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Evaluation of wheat (*Triticum aestivum* L.) genotypes under irrigated and rainfed conditions in intermediate zone of Jammu and Kashmir

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ABSTRACT

Field experiments were carried out at the research farm of Regional Agricultural Research Station, Rajouri, SKUAST-Jammu during 2013 – 2016 rabi season under irrigated (IC) and rainfed conditions (RC) of inter-mediate zone of UT of Jammu & Kashmir in order to determine the high adaptive yielding with high quality bread wheat genotypes.The experiments were laid out in a randomized block design with 4 replications and six varieties of wheat. Genotypes were significantly different among themselves for all the phenological traits under irrigated and rainfed conditions. The pooled results of three years revealed that wheat genotypes VL 804 and HS 562 performed better in terms of growth, yield attributes and yield under irrigated condition compared to genotypes cultivated under rainfed condition. However, genotypes VL 907 and HS 507 'Improved' found better in growth and yield than other genotypes under rainfed condition. The highest net returns of Rs. 76924 ha^{-1} and B:C ratio of 2.86 was recorded with in genotype VL 804 under irrigated condition and net returns of Rs. 39903 ha^{-1} and B:C ratio (2.78) in genotype VL 907 under rainfed condition.

Keywords: Wheat, genotypes, irrigated, rainfed, yield, Jammu & Kashmir

INTRODUCTION

Wheat (*Triticumaestivum*L.) is called as the "King of Cereals" and is one of the most important crops for global food security.Wheat occupies a central place in human nutrition providing 20% of the daily protein and food calories. In terms of food security, it is the second most important food crop in the developing world after rice, because an estimated 80 million farmers rely on wheat for their livelihoods. The consumption of wheat is increasing globally, even in countries with climates unfavourable for wheat production. Wheat is an important cereal crop for the food security of South Asia and is the 2nd major staple food crop after rice (Kumar *et al.* 2018, Wani*et al.* 2019).Wheat has its own definite abiotic and biotic requirement for its growth and development. Genotypes play a vital role in crop production. The choice of right genotype of wheat helps to augment crop productivity by about 20-25 per cent. Any genotype of wheat before recommended for general cultivation for particular region has to be judged for its potential, tolerance against disease and its responsiveness to added water and fertilizer. There is substantial genetic variability in wheat. Multi-environmental evaluation of genotypes provides accurate information regarding performance, adaptability, and stability of the genotypes (Woyann *et al.* 2019, Singh *et al.* 2019). In order to feed the projected population of 9.1 billion by 2050, crop production and productivity should be increased significantly (Poudel *et al.* 2020).Keeping the above points in view, an experiment on evaluation of wheat genotypes under rainfed and irrigated conditions was conducted to identify suitable variety and sowing climatic conditions.

MATERIALS AND METHODS

The field experiments were carried out during the *rabi* season of 2013-2014, 2014-2015 and 2015-2016at research farm of Regional Agricultural Research Station, Rajouri, SKUAST-Jammu under irrigated and rainfed conditions in intermediate zone at village Tandwal situated at 33° 42' N latitude and 74° 13' E longitude with anelevation of 950 m above mean sea level. The climate of the experimental site is sub-temperate characterized by moderately hot summers and severe cold winters. The annual rainfall of the area is about 1050 mm and the average total rainfall received during cropping period was 509.1 mm.The soil of the experimental field was clay loam in texture with pH 7.2, high in organic carbon (6.8 gkg^{-1}), available nitrogen (430 kgha^{-1}), available phosphorus (18.4 kgha^{-1}) and

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available potassium 246 kgha^{-1}. The experiment was laid out in randomized block design with four replications and 6 genotypes cultivated under irrigated and rainfed conditions. Six varieties namely HS 562, VL 967, VL 804, HS 507, VL 907 and HPW 349 were evaluated under irrigated and rainfed conditions of intermediate zone of J & K.Wheat varieties were grown as per recommended cultural practices at a line spacing of 22 cm. The recommended dose of NPK fertilizers were applied, where all P (as single superphosphate) and 1/3rd of N (as urea) were applied at the time of sowing and remaining N was applied in two equal splits at first irrigation or 20-25 days after sowing and at 2nd irrigation or 40-45 days after sowing. All other agronomic practices were followed as per standard recommendations. Crop was harvested at fully ripened stage. Five plants were selected randomly from each entry and plant height, tillers (m^2), effective tillers/plant, grains /spike, grains/plant, test weight, grain yield, straw yield, biological yield and harvest Index (%) were recorded. For statistical analysis of morphological, traits analysis of variance (ANOVA) was carried out according to SAS, version 9.4.The significanceof treatments was tested by 'F' test (Variance ratio). The difference in the treatment mean was tested by using critical difference (CD) at 5% level of probability.

RESULTS AND DISCUSSION

Growth parameters

The results revealed that the growth characters of different genotypes (Table 1) were significantly influenced under rainfed condition compared with irrigated condition.The sowing under irrigated condition recorded significantly taller plants, maximum tillers and effective tillers/plant.

