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Effect of different sowing methods on wheat (*Triticum aestivum* L.) cultivars on growth and yield attributing characters

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Abstract
A field experiment was conducted to determine the Effect of different sowing methods on wheat (*Triticum aestivum* L.) cultivars on growth and yield during the winter season (*Rabi*) of 2021 with 9 treatments (*viz.* Methods of sowing and cultivars at spacing of Line sowing 22.5 × 8_10 cm and SWI 20 × 20 cm respectively and Varieties are HD2967, HD 3086 and DBW 187 respectively) at Crop Research Farm, Department of Agronomy, Faculty of Agriculture, SHUATS, Prayagraj (Allahabad). Among the treatments T9 (SWI + DBW 187) recorded highest plant height (89.61 cm), Maximum number of Tillers/hill (12.83) and Plant dry weight (25.47). While Maximum number of Effective Tillers/hill (9.47), Length of the spike (12.13), maximum number of Grains/spike (55.94), Test weight (44.37), Grain yield (6.24), Straw yield (14.38), and Biological yield (20.62) was recorded maximum in treatment T9 (SWI + DBW 187).While Harvest index(%) (31.35) was recorded highest in treatment T7 (SWI + HD 2967).Maximum gross return(82935.00 ₹/ha), net return (56426.40 ₹/ha) and benefit cost ratio (2.13) was recorded highest in treatment T9 (SWI + DBW 187).

Keywords: Wheat, broadcasting, line sowing, SWI, growth, cultivars, yield, economics

Introduction
Wheat (*Triticum aestivum* L.) is one of the leading food crops of the world farming and occupies significant position among the cultivated cereals. Cultivation of wheat has been the symbolic of green revolution that played a vital role in making the nation a food surplus nation. Wheat is a member of the poaceae family with chromosome number 42 and a self - pollinated crop. Wheat ranks first among the world food crops, in terms of cultivated area (31.6 m ha), production (778.6 m t) and with productivity of (3500 kg/ha). It can be grown from below sea level to 5000 m altitude and in areas where rainfall ranges between300 - 1130 mm. Wheat contributes more calories (20%) and more protein to the world's diet than any other food crop. The availability of wheat has increased from about 79 g/capita/day to more than 185 g/capita/day despite the doubling of the population since 1961 (Bhardwaj *et al.*, 2010). SWI and some modified SWI intervention may give 54% more yield than the available best practices (Uphoff *et al.*, 2011). This is a system of modified agronomic practices such as low seed rate, seed treatment, sowing of seeds at proper spacing, control of water in the crop field, weeding or hoeing out puts which results in higher ratio of tillers to the mother seedlings, increased number of effective tillers per plant, enhance panicle length and bolden grains and finally enhanced yield of wheat. In the conventional system farmersuse about 100-140 kg/ha of seed, but in the SWI method seed requirement is only 5%-7.5%of this amount (Styger and Ibrahim 2009) [7]. DBW 187 is the latest wheat variety released for irrigated conditions. It matures in 115–120 days after sowing, the average height is about 105 cm. Moderately resistant for to yellow and brown rust, and tolerance loose smut. Its average yield is 24.0 quintals per acre.

Materials and Methods
The experiment was conducted during *Rabi* season of 2021-22. The experiment was conducted in Randomized Block Design consisting of nine treatment combinations with three replications and was laid out with the different treatments allocated randomly in each replication. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.2) with low in organic carbon (0.58%), available N (238 Kg/ha), P (32.10 kg/ha) and higher level of K (189 kg/ha). The treatment combinations consisted of three sowing methods include

Broadcasting, Line sowing (22.5-10 cm) and SWI (20x20 cm) and 3 wheat cultivars are HD 2967, HD 3086 and DBW 187.
There are 9 treatments in each replicated thrice. The treatment combinations are T1- Broadcasting + HD 2967, T2-Broadcasting + HD 3086, T3-Broadcasting + DBW 187, T4-Line sowing + HD 2967, T5-Line sowing + HD 3086, T6-Line sowing + DBW 187, T7-SWI + HD 2967, T8 + HD 3086, T9-SWI + DBW 187. The experiment was laid out in Randomized Block Design. It was sown on 5th December 2021.Recommended doses of nitrogen, phosphorus and potassium were applied.

Results and Discussion

Growth attributes

At 80 DAS, maximum plant height (84.21cm) was recorded highest in T9(SWI + DBW 187). There was proper root development from an early stage of crop growth which significantly increases plant height (Abraham *et al*., 2014) [1]. Number of tillers /hill (12.11) was highest in T9 (SWI + DBW 187). Total Number of tillers/hills was higher at 80 days after sowing and then declined afterwards tillharvest. The reduction in tillers after 80 DAS was due to intra species competition for higher space and nutrients which are responsible for degeneration of late formed tillers. System of wheat intensification had higher tiller numbers as under wider spacing each individual plant could have effectively utilized the available resources such as space, foraging area for root system, better root spread, more light interception etc., which resulted in enhanced tiller production as compared to conventional system of cultivation (Thakur *et al.,* 2010) [9]. Dry matter (17.50) was also recorded in T9 (SWI + DBW 187).

