

Original Research Article

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Effect of Different Levels of Nitrogen and Plant Growth Regulators on Lodging and Yield of Wheat (*Triticum aestivum* L.)

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ABSTRACT

Keywords

Nitrogen, Plant growth regulators (PGRs), Chlormequat chloride, Tebuconazole, lodging

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The influence of rate of N application and PGRs on Wheat (*Triticum aestivum* L.) on lodging and yield were studied under field conditions at Research Farm of, Bihar Agricultural University, Sabour in *Rabi* season of 2019-20. The experiment was conducted with ten treatments consisted of different nitrogen levels and growth regulators namely Chlormequat chloride and Tebuconazole applied @ 0.2% and 0.1% respectively. The obtained results indicated that grain yield, straw yield and biological yield were recorded significantly higher in treatment T₁₀ (150% RDF + PGRs) statistically at par with treatment T₇ (100% NPK) as compare to other treatments while harvest index was recorded maximum in treatment T₈ (0.45) and T₉ (0.45). PGRs effectively reduced the lodging as compared to the same in which no PGRs had applied, however in control no lodging was observed.

Introduction

Wheat the most imported *rabi* crops consisted first position among the world's food crops in terms of cultivated area (215.24 m ha), production (730.5 million tonnes) and productivity (3.39 tons ha⁻¹) (USDA 2018-19). Wheat also contributed more calories (20 percent) and protein to the world's diet than any other food crop. Now a days availability of wheat has increased from about 79 g capita⁻¹ day⁻¹ to more than 185 g capita⁻¹ day⁻¹ despite the doubling of the population since

1961 (Bhardwaj *et al.*, 2010). Thus the global challenge for wheat nutrition is to increase grain yield while maintaining its protein (Tilman *et al.*, 2002). Wheat yield and its quality depend upon the environment, genotype, and their interactions. Low soil fertility, especially nitrogen (N) deficiency, is one of the major constraints limiting wheat production in India especially for high potential wheat varieties. Inadequate supply of available N frequently results in plants that have slow growth, low protein levels, poor yield of low-quality products, and inefficient

water use. Therefore, the application of nitrogen fertilizer at the right rate and time is vital for the enhancement of crop productivity and soil fertility. High levels of N supply results in higher protein content, but increased efficiency of utilization is realized when the concentration in the kernels increases and grain yield remains stable (Ortiz Monasterio *et al.*, 1997). However, increased fertilizer especially nitrogen for obtaining higher yield has led to another problem of lodging in wheat under irrigated conditions. Lodging resulted in reduced wheat yield as well as lowered the quality of the final product and an increase in disease severity is the other detrimental effect of lodging. It has been estimated that losses may occur around 8.3% of the total wheat production due to lodging (Tripathi *et al.*, 2004).

Since information on the choice of a dose of nitrogen fertilizer as well as plant growth regulators (PGR's) for wheat varieties with high potential is scanty, an attempt has been taken to find out the standardization of various doses of N for enhancing the productivity of wheat while reducing lodging.

Materials and Methods

The experiment was conducted at the research farm of Bihar Agricultural University, Sabour during the rabi season of 2019-20. The soil was sandy loam having organic carbon (0.55%) with pH (7.23), available nitrogen (154.11 kg ha⁻¹), available phosphorus (24.45 kg ha⁻¹) and available potassium (184.46 kg ha⁻¹). The experiment consists of ten treatments viz: T₁- control (no fertilizer used), T₂- 50% recommended dose of fertilizer (RDF= 150kg N ha⁻¹) of N i.e. 75 kg N ha⁻¹, T₃- 75% RDF of N, T₄- 100% RDF of N, T₅- 125% RDF of N, T₆- 150% RDF of N, T₇- 100% RDF of NPK i.e. 150: 60: 40 N:P: K kg ha⁻¹. T₈- 125% RDF of N with PGRs spray (at first node and boot leaf stage (45 and 65 DAS

respectively)), T₉- 150% RDF of N with PGRs spray (at first node and boot leaf stage) and T₁₀- 150% RDF of NPK with PGRs (at first node and boot leaf stage). The experiment was laid out in a randomized block design with three replications. Wheat cultivar DBW187 (Karan vandana) was sown on 25th November 2019 and harvested on 4 April 2020. Wheat seed @ 100kg ha⁻¹ was sown at a row to row spacing of 20 cm. Urea, DAP and MOP were used as the source of nitrogen, phosphorus and potash respectively. The crop received two uniform irrigations at crown root initiation and flowering stage.

