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Mahipat Singh Yadav
Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh, India.

CS Dhanai
Associate Professor, Department of Forestry, Uttarakhand University of Horticulture & Forestry, Hill Campus Ranichauri (UK), India.

Correspondence
CS Dhanai
Associate Professor, Department of Forestry, Uttarakhand University of Horticulture & Forestry, Hill Campus Ranichauri (UK), India.

Effect of different doses of nitrogen and seed rate on various characters and seed yield of wheat (*Triticum aestivum* L.)

Mahipat Singh Yadav and CS Dhanai

Abstract
A field experiment was conducted to study the effects of different doses of nitrogen application on different seed rate a semi dwarf, high yielding with good quality traits on 'K-8020', variety of wheat was evaluated to study the effect of different seed rate and different doses of nitrogen application on germination percent, purity percent and yield of wheat. The results showed that different doses 100, 120 and 140 kg/ha nitrogen and 100, 125 and 150 kg/ha seed rate significantly out yielded the 100 kg/ha nitrogen and seed rate in seed yield, biological yield. Almost similar result were obtained in case of shoot length, plant height, dry matter (gm.), spike length (cm.), number of spike/ear, number of seeds/ spike, 1000 seed weight and harvest index. The application of 140 kg N/ha and 150 kg seed rate/ha was the best combination for getting higher seed yield with its better quality.

Keywords: wheat, nitrogen (N.), seed rate, seed yield, biological yield

1. Introduction
Wheat (*Triticum aestivum* L.) is one of the most important grain crop used in the world. Among world cereal crops it ranks first accounting 30 % of all cereal food in the world and is staple food for more than 10 billion people about in 43 countries. In India, wheat is the second most important cereal crop after rice, covering an area 25.63 million hectare contributing 68.43 million tones to world's food grain production with the productivity of 30.25q/ha during 2015-16, it is generally cultivated on plains. Wheat is nature's unique gift to mankind as it produces excellent source of nutrition in terms of carbohydrates, minerals and proteins. Although wheat is grown in most of the states, the major production comes from the north western part of the country. The increase in domestic demand of baked and pasta products in the country and economic liberalization and global trade have offered opportunities for better utilization of wheat. Wheat quality needs uppermost attention to meet the trade requirements of the domestic and international markets. Quality of food grain is a complex phenomenon and may be influenced by several factors which may be genetic and /or environmental. Cultural practices considerably influence the grain quality. A doption of suitable practices like different seed rate and nitrogen application play a key role on the quality of wheat. Nitrogen is the most important constituent of plant proteins and is required throughout the crop growth period from vegetative stage to subsequent harvesting. Application of nitrogen is known to mainly increase the grain yield, biological yield and other characters including plant height and 1000 seed weight etc. Many researchers have found that late season top dressed nitrogen addition as dry fertilizer material were most effective in attaining higher grain protein concentration, yield and increased fertilizer recovery and efficiency (M. Satyanarayana., 2015) [7] and (Parveen Kousar *et al*., 2015) [11]. Therefore, availability of nitrogen to wheat during various phases of its growth and development is an important factor influencing the yield and quality of grain (Muhammad Yousaf *et al*., 2015) [8]. Seed rate also plays a key role in the grain yield and quality of wheat. Seed rate governs the inter and intra plant competition, the numbers of tillers per plant, spikelet number per spike, grain size, grain shape etc. Likewise nitrogen nutrition, seed rate also influences the plant growth, development, seed size and other qualities of wheat. Although sufficient information is available on the effect of fertilizers on yield attributes but the information on the effect of time of nitrogen application and seed rate on biochemical parameters is meager. Keeping this aspect in mind, the present investigation is planned with the objectives to study the impact of different doses of nitrogen application and seed rate on seed yield, biological yield and other characters and its quality in a national variety 'K-8020' of wheat (*Triticum aestivum* L.) in the agro-climatic condition of Jhansi region (U.P.).