Yield attributes

Yield attributes and yield were significantly affected by System of Wheat intensification, wheat crop sown at 20x20 cm along with wheat cultivar DBW 187 resulted significant increase in number of grains (55.94). Wider spacings facilitated better utilization of resources for plant under SWI techniques. Wider spacings reduced competition between plants per water, nutrients, light and space that lead better growth of plant. This was in confirmative with the finding Hussain *et al.,* (2012) [2].
Length of ear head, number of grains ear head, grain yield in individual hills than in closely spaced plants. This was in confirmative with the findings of bracket (Thakur *et al*. 2010) [9]. the number of effective tillers per hill was significantly influenced by SWI of wheat cultivar DBW 187 at harvest. At harvest (9.47), recorded highest T9(SWI+DWI 187) the effective tillers per unit area reduced with increasing spacing which was due to the degrees in number of planting hills per unit area (Zheng *et al.,* 2013) [12] the data of length of spike(cm) was significantly influenced by system of wheat intensification at harvest the data recorded (12.13 cm) significantly higher in T9 (SWI+DW 187). The length of spikes significantly increased with increasing spacings. Wider spaced plant performed better than closer spaced plant due to adequate availability of nutrient, water, space and light interception that contribute better development of plant growth and yield attributing characters this was in confirmative with findings of (Thakur *et al*., 2010) [9] and (Zheng *et al*., 2013) [12]. The test was also recorded highest (44.37) in treatment T9 (SWI + DBW 187). The data of Grain Yield (t/ha) was significantly influenced by system of wheat intensification at harvest. At harvest the data recorded (6.24t) significantly higher in T9 [SWI + DBW 187]. Grain yield in crop is the results of a number of complex morphological and physiological processes affecting each other and occurring at different growth stages during vegetative period. Significantly higher grain and straw yield of wheat was found with the recommended (20 × 20 cm) spacing and significantly lower grain and straw yield was found with Broadcasting method (22.5cm). Recommended spacing had higher plant population per unit area. The higher population helps to get more No. of grains per spike, Number of spikes and Length of spikes (cm) which resulted in higher grain yield of wheat. (Hussain *et al.,* 2012) [2]. The data of Straw yield (t/ha) was significantly influenced by system of wheat intensification at harvest. At harvest the data recorded (14.38t) significantly higher in T9 [SWI + DBW 187]. Straw yield was significantly increased with increasing plant (row spacing) spacings. Highest straw yield was recorded with SWI DBW 187 (14.38t/ha), however, straw yield decreased when plant spacing increased more than 20cm in SWI. This was mainly due to the decrease in number of plant population and decrease in tillers number per meter square. This was in conformity with the finding of (Zheng *et al.,* 2013) [12]. The biological yield (20.62)(grain yield + straw yield) is recorded in T9 (SWI + DBW 187).The harvest index was recorded (31.35) in treatment T7 (SWI + HD 2967).

Table 1: Effect of different sowing methods on wheat cultivars on growth attributing characters

Treatment combinations	Plant height(cm)	No. of tillers/hill	Plant dry weight(gm)
Broadcasting + HD2967	81.5	10.14	15.4
Broadcasting + HD 3086	81.85	10.37	15.58
Broadcasting + DBW187	82.83	10.94	16.23
Line sowing + HD 2967	82.38	10.62	15.95
Line sowing + HD 3086	83.47	11.5	16.84
Lines owing + DBW 187	83.68	11.69	17.08
SWI + HD2967	83	11.21	16.62
SWI + HD3086	84.03	11.93	17.33
SWI + DBW187	84.21	12.11	17.5
F test	S	S	S
S.Em(±)	0.12	0.06	0.06
CD (P=0.05)	0.35	0.19	0.19

Table 2: Effect of different sowing methods on wheat cultivars on yield attributing characters

	Yield attributing characters								
	Treatment combinations	**No. of Effective tillers/hill Length of spikelet**	**Length of spike(cm)**	**No. of Grains/spike**	**Test weight(g)**	**Grain yield(t/ha)**	**Straw yield(t/ha)**	**Biological yield(t/ha)**	**Harvest Index (%)**
1	Broadcasting + HD2967	6.28	8.54	47.12	37.49	3.32	8.39	11.71	28.33
2	Broadcasting + HD 3086	6.6	9.06	47.74	37.96	3.58	8.82	12.4	28.85
3	Broadcasting + DBW187	7.46	10.03	50.05	39.34	4.26	10.01	14.27	29.86
4	Line sowing + HD 2967	7.03	9.62	49.09	38.56	3.92	9.22	13.15	29.83
5	Line sowing + HD 3086	8.3	10.81	53.13	42.65	5.18	12.33	17.51	29.57
6	Lines owing + DBW 187	8.88	11.15	54.65	43.26	5.68	13.58	19.26	29.5
7	SWI + HD2967	7.99	10.45	52.3	41.32	4.77	10.43	15.19	31.35
8	SWI + HD3086	9.15	11.84	55.09	43.91	5.96	13.97	19.93	29.9
9	SWI + DBW187	9.47	12.13	55.94	44.37	6.24	14.38	20.62	30.22
	F test	S	S	S	S	S	S	S	NS
	S.Em(±)	0.2	0.33	0.5	0.38	0.19	0.39	0.58	0.6
	CD (P=0.05)	0.59	0.98	1.5	1.13	0.57	1.17	1.72	1.79

Conclusion

In conclusion, it is inferred from the present investigation that sowing of wheat crop in System of wheat intensification method with proper spacing is recommended for receiving higher growth and yield of wheat than in broadcasting and line sowing method, among cultivars DBW 187 performed well both in terms of growth and yield than HD 3086 and HD 2967.

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