Vol.11 No. 2, Page No. 114–121 (2022)
Received: October, 2022; Accepted: December, 2022

Effect of Nitrogen levels and Row Spacing on Growth and Yield of Wheat (*Triticum aestivum* L.) under late Sown Condition in North Western Plains Zone

Sant Bahadur Singh[1], Prasenjit Patra[2] and Jitendra Kumar[*3]

[1]Professor, Dept. of Agronomy, R.B.S. College, Bichpuri, Agra (U.P.) India
[2]Dept. of Agronomy, R.B.S. College, Bichpuri, Agra (U.P.) India
[3]Research Scholar, Dept. of Agronomy, R.B.S. College, Bichpuri, Agra (U.P.) India
***Corresponding author's Email:** jkyadav.ag@gmail.com

Abstract

Field experiment was conducted at Agricultural Research Farm of Raja Balwant Singh College, Bichpuri Agra, during Rabi season of 2018-19 to evaluate the "Effect of nitrogen levels and row spacing on growth and yield of wheat in North Western Plains Zone". Application of Nitrogen had significant effect on germination count increased significantly with the application of 200 kg N ha^{-1}. Number of shoots metre^{-1} row length increased appreciably with every increasing levels of nitrogen up to 150 kg ha^{-1} at all the stages of crop growth. Shoot height increased with every increase in the level of nitrogen application; however the significant variations were recorded up to 150 kg N ha^{-1} at all the stages of crop growth. Dry matter accumulation in plants of 25 cm. row length was increased significantly with every increase in the rate of nitrogen application up to 150 kg N ha^{-1}at all the stages of crop growth. 75 per cent spike emergence and maturity delayed appreciably with every increase in level of nitrogen up to 150 kg N ha^{-1}. Length of spikes significantly increased with every higher level of nitrogen level up to 150 kg N ha^{-1}. Application of 150 kg N ha^{-1} did not differ 200 kg N ha^{-1} appreciably but both the levels produced higher number of spikelet's spike^{-1} over 50 and 100 kg N ha^{-1}. The number of grains spike^{-1} increased appreciably with every increase in the levels of nitrogen application up to 150 kg N ha^{-1}. Application up to 150 kg N ha^{-1} appreciably higher biological yield by 23.62 and 18.19 per cent, over 50 and 100 kg N ha^{-1}, respectively. Grain yield also increased conspicuously with every increase in the level of nitrogen application up to 150 kg N ha^{-1}.Appreciably higher straw yield was obtained with the application of 150 kg N ha^{-1}. The highest harvest index was recorded with 100 kg N ha^{-1}which was significantly higher than 150 and 200 kg N ha^{-1}.

Keyword : *Nitrogen levels, growth, yield, wheat*

Introduction

There is hardly any scope for expansion of area under Wheat. The main emphasis would be on increasing the productivity of Wheat by adopting the improved cultivation practices. In India, wheat is the second most important cereal crop after rice covering an area of 30.79 million hectares. Total annual production of wheat in India is 98.51 million tonnes with the productivity of 3.20 tonnes per hectare during 2017-18. India is the second largest wheat producer (approximately 12 per cent world's wheat production) and consumer after China[6]. With the current average productivity efforts need to be strengthened for further increasing productivity to meet the India's increasing wheat demand, which is expected to be up to 101.7 million tonnes by 2025. Therefore, in view of the above consideration the present investigation was conducted to study the effect of nitrogen on growth and yield of wheat, to optimize the row spacing for yield maximization in wheat, to access the interaction effect of levels of nitrogen and row spacing on wheat production, to work out the economics of the treatments.

