheat crop. The data in Table revealed that the grain yield of wheat is significant with the application of different dose of vermicompost and NPK. The increment of grain yield in T1 compared to control was 28.92% and the increment in grain yield in T2 compared to control was 25.05%. The recommended dose of fertilizers with optimum amount of nutrients produce more yield compare to over dose of fertilizers or applying lesser dose of fertilizers than required. These results collaborate with the findings of Kakraliya *et al*. (2017) [8] where they found that the application of 100% RDF and vermicompost significantly effect on yield of wheat crop. The straw yield was significantly affected by vermicompost and NPK in wheat crop. The maximum straw yield was found in T1 (7146 Kg

ha^{-1}). The lowest straw yield was found in T7 (5798 Kg ha^{-1}). The results were in accordance with Singh *et al*. (2018) [12] where they found that the application of 100% RDF and vermicompost significantly affect straw yield in wheat. The major factor among the all factors was NPK which is the major role in the process of photosynthesis, increased rate of NPK and vermicompost may leads to higher rate of photosynthesis gave more yield because of large amount of dry matter were produced and transported to fill the seeds which increase the grain yield of wheat crop. The biological yield of the wheat crop was maximum in T1 (11314.7 Kg ha^{-1}) and lowest biological yield was found in control (9031.3 Kg ha^{-1}). It was expected from the higher grain yield and higher straw yield that the biological yield will be more in T1 (100% NPK + 100% VC) as it is connected with the biological yield directly. The result was in accordance with Kakraliya *et al*. (2017) [8]. The harvest index presented in Table 2 revealed that there is no significant effect of vermicompost and NPK on harvest index in wheat. However, the maximum harvest index was found in T1 (36.8 %) and the minimum was found in T3, T6 and T7 (35.8 %). The result was similar to the results of Hadis *et al*. (2018) [5].

Effect on Economics

It is evident from the data presented in Table 3.3 that maximum cost of cultivation (₹50869.6 ha^{-1}) was incurred under T1 (100% NPK + 100% VC) as compared to the lowest cost of cultivation incurred under control (₹40389 ha^{-1}). The cost of cultivation while using 100% NPK + 100% VC was higher compared to other treatments. In this table 3 the 100% NPK + 100% VC (₹121638.9 ha^{-1})gave significantly higher gross returns as compared to control (₹ 95752.1 ha^{-1}).100% NPK + 50% VCalso had best gross returns comparatively (₹ 118796.2 ha^{-1}). ₹113615.0 ha^{-1}were the gross return given by 75% NPK + 100% VC.The data revealed that 100% NPK + 100% VC recorded significantly higher net returns of ₹70769.3 ha^{-1} as compared to control (₹55363.1 ha^{-1}). 100% NPK + 100% VC also had best net returns comparatively (₹69801.6 ha^{-1}). 100% NPK + 100% VC, 100% NPK + 50% VC and control had maximum net returns per rupee invested (1.4) over 50% NPK + 100% VC and 50% NPK + 50% VC (1.2).

Conclusion

The maximum grain yield was found in 100% NPK + 100% VC which was statistically at par with 100% NPK + 50% VC. The lowest grain yield was found in control treatment i.e T7. The increment of grain yield in T1 compared to control was 28.92% and the increment in grain yield in T2 compared to control was 25.05%. The maximum straw yield and biological yield was found in T1 followed by T2. Data revealed that there is no significant effect of vermicompost and NPK on harvest index in wheat.

Overall the results suggested that the improvement in growth, yield attributes and seed yield of wheat crop observed with the application doses of100% NPK + 100% VC. However, application of 100% NPK + 50% VC also shows appreciable improvement in growth and yield of the crop. The growth and yield attributes of the wheat obtained from the treated plots were superior as compare to plots under control. It is clearly seemed from the results that the application of NPK along with vermicompost to be most important agronomic practice for the successful growth, development and productivity of the wheat crop.

Table 1: Effect of vermicompost and NPK on Growth and development in wheat.

Treatments	Plant height (cm)					Dry matter accumulation (g m^{-2})					Number of tillers m^{-2}				
	30 DAS	60 DAS	90 DAS	120 DAS	Harvest	30 DAS	60 DAS	90 DAS	120 DAS	Harvest	30 DAS	60 DAS	90 DAS	120 DAS	Harvest
T1	15.5	43.8	73.2	80.4	85.1	24.5	46.8	120.5	167.4	195.3	80.7	128.1	150.9	176.2	180.2
T2	14.2	42.7	69.6	78.3	82.3	23.2	45.7	118.6	164.3	191.5	78.5	125.7	149.2	172.3	177.1
T3	13.8	41.4	67.9	77.5	80.8	22.0	44.4	110.4	161.2	189.9	76.1	123.8	147.3	170.7	172.9
T4	12.9	38.5	64.8	75.2	78.5	21.7	42.3	103.9	157.5	186.8	75.4	120.1	144.1	166.6	169.7
T5	12.1	36.3	63.1	73.6	77.2	19.8	39.9	100.8	154.1	184.6	74.8	119.6	140.7	163.1	166.9
T6	11.7	34.1	58.7	71.1	76.0	18.1	37.6	99.3	150.9	181.2	73.6	115.6	138.0	159.0	162.9
T7	9.8	30.6	53.4	66.8	72.3	14.9	32.0	91.7	141.0	175.7	69.6	108.4	131.1	141.5	150.1
SEm (±)	0.44	0.68	1.37	1.44	1.65	1.04	1.09	1.42	1.50	1.64	0.81	1.21	1.26	1.63	2.02
LSD (P=0.05)	1.36	2.09	4.21	4.43	5.09	3.22	3.36	4.38	4.62	5.05	2.50	3.74	3.88	5.02	6.22

