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Response of nitrogen levels on late-sown varieties of wheat (*Triticum aestivum* L.)

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Abstract
The experiment was conducted in randomized block design during *rabi* season of 2016-17 at research farm of Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya, to study the response of nitrogen levels on late-sown varieties of wheat (*Triticum aestivum* L.). The data revealed that PBW-373 has significance for growth attributes like Plant height, Number of tillers m^{-1} row length, Leaf area index, Dry matter accumulation, Days taken to 75% ear emergence and day to maturity than DBW 14, HUW-234 and HD-2643 except initial plant population which is not influenced significantly due to varieties and nitrogen management practices. Application of 150 kg nitrogen recorded at par with 120 kg + 30 kg for initial plant population (m^{-2}), Number of tillers m^{-1} row length, Leaf area index, Dry matter accumulation, Days taken to 75% ear emergence, day to maturity and plant height as increased significantly with increasing levels of nitrogen from 90 kg N ha^{-1} to 150 kg N ha^{-1}. The maximum benefit cost ratio (1.57) was obtained from treatment combination of 150 kg N ha^{-1} with the variety PBW-373 followed by benefit cost ratio (1.35) obtained from treatment combination of 120 kg N ha^{-1} + 30 Kg N through FYM with the variety PBW-373.

Keywords: growth, nitrogen management, randomized block design and wheat (*Triticum aestivum* L.)

Introduction
Wheat (*Triticum aestivum* L.) is a staple food of the world and falls under Poaceae family. It is primarily grown in temperate regions and also at higher altitude under tropical climatic areas in winter season. It ranks first in the world among the cereals both in respect of area (215.26 mha) and production (584.76mt.). In India, total area under wheat is 31.8 mha with the production and productivity of 96.5 mt and 3140 kg ha^{-1}, respectively. The nutritional composition of the wheat grain varies somewhat with differences in climate and soil. On an average, the kernel contains 12 percent water, 70 percent carbohydrates, 12 percent protein, 2 percent fat, 1.8 percent minerals, and 2.2 percent crude fibres. Thiamin, riboflavin, niacin, and small amounts of vit-A are present, but the milling processes removes most of those nutrients with the bran and germ. Wheat attained its premier position by virtue of its unique protein gluten, which is responsible for bread making properties of wheat flour.

The late transplanting of rice or use of long duration varieties of rice in low land delays the sowing of wheat from mid November to December. The preceding crops such as sugarcane, potato, toria etc. and other factors forced to sow the wheat as late as in the month of December and January. Due to delay sowing wheat yield is declined drastically. Low temperature, poor mineral accumulation, less translocation of photosynthates from source to sink, hot desiccating wind during milking stage forced premature drying and nutrient management are responsible for low yield under late sown wheat. Different varieties under late sown condition respond variably to various nitrogen management practices. The soil which enriched in organic matter has been found to respond better to the application of nitrogenous fertilizers (Subbiah and Bajaj, 1968) [6].

Materials and Methods
The field experiment was conducted at Agronomy Research Farm, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Ayodhya (U.P.), during *Rabi* season of 2016-17. The experiment was laid out in randomized block design with four varieties (DBW 14, HUW-234, PBW-373 and HD-2643) and five nitrogen management

practices (90 kg N ha^{-1}, 120 kg N ha^{-1}, 90 kg N ha^{-1} +30 Kg N through FYM, 120 kg N ha^{-1} + 30 Kg N through FYM, 150 kg N ha^{-1}) and replicated three times. Sowing was done on 15 December 2016 using 125 kg seed ha^{-1}. Spacing between rows was 20 cm apart. Field was sown with the help of Kudal. The nitrogen as per treatment through FYM was applied 15 days before sowing, while rest of the nitrogen was applied through Urea and DAP (18% N and 46% P_2O_5). ½ of the Urea was applied as basal (at time of sowing) and remaining ½ dose of nitrogen was applied at 30 days after sowing through the Urea. However, 60 kg P_2O_5 ha^{-1} through DAP and 40 kg K_2O ha^{-1} through muriate of potash was applied at the time of sowing as a basal dose. Observations recorded on growth attributes are like initial plant population (m^{-2}), Plant height(cm), Number of tillers m^{-1} row length, Leaf area index, Dry matter accumulation, Days taken to 75% ear emergence and day to maturity. The analysis of variance for different characters in Randomized Block Design was done according to Panse and Sukhatme (1967) [4]. The treatment differences were tested by 'F' test significance comparing the calculated variance ratio (F value).

Results and Discussion

Initial plant population per square meter

The data revealed that initial plant population was not influenced significantly due to varieties and nitrogen management practices. Therefore initial crop stand m^{-2} recorded at 15 DAS was almost uniform under all the varieties, indicating thereby the uniform seed viability and germination capacity of the varieties (Table 1).

