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Effect of growth parameters at different levels of seed rate in wheat under irrigated area

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Abstract
Optimum seeding rate is one of the most important production factors for higher grain yield as well as for quality crop. Indiscriminate use of seeding rates not only increases production costs but usually decrease wheat grain yield. Crop sown with quality of seeds, row-spacing of 22.5 cm and seed rate of 120 kg ha-1 had better growth and yield. Maximum plant height, number of tillers, length of ear head, grains spike-test weight, biological yield, grain yield and harvest index were found in breeder seed with 22.5 cm row-spacing at 120 kg ha-1 seed rate which was superior over other treatments combinations.

Keywords: Harvest index, row-spacing, growth and yield

Introduction
Wheat (*Triticum aestivum* L.) is a major cereal crop, which plays an important role in food and nutritional security. It shares upto 40 percent of total food grain production. In India, total area under wheat is 31.0 Mha, with production of 86.53 mt and the productivity of 2.8 t/ha 15. In India Wheat is the world most widely cultivated food grain crop of the family gramineae and second important staple food grain crops next to rice. Bread wheat sowing at the optimum seeding rate and at the appropriate row spacing significantly enhance the number of grains per spike, the spike length, grain weight per spike and 1000- grain weight and then finally produce high grain yield (Iqbal, 2010) [7]. Among the factors responsible for low wheat yield, delay in sowing, traditional sowing methods, low seed rate and improper row spacing are very important. Under the present practice of sowing wheat after rice and cotton, wheat sowing often gets delayed, reducing the yield to a considerable extent. Late seeding dates normally result in higher seeding rates because a delay in sowing normally reduces individual plant growth and tiller production. In other words, optimum seeding rate and suitable cultivars play an important role in achieving potential yield of bread wheat (Nizamani *et al.*, 2014) [12]. But seeding rate above or below the optimum may reduce the yield significantly (Peter *et al*., 1988). Row spacing plays a significant role on growth, development, and yield of bread wheat at its optimum level beside it provides scope to the plants for efficient utilization of solar radiation and nutrients (Mali and Choudhary, 2012).

Materials and Methods
The field trials were conducted during 2016-17 and 2017-18 in two rabi season at Department of Agronomy, CSAUA&T, Kanpur (U.P) located at 250 26' to 260 58' North latitude. Soil of the experimental site was sandy loam, non-saline, having low in organic matter (0.0.41-0.45%) and available nitrogen 262.0 kg ha^{-1} available phosphorus 13.10 kg ha^{-1}, available potassium 193.50 kg ha^{-1}. Three quality seeds (Breeder, Foundation and certified seed) were sown at different row-spacing (15 cm, 22.5 cm and broadcast) and seed rate (80 and 120 kg/ha). The experiment was conducted in split plot design with three replications following the procedures of Gomez and Gomez (1984). Land preparation operations were performed for equal distribution of irrigation and fertilizers. Sowing was done with a hand behind the country plough. Wheat (K-307) was sown during second week of November and harvested in the last week of March First irrigation was applied 25 days after sowing. Crop was subsequently irrigated as per need of the crop. Nutrients were applied at 120-60-40 NPK kg ha-1 in the form of urea, di-ammonium phosphate and mureate of potash respectively.

All P, K and half N were applied during land preparation at the time of sowing. The second half of N was split applied at 3rd irrigations. Weed management practices were done manually as well as by using herbicide. At complete loss of green color, the maturity days were counted as difference between sowing to harvest date in each treatment.

Results and Discussion

Growth Attributes

Number of tillers/m^2

The number of tillers significantly increased in breeder seed which was higher than foundation and certified seed, respectively in both the years. However, higher number of tillers (404.85 and 417.69) was recorded under breeder seed than foundation seed in both years and lower number of tillers (395.46 and 407.84, respectively) was observed under certified seed. The row-spacing of 22.5 cm produced significantly more number of tillers (339.08 and 411.64) as compare to 15 cm row-spacing and minimum number of tillers (372.21 and 384.45) obtained under broadcast in both years of experiment. Number of tillers/m2 maximum observed with 18 cm and significantly better to rest of the assorted units. Dhiman Mukherjee (2017) [4].

The application of 120 kg/ha seed rate recorded significantly higher number of tillers (393.65 and 406.40) than 80 kg/ha seed rate (382.44 and 394.51, respectively) during both the years of investigation. The result showed that the number of tillers declined at higher seed rate (100 kg/ha) as compared to 80 kg/ha and can be attributed to reduced number of tillers and effective tillers Singh *et al.* (2013) [14, 15].

