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Stability analysis for grain yield and its components under different moisture regimes in bread wheat (*Triticum aestivum*)

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ABSTRACT

The present study was undertaken to identify stable genotypes for grain yield and its components with resilient performance under water deficit and irrigated conditions in bread wheat (*Triticum aestivum* L.). The combined analysis of variance depicted significant g × e interaction mean squares for all the characters, except spike length and peduncle length. The highest pooled mean for grain yield/plant ranged from 4.98 to 7.05 g and the highest mean was exhibited by Raj 4037 (7.05 g) followed by PBW 373 (6.96 g), GW 273 and WR 544 (both 6.89 g) etc, respectively. For 1000 grain weight the genotypes, viz. DPW 621-50 (μ=36.67 g, b=1.01** and S^2di=-0.54) followed by UP 2425 (μ=36.67 g, b=0.89** and S^2di=-0.56) and Raj 4037(μ=36.50 g, b=0.95 and S^2di=-0.58) showed stable performance across the environments. The genotypes namely, viz. WR 544, GW 273, DBW 39, HD 2987, Raj 3777, UP 2425, Raj 3765, PBW 343 and UP 2338 revealed consistent performance for high biomass and grain yield in water stress and as well as in irrigated conditions.

Key words: Bread wheat, Moisture stress, Stability analysis

Wheat (*Triticum aestivum* L.) is one of the most important cereals of India and known to be cultivated since pre-historic times (Tandon 2000, Kumar and Maloo 2011). Globally, India is the second largest wheat producer and achieved an all time highest ever production of 93.90 mt, during 2011-12 (Anonymous 2012, Kallesh *et al.* 2012). However, to keep continuous rise in future wheat production, we have to have solutions for rigid challenges ahead as climate change, burgeoning population, depleting natural resources, biotic and abiotic stress etc. Water deficit among other abiotic stresses is a major concern (Araus *et al.* 2002) as enough wheat area in northern hills, north-eastern, central and peninsular India is under rainfed cultivation and majorly relied on reserve soil moisture of preceding monsoon. Grain yield and its components are complex phenomenons and function of genotype, environment and genotype × environment interaction (p = g + e + g × e) (Falconer 1989, Sharma 2001, Hamam *et al.* 2009). Genotype × environment interaction often misleads plant breeders, while assessing real worth of a genotype and distorts genetic analysis which depicts biased estimates, i.e. genetic variance, covariance, heritability, correlation, choice of breeding method etc. Stable genotypes are less influenced by g × e interactions and having individual or population buffering mechanism to make physiological adjustments to cope up with physical, chemical and biological changes in the interplay of genetic and non-genetic on their developmental phases. Therefore, the present study was undertaken with forty bread wheat genotypes, released for different agro-climatic and production conditions of India to identify consistent performer genotypes under different moisture regimes, which can be gainfully utilized in future wheat hybridization programmes to throw water stress resilient transgressive segregants.

MATERIALS AND METHODS

The present study was carried out at New Experimental Farm, Directorate of Wheat Research, Karnal, during *rabi* 2011-12. The experimental material comprising forty bread wheat genotypes were selected on the basis of their area of adoption, pedigree and production conditions (Table 1). Three environments/moisture regimes were created by skipping irrigations at different crop growth stages. In the first environment (E_1) single irrigation was applied at 23 days after sowing (DAS) at crown root initiation stage (CRI) and crop plants faced the severe water stress at tillering, heading and grain filling stages. In second environment (E_2), two irrigations were provided at CRI and heading stages, while third environment (E_3) was favourable environment, where recommended five irrigations were practiced at CRI, tillering, late jointing, heading and grain filling stages.

Forty bread wheat genotypes were grown in paired rows of two meter row length in complete randomized

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Table 1 Area of adoption, pedigree and production conditions of forty bread wheat varieties

