International Journal of Farm Sciences **6(3):** 261-265, 2016

Effect of environment on yield accumulation in wheat cultivars under Haryana conditions

PREETI, ISHWAR SINGH PANWAR, RAJESH KUMAR ARYA and DIVYA PHOUGHT

Wheat and Barley Section
Department of Genetics and Plant Breeding
CCS Haryana Agricultural University, Hisar 125004 Haryana, India
Email for correspondence: isp.panwar@gmail.com

ABSTRACT

A set of 42 genotypes of bread was grown in four different environments at the experimental area of Wheat and Barley Section, Department of Genetics and Plant breeding, CCS Haryana Agricultural University, Hisar during Rabi season of 2012-2013 to identify the suitable genotypes. Considerable genetic differences among genotypes for various traits were evident in all the four environments. From the mean performance of the genotypes based on all the four environments it appeared that genotypes WH 1105, WH 1142, WH 711, HD 2967, DBW 17, WH 542, PBW 343, DPW 621-50, PBW 550 and WH 1135 were promising for grain yield. Though grain yield production potential is the inherent property of a genotype, it is highly influenced by the environment.

Keywords: Wheat; grain yield; temperature; fertility effect

INTRODUCTION

Wheat (*Triticum aestivum* L em Thell) is one of the most important cereal crops of the world both in terms of area and production. The widespread cultivation of the crop all along the globe is largely due to high versatility of genome which enables its adaptation to different agro-climatic conditions and the unique property of wheat flour and dough which allows its processing into a range of food products. It is one of the major sources of energy, protein and fibre in human diet (Arya et al 2012). The ideal temperature for wheat cultivation is 15^{o}C which is very low. Therefore heat can influence the different stages of crop growth during crop cultivation in India. Climate change especially increasing temperature will be the main challenge in the coming years as far as increasing yield is concerned. As per UN report earth will be warmer by 2.4^{o}C by 2020 and crop production in India would fall by 30 per cent (Anon 2013). The productivity of bread wheat is often limited by an array of abiotic stresses that affect not only the plant growth but the grain filling as well and

ultimately affect the grain yield. The present investigation was carried out with the sole objective of identifying genotypes with high grain yield under different environments.

MATERIAL and METHODS

A set of 42 genotypes of bread wheat representing different agro-climatic zones was grown in four different environments at the experimental area of Wheat and Barley Section, Department of Genetics and Plant breeding, CCS Haryana Agricultural University, Hisar situated at a latitude of 29°10' N, longitude of 75°46' E and altitude of 215.2 m amsl in semi-tropical region of western zone of India during Rabi season 2012-2013 in randomized block design (RBD) with three replications. The 4 test environments were designated as E_1 (timely- November sown, high fertility, NPK 150:60:40 kg/ha), E_2 (late- December sown, high fertility, NPK 120:60:40 kg/ha), E_3 (early- last week of October sown, medium fertility, NPK 90:60:40 kg/ha) and E_4 (timely- November sown, low fertility, NPK 60:30:20 kg/ha). The soil was sandy loam (type- ustrochrepts). The metrological observations at weekly interval during experimental period were recorded and are depicted in Fig 1. Each entry was accommodated in a paired row of 3 meter length with spacing of 30 cm between row to row and 10 cm between plant to plant in each replication. Five competitive plants of each genotype in each replication and in each environment were randomly selected for grain yield per plant and data recording. The statistical analysis was done as described by Panse and Sukhatme (1967).

RESULTS and DISCUSSION

It was revealed that grain yield per plant varied from 20.55 (WH 1156) to 47.51 g (WH 1105) in E_1, 15.90 (WH 1156) to 38.31 g (WH 1105) in E_2, 16.01 (WH 416) to 35.98 g (WH 1105) in E_3 and 13.44 (WH 1156) to 28.66 g (WH 1105) in E_4. Overall means for this character were 30.74, 24.29, 24.61 and 19.05 in E_1, E_2, E_3 and E_4 respectively (Table 1). Eighteen varieties in E_1 and E_4 and seventeen in E_2 and E_3 showed significantly better performance than general mean.