2. Materials and Methods

The present investigation was carried out on Wheat cultivar 'K-8020' at the research farm Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.) during rabi (winter) season of 2015-16. The treatment comprising of three levels of nitrogen viz- 100, 120 and 140 kg/ha and three graded levels of seed rate viz- 100, 125 and 150 kg/ha were laid-out in randomized block design with three replications each. Thus total number of treatment combination were 09, the grass plot size in the experiment was taken 5X3.6 m=18m^2, whereas the net plot size was 4mX1.80=7.2m^2, row to row spacing was 20 cm, plant to plant spacing 5 cm, no. of rows sown per plot were 8 and no. of rows harvested per plot were 4. Urea was the sources of nitrogen. The observation were recorded on germination percentage, number of shoots length, plant height, number of functional leaves, dry matter, spike length (cm), number of spikes /ear, number of seeds /spike, seed yield, biological yield, straw yield, purity percentage,1000 seed weight and harvest index. The data was subjected to statistical analysis as per method proposed by (Cochran, W.G. and Cox. G.M. 1959) [2].

3. Result and Discussion

For the use of proper quality of fertilizers in most essential for enhancing yield and quality important inputs for increasing productivity of this crop, therefore these fertilizer were tried to find their role in wheat crop and the results of present study are discussed character wise.

3.1 Germination Percent

The seed germination percent of wheat under three levels of seed rate i.e. 100, 125, 150 kg/ha and three studied nitrogen fertilization rates as shown in (table-1) showed significant increase with the increase in seed rate of 100, 125 and 150 kg/ha. The highest germination percent (94%) was recorded with 100 kg seed rate/ha which was significantly higher than 125 and 150 kg seed rate/ha and lowest germination percent recorded (92%) in case of 150 kg seed rate/ha, respectively whereas crop fertilized with 140 kg N/ha was influenced significantly over control and produced highest germination percent of (94%) however, germination percent recorded with the application of 100 and 120 kg N/ha remained at per. This significant influence of different levels of nitrogen fertilization over the lower levels was observed because of nitrogen formation of plant height under higher rates of nitrogen. Those results are in full agreement with those observed by (Samiram *et al.*, 1993) [12] and (M. Satyanarayana 2015) [7], who observed that the increasing levels of nitrogen not only increased the germination percent but also gave higher yield of straw, more functional leaves, high growth rate and higher net assimilation rate at all the stage of growth.

3.2 Plant height

All the three seed rate of wheat viz- (100, 125 and 150 kg/ha) table-1 reveals on effect up to a greater extent with the increase in all three seed rate of wheat. After 60 and 90 days of sowing the plant height increased significantly up to 150 kg seed rate/ha showing the maximum plant height (38.0 cm. & 92.8 cm.) respectively, and 100 and 125 seed rate /ha gave almost similar minimum plant height, where in case of nitrogen application, the plant attained the maximum plant height of (40.0 cm. & 94.2 cm.) at nitrogen levels of 140 kg/ha, in both the stages, (60 & 90) days of sowing. At the harvesting stage, the maximum plant height was recorded (93.0 cm.) in case of 150 kg seed rate/ha and the minimum in 100 and 125 kg seed rate/ha, thus showing clear at effect of 150 kg seed rate increasing on plant growth. These findings are consonance with the reports of (Kumar B. *et al.*, 2000) [4] and (Amjed Ali *et al.*, 2011) [1]. While in case of nitrogen application, the maximum plant height recorded with the application of 140 kg N/ha was (95.4 cm.), which differed significantly from the plant height recorded at 100 and 120 kg N/ha was (90.0 and 95.1 cm.) respectively. Consequently, the main effect of nitrogen plant height during the observation recorded after 60 & 90 days of sowing and at harvesting stage was found significant. The combined effect of seed rate kg/ha and nitrogen levels kg/ha have showed significantly effect on plant height, the seed rate 150 kg/ha have showed significantly more plant height up to 140 kg N/ha while the plant height of 100 and 125 kg seed rate/ha was increased up to 120 kg N/ha beyond. These findings are comparable with (Pandey, I.B. *at el.*, 1999) [10], who stated that plant height, number of shoot length, increased significantly with the increasing levels of nitrogen fertilization.

