Original Research Article

"Effect of Nitrogen and Plant growth Regulator on Yield and Economics of Wheat (*Triticum aestivum* L.)"

ABSTRACT

A field experiment was conducted during rabi season, 2022 at crop research farm, Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. The objective is to study Influence of nitrogen and plant growth regulators on yield and Economics of wheat (*Triticum aestivum* L.). The treatments consisted of three levels of Nitrogen (120, 140 and 160 kg/ha) and three levels of Plant growth regulators [CCC – 0.2%, Tebuconazole – 0.1% and CCC – 0.2% + Tebuconazole – 0.1%]. The experiment was laid out in randomized block design (RBD) with the ten treatments combinations and replicated thrice. The soil in experimental field was sandy loam in texture, having alkaline reaction (pH 7.7) with very low organic carbon (0.44%), available higher N (171.48 kg/ha), P (27.0 kg/ha) and higher level of K (291.2 kg/ha). The results show significantly higher in yield attributes *viz*. maximum number of effective tillers/m^2 (271), spike length (15.10 cm), maximum number of grains/spike (60.05), Test weight (39.75), and yield *viz*. Higher grain yield (4.66 t/ha) and Straw yield (6.98 t/ha), Maximum gross return (140928.42INR/ha), net return (99715.52 INR/ha) and Benefit - cost ratio (2.42) was found in treatment (T9) with the application of Nitrogen 160 kg/ha + CCC (Chlormequat chloride) - 0.2% + Tebuconazole - 0.1%.

Keywords: Nitrogen, Plant Growth Regulator, Chlormequat Chloride, Tebuconazole, Yield attributes, Yield and Economics.

INTRODUCTION

Wheat (*Triticum aestivum* L.) a staple crop of the world contributing as a food source for more than 40 % of the world's population is the principle cereal crop (**Acevedo *et al.,* 2018**). It is rich in carbohydrate, protein, fat and minerals (zinc, iron) and also contains good amount of vitamins such as

thiamine and vitamin-B (**Kumar *et al.,* 2011).** Wheat is also a good source of essential dietary substances like carotenoids, flavonoids and phenolic compounds (**Ma *et al.,* 2015**).

Wheat is basically a temperate region crop but can also be grown under different subtropical and tropical conditions successfully. Wheat is grown mainly in two seasons in the world *viz*: Winter and spring. Winter wheat is grown in cold countries like Europe, U.S.A., Australia, Russia etc. while spring wheat is grown in Asia and parts of U.S.A. Spring wheat matures in 120-130 days while winter wheat takes 240-300 days for maturity. Considering the quality wheat has been divided into two categories 1. Soft wheat and 2. Hard wheat. *Triticum aestivum* (bread wheat) is known as soft wheat and *Triticum durum* is known as hard wheat. In India mainly three species of *Triticum* mainly *aestivum, durum* and *dicoccum* are cultivated. *Triticum aestivum* is cultivated in all the regions of the country while durum is cultivated in Punjab and Central India and *dicoccum* in Karnataka only.

The massive importance of wheat can be understood with the figures of grown area of 220.30 million hectares with annual production of 788.26 million metric tons and productivity of 3.58 t/ha during 2022-23 worldwide **(USDA 2020).** In India huge portion of total cultivation devoted under this crop, nearly 31.45 million hectares area with annual production of 107.59 million tones carrying average productivity 34.21 q/ha in year 2019-20 **(Pocket book of Agricultural Statistics 2020).**

Among the essential nutrients, nitrogen plays important role in augmenting the agricultural production and its deficiency limits crop production (**Aulakh and Malhi 2005, Kumar et al. 2017**). The most important role of N in the plant is its presence in the structure of protein, the most important building substances from which the living material or protoplasm of every cell is made (**Blumenthal et al. 2008**). Nitrogen occupies a conspicuous place in plant metabolism. All vital processes in plant are associated with protein, of which nitrogen is an essential constituent. Consequently, to get more crop production, nitrogen application is essential in the form of chemical fertilizer.

