



Effect of different treatments of NPK and FYM on growth and yield of wheat (*Triticum aestivum* L.)

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Abstract

The investigation entitled “Effect of Different Treatments of NPK and FYM on Growth and Yield of Wheat (*Triticum aestivum* L.)” was conducted at research farm of University Institute of Agricultural Sciences, Chandigarh University, Gharuan (Mohali) during *Rabi* season 2020-2021. The experiment was carried out in Randomized Block Design with seven treatments each replicated three times. The treatments were (T1-100% NPK + 100% FYM, T2-75% NPK + 100% FYM, T3-50% NPK + 100% FYM, T4-100% NPK + 75% FYM, T5-75% NPK + 75% FYM, T6-50% NPK + 75% FYM, T7-Control). The result indicates Plant height (cm), Dry matter accumulation (g m^{-2}), Number of tillers (m^{-2}), 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 (%) were significantly affected by different treatments. Overall the results suggested that the improvement in growth, yield attributes and seed yield of wheat crop was observed with the application doses of 100% NPK + 100% FYM. However, application of 100% NPK + 75% FYM also show 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 FYM to be most important agronomic practice for the successful growth, development and productivity of the wheat crop.

Keywords: NPK, FYM, wheat, *Triticum aestivum* L

Introduction

Cereals are one of the most significant source of protein and carbohydrates which cannot be substituted by any other food because of their functional properties and nutritional value. Wheat (*Triticum aestivum* L.) is one major cereal crop which contains proteins, minerals, B-group vitamins and dietary fiber and belongs to family poaceae (Kaur *et al.* 2014) [10]. Rice and wheat are the major cereals produced in the world. Many assumptions are regarding the origin of wheat. It is believed that the crop is originated from South-west Asia. The oldest remaining of the crop has been found from Syria, Jordan and Turkey (Ozkan *et al.* 2011) [13]. However, the oldest excavation of wheat was in eastern Iraq. Worldwide, wheat is cultivated in an area of 215 mha with 772 mt. In India, 30-million-hectare area is cultivated with the production of 99.70 mt. (Ramadas *et al.* 2020) [17]. Punjab is having only 1.53% area of India which contributed about 46% wheat. Wheat is considered as the world's staple food (Kahiluoto *et al.* 2019) [8]. Punjab, Haryana, UP, MP are the major states have good production potential in case of wheat crop (Gupta *et al.* 2004) [6]. The common wheat which is in great use by Indians are soft or hard and have medium protein and fairly similar to the US wheat. There are many products which can be made from wheat, which include chapati, cookies, bakery items, bread etc.

The organic manures are eco-friendly but the nutrients available in them will be available to the plants through a slow microbial decomposition. But the application of mineral fertilizers such as nitrogen, phosphorus and potassium give the efficiency to provide nutrients to the

crop readily. This helps the plants to uptake nutrients and grow. The application of mineral fertilizers improves the yield of the crop (Baniuniene and Zekaite, 2008) [3]. The continuous application of mineral fertilizers may lead to soil and water pollution. Organic manures are natural products obtained from plant and animal used by farmers to provide nutrients to the crop. There are a number of organic manures like farm yard manure (FYM), green manures, vermin-compost, poultry manure etc. Organic manure improves soil's physical, chemical and biological properties. Key beneficial effects associated with FYM application are building up of primary and secondary micro-nutrients, counteracting deleterious effects of soil acidity, salinity, alkalinity and substances of soil health (Ram *et al.* 2016) [15].

Wheat crop can adapt to subtropical, tropical and temperate conditions. Fertilizer and nutrient management are really important for the growth of the crop. It is absolutely necessary that essential nutrient elements should be supplied in appropriate proportion to maintain soil fertility and to get higher yield. Abundantly available chemical fertilizers give high production during initial few years, but productivity declines in subsequent years. Moreover, continuous application of chemical fertilizers alone in a system deteriorates soil health and effects crop productivity (Ali *et al.* 2009) [2].