Area of Adoption/Zone	Variety	Pedigree	Production conditions	Grain yield/plant (g) for E_3
Northern Hills Zone	VL829	IBWSN/CPAN2099	ES,RF	8.55
(NHZ)	VL 804	CPAN3018/CPAN3004//PBW65	TS,IR/RF	7.93
	VL 907	DYBR 1982-83/842 ABVD50/VW9365//PBW343	TS,IR	8.64
	HS 490	HS364/HPW114//HS240/HS346	LS,RIR	7.90
	VL 892	WH542/PBW226	LS,RIR	8.13
North Western	RAJ 1482	NAPO-TOB'S'/8156/KAL-BB	TS,IR	9.22
Plain Zone (NWPZ)	UP 2338	UP368/VL421//UP262	TS/LS,IR	9.15
	PBW 343	ND/VG9144//KAL/BB/3/YCO"S'/4/VEE#S"S"	TS,IR	8.89
	HD 2687	CPAN2009/HD2329	TS,IR	8.69
	DBW 17	CMH79A,95/3*CNO79//RAJ3777	TS,IR	10.18
	PBW 550	WH594/RAJ3858//W485	TS,IR	8.78
	DPW 621-50	KAUZ//ALTAR84/AOS/3/MILAN/KAUZ/4/HUITES	TS,IR	10.31
	HD 2967	ALD/CUC//URES/HD216OM/HD2278	TS,IR	10.40
	RAJ 3765	HD2402/VL639	LS/VLS,IR	9.27
	PBW 373	ND/VG9144//KAL/BB/3/YCO"S'/4/VEE#S"S"	LS,IR	9.88
	UP 2425	HD2320/UP2263	LS,IR	9.06
	DBW 16	RAJ3765/WR484//HUW468	LS,IR	9.64
	WH 1021	NYOT95/SONAK	LS,IR	9.80
Haryana	WH 711	ALD'S'HUAC//HD2285/3/HFW-17	TS,IR	8.95
Rajasthan	RAJ 3777	RAJ3160/HD2449	LS/IR/RF	9.31
North Eastern Plain	K 0307	K8321/UP2003	TS,IR	9.59
Zone (NEPZ)	CBW 38	CNDO/R143/ENTE/MEXI_2/3/*Ae. squarrosa*........	TS,IR	9.09
	DBW 39	ATTILA/HUI	TS,IR	8.87
	DBW 14	RAJ3765/PBW343	LS,IR	8.64
	HD 2985	PBW343/PASTOR	LS.IR	9.16
Central Zone (CZ)	LOK 1	S308/S331	TS/LS,IR	8.31
	GW 273	CPAN2084/VW205	TS,IR	9.95
	GW 322#	GW173/GW196	TS,IR	7.73
	HI 1531	HI1182/CPAN1990	TS,RF/LS,IR	7.49
	HI 1544	HINDI62/BOBWHITE/CPAN2099	TS,IR	7.84
	MP 4010	ANGOSTURA88	LS,IR	7.83
Peninsular Zone (PZ)	RAJ 4037	DL788-2/RAJ3717	TS,IR	9.93
	HD 2987	HI 1011/HD 2348//MENDOS//IWP72/DL 153-2	TS, RF/IR	8.99
	RAJ 4083	PBW343/UP2442//WR258/UP2425	LS,IR	8.56
	AKAW 4627	WH147/SUNSTAR*/C80.1(selection from Vimal)	LS,IR	8.76
Maharashtra	NIAW 34	CNO79/PRL ''S''	LS/VLS, IR	8.65
National Capital	HD 2851	CPAN3004/WR426//HW2007	TS,IR	8.33
Region (NCR)	WR 544	KALYANSONA/HD1999//HD2204/DW38	LS,IR	9.27
Problematic Soils of	KRL 210	PBW65/2*PASTOR	TS,IR	8.90
Northern Plains	KRL 213	CNDO/R143/ENTE/MEXL-2/3/*Ae. Squarrosa* 9TAUSO/4/WEAVER/5/28KAUZ	TS,IR	8.64

*ES=Early sown, TS=timely sown, LS=late sown, VLS=very late sown, IR=irrigated, RF=rainfed, RIR=restricted irrigation, # for PZ also

block design (CRBD) with two replications in each environment. The observations were recorded on eight quantitative traits, viz. spike length (cm), peduncle length (cm), tillers/meter, spikelets/spike, grains/spike, 1000 grain weight (g), biological yield/plant (g) and grain yield/plant (g). The data were recorded on ten randomly selected competitive plants for each character (except tillers/m) and analysis of variance was carried out as per standard procedures (Panse and Sukhatme 1985). The pooled analysis of variance and stability parameters, viz. regression and deviation from regression were computed as per Eberhart and Russell (1966), Singh and Chaudhary (1985).