Table1: Growth characters of wheat varieties under irrigated and rainfed conditions

Treatments	Plant height (cm)		Tillers (m^2)		Effective tillers/plant	
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
HS 562	93.1	78.3	416	378	7.46	5.28
VL 967	81.7	83.3	356	398	5.34	6.80
VL 804	94.8	84.6	482	410	7.94	6.90
HS 507	88.4	88.4	382	414	6.22	7.26
VL 907	92.8	89.8	398	432	7.34	7.62
HPW 349	84.3	81.0	376	392	5.92	6.48
SE(m)	0.28	0.09	0.632	0.477	0.228	0.035
CD(P=0.05)	0.86	0.28	1.924	1.452	0.695	0.105

Regarding the interaction effect between environment and genotypes on plant height the data indicated that the genotype VL 804 attained maximum plant height (94.8 cm) followed by HS 562 (93.1 cm) and VL 907 (92.8 cm) whereas, genotype VL 907recorded maximum plant height(89.8 cm) under rainfed condition than other genotypes. Similarly, sowing under irrigated condition also resulted in the significant increase of maximum tillers (482) and effective tillers/plant(7.94) in the wheat variety VL 804 (Ram *et al.*, 2012). Wheat variety VL 907 sown under rainfed condition recorded maximum tillers/m^2 (432) and effective tillers/plant (7.62) than other genotypes under rainfed condition. This shows that irrigation had significant effect on plant height and other growth parameters. Water is a fundamental constituent of plant protoplasm and its adequate supply is essential for cell division and cell elongation. Therefore, optimum availability of water to wheat might have improved the photosynthetic area of plants that cumulatively contributed to higher plant height, maximum tillers and effective tillers/plant of crop. The results of this study are in close agreement with those reported by Kharrou *et al.* (2011).

Yield attributes

The data (Table 2)indicated that irrigated condition had significant beneficial effect on yield attributes of wheat, viz. grains/spike, grains/plant and test weight.Under irrigated condition, higher yield attributes viz. grains/spike (34.9), grains/plant (255.2)and more test weight

Table2: Yield attributes of wheat varieties under irrigated and rainfed conditions

Treatments	Grains/spike		Grains/plant		Test weight (g)	
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
HS 562	34.4	29.3	253.4	148.6	39.40	33.90
VL 967	29.4	31.4	178.8	210.6	33.50	35.10
VL 804	34.9	32.1	255.2	240.4	42.40	36.70
HS 507	33.1	32.6	234.6	244.6	36.10	39.10
VL 907	33.1	32.9	242.3	248.9	37.80	39.30
HPW 349	32.8	31.3	202.3	196.9	32.90	34.20
SE(m)	0.25	0.02	1.80	0.29	0.349	0.388
CD(P=0.05)	0.76	0.08	5.48	0.90	1.061	1.181

(42.40) was observed in the wheat genotype VL 804. Under rainfed condition, the higher grains/spike (32.9), grains/plant (248.9)and more test weight (39.30) were observed in genotype VL 907.Application of irrigation to wheat facilitates sufficient moisture for higher growth and development of the plants which enhanced photosynthetic efficiency by improving source-sink relationship of the plants leading higher growth and development reflected by higher yield attributes of plants.These findings were in accordance with those of Mubeen *et al.* (2013) and Ali *et al.* (2012).

Yield

Data (Table 3) revealed that the mean maximum grain yield was recorded (42.83 q ha^{-1}) with genotype VL 804 followed by HS562 (38.14q ha^{-1}) and VL 907 (35.83q ha^{-1}) under irrigated condition. Similarly, maximum straw yield (63.08q ha^{-1}) and harvest index (40.4%) were recorded in VL 804 genotype under irrigated condition. However, under rainfed conditions genotype VL 907 recorded highest grain yield of 35.73q ha^{-1}followed by HS 507 (35.07 q ha^{-1}) and VL 804 (33.63 q ha^{-1}). The better performance of wheat in terms of yield under irrigated condition might be due to increased soil-moisture content which improved internal water status and growth of plant.Water is considered as one of the most crucial inputs for agricultural production. It facilitates a higher productive potential from the land, and significant response from applied agricultural inputs, viz. high-yielding varieties and fertilizer (Kukal *et al.*2014).

Table3: Yield andeconomics of wheat varietiesunder irrigated and rainfedconditions

Treatments	GTrains yield (q ha^{-1})		Straw yield (q ha^{-1})		Harvest Index (%)		Net returns (q/ha)		Cost Benefit ratio	
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
HS 562	38.17	31.17	58.42	53.17	39.5	36.9	40596	30318	1:2.59	1:2.35
VL 967	29.03	32.37	49.28	54.37	37.0	37.3	24708	32865	1:1.97	1:2.47
VL 804	42.83	33.63	63.08	55.63	40.4	37.6	47532	35172	1:2.86	1:2.57
HS 507	31.47	35.07	51.72	57.07	37.8	38.0	28809	38181	1:2.13	1:2.71
VL 907	35.83	35.73	56.08	57.73	38.9	38.2	35859	39903	1:2.41	1:2.78
HPW 349	30.73	31.50	50.98	53.50	37.6	37.0	28440	31110	1:2.12	1:2.39
SE(m)	0.434	0.182	0.434	0.183	0.10	0.05	-	-	-	-
CD (P=0.05)	1.321	0.554	1.321	0.555	0.31	0.15	-	-	-	-

Economics

The maximum net returns of Rs 47532ha^{-1}were recorded with the genotypes VL 804 followed by HS 562 with a net return of Rs 40596ha^{-1}, under irrigated condition. Under rainfed condition, the highest net return of Rs 39903 ha^{-1} were recorded with genotypes VL 907 followed by HS 507 with net returns of Rs. 38181 ha^{-1}. The highest B:C ratio of 2.86 was recorded with the genotype VL 804 under irrigated condition and 2.78with the genotype VL 907 under rainfed condition (Table 3). This showed that wheat crop is more responsive towards the inputs use and under good management and it can give even higher returns.

On the basis of generalization of the results obtained, it may be concluded that wheat genotypes VL 804 and HS 562 were most suitable in terms of growth and yield under irrigated condition of Jammu & Kashmir. However, genotypes VL 907 and HS 507 'Improved' found better in growth and yield than other genotypes under rainfed condition. This study will be helpful for farmers in understanding the cultivation of suitable wheat genotype under different conditions (irrigated and rainfed) in inter-mediate zone.

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