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Sowing methods and nitrogen levels effect on growth, yield and economics of wheat (*Triticum aestivum* L.)

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Abstract
The present investigation entitled "Sowing methods and nitrogen levels effect on growth, yield and economics of wheat (*Triticum aestivum* L.) was carried out at Crop Research Farm of National Post Graduate College, Barhalganj, Gorakhpur, (U P.) during rabi season of 2021 with the objective to study the effect of row spacing and nitrogen levels on growth, yield and economics of wheat (*Triticum aestivum* L.). The soil of the experimental field was silty loan in texture with low, medium and high in N, P and K, respectively. The experimental site is situated in subtropical zone in into agnatic planes.
The experiment was laid out in Randomized Block Design (Factorial) and sown on 7th December 2021 with two factors. A - sowing methods i.e., T1 - Broadcasting and T2 - Line Sowing and B - Nitrogen Levels i.e., T1 - 60 kg N as basal + 30 kg N after 1st irrigation+ 30 kg N after 2nd irrigation, T2 - 70 kg N as basal + 35 kg N after 1st irrigation + 35 kg N after 2nd irrigation and T3 - 80 kg N as basal + 40 kg N after 1st irrigation + 40 kg N after 2nd irrigation and with three replications. The crop was harvested on 16th April 2022. The result indicated that the Line Sown method of sowing proved significantly superior over Broadcasting method of sowing in terms of plant height, number of tillers per hill, number of leaves per plant, length of spike, number of grains per spike, test weight, grain yield, straw yield, harvest index, gross return (Rs/ha) and net return (Rs/ha.) respectively while 80 kg N as basal + 40 kg N after 1st irrigation + 40 kg N after 2nd irrigation gave significantly highest value in terms of terms of plant height, number of tillers per hill, number of leaves per plant, length of spike, number of grains per spike, test weight, grain yield, straw yield, harvest index, gross return (Rs./ha) and net return (Rs./ha.), respectively over rest of the treatments. Line sown method of sowing and 80 kg N as basal + 40 kg N after 1st irrigation + 40 kg N after 2nd irrigation increased the growth parameters and yield of Wheat.

Keywords: wheat, sowing method, broadcasting method, line sown method, fertilizer, nitrogen, growth attributing parameters, yield attributing parameters, yield, straw yield

Introduction
Wheat (*Triticum aestivum* L.) is one of the most important cereal crops both in regard to its antiquity and it uses a source of human food that belongs to family Poaceae. Among the cereal crops, Wheat, Rice and Maize together make up three - fourth of the world's grain production. Wheat being a global crop, has been cultivated in all the countries of the world with covering approximately one - sixth of the total arable land in the world. Wheat serves as a staple food for about one billion people in as many as 43 countries of the world. It provides about 20 percent of total food calories for the human race. Among various Wheat based cropping system Rice - Wheat is a major one occupying about 10.0 m. ha. area in India and worldwide this system occupies about 24 m. ha. area. (Ladha, *et al*. 2000) [4]. In India, Wheat is a second most important cereal crop, next to rice, occupying an area of 31.62 m. ha. with production of 105.92 m tons. (Anonymous, 2021) [1]. Inefficient utilization of available resources by crops, particularly solar radiation, under a close spacing and severe into competition among plants in a dense spacing have compelled researcher to optimize crop spacing for attaining better production of different crops and even varieties within the same species. Optimal crop spacing is one of the important agronomic approaches that can be used to enhance Wheat yield by optimizing tillering capacity and the efficient utilization of other available resources. Cultural practices like method of sowing, crop density and geometry have pronounced effect on crop weed interference. The productivity of wheat depends upon several factors like crop establishment techniques, irrigation, Weed management, sowing methods, seed rate, fertilizer management and other cultural practices. The method of sowing is significant as it determines the proper crop stand establishment and the production of individual plant depends on balancing plant to plant combinations.

In India, especially in U.P. wheat is sown through broadcasting in a large area after harvest of rice. Broadcasting not only requires higher seed rate but also results in lower or higher plant population, whereas the line sowing method is recommended because of its uniform seed distribution and sowing at desired depth, which usually results in higher germination and uniform stand. Besides other agronomic factors, sowing methods and nitrogen management are major factors which determine the crop vigor and ultimately yield (Korres and Froud, 2000) [2].

