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Effect of NPK and Growth Regulators on Yield Attributes of Wheat (*Triticum aestivum* L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present experimental study was carried out during *Rabi* season 2020-21 at Instructional farm, BTC College of Agriculture and Research station, Bilaspur (C.G.). The soil of the experimental field was clay in texture. The wheat Var. HI-1544 was grown and treatments were replicated three times in randomized block design. The experiment consists of nine treatments The crop was sown on 11th November, 2020 and harvesting was done on 24th March, 2021.The result revealed that maximum yield parameters the significantly higher grain (45.55 q ha^{1}) and straw (46.45 q ha^{-1}) yields were observed under the treatment 150 % RDF NPK + Two spray of growth regulator at first node (35 DAS) and boot leaf stage (60 DAS) (T_9). Further, among the nutrient management treatment, significantly maximum grain and straw yield up to (43.65q ha^{-1}) and (46.35q ha^{-1}) respectively were recorded under150 % RDF NPK (T_6). However, the treatment (T_9) was statically similar with the treatment (T_6). The improvement in yield attributes and yield of wheat was recorded with the application of 150 % RDF NPK + Two spray of growth regulator at first node (35 DAS) and boot leaf stage (60 DAS) (T_9) which was at par with the application of 150 % RDF NPK (T_6). Treatment (T_9) assigned yield advantage of 21.19 % and 21.52 % in grain and straw yield respectively as compared to 150 % RDF NPK (T_6).

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1. INTRODUCTION

"Wheat (*Triticu aestivum* L.) is the frist important and strategic cereal crop for the majority of world's populations. It is the most important staple food of about two billion people (36 percent of the world population). Wheat provides nearly 55 percent of the carbohydrates and 20 percent of the food calories consumed globally" (Graur et al.,1995). "India's 2020-21 wheat production stood at 107.6 million MT. up 3.9 percent from the period last year and higher in at least last five marketing seasons. Similarly, India's wheat ending stocks were seen at 27.5 million MT in 2020-21, the highest in last five years" (USDA-2021).

"Wheat grain contains all essential nutrients; kernel contains about 12 percent water, including carbohydrates (60-80 percent mainly as starch), proteins (8-15 percent), fats (1.5-2 percent), minerals (1.5-2 percent), vitamins (such as B complex, vitamin E) and 2.2 percent crude fibers. Wheat is grown only in the Rabi season (winter). Major wheat-producing states in India are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Chhattisgarh and Rajasthan" [1].

"Wheat is the important crop of Chhattisgarh state the cropping system of the state is mainly rain dependent. In Chhattisgarh, wheat occupies average of 3.6 million ha. with the productivity of the state ranging between 1.2 to 1.6 t ha-1 depending upon the rainfall. The agricultural economy of Chhattisgarh like India depends largely on food grains production" [2].

"Among various agronomic manipulations, application of nitrogen is one of the important factors which influence the grain yield and the quality of wheat. Plants take up most of their nitrogen as the Nitrogen (NO3-) is necessary for chlorophyll synthesis as a part of the chlorophyll molecule, involved in photosynthesis and constituent of all amino acids and protein which are considered responsible for quality of wheat. Nitrogen application rate and timing are very important for yield and quality of wheat. The yield responses of different cultivars vary widely under different nitrogen management" (Hariram, et al. 2017).

"Optimum dose of nitrogen, split application of fertilizer has a decisive effect on the yield of Wheat. Judicious application of fertilizer is one of the most effective means for maximum yield of wheat. The fact is that wheat plants require more nutrients to produce more yields. Yield increase (70-80 percent) of field wheat could be obtained by the application of nitrogen fertilizer. Nitrogen is one of the major nutrients" [3].

"Fertilizer application is required to replace crop land nutrients that have been consumed by previous plant growth. an average wheat and rice crops sown alternately cause losses of 600 kg ha-1 of NPK fertilizers from soil. It is also essential for economic yields" (Singh 2014). "Efficient application of the correct amounts of fertilizers for the supply of the nutrients is an important part of achieving profitable yields. The profit potential for farmers depends on producing enough crops per acre to keep production costs below the selling price. Moreover, optimizing fertilizer will help us preventing environmental effects like water pollution and health effects" [4].

