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Effect of different nitrogen levels on yield and yield attributes of wheat (*Triticum aestivum* L.)

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Abstract
A field experiment was performed during the *Rabi* season of 2020-21 at research farm of University Institute of Agricultural Sciences, Chandigarh University, Gharuan, Mohali (Punjab), to evaluate the effect of varying nitrogen levels on growth and yield of wheat. Seven levels of nitrogen i.e. 0, 30, 60, 90, 120, 150 and 180 kg ha^{-1} were evaluated. Experiment was conducted under randomized block design (RBD) with three replications. Observations and data was recorded for yield and yield contributing attributes like number of grains per spike, spike length, test weight, grain yield, biological yield and harvest index. All the yield parameters were significantly increased by different levels of nitrogen. Maximum spike length, number of grains per spike, test weight and highest grain and biological yield was recorded from the treatment where nitrogen was applied @ 180 kg ha^{-1}

Keywords: nitrogen levels, economics, grain yield, biological yield, harvest index

Introduction
Wheat (*Triticum aestivum* L.) is second most important cereal crop in the world after rice and is one of the most important stable food crop. Wheat is cereal grain, originated from the Levant region but now cultivated in at least 43 countries of the world. Nitrogen plays an important role in all the metabolic processes of plants, nitrogen is the major constituent of plants especially in living tissues formation. Every single indispensable process in the plant are related with protein, of which nitrogen is a fundamental constituent. Nitrogen is one of the major nutrients which reduce the yield of Wheat if not applied in proper amount as it is needed for fast growth of plants to get high production per hectare. All the biochemical processes occurring in plants are mainly governed by nitrogen, which make it essential for the growth and development of wheat (Kutnam *et al*, 2011) [5].

The application of nitrogen at 25% (30 kg) gave 2400-3100 kg ha^{-1} 50% (70 kg) nitrogen resulted in 2650-3000 kg ha^{-1}and 75% (90 kg) nitrogen produced 2650-3400 kg ha^{-1} of wheat yield (Bruno *et al*, 2015). The application of nitrogen up to 125% (156 kg) has shown an increasing trend of wheat grain yield 6472 kg ha^{-1} (Iqbal *et al*, 2012) [3]. Application of nitrogen to wheat increases its growth and development during various phases (Mahipat and Dhanai, 2016) [6]. Considering the key role of nitrogen in cultivation of wheat present study is based on the objectives to evaluate adequate nitrogen dosage for wheat crop.

Materials and methods
An experiment entitled "Effect of nitrogen and organic mulch on growth and yield attributes in wheat (*Triticuma estivum* L.) Was conducted during the *Rabi* season of 2020-21 at research farm of University Institute of Agricultural Sciences, Chandigarh University, Gharuan, Mohali (Punjab). The experiment was conducted in a randomized complete block design with three replications. The experiment was laid out with the following treatments T_1 - 25 % Nitrogen with mulch (RDF), T_2 - 50 % Nitrogen with mulch (RDF), T_3 - 75 % Nitrogen with mulch (RDF), T_4 - 100 % Nitrogen with mulch (RDF), T_5 - 125 % Nitrogen with mulch (RDF), T_6 - 150 % Nitrogen with mulch (RDF), T_7 – Control. Half dose of nitrogen was given to all the plots at the time of sowing and remaining half dose was applied at the time of first irrigation. Wheat was sown with a row spacing of 22.5 cm. Wheat variety "Unnat PBW-343" was sown using seed rate of 100 kg ha -1 in first week on well prepared seed bed in December, 2020. Cultural practices are same for all the treatments. The following observations were recorded during the conduct of research; spike length, Number of grains spike^{-1}, Test weight (g), Grain yield (q/ha), Straw yield (q/ha), Biological yield (q/ha) and Harvest index. Analysis of variance was done by using fishers techniques. Least significant test at 5% level was applied to evaluate the treatment means.

