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Growth and yield of wheat crop (*Triticum aestivum* L.) as influenced by different levels of NPK and FYM

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Abstract
An experiment was conducted during *Rabi* season 2020-2021 at research farm of Chandigarh University, Gharuan for "Growth and yield of wheat crop (*Triticum aestivum* L.) as influenced by different levels of NPK and FYM". The wheat (PBW-343) was grown and treatments were replicated three times in randomized block design. The experiment consists of 7 treatments *viz*., T_1 (100% NPK+100% FYM), T_2 (100% NPK+50% FYM), T_3 (75% NPK+100% FYM), T_4 (75% NPK+50% FYM), T_5 (50% NPK+100% FYM), T_6 (50% NPK+50% FYM), T_7 (Control). The results revealed that growth parameters *viz*., plant height (cm), number of tillers (m^{-2}), dry matter accumulation (g/m^2) at 30, 60 and 90 DAS were recorded maximum with the application of 100% NPK+100% FYM as compared to control. The yield and yield attributes were recorded significantly higher with the application of 100% NPK +100% FYM as compared to control. Over all other treatments T_1 was significantly superior.

Keywords: wheat, FYM, NPK, growth parameters, yield

Introduction

Cereals plays an important role in human nutrition. In India, more than 400 million people are vegetarian and depends on cereals. Around 30% population in India identified as vegetarian. Cereals are grown in large quantities and provide more food energy worldwide than any other type of crops (Beverly, 2014) [1]. Cereals are primary source of carbohydrates for both humans and animals. Cereals provide nutrients in the form of protein, fat, fiber, minerals and vitamins. Two main constituents of cereals are starch (40-70%) and other carbohydrate ranges from 5-23% (Soria *et al* 2012) [10]. According to the Food and Agriculture Organization (FAO), total crop production during 2016 reached 2577.85 million tons, whereas the production of cereal grains other than reached 1330.02 million tons (Papageorgiou and Skendi, 2018) [8]. The main cereal crops grown in the world are rice, wheat, maize, barley, oats, sorghum and rye.

Wheat (*Tritium aestivum* L.) is one among the foremost of the consumed cereal crops followed by rice. Globally, India stands 2nd in wheat production after China. The total area under the crop is about29.8 million hectares in the country. Wheat occupies around 217 million hectares holding the position of highest acreage among all crops with an annual production around 731 million tons (Ramadas *et al* 2019) [9]. The topmost growing countries are India, Russian, USA, and Canada. Wheat is second most important stable food crop in India after rice and cultivated in about 30 million hectares with production of 99.70 million tones and productivity of 3371 kg/hectares (Ramadas *et al* 2019) [9].

Major wheat producing states in India are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, and Rajasthan. Uttar Pradesh has largest share in area with 9.75 million hectares (32%), followed by Madhya Pradesh (18.75%), Punjab (11.48%), Rajasthan (9.74%), Haryana (8.36%) and Bihar (6.82%). However, a major expansion in wheat area was observed in the states such as Jharkhand (51%), Madhya Pradesh (27%) and Rajasthan (13%) (Ramadas *et al* 2019) [9]. Wheat crop plays a very vital role in stabilizing the food grain production in the country over the past few years.

The starch content of wheat crop varies between 70-75%, moisture content ranges 11%, protein content ranges between 10-12% (Weiser *et al* 2020) [16]. The nutritional value of wheat is extremely important and extensively grown as staple food sources. The importance of wheat is mainly due to that its seed can be ground into flour, semolina, etc., which form the basic ingredients of bread and other bakery products.

For better crop growth and yield there is need of essential nutrients which is to be fulfilled by inorganic fertilizers (Selim, 2020) [12]. Nitrogen, Phosphorus and Potassium are the primary elements required by crop plant for proper growth and development. Combination of NPK provide sufficient amount of nutrients to plants and prevent them from various post sowing damages (Tahat *et al* 2020) [14]. NPK fertilizer treatment has the highest value for growth and yield of various crops followed by compost, mulch, control, and legume cover crop, although NPK fertilizer can supply all the nutrients, which are required by the plants.