SEm (±): Standard error of mean, LSD: Least significant difference, NS: Non-significant

Table 2: Effects of vermicompost and NPK on yield and yield attributes in wheat.

Treatments	Yield And Yield Attributes					
	Number of effective tillers m^{-2}	1000 seed weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index (%)
T1	305	44.0	4169	7146	11314.7	36.8
T2	301	43.5	4044	7078	11121.7	36.4
T3	295	42.5	3835	6887	10722.0	35.8
T4	286	41.8	3784	6746	10530.3	35.9
T5	282	40.4	3656	6541	10197.0	35.9
T6	270	39.4	3566	6409	9975.0	35.8
T7	252	38.5	3234	5798	9031.3	35.8
SEm (±)	1.96	0.83	54.75	60.59	80.59	0.42
LSD (P=0.05)	6.04	2.57	168.72	186.70	248.35	NS

SEm (±): Standard error of mean, LSD: Least significant difference, NS: Non-significant

Table 3: Effect of NPK and vermicompost on economics of wheat

Treatments	Economics			
	Cost of cultivation	Gross return	Net return	Net return per rupee invested
T1	50869.58	121638.9	70769.3	1.4
T2	48994.58	118796.2	69801.6	1.4
T3	49936.93	113615.0	63678.1	1.3
T4	48061.93	111838.8	63776.9	1.3
T5	49004.29	108186.3	59182.0	1.2
T6	47129.29	105682.8	58553.5	1.2
T7	40389	95752.1	55363.1	1.4
SEm (±)		1123.19	1123.19	0.03
LSD (P=0.05)		3461.20	3461.20	0.08

SEm (±): Standard error of mean, LSD: Least significant difference, NS: Non significant

Reference

1. Anonymous Department of Economics and Statistics. Govt. of India, 2013.
2. Devi K, Singh M, Singh N, Athokpam. Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.). Journal of Crop and Weed,2011:7(2):23-27.
3. Fischer J, Hartel T, Kuemmerle T. Conservation policy in traditional farming landscapes. Conservation letters,2012:5(3):167-175.
4. Gupta AP, Nath J. Effect of FYM on the crop yield and nutrient uptake. Experimental Report. CCS Haryana Agricultural University, Hisar, 1998.
5. Hadis M, Meteke G, Haile W. Response of bread wheat to integrated application of vermicompost and NPK fertilizers. African Journal of Agricultural Research, 2018:13(1):14-20.
6. Jiang D, Hengsdijk H, Ting-Bo DAI, Qi JING, Wei-Xing CAO. Long-term effects of manure and inorganic fertilizers on yield and soil fertility for a winter wheat-maize system in Jiangsu, China. Pedosphere,2006:16(1):25-32.
7. Kahiluoto H, Kaseva J, Balek J, Olesen JE, Ruiz-Ramos M, Gobin A et al. Decline in climate resilience of European wheat. Proceedings of the National Academy of Sciences,2019:116(1):123-128.
8. Kakraliya S, Kumar N, Dahiya S, Kumar S, Yadav D, Singh M. Effect of integrated nutrient management on growth dynamics and productivity trend of wheat (*Triticum aestivum* L.) under irrigated cropping system. Journal of Plant Development Sciences,2017:9(1):11-15.
9. Kaur R, Singh G, Kumar S, Singh G. Effect of integrated nutrient management on yield of wheat (*Triticum aestivum* L.) under irrigated conditions. International Journal of Chemical Studies,2018:6(2):904-907.
10. Kumar A, Dhyani B, Rai A, Kumar V. Effect of timing of vermicompost application and different level of NPK on growth, yield attributing characters and yield of rice in rice-wheat cropping system. International Journal of Chemical Studies,2017:5(5):2034-2038.
11. Mengel K, Hutsch B, Kane Y. Nitrogen fertilizer application rates on cereal crops according to available mineral and organic soil nitrogen. European Journal Of Agronomy,2006:24:343-348.
12. Singh G, Kumar S, Singh G, Kaur R. Effect of integrated nutrient management on yield of wheat (*Triticum aestivum* L.) under irrigated conditions. International Journal of Chemical Studies,2018:6(2):904-907.
13. Sujit Adhikary. Vermicompost, the story of organic gold: A review. Agricultural Sciences,2012:7:1-13.
14. Suthar S. Effect of vermicompost and inorganic fertilizer on wheat (*Triticum aestivum* L.) production. Nature. Environmental Pollution Technology,2006:5:197-201.