Growth retardants are chemical substances that have the potential to alter structural or vital processes inside the plant by modifying hormone balance to increase yield, improve quality or facilitate harvesting through checking lodging especially in cereals. Lodging preventers (plant height retardants) are generally antagonistic to gibberellin and act by altering their and for aforesaid reason they are frequently called anti-gibberellin. The nature and extent of lodging are closely related to height of the stem, which can be modified by application of growth inhibitors **(Peng *et al.* 2014)**. Application of growth inhibitors, like CCC (Chlormequat Chloride), or tebuconazole was reported to be useful in decreasing plant height and subsequently reducing lodging. The nature and extent of lodging are closely related to height of the stem, which can be modified by application of growth inhibitors. Keeping above facts in view an experiment was laid out on “Influence of nitrogen and plant growth regulators on yield and economics of wheat (*Triticum aestivum* L.)”.

MATERIALS AND METHODS

A field experiment was carried out during rabi season of 2022 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The crop research farm is situated at 25^0 39" 42" N latitude, 81^0 67" 56" E longitude and at an altitude of 98 m above mean sea level. The experiment was conducted in randomized block design and it consist of ten treatment combinations with three replications and was laid out with different treatments assigned randomly in each replication. The soil in experimental field was sandy loam texture, having alkaline reaction (pH 7.7) with very low organic carbon (0.44%), available higher N (171.48 kg/ha), P (27.0 kg/ha) and higher level of K (291.2 kg/ha). Treatment combination were T_1 - Nitrogen 120 kg/ha + CCC (Chlormequat chloride) - 0.2% , T_2 - Nitrogen 140 kg/ha + CCC (Chlormequat chloride) - 0.2%, T_3 - Nitrogen 160 kg/ha + CCC (Chlormequat chloride) - 0.2%, T_4 - Nitrogen 120 kg/ha + Tebuconazole (0.1%), T_5 - Nitrogen 140 kg/ha + Tebuconazole (0.1%), T_6 - Nitrogen 160 kg/ha + Tebuconazole (0.1%), T_7 - Nitrogen 120 kg/ha + CCC (0.2%) + Tebuconazole (0.1%), T_8 - Nitrogen 140 kg/ha + CCC (0.2%) + Tebuconazole (0.1%), T_9 - Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%), T_{10} - Control (150-60-40) NPK Kg/ha). Seeds are sown at a spacing of 22.5 cm × 10 cm to a seed rate of 100 kg/ha. The recommended dose of phosphorus (60 kg/ha) and potassium (40 kg/ha) was applied as basal and Nitrogen were applied as per the treatments. The observations were recorded on yield and yield parameters *viz.* number of effective tillers/m^2, spike length (cm), Number of Grains/spike, Test weight (g), Grain yield (t/ha), Straw yield (t/ha), Harvest index (%), Gross Return (INR/ha), Net Return (INR/ha), Benefit - Cost Ratio (B:C).

RESULTS AND DISSCUSION

Yield Parameters

Number of effective tillers/m^2

The data revealed that treatment with application of Nitrogen 160 kg/ha kg/ha + CCC (0.2%) + Tebuconazole (0.1%) Significantly recorded maximum number of tillers/m^2 (271). However, the treatments with Nitrogen 160 kg/ha + CCC (Chlormequat chloride) - 0.2% (257) which were found to be statistically at par with Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) similar findings were reported by **Rodrigues et al., (2003).** The increase in tiller production was probably because of greater supply of nitrogen to be used for cell multiplication and enlargement and also for the formation nucleic acid and other vitally important compounds in the cell sap. These results are in agreement with the previous finding by **Zhang (1997**) and **Gouping et al., (2001).** Significantly higher effective tiller density in high nutrient levels might be due to the optimal supply of nutrients, resulting in higher interception of photosynthetically active radiations and dry matter accumulation. Better nutrition resulted in better development of plants and more tillering accounting to more effective tillers produced in treatments with higher levels of

nutrients. Other scientists have also reported higher tiller density with higher nutrient levels (**Shukla et al., 2004; Mauriya et al., 2013; Mjhanty et al., 2015**)

Spike length (cm)

The data revealed that treatment with application of Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) was significantly recorded highest spike length (15.10 cm). However, the treatments Nitrogen 160 kg/ha + CCC (Chlormequat chloride) - 0.2%, Nitrogen 160 kg/ha + Tebuconazole - 0.1% and Nitrogen 140 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) (13.29, 13.83 and 13.00 cm) which was found to be statistically at par with Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%). These results are in conformity with those of **ali et al.,** and **asif et al.,**

However more spike length was observed at 160 kg/ha nitrogen level. These results are in agreement with those of **Hussain et al., (2001)** and **Ahmad et al., (2000).** They concluded that spike length of wheat was increased significantly with increasing nitrogen levels.

