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Effect of nitrogen levels and cultivars on yield, nutrient uptake and economics of wheat (*Triticum aestivum* L.) under late sown condition

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Abstract
A field experiment was carried out at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during *Rabi* season of 2015-16 to study the response of late sown wheat varieties to various doses of nitrogen application. Eighteen treatments consisted of six doses of nitrogen (0, 40, 80, 120, 160 and 200 kg ha^{-1}) and three varieties of wheat (Unnat Halna, HUW-234, and NW-1014). The grain yield, protein content in grain, nitrogen content and uptake in grain and straw, were increased significantly with 120 kg N ha^{-1} and among the varieties NW-1014 being at par with variety HUW-234 recoded significantly higher values of above characters over Unnat Halna. The maximum net return (₹50281 ha^{-1}) and B:C ratio (1.46) were obtained at 120 kg ha^{-1}.Thus application of 120 kg N ha^{-1} along with variety NW-1014 was found most suitable for cultivation under late sown condition for Eastern Plain zone.

Keywords: economics, nitrogen levels, protein content, wheat varieties and yield

Introduction
Wheat *(Triticum aestivum* L.) belongs to the family poaceae; it is a staple food, most important and widely cultivated crop in the world. In India, wheat is the second important cereal crop after rice. Wheat compares well with other important cereals in its nutritive value. It contains more protein than other cereals. Wheat has relatively high content of niacin and thymine. Wheat protein gluten is very essential for bakers. Flour of other cereals lacking gluten, is therefore, not good for bread making. It is consumed mostly in the form of chapatti. Wheat straw is used for feeding the cattle. Improving the production of wheat, as in any other crop, introduction of varieties with a high yield potential is essential. Variety alone contributes more than 50% of the increased production. The next important component for increased production is the nutrients availability. Native fertility level of the tropical soil with special reference to nitrogen is invariably insufficient for touching the peak production mark of a variety and hence, the need for supplementing this nutrient is obvious with most of the varieties. Selection of suitable genotype is of prime importance as the genetic potential of varieties limits response to nitrogen. Moreover, varieties differ both in yield and nutrient uptake. Hence, it is necessary to find out the correct dose of nitrogen and suitable varieties for maximizing wheat yield.

Materials and Methods
A field experiment was carried out at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during *Rabi* season of 2015-16 to study the response of late sown wheat varieties to various doses of nitrogen application. Eighteen treatments consisted of six doses of nitrogen (0, 40, 80, 120, 160 and 200 kg ha^{-1}) and three varieties of wheat (Unnat Halna, HUW-234, and NW-1014). The experiment was laid out in Randomized Block Design (factorial) with three replications on silt loam soil having low organic carbon (0.37%), nitrogen (194.25 kg ha^{-1}), medium in phosphorus (18.03 kg ha^{-1}) and potassium (250.25 kg ha^{-1}).

Result and Discussion
The data pertaining to grain yield were recorded and presented in Table 1. The data revealed that the grain yield influenced significantly by varieties and nitrogen levels.

Among the varieties, maximum grain yield was recorded with variety NW-1014 which was significantly superior over variety HUW-234 and Unnat Halna. Regarding nitrogen levels grain yield increased with increasing levels of nitrogen from 0 to 200 kg N ha^{-1}.The maximum grain yield 36.50 q ha^{-1} was realised with 200 kg N ha^{-1} which was at par to 160 and 120 kg N ha^{-1} and significantly higher over 0, 40 & 80 kg N ha^{-1}. Similar findings were obtained by Ram *et al*. (2005), Sardana *et al.* (1999) and Singh (1998) [3, 5, 7]. The interaction between variety and nitrogen levels did not influence the grain yield significantly. The similar findings were reported by Singh and Uttam (1992) and Singh (1998) [6, 5]. The data on protein content in grain and nitrogen content in grain and straw as influenced by different varieties and nitrogen levels are furnished in Table 1. Protein content was not significantly influenced by varieties. Nitrogen levels increased the protein content in grain up to 200 kg N ha^{-1} which was at par with 160 kg N ha^{-1} and significantly superior over rest of the nitrogen levels. The nitrogen content in grain did not differ significantly due to different varieties. However, variety NW-1014 recorded maximum N content followed by Unnat Halna and HUW-234, respectively. Nitrogen content increased with increasing levels of nitrogen up to 200 kg N $ha^{-1}$and maximum nitrogen content i.e. 1.90% was recorded with 200 kg N ha^{-1} which was at par with 160 and 120 kg N ha^{-1} and significantly superior over rest of nitrogen levels. The results were in conformity with Prakash *et al*. (1999) [2]. Nitrogen content in straw did not differ significantly due to different varieties. However, variety NW-1014 recorded maximum N content followed by Unnat Halna and HUW-234. Nitrogen levels increased the nitrogen content in straw up to 200 kg N ha^{-1} which was at par with 160, 120 and 80 kg N ha^{-1} and significantly superior over rest of the nitrogen levels. The data on total nitrogen uptake in grain & straw as influenced by different treatments have been furnished in Table 1. The variety NW-1014 recorded maximum nitrogen uptake which was significantly superior than other varieties. Nitrogen uptake in grain with different nitrogen levels increased up to 200 kg N ha^{-1}. Maximum uptake i.e. 69.39 kg ha^{-1} was observed with 200 kg N ha^{-1}that remained at par with 160 and 120 kg N ha^{-1} and significantly superior over rest of the nitrogen levels. The interaction effect between varieties and nitrogen levels did not differ significantly. The significantly higher nitrogen uptake in straw was recorded with variety NW-1014 than over rest of the varieties. As regards nitrogen levels, maximum nitrogen uptake in straw was recorded with 200 kg N ha^{-1} which was at par with 160 and 120 kg N ha^{-1} and significantly superior over rest of the nitrogen levels. The interaction effect of varieties and nitrogen levels on nitrogen uptake by straw was found non-significant.

