

Yield Improvement of Wheat (*Triticum aestivum* L.) by Manipulating Row Spacing

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Abstract A field experiment was conducted during *rabi* 2010-11 and 2011 -12 to study yield improvement of wheat (*Triticum aestivum* L.) by manipulating row spacing and varieties . Four varieties of wheat (DBW 17, PBW 550, PBW 502 and WH 711) with four row spacings (15.0, 17.5, 20.0 and 22.5 cm) . Experiment was laid out in split plot design with three replications. Result of experiment revealed that all growth parameters, yield and yield attributes were significantly influenced by row spacing and varieties. Based on pooled data, maximum plant height and effective tillers/m² was recorded in 15.0 cm spacing crop, which is significantly higher than wider spacing. Higher test weight and grains/spike was observed in 22.5 cm row spacing . Crop sown at 15.0 cm row spacing recorded highest grain yield (62.2 q/ha) and straw yield (96.0 q/ha), which was significantly higher than wider row spacing. Among the cultivars, PBW 502 recorded significantly higher plant height and effective tillers/m² than

other varieties. Variety WH 711 recorded highest test weight, whereas maximum grains/spike was found in PBW 550. DBW 17 recorded significant higher grain yield (60.1 q/ha) than other varieties. The maximum harvest index was recored by PBW 550, which was significantly higher than other varieties.

Keywords Wheat, Row spacing, Varieties, Grain yield.

Introduction

Wheat (729.8 million tons) is second to rice as the main human food crop [1]. In India, wheat is the second most important food crop, cultivated extensively in North-Western and central zones. The area, production and productivity of wheat in India and Haryana during 2014-15 is 30.97 m ha, 86.53 mt, 2794 kg ha⁻¹ and 2.59 m ha , 10.35 mt, 3995 kg ha⁻¹, respectively [2]. Among the agronomic practices spacing plays a significant role in maximizing the crop yield as well as productivity. Inter row spacing

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is very important for proper distribution of plants over cultivated area and for better utilization of available soil and natural resources [3]. Proper row spacing is important for maximizing light interception, penetration, light distribution in crop canopy and average light utilization efficiency of the leaves in the canopy and thus affects yield of a crop reported earlier [4–9].

Proper spacing can help to optimize tillering capacity and improve the yield components of wheat crop. The plant population per unit area beyond an optimum limit enhance competition among the plants for natural resources, resulting in weaker plant and severe lodging [10]. In this view, it was imperative to evaluate the role of different row spacings on the growth and productivity of newly developed wheat cultivars under the agro ecological conditions of Hisar.

Materials and Methods

Experiment was conducted during 2010-11 and 2011-12 at CCS Haryana Agricultural University, Hisar (India) located in Indo-Gangetic plains of North-West India with latitude of 29°10' North and longitude of 75°46' East at 215.2 meters above mean sea level. The soil of the field was sandy slightly alkaline in pH (7.9), low in organic carbon, poor in available nitrogen and medium in available phosphorus and available potassium. The experiment consisting of four row spacings viz. 15.0, 17.5, 20.0 and 22.5 cm in main plots and four varieties viz. DBW 17, PBW 550, PBW 502 and WH 711 in sub-plots was laid out in split plot design with three replications. The crop was sown manually with hand plough on 7th November during both the years. 150 kg N + 60kg P₂O₅ ha⁻¹ were applied through urea and DAP. Half N and full P were applied as basal dose. Remaining half urea was top dressed after 1st irrigation. To control weeds, one hand weeding was done at 30 DAS. Other management practices were adopted as per recommendations of wheat crop. Data on plant height, effective tillers, grains per earhead, 1000 grain weight, grain yield, straw yield and harvest index were recorded by using standard procedure. The crop was harvested on 7th April 2011 and

19th April 2012 during 2010-2011 and 2011-12, respectively. The ANOVA test was done by statistical software of OPSTAT.

Results and Discussion

Row spacing significantly influenced the growth, yield and yield components yield of wheat cultivars.

Growth

Plant height (cm)

Highest plant height was observed at 15 cm row spacing, which is significantly higher than wider row spacing (Table 1). This might be due to competition for light at high plant population density and at wider spacing due to less competition for light and other resource. These results are in agreement with the results obtained by Hozayn et al. [11]. Among the varieties, PBW 502 recorded maximum plant height (106.6 cm), which is significantly higher than other varieties.

Yield and yield attributes

Effective tillers/m²

The number of effective tillers/m² was significantly higher in 15.0 cm (513) row spacing and it decreased with increasing row spacing (Table 1). This might be due to more spatial distribution and less in row plant to plant competition compared with the wider row spacing. These results confirm the finding of Hussain et al. [12]. PBW 502 produced significantly higher effective tillers/m² WH 711 and PBW 550, but at par with DBW 17. The results indicated that inherent tillering potential of PBW 502 was relatively higher than that of other varieties.

