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Effect of Different Rate of N, P and K Combinations on Yield and Components of Yield of Wheat

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ABSTRACT

A field study was conducted to determine the growth and yield response of wheat to N, P and K application in different combinations at the Agronomic Research Area, University of Agriculture, Faisalabad during the year 1992–93. The fertilizer treatments comprised the control, 35–75–50, 70–75–50, 105–75–50, 140–75–50, 175–75–50 kg NPK ha^{-1}. The experiment was laid out in randomized complete block design with four replications using a net plot size 3 m x 6 m. The highest grain yield of 7083 kg ha^{-1} was achieved from plot fertilized at the rate of 140–75–50 kg NPK ha^{-1} which was significantly higher than control and other treatments. It can be concluded that in these soils application of 140–75–50 kg NPK ha^{-1} remained optimum dose for exploiting the maximum potential of a cultivar like Pasban-90.

Key Words: Yield; Yield components; Fertilizer; Pakistan

INTRODUCTION

Wheat (*Triticum aestivum* L.) is grown on an area of 8354.6 thousand hectares with an annual production of 18694 thousand tonnes, resulting in an average yield of 2238 kg ha^{-1} (Anonymous, 1999). This average grain yield is very low as compared to other wheat producing countries of the world such as; France (6487 kg ha^{-1}), Egypt (5209 kg ha^{-1}), U.S.A. (2655 kg ha^{-1}) (FAO 1990).

The judicious use of inorganic fertilizers can increase yield from 30–40%. The N, P and K are the main plant food nutrients and most of our soils are deficient in these nutrients (Tahir, 1980). So, attention must be paid to maintain the fertility status of soil. This can be achieved through the use of organic and inorganic manures, where inorganic or chemical fertilizers remain the major source of providing the essential nutrients to a crop in a short time.

Phosphorus counter balances the effect of excessive nitrogen by hastening plant maturity, improving grain quality and retarding excessive vegetative growth. It is also involved in many metabolic activities and if soil is deficient in phosphorus, the response of crop to nitrogen would be reduced (Senigagliesi *et al.*, 1983).

The present study was, therefore, planned to investigate the optimum and balanced doses of nitrogen, phosphorus and potash for exploiting maximum potential of new wheat cv. Pasban-90 under Faisalabad conditions.

MATERIALS AND METHODS

The studies to determine the effect of different N, P and K combinations on the growth and yield of wheat were carried out at the Agronomic Research Area, University of Agriculture, Faisalabad during 1992–93 on a sandy clay loam soil having total nitrogen 0.058 per-cent, available phosphorus 8.10 ppm and available potash 217.5 ppm. The experiment was laid out in a Randomized Complete Block Design with four replications and net plot size measuring 3 m x 6 m. The treatments (NPK fertilizer levels, kg ha^{-1}) were: F_0 = 0–0–0, F_1 = 35–75–50, F_2 = 70–75–50, F_3 = 105–75–50, F_4 = 140–75–50 and 175–75–50.

Wheat variety Pasban-90 was sown in 25 cm apart rows with the help of hand drill during the second week of November, 1992. A seed rate of 110 kg ha^{-1} was used. Urea, Single Super-phosphate and Potassium sulphate were used as a source of N, P and K, respectively. The whole quantity of phosphorus and potash and half of the nitrogen were applied at the time of sowing by side dressing, while remaining half of the nitrogen was applied with first irrigation. All other cultural practices such as irrigation, weeding, etc were kept normal and uniform for all treatments. Following observations such as total number of tillers, plant height at maturity, spike length, number of spikelets per spike, number of grains per spike, 1000-grain weight and grain yield were recorded according to standard procedures.

The data collected were analysed statistically by using analysis of variance technique, least significant difference test at 5% level of probability was used to compare the differences among the treatments means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Total number of tillers per unit area. The increasing rate of fertilizer application significantly increased the number of tillers over check (Table I). Although there was a progressive increase in tillering with each successive dose of nitrogen along with phosphorus and potash but treatment F_4 (140–75–50 kg NPK ha^{-1}) produced the maximum number of tillers (389 m^{-2}). Wheat grown without any fertilizer produced the lowest number of tillers (294 m^{-2}). The increase in number of tillers with increasing nitrogen levels could be attributed to the well-accepted role of nitrogen in accelerating vegetative growth of plant.

Similar results were also reported by Dilbaugh *et al.* (1988). However, Singh and Sharma (1972) reported different results who observed that with different NPK applications there were no significant differences in the densities of wheat crop at harvest.

