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Performance of Wheat (Triticum Aestivum L.) under Different Planting Patterns and Nitrogen Levels

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Abstract

The field experiment was conducted on the research farm of Department of Agronomy, Lovely Professional University, Phagwara (Punjab) on, "Performance of wheat (Triticum aestivum L.) under different planting patterns and nitrogen levels". The field study was conducted in Split Plot Design with three planting patterns viz. 2 rows/bed, cross sowing, flat sowing in main plots and five nitrogen levels viz. 0 kg/ha, 40 kg/ha, 80 kg/ha, 120 kg/ha, 160 kg/ha in sub plots. The result revealed that significantly higher grain yield was obtained from two rows/bed (43.86 q/ha) followed by cross sowing (42.48 q/ha) and flat sowing (40.77 q/ha). Also bed sowing increased grain yield of wheat by 4.2 and 7.6 % than cross and flat sowing respectively. Also cross sowing method recorded significantly more grain yield than line sowing method. Grain yield was significantly higher with use of 160 kg N/ha (54.95 q/ha) as compared to all other nitrogen levels. There was subsequent and significant increase in grain yield of wheat with successive increase in nitrogen level from 0 to 160 kg/ha. Grain yield of 0 kg N/ha was significantly less than all other nitrogen levels. There was 100.4, 92.7, 60.0 and 19.6 percent increased in grain yield of wheat with the application of 160 Kg, 120 Kg, 80 kg and 40 kg N respectively as compared to 0 kg N/ha (control).

Keywords: *Nitrogen, Performance, Planting Patterns, Wheat*

1. Introduction

The various crops like cereals, pulses, oilseeds, commercial crops, fodders, fibres, sugar and other root & tuber crops are grown in India. Among cereal crops, wheat is one of the most important staple food of India after rice. Wheat is most common cereal crop, grown in 219 million hectare in the World and 29.8 million hectare in India. India is the second largest producer of wheat after China (Anonymous, 2019-20). The production of wheat in India is 108.8 million tonne, area 31.8 million hectare and productivity of 3425 kg/ha (Annual report 2020-21). In India, Uttar Pradesh tops among wheat producing State (359 lakh metric tonne) and Punjab has higher productivity per unit area. Wheat grains has high nutritive value i.e. protein 8-15%, oil and fat 1-5 %, carbohydrates 62-71%, mineral matter 1.5-2 %, cellulose 2-2.5 % (Baba et al. 2020).

The planting pattern is most important for obtaining a high return and high crop yield. The flat and bed method has their own advantages and disadvantages. In terms of growth parameters and yield, bed sowing out performed traditional flat sowing. The row spacing is also important for maintaining the plant population. The bed sowing method is more efficient than flat sowing because it provide mechanical strength to roots of wheat plants, encourages water saving, increase fertilizer use efficiency and reduce the competition between crop and weeds, reduce crop lodging as well as soil erosion etc. (Singh et al. 2016). Raised-bed farming has historically been linked to problems with

water management, either by offering ways to lessen the effects of excess water especially in heavy texture soils or by more effectively delivering irrigation water in high-production irrigated systems (Sayre et al. 2004).

Nitrogen is necessary for growth and development of all plants and the same in case of cereal crops (Rafiq et al. 2010). Nitrogen is important constituent of protoplasm, amino acids, nucleotides, enzymes, protein and provides the huge frame of pods and flowers (Anjum et al. 2012). Also Khurseed et al. 2015 recorded that nitrogen fertilizers increase the plant height, shoot dry weight, grain yield, protein content, number of ear/plant, test weight, number of tillers, chlorophyll content, flag leaf area, straw yield in wheat crop. Yousaf et al. 2014 observed that at different nitrogen levels viz. 0, 80, 100, 120, 150 kg/ha, the higher yield was recorded under use of high nitrogen doses. The all growth parameters, yield and quality parameters increased with use of high nitrogen doses. The maximum plant height (96.6 cm), number of spikelets/spike (18), maximum number of fertile tillers (402/m2), test weight (43.8 g) were recorded in 150 kg N/ha than 0, 80, 100, 120 kg N/ha.

