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Effect of nitrogen management and plant growth regulators on yield and yield attributes of wheat (*Triticum aestivum* L.)

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Abstract
The present investigation was conducted with the aim to know the effect of nitrogen management through organic and in-organic sources and plant growth regulators on the yield and yield attributes of the wheat cultivar HD-2968. The present study was conducted in the split plot design the treatments consist of four nutrient management, absolute control, RDF (Recommended dose of fertilizer) 150:60:40, 150% RDF.(225:90:60), 150% RDF+15 t FYM ha^{-1} in main plots and four plant growth regulators, control- two sprays of water (400 lit water ha^{-1}) at first node and flag leaf stages. two spray of Chlormequat chloride (CCC) (Lihocin @ 0.2% (800 ml ha^{-1}) of commercial product dose at first node (Around 45 DAS) and flag leaf (Around 80 DAS) using 400 lit water ha^{-1}. two sprays of Tebuconazole (Folicur 430 sc) @ 0.1% at (400 ml ha^{-1}) First Node and Flag leaf with 400 lit water ha^{-1}. two spray combined application of Lihocin + Folicar in sub-plots.

Keywords: Wheat, nitrogen, yield, yield attributes and plant growth regulators

Introduction

Wheat (*Triticum aestivum* L.) belongs to family Poaceae, is the first important and strategic cereal crop for the majority of world population. It is the most important staple food of about two billion people (36.00% of the world population) worldwide. It provides nearly 55% of the carbohydrates and 20.00% of the food calories consumed globally and straw is a good source of feed for a large population of cattle in our country. It exceeds in acreage and production every other grain crop (including rice, maize, etc.) and therefore, the most important cereal grain crop of the world, which is cultivated over a wide range of climatic conditions.

Among the different management practices, role of macro nutrients is crucial in crop nutrition for achieving higher yields (Raun & Johnson, 1999) [10]. The soils of India are deficient in nitrogen and are supplemented with chemical fertilizer for enhancing the crop productivity. Nitrogenous fertilizers play a vital role in modern farm technology, however only 20-50% of the soil applied nitrogen is recovered by the annual crops (Bajwa, 1992) [2]. The leftover nitrogen is lost from the soil system through denitrification, volatilization and leaching.

Efficient nitrogen (N) fertilization is crucial for economic wheat production and the protection of ground and surface waters (Alley *et al.*, 1999) [1]. 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 (Simians 1982., Alley *et al*., 1999) [1] and such as intensive management systems is to increase N fertilizer rates and control lodging with PGRs ultimately to increase grain yields (Knapp and Harms, 1988; Van Sanford *et al*., 1989., Tripathi *et al*., 2003) [9, 14, 13].

The qualities of grain yield are influenced by fertilization treatment, environmental factors and by the genetic predispositions of a particular variety. It is commonly known that fertilization, especially nitrogen fertilization, has a fundamental position in the attainment of high yields and high quality grain. Nitrogen positively influences the leaf area and its chlorophyll concentration, thereby inducing crude protein content and the rheological properties of dough (Blandino and Rezneri, 2009) [5] and several field experiments showed that in winter wheat the number of spikes per unit area generally increases as the N rate increases while mean kernel weight usually declines (Batey and Reynish, 1976; Knapp and Harms, 1988; Alley *et al*. 1999) [4, 9, 1].

Materials and Methods

The present study was conducted in the split plot design the treatments consist of four nutrient management, absolute control, RDF (Recommended dose of fertilizer). 150:60:40, 150% RDF. (225:90:60), 150% RDF+15t/ha^{-1} FYM in main plots and four plant growth regulators, control- two sprays of water (400 lit water/ha^{-1}) at first node and flag leaf stages. two spray of Chlormequat chloride (CCC) (Lihocin @ 0.2% (800 ml/ha^{-1}) of commercial product dose at First node (Around 45 DAS) and flag leaf (Around 80 DAS) using 400 lit water /ha. two sprays of Tebuconazole (Folicur 430 sc) @ 0.1% at (400 ml/ha^{-1}) First Node and Flag leaf with 400 lit water/ha^{-1}**.** two spray combined application of Lihocin + Folicar in sub-plots. The treatments were replicated thrice.

Results and Discussion

Yield and yield attributes are the function of vegetative growth and development. Different nutrient levels influenced significantly yield and yield component during both the years of investigation. The results clearly indicated that earhead/m^2, length of ear, number of grains/ear head, number of spikelets per spike, test weight increased with increase in nutrient levels up to 150% RDF + 15 t ha^{-1} FYM. This may be attributed to favourable effects of nitrogen, throughout crop growth period on plant growth and development. As under adequate supply of nitrogen, plant height, tillers m^{-2}, leaf area index and dry matter accumulation were highest which results in improved yield attributes due to improved photosynthetic activity of leaves.

The increase in yield attributes was due to better nutrient translocation during reproductive and grain filling stages and increasing rate of photosynthesis. The ear formation is directly related to number of tillers. Hence conditions that favor the formation of more no. of tillers were also responsible for the production of higher no. of ears. The number of grains determined primarily by the amount of nutrients absorbed and secondary by the amount of carbohydrates produced at the time of spikelets differentiation. Hence under present study increase in number of grains might be due to better assimilation of carbohydrates in ear. Similar findings also were reported by Yadav *et al.* (2005) [15], Chaturvedi *et al.* (2006) [6] and Khan *et al.* (2008) [8].

