International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 13-08-2021, Accepted: 27-08-2021, Published: 13-09-2021
Volume 6, Issue 5, 2021, Page No. 454-457

Response of growth and productivity of wheat (*Triticum aestivum* L.) under the different levels of NPK doses and FYM doses

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Abstract
An experiment was conducted at the farm of University Institute of Agricultural Sciences, Chandigarh University, Gharuan (Mohali) during the *Rabi* season 2020-2021 to find the effects of different doses of NPK and FYM on growth, phenological attributes, yield attributes and wheat yield. The experiment was comprised of RBD design with 7 treatments. (T1-100% NPK + 50% FYM, T2-100% NPK + 100% FYM, T3- 125% NPK + 50% FYM, T4-125% NPK + 100% FYM, T5-150% NPK + 50% FYM, T6-150% NPK + 100% FYM and T7-Control) with 3 replications. Results revealed that growth parameters (Plant height, Dry matter accumulation, No. of tillers), yield attributes (No. of effective tillers, Ear length, No. of grains) and straw of wheat increased with (100% NPK + 100% FYM). The yield attributes and final yield of the crop were highest with the utilization of 100% NPK + 100% FYM. Maxi mum number of days was taken to tillering in T2 treatment (48 days) followed by T1 and T3 (46 days) T4 and T5 (45 days) and T6 (44 days). The lowest number of days was taken to tillering by T7 (43 days).

Keywords: nitrogen, phosphorus, potassium, farmyard manure, wheat

Introduction
Chemical fertilizers were one of the main factors which played a key role in green revolution. The intensive agricultural practices make the land deficient in micro and macro nutrients (Sadaf, 2017) [7]. When compared to the organic manures especially FYM, the chemical fertilizers such as urea, SSP, MOP, DAP etc. provides a large quantity of nutrients and these nutrients are readily absorbed by the plants. These nutrients will help the plant to grow and develop faster. However, these chemical fertilizers can pollute the soil and the environment. At the same time using organic manures would be healthier for the soil microbes which directly influence the fertility status. The organic manures are cheap but it provides less amount of nutrients compared to inorganic fertilizers, have to be used in bulk and also the result is not immediate. Integrated Nutrient Management refers to the conservation of the soil productiveness and of plant available nutrient source at an optimal amount for satisfying the anticipated through improvement of the assistance from all conceivable bases of organic, inorganic and biological workings in an integrated manner (Rather and Sharma, 2009) [5]. The best way to increase the yield of the crop is to integrate the possible available organic fertilizers and inorganic fertilizers. In this experiment different dose of FYM was applied with different level of NPK dose to find the maximum maturation and development of the wheat.

Material and Methods
The research project was practised at the Research field of University institute of agricultural sciences, Chandigarh University, Gharuan (Mohali). This research field falls under the trans-gangetic region of agro-ecological zone of the union territory. The coordinates of the place is 30.76° N, 76.57° E. The research site comes under humid sub-tropical with cool rabi season, warm weather in summers and extreme rainfall in the month of July and September. SW Monsoon is the major source of rainfall in the region. The temperature variation can be from -1°C to 46°C. The site receives winter rains occasionally. The annual rainfall is 1110.7 mm (IMD). The soil texture of the experimental field was sandy loam having a pH of 8.1 and was determined by the initial fertility condition of the soil. The experiment was implemented in Randomized Design with seven treatments and three replications in 21 plots *viz*. T1: 100% NPK + 50% FYM, T2: 100% NPK + 100% FYM, T3: 125% NPK + 50% FYM, T4: 125% NPK + 100% FYM, T5: 150% NPK + 50% FYM, T6: 150% NPK + 100% FYM and T7: Control. The preparatory tillage was given by four to five ploughing proceed by planking. The process of sowing of the crop was done on 15th November 2020 by line sowing method. The rate of seed required was 125 kg/ha and the sowing of the seeds was done manually. The crop was grown under irrigated field and four irrigations were applied. The first irrigation was applied at 20-25th DAS, second at 40-45th DAS, 3rd at 70-75th DAS, 4th at 90-95th DAS and 5th at 110-115 DAS. Pendimethalin @1kg$^{-ha.}$ was sprayed as a pre-emergence herbicide. Height of the plant, dry matter, number of tillers, days to tillering, days to flowering, days to maturity, Number of effective tillers m^{-2}, ear length, number of ears, 1000 grain weight, seed yield, straw yield and harvest index of the crop was measured and were analyzed using the standard procedures using analysis of variance as per procedure.