Material and Methods

The present Field experiment was conducted at Agricultural Research Farm of Raja Balwant Singh College, Bichpuri Agra, during *Rabi* season of 2018-19 to evaluate the "Effect of nitrogen levels and row spacing on growth and yield of wheat in North Western Plains Zone". The research farm is situated at about 11 km to the west of Agra on Agra-Bharatpur Road at latitude of $27^0 2'$ N and longitude of $77^0 9'$ E with an elevation of 163.4 m above the mean sea level. Agricultural Research Farm, Raja Balwant Singh College Bichpuri, Agra (U.P.) has semi-arid, sub-tropical climate with extremes of temperature both in summers and winters. The winters (December to January) are severe with minimum temperature at 2 ^{0}C (in general) and during summers (May to June) temperature often goes up to 46 to 48 ^{0}C accompanied with hot and desiccating winds. The field at Bichpuri farm having homogenous fertility and uniform textural make up was selected for the field experimentation. This region falls under south-western semi-arid zone of Uttar Pradesh. The soil of experimental field was Gangetic alluvial with calcareous layer at the depth of about 1.5 m to 2.0 metre and was well drained. To determine the fertility status and other physico chemical properties of soil of experimental field a composite soil sample from 30 cm depth was taken just before layout and was subjected to mechanical and chemical analysis. To fulfill the requirement of objectives of the investigation field experiment was conducted during *Rabi* season of 2018-19. A "Randomized Block Design" with four nitrogen levels and three row spacing replicated four times was adopted. Other details about treatments are given in Table 1.

Table 1 Treatment details with notations

S. No.	Treatments	Notations
A.	**Nitrogen levels (Kg ha^{-1})**	
1.	50	N_1
2.	100	N_2
3.	150	N_3
4.	200	N_4
B.	**Row spacing (cm)**	
1.	16	S_1
2.	20	S_2
3.	24	S_3

The experimental field was given a pre-sowing irrigation and at proper tilth two ploughings by tractor were done followed by planking each time. Then field was finally laid out into plots leaving irrigation channels and bunds in between treatments. The full doses of phosphorus (60kg P_2O_5 ha^{-1}) and potash (40 kg K_2O ha^{-1}) were supplied through DAP and MOP, respectively as basal dose at sowing time along with one-third of the nitrogen as per treatment through urea and rest 2/3rd nitrogen was applied in two split doses after first and second irrigation by top dressing of urea. Seed material obtained from Indian Institute of Wheat and Barley

Research, Karnal, Haryana, under All India Coordinated wheat Improvement Project. The was treated with Agrosan GN @ 2 g kg^{-1} seed. The seeding material of variety HD-2967 was applied @ 125 kg seed ha^{-1} (on the basis of 1000 seed weight of 38 g) in furrows keeping row spacing as per treatment at the depth of 4-5 cm with the help of *kudali* and was covered by light planking. The crop was irrigated at the proper time as judged by the appearance of soil and the crop. Five irrigations were given to the crop and source of irrigation water was canal and tube-well.

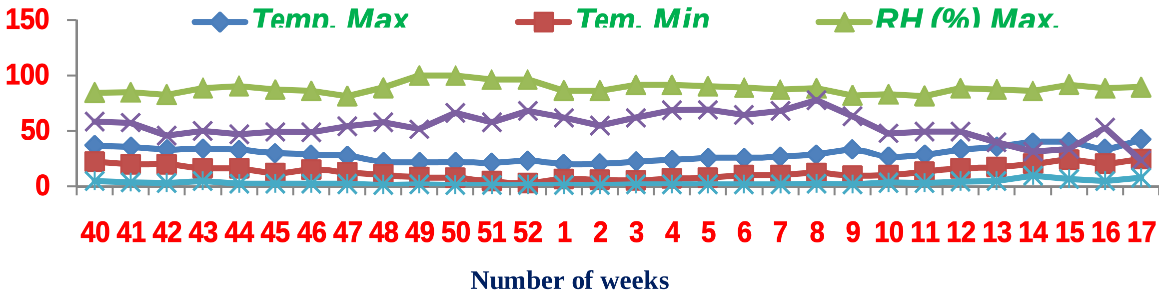

Fig1. Mean weekly meteorological, observation recorded during crop season of 2018-19 at meteorological observatory, R.B.S. College, Bichpuri, Agra.

