Effect of NPK and growth regulators on growth and productivity of wheat (*Triticum aestivum* L.)

ABSTRACT

Th present study highlights the effect of NPK and growth regulators on growth and productivity of wheat (*Triticum aestivum* L.). Wheat is one of the most important and widely grown food crops with over 25000 different cultivars. The exploration 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 site was clayed in texture. The wheat (Var. HI-1544) was grown and treatments were replicated three times in randomized block design. The experiment consists of twelve treatments The crop was sown on 11 November, 2020 and harvesting was done on 24 March 2021.The result that higher grain (45.55 q ha^{-1}) and straw (46.45 q ha^{-1}) yield were observed under the treatment 150% RDF + Two spray of growth regulator at first node(35 DAS) & boot leaf stage (60 DAS) (T9). The improvement in yield of wheat was recorded with the application of 150% RDF + Two spray of growth regulator at first node(35 DAS) & boot leaf stage (60 DAS) (T9) which was at par with the application of 150% RDF (T6). Treatment (T9) assigned yield advantage of 21.19% and 21.52% in grain and straw yield respectively as compared to 150% RDF (T6) and Absolute control (T1).The result of the present study came to the conclusion that the application of 150% RDF+ growth regulators through fertilizer is essential to get higher production output and profit from wheat cultivation and reduce the risk.

Key words- NPK,PGR growth and productivity on Wheat(*Triticum aestivam* L.)

INTRODUCTION

Wheat (*Triticuaestivum* L.) is the first and most important cereal crop for most people in the world. It is the most important staple food for about two million people (36% of the world) worldwide, wheat provides about 55% of carbohydrates and 20% of calories consumed worldwide (Graur et al., 1995). 2020-21 wheat production in India at 107.6 million mt. increased by 3.9% from last year and at least in the last five years of advertising. Similarly, India's end of wheat stocks are projected at 27.5 million mt by 2020-21, the highest figure in the last five years. (USDA-2021). “Wheat is one of the most important and widely grown food crops with over 25000 different cultivars” (Sapone *et al.*2012). “Wheat is an annual grass that grows to between ½ to 1¼ m in height, with a long stem that ends up in a cluster of dried kernels covered with bearded heads” (Smith 2010). “Wheat grains contain all the essential nutrients; The kernel contains about 12% water, including carbohydrates (60-80%) mainly as starch), proteins (8-15%) and all essential amino acids (except lysine, Tryptophan and methionine), fats (1.5-2%), minerals (1.52%), vitamins (such as B complex, vitamin E) and 2.2% raw fibers. Wheat is only planted during the Rabbi (winter) season. The major wheat producing regions of India are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Chhattisgarh and Rajasthan” (Nachit 1992)

“Wheat is the important crop of Chhattisgarh region the state's farming system is heavily reliant on rainfall. Wheat is a major crop farmed on about 44 million hectares of land in the country, with a yield of 2.2 tonnes per hectare, which is lower than that of many other countries.The country's annual population growth rate is roughly 1.8% and if per capita wheat consumption is 400-410g per day, the demand for wheat in 2025 would be 130 million tonnes. Wheat is grown on an average of 3.6 million hectares in Chhattisgarh, with state productivity varying from 1.2 to 1.6 tonnes ha^{-1} depending on rainfall.The agricultural economy of Chhattisgarh like India depends largely on food grains production” (Shrivastava, *et al.*, 2015)

MATERIALS AND METHODS.

Location and Experimental site

The experiment was conducted during *Rabi*, 2020 at ResearchFarm of BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh India. during *Rabi* season (11 November to 24 March) of 2021. Bilaspur is located at 22˚09’ N latitude and 82˚15’ E longitude and located at an altitude of 298 m above the mean sea level. [The region falls under the Eastern plateau and hill region (Ago-climatic zone-7) of India]. Chhattisgarh state is classified into three agro-climatic zones, of which Bilaspur comes under the Chhattisgarh plains zone of the state.

Weather conditions of Experimental site

The experimental site comes under the seventh Agro-climatic zone of the country ie., Eastern Plateau and Hills and is termed as sub humid with hot summer and cool winter. Average (80 per cent) rainfall at the experimental site is 1503 mm (based on 80 years mean) per annum, most of the rainfall (85%) occur from June to September. Temperature varies from 37.9°C in summer and 8.5°C in winter. May and December are the hottest and coolest month respectively.

Physico-chemical characteristics of the soil

In order to evaluate the physico-chemical properties and nutrient status of the soil, ten samples were collected randomly from the experimental plot area at 0-15cm depth with the help of the soil auger and a composite sample was made for mechanical and chemical analysis of the soil. The data on physico-chemical properties of experimental site are presented in Table 1. The soil texture of soil, of experimental field was clay soil (Vertisols) locally known as kanhar. The soil was neutral in pH reaction. It had medium in organic carbon, low in nitrogen and medium in phosphorus and potassium contents.