Among essential plant nutrients, nitrogen is one of the most important primary nutrient and being a constituent of chloroplast, plays very important role in harvest of solar energy and thereby photosynthesis, which is directly reflected in the total dry matter production. Nitrogen use efficiency is very low due to its movable nature and its real time management as per crop need is very indispensable. The use of optimum dose of fertilizer and their suitable method of application are essential for improving the productivity level and finally the net income. Some of the estimate on the uptake of nutrients have shown that a healthy wheat crop of one ha. remove 140 kg Nitrogen, 50 kg Phosphorus, 10 kg Potash, 210 g. Zinc, 341 g Magnesium and 65 g copper. (Takkar and Nayer, 1983) [9]. Keeping all this in a view, the present experiment was planned to investigate the growth, yield and economics of wheat as affected by different method of sowing and nitrogen levels.

The field experiment was carried out at the Crop Research Farm of National Post Graduate College, Barhalganj, Gorakhpur, U.P. during Rabi season of 2021. The experimental site is situated in subtropical zone in Indo-genetic plains and lies between 260471 North latitude, 820101 East longitude and 1130m above sea level. The soil of the experimental field was silty loam in texture and slightly alkaline in reaction with PH, 7.6, EC 0.20 ds-m, organic carbon 0.40% and available Nitrogen 196 kg ha^{-1}, Phosphorus 18.9 kg ha^{-1} and Potassium 260.50 kg ha^{-1} at 0 - 15 cm soil depth. The experiment was laid out in Randomized Block Design (Factorial) and sown on 7th December 2021 with two factors. A - sowing methods i.e., T1 - Broadcasting and T2 - Line Sowing and B - Nitrogen Levels i.e., T1 - 60 kg N as basal + 30 kg N after 1st irrigation+ 30 kg N after 2nd irrigation, T2 - 70 kg N as basal + 35 kg N after 1st irrigation + 35 kg N after 2nd irrigation and 80 kg N as basal + 40 kg N after 1st irrigation + 40 kg N after 2nd irrigation and with three replications. The crop was sown by using seed rate of 120 kg per ha., while method of sowing and nitrogen levels were applied to the crops as per treatment of the experimental crops. The other agronomical cultural practices such as Phosphorus, Potash, irrigation, weeding and plant protection measures have been performed as per requisite and recommendation of the crop. The crop was harvested manually at the maturity dated on 16th April 2022 and grain and straw were recorded.

Result and Discussion

Effect of sowing methods

As experiment was conducted to observe the influence of method of sowing on growth and yield of wheat. The data pertaining to growth, yield and economics along with statistical interpretations are presented and discussed. The data (Table - 1) revealed that the method of sowing had a significant influence on crop growth parameters *viz.* plant height and number of tillers per hill and crop yield parameters *viz.* length of spike, number of grains per spike, grain yield, straw yield and harvest index during the year of study. Results clearly indicates that the maximum crop growth parameters i.e. plant height and number of tillers per hill (89.61cm and 9.10) were recorded with the line sown method, which were significantly superior over broadcasting method, while the lowest value were observed (plant height-88.59 cm and numbers of tillers per hill - 7.93) with broadcasting method and maximum yield parameter i.e. length of spike, number of grains per spike, grain yield, straw yield and harvest index (11.03 cm, 32.91, 43.04 q. per ha., 57.37 q per ha. and 46.88% respectively) were found with the line sown method, which were significantly highest over broadcasting method, while the lowest values i.e., length of spike, number of grains per spike, grain yield, straw yield and harvest index (8.74 cm, 30.68, 37.34 q. per ha., 54.34 q per ha. and 46.43% respectively) were observed with the broadcasting method. This indicates that narrow spacing might have led to more mutual competition among the plants. The results are in line with the findings of Pandey, *et al*. (2013) [6]. Higher dry matter and tillers under higher spacing was obtained by Mali and Chaudhary (2014) [5] and Kumar *et al*. (2010) [3]. The results are in collaborated with research finding reported by Pandey, *et al*. (2005) [7].