RESULTS AND DISCUSSION

The analysis of variance revealed significant mean squares ($p>0.01$) for all the characters, indicating presence of adequate genetic variation among the genotypes in three moisture regimes. The combined analysis of variance

Table 2 Pooled analysis of variance for eight quantitative characters under three moisture regimes

Source	df	Spike length (cm)	Peduncle length (cm)	Tillers/ meter	Spikelets/ spike	Grains/ spike	1000 grain wt. (g)	Biological yield/ plant (g)	Grain yield/ plant(g)
Replication	1	2.40	8.06	1870.50	1.84	218.50	93.75	97.99	9.52
Variety	39	6.65**	57.37**	1348.63**	18.87**	221.01**	13.42**	13.35**	1.55**
Environment	2	136.55**	155.63**	37571.37**	107.33**	9890.12**	1255.31**	4153.36**	585.73**
Var. × Environment	78	0.41	1.27	132.81**	1.08*	29.53**	2.27**	3.34**	0.42**
Pooled error	117			48.56	0.79	16.27	1.16	2.00	0.20
Environ.+ (Var. × Environ.)	80			534.38	1.87	138.02	16.80	53.54	7.52
Environment (Lin.)	1			37571.40	107.33	9890.13	1255.31	4153.36	585.73
Var. × Environment (Lin.)	39			100.52**	0.78**	24.75**	1.87**	2.18*	0.25*
Pooled deviation	40			31.48	0.29	4.65	0.39	1.13	0.16

depicted highly significant differences among genotypes and environments ($p>0.01$), indicating the presence of adequate genetic and environmental variation (Table 2). The G × E interaction mean squares were also significant for all the characters, except spike length and peduncle length. The significant interaction mean squares exhibited that grain yield and its component characters, viz. tillers/m, spikelet/spike, grains/spike, 1000 grain weight and biological yield/plant were highly influenced by the environment, i.e. water deficit at different growth stages and genotypes performed differentially in all three environments. The G × E interaction mean squares were further partitioned into linear and non-linear (pooled deviation) components. The linear interactions were found significant and tested against the pooled deviation, revealing genetic differences among genotypes for their linear regression on the environmental index.

The highest pooled mean was exhibited for tillers/m (112.34) followed by grains/spike (55.81), 1000 grain weight (34.30 g), biological yield/plant (16.40 g), spikelets/spike (15.78), peduncle length (13.80 cm), spike length (10.68 cm) and grain yield/plant (6.21 g), respectively. In severe water stress environment (E_1), the highest general mean for grain yield/plant was observed for HS 490 (4.80 g) followed by GW 273 (4.26 g) and DPW 621-50 (4.18 g), in E_2 for WR 544 (7.53 g), Raj 4037 (7.40 g) and PBW 373 (7.01 g), while in irrigated favourable environment (E_3) the highest mean grain yield was depicted by HD 2967 (10.40 g) followed by DPW 621-50 (10.31 g) and DBW 17 (10.18 g), respectively. The highest pooled mean for grain yield/plant ranged from 4.98 to 7.05 g and the highest mean was exhibited by Raj 4037 (7.05 g) followed by PBW 373 (6.96 g), GW 273 and WR 544 (both 6.89 g), respectively.

Stability analysis showed a wide range of adaptation and resilient performance of genotypes as some genotypes were highly adapted for favourable environment (E_3), while other exhibited specific adaptation to water deficit environments. For tillers/m the genotypes, viz. WH 1021, DBW 39 and CBW 38 exhibited stable performance across the environments due to their high mean values (127.17 g, 117.50 g and 117.17 g, respectively), regression coefficient (b) close to unity (1.00*, 1.05* and 1.08*, respectively) and non-significant deviations (S^2di) from regression coefficients (Table 3). Eberhart and Russell (1966), Lin and Binns (1988), Koemel *et al.* (2004) and Lillimo *et al.* (2004) also emphasized that genotypes with high mean, regression coefficient near to unity and with non-significant deviations are desirable and stable in performance across the different environments.

The genotypes namely, viz. HD 2967, DPW 621-50, DBW 17, Raj 4083 etc. were specifically adapted to irrigated conditions for tillers/m, while the genotypes, viz. Raj 3777, HI 1531, Raj 4037, VL 907, MP 4010 were found promising for water deficit environments (Table 3). The genotypes, viz. HS 490, UP 2338, NIAW 34 and HD 2967 showed stability in performance for spikelets/spike, while PBW 373 and WH 711 exhibited stable performance for grains/ spike in different moisture regimes.