2. Materials And Methods

The field study was conducted during Rabi season 2022-2023 at the research farm of Lovely Professional University, Phagwara. The soil was sandy loam in texture and having pH 6.07. The available nitrogen content was 305.4 kg/ha. The experimental study was conducted in Split Plot Design with 3 planting patterns and 5 nitrogen levels with four replications were kept. The three planting methods i.e. M1- Two rows/bed, M2- cross sowing, M3- flat sowing were kept in main plots and five nitrogen levels i.e. T1- 0 kg/ha, T2- 40 kg/ha, T3- 80 kg/ha, T4- 120 kg/ha, T5- 160 kg/ha in sub-plots. The size of each sub plot was 5.50×3.25 m and main plot was 89.3 m. PBW824 - variety of wheat was sown which was developed by Punjab Agriculture University, Ludhiana. The field was prepared with mould board plough and after fine preparation, layout was done with three main plots, five sub-plots and with four replications. The size of bed top was 37.5 cm and furrow of 30 cm and two rows/bed were sown on bed top in bed sowing method. In cross/bidirectional sowing, half the recommended seed rate was used in one direction and remaining in other direction. Flat sowing was done by keeping row to row spacing of 22.5 cm. The crop was sown on 18 November, 2022 as per treatment. The sowing was done with pora method. The spray of ACM-9 (metribuzin+clodinafop) was done as post-emergence after 35 days of sowing uniformly on the entire experiment. The different levels of nitrogen were applied according to the treatments with half dose of nitrogen at sowing and second half dose after 30 days after sowing. The 3-4 irrigations were applied for crop. The first irrigation was applied after 21 DAS at CRI stage, second at tillering, third at booting, fourth at dough stage according to rainfall conditions.

To control the attack of aphid and jassids, the crop was sprayed with Malathion 50 EC @ 1.0 lit./ha. Then crop was harvested after 140-145 days after sowing after judging the symptoms of maturity, i.e. hardness of seed and change in plant colour. The crop was harvested with sickle. The crop was tied after harvesting of net plot per plot and keep in sun to loss the moisture. Then crop was threshed with sticks and seeds were cleaned and weighed on electronic balance plot wise. The statistical analysis was done by OPSTAT.

3. Results and Discussion

Plant height (cm)

Plant height is one of most important growth factor for determining crop yield. However, plant height is mainly governed by genetic characteristics and other agronomic practices. Plant height recorded at 60, 90, 120 day after sowing was significantly higher in planting patterns of two row/bed as compare to other planting patterns i.e. cross sowing and flat method. However, plant height recorded at harvest was found to be at par in two row/bed and cross sowing planting techniques and both these methods were found to produce significantly higher plant height than flat planting technique. Higher plant height in bed planted treatments may be due to the availability of loose soil conditions which favoured better crop growth as compared to flat planting conditions. Plant height was also more in cross sowing may be due to self-competition of crop plants.

The plant height recorded at 60 and 90 DAS being at par in both 120 kg N/ha and 160 kg N/ha treatments which was significantly more than all other nitrogen levels. At 120 DAS and at harvest

significantly more plant height was recorded in 160 kg/ha nitrogen than all other nitrogen levels. Application of 0 kg N/ha recorded significantly less plant height than all other nitrogen level treatments because there was slow growth without nitrogen. More plant height in 160 kg N/ha treatment may be due to better crop growth because nitrogen is responsible for vegetative growth as compared to all other nitrogen levels. Singh et al. 2017 and Amjed et al. 2011 reported similar findings.

Table 1: Effect of different planting patterns and nitrogen levels on plant height (cm) of wheat

Treatments	60 DAS	90 DAS	120 DAS	At harvest
Main plot(Planting patterns)				
Two rows/bed	34.30	68.30	89.55	90.66
Cross sowing	32.18	66.30	88.39	89.46
Flat sowing	30.11	64.11	87.26	88.50
C.D. at 5%	1.32	1.38	1.12	1.47
Sub plot(Nitrogen levels)				
0 kg N/ha	26.25	60.25	68.01	69.36
40 kg N/ha	29.88	63.88	84.78	86.09
80 kg N/ha	33.20	67.20	90.16	91.06
120 kg N/ha	35.45	69.65	97.62	98.54
160 kg N/ha	36.20	70.20	101.42	102.64
C.D. at 5%	0.78	1.02	2.01	1.66
C.D. for interaction	NS	NS	NS	NS

Crop dry matter (q/ha)

Dry matter accumulation by crop was due to all metabolic processes occurring within the plant. Significantly, higher crop dry matter accumulation was recorded in two rows per bed at 60 and 90 DAS than other planting methods i.e. cross sowing and flat method. The difference in crop dry weight was found to be non- significant at 120 DAS among planting techniques. When recorded at harvest, dry matter of crop in two rows per bed and cross sowing treatments were found at par among themselves. Crop dry matter recorded in two rows/bed was significantly more than flat sowing method. Similar findings were observed by Singh et al. 2019 who reported that bed planting method produces more crop dry matter than flat method.