Table 1: Effect of nitrogen levels and cultivars on yield, protein content, N content and uptake in grain and straw of wheat

Treatments	Grain yield (q ha^{-1})	Protein (%)	N content in grain (%)	N content in straw (%)	N uptake by grain (kg)	N uptake by straw (kg)
(A) Varieties						
Unnat Halna	28.37	11.31	1.81	0.52	51.68	20.85
HUW-234	31.90	11.25	1.80	0.51	57.70	22.56
NW-10 14	33.73	11.56	1.85	0.53	62.78	24.64
SEm±	0.47	0.13	0.02	0.01	0.98	0.63
CD (P=0.05)	1.35	NS	NS	NS	2.82	1.80
(B) Nitrogen levels (kg ha^{-1})						
0	20.75	10.75	1.72	0.48	35.93	15.45
40	25.42	11.06	1.77	0.50	45.05	18.44
80	32.98	11.31	1.81	0.52	59.62	23.62
120	35.94	11.50	1.84	0.53	66.14	25.32
160	36.43	11.75	1.88	0.54	68.51	26.36
200	36.50	11.88	1.90	0.55	69.39	26.90
SEm±	0.67	0.18	0.03	0.01	1.39	0.88
CD (P=0.05)	1.92	0.52	0.08	0.03	3.98	2.54

Table 2: Economics of various treatment combinations

Treatment combinations	Cost of cultivation (≠ ha^{-1})	Gross return (≠ha^{-1})	Net return (≠ha^{-1})	B:C (Ratio)
Unnat Halna, 0kg	32513	42640	10127	0.31
Unnat Halna,40kg	33121	51482	18361	0.55
Unnat Halna, 80kg	33730	66796	33066	0.98
Unnat Halna, 120kg	34339	71846	37507	1.09
Unnat Halna, 160kg	34947	73135	38188	1.09
Unnat Halna, 200kg	35556	73191	37635	1.05
HUW-234, 0kg	32513	49019	16506	0.50
HUW-234, 40kg	33121	58393	25272	0.76
HUW-234, 80kg	33730	74203	40473	1.19
HUW-234, 120kg	34339	79644	45305	1.31
HUW-234, 160kg	34947	81252	46305	1.32
HUW-234, 200kg	35556	81328	45772	1.28
NW-1014, 0kg	32513	51992	19479	0.59
NW-1014, 40kg	33121	61900	28779	0.86
NW-1014, 80kg	33730	77988	44258	1.31
NW-1014, 120kg	34339	84620	50281	1.46
NW-1014, 160kg	34947	85175	50228	1.43
NW-1014, 200kg	35556	85473	49917	1.40

The data pertaining to economics were recorded and presented in Table 2. Data clearly revealed that cost of cultivation increased linearly with increasing nitrogen levels from 0 to 200 kg ha^{-1} in combination to all the varieties. The maximum cost of cultivation (≠ 35556 ha^{-1}) was computed at 200 kg N ha^{-1} with all the varieties. The maximum gross returns (≠ 85473 ha^{-1}) was recorded under the treatment combination of 200 kg N ha^{-1} with the variety NW-1014. Highest net returns (≠ 50281 ha^{-1}) were found under the treatment combination of 120 kg N ha^{-1} with the variety NW-1014. The lowest net return (≠ 10127 ha^{-1}) was recorded under 0 kg N ha^{-1} with the variety Unnat Halna. With regard to benefit-cost ratio (B: C ratio), the maximum B: C ratio (1.46) was obtained from treatment combination of 120 kg N ha^{-1} and the variety NW-1014 followed by 1.43 and 1.40 obtained from treatment combination of 160 kg and 200 kg N ha^{-1} with the variety NW-1014. The lowest B: C ratio (0.31) was obtained with variety Unnat Halna under 0 kg N ha^{-1}. Similar findings were also reported by Narolia and Pareek (2004) [1] and Yadav and Verma (1991) [8].

Conclusion

On the basis of results obtained from the present investigation, it can be concluded that NW-1014 variety coupled with N dose of 120 kg ha^{-1}appeared to be the most suitable agronomic interventions for realizing higher wheat yield and remuneration in eastern plain zone under late sown condition.

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