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Effects of different levels of NPK on growth of wheat (*Triticum aestivum L.*).

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Abstract
A field experiment was conducted to investigate the combined effect of NPK (Nitrogen, Phosphorus and Potash) on the growth of wheat cultivars super golden. The objective of study was to determine effects of different levels of NPK on Growth by wheat (*Triticum eastiveum L.*) variety. The thrice replicated treatments (T0: 0 -0 -0 NPK, T1: 30- 0-20 NPK, T2: 60 -0 -0 NPK, T3: 120 -0 -0 NPK, T4: 0 -15 -50 NPK, T5: 0 -30 -0 NPK, T6: 0 -60 -10 NPK, T7: 120 -60 -50 NPK and T8: 60 -30 -25 NPK) Kg ha^{-1} were tested in Randomized Block Design (RBD). The results revealed that highest growth parameters replied significantly to NPK fertilizers. It is resulted that highest growth was recorded with the application of (120-60-50) NPK Kg ha^{-1} and lowest conclude treatment combinations T0 (0- 0- 0) NPK kg ha^{-1}.

Keywords: Growth, NPK fertilizers, wheat

Introduction

Wheat (*Triticum spp*.) the world's most widely cultivated crop, in 2000, world wheat production was approximately 572 million metric tons on 205 million hectares (Anonymous 2002 and Stoskopf, 1985) [1, 9]. Wheat is the staple food for about 40% of the world's population (Wiese,
1987) [11].

Wheat is also the staple food in Afghanistan, accounting for approximately 60 percent of the calorie intake of the population. It also has the distinction of being Afghanistan's major crop, accounting for roughly 70 percent of the cultivated land area (Chabot and Dorosh, 2007) [2], however, the country's domestic production of wheat has never been sufficient for meeting demand, and is also prone to great weather-induced fluctuations. Wheat imports from neighboring countries have been required to meet local demand. Approximately 45 percent of Afghanistan's wheat acreage in a normal year is irrigated, accounting for about 70 percent of production. The remaining 55 percent of wheat acreage relies on timely rainfall and typically provides the remaining 30 percent of home production. Winter snowfall in the mountain ranges of central Afghanistan supplies over 80 percent of the country's annual precipitation, with snowmelt in the spring the major source of irrigation water, running through rivers and streams that originate in the mountains Osmanzai *et al*. (2010) [7].

Wheat is world's most widely cultivated food crop and in India is the second important staple cereal food. As a rabi season (winter) crop, wheat played vital role in stabilizing the food grain production in the country. It is mostly eaten in the form of chapaties. Besides, wheat is also consumed in various other forms such as poories, dalia, halwa, sweet meals etc. In areas where rice is the staple food, wheat is used in the form of upma or poories. Wheat is also used for manufacturing of bread, flakes, cakes, biscuits etc.

The total area under the crop is about 29.8 million hectares in the country state. The production of wheat in the country has increased significantly from 75.81 million MT in 2006-07 to an all time record high of 94.88 million MT in 2011- 2012. The productivity of wheat which was 2602 kg/ha in 2004-05 has increased to 3140 kg/ ha in 2011-2012. The major increase in the productivity of wheat has been observed in the states of Haryana, Punjab and Uttar Pradesh. Higher area coverage is reported from MP in recent years Christopher *et al.* (2006) [3].

Nitrogen is the most important element to achieve stable high grain yields and growth it is essential for improving grain quality of wheat. Both high yield and good and stable quality are important features in today's wheat market. To reach these goals N fertilizer rates, split N application and timing of application have been the major strategies recommended to increased protein content and improved alveograph parameters Shejbaloval *et al.* (2014) [8].

Phosphorus is the second to nitrogen as the nutrient that most commonly limits wheat growth and development. Phosphorus has been the subject of more fertility investigation than any of the other essential elements. Monoammonium Phosphate (MAP), Diammonium Phosphate (DAP) and Triple Supper Phosphate (TSP) are the sources of phosphatic Fertilizers.