Dry matter accumulation(g plant^{-1})

In order to get dry matter production, five plants in each plot from the second row were carefully uprooted and the dry weight was taken in an interval of 30, 60, 90 DAS and at harvest. Plants taken from randomly-fixed sampling row were air-dried and then oven-dried at 65^{0}C for 48 hours at different crop growth stages. The average dry weight plant^{-1} was worked out and was expressed in grams.

Crop growth rate(g plant $^{-1}$ day^{-1})

It denotes the overall growth rate of the crop per unit time, irrespective of the previous growth rate. The mean crop growth rate was calculated with the help of the following formula (Watson *et al.*, 1963):

Crop growth rate g day^{-1}plant^{-1}

$$= \left(\frac{W_2-W_1}{T_2-T_1} \right) \times \left(\frac{1}{S} \right)$$

$W_2$and W_1 are the total dry weight (g) of plants at the time T_2 and T_1, respectively S is land area (m^2) occupied by plants

Relative growth rate (g g^{-1} day^{-1})

It is an index of the amount of growing material per unit dry weight of plant per unit time. It is also called efficiency index. RGR is the mean relative growth rate in mg/g dry matter/day. The mean relative growth rate was worked out with the following formula (Watson *et al.*, 1963):

Relative growth rate $g^{-1}day^{-1}plant^{-1}$

$$= \frac{LnW_2 - LnW_1}{T_2 - T_1}$$

Where,

LnW_1 and LnW_2 are natural logarithm of total dry weight of $plant^{-1}$ at the time interval T_1 and T_2.

Table:1.Physico-chemical characteristics of the soil (0-15 cm depth)

S. No.	Soil property	Values	Class	Method employed
A.	**Physical**			
(i)	Partical size distribution Composition			International pipette Method (Piper, 1965)
	a. Sand (%)	24.32	Clay (Vertisols)	
	b. Silt (%)	22.72		
	c. Clay (%)	51.86		
(ii)	Bulk density, Mg m^{-3}	1.34		Soil core method (0-10cm)(Black, 1965)
B.	**Chemical**			
1.	Organic carbon (%)	0.75	Medium	Walkley and black's rapid titration method (Jackson, 1976)
2.	Available N (kg ha^{-1})	275	Low	Alkaline permanganate method (Subbaiah and Asija, 1956)
3.	Available P (kg ha^{-1})	13.75	Medium	Olsen's method (Olsen, et al., 1954)
4.	Available K (kg ha^{-1})	268	Medium	Flame photometric method (Jackson, 1973)
5.	PH (1:2.5) soil: water	6.9	Neutral	Glass electrode pH meter (Piper, 1965)
6.	EC (dSm^{-1} at 25^0C)	0.21	Low	Solubridge conductivity method (Black, 19

RESULT &DISCUSSION

Data collected from the experimental field for various growth and yield parameters of wheat were analysed statistically and results have been discussed in present chapter.

Pre harvest observation

1. Plant population (m^{-2})

The data on plant population was recorded at 30 DAS and at harvest are presented in table.1 and depicted in fig.1 the treatment failed to cause significant variation in the plant population as recorded at 30 DAS and at harvest stage Application of fertilizer and growth regulators in combination with each other did not cause significant variation in plant stand establishment of wheat during both the period of observations. However among the treatment plots, highest plant population of 139.39 and 136.74 at 30 DAS and at harvest stage respectively was recorded with the application 150% RDF + growth regulators (T6) followed by application of 150% RDF (T6) and the minimum number of plant population per square meter (viz., 109.34 and 96.54 at

30DAS as well as harvest time) was recorded in Absolute control (T1).

Table:2.Effect of NPK and growth regulators on plant population at 30 DAS and at harvest

Treatments		Plant population, m^{-2}	
		30 DAS	At harvest
T1	Absolute control	109.34	96.54
T2	50% RDF NPK	111.49	108.16
T3	75% RDF NPK	115.18	115.42
T4	100% RDF NPK	125.78	123.78
T5	125% RDF NPK	129.39	125.51
T6	150% RDF NPK	137.43	130.67
T7	100% RDF NPK + Two spray of growth GR's at first node (35 DAS) & boot leaf stage (60 DAS)	128.67	125.67
T8	125% RDF NPK + Two spray of growth GR's at first node(35 DAS) & boot leaf stage(60 DAS)	130.31	126.51
T9	150% RDF NPK + Two spray of GR's at first node(35 DAS) & boot leaf stage (60 DAS)	139.39	136.74
	SEm (±)	0.99	1.22
	CD (P=0.05)	NS	NS