Plant height. Plant height at maturity was significantly influenced by various fertilizer combinations over control (Table I). The treatment F_4 (140–75–50 kg NPK ha^{-1}) produced the tallest plant (97.9 cm) while the treatment F_3 produced plant height of 92.1 cm and differed significantly with one another. The lowest plant height of 87.4 cm was recorded in control while the treatment F_1 and F_2 produced 88.7 and 89.3 cm plant height, respectively which were statistically at par with each other. The treatment F_5 gave 90.9 cm plant height which was significantly lower than the F_3 and F_4 treatments.

Spike length. There were significant differences in spike length among various fertilizer treatments. Treatment F_4 produced the longest spikes (11.0 cm). This was followed by treatment F_3 producing 10.4 cm long spikes (Table I). Treatments F_1, F_2 and F_5 produced 9.5, 9.9, and 9.8 cm long spikes, respectively which did not differ significantly with each other. The minimum spike length of 9.3 cm was noted in treatment F_0 (control). These findings are similar to those of Kadry *et al.* (1984) and Ram and Joshi (1987).

Number of spikelets per spike. Number of spikelets per spike is an important yield contributing parameter. The treatment F_4 (140–75–50 kg NPK ha^{-1}) produced the highest number of spikelets per spike (19.7). The lowest number of spikelets per spike (17.3) was produced in control treatment which did not differ significantly with F_1 (17.9). The treatments F_2, F_3 and F_5 produced 18.7, 18.8 and 18.5 spikelets/ spike, respectively and were statistically at par. These results are in accordance with those of Ram and Joshi (1987).

Number of grains per spike. The treatment F_4 (140–75–50 kg NPK ha^{-1}) produced the highest number of grains per spike (53.9) followed by F_3 (105–75–50) kg NPK ha^{-1}) having 47.7 grains per spike. The lowest number of grains per spike (38.9) were produced in control treatment, while F_1 and F_2 produced 40.9, 44.9 grains per spike, respectively, and were statistically at par with each other. These results are similar with those of Kadry *et al.* (1984) and Dilbaugh *et al.* (1988).

1000-grain weight. All fertilizer combinations influenced 1000-grain weight significantly. Treatment F_4 (140–75–50 kg NPK ha^{-1}) produced the highest 1000-grain weight of 54.8 g and differed significantly from all other treatments including control. The lowest 1000-grain weight of 49.7 g was recorded in control which was at par with F_1. Treatment F_2 and F_5

Table I. Effect of different fertilizer rates on yield and yield components of wheat

Treatments N P K (kg ha^{-1})	No. of tillers (m^{-2})	Plant height (cm)	Spike length (cm)	No. of spikelets/ spike	No. of grains/ spike	1000-grain weight (g)	Grain yield (kg ha^{-1})
F_0 = 0-0-0	294 f	87.4 e	9.32 d	17.34 c	38.9 f	49.7 d	5000 c
F_1 = 35-75-50	308 e	88.7 d	9.48 cd	17.85 c	40.9 d	49.5 d	5417 c
F_2 = 70-75-50	322 d	89.3 d	9.85 c	18.74 b	44.9 c	51.2 c	5972 b
F_3 = 105-75-50	347 c	92.1 b	10.36 b	18.75 b	47.7 b	52.0 b	6458 b
F_4 = 140-75-50	389 a	97.9 a	10.99 a	19.67 a	53.9 a	54.8 a	7083 a
F_5 = 175-75-50	374 b	90.9 c	9.82 c	18.54 b	42.7 c	50.8 c	6319 b

Any two means not sharing a letter differ significantly at 5% probability level.

produced grain showing 1000-grain weight of 51.2 and 50.8 g, respectively and did not differ significantly with each other. The treatment F_3 (105–75–50 kg NPK ha^{-1}) produced 1000-grain weight 52.0 g which differs significantly with all the treatments. Increased grain weight can be attributed to the fact that under nutrient rich soil, more nutrients up take, increased metabolic activity and faster translocation of metabolites result in heavier grains. These results corroborate the findings of Dilbaugh *et al.* (1988), who also reported similar results.

Grain yield. Different fertilizer treatments significantly affected the grain yield of wheat. Treatment F_4 (140–75–50 kg NPK ha^{-1}) gave the highest mean grain yield of 7083 kg ha^{-1}. This was due to an increase in number of spikes per unit area and mean grain weight (Table I). The lowest grain yield of 5000 kg ha^{-1} was recorded in control and it was at par with treatment F_1. Treatment F_2, F_3 and F_5 produced mean grain yield of 5972, 6458 and 6319 kg ha^{-1}, respectively, which were statistically at par with each other. The findings of Sachen *et al.* (1979), Agarwal (1980), Buchner and Sturm (1982), Curic (1982) and Ram and Joshi (1987) also showed similar results. In conclusion, application of 140–75–50 kg NPK ha^{-1} can be considered as an optimum dose of fertilizer application on these soils for maximizing wheat yield.

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