Soil phosphorus (P) deficiency is a major constraint to increased crop yields in many areas of the world Vance *et al.* (2003) [10]. In general, P deficient soils require pre-plant broadcast-incorporated rates of 11 to 22 kg Pha^{-1} to correct the deficiency in either wheat or corn. At a PUE of 16%, this addition results in only 1.7 to 3.5 kg of fertilizer P taken up in the grain. Haloi (1980) reported that when initial P deficiency symptoms appeared 25 days after sowing in wheat, higher doses of ammonium phosphate as a foliar spray gave the greatest reduction in P deficiency and highest yields

Potassium deficiency can lead to a reduction in both the number of leaves produced and the size of individual leaves. Coupling this reduced amount of photosynthetic source

material with a reduction in the photosynthetic rate per unit leaf area, and the result is an overall reduction in the amount of photosynthetic assimilates available for growth. The production of less photosynthetic assimilates and reduced assimilate transport out of the leaves to the developing fruit greatly contributes to the negative consequences that deficiencies of potassium have on yield and quality production William, (2008) [12].

Materials and Methods

This experiment was conducted at crop research farm of soil Science, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Science, Allahabad during the years of 27 November 2015- 26 March 2016. The area is situated in the south of Allahabad on right hand of rivers Yamuna at Rewa Road at a distance of about 6 km Allahabad city. It is positioned 25^0 57' N Latitude 81^0 50' E longitude and the altitude of 98 meters above the near sea level. The experiment carried out in randomized block design with three replications and nine treatments combination of three levels of nitrogen does three levels of phosphorus and three levels potassium with replications. The total numbers of plots in the experimental design were 27. The treatments were randomly arranged in the experiment. The gross area 196.24 m2, the net cultivated area 108m2, the net plot area 2× 2m2, the treatments comprised of; (T0: 0 -0 -0 NPK, T1: 30- 0-20 NPK, T2: 60 -0 -0 NPK, T3: 120 -0 -0 NPK, T4: 0 -15 -50 NPK, T5: 0 -30 -0 NPK, T6: 0 -60 -10 NPK, T7: 120 -60 -50 NPK, T8: 60 -30 -25 NPK) kg ha^{-1} were tested in (RBD). Super Golden Wheat (*Triticum aestivum L.*) sowing was done in lines by hand on 27 November 2015, The seed were serum 120 kg ha^{-1} apart in plant to plant distance of 5 cm and row to row distance of 20 cm immediately after sowing the seeds areas coursed with soil. all phosphate and Potash was applied at the time of seed bed preparation along with 1/3 dose of Nirogen. The remaining egual splits of Nitrogen were during top dressing with first irrigation and second were during flowering stage. The source of Nitrogen, Phosphorus and Potassium were Urea 46%, Single Supper Phosphate, P_2O_5 (16-22) % and MOP (Muriate of potassium), K_2O (60-62)%, respectively.

The growth character followed

Plant height (cm): The height of five plants were measured in cm from ground level up to the height levels reached by the leaves and the average height per plant was calculated. The observations were taken at 30, 60, 90 and 120 days and then averaged.

Number of tillers per plant: The numbers tillers were taken from five plants where the plants were tagged in each plot. Number of tillers per plant was calculated by total number of tillers then it was divided by the total number of selected plants. The observation was taken at 30, 60, 90 and 120 days and averaged.

Dry weight per plant (g): The five air dried plants was kept in an oven for 240c for complete drying to get a constant weight. Average value of these dried weight per plant were taken as dry matter yield and expressed in g/ plant. The observation was taken at 30, 60, 90 and 120 days. Following observations like: plant height, number of tillers per plant, dry weight of plant, crop growth rate and relative growth rate were recorded to standard procedures. The data recorded during the course of investigation were subjected to statistical analysis as per method of" Analysis of variance". The significant and non-significant of the treatment effect were judged with the help of 'F' variance ratio test calculated with table value 'F' level of significance (Fisher, 1950).