Result and Discussion
Effect on morphological characters
The plant height which were measured 30 DAS, 60 DAS, 90 DAS, 120 DAS and at harvest shows that T2 (100% NPK +

100% FYM) had positive impact on the height of plant. The result shows a positive trend with the utilization of 100% NPK + 100% FYM throughout the life cycle. This may be because this treatment provides the optimum required quantity of organic and inorganic fertilizer for its growth. Similar result were found by (Verma *et al*. 2006) [11] with the application of 100% NPK along with suggested dose of organic matter (FYM). The other doses such as 100% NPK + 50% FYM and 125% NPK + 50% FYM also had a good effect on the plant growth comparatively.The maximum amount of dry matter accumulation at 30 DAS were found in T2: 100% NPK + 100% FYM followed by T1: 100% NPK + 50% FYM, T3: 125% NPK + 50% FYM. The accumulation of dry matter measured at 60 DAS and 90 DAS found the highest dry matter were found in T2 followed by T1. At 120 DAS, the maximum dry matter was measured in T2 result by both T3 and T1. The dry matter accumulation at maturity indicates shows that T2 had significant effect over other treatments followed by T1. It is clearly visible that T7 (Control) were lowest among all from 30 days after sowing till maturity stage. The result was in accordance with (Bhattacharyya R. *et al*. 2007) [1] where they found that the application of 100% NPK along with 100% of FYM increases the crop growth factors such as dry matter. Supreme number of tillers at 30 DAS, 60 DAS and 90 DAS were found in T2 followed by T1. The number of tillers in T2 at 120 DAS and at harvest was 163.5 and 176.2. The number of tillers which followed the same pattern shows that the number of tillers could be possibly increased by the application of 100% NPK along with 100% FYM. The postulation of 100% NPK with 50% FYM also showed good effects on the number of tillers. The utilization of optimum dose of fertilizers and manures increase the growth attributes of the plant were application of these inputs in a large quantity or less quantity than recommended may also create lowest growth and yield. The results of (Kanaujia, 2016) [3] found the application of farmyard manure along with 100% of NPK improves plant growth attributes.

Effect on Phenological Studies

The days to tillering is significantly affected by the various treatments. The application of 100% NPK + 100% FYM (T2) has taken 48 days for tillering while T1. T3 took 46 days, T4 and T5 took 45 days and T6 has taken 44 days. The lowest number of days was taken by T7 as 43 days for tillering. The results represents those 81 days were taken by T2 to complete 50% of maturity, 79 days were taken by T1 and 78 days were taken by T3. However, the lowest days taken to 50% maturity is by T6 and T7 (Jiang, 2006) [2] Reported positive effects of NPK fertilizers on maturity of the crop. None of the treatment had significant effect over another on number of days to maturity. The variety PBW 343 takes around 140-143 days to maturity and the same were found in all the treatments. When comparing the result, the highest days to maturity were found in T2 (100% NPK + 100% FYM) 144 days. These findings are in conformance with the results of (Singh and Patra, 2017) [9].

Yield and yield attributes

The maximum number of tillers were reported in T2 (100% NPK + 100% FYM) and T1 (100% NPK + 50% FYM) followed by T3 (125% NPK + 50% FYM). The amount of the fertilizer may matter more. If the fertilizer we apply is little it may not help the plant to grow and develop and the same is in case with application of fertilizers in a large quantity than required. The lowest number of effective tillers per square meter were found in T7 (control)- where no fertilizers or manures used. The result agrees with finding of (Sushila and Giri, 2000) [10]. The result explained in Table 3. Shows that the maximum ear length were found in T2 where the combination of 100% recommended dose of fertilizers and 100% of farmyard manure were used followed by T1, T3. The lowest ear length was reported in control. The result were similar to finding of (Sharma, 2007) [8] where they found application of 100%NPK and FYM together increases yield and yield attributes of the crop. No. of grains were found at maturity stage and the findings indicate that the maximum number of the grains were found with the postulation of 100% NPK and 100% FYM and the lowest number of grains were found in control (Rehman, 2008) [6] Also found similar results in wheat produced maximum grains per spike with the practical application of 100% RDF and 100% advisable dose of FYM. Weight of 1000 seeds in Table 3 indicates that the 1000 seed weight is affected significantly by the application of FYM and NPK in different doses. The weight of 1000 seeds measured at the maturity stage shows that T2 had been maximum weight of 1000 seeds followed by T1, T3. The lowest grain weight of 1000 seeds was found in the data on the grain yield explains that T2 (5044 kg ha-1) were the significant treatment over another followed by T1 (4946 kg ha^{-1}), T3 (4802 kg ha^{-1}). The consequence shows that the maximum yield in T2 were because of the practical application of 100% NPK and 100% FYM. This treatment had been significant over all other growth, development and yield attributes. This is because of the optimal use of the fertilizers. In all other treatments, the amount of FYM or NPK was either more than the required or less. The other treatments like application of 100% NPK + 50% FYM, 125% NPK + 50% FYM also had a positive effect on all the parameters. The similar results were found by (Kanaujia 2016) [3] in wheat where they suggest the application of 100% RDF along with the FYM for maximization of the yield in wheat. The maximum straw yield were reported in T2 (7148 Kg ha^{-1}) predate by T3 (6330 Kg ha^{-1}) as per the data presented in Table 3. The lowest straw yield among the treatments was T7- control (5731 Kg ha^{-1}). It should be said that 100% NPK + 100% FYM and 125% NPK + 100% FYM is to be used for significant straw yield. The result was in accordance with (Bhattacharyya *et al*. 2007) [1]. Harvest index is influenced by different treatments of FYM and NPK doses in the wheat. The harvest index was found to have maximum effect on T4 Followed by T1 and T5. The lowest harvest index was found in T2. These results are in agreement with the aggregation of (Malakar *et al*. 2009) [4].