Nitrogen, Phosphorus and Potassium are the three main nutrients which are called as primary nutrients and are required by the crop in a large quantity compared to other nutrients. Nitrogen is essential for the vegetative growth of the plant. Nitrogen improves the growth and development of

the crop. Nitrogen is essential in the formation of proteins. Nitrogen is absorbed in large quantity compared to other nutrients. Phosphorous is required for the storage and usage of energy in plants. It is very essential for the process of photosynthesis. Potassium helps by resisting plant diseases and have an important role in crop yield and quality (Meena *et al.* 2015) ^[12]. NPK fertilizers are usually used to increase the growth of a plant. The N (Nitrogen) element in NPK fertilizer prepares amino acids (proteins), nucleic acids, nucleotides, and chlorophyll in plants. The element P (phosphorus) in the NPK fertilizer stores and transfers energy. The K (Potassium) element in the NPK fertilizer acts as an enzyme activator, and assists in the transport of assimilated results from the leaf to the plant tissue (Barita *et al.* 2018) ^[4]

The integrated way of application of fertilizers is the best method to avoid such problems. The combined application of organic and inorganic fertilizers has a lot of advantages (Ramesh *et al.* 2009) ^[18]. The sole application of chemical fertilizers may provide immediate availability of nutrients but the effect may not be available at the later stages. To gain the merits of both fertilizer source, one can opt for application of combined dose. When organic and inorganic fertilizers are combined, the availability of nutrients to the plants is immediate and also it is available to the plants in its life cycle. The combined application can improve the soil's physical and chemical properties, improves the yield of the crop, and also helps in better economics.

Materials and Methods

A field experiment was conducted in 2021 in *Rabi* season at research farm of University institute of agricultural sciences, Chandigarh University, Gharuan. The experimental site was 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 trans-gangetic plain of the agro-climatic zones of India. The experimental site with sub-tropical humid region with cool weather in the months of November, December and January and hot weather in summers with distinct rainfall in the month of June to August. The place depends on south-west monsoon for rain. The temperature ranged from 1 to 46 but never goes below zero. The soil sample must be collected from 0-15 and 15-30 cm from the soil before the sowing to find the nutrient status of the soil. The soil samples are air dried after the collection and then sieved and subjected to mechanical, chemical and physical analysis. The initial fertility status of soil were fine sand (66.3 %), silt (17.6%), clay (15.6%), the soil texture was sandy loam with pH range of 8.1. An experiment was carried out in Randomized Block Design with seven treatments and three replications in 21 plots. The seven treatments were undertaken *viz*: T1-100% NPK + 100% FYM, T2-75% NPK + 100% FYM, T3-50% NPK + 100% FYM, T4-100% NPK + 75% FYM, T5-75% NPK + 75% FYM, T6-50% NPK + 75% FYM, T7-Control. The total area was 500 meter square with net plot size of 6.25 meter square and plant border of 0.5 cm. The variety PBW-343 was sowed in between 15th - 30th November for better results. The wheat crop was sown using seed rate 125 kg ha⁻¹ at row to row spacing of 20 cm. sowing of wheat variety PBW-343 was done on 17 November 2020. The wheat crop was sown using seed rate 125 kg ha⁻¹ at row to row spacing of 20 cm. The seed was placed at nearby 1-3 cm deep. The crop was grown under irrigated condition and four irrigations were applied. The

first irrigation was applied at 20-25th, 2nd 40-45th, 3rd 70-75th, 4th 90-95th and 5th at 110-115 DAS.

Results and Discussion

The results obtained with effect of NPK and FYM on growth and yield of wheat carried out at Crop Research Centre 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.

Growth and Development Attributes of Wheat

The data on the effect of different treatments of NPK and FYM on height of plant have been shown in Table 1. The maximum height of plant was observed in T1 (100% NPK + 100% FYM) and the lowest plant height among all was found in T7 (Control) at all the stages of life. Cells protein content increase as the application of nitrogen increase and size of plant cell increases, as a result of that leaf area and photosynthesis rate rises which ultimately make the plant taller. The results collaborate with the findings of (Shiva kumar and Ahlawat 2008) ^[21] and (Jiang *et al.* 2006) ^[7] in wheat crop. The maximum number of tillers at 30 DAS was found in T1 (81.8) followed by T4 (78.7). The same pattern was followed at 60, 90 and 120 DAS where maximum number of tillers found in T1 which was followed by T4. The lowest number of tillers were recorded in T7 (control). The same pattern was followed at harvest. Increased levels of nitrogen resulted in reduction of mortality of tillers and produced more tillers from the main stem. Similar results have been observed by (Abedi *et al.* 2010) ^[1] and (Choudhary and Suri 2009) ^[5] in wheat crop where they recorded that the application of 100% RDF with the combination of FYM produced maximum growth parameters such as number of tillers m⁻². At 30 DAS the maximum dry matter accumulation was found in T1 (23.3 g m⁻²) followed by T4 (20.1 g m⁻²). At harvest maximum accumulation of dry matter was found in T1 (192.3 g m⁻²). The lowest accumulation of dry matter was found in control at all the stages. Higher dosage of nitrogen has increased the photosynthesis rate which resulted in more vegetative growth of the plant. There result was in accordance with findings of (Kakraliya *et al.* 2017) ^[9] in wheat crop where they found application of 100% RDF and FYM increased dry matter accumulation.