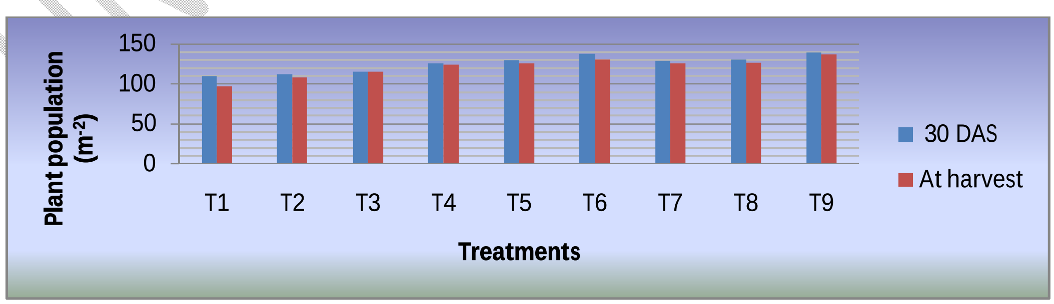

Fig: 1. Effect of NPK and growth regulators on plant population (m^{-2}) at 30 DAS and at harvest

2. Plant height (cm)

The pant height is an important growth characteristic directly linked with the production potential of plants in terms of biological and grain yield. The data on plant height was recorded periodically at 30, 60, 90 DAS and finally at harvest as depicted in table 3.and fig 3.The plant height in general, under different nutrient management was minimum at 30 DAS, but increased correspondingly during 60 DAS and there after increase in plant height was observe steadily up to 90 DAS, but at harvest there was minimal decline in plant height perpetually in all the treatment.It is evident from the data that the growth of wheat in terms of plant height varied significantly due to application of NPK and growth regulatorsduring all stage of crop growth except at 30 DAS.

Among the treatment, the maximum plant height was recorded with the application of 150% RDF which was at par with the application of T7, T9, T8, T5, and it was significantly superior over the other treatment at all stages of observation. The height of plants was recorded least with the application of Absolute control (T1),

At 30 DAS, signification height plant (32.87 cm) was recorded under the treatment (T6) where 150% RDF was applied through urea, SSP and MOP as compared to T5, T4, T3, T2, T1, However, treatment T7, T9, T8, were found at par with the treatment (T6) at 30 DAS.At 60 DAS, 90 DAS and at harvest also, 150% RDF (T6) significantly increased the plant height over Absolute control (T1) plant height at 60 DAS 90 DAS and at harvest exhibited almost similar trend as observed at 30 DAS.

Shekoofa*et al.,* (2008) Application of Nitrogen levels (0, 100 and 200 kg ha^{-1}) were the main plots. The N was applied as Urea (46percent N), half at the time of stem elongation and the other half at onset of flowering. The PGR treatments included CCC at 2.20 kg ha^{-1} applied at Zadoks growth stage (ZGS) 25, ethephon at 0.28 kg ha^{-1} at Zadoks growth stage (ZGS) 39, and controls (without any PGR) were assigned the results showed that both PGR treatments reduced the plant height

Table: 3. Effect of NPK and growth regulators on plant height (cm)					
		Plant height (cm)			
	Treatment	30 DAS	60 DAS	90 DAS	At Harvest
T1	Absolute control	26.37	65.04	80.62	85.17
T2	50% RDF NPK	28.23	69.99	85.11	87.60
T3	75% RDF NPK	29.06	70.40	88.61	90.43
T4	100% RDF NPK	30.63	72.48	93.91	95.09
T5	125% RDF NPK	31.17	73.12	97.54	99.27
T6	150% RDF NPK	32.87	79.27	99.60	101.53
T7	100% RDF NPK +Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	28.27	70.46	87.07	91.21
T8	125% RDF NPK +Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	29.27	72.41	88.21	94.89
T9	150% RDF NPK +Two spray of growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	31.40	75.29	89.86	97.22
	SE (m±)	0.50	0.76	0.92	1.65
	CD (P=0.05)	1.51	2.28	2.78	4.96