3.3 Dry matter (gm.)

Concerning dry weight under the studied of three levels of seed rate viz. 100, 125 and 150 kg/ha and nitrogen fertilization levels, viz. 100, 120, and 140 kg/ha, data of (table-1) revealed that it is clear from the table that maximum dry matter was recorded (16.0 gm.) in 100 kg seed rate/ha, it was significantly superior comparison of 125 and 150 kg seed rate/ha, and 125 and 150 kg seed rate/ha produced almost similar dry weight (gm.). However in case of application of nitrogen up to 140 kg N/ha recorded significantly higher dry weight (gm.) than 100 kg N/ha, although dry weight with the application of 120 kg N/ha remained at par with 140 kg N/ha, the high dry weight (15.7 gm.) being recorded at 140 kg N/ha level. Henceforth, improvement in the growth and yield attributes of wheat due to nitrogen application was quit logical. The results are in conformity with the findings of (Parveen Kousar *et al.*, 2015) [11], who also reported increased dry weight with increased fertilization of nitrogen.

3.4 Number of functional leaves

Concerning number of functional leaves per plant under the studied of three levels of seed rate viz. 100, 125 and 150 kg/ha and nitrogen fertilization levels, viz. 100, 120, and 140 kg/ha, data of (table-1) revealed that it is clear from the table that maximum number of functional leaves was recorded (28.4) in 100 kg seed rate/ha, it was significantly superior comparison of 125 and 150 kg seed rate/ha, and 125 kg seed rate/ha produced number of functional leaves (26.0) was superior in comparison to 150 kilogram of seed rate. However in case of application of nitrogen up to 140 kg N/ha recorded significantly higher number of functional leaves per plant than 100 kg N/ha, although number of functional leaves per plant with the application of 120 kg N/ha remained at par with 140 kg N/ha, the high number of functional leaves per plant (28.4) being recorded at 140 kg N/ha level. Henceforth, improvement in the growth and yield attributes of wheat (*Triticum aestivum* L.) due to nitrogen application was quit logical. The results are in conformity with the findings of (Sawires E.S., 2000) [13] and (M. S. Alam, 2012) [6], who also reported increased number of functional leaves per plant with increased fertilization of nitrogen.

3.5 Number of shoots / length

It is revealed from (table-1) that all three doses of nitrogen and seed rate kg/ha of wheat had highly significantly effect on

the number of shoots/length. The highest number of shoots/length was recorded (102.0) at in 150 kg seed rate/ha which was significantly higher than 100 and 125 kg seed rate/ha, but in case of 125 kg seed rate/ha recorded significantly highest number of shoots/length (94.2) in comparison to 100 kg seed rate/ha. However in case of nitrogen, similar trend of significant increase was observed for number of shoots/length, their number varying from 36.0 to 40.0 with highest increased was observed for number of shoots/length was increased with increasing levels of nitrogen up to 140 kg/ha and there after it was increased numerically. The number of shoots/length was influenced with the combined effect of seed rate and nitrogen levels. This could be on account of various vegetative growths due to greater cell division and more meristematic activity increasing supply of nitrogen for the formation of shoots/length it is well known that nitrogen being the constituent of amino acids, proteins, chlorophyll and protoplast would directly influence the growth and attributing characteristic through better utilization of photosynthesis. These result are in agreement with those obtained by (Palfdey, L.F *at el.,* 1999) [9], who has are ported that the increasing levels of nitrogen increasing plant height, number of shoot length, yield straw and functional leaves per plant, relative growth rate and assimilation retreat all the stages of crop growth.

3.6 Spike length (m.)

It is revealed from the data given in table-1 that different levels of seed rate had considerable effect on length of spike. The height length of spike (7.8 cm.) was recorded in 100 kg seed rate/ha which was significantly higher than the length of spike in other levels of seed rate including 150 kg seed rate/ha. This could be due to the availability of more nutrients for proper development of vegetative parts of plant including spike under higher doses of seed rate kg/ha. These results are in full agreement with those observed by *Kumar at el., 2000*. However, in case of 140 kg levels of nitrogen, (7.9 cm.) length of spike was recorded which was significantly higher than the spike length observed in 100 and 120 kg doses of nitrogen per hectare. These findings are in full agreement to those reported by (Muhammad Yousaf *et al.,* 2015) [8], who observed that the increasing level of nitrogen not only increased the spike length but also gave higher yield of straw, more functional leaves, high growth rate and higher net assimilation rate at all the stages of crop growth.