Results and discussion

Plant height: Data in table (1) reveals The observation on plant height at different stages of growth 30, 60, 90 and 120 DAS that treatment combinations T7 (N_{120} P_{60} K_{50}) results is grater increase in height (22.87, 47.87, 96.73 and 100.73) cm respectively in successive stage of growth.

At 30 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase in height that is 22.87 cm comparison to T3 (N_{120} P_0 K_0) and T8 ($N_{60}P_{30}K_{25}$) kg ha^{-1} the plant height were (20.07 and 19.93) cm and minimum height was observation in treatment combinations T0 (control) that is 13.40 cm

At 60 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows a significant increase in height that 47.87 cm in comparison to T3 (N_{120} P_0 K_0) and T8 ($N_{60}P_{30}K_{25}$) kg ha^{-1} the plant height were (47.60 and 46) cm and minimum height was observed in treatment combinations T0 (control) that is 36.73 cm.

At 90 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1}shows significant increase in height that is 96.73 cm comparison to T3 ($N_{120}P_0$ K_0) and T8 ($N_{60}P_{30}K_{25}$) kg ha^{-1} the plant height where recorded that are (93.20 and 92.34) cm and minimum height was observed in treatment combinations T0 (control) that is 85.47 cm.

At 120 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) shows significant increase in height that is 100.73 cm comparison to T3 (N_{120} P_0 K_0) and T8 ($N_{60}P_{30}K_{25}$) kg ha^{-1} the plant height were 97.20 and 96.60 cm and minimum height was observed in treatment combinations T0 (control) that is 88.07 cm. Similar results were reported by Malghani *at el*. (2010) [6] and Hussain *et al*. (2002) [4].

Number of tillers per plant: Data has given in Table (1) reveals that the average number of tillers per plant at successive stages of growth under various treatment combinations.

Data on number of tillers per plants at successive stages of growth 30, 60, 90 and 120 DAS revealed the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} resulted in maximum number of tillers per plant.

At 30 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows a significant increase number on tillers per plant is 7.07 in comparison to T8 (N_{60} P_{30} K_{25}) kg $ha^{-1}$the number of tillers per plant where observed 6.00 and minimum number of tillers per plant observed in treatment combinations T0 (control) which is 4.40.

At 60 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase number of tillers per plant in 5.07 in comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the number of tillers per plant recorded 4.87 and minimum number of tillers per plant where observed in treatment combinations T0 (control) which is 3.04.

At 90 DAS, the maximum tillers per plant recorded in treatment T7 (N_{120} P_{60} K_{50}) kg ha^{-1} that shows a significant increase number of tillers per plant that is 4.80 in comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the number of tillers per plant were

recorde 4.20 and minimum number of tillers per plant observed in treatment T0 (control) that is 2.67.

At 120 DAS, the maximum tillers per plant were reported in treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} that shows a significant increase number of tillers per plant that is 4.80 in comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the number of tillers per plant were recorded 4.19 and minimum number of tillers per plant observed in treatment combinations T0 (control) that is 2.70.

Dry weight per plant: The observation at different stages revealed that the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} resulted in 30, 60, 90 and 120 DAS maximum dry weight per plant.

At 30 DAS the maximum dry weight per plant where reported in treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} that shows significant increased dry weight per plant that is 0.27 g in to T3 (N_{120} P_0 K_o) and T8 ($N_{60}P_{30}K_{25}$) kg ha^{-1} the dry weight per plant were recorded (0.25 and 0.24) g and minimum dry weight per plant where observed in treatment combinations T0 (control) that is 0.17 g.

At 60 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase dry weight per plant that is 2.12 g in comparison to T8 (N_{60} P_{30} K_{25}) the dry weight per plant were 1.93 g and minimum dry weight per plant were observed in treatment combinations T0 (control) which is 0.88 g.

At 90 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase dry weight per plant that is 11.11 g in comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the dry weight per plant where 10.94 g and minimum dry weight per plant were observed in treatment combinations T0 (control) which is 6.44 g.