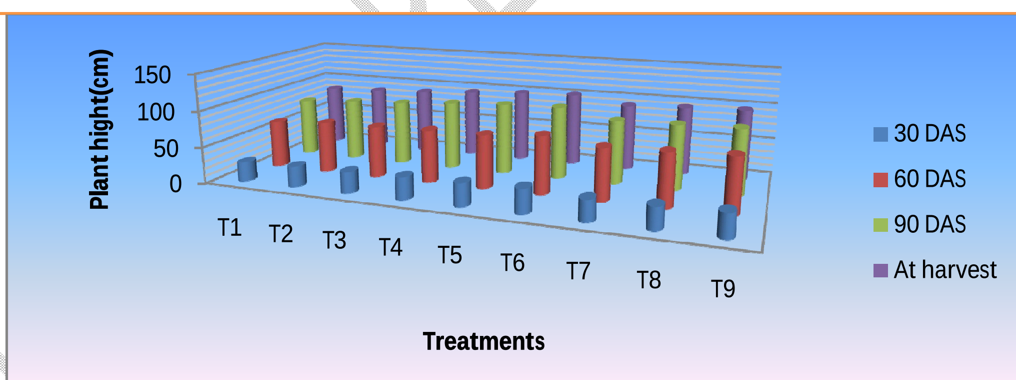

Fig: 2.Effect of NPK and growth regulators on plant height (cm) wheat at 30, 60, 90 DAS and at harvest

3. Number of active leaves plant^{-1}

The data on number of leaves hill^{-1} recorded at 30, 60 and 90 day after sowing are recorded in table. Significant differences in number of green leaves hill^{-1} were recorded among the treatment (Table 4 and fig 3)The number of green leaves hill^{-1} progressively increased up to 60 DAS. The results showed that the application of recommended doses of fertilizer significantly higher number of green leaves hill^{-1} at 30 and 60 DAS. (T9) at 30 DAS and (T9) at 60 DAS produced the lowest number of green leave hill^{-1} (T1) was best treatment after (T9) with respect to green leaves hill^{-1} at 30 and 60 DAS.As regards the effect of combination NPK and growth regulators, it is evident that application of fertilizers and growth regulators accelerated the number of green leaves hill^{-1} significantly compared to other treatment at all the growth stage of crop. Application of 150% RDF + growth regulators resulted in significantly the maximum number of leaves viz. 12.53 and 27.78 hill^{-1} during 30 and 60 DAS compared to those observed in rest of the treatment combination. Such response can be attributed to the adequate nitrogen availability which might facilitate growth and development of the plants, resulting in a greater number of leaf productions. The minimum number of green leaves was recorded in treatment the minimum number of green leaves was recorded in treatment (T1) in which Absolute control treatment

Table: 4.Effect of NPK and growth regulators on Number of active leaves in wheat.

	Treatment	Number of active leaves, plant^{-1}	
		30 DAS	**60 DAS**
T1	Absolute control	6.66	18.60
T2	50% RDF NPK	8.53	20.94
T3	75% RDF NPK	8.99	22.91
T4	100% RDF NPK	9.45	24.58
T5	125% RDF NPK	10.38	26.50
T6	150% RDF NPK	12.31	27.34
T7	100% RDF NPK +Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	9.62	25.19
T8	125% RDF NPK +Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	11.33	26.67
T9	150% RDF NPK +Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	12.53	27.78
	SE (m±)	0.62	0.66
	CD (0=05)	1.86	1.98

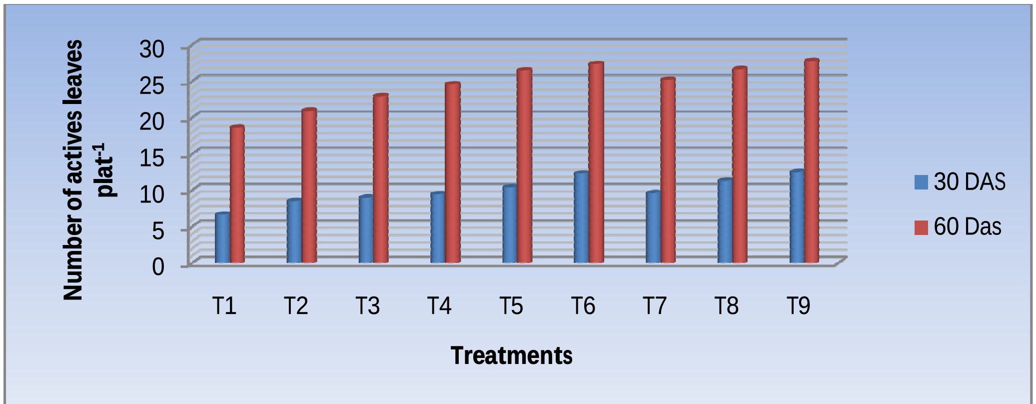

Fig: 3. Effect of NPK and growth regulators on Number of active leaves plant^{-1} of wheat at 30, 60 DAS.