Table 1: Effect of nitrogen levels and seed rate on germination percent, plant growth, seed yield and some other traits of wheat.

Fertilizer	Germination Percent	Plant height			Dry matter (gm.)	No. of functional leaves	No. of shoots/length	Spike length (cm.)
Nitrogen (kg/ha)		60 day	90 days	At harvest				
100	92	36.0	88.0	90.0	12.0	24.5	85.1	7.1
120	93	38.5	92.0	95.1	14.4	26.1	96.2	7.6
140	94	40.0	94.2	95.4	15.7	28.4	100.4	7.9
SE m±	0.3	1.1	1.9	1.1	1.0	2.2	2.0	0.5
CD at 5%	0.9	NS	NS	NS	3.2	NS	6.1	NS
Seed rate (kg/ha.)								
100	94	38.3	91.2	92.0	16.0	28.4	85.3	7.8
125	93	38.2	91.5	92.1	14.4	26.0	94.2	7.7
150	92	38.0	92.8	93.0	13.0	24.0	102.0	6.3
SE m±	0.3	1.1	1.9	1.1	1.0	2.2	2.0	0.5
CD at 5%	0.9	NS	NS	NS	3.2	NS	6.1	NS

3.7 Number of spikes/ear

The result presented in table-2 indicated that all the two levels of seed rate kg/ha i.e. 100 and 125 kg/ha gave two significantly higher number of spikes/ear in comparison to 150 kg seed rate/ha. The difference in the number of spikes/ear with the doses of 100 and 125 kg nitrogen/ha were also significant. The highest number of spikes/ear was recorded in (18.0) kg N/ha followed by 100 kg N/ha. These findings are in consonance to result reported by (Singh, Ved. *et al.,* 2003) [14] and (Parveen Kousar *et al.,* 2015) [11]. In case of nitrogen application, 140 kg/ha dose of nitrogen produced highest number of spike/ear followed by 120 kg of nitrogen/hectare. The differences in the number of spikes/ear among all the doses of nitrogen including control 100 kg N/ha were significant. The successive increasing the number of spikes/ear under varied doses of nitrogen and seed rate may due to availability of more nutrients for proper growth of plant at different stages of wheat crop. These findings are in full agreement to the results reported earlier by (Sawires, E.S. *et al.,* 2000) [13] and (Kumar B. *et al.,* 2000) [4].

3.8 Number of seeds/spike

Number of seeds/ spike recorded in wheat under three levels of nitrogen application are given in table-2 which revealed that there were significant difference in the mean values of seed per spike (43.5) was recorded in 100 kg seed rate/ha and lowest (40.0) in case of 150 kg seed rate/ha it was observed that this doses was significantly better over control as well as other doses (125 and 150 kg/ha) of seed rate in increasing the number of seed per spike in other in producing the number of seed per spike. In case of nitrogen, the number of seed per spike recorded in wheat under three doses of nitrogenous fertilizers. The highest number of seeds per spike (42.5) was recorded in 140 kg N/ha and lowest (40.5) in case of 100 kg N/ha it was evident that increase in the number of seed/spike with the application of 120 kg N/ha was successive and it amounted (119.45%) higher over 100 kg N/ha, respectively, similar result were reported by (Lathwal *et al.,* 1992) [5] and (Kibe *at el.,* 2003) [3], who found that use of higher doses of nitrogen in wheat crop increased the number of grain per spike.