Results and Discussion

In case of wheat the main yield contributing characters are length of spike, number of spikelet's spike^{-1} number of grains spike^{-1}, grain weight spike^{-1} and 1000 grain weight. The variations in these yield attributes due to treatment effect were measured and results so obtained were subjected to statistical analyses. The data pertaining to the main effects of all yield attributes have been summarized in Table 2. A critical study of the data presented in Table 2 revealed that nitrogen levels had significant effect on length of spike. The length of spike significantly increased with every higher level of nitrogen level up to 150 kg N ha^{-1}.When the nitrogen level increased from 150 kg N ha^{-1} to 200 kg N ha^{-1} the difference in length of spike was nominal and could not cross the level of significance. The magnitude of increase in spike length with the application of 150 kg N ha^{-1} (N_3) was to the tune of 7.05 and 5.93 per cent, respectively when compared with N_1 (50 kg N ha^{-1}) and N_2 (100 kg N ha^{-1}) levels.

Table 2 Yield attributes of wheat as influenced by nitrogen levels and row spacing.

Treatments		Spike Length (cm)	No. of spikelet's spike^{-1}	No. of grains spike^{-1}	Grains weight spike^{-1} (g)	1000 grain weight (g)
Nutrient levels						
50	N_1	8.51	16.53	46.71	1.90	41.40
100	N_2	8.60	16.71	48.42	2.00	42.53
150	N_3	9.11	17.32	51.48	2.08	42.86
200	N_4	9.16	17.19	51.54	2.11	42.94
SEm ±		0.17	0.21	0.97	0.03	0.11
CD at 5%		0.48	0.59	2.78	0.08	0.32
Row spacing						

16 cm	S_1	8.66	16.59	47.75	1.94	41.78
20 cm	S_2	8.91	17.02	49.41	2.02	42.72
24 cm	S_3	8.97	17.20	51.45	2.10	42.80
SEm ±		0.19	0.24	1.12	0.03	0.13
CD at 5%		0.55	0.68	3.21	0.09	0.37

The data summarized in Table 2 clearly showed that length of spike modify significantly due to different row spacings. The highest length of spike was recorded with 24 cm row spacing which was significantly higher by 3.58 per cent over 16 cm row spacings (S_1). However, the variation in length of spike with 20 cm (S_2) and 24 cm (S_3) row spacings was marginal and could not cross the level of significance. It is apparent that different levels of nitrogen application exert significant effect of number of spikelet's spike^{-1}. Application of 150 kg N ha^{-1} (N_3) did not differ from N_4 (200 kg N ha^{-1}) appreciably but both the levels produced higher number of spikelet's spike^{-1} over N_1 (50 kg N ha^{-1}) and N_2 (100 kg N ha^{-1}) which were statistically at par. The magnitude of increase in number of spikelet's spike^{-1} with 150 kg N ha^{-1} was to the tune of 3.58 and 0.67 per cent when compared with N_1 (50 kg N ha^{-1}) and N_2 (100 kg N ha^{-1}), respectively. The variations in number of spikelet's spike^{-1} of wheat were significantly affected due to row spacing. Wheat crop sown on 20 cm (S_2) and 24 cm (S_3) row spacing were statistically at par with respect to number of spikelet's spike^{-1} but had significantly higher number of spikelet's spike^{-1} by 2.59 and 3.68 per cent than that of row spacing of 16 cm (S_1), respectively.