Considering the mean performance of 42 genotypes studied in the four environments genotypes WH 1105, WH 1142, WH 711, HD 2967, DBW 17, WH 542, PBW 343, DPW 621-50, PBW 550 and WH 1135 were promising varieties for grain yield per plant over the environments. This may be due to their response to suitable temperature and fertility status. However their adaptability to high temperature and low fertility made them promising for warmer environment under late sown conditions and low soil fertility conditions. Highest grain yield was recorded in E_1 for most of the genotypes. However only one genotype (WH 1134) produced maximum in E_2. Contrary to it lowest grain yield was recorded in E_4 for most of the genotypes

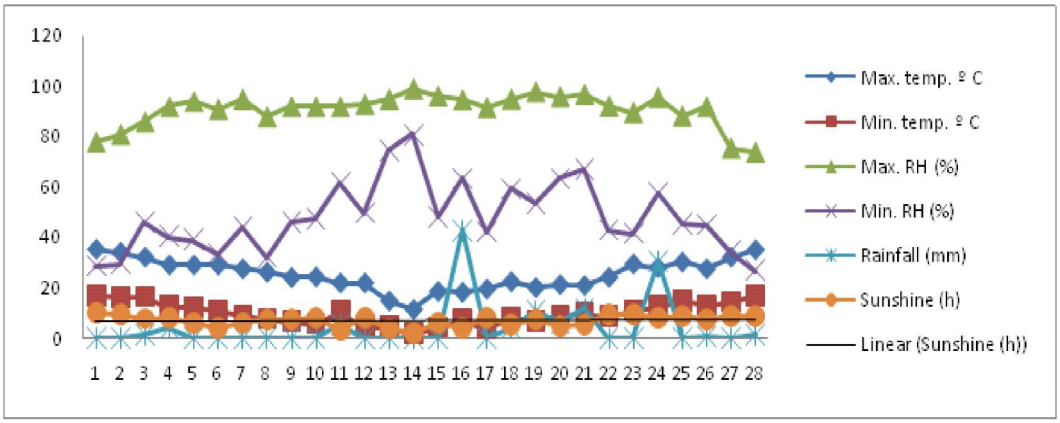

Fig 1. Weekly meteorological data of Hisar station for Rabi season 2012-13

but the genotype WH 1100 and WH 1162 in E_2 and WH 1164 in E_3 produced lowest. Thus it is self-evident that changes in grain yield were not homogenous in all the genotypes grown under four different environments. Thus it is supported that grain yield in crop plants depends on plant phenology along with environmental conditions.

Different genotypes responded differently under different levels of fertility. The analysis showed that increasing temperature generally shortened the growing period of commercial crops resulting in a shorter time for biomass accumulation and thus in low grain yield. However the increase in fertilizer generally increased the growing period of crop resulting in more production due to harvesting more energy from sun. Moreover changes in yield were not homogeneous and were dependent on crop phenology (Arya et al 2014).

Under late sown condition the increase in temperature was responsible for advancement in the main phonological stages shortening the growing season which resulted in severe yield reduction. These findings are supported by Moriondo et al (2010). The pattern of genotypic response was not similar in all the four environments due to variations in genotypic response over the dates of sowing and fertility levels. Similar findings were also reported by Rane et al (2007). Grain yield is a polygenetic trait which is considerably affected by environmental factors viz temperature, soil moisture and fertility prevailing during crop growth and especially during grain filling (Arya et al 2014, Kant et al 2014).

REFERENCES

Anonymous 2013. Progress report, All India Coordinated Wheat and Barley Improvement Project, 2012-2013, Directorate of Wheat Research, Karnal, Haryana, India, 204p.