Organic fertilizers are naturally available source of nutrients which are mainly required for better crop production. Organic fertilizers help in mitigate the problems associated with synthetic fertilizers. They are slow releasing fertilizers and contain many trace elements which are essential for plant growth (Shaji *et al* 2020) [11]. The organic carbon content of organic fertilizers is as important as nitrogen and phosphorus content. Nitrogen and phosphorus content are lower as compared to inorganic fertilizers, so they are applied in large amount. Farmyard Manure (FYM) is one of the important organic fertilizer consist of different essential nutrients.

Integrated Nutrient Management (INM) in terms of using chemical fertilizers in conjugation with organic manures as well as biological inputs is needed to improve the nutrient status of the soil (Jaga and Upadhyay, 2013) [4]. INM increases the nutrient uptake rate of the plant and influences the nutrient supply in the soil system. As soil is the primary source of nutrients, any degradation in the quality of soil can create a reduction in crop yield (Wu and Ma, 2015) [15]. Hence, the adoption of suitable measures is highly necessary for sustaining the environment and enhancing productivity. Integrated farming consists of different cropping methods and other agricultural technique which helps in fulfil both ecological and economic demands (Behera and France, 2016) [2].

Materials and Methods

The experiment was carried out during *Rabi* season 2020-2021 at research farm of Chandigarh University, Gharuan located at Latitude 30.69° N, Longitude 76.72° E and 316 m above from mean sea level in sub-tropical climate of Indo-Gangetic plains. The experimental site was sandy loam with a pH of 7.8 and determined by the initial fertility status of the soil. The annual rainfall of this region is about 792 mm. The lowest mean temperature was recorded in January during 2020-21. The maximum temperature (31.5 °C) was observed in fourth week of June. Around 3705.7 hours of sunshine are counted in Mohali throughout the year. Average sunshine hours per month are 121.82. Most precipitation falls in July month, with an average of 195 mm. It was low in organic carbon, moderately fertile, and available nitrogen, phosphorus and potassium. An experiment was implemented in Randomized Block Design with seven treatments with three replications. The seven treatments were under taken *viz*., T_1-100% NPK+100% FYM, T_2- 100% NPK+50% FYM, T_3- 75% NPK+100% FYM, T_4- 75% NPK+50% FYM, T_5- 50% NPK+100% FYM, T_6- 50% NPK+50% FYM, T_7- Control. The recommended dose of fertilizer for wheat are 120, 60, 40 kg of N, P_2O_5 and K_2O ha^{-1} respectively. Full dose of P_2O_5, K_2O_5 and 30% of N were applied at the sowing time. Remaining dose of nitrogen was applied as top dressing. The amount of FYM was applies as per treatment wise. Observations were recorded at 30, 60 and 90 DAS and at harvesting stage. Yield attributes parameters were recorded just before harvesting of crop. Harvesting was done when the spikes matured and plant was dried up. The grain yield of plots was recorded as kg $plot^{-1}$ and then converted into q ha^{-1}. After threshing, straw was collected separately. Statistical data were analyzed by standard procedure of Gomez & Gomez (1984) [3].