Table 2 clearly indicates that application of different nitrogen levels had significant effect on number of grains spike^{-1}. The number of grains spike^{-1} increased appreciably with every increase in the levels of nitrogen application up to 150 kg N ha^{-1}. Further increase in level of nitrogen increased number of grains spike^{-1}marginally which could not cross the level of significance. Per cent increase in number of grains spike^{-1} with 150 kg N ha^{-1}was to the tune of 10.21 and 6.32 over 50 and 100 kg N ha^{-1}, respectively. It was noted that variations in number of grains spike^{-1} due to different row spacing were found significant .Every increase in row spacing increase number of grains spike^{-1}significantly. However, 24 cm row spacing (S_3) had maximum number of grains spike^{-1} over 16 cm and 20 cm row spacing and the difference was 7.75 and 4.13 per cent, respectively. An examination of the Table 2 under reference indicate that the application of 150 kg N ha^{-1} gave significantly higher grain weight spike^{-1} by 9.47and 4.00 per cent than that of 50 and 100 kg N ha^{-1}, respectively. When the level of nitrogen was increased from 150 to 200 kg N ha^{-1}, grain weight spike^{-1}, increased marginally and the difference could not cross the level of significance. The results enumerated in Table 2 indicate that grain weight spike^{-1} modify significantly due to different row spacings. The variation in grain weight spike^{-1}with 20 cm (S_2) and 24 cm (S_3) row spacings was not appreciable but both the row spacings resulted significantly higher grain weight spike^{-1} by 8.25 and 4.12 per cent over 20 cm row spacing (S_1), respectively. The data set out in Table 2 indicated that levels of nitrogen had significant effect on 1000-grains weight. The 1000 grains weight increased appreciably with every increase in the level of nitrogen application. However, the difference in 1000-grains weight due to 150 kg N ha^{-1} (N_3) and 200 kg N ha^{-1}(N_4) levels of nitrogen was nominal and could not reach the level of significance. The magnitude of increase in 1000-grains weight with 150 kg N ha^{-1} (N_3) level was to the tune of 3.53 and 0.78 per cent, respectively over 50 kg N ha^{-1} (N_1) and 100 kg N ha^{-1}(N_2) levels, respectively, Clearly showed that different row spacing had significant effect on 1000-grains weight. Row spacing S_3 (24 cm) and S_2 (20 cm) did not differ much among themselves but both the spacings registered significantly higher 1000-grains weight by 2.44 and 2.25 per cent than S_1 (16 cm), respectively.

Table 3 Biological, Grain, Straw yields of wheat and harvest index as influenced by nitrogen levels and row spacing

Treatments		Biological yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
Nutrient levels					
50	N_1	120.31	47.37	72.94	39.37
100	N_2	125.84	50.21	75.63	39.90
150	N_3	148.73	54.19	94.54	36.44
200	N_4	147.50	54.00	93.50	36.61
SEm ±		0.57	0.81	0.39	0.73
CD at 5%		1.64	2.32	1.12	2.08
Row spacing					
16 cm	S_1	127.21	47.53	79.68	37.36
20 cm	S_2	130.38	51.62	78.76	39.59
24 cm	S_3	149.21	55.18	94.03	36.98
SEm ±		1.02	0.94	0.45	0.84
CD at 5%		1.89	2.68	1.29	2.40

Biological yield (q ha^{-1}) increased appreciably with increasing levels of nitrogen application upto 150 kg N ha^{-1}.The magnitude of increase in total biological yield with 150 kg N ha^{-1}was to the tune of 23.62 and 18.19 per cent, respectively over the 50 and 100 kg N ha^{-1}, respectively. A deep look on the data arranged in table 3 indicates that biological yield (q ha^{-1}) was significantly influenced due to row spacing. Row spacing of 24 cm (S_3) recorded maximum biological yield (149.21 q ha^{-1}) which was significantly higher by 17.29 and 14.44 per cent over row spacing of 16.0 cm (S_1) and 20 cm (S_3), respectively. Row spacing of 20.0 cm also gave significantly higher biological yield ha^{-1} by 2.49 per cent over 16 cm (S_1).