3.9 Seed yield (q/ha)

It was observed (table-2) that there was remarkable increase in seed yield with increase in the doses of seed rate kg/ha against control. The highest seed yield was recorded in 150 kg seed rate /ha (41.0 q/ha) followed by 125 kg seed rate/ha (40.5 q/ha) and the lowest seed yield was recorded by 100 kg seed rate/ha (36.0 q/ha). The increase in seed yield under all the two seed rate kg/ha (125 and 150 kg/ha) was significantly higher as compared to 100 kg seed rate/ha respectively. These findings are in consonance with the reports of (Pandey, I.B. *et*

al., 1999) [10], while in case of nitrogen maximum seed yield recorded with the application of 140 kg N/ha was (40.5 q/ha), which was significantly higher than all the three levels of nitrogen. The result are conformity with the findings of (Muhammad Yousaf *et al.,* 2015) [8], who reported that the treatment doses of 120 kg N/ha were observe highest seed yield as compare to other treatment.

3.10 Straw yield (q/ha)

As, for the straw yield q/ha, the highest value of (83.5 q/ha) was obtained at 150 kg seed rate/ha showing a significant increase with the increasing dose of seed rate kg/ha. The various straw yields attributes like higher seed yield showed their additive effect in influencing the straw yield with increasing rate of seed rates kg/ha ultimately all these straw yield attributes had their pronounced effect in significantly increasing the straw yield of wheat at higher rates of nitrogen application up to 150 kg N/ha. These results are in accordance with the early research workers working on wheat (Pandey, I.B. *et al.,* 1999) [10], who also reported that increased straw yield with the increased straw yield with increased seed rate kg/ha. Comparing the straw yield q/ha, under the nitrogen rates, data presented in table-2 showed that the highest straw yield q/ha (85.6 q/ha) was obtained under 140 kg N/ha level. Thus, the straw yield q/ha increased significantly with a successive increase in levels of nitrogen fertilization, similar to seed rate. The reason being straw yield of wheat is chiefly a product of yield attributing characters like grain weight per year. Consequently, the increase in other yield attributing characters due to nitrogen fertilization resulted in increase straw yield q/ha of wheat. These results confirm the findings of (M. S. Alam, 2012) [6].

3.11 Biological yield

The result presented in table-2 showed that all the three levels of seed rate viz- 100 and 125 kg/ha gave significantly higher biological yield over 100 kg N/ha it was farther clear from the seed rate 150 kg/ha has yielded significantly higher biological yield (124.4 q/ha) in compared to 100 and 125 kg seed rate/ha respectively similarly, seed rate 125 kg/ha has also given significantly higher biological yield (115.2 q/ha) in compare to 100 kg seed rate/ha respectively. These results are in agreement with those obtained by (Parveen Kousar *et al.,* 2015) [11]. However in case of nitrogen application the biological yield was increased with increasing doses of nitrogen up to 140 kg N/ha (126.1 q/ha). The biological yield kg/ha was significantly influenced by seed rate and nitrogen doses in which seed rate of 150 kg/ha produces significantly the maximum biological yield (115.2 q/ha) at 120 kg N/ha. The results are in conformity with the findings of (Singh, Ved. *et al.,* 2003) [14] and (M. Satyanarayana., 2015) [7].

3.12 Purity percent

The data given table-2 revealed that all the three seed rate kg/ha of wheat. The seed rate of 100 kg/ha gave significant higher Purity percent (96 %) as compared to 125 and 150 kg seed rate/ha and the lowest Purity percent was founded (94 %) in seed rate of 150 kg/ha respectively. The data revealed that all the three levels of Nitrogen gave significantly higher Purity percent as compared to 140 kg levels of Nitrogen. The use of 140 kg N/ha gave significantly higher Purity percent **(**96 %) over other two doses i.e. 100 and 120 kg N/ha. The difference in the harvest index between 120 kg N/ha was non-significant. The value of Purity % in 140 kg/ha of Nitrogen was at per with the Purity percent value of all the other two levels of nitrogen similar result were reported by (Sawires, E.S. *et al.,* 2000) [13], who reported that Purity percent, Germination percent and spike length (cm.) increased significantly with increasing levels of nitrogen fertilization.