Grains spike⁻¹

Number of grains/spike increased with increased row spacing (Table 1). The higher number of grains/spike in wider row spacing crop might be due to more space and nutrients utilization by the plants [13]. PBW 550 produced significantly higher number of

Table 1. Effect of row spacing and varieties on plant height and yield attributes of wheat 2010-11 and 2011-12.

Treatments	Effective tillers/m ²			Test weight (g)			Grains/earhead			Plant height (cm)		
	2010-11	2011-12	pooled	2010-11	2011-12	pooled	2010-11	2011-12	pooled	2010-11	2011-12	pooled
Row spacing (cm)												
15.0	516	511	513	37.3	43.2	40.3	31.2	29.5	30.3	93.7	99.8	96.7
17.5	452	474	463	38.3	43.7	41.0	32.4	31.0	31.7	92.0	98.6	95.3
20.0	398	449	424	39.2	44.4	41.8	35.4	31.5	33.5	91.3	97.7	94.5
22.5	384	414	399	40.0	44.8	42.4	35.3	32.1	33.7	90.0	97.2	93.6
SE(m)±	7.73	6.30	5.32	0.26	0.32	0.24	0.45	0.66	0.38	0.54	0.52	0.39
CD at 5%	26.7	21.7	18.4	0.89	1.09	0.83	1.55	NS	1.31	1.88	1.79	1.34
Varieties												
DBW 17	442	464	453	37.9	41.9	39.9	35.6	31.9	33.7	90.8	97.0	93.9
PBW 550	414	457	436	34.6	44.0	39.3	37.0	32.2	34.6	90.3	92.8	91.5
PBW 502	468	468	468	40.1	45.3	42.7	30.4	28.8	29.6	101.7	111.5	106.6
WH 711	426	460	443	42.2	44.8	43.5	31.4	31.3	31.3	84.3	91.8	88.0
SE(m)±	7.49	6.61	5.44	0.26	0.30	0.19	0.73	0.73	0.53	0.62	0.80	0.56
CD at 5%	21.9	NS	15.9	0.76	0.87	0.55	2.12	2.14	1.56	1.81	2.34	1.63

grains /spike (34.6) than PBW 502 and WH 711 but statistically at par with DBW 17. The differences in number of grains spike⁻¹ were probably due to variation in genetic potential from variety to variety [14-15].

1000 grain weight (g)

The highest 1000-grain weight (42.4 g) was obtained by 22.5 cm row spacing, which is significantly higher than 15.0 and 17.5 cm row spacing (Table 1). This result indicated that wider row spacing increased 1000-grain weight due to vigorous and bold seeds (15). Variety WH 711 recorded maximum (43.5 g) 1000-grain weight, which is significantly higher than other varieties.

Grain yield (q/ha)

Grain yield decreased with increased row spacing (Table 2). 15 cm row spaced crop produced significantly higher grain yield (62.2 q/ha) than wider row crop. Row spacing of 15 cm recorded about (10.2 and 8.34%, 8.55 and 3.24%, 6.88 and 1.08%) higher grain yield than 22.5, 20 and 17.5 cm row spacing in 2010-11 and 2011-12, respectively. The study exhibited that at 15 cm row spacing produced more effective tillers / m² as compared to wider row spac-

ing (Table 1). On the other 22.5 cm row spacing produced minimum number of effective tillers, so average yield low. In this study more yield produced at narrower spacing than 22.5 cm spacing indicating uniform distribution of seeds, better utilisation of environmental resources and less lodging with more wind resistance in narrow rows than wider rows. Increasing light capture by a canopy has been reported in wheat with narrow row spacing configurations. These results also agree with the finding of Bakht et al. [16]. Among the genotypes, DBW 17 recorded significantly higher grain yield (58.9 q/ha) than WH 711 (55.6 q/ha) and PBW 550 (51.9 q/ha) but at par with PBW 502 (56.7 q/ha) in 2010-11, whereas in 2011-12, maximum and minimum grain yield was attained by PBW 550 (64.5 q/ha) and PBW 502 (60.7 q/ha), respectively. The highest grain yield in DBW 17 (60.1 q/ha) might be due to higher number of effective tillers/m².

Straw yield (q/ha)

Highest straw yield (96.0 q/ha) was obtained with 15 cm row spacing (Table 2), which was significantly higher than wider row spacing. More straw yield produced at narrower spacing than wider spacing indicating better resources utilisation (water, nutrient and light) in narrow rows than wider rows reported ear-

Table 2. Effect of row spacing and varieties on yield and harvest index of wheat.