4. Number of tillers (m^2)

Data on number of tillers of wheat were recorded at 30, 60, 90 DAS and at harvest (Table 5.) and depicted in figure 4. The effect of NPK and growth regulators were significantly affected the number of tillers at all the growth stages of crop. Irrespective of the treatments, number of tillers increased up to 90 DAS and slightly declined at harvest. At 30 DAS, among the application 150% RDF + growth regulators (T9) produced the significantly higher number of tillers as compared to other treatments and result was recorded at 60 DAS under 150% RDF and growth regulators.(T9). At 90 DAS and at harvest, application of 150% RDF + growth regulators (T9) produced the higher number of tillers, which was at par with the 150% RDF (T6) and was significantly superior over the other treatments. Treatment 150% RDF + growth regulators (T9) had higher dose of nutrient and growth regulators i.e. 25% higher which might help to form tiller, plants need energy and abundance of water and nutrient which will positively affect the yield.

Table: 5 Effect of NPK and growth regulators on number of tillers m-^{2}

Treatment		Numbers of tillers, m^{-2}			
		30 DAS	60 DAS	90 DAS	At Harvest
T1	Absolute control	120.23	159.37	285.45	289.92
T2	50% RDF (NPK)	138.33	264.03	300.41	304.81
T3	75% RDF (NPK)	168.96	285.94	315.53	316.07
T4	100% RDF(NPK)	190.96	309.49	350.25	354.10
T5	125% RDF (NPK)	195.11	340.26	390.15	395.91
T6	150% RDF (NPK)	199.27	345.80	404.64	406.37
T7	100% RDF (NPK) +Two spray of GR'sat first node (35 DAS) & boot leaf stage (60 DAS)	191.30	310.85	350.78	359.68
T8	125% RDF NPK +Two spray of GR's at first node(35 DAS) & boot leaf stage(60 DAS)	197.63	341.38	395.08	402.92
T9	150% RDF NPK + Two spray of GR's at first node(35 DAS) & boot leaf stage (60 DAS)	202.84	348.57	405.22	408.67
SEm(±)		4.06	4.05	2.49	2.40
CD (P=0.05)		12.04	12.12	7.47	7.21

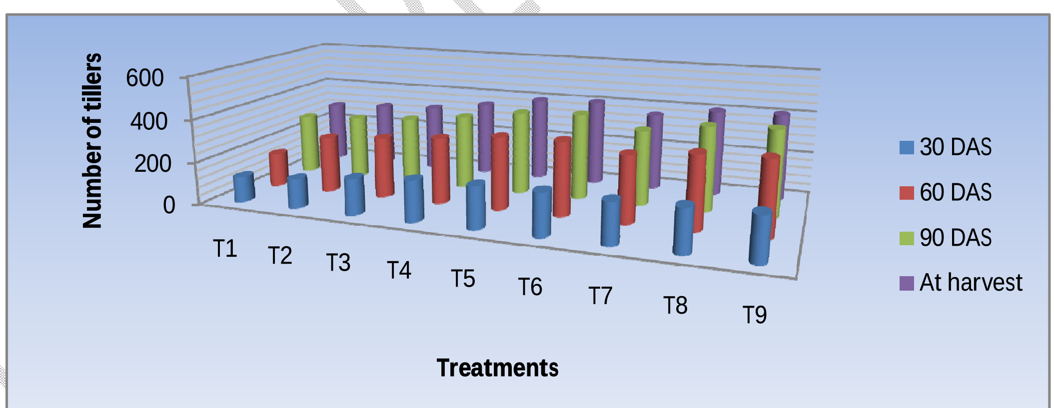

Fig: 4. Effect of NPK and growth regulators on number of tillers (m^{-2}) of wheat at 30, 60, 90DAS and at harvest

5. Dry matter accumulation (g plant^{-1})

From the table, it could be seen that at 30 DAS dry matter accumulation did not reach to level of significance. However in 60, 90 DAS and at harvest significant results were found. The highest dry matter was accumulated (viz., 0.44, 11.26, 21.48 and 49.15 in treatment receiving 150% RDF + growth regulators (T9), being significantly superior over other treatments. The minimum amount of dry matter was accumulated by plants treated with Absolute control (T1).