For 1000 grain weight the genotypes, viz. DPW 621-50 (μ=36.67 g, b=1.01** and S^2di=-0.54), UP 2425 (μ=36.67 g, b=0.89** and S^2di=-0.56), Raj 4037(μ=36.50 g, b=0.95 and S^2di=-0.58), Raj 1482 (μ=36.17 g, b=1.09** and S^2di=-0.45), KRL 213 (μ=34.67 g, b=1.01** and S^2di=-0.54), KRL 210 (μ=34.50 g, b=1.08 and S^2di=-0.58) and PBW 373 (μ=34.33 g, b=1.02** and S^2di=-0.54) were showed stable performance across the environments, while NIAW 34 and HD 2967 performed well in irrigated conditions (Table 4). The genotypes, viz. CBW 38, WH 1021, PBW 550, K0307, Raj 3777, MP 4010 and GW 322 exhibited phenotypic plasticity for 1000 grain weight under water deficit conditions with high mean, low regression coefficients than unity and non-significant deviations from regression.

For grain yield/plant the genotypes namely, viz. Raj 4037 (μ=7.05 g, b=1.13* and S^2di=-0.10), DBW 17 (μ=6.74 g, b=1.27 and S^2di=-0.10), DPW 621-50 (μ=6.71 g, b=1.13 and S^2di=1.55**), HD 2967 (μ=6.66 g, b=1.24** and S^2di=0.74**) and WH 1021 (μ=6.55 g, b=1.12* and S^2di=0.13) depicted specific adaptations for irrigated conditions, while the genotypes KRL 213 and HS 490 were

Table 3 Stability parameters (Eberhart and Russell 1966) for tiller/m, spikelets/spike and grains/spike in bread wheat

Variety	Tillers/meter			Spikelets/spike			Grains/spike		
	Mean (μ)	bi	S^2di	Mean (μ)	bi	S^2di	Mean (μ)	bi	S^2di
AKAW 4627	111.17	0.79*	4.34	14.33	0.88*	–0.29	55.17	1.15**	–6.04
CBW 38	117.17	1.08*	–3.26	14.67	1.37	3.26*	58.33	0.85*	–4.02
DBW 14	113.33	0.92	–24.28	17.00	0.43	–0.40	54.67	0.92*	3.81
DBW 16	115.67	0.98*	16.35	16.00	0.62	0.06	58.67	0.56**	–8.09
DBW 17	126.17	2.14	329.41**	17.50	1.96*	–0.22	58.67	1.60**	–8.08
DBW 39	117.50	1.05*	–1.50	16.83	0.64	–0.33	66.67	1.42*	3.76
DPW 621–50	126.50	1.55*	51.11	15.50	1.29**	–0.38	62.67	1.39**	–7.43
GW 273	78.83	0.23	–19.67	18.83	0.64	–0.33	64.67	0.49	–3.94
GW 322	111.00	0.99**	–23.70	16.67	0.65*	–0.38	55.67	0.94*	2.63
HD 2687	120.50	0.80**	–24.23	16.50	0.67	–0.10	55.83	0.81**	–7.49
HD 2851	99.00	0.87**	–22.23	15.33	0.64	–0.33	56.50	0.79*	–4.72
HD 2967	136.83	1.45*	55.34	15.83	0.88*	–0.29	61.67	1.24*	–0.99
HD 2985	107.50	0.72**	–19.80	13.83	1.26	0.49	51.33	0.74**	–7.07
HD 2987	120.00	0.82**	–22.16	15.50	0.86**	–0.39	54.17	1.39**	–7.43
HI 1531	121.17	0.89*	1.79	10.50	1.29**	–0.38	45.00	0.67*	–2.19
HI 1544	122.67	1.60*	30.84	15.83	1.31*	–0.32	54.67	0.72**	–7.98
HS 490	67.67	0.32**	–23.84	19.67	1.08**	–0.39	48.00	1.48*	5.20
K 0307	102.83	1.27**	–17.37	15.17	1.28	–0.11	53.17	0.70**	–7.12
KRL 210	117.67	1.11*	–3.16	14.67	0.46	0.20	53.83	0.99*	–5.42
KRL 213	110.50	0.91**	–24.25	16.67	0.42	–0.20	56.00	1.37**	–4.84
LOK 1	118.67	1.04**	–23.49	14.50	1.29**	–0.38	34.17	0.36**	–7.97
MP 4010	120.50	0.96	107.31	10.50	0.43	–0.40	47.00	0.65*	–4.80
NIAW 34	81.83	0.75	61.18	16.67	0.89	0.14	58.83	0.76*	–7.96
PBW 343	122.50	1.04**	–24.05	17.17	0.65*	–0.38	59.83	1.30	20.24
PBW 373	122.17	1.10	44.07	16.83	0.45	–0.26	61.83	0.94*	–4.03
PBW 550	98.17	0.94	67.24	14.83	1.31**	–0.32	53.67	1.06**	–8.09
RAJ 1482	122.67	0.99**	–19.90	15.50	2.39**	–0.25	58.50	0.74	10.34
Raj 3765	128.83	1.07**	–20.57	15.17	0.85	–0.16	59.83	1.19**	–8.10
Raj 3777	118.00	0.91**	–23.21	16.17	0.46	0.20	67.00	0.72*	–6.66
Raj 4037	119.67	0.90**	–24.13	14.17	0.85	–0.16	55.33	1.30**	–5.40
Raj 4083	122.83	1.40*	16.27	16.83	0.64	–0.33	58.00	1.15**	–7.78
UP 2338	79.50	0.54*	–16.39	18.17	0.85	–0.16	50.83	1.62**	–4.07
UP 2425	107.33	1.09*	–5.04	15.17	1.52	–0.39	64.83	1.37**	–6.15
VL 804	110.33	0.88**	–22.78	14.33	0.83	0.41	54.67	0.70*	–6.06
VL 829	118.00	1.09*	–11.54	17.33	0.45	–0.26	54.67	0.97*	–3.16
VL 892	114.00	1.02**	–20.37	15.67	1.71*	–0.07	51.33	1.15*	–1.19
VL 907	121.33	0.92*	–10.64	16.33	1.93*	–0.24	53.67	0.72**	–7.98
WH 1021	127.17	1.00*	2.35	17.50	2.59**	–0.33	55.67	0.97	7.02
WH 711	105.50	1.15**	–24.00	15.00	0.62	0.06	56.33	0.97**	–6.14
WR 544	91.00	0.72**	–24.17	16.50	0.67	–0.10	51.17	1.12*	–3.90
GM	112.34	1.00		15.78	1.00		55.81	1.00	
$SE_{(m)}$	3.96	0.18		0.38	0.33		1.52	0.13	

