"Response Of N, P, K, S And Zn On Growth Parameters In Wheat (Triticum Aestivum L.) Under Dehradun District Of Uttarakhand"

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ABSTRACT
A field experiment was carried out at research block of Shri Guru Ram Rai University, Dehradun, Uttarakhand, during rabi season 2018-19 to investigate the response of yield attributes of wheat (*trticum aestivum L.*) to different dosage of NPK S and Zn under irrigated conditions in Dehradun Valley, India. For this purpose, eight treatments having different dose combinations of NPK, Zn and S were tested in randomized block design (RBD) with three replicates using a net plot size 4.0×2.7m. Dosage of Nitrogen varied under studied treatments. Seven yield parameters were studied and evaluated to know if they are significantly different under each treatment or not. Statistical measures like CD, ANOVA and comparative analysis was conducted to explore responses of growth attributes such as plant population, Number of Tillers and dry matter accumulation to different treatments (fertilizer dosage combinations).

Keywords: Fertilizer, NPK, Nutrients, Wheat, Treatment, Yield

INTRODUCTION

In developing countries like India, food security is a challenge and concern to satisfy cereal demand from large number of populations. After attaining independence in 1947, India's major concern was production of adequate food grains to fulfill country' s requirements at domestic level. Focusing on this, the green revolution emanated in India which made country in dependent to its crop production mainly wheat. The majority of Indians are guaranteed nutritional security through production and consistent supply, thanks to the country's different and enriched agroecological conditions, especially in recent times. Wheat (*Triticum aestivum*) is one of the most important cereal crops in India. Wheat not only fulfills a huge demand for food, but also contributes a lot in farm income. At global level, it is the national staple food in forty-three countries With an annual production of about 731 million tons, wheat holds the position of crop with the largest acreage worldwide, occupying roughly 217 million hectares.. (USDA, 2018). If we consider the nutritional values, it has high starch content (60-68%) with mineral matter (1.5–2%), protein (8–15%), fat (1.5–2%), sugar (2.3%), and cellulose (2.5–3%). Apart from its nutritional attributes, wheat also contains Vitamin A, B1, B2, Nicotinic acid, and E, which makes it a highly favored grain in the Indian subcontinent. India is currently the world's second-largest producer of wheat (Sharma and Sendhil, 2016). With an unprecedented average productivity of 3371 kg/ha, the crop has been cultivated on around 30 million hectares (14% of the world's total area) to create the highest-ever output of 99.70 million tons, or almost 13% of world production (MoA&FW, 2018).

Along with required soil amendments, nutrient-fertilizers are considered as important tool to obtain more crop yield. Generally N fertilizers are considered popular among farmers to grow crop under irrigated conditions in India. For wheat crop, The utilization of NPK in combination is crucial to its manufacturing. Wheat yield is greatly affected by the application of NPK in a balanced amount at the appropriate time. The ways that different plant species, and even variants within species, receive and use NPK for grain production, varies. (Gilland Rahmat, 1994). However, a balanced nutrient intake is required for optimum crop yield and ideal soil health. As indiscriminate use of inorganic fertilizer leads to deficiency of macro and micronutrients in soil (Swaroop and Ganeshmurthy, 1993).
Keeping required nutrient uptake, and their role in wheat crop production, this study was conducted to analyze the yield responses in the Uttarakhand valley region of India, wheat (Triticum aestivum L.) was subjected to varying dosages and combinations of NPK, Zn, and S..

MATERIAL AND METHODS:

Study site and description

During the rabi season, the experiment was carried out in the research plot of Shri Guru Ram Rai University in Dehradun, Uttarakhand. 2018-19. Dehradun valley is situated between latitudes 30˚ 19' N and longitudes 78˚ 04' E. The climate of Dun valley is humid subtropical. Summer temperature can reach upto 44˚C for a few days while in winters, temperature ranges usually 1 to 20˚C. The average annual precipitation is 2208.9 mm

The experiment consisting of eight treatment combinations conducted using three replications in a randomized block design (RBD). The total no of plots were 24. Net size of plot was 4.0×2.7m. The treatments (T) carried out to explore yield response of wheat, were comprised of:

T1: Farmers practice (100kg DAP/ha)
T2: T1 + (15kg S+ 2.5kg Zn)/ha= (100kg DAP+15kg S+ 2.5kg Zn)/ha.
T3: Recommended dose of fertilizer (RDF)= (120kg N, 60kg P and 40kg K)/ha.
T4: T3+ (15kg S+ 2.5kg Zn)/ha= (120kg N, 60kg P and 40kg K+15kg S+ 2.5kg Zn)/ha.
T5: 150% RDF= (180kg N, 90kg P, 60kg K)/ha.
T6: T5+ 15kg S+ 2.5kg Zn/ha=(180kg N+ 90kg P+60kg K+15kg S+ 2.5kg Zn)/ha.
T7: (96kg N+ 96kg P+42kg K)/ha
T8: T7+ 15kg S+ 2.5kg Zn/ha)=(96kg N+ 96kg P+42kg K+15kg S+ 2.5kg Zn)/ha

RESULT AND DISCUSSION

The experimental findings regarding multiple aspects of growth, yield attributes, yield, soil fertility status (initial and after harvest), economic appraisal of the treatments and uptake as obtained have been described in this chapter. The data on the above aspects were analyzed statistically and have been presented in the table.

1. The number of plants

The statistical evaluation of plant population data collected at 15 days post-sowing (DAS).Table 4.1 analysis showed that, across all treatments, the plant population was consistent and statistically equal.

2. Height of plant (cm)

Table 4 displays the progressive plant height measured at each growth stage.2. As the plant grew toward the harvest stage, the overall height of the plant increased significantly across all treatments. Up until 50 DAS, the plant's height was observed to increase quite quickly; after that, it increased slowly until the harvest stage.

At 25 DAS, crop fertilized according to T6 (180 kg N + 90 kg P_2Os + 60 kg K_2O + 15 kg S + 2.5 kg Zn/ha) gave maximum plant height and was statistically similar with treatment T 5 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O /ha), T4 (120 kg N + 60 kg P_2O_5 + 40 kg K_2O + 15 kg S + 2.5 kg Zn/ha) T3 (120 kg N + 60 kg P_2O_5 + 40 kg K_2O/ha) T7 (96 kg N + 96 kg P_2O_5 + 42 kg K_2O/ha) and T8 (96 kg + 96 kg P_2O_5 + 42 kg K_2O+ 15 kg S + 2.5 kg Zn /ha) but higher than the treatments T2 (100 kg DAP + 20 kg S + 5 kg Zn/ha) and T1 (100 kg DAP/ ha).

At 50 DAS treatment T4 (120 kg N + 60 kg P_2O_5 + 40 kg K_2O + 15 kg S + 2.5kg Zn/ha) T5 (180 kg + 90 kg P_2O_5 + 60 kg K_2O /ha) and T6 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O/ha, being at par with each other and resulted taller plants over rest of the treatments.

At 75 DAS equal and maximum plant height was recorded in treatment T5 (180 kg + 90 kg P_2O_5 + 60 kg K_2O /ha) and T6 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O/ha which was closely followed by T4 (120 kg N + 60 kg P_2O_5 + 40 kg K_2O + 15 kg S + 2.5 kg Zn/ha).

At Harvest the maximum plant height was recorded in T 6 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O + 15 kg S + 2.5 kg Zn/ha) treatment which was followed by T_5 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O /ha) and former treatment produced significantly taller plants than rest of the treatments. Furthermore all treatments except T5 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O /ha)and T 6 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O + 15 kg S + 2.5 kg Zn/ha) were found at par to each other. At all crop growth stages the minimum pl ant height was recorded under he treatment T1 (100 kg DAP/ha) followed by T 2 (100 kg DAP + 15 kg S + 2.5 kg Zn/ha).

3. The number of tillers

Table 4.3 summarizes the results for the number of tillers per meter row length and per square meter at different growth stages.

An analysis of the data and figure showed that the administration of NPK at greater levels, either alone or in conjunction with S and Zn, improved the number of tillers at all stages compared to farmers' practices. Up until 50 DAS, the number of tillers increased quickly in all treatments as plant growth advanced. It then stayed constant until 75 DAS, at which point it gradually dropped as plant growth stages increased from 75 DAS to the harvest stage.