Fresh weight

The data in table 1 revealed that the significant variation in fresh weight found due to quality seeds at all the growth stages during both years of experimentation. However, highest fresh weight per plant (157.29 and 165.42 g) was recorded under breeder seed than foundation seed at all the growth stages during 2016-17 and 2017-18 and lowest number of fresh weight per plant (141.34 and 148.38 g) was observed under certified seed. The row-spacing of 22.5 cm was found significantly better than all other spacing at all the growth stages of crop during two years of study. However, the maximum fresh weight per plant (154.98 and 162.90 g) was obtained under 22.5 cm row -spacing and higher over broadcast (144.60 and 152.30 g) during 2016-17 and 2017-18. It is clear from the results that applications of different seed rate found significant at all the stages but it is found non-significant at 30 DAS during both the years of investigation. However, 120 kg/ha level of seed rate at 60 DAS produced maximum fresh weight per plant (152.93 and 160.79 g) as compare to 80 kg/ha seed rate (148.53 and 156.03 g, respectively). Reported that seed rates of 50, 100,150 and 200 kg seed ha^{-1} the effect of seed rates was significant on most of agro-physiological traits. Fresh weight at higher seed rate of 200 kg ha^{-1}. Hussain *et al.* (2010) [6].

Dry weight

The dry weight per plant was significantly influenced by quality seeds at all the stages of crop growth except 30 DAS in two years. However, at harvest stage, highest dry weight per plant (20.66 and 21.70 g) was observed under breeder which was higher over certified seed. The lower number of fresh weight per plant (18.12 and 19.03 g) was obtained with certified seed during 2016-17 and 2017-18. The results revealed that dry weight per plant was significantly increased at 22.5 cm row-spacing which was more than 15 cm row-spacing and broadcast at all the growth stages but at 30 DAS it was found non-significant during 2016-17 and 2017-18. However, the maximum dry weight per plant (20.03 and 20.97 g) at harvest stage was recorded with 22.5 cm row-spacing at all the growth stages of crop and lowest dry weight per plant (18.53 and 19.50 g) was recorded under broadcast during both the years of experiment.

The dry weight per plant was significantly increased by different levels of seed rate at all the growth stages but at 30 DAS it was found non-significant in two years of experimentation. The application of 120 kg/ha seed rate attained significantly higher dry weight per plant (20.05 and 21.03 g). However, minimum dry weight per plant (18.93 and 19.88 g) was observed in 80 kg/ha seed rate during both the years of experiment

Yield Attributes

Number of grains/ear

It is evident from the data that there was a significant variation found in number of grains/ear due to quality of seeds in two years. However, breeder seed produced maximum number of grains/ear (53.798 and 56.43) and minimum number of grains/ear (48.36 and 50.76) was observed in certified seed during 2016-17 and 2017-18. The data showed that the row-spacing of 22.5 cm was found significantly better than all other treatments in both years. However, maximum number of grains/ear (52.96 and 55.60) was obtained under 22.5 cm row-spacing. While, minimum number of grains/ear (49.50 and 51.87) was recorded under broadcast during both the years of study. The effect of row spacing (20, 30 and 40 cm) on wheat morphology and grains per spike was studied. The maximum grains per spike were observed in the 40 cm spacing. Khalil, S. K. *et al*. (2000) [8]. The level of 120 kg/ha seed rate significantly produced highest number of grains/ear (52.32 and 54.90) as compare to 80 kg/ha seed rate (50.79 and 53.28) during both the years of investigation. Statistical analysis of the data revealed that the plots treated with 150 kg ha^{-1} seed rate had higher number of grains spike^{-} Ijaz Ahamd Khan *et al*. (2002) [9].

Weight/ear

The data on weight/ear increased significantly in both years. The breeder seed was found significantly better than all other treatments, hence, maximum weight/ear (2.91 and 13.04 g) was observed under breeder seed during 2016-17 and minimum weight/ear (2.61 and 2.74 g) was recorded with certified seed during both the years of investigation**.** The row-spacing exhibit significantly differences in weight/ear during both the years of experiment. The row- spacing of 22.5 cm produced maximum weight/ear (2.87 and 3.0 g) which was statistically similar during first year with 15 cm row-spacing and higher than certified seed. Among different level of seed rate, 120 kg/ha produced significantly highest weight/ear (2.83 and 2.96 g, respectively) and 80 kg/ha seed rate provide lowest weight/ear (2.74 and 2.87 g) during 2016-17 and 2017-18.