"Efficient nitrogen (N) fertilization is crucial for economic wheat production and the protection of ground and surface waters. Nitrogen fertilizer rate and timing are the major tools available after planting for manipulating wheat growth and development to produce a greater grain yield per unit area and such as intensive management systems is to increase N fertilizer rates and control lodging with PGRs ultimately to increase grain yields" (Gupta et al 2019).

"Plant growth regulators (PGRs) are widely used for lodging control in winter wheat (*Triticum aestivum* L.) grown at high N dose. Although an introduction of semi-dwarf wheat cultivars have largely solved the problem of lodging, evidence was already accumulating that the timely application of a growth retardant such as chlormequat (CCC) or ethephon could increase the grain yield of wheat, by the alteration of dry matter partitioning independently of any control of lodging" [5].

"Potential use of plant growth regulators (PGRs) and related compounds minimize thelodging as they reduce the plant height. The synthetic PGRs such as chlormequat chloride (CCC), ethephon, rinexepac-ethyl and prohexadione calcium can minimize lodging risk by reducing stem elongation. Chlormequat and ethephon are the common PGRs which are often used to limit lodging in wheat" [6].

2. MATERIALS AND METHODS

Field experiment was carried at the Research Farm, BTC College of Agriculture and Research

station, Bilaspur, Chhattisgarh during rabi season of 2020-2021.The experiment was laid out in randomized block design with three replications. The treatment comprised of absolute control (T1),50% RDF NPK (T2), 75% RDF NPK (T3), 100% RDF NPK (T4), 125% RDF NPK (T5), 150% RDF NPK (T6), 100% RDF NPK + Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS) (T7), 125% RDF NPK + Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS), (T8),150% RDF NPK + Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS) (T9), Recommended dose of fertilizers 120:60:40 kg of N, P2O5,K2O ha-1 respectively and growth regulators were applied. A basal dose P at 60 kg P2 O5 and 40 kg K2O ha-1 was applied in the form of single super phosphate and muriate of potash respectively. Wheat (variety HI-1544) was sown on 11 November 2020 using a seed rate of 100 kg ha-1 lines. In case of line sowing seeds were sown at row spacing of 20 cm apart. The crop was harvested on 24 March 2021, after attaining physiological maturity.

The soil of experimental field was neutral in reaction 6.9 and clay (vertisol) in texture. The soil was categorized as medium inorganic carbon (0.75%), low in available nitrogen (275 kg ha-1) and medium in available phosphorus (13.52 kg ha-1) and Potassium content (268 Kg ha-1) Total mean weekly rainfall of 7.01 mm was received in cropping season. Other weather condition remained almost favorable for growth parameter and yield attributes, harvest index were recorded, tabulated and analyzed statistically.

3. RESULTS AND DISCUSSION

3.1 Yield Attributing Parameters

The number of grain ear-1 and test weight were augmented significantly due to increased supply of fertilizer and growth regulators treatments. (Table 1) Maximum number of seeds (36.99 ear-1 head), weight of grains ear-1 (2.56 g), test weight (41.71 g) was recorded in treatments except treatment T6, T8, T7, T5, and T4, T3, T2, T1, The treatment 150% RDF (T6) attained the second best position with respect to encourage yield attributing parameters. The minimum number of grain (28.20 ear-1 head), weight of grains ear-1 (1.38g), test weight (35.62) were recorded in treatment Absolute control (no fertilizers and no growth regulators spray) (T1). Result confirmed by the Combined application of 150% RDF + with Lihocin + Tebuconazole gave significantly higherseed yield of wheat Singh et al. [7].

maximum Seed yield (45.55ha-1), denoted T-9 150% RDF NPK + Two spray of Growth regulator at first node (35 DAS) & boot leaf stage and The minimum seed yield (19.10 ha-1) were recorded in treatment Absolute control (no fertilizers and no growth regulators spray) (T1) (Table 2) [8-11]

Table 1. Effect of NPK and growth regulators on spike length, number of grains, test weight of wheat