Yield Attributes and Yield of Wheat Crop

The results are shown in Table 2. The data revealed that the maximum number of effective tillers were recorded in T1 (302) which was at par with T4 (297), T2 (295) and T5 (287).

The lowest number of effective tillers m⁻² was recorded in control T7 (253). Less mortality rate of tillers might be the reason for the higher number of effective tillers m⁻² in T1. The results are in accordance with (Rather and Sharma 2009) ^[19] in wheat where they found that combination of NPK and FYM had significant effect on number of effective tillers. The maximum 1000 seed weight was found in T1 (44.2 g) and the lowest 1000 seed weight was found in control (38 g). Similarly, (Patil and Bhilare 2000) ^[14] found increase in 1000 seed weight in wheat crop. Highest crop growth rate and photosynthetic efficiency might be the reason for the maximum 1000 seed weight.

The maximum grain yield was observed with the application of various organic and inorganic fertilizers in T1 (4135 Kg ha⁻¹) which was followed by T4 (3906 Kg ha⁻¹) and T2 (3775 Kg ha⁻¹). The lowest grain yield was observed in control (2864 Kg ha⁻¹). The application of 100% recommended dose of fertilizers provide 100% nutrients for the crop at optimum amount. This is due to the fact that among all the essential nutrients applied to the plants nitrogen is the major one which has a key role in the process of photosynthesis. Increased rate of photosynthesis by the high dose of nitrogen gave more yield because of large amount of dry matter, more assimilates were produced and transported to fill the seeds as a result of more applied nitrogen. The results are in collaboration with the findings of (Selvi *et al.* 2004)^[20] in wheat crop. The treatment T1 produced highest straw yield (7228 Kg ha⁻¹) followed by T4 (7007 Kg ha⁻¹) and T2 (6863 Kg ha⁻¹). The lowest straw yield was recorded in control (5764 Kg ha⁻¹). The result was in accordance with (Ram and Mir 2006)^[16] and (Kakraliya *et al.* 2017)^[9] where the straw yield was affected significantly by the application of 100% RDF and FYM. More application of nitrogen gave tall plants, more dry matter and high vegetative growth, which collectively resulted in higher straw yield. The maximum biological yield was recorded in T1 (12430.3 Kg ha⁻¹) followed by T4 (12017.3 Kg ha⁻¹). The lowest biological yield was recorded in T7 (10064.7 Kg ha⁻¹). The biological yield is connected directly with straw and grain yield. This result indicates that organic and inorganic fertilizer sources have significant effect on biological yield of the crop. The results are in accordance with (Verma *et al.* 2006)^[22] and (Kulkarni *et al.* 2018)^[11] in wheat crop. More application of nitrogen gave tall plants, more number of tillers, more grain yield, straw yield and total dry matter which collectively resulted in higher biological yield. The harvest index presented in Table 4.6 recorded that various combination of organic and inorganic fertilizers have no significant effect on harvest index. However maximum harvest index was found in control and minimum was recorded in T3.

Economics

It is evident from the data presented in Table 3 that maximum cost of cultivation (₹47155 ha⁻¹) was incurred under T1 (100% NPK + 100% FYM) as compared to the lowest cost of cultivation incurred under control (₹3960 ha⁻¹). The cost of cultivation while using 100% NPK + 100% VC was higher compared to other treatments. An examination of the data represented in Table 3 show that

100% NPK + 100% FYM (₹121413.6 ha⁻¹) gave considerably higher gross returns as compared to control (₹ 88267.8 ha⁻¹). 100% NPK + 75% FYM also had best gross returns comparatively (₹ 115686.7 ha⁻¹). The data at Table 3 also revealed that 100% NPK + 100% FYM recorded significantly higher net returns of ₹74258.6 ha⁻¹ as compared to control (₹48667.8 ha⁻¹). 100% NPK + 75% FYM also had best net returns comparatively (₹68687.75 ha⁻¹). It also shows that 100% NPK + 100% FYM had maximum net returns per rupee invested (1.5) over control (1.2).