Conclusion

The present study concluded that the growth parametric quantity, phenological parameters, seed yield and yield parameters of the wheat can be influenced importantly by the application of various levels of NPK and FYM doses. Plant height, dry matter, number of tillers, days taken to tillering, days taken to Earzing and maturity were all maximum with the postulation of 100% NPK + 100% FYM. The yield abstraction and yield of the crop were highest with the application of 100% NPK + 100% FYM. The application of 100% NPK + 50% FYM and 125% NPK + 50% FYM also had significant results.

Table 1: Effect of different treatments on plant height, dry matter accumulation and number of tillers of 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
100% NPK + 50% FYM (T1)	13.4	40.3	65.1	76.6	78.1	21.9	43.4	112.7	190.5	193.3	80.5	125.3	149.4	159.6	172.3
100% NPK + 100% FYM (T2)	14.3	41.9	69.6	78.3	80.3	23.0	45.7	116.9	195.4	198.8	81.0	127.9	151.9	163.5	176.2
125% NPK + 50% FYM (T3)	13.0	38.5	63.0	75.7	76.2	20.7	42.1	107.3	191.1	193.0	79.7	123.8	147.0	158.2	170.7
125% NPK + 100% FYM (T4)	13.5	36.6	60.7	74.2	74.9	19.2	40.2	102.0	188.9	191.3	78.2	120.1	142.5	152.9	166.6
150% NPK + 50% FYM (T5)	12.6	34.2	59.5	72.5	73.0	18.6	38.9	105.5	184.8	187.9	75.5	117.2	139.7	148.1	163.1
150% NPK + 100% FYM (T6)	11.7	31.4	56.3	70.5	71.5	17.5	36.5	103.4	183.6	186.7	73.6	113.9	138.3	145.7	159.0
Control (T7)	9.8	28.7	51.8	68.8	69.7	14.0	29.6	92.7	179.5	181.2	69.3	106.1	130.1	135.0	141.5
SEm (±)	0.67	0.70	0.83	1.11	1.23	1.10	1.99	2.17	2.35	2.38	0.85	1.29	1.40	1.56	1.63
LSD (P=0.05)	2.05	2.17	2.57	3.42	3.80	3.40	6.12	6.67	7.23	7.33	2.61	3.98	4.30	4.80	5.02

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

Table 2: Effect of treatments on phenological studies of wheat

Growth Parameters			
Treatments	**Days to tillering**	**Days to 50 % earing**	**Days to maturity**
100% NPK + 50% FYM (T1)	46	79	143
100% NPK + 100% FYM (T2)	48	81	144
125% NPK + 50% FYM (T3)	46	78	143
125% NPK + 100% FYM (T4)	45	77	143
150% NPK + 50% FYM (T5)	45	77	142
150% NPK + 100% FYM (T6)	44	75	142
Control (T7)	43	75	140
SEm (±)	0.49	0.77	0.99
LSD (P=0.05)	1.51	2.39	NS

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

Table 3: Effect of treatments on yield and yield attributes of wheat

Yield and Yield Attributes							
Treatments	**Number of effective tillers m^{-2}**	**Ear length (cm)**	**Number of grains ear^{-1}**	**1000 seed weight**	**Grain Yield (kg ha^{-1})**	**Straw yield (kg ha^{-1})**	**Harvest index (%)**
100% NPK + 50% FYM (T1)	306	11.8	56	46.2	4946	6304	44.0
100% NPK + 100% FYM (T2)	310	12.2	57	47.0	5044	7148	41.4
125% NPK + 50% FYM (T3)	296	11.4	56	45.0	4802	6330	43.1
125% NPK + 100% FYM (T4)	284	10.6	56	44.7	4754	5981	44.3
150% NPK + 50% FYM (T5)	279	10.1	56	44.0	4669	5950	44.0
150% NPK + 100% FYM (T6)	266	9.4	54	43.5	4574	5860	43.8
Control (T7)	230	8.8	52	43.0	4390	5731	43.4
SEm (±)	1.93	0.56	1.04	0.50	62.27	49.34	0.45
LSD (P=0.05)	5.94	1.72	3.21	1.54	191.88	152.05	1.38

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

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