The data computed in table 3 clearly indicated that the grain yield differed significantly due to levels of nitrogen. Every increase in the nitrogen level increased the grain yield significantly up to 150 kg N ha^{-1}. The per cent increase in grain yield with the application of 150 kg N ha^{-1} was to the tune of 14.40 and 7.93 per cent over 50 and 100 kg N ha^{-1}, respectively. When the nitrogen level increased from 150 kg N ha^{-1}to200 kg N ha^{-1} the grain yield decreased slightly and the difference was not significant. The data set out in table-3 indicated that row spacing had significant effect on grain yield. The highest grain yield was obtained when wheat crop was sown at the row distance of 24 cm (S_3). The magnitude of increase in grain yield with the row spacing of 24 cm was to the tune of 16.10 and 6.90 per cent over row spacing of 16 cm (S_1) and 20 cm (S_2), respectively. A perusal of data set out in Table 3 showed that levels of nitrogen had significant impact on straw yield. Table further indicated that application of 150 kg N ha^{-1} (N_3) produced the maximum straw and this level of nitrogen was significantly superior as compared to other levels of nitrogen. The magnitude of increase in straw yield with the application of 150 kg N ha^{-1}over 50 and 100 kg N ha^{-1} was 29.61 and 23.63 per cent, respectively. The data given in table-3 showed that row spacing had significant impact on straw yield. Significantly maximum straw yield was obtained when wheat crop was sown at the row spacing of 24 (S_3) which was 18.01 and 19.39 per cent higher over 16 and 20 cm row spacing, respectively. Different levels of nitrogen application had significant effect on harvest index (Table 3). The highest harvest index was recorded with 100 kg N ha^{-1} (N_3) which was significantly higher than 150 kg N ha^{-1} (N_3) and 200 kg N ha^{-1}(N_4) levels of nitrogen, which were statistically at par among themselves. Row spacing influenced the harvest index significantly (Table 3). However, crop grown at 20 cm row spacing (S_2) had considerably higher harvest index as compared to row spacing of 16 (S_1) and 24 cm (S_3) which were statistically at par.

The present study entitled "Effect of nitrogen levels and row spacing on growth and yield of wheat in North Western Plains Zone" was designed mainly to determine the response of wheat to nitrogen application and row spacing in terms of growth and development, yield and yield attributes, and also work out maximum net return from Levels of nitrogen application in wheat influenced the initial plant population significantly. Number of shoots per running metre and shoot height increased appreciably with the application of 150 and 200 kg N ha^{-1} over 50 and 100 kg N ha^{-1} at almost all the stages of crop growth. The favourable effect of 150 kg N ha^{-1} over lower levels of nitrogen on plant growth might be due to the fact that optimum nitrogen is required by plants for meristematic activities of the cells and results increased number of shoots and plant height, all these growth characters in turn decide the maximum utilization of light and other growth affecting factors which ultimately results in more bet photosynthetic within the plant body. It may also be pointed out here that under nitrogen deficiency, the respiratory activities of the plants are proportionally more than in the ample supply of this nutrient, while the photosynthetic activities may be reduced.

The increment in one or more characters *i.e.* number of shoots, shoots height and dry matter accumulation in plant up to 150 kg N ha^{-1} have also been reported earlier[2,3]. Earliness of longer period of a cereal crop as judged by the number of days required for 75 per cent blooming and for maturity of the seed when the spikes are harvestable. The rates of nitrogen application had significant effect on number of days taken to 75 per cent blooming and maturity. Higher rate of nitrogen application has extended the days to 75 per cent blooming and maturity of the crop. On an average, about 93 and 117 days were required for 75 per cent blooming and maturity with 50 kg N ha^{-1}, respectively, Whereas the plants with 150 and 200 kg N ha^{-1} took about 97 and 122 days for 75 per cent blooming and maturity, respectively. It may be argued here that more availability of nitrogen favors vegetative phase, therefore delay in emergence of reproductive phase and senescence under high nitrogen rates seem to be logical.