Conclusion

All the treated plots of FYM and NPK showed positive results in comparison with the plots under control. The plant height was always highest in T1 and was lowest in T7. The maximum number of tillers was found in T1 with the application of 100% NPK + 100% FYM. Higher dry matter accumulation was observed in 100% NPK + 100% FYM. The result reveals that the maximum days taken to till was found in T1 and T4 and the least number of days taken to till was found in T7. The maximum number of effective tillers were found in T1 at par with T4. Different treatments of FYM and NPK had no significant effect over 1000 seed weight in wheat. The maximum number of grains were found in T1 which was at par with T4. The lowest number of grains were found in control. The maximum grain yield was found in T1 which was at par with 100% NPK + 75% VC. The lowest grain yield was found in control. The increment of grain yield in T1 compared to control was 36.31% and the increment in grain yield in T4 compared to control was 30.78%. The maximum straw yield and biological yield was found in T1 followed by T4. Data showed that there is no significant effect of FY Mand NPK on harvest index in wheat. Maximum cost of cultivation (₹ 47155 ha⁻¹) was incurred under T1 as compared to the lowest cost of cultivation incurred under control. T1 had maximum net returns per rupee invested (1.57) over control (1.23). Overall the results suggested that the improvement in growth, yield attributes and seed yield of wheat crop observed with the application doses of 100% NPK + 100% FYM. The growth and yield attributes of the wheat obtained from the treated plots were superior as compare to plots under control. It is clearly seen from the results that the application of NPK along with FYM to be most important agronomic practice for the successful growth, development and productivity of the wheat crop.

Table 1: Effect of different treatments of NPK and FYM on plant height (cm), dry matter accumulation (g m⁻²), number of tillers (m⁻²) at 30, 60, 90, 120 DAS and at harvest in wheat.

Treatments	Plant height (cm)					Dry matter accumulation (g m ⁻²)					Number of tillers m ⁻²				
	0 30 DAS	60 DAS	90 DAS	120 DAS	Harvest	0 30 DAS	60 DAS	90 DAS	120 DAS	Harvest	0 30 DAS	60 DAS	90 DAS	120 DAS	Harvest
T1	13.9	43.8	72.8	80.4	90.9	23.3	43.8	117.2	171.2	192.3	81.8	132.5	155.6	178.2	189.3
T2	12.5	41.3	67.0	74.3	82.3	18.5	38.2	106.7	164.3	184.3	76.4	125.7	147.4	171.0	178.2
T3	11.2	39.4	61.6	71.0	79.8	14.4	34.5	99.3	153.2	178.4	68.8	116.2	139.2	163.1	167.5
T4	13.1	42.1	69.5	76.9	84.8	20.1	40.5	112.7	166.6	187.8	78.7	128.8	149.7	173.9	183.3
T5	12.1	40.5	64.1	73.6	81.2	16.2	36.2	100.4	156.1	180.6	73.7	121.3	142.6	167.4	173.9
T6	10.6	37.5	59.8	68.8	76.0	13.1	33.1	97.0	150.9	175.1	65.5	112.6	137.0	159.0	162.4
T7	9.8	30.6	52.3	63.7	72.3	11.0	31.3	91.7	139.3	167.8	58.3	107.7	130.8	141.1	149.5
SEm (±)	0.40	0.53	0.89	1.47	1.71	0.61	0.91	1.75	1.87	1.67	0.96	1.38	1.62	2.25	2.36
LSD (P=0.05)	1.24	1.65	2.73	4.53	5.26	1.87	2.80	5.40	5.76	5.16	2.96	4.26	5.00	6.93	7.26

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

Table 2: Effect of different treatments of NPK and FYM on yield attributes, grain yield (kg ha⁻¹), straw yield (kg ha⁻¹), bio logical yield (kg ha⁻¹) and harvest index (%) in wheat.

Treatments	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	302	44.2	4135	7228	12430.3	41.9
T2	295	42.5	3775	6863	11764.3	41.7
T3	282	40.6	3513	6573	11197.0	41.3
T4	297	43.5	3906	7007	12017.3	41.7
T5	287	41.1	3652	6720	11537.7	41.8
T6	274	39.9	3378	6303	10848.3	41.9
T7	253	38.0	2864	5764	10064.7	42.7
SEm (±)	1.82	0.82	38.55	39.89	45.08	0.27
LSD (P=0.05)	5.61	2.53	118.78	122.91	138.93	NS

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

Table 3: Effect of different treatments of NPK and FYM on Economics of wheat Crop.

Treatments	Economics			
	Cost of cultivation	Gross return	Net return	Net return per rupee invested
T1	47155	121413.67	74258.67	1.57
T2	46222	112309.33	66087.33	1.43
T3	45290	105531.42	60241.42	1.33
T4	46999	115686.75	68687.75	1.46
T5	46066	109082.25	63016.25	1.37
T6	45134	101390.42	56256.42	1.25
T7	39600	88267.83	48667.83	1.23
SEm (±)		858.26	858.26	0.02
LSD (P=0.05)		2549.99	2549.99	0.06

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

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