Table 1. Average grain yield of genotypes under different environments

Genotype	Average grain yield/plant (g)				
	E_1	E_2	E_3	E_4	Mean
WH 416	23.89	19.23	16.01	14.66	18.45
WH 1163	23.49	18.73	19.15	17.15	19.63
WH 1100	22.10	17.46	21.76	18.59	19.98
WH 1132	25.99	22.35	29.33*	21.52*	24.80
WH 1134	27.23	27.97*	24.39	20.62*	25.06
WH 1156	20.55	15.90	17.09	13.44	16.75
WH 1154	24.64	23.26	25.17*	20.17*	23.31
WH 1102	24.43	22.24	21.85	16.09	21.15
WH 590	28.78	25.80*	23.24	15.41	23.31
WH 147	23.13	17.87	17.01	14.13	18.04
WH 1123	26.02	24.12	21.76	18.08	22.50
WH 1158	23.73	20.29	19.46	17.67	20.29
DPW 621-50	41.59*	24.31*	32.62*	19.66*	29.55
WH 1164	25.27	21.70	20.21	20.54*	21.93
WH 1131	20.75	16.00	16.26	13.82	16.71
WH 283	25.07	18.80	22.37	14.83	20.27
WH 1133	24.41	23.18	22.71	16.74	21.76
WH 1165	28.91	18.92	24.97*	18.79	22.90
WH 1162	21.22	16.26	30.06*	22.07*	22.41
WH 1098	31.29*	28.72*	23.98	19.99*	26.00
WH 1105	47.51*	38.31*	35.98*	28.66*	37.62
WH 1151	37.94*	23.86	22.91	18.19	25.73
WH 1135	40.61*	25.49*	25.39*	17.12	27.16
WH 1155	37.52*	24.83*	19.32	16.99	24.67
WH 1142	40.91*	36.89*	37.66*	24.84*	35.08
WH 1127	38.61*	24.97*	22.81	17.67	26.02
WH 1153	31.23*	24.78*	26.72*	15.09	24.46
WH 1126	30.73	23.66	24.01	22.88*	25.33
PBW 343	40.13*	33.77*	30.02*	22.92*	31.71
PBW 550	38.33*	29.50*	27.63*	21.46*	29.23
WH 1021	28.32	24.16	25.24*	23.11*	25.21
WH 1081	33.57*	25.80*	23.54	20.40	25.83
WH 542	42.76*	30.00*	32.59*	22.21*	31.89
RAJ 3765	24.48	20.44	21.38	16.51	20.70
PBW 373	23.40	19.33	17.38	14.53	18.66
HD 2851	21.27	19.81	19.31	18.15	19.64
C306	30.96*	23.16	23.55	18.65	24.08
WH 1080	35.08*	23.73	25.65*	20.50*	26.24
DBW 17	44.38*	33.89*	32.87*	20.92*	33.02
WH 1025	25.72	20.88	21.67	18.10	21.60
HD 2967	42.40*	35.26*	33.97*	22.50*	33.54
WH 711	42.86*	34.46*	34.51*	24.94*	34.20
Mean	30.74	24.29	24.61	19.05	
SEm±	1.15	1.35	1.12	1.17	
CD	3.25	7.97	3.16	9.66	

*Tested against general mean

Arya RK, Munjal R and Dhanda SS 2012. Evaluation of bread, durum and synthetic wheats and triticale for physiological traits under heat stress conditions. National Seminar on Sustainable Agriculture and Food Security: Challenges in Changing Climate, 27-28 March 2012, CCS Haryana Agricultural University, Hisar, Haryana, India.

Arya RK, Singh MK, Yadav AK, Kumar A and Kumar S 2014. Advances in pearl millet to mitigate adverse environment conditions emerged due to global warming. Forage Research **40(2):** 57-70.

Kant S, Lamba RAS, Arya RK and Panwar IS 2014. Effect of terminal heat stress on stability of yield and quality parameters in bread wheat in southwest Haryana. Journal of Wheat Research **6(1):** 66-75.

Moriondo M, Giannakopoulos C and Bindi M 2010. Climate change impact assessment: the role of climate extremes in crop yield simulation. Climate Change **104:** 679-701.

Panse VG and Sukhatme PV 1967. Statistical methods for agricultural workers. ICAR, New Delhi, India.

Rane J, Pannu RK, Sohu VS, Saini RS, Mishra B, Shoran J, Crossa J, Vargas M and Joshi AK 2007. Performance of yield and stability of advanced wheat genotypes under heat stress environments of the Indo-Gangetic plains. Crop Science **47:** 1561-1573.

Received: 6.6.2015 ***Accepted: 14.10.2015***