At 120 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase dry weight per plant that is 39.52 g in comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the dry weight per plant were 36.03 g and minimum dry weight per plant were observed in treatment combinations T0 (control) which is 13.8 g. Similar results have recorded by laghari *et al*. (2010) [5].

Crop growth rate: The observation on crop growth rate at different stages of growth 30, 60, 90 and 120 DAS reveals that treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} results in crop growth rate were (0.95, 0.86 and 0.25) g day^{-1}.

At 30 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant crop growth rate that is 0.01 g day^{-1} comparison to T3 (N_{60} P_{30} K_{25}) kg ha^{-1} the crop growth rate was 0.01 g day^{-1} and crop growth rate observation in treatment combination T0 (control) that is 0.01 g day^{-1} all the treatment combinations showed same results in the first observation during 30 DAS.

At 60 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase in crop growth rate that is 0.07 g day^{-1} comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the crop growth rate was 0.06 g day^{-1} and minimum crop growth rate where observed in treatment combinations T0 (control) that is 0.02 g day^{-1}.

At 90 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase crop growth rate that is 0.31 g day^{-1} comparison to T8 ($N_{60}P_{30}$ K_{25}) kg ha^{-1} the crop growth rate where 0.29 g day^{-1} and minimum crop growth rate has observed in treatment combinations T0 (control) that 0.19 g day^{-1}.

At 120 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase crop growth rate that is 0.95 g day^{-1} comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the crop growth rate where 0.86 g day^{-1} and minimum crop growth rate has observed in treatment combinations T0 (control) that is 0.25 g day^{-1}. Similar results have recorded by laghari *et al*. (2010) [5].

Relative growth rate: Data on relative growth rate per plants at successive stages of growth at 30, 60, 90 and 120 DAS revealed the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} resulted maximum.

At 30 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase relative growth rate per plant is (-0.01) g g^{-1} day^{-1} in comparison to T8 (N_{60} P_{30} K_{25}) the relative growth rate per plant was observed (- 0.02) g g^{-1} day^{-1} and minimum relative growth rate per plant where observed in treatment combinations T0 (control) which is (- 0.03) g g^{-1} day^{-1}.

At 60 DAS, the treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} shows significant increase relative growth rate per plant that is (0.04) g g^{-1} day^{-1} in comparison T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the relative growth rate per plant were (0.03) g g^{-1} day^{-1} and minimum relative growth rate per plant were observed in treatment combinations T0 (control) which is (0.02) g g^{-1} day^{-1}.

At 90 DAS, the maximum relative growth rate per plant were reported in treatment T7 (N_{120} P_{60} K_{50}) kg ha^{-1} that shows significant increase relative growth rate per plant that is (0.04) g g^{-1} day^{-1} in comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the relative growth per plant where recorded (0.03) g g^{-1} day^{-1} and minimum relative growth rate per plant was observed in treatment T0 (control) that is (0.01) g g^{-1} $day^{-1.}$

At 120 DAS, the maximum relative growth rate where reported in treatment combinations T7 (N_{120} P_{60} K_{50}) kg ha^{-1} that shows significant increase relative growth rate per plant that is (0.03) g g^{-1} day^{-1} in comparison to T8 (N_{60} P_{30} K_{25}) kg ha^{-1} the relative growth rate per plant were (0.02) g g^{-1} day^{-1} and minimum relative growth rate per plant was observed in treatment combinations T0 (control) that is (0.01) g g^{-1} day^{-1}.

All the successive growth stages of relative growth rate per plant at 30, 60, 90 and 120 DAS treatment T0 recorded minimum relative growth rate per plant. This result indicates that relative growth rate per plant of wheat in made effective highly by reatment where optimum dose of inorganic fertilizer i.e. T7 (N_{120} P_{60} K_{50}) kg ha^{-1}.

Table 1: Effects of different levels Nitrogen, Phosphorus and Potassium on Growth of wheat (*Triticum aestivum L*).