Effect of nitrogen levels

As experiment was conducted to observe the influence of different nitrogen levels on growth and yield of wheat. The data pertaining to growth and yield along with statistical interpretations are presented and discussed. Crop growth parameters *viz*. plant height and number of tillers per hill have been shown in Table - 1 clearly indicates that plant height and number of tillers per hill (90.40 cm and 9.63, respectively) were recorded significantly highest with the nitrogen levels N2 i.e. 70 kg N as basal + 35 kg N after 1st irrigation+ 35 kg N after 2nd irrigation over rest of the treatment, while the lowest values were observed (88.48 cm and 7.70, respectively) with the nitrogen levels N1 i.e. 60 kg N as basal + 30 kg N after 1st irrigation + 30 kg N after 2nd irrigation and maximum yield parameters *viz*. length of spike, number of grains per spike, grain yield, straw yield and harvest index (10.66 cm, 34.20, 44.69 q per ha., 58.03 q per ha. and 46.96%, respectively) were found with nitrogen levels N2 i.e., 70 kg N as basal + 35 kg N after 1st irrigation + 35 kg N after 2nd irrigation, which were significantly superior over rest of the treatment, while the lowest values were observed (9.47 cm, 30.36, 37.48 q per ha, 54.48 q per ha and 46.52%, respectively) with the nitrogen levels N1 i.e. 60 kg N as basal + 30 kg N after 1st irrigation + 30 kg N after 2nd irrigation. Furthermore, among the nitrogen level treatments, the contribution of leaves and spikes towards total dry matter increases with increasing fertility levels, while contribution of stem towards total dry matter increases with increasing fertility levels. Adequate supply of the nutrient to the crop helped in synthesis of carbohydrates and protein in plants. The role of nitrogen in synthesizing protoplasm and body building material of plants are well documented. (Tisdal, *et al*., 1985) [10]. The amount of chlorophyll was significantly linked to the concentration of nitrogen in the wheat plant and the leaves. The results are in collaborated with research finding reported by Schlichting et al. (2015) [8].

Table 1: Plant height, number of tillers per hill, length of spike, number of grains per spike, grain yield, straw yield and harvest index as affected by method of sowing and different nitrogen levels.

Treatment	Plant Height (cm)	Number of tillers per hills	Length of spike (cm)	Number of grains per spikes	Grain yield (q per ha)	Straw yield (q per ha)	Harvest index (%)
Sowing Method							
Broadcasting	88.59	7.93	8.74	30.68	37.34	54.34	46.43
Line Sown	89.61	9.10	11.03	32.91	43.04	57.37	46.88
S.Em	0.22	0.15	0.33	0.54	0.34	0.34	0.06
CD at 5%	0.71	0.49	1.08	1.73	1.11	1.10	0.15
Level of Nitrogen							
N1	88.48	7.70	9.47	30.36	37.48	54.48	46.52
N2	90.40	9.63	10.66	34.20	44.69	58.48	46.96
N3	88.79	8.24	9.53	30.83	38.39	55.06	46.48
S.Em	0.27	0.18	0.41	0.66	0.42	0.42	0.07
CD at 5%	0.87	0.58	1.01	2.12	1.36	1.35	0.23

Economic Feasibility

To examine the economic feasibility and viability of different treatments under investigation, economics of green gram production in terms of gross return (Rs per ha), net return (Rs per ha) and B C ratio were calculated for different treatment combinations and the outcome is presented in Table - 2.

Table 2: Gross return, net return and benefit: cost ratio of Wheat as affected by method of sowing and different nitrogen levels.

Treatments	Gross return (ha 1)	Net Return (ha 1)	B:C ratio
S1N1	113576.00	69238.00	1.56
S1N2	117866.00	72867.00	1.61
S1N3	108363.00	63104.00	1.39
S2N1	118239.00	73701.00	1.65
S2N2	143496.00	98297.00	2.17
S2N3	118952.00	73493.00	1.61

It is obvious from the above Table that the Treatment T2 N2 i.e., Line sown and 70 kg N as basal + 35 kg N after 1st irrigation+ 35 kg N after 2nd irrigation registered highest gross return (Rs-143496.00), net return (Rs. 98297.00) and benefit cost ratio (1: 2.17) per ha., this might be due to higher yield in the treatment compared to other treatments

Conclusion

Based on the experimental findings, it is described that Line sown and 70 kg N as basal + 35 kg N after 1st irrigation + 35 kg N after 2nd irrigation has been proved significantly best treatment among the different treatment of experiment to exploit the maximum yield.

Hence, it is concluded that sowing with Line sown and 70 kg N as basal + 35 kg N after 1st irrigation + 35 kg N after 2nd irrigation registered the highest B: C ratio i.e., 1: 2.17 can be used as remunerative strategy and can be adopted in a eastern Uttar Pradesh

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