Crop fertilized with 180 kg N + 90 kg P_2O_5 + 60 kg K_2O + 15 kg S + 2.5 kg Zn/ha produced significantly higher number of tillers per metre row length as well as per square metre at each crop growth stages over rest of the treatments. Application of fertilizer as per farmers' practice recorded significantly lowest tillers but it was on par with treatment T2 (100 kg DAP + 15 kg S + 2.5 kg Zn/ha) at all growth stages and also with T 7 (96 kg N + 96 kg P_2O_5 + 42 kg K_2O/ha) at 50, 75 DAS and at harvest.

4. Dry matter accumulation per plant

Table 4 summarizes the data for several treatments for the amount of dry matter per plant at different growth stages. Table 4 showed that as plant growth progressed, dry matter in general increased across all treatments. It was discovered that the dry matter increased rapidly up to 50 DAS. It also significantly increased up to the 75-day stage of crop growth after 50 DAS. At every stage of crop growth, the application of NPK alone at greater rates or in conjunction with S and Zn significantly altered the amount of dry matter produced by wheat plants. (Appendix II).

At 25 DAS, the maximum dry matter accumulation was recorded under treatment T 6 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O + 15 kg S + 2.5 kg Zn/h) which was statistically at par with T 5 (180 kg N + 90 kg P_2O_5 + 60 kg K_2O /h·), T 8 (96 kg N + 96 kg P_2O_5 + 42 kg K_2O+ 15 kg S + 2.5 kg Zn /h), T 7 (96 kg N + 96 kg P_2O_5 + 42 kg K_2O /ha) and T4 (120 kg N + 60 kg P_2O + 40 kg K_2O + 15 kg S + 2.5 kg Zn/ha). The minimum dry matter accumulation was recorded under T1(100kg DAP/ha) follow by T 2(T1 + 15Kg S + 2.5 Kg Zn /h) and T3 (120 kg N + 60 Kg P_2O_5 + 40 kg K_2O/ha) and all these treatments were at par to each other.

Table 1: Effects of different treatments at 15 DAS on the number of plants per meter of row length

Treatments	15 DAS
T 1 Farmers' practice	35.3
T2 T1+ 15 kg S/ha + 2.5 kg Zn/ha	39.7
T3 RDF (120:60:40 N:P_2O_5:K_2O kg/ha)	36.8
T4 T 3+ 15 kg S/ha + 2.5 kg Zn/ha	38.9
T5 150 % of RDF	40.8
T6 T5+ 15 kg S/ha + 2.5 kg Zn/ha	39.3
T7 STCR based NPK for 40 q/ha yield target	39.7
T8 T 7+ 15 kg S/ha + 2.5 k Zn/ha	40.4
SE (m) ±	0.458
CD (at 5%)	1.402

Table 2 Effect of different treatments on wheat growth phases and plant height (cm)

Treatment	25 DAS	50 DAS	75 DAS	At harvest
T 1 Fertilizer dose as per farmers' practice (100 kg DAP/ha)	26.98	81.32	91.25	99.10
T2 T1+ 15 kg S/ha + 2.5 kg Zn/ha	29.22	82.10	95.55	99.40
T3 RDF (120:60:40 N:P_2O_5:K_2O kg/ha)	31.71	86.00	96.10	101.85
T4 T 3+ 15 kg S/ha + 2.5 kg Zn/ha	31.85	88.00	98.04	101.90
T5 150 % of RDF	33.70	89.75	98.10	103.45
T6 T_5+ 15 kg S/ha + 2.5 kg Zn/ha	33.82	90.60	98.10	105.50
T7 STCR based NPK for 40 q/ha yield target (96:96:42 N:P_2O_5:K_2O k /ha)	32.20	85.20	94.70	100.70
T8 T 7+ 15 kg S/ha + 2.5 k Zn/ha	33.00	85.70	95.55	101.75
SE (m) ±	0.492	0.801	1.647	1.384
CD (at 5%)	1.506	2.452	N/A	N/A

Table 3: Effect of different treatments on the number of tillers per meter row length at different stages of wheat growth