Economic yield

Harvest index

It is obvious from the data that harvest index was influenced significantly by the quality of seeds. However, the highest harvest index (38.14 and 37.88%) was recorded with breeder seed fallowed by Foundation (37.72 and 37.20%) and

certified seed (36.90 and 36.11%) during both the years of study.

During row-spacing maximum harvest index (37.88 and 37.48%) was significantly produced under the 22.5 cm row-spacing and minimum harvest index (37.18 and 36.52%) was recorded under the broadcast in both the years. Wheat was sown at row spacing of 20, 30 and 40 cm, Row spacing significantly affected harvest index was found in 20 cm row spacing. Result of this study is agreement with Ahmad, J. *et al.* (2005) [1]. It is clear from the data the highest harvest index (37.73 and 37.31%) significantly was observed under the 120.0 kg/ha seed rate as compare to 80 kg/ha seed rate (37.48 and 36.74%) during 2016-17 and 2017-18. Significant effects between seeding rates were detected on harvest index. The highest harvest index was recorded for seeding 300 seeds m-2), while the lowest values were found for seeding 100 seeds m-2. The results of the study reported by Essam A. and Abd El-Lattief (2014) [5].

Table 1: Effect of different treatments on Number of tillers/m^2, Fresh weight (g) and Dry weight (g)

Treatments	Number of tillers/m^2		Fresh weight (g)		Dry weight (g)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Quality seeds						
Breeder	404.85	417.69	157.29	165.42	20.66	21.70
Foundation	395.46	407.84	153.57	161.43	19.69	20.64
Certified	363.82	375.83	141.34	148.38	18.12	19.03
SE(d) ±	2.87	3.29	2.00	2.53	0.24	0.31
CD at 5%	7.98	9.15	5.57	7.03	0.69	0.87
Spacing						
15.0	392.85	405.26	152.62	160.01	19.91	20.88
22.50	399.08	411.64	154.98	162.90	20.03	20.97
Broadcast	372.21	384.45	144.60	152.30	18.53	19.50
SE(d) ±	2.20	2.48	1.51	1.67	0.20	0.25
CD at 5%	4.81	5.41	3.29	3.65	0.45	0.54
Seed rate						
80	382.44	394.51	148.53	156.03	18.93	19.88
120	393.65	406.40	152.93	160.79	20.05	21.03
SE(d) ±	2.91	3.29	2.00	2.11	0.26	0.32
CD at 5%	6.11	6.92	4.22	4.44	0.55	0.68

Table 2: Effect of different treatments on Number of grains/ear, Weight/ear (g) and Harvest index (%)

Treatments	Number of grains/ear		Weight/ear (g)		Harvest index (%)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Quality seeds						
Breeder	53.79	56.43	2.91	3.04	38.14	37.88
Foundation	52.52	55.09	2.83	2.97	37.72	37.20
Certified	48.36	50.76	2.61	2.74	36.90	36.11
SE(d) ±	0.60	0.65	0.03	0.03	0.12	0.15
CD at 5%	1.68	1.80	0.08	0.09	0.33	0.41
Spacing						
15.0	52.22	54.81	2.82	2.96	37.73	37.09
22.50	52.96	55.60	2.87	3.00	37.88	37.48
Broadcast	49.50	51.87	2.67	2.80	37.18	36.52
SE(d) ±	0.45	0.47	0.02	0.02	0.08	0.10
CD at 5%	0.98	1.03	0.05	0.06	0.18	0.23
Seed rate						
80	50.79	53.28	2.74	2.87	37.48	36.74
120	52.32	54.90	2.83	2.96	37.73	37.31
SE(d) ±	0.59	0.67	0.03	0.03	0.11	0.12
CD at 5%	1.23	1.42	0.06	0.07	0.24	0.25

Conclusion

Breeder seed at 22.5 cm row-spacing along with seed rate of 120 kg ha-1 increased significantly at all the treatments as compare to foundation seed and 15 cm spacing with 80 kg/ha. However, maximum number of tillers, fresh and dry weight, number of grains/ear, weight/ear and harvest index were found under the treatments combination of Breeder seed, 22.5 cm spacing and 120 kg/ha as compare to certified seed, broadcast and level of 80 kg/ha seed rate combination.

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