Table : 6 Effect of NPK and growth regulators on dry matter Accumulation (g plant^{-1})

Treatment		Dry matter accumulation (g plant^{-1})			
		30 DAS	60 DAS	90 DAS	At Harvest
T1	Absolute control	0.20	5.77	10.67	29.33
T2	50% RDF NPK	0.29	6.83	13.01	35.15
T3	75% RDF NPK	0.30	7.57	14.33	39.59
T4	100% RDF NPK	0.37	8.87	15.17	43.37
T5	125% RDF NPK	0.39	10.13	16.49	45.88
T6	150% RDF NPK	0.41	11.08	20.56	48.16
T7	100% RDF NPK +Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	0.38	9.52	17.12	44.82
T8	125% RDF NPK +Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	0.40	10.23	18.17	46.73
T9	150% RDF NPK +Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	0.44	11.26	21.48	49.15
SEm (±)		0.016	0.016	0.89	1.14
CD (P=0.05)		0.05	0.04	2.67	3.42

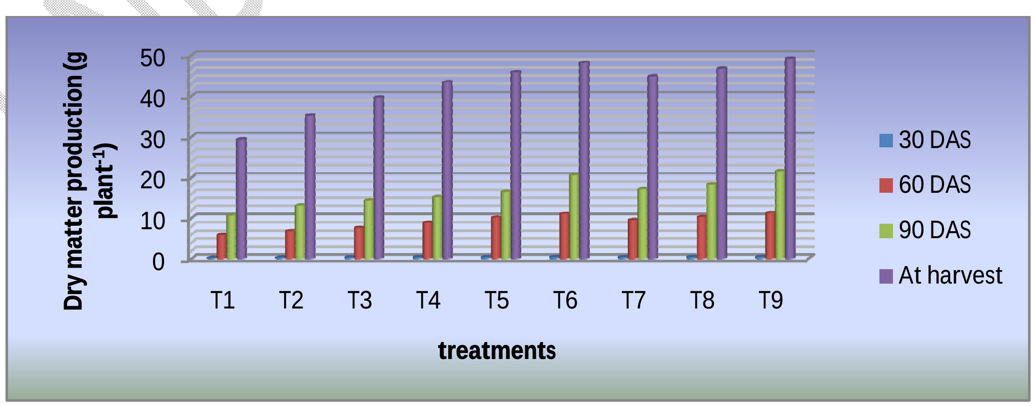

Fig: 5.Effect ofNPK and growth regulators on dry matter accumulation (g plant^{1}) at 30,60,90 DAS and at harvest.

6. Crop growth rate(g day^{-1} plant^{-1})

Crop growth rate of wheat was calculated between 30-60 and 60-90 DAS and 90 DAS – harvest intervals (Table 7 and depicted in Figure 6). The higher crop growth was recorded at 30-60 DAS interval, there after growth rate almost declined till maturity. Highest crop growth rate was observed under 150% RDF NPK + growth regulators (T9) at 30-60, 60-90 and 90 DAS - harvest. Lower crop growth rate was observed under absolute control treatment (T1)

Table:7 Effect of NPK and growth regulators on crop growth rate

Treatment		**Crop growth rate (g plant^{-1} day^{1})**		
		30 – 60 (DAS)	60 – 90 (DAS)	90 (DAS) – At harvest
T1	Absolute control	0.134	0.389	0.504
T2	50% RDF NPK	0.199	0.400	0.510
T3	75% RDF NPK	0.204	0.421	0.521
T4	100% RDF NPK	0.224	0.445	0.525
T5	125% RDF NPK	0.260	0.469	0.554
T6	150% RDF NPK	0.287	0.488	0.578
T7	100% RDF NPK +Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	0.231	0.453	0.535
T8	125% RDF NPK +Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	0.272	0.479	0.562
T9	150% RDF NPK +Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	0.297	0.499	0.584
	Mean	**0.234**	**0.449**	**0.541**

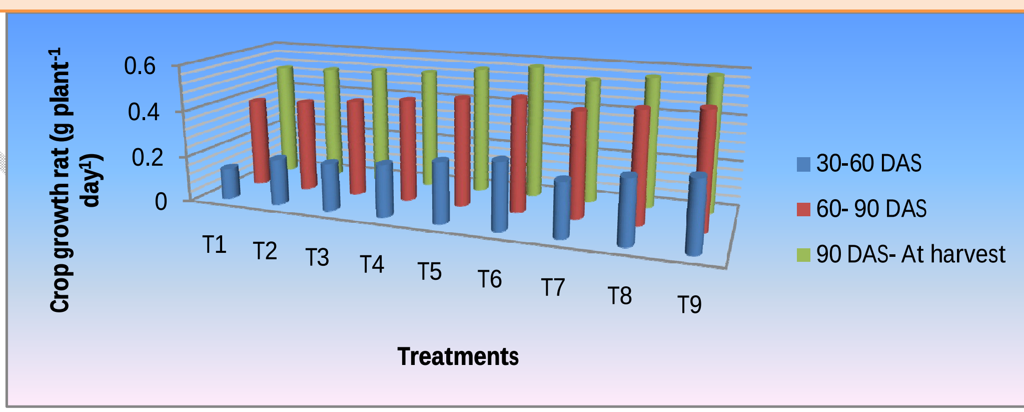

Fig: 6. Effect ofNPK and growth regulators on crop growth rate(g plant^{-1} day^{1}) (g plant^{-1}) at 30, 60, 90 DAS and at harvest