Among nitrogen level treatments, significantly less dry weight of crop was recorded in no nitrogen treatment than all other nitrogen levels. When observations were recorded at all growth stages among nitrogen level treatments, application of 160 kg/ha recorded significantly higher crop dry matter than other nitrogen level treatments. This holds good when observations were recorded at 60, 90, 120DAS and at harvest. Higher crop dry matter in high dose of nitrogen may be due to better crop growth and development as compared to lower levels of nitrogen. These results are in close conformity with the observations of Meng et al 2013 and Singh et al. 2017.

Table 2: Effect of different planting patterns and nitrogen levels on dry matter accumulation (q/ha) of wheat

Treatments	60 DAS	90 DAS	120 DAS	At harvest
Main plot(Planting patterns)				
Two rows/bed	10.13	29.53	38.60	60.01
Cross sowing	9.48	28.04	37.02	58.79
Flat sowing	9.29	27.09	36.89	57.18
C.D. at 5%	0.35	0.75	NS	1.87
Sub plot(Nitrogen levels)				
0 kg N/ha	8.68	23.87	31.18	50.31
40 kg N/ha	9.07	25.67	34.15	52.79
80 kg N/ha	9.46	27.78	36.80	58.30
120 kg N/ha	9.99	30.89	40.17	64.96

160 kg N/ha	10.96	32.88	45.23	66.93
C.D. at 5%	0.21	0.79	1.17	1.91
C.D. for interaction	NS	NS	NS	NS

Total tiller count (m^2)

Significantly higher number of tillers were recorded in two rows/bed when recorded at 60 and 90 DAS than other planting methods i.e. cross and flat sowing. Total tillers recorded 120 DAS and at harvest were significantly less in flat method than bed and cross sowing. The total number of tillers were significantly higher at harvest in bed method than flat sowing which may be due to less contact of water with plant roots, more friable soil, less weed infestation and better crop growth. Bhullar et al. 2012 examined that the higher plant height, effective tillers, panicle length, seed yield (58.7 cm, 56.2, 9.5 cm, 4.04 t/ha respectively) were recorded in bed planting method than other planting practices like zero tillage, conventional tillage. In nitrogen levels significantly higher number of tillers were recorded in 160 kg N/ha as compared to 0, 40, 80, 120 kg N/ha when observations were recorded at 60, 90, 120 DAS and at harvest because all growth parameters increased with increase the nitrogen doses. There was subsequent and significant increase in periodic tillers with each increment in nitrogen level from 0 kg to 160 kg/ha. These results are in close conformity with the observations of Chaturvedi 2006.

Table 3: Effect of different planting patterns and nitrogen levels on total tiller count (m^2) of wheat

Treatments	60 DAS	90 DAS	120 DAS	At harvest
Main plot(Planting patterns)				
Two rows/bed	459.0	441.0	392.8	387.6
Cross sowing	436.0	413.3	383.6	373.7
Flat sowing	407.2	387.6	372.1	364.7
C.D. at 5%	18.3	12.8	13.4	16.4
Sub plot(Nitrogen levels)				
0 kg N/ha	338.2	306.7	268.4	265.1
40 kg N/ha	391.1	353.2	307.1	302.6
80 kg N/ha	433.8	415.1	372.3	365.6
120 kg N/ha	475.1	466.1	455.6	447.7
160 kg N/ha	532.1	528.7	510.7	495.7
C.D. at 5%	19.3	15.5	14.1	15.5
C.D. for interaction	NS	NS	NS	NS

Effective tillers (m^2), Spike length (cm), Number of grains/ear and Test weight (g)

Planting pattern of two rows per bed produced significantly higher effective tillers, spike length, no. of grains/ear, test weight than other planting methods which may be due to more growth and development of crop plants and more availability of space. Among different nitrogen levels, these parameters were significantly higher in 160 kg N/ha than all other doses.