Results and Discussion

Effect on growth parameters of Wheat

The result of this study indicated that growth parameters of plant such as plant height (cm), number of tillers $m^{-2)}$, dry matter accumulation (g m^{-2}) of wheat was significantly influenced by different integrated nutrient management treatments. Among the treatments, the maximum plant height was recorded in 100% NPK+100% FYM (T_1) which was superior to other treatments at 30, 60 and 90 DAS. T_1 was significantly superior over all treatments at all the stages of observations in wheat. The minimum plant height was recorded in control plot. Growth parameters recorded more in those plots where 100% recommended doses are applied which resulted in better crop growth and more dry matter accumulation and number of tillers/m^2. Integrated application of fertilizers helps in nutrient mobility and better uptake of nutrients. Cell protein content increases and size of plant cell increases, as a result of that leaf area and photosynthesis rate rises which ultimately influence growth parameters. The result indicated that number of tillers were influenced under different treatments of NPK and FYM. The maximum number of tillers were recorded in T_1 with the application of 100% NPK+100% FYM. The dry matter accumulation increases due to higher number of tillers in T_1 treatment. These results were supported by Kakraliya *et* al. (2017) [7], Kumar *et al*. (2020) [5] and Thakur *et al*. (2020) [13] in wheat crop.

Effect on yield and yield attributes of Wheat

Yield attributes, which determines yield, is the resultant of the vegetative development of wheat crop. All the attributes of yield *viz*., number of grains $spike^{-1}$, grain weight (1000), grain yield, straw yield, biological yield and harvest index were significantly influenced by different treatments of integrated nutrient management. The improvement in yield and yield attributes of wheat crop was recorded with the application of T_1- 100% NPK+ 100% NPK. This was due to effect of integration of NPK with FYM on wheat crop. Application of 100% NPK+100% FYM was superior as compared to control. Number of grains $spike^{-1}$ (64.72) and grain weight (46.38 g) was superior in T_1 treatment. Comparing with other fertilizer treatments, the grain weight was minimum in control plot (29.50 g). Yield attributes was significantly lower in treatments where recommended dose was below 50%. The increase in effective tillers, number of grains $spike^{-1}$, grain weight (1000) was recorded significantly more where recommended dose was 100% combined with FYM. These results were supported by Kakraliya *et* al. (2017) [7] and Thakur *et al*. (2020) [13] in wheat crop. Grain yield (q ha^{-1}) and straw yield (q ha^{-1}) were significantly affected by different treatments. It increases with increasing level of nutrient (NPK) applied with organic source (FYM). The highest grain yield was recorded in 100% NPK+100% FYM (T_1) which was superior as compared to other treatments. Incorporation of inorganic and organic nutrients which results in more assimilation, production and partitioning of dry matter, thereby increasing the yield. Maximum grain yield was recorded in T_1 treatment (50.82 q ha^{-1}) and minimum yield in control (29.37 q ha^{-1}). T_2 (100% NPK+50% FYM) recorded more straw yield (64.62 q ha^{-1}) as compared to control (42.04 q ha^{-1}). Harvest index were maximum in T_2 treatment. Combined application of organic and inorganic fertilizers throughout the plant life cycle and other is optimal dose of fertilizers effect crop yield. Application of 100% fertilizer dose might provide the nutrient required for crop and also the combined application of organic and inorganic provide nutrients in adequate quantity throughout the growth stages in wheat crop. These results were supported by Kakraliya *et* al. (2017) [7] and Thakur *et al*. (2020) [13] in wheat crop.

Conclusion

These results suggested that application of inorganic and organic fertilizers shows significantly higher growth and yield of wheat crop. Application of 100%% NPK +100% FYM shows maximum growth and yield as compared to other combination treatments. On the basis of these results,

it can be concluded that balanced application of organic and inorganic fertilizers increases nutrient availability and increases growth and yield of wheat crop. The maximum cost of cultivation (Rs. 50110.16 ha^{-1}) was recorded under T_1 (100% NPK+100% FYM), while minimum cost of cultivation (Rs. 30200 ha^{-1}) was recorded from control. Gross return was maximum in T_1 treatment (Rs. 139716.5 ha^{-1}) as compared to control plot (Rs. 81132.5 ha^{-1}). The maximum net return was recorded in T_1 (Rs. 89606.3ha^{-1}) as compared to control (Rs. 50932.0 ha^{-1}). Application of 100% NPK+100% FYM gave best results in respect to all growth, yield and yield attributing parameter.