found promising for water stress environments (Table 4). In general, the genotypes, viz. WR 544, GW 273, DBW 39, HD 2987, Raj 3777, UP 2425, Raj 3765, PBW 343 and UP 2338 revealed consistent performance for high biomass and grain yield in water stress and as well as in irrigated conditions.

On the basis of the above results, it can be concluded that the genotype DBW 39 was consistent in performance for multiple traits, viz. tillers/m, biological yield and grain yield followed by UP 2338 for spikelets/spike, biological yield and grain yield and UP 2425 for 1000 grain weight, biological yield and grain yield under different moisture regimes. The genotype HD 2967 was specific adaptive for favourable environment for many metric traits, viz. tillers/m, grains/spike, 1000 grain weight, biological yield and grains yield, DBW 17 for tillers/m, spikelets/spike, grains/spike, biological yield and grain yield, while DPW 621-50 was high yielding with tillers/m and grain/spike under irrigated conditions. The superior performance of these genotypes under irrigated conditions is confirmation that

Table 4 Stability parameters (Eberhart and Russell 1966) for 1000 grain weight, biological yield/plant and grain yield/plant in bread wheat

Variety	1000 grain wt (g)			Biological yield/plant (g)			Grain yield/plant (g)		
	Mean (μ)	bi	S^2di	Mean (μ)	bi	S^2di	Mean (μ)	bi	S^2di
AKAW 4627	31.83	1.22**	–0.11	16.76	1.08**	–0.82	6.10	1.01**	–0.06
CBW 38	35.50	0.83**	–0.57	16.99	1.19**	–0.14	6.16	1.03**	0
DBW 14	33.00	1.00*	–0.20	16.43	0.88*	–0.08	6.27	0.94*	0.09
DBW 16	33.50	1.30*	2.18	18.38	1.13**	–0.98	6.83	1.05**	–0.08
DBW 17	34.67	0.86	1.25	16.98	1.17**	–0.39	6.74	1.27	–0.10
DBW 39	34.17	0.96**	–0.39	17.55	1.04**	–0.92	6.46	0.92**	–0.04
DPW 621–50	36.67	1.01**	–0.54	16.56	1.06*	4.02	6.71	1.13	1.55**
GW 273	32.17	1.71	–0.05	17.84	0.92*	0.16	6.89	1.05*	0.16
GW 322	36.17	0.51**	–0.57	15.81	0.68*	1.23	5.93	0.69**	–0.08
HD 2687	33.17	1.29*	0.14	16.74	0.94*	0.94	6.18	0.94**	–0.09
HD 2851	32.50	0.93*	0.83	16.49	0.87	1.12	6.01	0.88**	–0.06
HD 2967	35.33	1.22**	–0.11	16.89	1.21*	5.23*	6.66	1.24**	0.74**
HD 2985	34.00	0.95	–0.58	15.69	0.97*	2.49	6.15	1.03*	0.19
HD 2987	34.83	0.84*	0.26	17.49	0.94	–1.00	6.35	0.99**	–0.09
HI 1531	34.17	0.96**	–0.39	12.51	0.90**	–0.85	4.98	0.95**	–0.08
HI 1544	31.83	1.12*	0.63	15.23	0.77**	–0.79	5.84	0.78**	–0.01