7. Relative growth rate (g g^{-1} day^{-1})

Relative Growth Rate (g $plant^{-1}$) of wheat effect ofNPK and Growth regulators treatment are presented in Table 8. depicted in Figure 7. revealed that higher relative growth rate was recorded by150% RDF NPK +Growth regulators (T9) and lower relative growth rate was observed Absolute control (T1) treatment at 30-60 DAS. At 60-90 DAS treatment 150% RDF NPK(T6) recorded the higher relative growth rate and (T1)recorded the lower relative growth rate. At 90 DAS – at harvest treatment 150% RDF + growth regulators (T9) had the higher relative growth rate and lowest relative growth rate was observed under absolute control treatment (T1)

Table : 8. Effect of NPK and growth regulators on Relative growth rate

Treatment		Relative growth rate (g g^{-1} day^{-1})		
		30 – 60 (DAS)	60 – 90 (DAS)	90(DAS) – At harvest
T1	Absolute control	0.014	0.040	0.0029
T2	50% RDF NPK	0.017	0.050	0.0031
T3	75% RDF NPK	0.019	0.054	0.0034
T4	100% RDF NPK	0.020	0.058	0.0035
T5	125% RDF NPK	0.022	0.055	0.0035
T6	150% RDF NPK	0.024	0.067	0.0037
T7	100% RDF NPK +Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	0.021	0.061	0.0036
T8	125% RDF NPK +Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	0.023	0.066	0.0036
T9	150% RDF NPK +Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	0.025	0.068	0.0038
	mean	0.0205	0.0581	0.00345

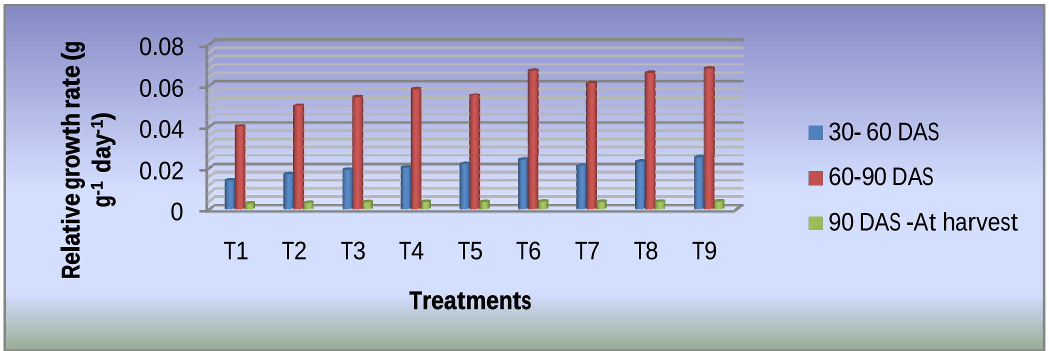

Fig: 7. Effect of NPK and growth regulators on Relative growth rate (g g^{-1} day^{-1})wheat at 30, 60, 90 days after sowing and at harvest

Post harvest observation

1. Grain yield (q ha^{-1})

Data on grain yield of wheat which were recorded at harvest (Table 9) and depicted in figure.8. The effect of NPK and regulators were significantly affected by the grain yield at harvest of crop. At harvest, among The application 150% RDF + growth regulators (T9) (45.01) had the higher grain yieldwhich was at par with 150% RDF (T6) (43.65) and the lowest grain yield was obtained under absolute control (T1) (19.10).

The grain yield was higher under 150% RDF + growth regulators was also less which results in higher plant population which followed with higher number of tiller and thus results in higher grain yield. These results were confirmed with the findings of the Tripathi and Chauhan (2000), Nayak and Nadagouda (2015) and Kumar *et al.*, (2016)

2. Straw yield (q ha^{-1})

Data on straw yield of wheat which were recorded at harvest (Table 9) and depicted in figure.8. The effect of NPK and growth regulators were significantly affected by the straw yield at harvest of crop. At harvest, among the application 150% RDF+ growth regulators (T9) had the higher straw yield which was significantly superior over the other treatments and the lower straw yield was observed under absolute control (T1).

The higher straw yield it might be due to the treatment got 150% higher dose of RDF and growth regulators, results in higher plant population, which followed the steps for more tiller which followed more grain yield and thus resulted in higher grain yield. These results were confirmed by the findings of the Sharma *et al.*, (2013) and Singh *et al.*, (2016).