Results and Discussions
Yield attributes of wheat
The data pertaining to spike length in wheat has been presented in Table 1. The data revealed that spike length of wheat increased with increasing levels of nitrogen over the control. Spike length was high in treatment T_6 (11.8cm) as compared to control and other treatments. In treatment T_6 (150% Nitrogen (RDF) with mulch) spike length was significantly higher (11.8cm) as compared to control (7.48cm). These results collaborate with the findings of Ullah *et al*. (2018) [10] who observed that higher levels of nitrogen increased all growth and yield parameters of wheat. Maximum number of grains spike^{-1} were recorded from treatment T_6 (56.80). While, minimum number of grains spike^{-1} was observed in control (45.17). Nitrogen promotes the initiation of spikelet's that resulted in a greater number of grains spike^{-1}. In treatment T_6 (150% Nitrogen (RDF) with mulch) number of grains spikes^{-1} spike was significantly higher (56.80) as compared to control (45.17). Similar results has been reported in wheat by (Noureldin *et*

al, 2013) [7]. The data presented in Table 1 indicated that different levels of nitrogen fertilizer application significantly increased the 1000 grain weight of wheat crop. Maximum test weight was found in treatment T_6 (45.08g) which is statistically identical to T_5 (43.15g), while, minimum test weight was observed in control (39.71g). These results are similar to those reported by (Iqbal *et al*, 2012) [3] in wheat crop.

Yield of wheat

Grain yield significantly increased by different levels of nitrogen. Maximum grain yield (3996.24 kg ha^{-1}) was reported in treatment T_6 (150% Nitrogen (RDF) with mulch), while minimum grain yield (2187.18 kg ha^{-1}) was recorded in control. High photosynthesis rate has occurred due to high application of nitrogen, which resulted in more dry matter, more assimilates were transported to the spikes. These results are quite in line with Hossain *et al*. (2006) [2] who reported that higher dose of nitrogen significantly increased grain yield of wheat. Similarly Subede *et al*. (2007) [9] concluded N application increased grain yield of wheat. Maximum straw yield (5996.55 kg ha^{-1}) was obtained from T_6 (150% Nitrogen (RDF) with mulch), while minimum straw yield (3272.39 $kgha^{-1}$) was recorded from treatment where no application of nitrogen was done. More application of nitrogen gave tall plants, more dry matter and high vegetative growth, which collectively resulted in higher straw yield. These results are in collaboration with (Iqtidar *et al*, 2006) [4] who reported that higher dose of nitrogen significantly increased straw yield of wheat. The data pertaining to Biological yield of wheat has been presented in Table 2. Different levels of nitrogen fertilizer application increased biological yield significantly. Maximum biological yield (9992.79 kg ha^{-1}) was obtained from T_6 {150% Nitrogen (RDF) with mulch}, while minimum biological yield (5459.64 kg ha^{-1}) was recorded from treatment where no application of nitrogen was done. Application of nitrogen has led to tall plants, more tillers, high grain, straw yield which collectively increased the biological yield of wheat. These results are quite in line with (Ullah *et al*, 2018) [10] who observed that higher biological yield was observed from treatment where nitrogen was applied @ 180 kg ha^{-1}. Statistically there is no much difference between treatments in terms of harvest index. All the treatments are more or less equal with each other.

Economics of Wheat

A perusal of data presented in Table 3 revealed that T_6 (150% Nitrogen (RDF) with mulch) has recorded highest gross returns (Rs. 110154.33 ha^{-1}) as compared with control (Rs 60150 ha^{-1}) and other treatments. Maximum gross returns were recorded under T_6 (150% Nitrogen (RDF) with mulch) due to higher yield as compared with control. These results are in accordance with (Singh and Vinay, 2017) [8] who reported maximum gross returns with 180 kg N ha^{-1}. Maximum net returns were recorded under T_6 (150% Nitrogen (RDF) with mulch) due to higher grain yield and straw yield as compared with control. T_6 (150% Nitrogen (RDF) with mulch) has recorded highest B: C ratio (1.17) as compared with control (0.94) and other treatments. Maximum B: C ratio were recorded under T_6 (150% Nitrogen (RDF) with mulch) due to higher grain and straw yield as compared with control. These results are in accordance with (singh and vinay 2017) [8] who reported that maximum B: C ratio was recorded with 180 kg N ha^{-1}.