Treatment	25 DAS	50 DAS	75 DAS	At harvest
T 1 Fertilizer dose as per farmers' practice (100 kg DAP/ha)	156.25	190.25	190.25	177.75
T2 T1+ 15 kg S/ha + 2.5 kg Zn/ha	159.50	192.50	192	184
T3 RDF (120:60:40 N:P_2O_5:K_2O kg/ha)	171.50	197.50	197.50	187.50
T4 T 3+ 15 kg S/ha + 2.5 kg Zn/ha	171.50	198.70	198.70	188.25
T5 150°/o of RDF	172.75	199.50	199.50	189
T6 T_5+ 15 kg S/ha + 2.5 kg Zn/ha	191.50	208.75	208.75	196.50
T7 STCR based NPK for 40 q/ha yield target (96:96:42 N:P_2O_5:K_2O k /ha)	161.50	194.00	194.00	184
T8 T 7+ 15 kg S/ha + 2.5 k Zn/ha	169.50	196.00	196.00	186.75
SE (m) ±	1.75	1.58	1.60	2.04
CD (at 5%)	5.16	4.63	4.70	6.00

Table 4: Effects of different treatments on the quantity of tillers per square meter at different stages of wheat growth

Treatment	25 DAS	50 DAS	75 DAS	At harvest
T 1 Fertilizer dose as per farmers' practice (100 kg DAP/ha)	696.5	852.9	850.00	795.9
T2 T1+ 15 kg S/ha + 2.5 kg Zn/ha	710.5	855.5	853.5	812.5
T3 RDF (120:60:40 N:P_2O_5:K_2O kg/ha)	759.5	880.9	880.9	832.00
T4 T 3+ 15 kg S/ha + 2.5 kg Zn/ha	759.5	883.5	883.5	835.6
T5 150°/o of RDF	768.5	886.6	886.6	842.3
T6 T_5+ 15 kg S/ha + 2.5 kg Zn/ha	851.00	925.9	925.9	873
T7 STCR based NPK for 40 q/ha yield target (96:96:42 N:P_2O_5:K_2O k /ha)	721.5	865.7	865.7	812.5
T8 T 7+ 15 kg S/ha + 2.5 k Zn/ha	753.5	875.6	875.6	831.3
SE (m) ±	7.7	7.00	9.12	9.00
CD (at 5%)	22.9	20.6	20.9	26.7

Table 5: Effects of different treatments on the amount of dry matter accumulated by each plant at different stages of wheat growth

Treatment	25 DAS	50 DAS	75 DAS
T 1 Fertilizer dose as per farmers' practice (100 kg DAP/ha)	0.27	1.55	4.20
T2 T1+ 15 kg S/ha + 2.5 kg Zn/ha	0.31	1.83	4.28
T3 RDF (120:60:40 N:P_2O_5:K_2O kg/ha)	0.34	2.06	4.73
T4 T 3+ 15 kg S/ha + 2.5 kg Zn/ha	0.42	2.15	4.82
T5 150°/o of RDF	0.58	2.33	5.30
T6 T_5+ 15 kg S/ha + 2.5 kg Zn/ha	0.60	2.41	5.65
T7 STCR based NPK for 40 q/ha yield target (96:96:42 N:P_2O_5:K_2O k /ha)	0.45	1.87	4.43
T8 T 7+ 15 kg S/ha + 2.5 k Zn/ha	0.52	1.90	4.56
SE (m) ±	0.07	0.12	0.19
CD (at 5%)	0.21	0.35	0.56

CONCLUSION:

- The application of 150°/o RDF in conjunction with 2.5 kg Zn and 15 kg S/ha (T6) produced the highest values of the growth metrics.
- Although somewhat more affordable than treatment T 6 (180 kg N + 90 kg P2O5 + 60 kg K2O + 15 kg S + 2.5 kg Zn/ha), application of 150°/o RDF was shown to be the second best treatment, exhibiting superior growth characteristics, yield-attributing features, and grain yield.

Based on the results of this experiment, farmers can choose to implement treatment T 6 (180 kg N + 90 kg P2O5 + 60 kg K2O + 15 kg S + 2.5 kg Zn/ha) to maximize grain yield, or they can choose to implement treatment T 5 (180 kg N + 90 kg P2O5 + 60 kg K2O /ha), which has the highest net returns.

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