Number of grains/spike

The data revealed that treatment with application of Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) was significantly recorded more number of grains/spike (60.05). However, the treatment Nitrogen 160 kg/ha + Tebuconazole - 0.1% (54.66) which were found to be statistically at par with Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%).

Test weight (g)

The data revealed that treatment with application of Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) was significantly recorded higher test weight (39.75 g). However, the treatments Nitrogen 160 kg/ha + CCC (Chlormequat chloride) - 0.2% and Nitrogen 160 kg/ha + Tebuconazole - 0.1% (39.21 and 39.01 g) which was found to be statistically at par with Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%). Test weight was increased by application of growth regulator. This result may be discussed in the light of fact that due to reduction in plant height there was less competition between the plants for light absorption which help in better photosynthesis and more accumulation of photosynthates in grains **(Dastan *et al.,* 2011).**

Grain Yield

The data revealed that treatment with application of Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) significantly recorded highest Grain yield (4.66 t/ha). However, the treatments with (4.28 t/ha) in Nitrogen 140 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) which were found to be statistically at par with Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%).The higher grain yield could be due to more dry matter accumulation in grain and number of grains per spikes because of application of plant growth

regulator. Such finding was also supported by the **Rahman *et al.*, (2011). Bahrami *et al.*, (2014)** also found that height reduction at tillering led to higher tiller survival and enhanced fertile tillers, which resulted in higher yield.

Straw yield

The data revealed that treatment with application of Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) significantly recorded highest straw yield (6.98 t/ha). However, the treatments with Nitrogen 160 kg/ha + Tebuconazole - 0.1% (6.71 t/ha). which were found to be statistically at par with Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%). **Khalil *et al*. (2011)** reported that each increment of N increased biological yield and maximum yield (100.9 q/ha) recorded at 160 kg/ha nitrogen as compared to 80 kg/ha nitrogen. The growth regulator application also had a significant effect on the biological yield.

Harvest index (%)

The data revealed there was no significant difference among the treatments. However, highest Harvest index (40.4 %) was recorded with the treatments Nitrogen 160 kg/ha + CCC (Chlormequat chloride) - 0.2%. whereas, minimum Harvest index (38.4 %) was recorded with Nitrogen 160 kg/ha + Tebuconazole - 0.1%.

ECONOMICS

Cost of cultivation

Higher cost of cultivation has been recorded with the application of Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) (41212.90 INR/ha). whereas minimum cost of cultivation (36893.44 INR/ha) was recorded with Control (150-60-40) NPK Kg/ha.

Gross returns

Higher Gross returns have been recorded with the application of Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) (Rs. 140928.42 INR/ha). whereas minimum gross return was recorded with Nitrogen 120 kg/ha + Tebuconazole - 0.1% (Rs. 111628.17 INR/ha).

Net returns

Higher Net returns have been recorded with the treatment Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) (Rs. 99715.52 INR/ha). whereas minimum Net returns was recorded with Nitrogen 120 kg/ha + Tebuconazole - 0.1% (Rs. 72393.44 INR/ha).

Benefit cost ratio

Highest Benefit cost ratio have been recorded with the treatment Nitrogen 160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%) (2.42) over rest of the treatments. Followed by Nitrogen 160 kg/ha + Tebuconazole - 0.1% (2.25). whereas lower Benefit cost ratio was recorded with Nitrogen 120 kg/ha + Tebuconazole - 0.1% (1.85). It is evident from the results that N is positively correlated with B: C ratio and hence there was linear increase in B: C ratio with rising N rate up to optimum level followed by decreasing trend showed negative effect. The possible reason for variation in B: C ratio might be variation in yield due to different N rates, which means that increase in N up to optimum rate increased B: C ratio followed by declined in excessive nitrogen. However, lowest B:C ratio in control due to lowest yield. The findings were in agreement with **Usman et al., 2013** and **Yousaf et al., 2014**

Table: 1 Influence of Nitrogen and Plant Growth Regulators on yield and yield attributes of Wheat.