Lodging observation

Lodging score: to score lodging, the percentage area of the plot that lodged was estimated and the angle of the stem was estimated (Rebetzke *et al.*, (2011).

$$\text{Lodging score} = \frac{\% \text{ plot area lodged} \times \text{angle of lodging from vertical}}{90}$$

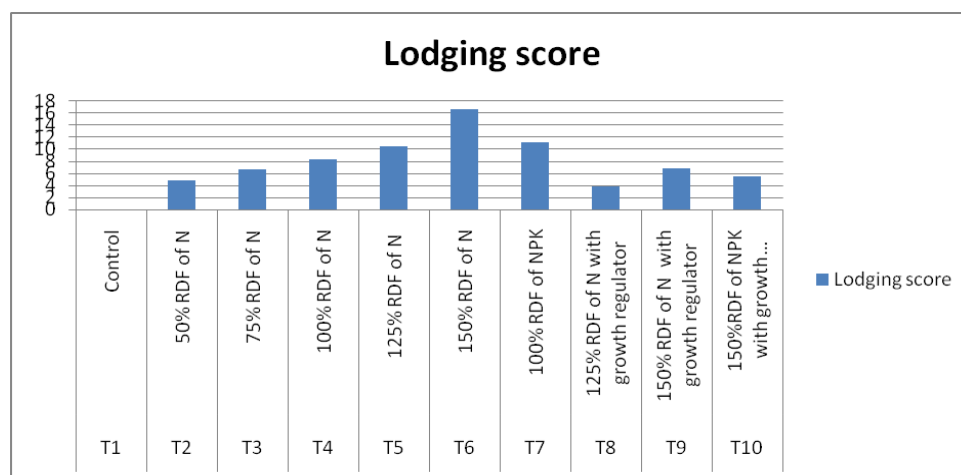
Results and Discussion

Data presented in figure 1 revealed that increment in the rate of nitrogen fertilizer increased the lodging of the wheat crop. The lodging of the crop occurred after the flowering which was associated with the high nitrogen levels, onset of rainfall and high-speed wind. The range of the lodging score varied from 3.87 to 16.63. Maximum lodging score was observed in treatment T₆:150% RDF of N (16.63) while no lodging occurred in treatment control (T₁). Application of plant growth regulator (Chloromequat chloride 0.2% and tebuconazole 0.1%) at first node and boot leaf stage reduced the crop lodging in treatment T₈ (3.87) and T₉ (6.80) as compared to treatment T₅ (10.53) and T₆ (16.63) in which no plant growth regulators were applied.

Table.1 Effect of nitrogen levels and plant growth regulators on the yield of wheat

Treatment		Grain q ha ⁻¹	Straw q ha ⁻¹	Biological q ha ⁻¹	HI
T ₁	Control	28.15	39.45	67.60	0.42
T ₂	50% RDF of N	32.97	43.33	76.30	0.43
T ₃	75% RDF of N	36.74	46.79	83.53	0.44
T ₄	100% RDF of N	38.96	50.58	89.55	0.44
T ₅	125% RDF of N	40.19	53.68	93.87	0.43
T ₆	150% RDF of N	41.45	53.30	94.75	0.44
T ₇	100% RDF of NPK	49.23	63.85	113.07	0.44
T ₈	125% RDF of N with growth regulator	43.06	52.02	95.08	0.45
T ₉	150% RDF of N with growth regulator	44.41	55.43	99.84	0.45
T ₁₀	150%RDF of NPK with growth regulator	51.71	65.38	117.09	0.44
S.Em.(±)		1.29	1.48	2.45	0.01
CD (p=0.05)		3.84	4.40	7.27	0.02

Fig.1 Effect of nitrogen levels and growth regulators on lodging score of wheat



Effect on grain yield of Wheat

Highest grain yield was recorded in treatment T₁₀ (51.71q ha⁻¹) which was significantly higher than all the treatments but statistically at par with treatment T₇ (49.23 q ha⁻¹). A similar trend was observed with straw and biological yield also in which treatment T₁₀ (65.38 q ha⁻¹ and 117.09 q ha⁻¹ respectively) was significantly higher than all the treatment except treatment T₇ (63.85 and 113.07 q ha⁻¹ respectively).

However, the highest harvest index was found in treatment T₈ and T₉ (0.45 in both) and the minimum was recorded in control: T₁ (0.42). The increase in yield might be due to increased growth and yield attributing characters and higher photosynthesis activities at a higher fertility level. Balanced nutrition throughout various growth stages of a plant enables it to assimilate sufficient photosynthetic products and enhanced dry matter accumulation.

Minimum losses due to lodging were observed in treatments supplied with chlormequat chloride 0.2% + tebuconazole 0.1% at the first node and boot leaf stage which protected the plants against lodging. The observations confirmed with the findings of Shekoofa and Emam (2008). Tebuconazole application resulted in increased leaf area and delayed senescence of leaves which is a major supporter of photosynthates from source to sink (grain) and this resulted in higher grain yield. It is also a well-known fact that with the increasing level of fertilizer application, the intensity and nutrient supply capacity of soil also increased (Wang *et al.*, 2012).

Based on summarized results, it can be concluded that spray of PGRs effectively reduced the lodging of wheat and enhanced grain and straw yield of the plants. The highest grain and straw yield was recorded with 150% RDF of NPK i.e. 225:90:60 N:P:K kg ha⁻¹ with chlormequat chloride 0.2% + tebuconazole 0.1% at 45 and 65 DAS of sowing.

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