Conclusion

Nitrogen level of 180 kg ha^{-1} recorded maximum grain yield and straw yield than all other nitrogen levels. In case of gross returns and net returns 180% N + organic mulch recorded higher gross returns and net returns. Maximum B: C ratio were recorded under T_6 (150% Nitrogen (RDF) with mulch) due to higher grain and straw yield as compared with control. T_6 (150% Nitrogen (RDF) with mulch) has recorded highest B: C ratio (1.17) as compared with control (0.94) and other treatments. Overall the results suggested that the improvement in growth, yield attributes and seed yield of Wheat crop observed with the application of nitrogen 180 kg ha^{-1}, however technically organic mulch used in the plots has competed for the availability of nutrients, water, space and sunlight with the main wheat crop. It is clearly seemed from the results that application of higher doses of nitrogen have produced superior results as compared with other treatment.

Table 1: Effect of treatments on yield contributing characters of wheat

Treatments	Spike length(cm)	No. of grains $spike^{-1}$	1000 grain weight(g)
25% N + Organic mulch	8.19	47.26	41.10
50% N + Organic mulch	9.17	48.41	41.74
75% N + Organic mulch	9.98	51.32	42.27
100% N + Organic mulch	10.26	54.37	42.50
125% N + Organic mulch	10.81	55.45	43.15
150% N + Organic mulch	11.80	56.80	45.08
0% N + Organic mulch	7.48	45.17	39.71
SEm (±)	0.29	0.55	0.34
CD (P=0.05)	0.91	1.70	1.04

Table 2: Effect of treatments on yield of wheat

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index
25% N + Organic mulch	3001.92	4070.25	7072.17	42
50% N + Organic mulch	3093.62	4281.48	7375.10	41
75% N + Organic mulch	3330..3	4582.63	7912.65	42
100% N+ Organic mulch	3578.53	5041.11	8619.64	41
125% N + Organic mulch	3785.97	5669.38	9455.35	39
150% N + Organic mulch	3996.24	5996.55	9992.79	39
0% N + Organic mulch	2187.18	3272.39	5459.64	40

SEm (±)	47.68	63.15	95.08	0
CD (P=0.05)	146.92	194.39	292.99	0.001

Table 3: Effect of treatments on economics of wheat

Treatments	Cost of Cultivation (Rs ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	Net returns per rupee invested
25% N + Organic mulch	42387	80377	37990	0.89
50% N + Organic mulch	43128	82732	39604	0.91
75% N + Organic mulch	45269	91139	45870	1.01
100% N+ Organic mulch	48161	96813	48652	1.00
125% N + Organic mulch	49952	104292	54340	1.08
150% N + Organic mulch	50693	110154	59458	1.17
0% N + Organic mulch	30850	60150	29300	0.94
SEm (±)		1529	1529	0.04
CD (P=0.05)		4712	4712	0.11

Table 4

Treatments	Cost of cultivation (Rs ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	Net returns per rupee invested
RDF	50288	116862	66574	1.32
25% N + 100% P	48068	111153	63085	1.31
50% N + 100% P	49155	113804	64649	1.32
75% N + 100% P	50246	115030	64784	1.29
125% N + 100% P	52078	120062	67984	1.31
150% N + 100% P	53169	124903	71734	1.35
0% N + 100% P	38100	85448	47348	1.24
SEm (±)		1574	1574	0.03
CD (P=0.05)		4850	4850	NS

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