3.13 1000 seed weight

The seed weight of wheat under three levels of seed rate i.e. 100, 125, 150 kg/ha and three studied nitrogen fertilization rates as shown in (table-2) showed significant increase with the increase in seed rate of 100, 125 and 150 kg/ha. The highest 1000 seed weight (43.0) was recorded with 100 kg seed rate/ha which was significantly higher than 125 and 150 kg seed rate/ha and lowest 1000 seed weight recorded (41.0) in case of 150 kg seed rate/ha, respectively where as crop fertilized with 140 kg N/ha was influenced significantly over control and produced highest 1000 seed weight of (43.0) however, 1000 seed weight recorded with the application of 100 and 120 kg N/ha remained at per. This significant influence of different levels of nitrogen fertilization over the lower levels was observed because of nitrogen formation of plant height and shoot length under higher rates of nitrogen. Those results are in full agreement with those observed by (Samiram, J.S. *et al.,* 1993) [12], who observed that the increasing levels of nitrogen not only increased the 1000 seed weight but also gave higher yield of straw, more functional leaves, high growth rate and higher net assimilation rate at all the stage of growth.

3.14 Harvest index

The data given table-2 revealed that all the three seed rate kg/ha of wheat. The seed rate of 125 kg/ha gave significant higher harvest index (35.1 %) as compared to 100 and 150 kg seed rate/ha and the lowest harvest index was founded (32.9 %) in seed rate of 150 kg/ha respectively. The data revealed that all the three levels of nitrogen gave significantly higher harvest index as compared to 140 kg levels of nitrogen. The use of 100 kg N/ha gave significantly higher harvest index (35.9 %) over other two doses i.e. 120 and 140 kg N/ha. The difference in the harvest index between 120 kg N/ha was non-significant. The value of harvest index in 140 kg/ha of nitrogen was at per with the harvest index value of all the other two levels of nitrogen similar result were reported by (Sawires, E.S. *et al.,* 2000) [13], who reported that harvest index, dry weight and shoot length increased significantly with increasing levels of nitrogen fertilization.

Table 2: Effect of nitrogen levels and seed rate on seed yield, straw yield, biological yield and some traits of wheat.

Fertilizer Nitrogen(kg/ha)	No. of spikes/ear	No. of seeds/ spike	Seed yield (q/ha)	Straw yield	Biological yield	Purity Percent	1000-seed weight	Harvest index (%)
100	16.0	40.5	37.4	66.6	104.0	94	40.5	35.9
120	17.5	42.0	40.1	75.1	115.2	95	42.5	34.8
140	18.5	42.5	40.5	85.6	126.1	96	43.0	32.1
SE m±	0.4	0.6	1.72	2.2	2.8	0.12	0.5	0.6
CD at 5%	1.3	1.8	NS	6.8	8.6	0.37	1.5	1.9
Seed rate (kg/ha.)								

100	18.0	43.5	36.0	69.0	105.0	96	43.0	34.2
125	17.5	41.0	40.5	74.7	115.2	95	42.5	35.1
150	16.5	40.0	41.0	83.5	124.5	94	41.0	32.9
SE m±	0.4	0.6	1.72	2.2	2.8	0.12	0.5	0.6
CD at 5%	1.3	1.8	5.16	6.8	8.5	0.37	1.5	1.9

4. Conclusion

It can be concluded from the present study the treatment of nitrogen application at 140 kg N/ha made in conjunction with 150 kg seed rate/ha, are best than all other treatments for achieving the highest traits of expression of number of shoot length, plant height, seed yield (q/ha), straw yield (q/ha), biological yield (q/ha) and quality parameters, and treatment of nitrogen application of 140 kg N/ha made in conjunction with 100 kg seed rate/ha are best than all other treatments for achieving the highest traits of expression of dry matter (gm), spike length (cm), number of spikes/ear, number of seed per spike, 1000 seed weight but combination of 100 kg N/ha with 125 kg seed rate/ha achieving the highest traits of expression of harvest index, thus promising to boost the productivity of wheat (*Triticum aestivum* L.) in agro-ecological condition of Bundelkhand region (U.P.).

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