Plant height (cm)

Plant height increased progressively at the successive stages of crop growth as influenced by various varieties and nitrogen management practices. Data pertaining to plant height is summarized in Table 2. In general, plant height increased successfully at 30, 60 and 90 DAS. There after the rate of increase in plant height was nominal at harvest stage of the crop. Maximum plant height was recorded with variety PBW-373, which was at par with HD-2643 and significantly superior over DBW-14 and HUW-234 varieties. Same trend as 60 DAS was found at 90 days after sowing and at harvest stage. Regarding nitrogen management practices, plant height as increased significantly with increasing levels of nitrogen from 90 kg N ha^{-1} to 150 kg N ha^{-1}. Application of 150 kg N ha^{-1} was found at par with 120 kg N ha^{-1} + 30 Kg N through FYM and 120 kg N ha^{-1} and it was found significantly superior with respect to the plant height over rest of the nitrogen management practices at 30 days after sowing. Same trend was found at 60 and 90 DAS whereas at harvest stage, it was at par only 120 kg N ha^{-1} + 30 Kg N through FYM and significantly superior over all other nitrogen management practices. Variation in plant height among varieties might also be probably due to their genetic characters. Similar finding in respect to varieties were reported by Brijkishor (1998) [3].

Number of tillers m^{-1} row length

The number of tillers m^{-1} row length increased progressively at the successive stages of crop growth as influenced by various varieties and nitrogen management practices. Data pertaining to number of tillers m^{-1} have been summarized in Table 3. In general, number of tiller increased progressively up to 90 DAS stage. Maximum number of tillers was found at 90 days after sowing and thereafter, decreased till the maturity. The higher number of tillers m^{-1} row length were recorded with variety PBW-373, which was at par with variety DBW-14 and significantly superior over all other varieties. Variation in number of tillers might be due to their own genetic characterstics. Similar finding in respect to varieties were reported by Behra (1994) [2] and Singh (1998) [5]. Number of tillers was significantly affected by various nitrogen management practices at all the stages of crop growth. Regarding nitrogen management practices, number of tillers increased significantly with increasing levels of nitrogen. Application of 150 kg N ha^{-1} was found at par with 120 kg N ha^{-1} + 30 Kg N through FYM and 120 kg N ha^{-1} and significantly superior over rest of the nitrogen levels at 30 DAS, while at 60, 90 DAS and harvest stage it was only at par with 120 kg N ha^{-1} + 30 Kg N ha^{-1} through FYM and significantly superior over all other nitrogen management practices.

Leaf area index (LAI)

In general leaf area index influenced significantly by varieties and nitrogen management practices at all the stages of crop growth (Table 4). In general, leaf area increased very slowly till 30 DAS and thereafter, it expanded at faster rates reaching the maximum at 60 DAS (5.10) and decreased after 90 days after sowing due to decreasing growth rate and senescence stage which showed drying and shattering of the leaves. The data revealed that maximum leaf area index recorded in variety PBW-373, which was at par with DBW-14 and significantly superior over all other varieties at 30, 60 and 90 DAS. Regarding nitrogen management practices, maximum leaf area index was recorded at 150 kg N ha^{-1} which was found at par with 120 kg N ha^{-1} + 30 Kg N through FYM and 120 kg N ha^{-1} and significantly superior over all other nitrogen management practices at 30, 60 and 90 DAS.

Dry matter accumulation (g m^{-1} row length)

Dry matter accumulation was significantly influenced by various varieties and nitrogen management practices (Table 5). In general, the dry matter accumulation increased with advancement in crop growth stages. A perusal of data in table revealed that maximum dry matter accumulation was recorded with variety PBW-373(679.90 g m^{-1} row length) which was at par with DBW-14 and significantly superior to rest of the varieties at 30, 60, 90 DAS and at harvest stage; similar findings were reported by Singh (1998) [5]. Regarding nitrogen management practices, dry matter accumulation was influenced significantly. Maximum dry matter accumulation was recorded with the application of 150 kg N ha^{-1} which was found at par with 120 kg N ha^{-1} + 30 Kg N through FYM and significantly superior over all other nitrogen levels at all stages of crop growth.

Days taken to 75% ear emergence and days taken to maturity

The data pertaining to days taken to 75% ear emergence and days taken to maturity as affected by different treatments recorded are presented in Table 6. The data revealed that the days taken to 50% ear emergence and days taken to maturity were not influenced significantly by varieties as well as nitrogen management practices.

Table 1: Effect of different treatments on initial plant population of wheat crop

Treatments	Initial plant population (m^{-2}) at 15 DAS
(A) Varieties	
DBW 14	177.40
HUW-234	178.40
PBW-373	179.40
HD-2643	176.40
SEm±	3.434
CD (P=0.05)	NS
(B) Nitrogen management practices	
90 kg N ha^{-1}	171.50
120 kg N ha^{-1}	174.50
90 kg N ha^{-1} + 30 Kg N through FYM	177.50
120 kg N ha^{-1} + 30 Kg N through FYM	185.50
150 kg N ha^{-1}	180.50
SEm±	3.839
CD (P=0.05)	NS

Table 2: Effect of different treatments on plant height at various growth stages of the wheat crop