3. Biological yield(q ha^{-1})

Data on biological yield of wheat which were recorded at harvest (Table 9) and depicted in figure.8 the effect of combination NPK and growth regulators were significantly affected by the biological yield at harvest of crop. At harvest, among the application 150% RDF + growth regulators (T9) had the higher straw yield which was significantly superior over the other treatment and the lover biological yield was observe under absolute control (T1).

4. Harvest index (%)

Data on harvest index of wheat which were recorded at harvest (Table 9) and depicted in figure 8. 150% RDF+ growth regulators (T9) (48.90) had the higher harvest index and absolute control (T1) (38.10)had the lower harvest index.

Table: 9. Effect of NPK and growth regulators on grain yield (q ha^{-1}), straw yield (q ha^{-1}), biological yield (q ha^{-1}) and harvest Index (%)

Treatment		Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest Index (%)
T1	Absolute control	19.10	31.02	50.12	38.10
T2	50% RDF NPK	32.22	43.59	75.81	42.50
T3	75% RDF NPK	33.22	44.52	78.50	42.58
T4	100% RDF NPK	38.06	41.66	79.72	47.74
T5	125% RDF NPK	41.22	47.98	85.90	47.98
T6	150% RDF NPK	43.65	46.35	90.00	48.50
T7	100% RDF NPK + Two spray of growth regulator at first node (35 DAS) & boot leaf stage (60 DAS)	38.23	43.72	81.95	46.65
T8	125% RDF NPK + Two spray of growth regulator at first node(35 DAS) & boot leaf stage(60 DAS)	42.00	46.18	87.00	48.27

T9	150% RDF NPK + Two spray of Growth regulator at first node(35 DAS) & boot leaf stage (60 DAS)	45.01	47.02	92.03	48.90
	SEm(±)	0.62	0.57	0.66	-
	CD (P=0.05)	1.86	1.71	1.98	-

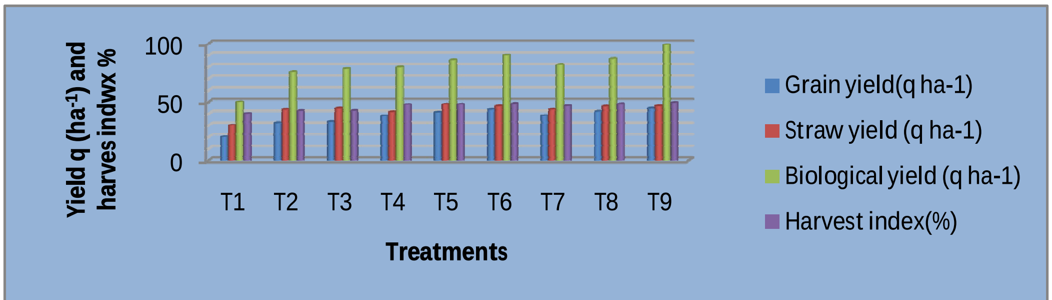

Fig: 8.Effect of NPK and growth regulators on grain yield (q ha^{-1}), straw yield (q ha^{-1}), biological yield (q ha^{-1}) and harvest Index (%)

Conclusion

Growth parameters yield and attributes and economics varied considerably in response to application of nutrient and growth regulators. The results of the present conclusion drawn may be accomplished under,The results showed that growth parameters viz., plant population, , number of green leaves hill^{-1}, number of tillers m^{2} and yield attributes viz., number of tillers m^{2} number of grain ear^{-1} head, weight of grain ear^{-1}, test weight as well as grain yield, straw yield and harvest index was found to be significantly higher under 150% RDF+ growth regulators (T9) closely followed by 150% RDF (T6) noticed significantly inferior values for most of the aforesaid parameters.

Application of 150% RDF + growth regulators (T9) illustrated significantly higher grain (45.01 q ha^{-1}) and straw (47.02 q ha^{-1}) yield of wheat closely followed by the use of 150 % RDF (T6) treatment (T6) assigned yield advantage of over (43.65 q ha^{-1}) and (46.35 q ha^{-1}) in grain and straw yield respectively as compared to Absolute control treatment (T1).The result of the present study came to the conclusion that the application of 150% RDF+ growth regulators through fertilizer is essential to get higher production output and profit from wheat cultivation and reduce the risk lodging.

Suggestion for future research work

In the light of research trial gained during the course of investigation and results obtained, it is felt that the following points should be given due consideration in further studies.

- The experiment should be repeated for one or more year to draw to concrete conclusion for the recommendation to the farmers.
- Future work should be done at more effective combinations for yield maximization of wheat.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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Details of the AI usage are given below:

1. No use of AI

2. no

3.

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