These findings also similar with Choudhary et al. 2013, Sharma et al. 2022 and Yousaf et al. 2014. Also Singh et al. 2019 recognized that the bed planting produce the higher plant height (95.4 cm), dry matter (88 q/ha), effective tillers (315.6), leaf area index (3.45), grain/year (39), test weight (35.8 g), straw yield (48.2 q/ha), grain yield (41.1 q/ha), harvesting index (46.1), B: C ratio (1.59) than flat method; zero tillage, happy seeder techniques.

Table 4: Effect of different planting patterns and nitrogen levels on effective tillers (m^2), spike length (cm), no. of grains/ear and test weight (g) of wheat

Treatments	Effective tillers/ sq.m.	Spike length cm	No. of grains/ear	Test weight g
Main plot(Planting patterns)				
Two rows/bed	359.1	11.06	49.95	37.41

Cross sowing	346.5	9.45	47.61	36.61
Flat sowing	342.2	9.18	45.15	36.12
C.D. at 5%	12.2	0.31	0.96	0.37
Sub plot(Nitrogen levels)				
0 kg N/ha	241.7	6.81	28.22	35.07
40 kg N/ha	270.9	8.09	39.18	35.65
80 kg N/ha	347.9	9.02	47.31	36.45
120 kg N/ha	432.8	11.75	59.36	37.56
160 kg N/ha	452.4	13.80	63.76	38.83
C.D. at 5%	11.3	0.43	1.60	0.59
C.D. for interaction	NS	NS	NS	NS

Grain yield (q/ha), Biological yield (q/ha), Straw yield (q/ha) and HI (%)

Seed yield (q/ha) is the final economical product which depends upon growth parameters and yield attributes of crops in a particular treatment. Planting patterns and nitrogen level treatments influenced significantly the seed yield of wheat. The planting pattern with two rows per bed produced significantly higher seed yield than cross sowing and flat sowing. However seed yield of cross sowing was significantly better than flat planting techniques. Highest seed yield of (43.86 q/ha) was recorded in two row per bed which was followed by cross sowing (42.48 q/ha) and flat planting technique (40.77 q/ha). Highest yield in two row per bed technique may be due to better growth and yield attributes. The planting patterns of two rows/bed gave 4.2 and 7.6% higher grain yield than cross sowing and flat sowing techniques. Higher grain yield in bed planting technique may be due to more plant height, dry matter accumulation by crop, total tillers and yield attributes compared to other planting patterns. Also the biological yield and straw yield was also significantly higher in two rows/bed than cross sowing and flat sowing. The differences in harvest index were non-significant among different planting patterns. The biological yield, seed yield, straw yield were significantly higher in 160 kg N/ha as compared to all other nitrogen levels. Application of 160 kg, 120 kg, 80 kg, 40 kg N/ha increased grain yield by 100.4, 92.7, 60.0 and 19.6 % than 0 kg N/ha. Higher yield in 160 kg N/ha may be due to better growth and better yield attributes as compared to other nitrogen levels. Walia et al. 2003, Sudesh et al. 2017 and Ullah et al. 2018 reported similar findings.

Table 5: Effect of different planting patterns and nitrogen levels on Grain yield (q/ha), Biological yield (q/ha), Straw yield (q/ha) and HI (%) of wheat

Treatments	Grain yield (q/ha)	Biological yield (q/ha)	Straw yield (q/ha)	HI (%)
Main plot(Planting patterns)				
Two rows/bed	43.86	103.87	60.01	41.54
Cross sowing	42.48	101.28	58.79	41.46
Flat sowing	40.77	97.95	57.18	40.91
C.D. at 5%	1.01	2.09	1.87	NS
Sub plot(Nitrogen levels)				
0 kg N/ha	27.42	77.73	50.31	35.26
40 kg N/ha	32.80	85.59	52.79	38.33
80 kg N/ha	43.86	102.16	58.30	42.98
120 kg N/ha	52.83	117.80	64.96	44.85
160 kg N/ha	54.95	121.89	66.93	45.08
C.D. at 5%	1.19	2.21	1.91	1.13
C.D. for interaction	NS	NS	NS	NS

4. Conclusion

All the above discussed parameters revealed that two rows/bed played a significant role for improving yield and yield attributes as compared to cross and flat planting technique. Moreover, a bed with two rows performed significantly better in all growth and yield attributes than in cross and flat planting technique. Bed with two rows recorded significantly more seed yield and biological yield than other planting patterns. Among nitrogen levels, the growth and yield parameters were significantly higher in 160 kg N/ha because growth parameters were high and yield attributes were better resulting into increased seed yield, biological, straw yield than other treatments.

Conflict of interest

No

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