Grain, straw and biomass yield increased significantly with increasing nitrogen levels. The maximum grain, straw and biomass yield was recorded with the application of 150% RDF + 15 t ha^{-1} FYM during both the years. The increased grain, straw and biomass yield might be due to the improvement in growth and yield attributing characters and higher photosynthetic activity. The observations was in conformity with the findings of Sobh *et al.* (2000), Mosalem *et al.* (2002), Barthwale *et al.* (2013) and Singh *et al.* (2017).

It is clear from the result presented in the previous chapter that application of growth regulator with nutrients significantly influenced yield attributes *viz*., earhead/m^{-2}, length of ear head, number of grains/ ear head, number of spikelets/ spike, test weight recorded maximum under the two spray of Lihocin +Folicur during both the years. The minimum in values of yield attributes was recorded in the absolute control during both the years. These results can be discussed in light of fact that when plant growth especially especially height was restricted by the growth regulators. Similarly, crop yields were higher in treatments hiving better development of yield attributes than those with poor yield attributes. Zhang *et al.* (2017) [16] reported that application of PGRs significantly reduced grain yield, and the combination of the two PGRs (Manipulator and Palisade) had a synergistic effect and lowered the yield.

The maximum grain, straw and biomass yield was recorded with the application of two spray of Lihocin + Folicur and minimum in control. This might be due to the growth of plants and the plant height was reduced due to the application of Lihocin + Folicur which leads to the conversion of photosynthets towards the reproductive parts of the plants. The earlier researcher Gurmani *et al.* (2006) [7] reported that higher grain yield and 1000- grain weight was recorded by IR-6.

Table 1: Effect of nutrient management and plant growth regulators on yield attributes

Treatments	Earhead/m^{-2}		Length of ear head		No. of grains/ ear head		No. of spikelet's/spike		Test weight	
(A) Nitrogen levels (kg ha^{-1})	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
1. Absolute control.	180.83	169.17	9.70	9.43	38.50	37.14	17.32	16.83	33.74	35.92
2. RDF (150:60:40)	293.75	312.58	11.10	9.96	45.50	39.80	19.82	17.79	35.53	38.16
3. 150% RDF.(225:90:60)	315.00	335.50	11.70	10.21	48.50	41.07	20.89	18.24	36.82	38.50
4. 150% RDF+15 t ha^{-1} FYM.	360.00	394.58	12.05	12.28	50.25	51.42	21.52	21.93	38.71	40.73
S.Em±	5.563	4.374	0.195	0.237	0.973	1.183	0.347	0.422	0.618	0.570
CD (P=0.05)	19.250	15.137	0.673	0.818	3.366	4.092	1.202	1.462	2.139	1.973
(B) Plant growth regulatores										
1. Control- two spray of water	247.50	280.58	10.60	9.75	43.00	38.75	18.93	17.41	35.25	37.09
2. Two spray of Lihocin @ 0.2%	299.58	309.50	11.35	10.91	46.75	44.57	20.27	19.49	36.78	38.92
3. Two sprays of Folicur @ 0.1%	285.00	299.00	11.00	10.15	45.00	40.77	19.64	18.13	35.70	36.82
4. Two spray of Lihocin + Folicur.	317.50	322.75	11.60	11.07	48.00	45.33	20.71	19.76	37.08	40.48
S.Em±	4.787	3.389	0.173	0.218	0.866	1.052	0.309	0.390	0.553	0.518
CD (P=0.05)	13.973	9.890	0.506	0.637	2.528	3.186	0.903	1.138	1.616	1.511

Table 2: Effect of nutrient management and plant growth regulators on Grain Yield, Straw Yield, (qha^{-1}), Harvest index (%) and Biomass

Treatments	Grain Yield (qha^{-1})		Straw Yield (qha^{-1})		Harvest index (%)		Biomass (q ha^{-1})	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
(A) Nitrogen levels (kg ha^{-1})								
1. Absolute control.	17.02	11.45	23.86	14.91	41.79	43.45	40.87	26.36
2. RDF (150:60:40)	47.66	47.64	69.13	65.70	40.89	42.13	116.79	113.34
3. 150% RDF.(225:90:60)	51.85	51.36	77.79	77.48	40.15	39.85	129.64	128.84
4. 150% RDF+15 t ha^{-1} FYM.	53.96	62.43	83.63	87.10	39.20	41.74	137.58	149.53
S.Em±	1.070	1.023	2.747	1.488	1.903	0.549	2.089	2.153

CD (P=0.05)	3.702	3.540	9.506	5.150	6.584	1.899	7.230	7.451
(B) Plant growth regulatores								
1. Control- two spray of water	38.32	41.00	57.20	58.73	40.55	41.54	95.51	99.74
2. Two spray of Lihocin @ 0.2%	44.84	43.98	66.91	62.53	40.49	41.71	111.75	106.51
3. Two sprays of Folicur @ 0.1%	40.11	42.46	59.86	59.33	40.48	42.14	99.97	101.80
4. Two spray of Lihocin + Folicur.	47.22	45.45	70.43	64.59	40.52	41.78	117.65	110.04
S.Em±	0.800	0.861	1.699	1.399	0.800	0.561	1.704	1.879
CD (P=0.05)	2.334	2.512	4.960	4.084	2.334	1.639	4.973	5.484

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