The data assembled in table 3 very well indicate that importance of nitrogen as judged by grain production. It may be seen that the grain yield ha^{-1} with 50, 100,150 and 200 kg N ha^{-1} was 47.37, 50.21, 54.19 and 54.0 q ha^{-1}, respectively. The effect of nitrogen fertilization was very well marked with the application of 150 and 200 kg N ha^{-1} application the reproductive energy is increased and there is an increased number of effective shoots which form the set of spikes. The more number of effective shoots the greater would be the spike number. The similar results have also been reported in the past[4]. Grain weight $spike^{-1}$ significantly increased with 150 and 200 kg N ha^{-1} over 50 and100 kg N ha^{-1}. The grain yield decreased marginally with increasing rate of nitrogen from 150 to 200 kg N ha^{-1}. The higher grain yield might be due to increase in protoplasm and consequently the amount of proteins accumulated in grain caused large grain size and thus produced heavy grains in 150 and 200 kg N fertilized plants. Rates of nitrogen application had significant effect on length of spike and number of grains spike up to 150 Kg ha^{-1}. Similar trend was also noticed in case of 1000 grain weight.

In the present experiment, the wheat crop was grown at three different row spacings *i.e.*16 cm, 20 cm and 24 cm apart. Due to competition for light, air and nutrients among the plants the row to row and plant to plant distance is very crucial factor for plant growth and development and ultimately for yield. All the growth and development character such as number of shoots per cent row length shoots height, dry matter accumulation in plants of 25 cm row length and days to 75 per cent spike emergence and days to maturity differ significantly due to different row at almost all the stages of crop growth. However, these growth and development characters were decreased with every change in the spacing thus, the maximum values were recorded with 20 cm row spacing. Similar trend in dry matter accumulation was observed and 20 cm row spacing (S_2) had maximum values at all the stages of crop growth and at harvest over16 cm and 24 cm row spacings. Days to spike emergence and days to maturity might be genetically influenced factors. The observation revealed that the variation in number of days required to spike emergence due to row spacing were non-significant. However, the number of days required to spike emergence were more with 20 row spacing than that of other treatments of row spacings. The same observation was observed in case of number of days required to maturity clearly indicate that the effect of row spacing on length of spike, number of spikelet's per spike, Grains weight spike^{-1} and 1000- grain weight was significant. A perusal of the data presented in Table 3 clearly reveals that the variation in biological, grain and straw yield due to row spacing was significant. However, barley crop planted in rows of 20 cm apart recorded higher biological, grain and straw yield over the crops planed in row spacing of 16 and 24 cm. These results are in close conformity with the finding earlier workers[7].

References

1. Ali, Nasir; Durrani, Saba; Shabaz, M.A.; Abdul Hafeez and Abdul Waheed (2018). Effect of Different Nitrogen Levels on Growth, Yield and Yield Contributing Attributes of Wheat, *International Journal of Scientific & Engineering Research*, 9(9):595:602.
2. Ananda, N. and Patil, B. N. (2007). Effect of zinc, iron and split application of nitrogen on growth, yield of durum wheat (*Triticum durum Desf.*) and on available nutrient status in soil. *Research. On crops*, 8(3):515-519.
3. Bisen, P.K. and Singh, P.K. (2001). Performance of wheat genotype under varying levels of nitrogen application as affected by weather condition. *Research on crop*, 2(3): 441-442.
4. Imdad Ullah, Nasir Ali, Saba Durrani and Muhammad, Adeel (2018). Effect of different nitrogen levels on growth, yield and yield contributing attributes of wheat, *International Journal of Scientific & Engineering Research*, 9(9):596-602.
5. Iqbal, N.; Akbar, N.; Ali, M.; Sattar, M. and Ali, L. (2012). Effect of seed rate and row spacing on yield and yield components of wheat (*Triticum aestivum* L.), *Journal of Agriculture Research*, 48(2):151-156.
6. Patel, M.D.; Dabhi, M.S.; Patel, A.K.; Desai, H.A. and Chatra Ram (2018). Response of Wheat Varieties (*Triticum aestivum* L. and *Triticum durum* Desf.) to Sowing Time, *International Journal of Current Microbiology and Applied Sciences*, 7(10): 1555-1561.
7. Yadav, R.K.; Shishir Kumar and Dawson, J. (2008). Effect of light interception, row orientation, Row spacing and weed management on economics of wheat (*Triticum aestivum* L.), *Plant Archives*, 8(1)389-391.