Treatments	Plant height (cm)			
	30 DAS	**60 DAS**	**90 DAS**	**At harvest**
Varieties				
DBW 14	23.46	56.82	76.14	77.40
HUW-234	24.46	71.50	73.81	75.05
PBW-373	23.74	64.48	81.59	82.97
HD-2643	23.74	62.56	79.26	80.58
SEm±	0.422	1.127	1.50	1.37
CD (P=0.05)	NS	3.225	4.79	3.93
Nitrogen management practices				
90 kg N ha^{-1}	23.05	59.37	72.26	73.49
120 kg N ha^{-1}	23.50	61.29	78.47	79.76
90 kg N ha^{-1} + 30Kg N through FYM	23.95	63.20	74.58	75.83
120 kg N ha^{-1} + 30Kg N through FYM	24.65	67.03	80.03	81.37
150 kg N ha^{-1}	24.10	68.31	83.15	85.55
SEm±	0.471	1.260	1.67	1.53
CD (P=0.05)	NS	3.606	4.79	4.39

Table 3: Effect of different treatments on number of tillers at various growth stages of the wheat crop

Treatments	Number of tillers m^{-1} row length			
	30 DAS	**60 DAS**	**90 DAS**	**At harvest**
Varieties				
DBW 14	42.58	64.20	73.83	71.62
HUW-234	42.82	54.04	62.14	60.28
PBW-373	43.06	70.87	81.50	79.06
HD-2643	42.34	56.30	64.15	62.23
SEm±	0.768	1.170	1.290	1.390
CD (P=0.05)	NS	3.348	3.692	3.977
Nitrogen management practices				
90 kg N ha^{-1}	41.16	57.49	66.11	64.13
120 kg N ha^{-1}	42.60	60.65	69.75	67.65
90 kg N ha^{-1} + 30 Kg N through FYM	41.88	59.08	67.94	65.90
120 kg N ha^{-1} + 30Kg N through FYM	43.32	64.21	73.84	71.63
150 kg N ha^{-1}	44.52	65.33	74.38	72.15
SEm±	0.858	1.308	1.442	1.554
CD (P=0.05)	NS	3.744	4.128	4.447

Table 4: Effect of different treatments on leaf area index at various growth stages of the wheat crop

Treatments	Leaf area index		
	30 DAS	**60 DAS**	**90 DAS**
(A) Varieties			
DBW 14	1.01	4.44	4.62
HUW-234	0.97	3.74	3.89
PBW-373	1.09	4.90	5.10
HD-2643	1.05	3.90	4.05
SEm±	0.028	0.087	0.078
CD (P=0.05)	NS	0.249	0.223

(B) Nitrogen management practices			
90 kg N ha^{-1}	1.42	3.98	4.14
120 kg N ha^{-1}	1.47	4.20	4.37
90 kg N ha^{-1} + 30 Kg N through FYM	1.44	4.09	4.25
120 kg N ha^{-1} + 30 Kg N through FYM	1.49	4.44	4.62
150 kg N ha^{-1}	1.54	4.52	4.70
SEm±	0.031	0.097	0.087
CD (P=0.05)	NS	0.279	0.249

Table 5: Effect of different treatments on dry matter accumulation at various growth stages of the wheat crop

Treatments	Dry matter accumulation (g m^{-1} row length)			
	30 DAS	**60 DAS**	**90 DAS**	**At harvest**
(A) Varieties				
DBW 14	58.36	343.32	686.64	807.81
HUW-234	49.12	288.96	577.92	679.90
PBW-373	64.43	378.99	757.98	891.75
HD-2643	51.19	301.09	602.18	708.45
SEm±	1.024	5.696	8.289	10.014
CD (P=0.05)	2.932	16.305	23.726	28.662
(B) Nitrogen management practices				
90 kg N ha^{-1}	52.26	307.43	614.86	723.37
120 kg N ha^{-1}	55.14	324.33	648.66	763.13
90 kg N ha^{-1} + 30 Kg N through FYM	53.71	315.94	631.88	743.38
120 kg N ha^{-1} + 30 Kg N through FYM	58.37	343.37	686.75	807.94
150 kg N ha^{-1}	59.39	349.38	698.76	822.07
SEm±	1.145	6.369	9.267	11.195
CD (P=0.05)	3.278	18.230	26.527	32.045

Table 6: Effect of different treatments on days taken to 75% ear emergence and days taken to maturity

Treatments	Days taken to 75% ear emergence	Days taken to maturity
(A) Varieties		
DBW 14	86.60	127.60
HUW-234	86.96	127.96
PBW-373	85.92	126.92
HD-2643	87.10	128.10
SEm±	1.608	2.385
CD (P=0.05)	NS	6.827
(B) Nitrogen management practices		
90 kg N ha^{-1}	84.60	125.60
120 kg N ha^{-1}	86.23	127.23
90 kg N ha^{-1} + 30 Kg N through FYM	85.88	126.88
120 kg N ha^{-1} + 30 Kg N through FYM	87.55	128.55
150 kg N ha^{-1}	88.98	129.98
SEm±	1.798	2.667
CD (P=0.05)	NS	7.633

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