Table 1: Effect of different treatments on growth parameters of wheat crop

Treatments	Plant height (cm)			Dry matter accumulation (g/m^2)			Number of tillers/m^2		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1	19.18	42.12	77.26	34.26	161.50	618.23	222.11	419.22	398.41
T_2	17.32	38.66	74.58	31.53	150.56	565.90	214.71	385.74	364.64
T_3	15.23	34.97	71.59	30.31	142.49	529.92	207.93	372.41	351.26
T_4	14.45	32.92	69.01	29.40	140.41	525.47	205.62	370.33	350.65
T_5	11.59	30.34	64.07	28.49	135.59	512.23	196.22	360.41	341.54
T_6	11.49	30.14	62.24	28.09	133.19	508.24	194.28	358.30	340.48
T_7	9.32	29.22	60.16	26.28	126.16	483.11	187.26	328.82	311.64
SEm (±)	0.19	0.90	0.41	0.20	0.44	0.80	0.54	0.90	0.65
LSD (P=0.05)	0.57	2.76	1.25	0.61	1.37	2.47	1.67	2.79	2.01

SEm (±): Standard error of means, LSD: Least significant difference

Table 2: Effect of different treatments on yield and yield attributes of wheat crop

Treatments	Yield and yield attributes					
	Number of grains spike^{-1}	grain weight (g)	Grain yield (kg ha^1)	Straw yield (kg ha^{-1})	Biological yield (kg ha^1)	Harvest Index (%)
T_1	64.72	46.38	50.82	71.54	122.36	41.53
T_2	62.58	45.75	47.15	64.62	111.77	42.18
T_3	48.34	41.60	41.68	61.68	103.36	40.32
T_4	46.43	40.60	39.70	61.37	101.07	39.28
T_5	43.71	37.90	33.71	58.30	92.01	36.53
T_6	42.14	37.21	32.65	57.58	90.23	36.18
T_7	38.31	29.50	29.37	42.04	71.41	41.13
SEm (±)	0.30	0.18	0.19	0.35	0.49	0.12
LSD (P=0.05)	0.92	0.56	0.60	1.09	1.51	NS

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

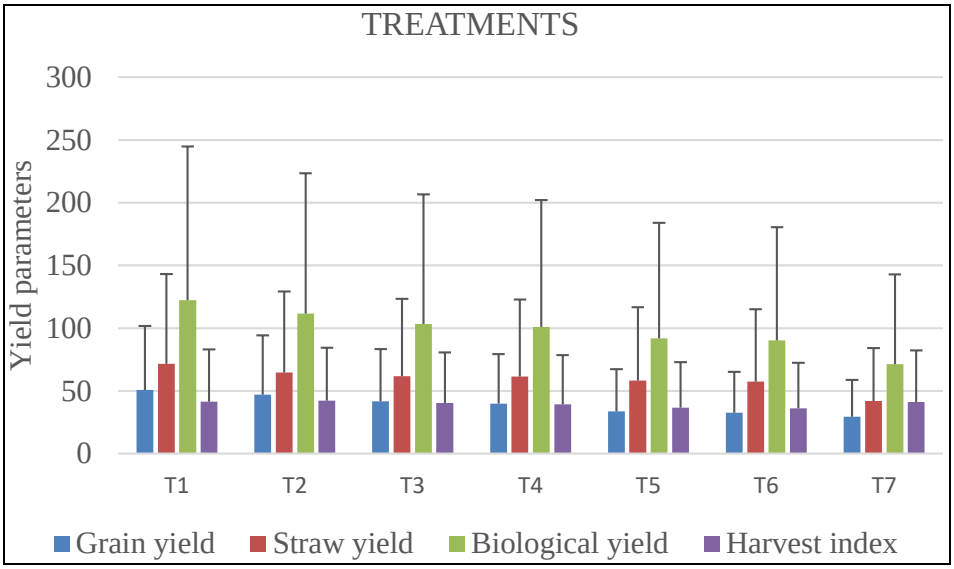

Fig 1

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