HS 490	34.17	1.01**	–0.05	17.07	0.55*	0.67	6.49	0.57*	0.02
K 0307	35.50	0.83**	–0.57	15.94	1.29**	–0.99	6.20	1.26**	–0.10
KRL 210	34.50	1.08	–0.58	15.39	1.02**	–0.01	5.84	1.09**	–0.03
KRL 213	34.67	1.01**	–0.54	17.48	0.99**	–0.31	6.39	0.87**	–0.01
LOK 1	33.17	1.06*	0.16	15.03	1.04**	–0.99	5.54	1.04**	–0.08
MP 4010	36.33	0.77**	–0.46	13.01	0.92**	–0.88	5.03	1.01**	–0.07
NIAW 34	34.83	1.20**	–0.30	16.98	1.13**	–0.53	6.03	0.97	–0.10
PBW 343	33.00	1.05*	1.02	17.03	0.97**	–0.96	6.40	0.98*	0.11
PBW 373	34.33	1.02**	–0.54	18.70	1.16	–1.00	6.96	1.09**	–0.09
PBW 550	35.33	0.49	–0.07	16.34	1.01**	–0.97	6.03	1.02	–0.10
RAJ 1482	36.17	1.09**	–0.45	16.27	0.92*	–0.10	6.39	0.96*	0.17
Raj 3765	35.00	0.70**	–0.55	17.21	0.94**	–0.58	6.75	0.96**	–0.06
Raj 3777	35.67	0.76	–0.58	17.36	1.03**	–0.99	6.67	0.97	–0.10
Raj 4037	36.50	0.95	–0.58	18.46	1.17**	0.02	7.05	1.13*	0.10
Raj 4083	33.17	0.89**	–0.56	14.38	0.97*	0.91	5.62	1.02*	0.11
UP 2338	33.50	1.65**	–0.54	16.73	1.00**	–0.66	6.57	1.02*	0.10
UP 2425	36.67	0.89**	–0.56	17.22	0.94*	0.43	6.43	0.99**	–0.08
VL 804	31.83	1.09*	0	13.34	0.86	–1.00	5.34	0.92**	–0.04
VL 829	31.17	1.21**	–0.50	15.16	1.09**	–0.72	5.69	1.08**	–0.07
VL 892	32.50	1.15**	–0.31	15.75	0.99**	–0.99	5.64	0.93**	–0.09
VL 907	35.17	0.76	–0.58	14.64	0.98**	–0.86	5.78	0.99*	0.09
WH 1021	35.50	0.88*	–0.29	17.54	1.25*	2.39	6.55	1.12*	0.13
WH 711	34.17	0.96	–0.39	15.30	1.02*	0.96	6.02	1.11**	–0.05
WR 544	35.67	0.76	–0.58	19.53	0.98	3.44	6.89	0.99*	0.55*
GM	34.30	1.00		16.41	1.00		6.21	1.00	
$SE_{(m)}$	0.44	0.11		0.75	0.10		0.28	0.10	

DBW 17 (2006) is a mega variety of north western plain zone (NWPZ), while HD 2967 and DPW 621-50 are recently released varieties (2011) and now acting as national checks for irrigated and timely sown conditions of NWPZ. In general, the genotypes, viz. Raj 3777, GW 322, GW 273, HS 490 and NIAW 34 were found promising for poor environments, i.e. water deficit conditions, with high means, low regression coefficients than unity and with non-significant deviations. The identified high yielding and water stress resilient genotypes may be further assessed for their genetic distances and diverse parents can be gainfully utilized in future wheat hybridization programmes to generate heterotic combinations with increasing effect gene constellations.

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