Treatments	Grain yield (q/ha)			Straw yield (q/ha)			Harvest index (%)		
	2010-11	2011-12	pooled	2010-11	2011-12	pooled	2010-11	2011-12	pooled
Row spacing (cm)									
15.0	59.6	64.7	62.2	92.1	99.8	96.0	39.3	39.3	39.3
17.5	55.5	64.0	59.8	83.5	98.2	90.9	40.0	39.5	39.7
20.0	54.5	62.7	58.6	80.2	97.6	88.9	40.5	39.1	39.7
22.5	53.5	59.5	56.4	76.6	94.4	85.5	41.1	38.6	39.8
SE(m)±	1.04	0.64	0.60	1.45	1.27	1.16	0.24	0.20	0.13
CD at 5%	3.58	2.21	2.06	5.01	NS	4.01	0.82	NS	NS
Varieties									
DBW 17	58.9	61.4	60.1	84.7	97.6	91.2	41.0	38.6	39.8
PBW 550	51.9	64.5	58.2	77.4	93.6	85.5	40.2	40.8	40.5
PBW 502	56.7	60.7	58.7	89.0	99.4	94.2	38.9	37.9	38.4
WH 711	55.6	64.1	59.8	81.4	99.3	90.4	40.7	39.2	39.9
SE(m)±	0.82	0.86	0.50	1.22	1.41	0.99	0.27	0.19	0.19
CD at 5%	2.38	2.50	1.47	3.56	4.11	2.90	0.79	0.56	0.56

lier [3, 6]. Among the varieties, the highest straw yield in PBW 502 (94.2 q/ha) might be due to maximum plant height and more number of effective tillers/m² as compared to other varieties.

Harvest Index (%)

The harvest index was not influenced significantly by different row spacing (Table 2). Variety PBW 550 recorded significantly higher harvest index (40.5%) than other varieties. Variety PBW 550 showed higher harvest index indicated its superior ability of better dry matter partitioning towards grains. These findings are in agreement with the work of Ali et al. [13].

Conclusion

Study concludes that narrow row spacing crop produced significantly higher grain yield as compared to wider spaced crop. Row spacing of 15 cm recorded about (10.2 and 8.345, 8.5% and 3.24%, 6.88 and 1.08%) higher grain yield than 22.5, 20 and 17.5 cm row spacing in 2010-11 and 2011-12, respectively. Row spacing 15 cm should be adopted for its contribution towards higher grain yield. Among the varieties, DBW 17 produced highest grain yield which was significantly higher than PBW 550.

References

1. FAO (2014-15) www.fao.org
2. Anonymous (2014-15) www.indiastat.com
3. Mali H, Choudhary (2013) Performance of braed wheat (*Triticum aestivum* L.) varieties under different row spacing. J Wheat Res 4 : 55—57.
4. Drews S, Neuhoff D, Kopke U (2009) Weed suppression ability of three winter wheat varieties at different row spacing under organic farming conditions. Weed Res 49 : 526—533.
5. Das TK, Yaduraju NT (2011) Effects of missing-row sowing supplemented with row spacing and nitrogen on weed competition and growth and yield of wheat. Crop Pasture Sci 62 : 48—57.
6. Kalpana A, Prusty P, Mukhopadhyay SK (2014) Performance of wheat genotypes under different row spacing in New Alluvial Zone of West Bengal. J Crop Weed 10 : 480—483.
7. Ali S, Zamir MS, Farid M, Farooq MA, Rizwan M, Ahmad R, Hannan F (2016) Growth and yield response of wheat (*Triticum aestivum* L.) to tillage and row spacing in maize-wheat cropping system in semi-arid region. Eurasian J Soil Sci 5 : 53—61.
8. Iqbal N, Akabar N, Ali M, Sattar M, Ali L (2010) Effect of seed rate and row spacing on yield and yield components of wheat (*Triticum aestivum* L.). J Agric Res 48 : 151—156.
9. Hassan FU, Arif M (2012) Response of white mustard (*Sinapis alba* L.) to spacing under rainfed conditions. J Anim Pl Sci 22 : 137—141.
10. Mukhtar T, Arif M, Hussain S, Atif M, Rehman SU, Hussain K (2012) Yield and yield components of maize hybrids as influenced by plant spacing. J Agric Res 50 : 59—69.
11. Hozayn M, Shahawy TAG, Sharara FA (2012) Implication of crop row orientation and row spacing for controlling weeds and increasing yield in wheat. Aust J Basic Appl Sci 6 : 422—427.

12. Hussain N, Yasmeen A, Arif M, Nawaz H (2014) Exploring the role of row spacing in yield improvement of wheat cultivars. Pak J Agric Sci 51 : 25—31.
13. Ali M, Ali L, Ali MA (2010) Improvement in wheat (*Triticum aestivum* L.) yield by manipulating seed rate and row spacing in Vehari Zone. J Anim Pl Sci 24 : 225—230.
14. Inamullah HA, Mohammad SU, Hassan G, Gul R (2006) Diallel analysis of the inheritance pattern of agronomic traits of bread wheat. Pak J Bot 38 : 1169—1175.
15. Nizamani GS, Khan IA, Khatri A, Siddiqui MA, Nizamani MR, Khaskheli MI (2014) Influence of different row spacing on agronomic traits in different wheat varieties. Int J Dev Res 11 : 2207—2211.
16. Bakht J, Qamar Z, Shafi M, Akber H, Rehman M, Ahmad N, Khan MJ (2007) Response of different wheat varieties to various row spacing. Sarhad J Agric 23 : 839—845.