Treatment	Details	Spike length (cm)	Number of seeds Ear^{-1} head	Grain weight Ear^{-1} head (g)	Test weight (g)
T_1	Absolute control	.77	28.20	1.38	35.62
T_2	50% RDF NPK	7.88	29.33	1.81	38.38
T_3	75% RDF NPK	8.15	31.04	1.69	38.76
T_4	100% RDF NPK	8.36	32.31	1.87	39.23
T_5	125% RDF NPK	9.28	34.92	2.10	39.45
T_6	150% RDF NPK	9.61	36.25	2.06	41.68
T_7	100% RDF NPK + Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	8.48	33.14	1.92	40.00
T_8	125% RDF NPK + Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	9.50	35.16	2.18	41.38
T_9	150% RDF NPK + Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	9.64	36.99	2.56	41.71
	SEm (±)	0.34	0.92	0.29	0.95
	CD (P=0.05)	1.02	2.76	0.87	NS

Table 2. Effect of NPK and growth regulators on grain yield, straw yield, harvest index of wheat

Treatment	Details	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest Index (%)
T_1	Absolute control	19.10	31.02	38.10
T_2	50% RDF NPK	32.22	43.59	42.50
T_3	75% RDF NPK	33.22	44.52	42.58
T_4	100% RDF NPK	38.06	41.66	47.74
T_5	125% RDF NPK	41.22	47.98	47.98
T_6	150% RDF NPK	43.65	46.35	48.50
T_7	100% RDF NPK + Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	38.23	43.72	46.65
T_8	125% RDF NPK + Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	42.00	46.18	48.27
T_9	150% RDF NPK + Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	45.55	46.45	49.51
	SEm (±)	0.62	0.57	-
	CD (P=0.05)	1.86	1.71	-

Table 3. Effect of NPK and growth regulators on cost of cultivation, gross return, net return

Treatment	Details	Cost of cultivation (Rs.ha^{-1})	Gross return (Rs.ha^{-1})	Net return (Rs.ha^{-1})
T_1	Absolute control	27330	41420.5	14090.5
T_2	50% RDF NPK	30843	68561.5	37618.5
T_3	75% RDF NPK	31118	70626.5	38508.5
T_4	100% RDF NPK	33723	79514.5	45791.5
T_5	125% RDF NPK	34765	86545.5	51780.5
T_6	150% RDF NPK	36157	90978.75	54821.75
T_7	100% RDF NPK + Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	33991	801507	46159.7
T_8	125% RDF NPK + Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	35098	87777	52679
T_9	150% RDF NPK + Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	37437	94651.25	57314.25
	SEm (±)	-	-	-
	CD (P=0.05)	-	-	-

3.2 Productivity Parameters

3.2.1 Economical returns

Amongst the application of 150% RDF + growth regulators at first node (35 DAS) & boot leaf stage (60 DAS) mention Table 3 gave the maximum net return up to (57314.25 ₹ ha-1 which gave 54821.75, 52679, 51780.5, 46159.7, 45791.5, 38508.5, 37618.5,14090.5 ha-1 net return and respectively. The highest gross (94651.25 ₹ ha-1) in the treatment (T9) is the reason for maximum net return application of 150% RDF + growth regulators at first node (35 DAS) & boot leaf stage (60 DAS) were result confirmed by Sachin Singh et al. (2018).

4. CONCLUSION

Yield attributes, application of nutrient and growth regulators treatment also has pronounced effect on yield of wheat. The grain yield of wheat was significantly greater in treatment (T_9) in which 150% RDF + growth regulators was applied. The maximum grain (45.55 q ha^{-1}) and straw (46.54 q ha^{-1}) yield was obtained in treatment receiving 150% RDF+ growth regulators at first node(35 DAS) & boot leaf stage (60 DAS) as compared with other treatment, while it was at par with the treatments

T_6, T_8, T_5, T_7, and T_4, T_3, T_2, T_1 The application of 150% RDF (T_6) result in significantly higher grain and straw yield up to 43.65q ha^{-1} and 46.35 q ha^{-1} and is the second best treatment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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