Treatment Combinations	plant height (cm)				Number of tillers/plant				Dry weight of plant (g)			
	30 Days	60 Days	90 Days	120 Days	30 Days	60 Days	90 Days	120 Days	30 Days	60 Days	90 Days	120 Days
T0= 0 -0 -0 NPK	13.4	36.73	85.47	88.07	4.4	3.04	2.67	2.7	0.17	0.88	6.44	13.81
T1= 30- 0-20 NPK	15.93	43.8	89.07	93.2	4.65	3.53	3.33	3.33	0.22	1.14	7.5	16.02
T2= 60 -0 -0 NPK	16.27	45.93	92.20	96	5.4	3.73	3.53	3.53	0.23	1.87	10.74	21.29

T3= 120 -0 -0 NPK	20.07	47.6	93.2	97.2	5.87	3.8	4	4.01	0.25	1.05	9.17	26.75
T4= 0 -15 -50 NPK	18.13	38.2	89.4	93.4	4.6	3.1	3.07	2.87	0.22	1.74	9.94	22.37
T5= 0 -30 -0 NPK	16.07	41.53	91.27	95.27	5.07	3.07	2.87	3.11	0.19	1.09	7.7	17
T6= 0 -60 -10 NPK	18.4	39.07	91.67	95.67	5	3.33	3.13	3.13	0.21	0.97	7.81	16.43
T7= 120 -60 -50 NPK	22.87	47.87	96.73	100.73	7.07	5.07	4.8	4.8	0.27	2.12	11.11	39.52
T8= 60 -30 -25 NPK	19.93	46	92.34	96.60	6	4.87	4.2	4.19	0.24	1.93	10.94	36.03

Table 2: Effects of different levels Nitrogen, Phosphorus and Potassium on Growth of wheat (*Triticum aestivum L*).

Treatment Combinations	**Crop growth rate(g day^{-1})**				**Relative Growth Rate (g g^{-1} day^{-1})**			
	30 Days	**60 Days**	**90 Days**	**120 Days**	**30 Days**	**60 Days**	**90 Days**	**120 Days**
T0= 0 -0 -0 NPK	0.01	0.02	0.19	0.25	-0.03	0.02	0.01	0.01
T1= 30- 0-20 NPK	0.01	0.03	0.21	0.28	-0.02	0.02	0.03	0.01
T2= 60 -0 -0 NPK	0.01	0.03	0.28	0.35	-0.02	0.03	0.03	0.01
T3= 120 -0 -0 NPK	0.01	0.04	0.27	0.59	-0.02	0.02	0.03	0.02
T4= 0 -15 -50 NPK	0.01	0.05	0.27	0.41	-0.02	0.02	0.02	0.01
T5= 0 -30 -0 NPK	0.01	0.03	0.22	0.31	-0.02	0.02	0.02	0.01
T6= 0 -60 -10 NPK	0.01	0.03	0.23	0.29	-0.02	0.02	0.02	0.01
T7= 120 -60 -50 NPK	0.01	0.07	0.31	0.95	-0.01	0.04	0.04	0.03
T8= 60 -30 -25 NPK	0.01	0.06	0.29	0.86	-0.02	0.03	0.03	0.02

Conclusion

In generally all the successive growth stages of plant height, number of tillers/ plant, dry weight, crop growth rate and relative growth rate at 30, 60, 90 and 120 DAS treatment T0 recorded lowest that is control but the highest growth recorded in treatment combinations where optimum dose of inorganic fertilizer i.e. T7 (N_{120} P_{60} K_{50}) kg ha^{-1}. Statistical data reveals that different levels of nitrogen, phosphorus and potassium fertilizer inoculation and interaction between them had a significant effect on relative growth rate. The above finding showed that the optimum dose of nitrogen, phosphorus and potassium and their interaction increased the plant height, number of tillers/ plant, dry weight, CGR and RGR significantly which may be attributed to bringing the inorganic fertilizer.

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