Sr. No.	Treatment combination	Number of effective tillers/m^2	Spike length (cm)	Number of grains/spike	Test weight (g)	Grain Yield (t/ha)	Straw Yield (t/ha)	Harvest Index (%)
1	N_1- 120 kg/ha + CCC (Chlormequat chloride) - 0.2%	219	10.60	43.89	36.07	3.78	5.82	39.4
2	N_2-140 kg/ha + CCC (Chlormequat chloride) - 0.2%	256	12.43	49.50	35.50	4.04	6.02	40.2
3	N_3 -160 kg/ha + CCC (Chlormequat chloride) - 0.2%	257	13.29	52.33	39.21	4.15	6.14	40.4
4	N_1- 120 kg/ha + Tebuconazole - 0.1%	243	9.97	49.00	36.20	3.63	5.74	38.8
5	N_2-140 kg/ha + Tebuconazole - 0.1%	251	12.00	52.00	37.28	4.14	6.27	39.8
6	N_3 -160 kg/ha + Tebuconazole - 0.1%	255	13.83	54.66	39.01	4.17	6.71	38.4
7	N_1- 120 kg/ha + CCC (0.2%) + Tebuconazole (0.1%)	239	11.10	47.84	36.47	3.98	5.89	40.3
8	N_2-140 kg/ha + CCC (0.2%) + Tebuconazole (0.1%)	242	13.00	50.00	37.38	4.28	6.40	40.2
9	N_3 -160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%)	271	15.10	60.05	39.75	4.66	6.98	40.0
10	Control (150-60-40) NPK Kg/ha	234	9.47	43.35	33.77	3.68	5.63	39.5
	F-test	S	S	S	S	S	S	NS
	Sem (±)	7.62	0.56	1.68	1.12	0.13	0.25	1.03
	CD (p=0.05)	22.63	1.68	5.0	3.34	0.38	0.73	-

Table: 2 Influence of Nitrogen and Plant Growth Regulators on Economics of Wheat.

Sr. No.	Treatment combinations	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C
1	N_1- 120 kg/ha + CCC (Chlormequat chloride) - 0.2%	38734.73	115319.67	76584.94	1.98
2	N_2-140 kg/ha + CCC (Chlormequat chloride) - 0.2%	38973.87	121871.92	82898.05	2.13
3	N_3 -160 kg/ha + CCC (Chlormequat chloride) - 0.2%	39212.9	125017.17	85804.27	2.19
4	N_1- 120 kg/ha + Tebuconazole - 0.1%	39234.73	111628.17	72393.44	1.85
5	N_2-140 kg/ha + Tebuconazole - 0.1%	39473.87	125640.75	86166.88	2.18
6	N_3 -160 kg/ha + Tebuconazole - 0.1%	39712.90	128963.50	89250.60	2.25
7	N_1- 120 kg/ha + CCC (0.2%) + Tebuconazole (0.1%)	40734.73	119891.58	79156.85	1.94
8	N_2-140 kg/ha + CCC (0.2%) + Tebuconazole (0.1%)	40973.87	129312.92	88339.05	2.16
9	N_3 -160 kg/ha + CCC (0.2%) + Tebuconazole (0.1%)	41212.90	140928.42	99715.52	2.42
10	Control (150-60-40) NPK Kg/ha	36893.44	112059.00	75165.56	2.04

CONCLUSION

It is concluded that with the application of Nitrogen at 160 kg/ha along with the application of Chlormequat chloride (0.2%) and Tebuconazole (0.1%) in Treatment 9 has performed better and observed higher Grain yield (4.66 t/ha) and benefit cost ratio (2.42) in wheat crop. It can be recommended to farmers following further experiments.

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