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Stability Analysis to Study the Effects of Different Date of Sowing on Grain Yield Performance in Wheat (*Triticum sp.*)

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A B S T R A C T

Genotype x Environment interaction effects and the stability for grain yield was determined by evaluating eighteen wheat genotypes in three different sowing dates at AICRP on wheat, MARS, University of Agriculture Sciences, Dharwad (Karnataka) during *rabi* 2017-18 under irrigated conditions using a RCBD with two replications. The genotypes NIAW 34, HW 1098 and BMZ 15-16-2 showed higher grain yield (2965.7, 3131.5 and 3037.7kg/ha), average responsiveness (bi = 1) and non-significant S^2di value which suggesting suitability of these genotypes for different dates of sowing. The genotype HW 1098 exhibited superior performance for yield contributed by high tiller under early sown conditions. The genotype HD 3090 recorded lower mean value with average responsiveness (bi=1) indicating, poor adoptability to different dates of sowing and suitable only for timely sowing. The genotypes, GW 322, UAS 415 and DDK 1029 showed higher mean values and bi > 1 indicating sensitive to environmental changes and specific adaption to early sowing. The genotypes BMZ 15-16-5 shows above average mean value and bi <1 indicated specific adoption to only early sowing conditions. Results inferred that the genotypes namely NIAW 34, HW 1098 and BMZ 15-16-2 suitable for all the three dates of sowing condition. It was also found that early sowing is the most optimum time for sowing of wheat crop.

Introduction

Wheat (*Tritium aestivum* L.) is the second most important crop that contributes significantly to the global food and food security (Singh, 2013). At global level, wheat occupies an area of 221.68 mha, with a production and productivity of 728.28 mt and 32.9 q/ha respectively. India's share in world wheat area is about 12.50 %, whereas it occupies 12.05 % share in the total world wheat production, which is the second largest after China (USDA, 2016). In India wheat occupies an area of about 31.23 mha with a production of 98.38 mt. and average productivity of 32.16 q/ha (Indian Institute of Wheat and Barley Research Annual Report, 2017-18). Information about phenotypic stability is useful for selection of crop varieties in a breeding program. Plant breeders encounter genotype × environment interaction (G × E) when testing varieties across the different date of sowing. The magnitude of the interaction or the differential genotypic responses to environments differs greatly across environments (Kaya *et al.*, 2002). The task of breeder is to screen out genotype planted at different interval to enable selection of those varieties, which are suitable for wider range of planting. Hence a study of genotype x environment interaction can lead to successful evaluation of wheat cultivars for stability in yield performance across environments. The measure of the relative performance of varieties under different environments provides information on stability pattern of these varieties.

Materials and Methods

Eighteen wheat genotypes viz., UAS 347, NI 5439, GW 322, UAS 304, HI 944, NIAW 34, HD 3090, UAS 415, UAS 428, DDK 1025, DDK 1029, HW 1098, BMZ 15-16-10, BMZ 15-16-5, BMZ 15-16-9, BMZ 15-16-2, BMZ 15-16-7, BMZ 15-16-6, were evaluated at three different dates of sowing (October 25, November 25 and December 25) at AICRP on wheat, MARS, University of Agriculture Sciences, Dharwad (Karnataka) during *rabi* 2017-18 for twelve characters *viz*., days to anthesis, NDVI at anthesis, canopy temperature at anthesis, chlorophyll at anthesis, days to maturity, spike length, number of spikelets, tillers per meter, grain yield, biomass, 1000 grain weight and spike length under irrigated conditions using a RCBD with two replications.

GE interaction was analyzed using linear regression techniques. Stability parameter was estimated using the Eberhart and Russell (1966) method. Two stability parameters i.e., regression coefficient (bi) and deviations from regression (s^2di) were worked out and tested by using t-test and F-test separately from the pooled analysis.

Results and Discussion

Pooled analysis of variance for grain yield and yield related components across four environments are presented in the Table 1 following Eberhart and Russell (1966) model. The results revealed that there were significant differences among the genotypes tested at both 5 and 1 per cent level of significance for all the characters studied. The environment in which all the observations were recorded also differed significantly (both at 5 and 1% probability) to influence significant variation in all the characters recorded.

The mean squares due to genotypes were highly significant against pooled error as well as pooled deviation for various characters except for 1000 grain weight under study indicating sufficient genetic variability present among the genotypes.

Environmental mean squares were also highly significant except spike length and number of spikelets against pooled error and pooled deviation which indicated that environments chosen in the study were highly variable. Significance of E+ (G x E) interactions mean square for most of the characters except days to anthesis, spike length and number of spikelets, tiller/m, 1000 grain weight and grains/spike against pooled error and for all the characters against pooled deviation indicated presence of G x E interaction.

Mean square due to genotypes x environment (linear) tested against pooled error were significant for three characters *viz.*, CT at anthesis, grain yield (Kg/ha) and biomass (Kg/ha). But were highly significant for all the characters when tested against pooled deviation. This indicated the preponderance of linear component of G x E interaction was higher than non-linear component hence, predictions appeared possible.

Environment (linear) were significant for all the characters except spike length and number of spikelets indicating significant differences among genotypes in four environments. In genotypes x environment (linear) portion was higher in magnitude than non-linear (pooled deviation) for CT at anthesis, grain yield (Kg/ha) and biomass (Kg/ha), except for days to anthesis, NDVI at anthesis, chlorophyll at anthesis, days to maturity, spike length, number of spikelets, tiller/m, 1000 grain weight and grains/spike.

Days to anthesis

The studies on estimate of stability parameters revealed that none of the genotype was stable for all the characters. The genotype BMZ 15-16-2 shows stable characters which had showed bi value close to unity (b_i=1) and non-significant (S^2di) indicating its superiority for average response and stability over all environment whereas, NI 5439, GW 322, HD 3090, UAS 428, DDK 1029, BMZ 15-16-10 and BMZ 15-16-7 were suitable for favourable environment conditions and the genotype, HW 1029 showed bi value close to unity (b_i=1) and non-significant (s2di) and lower mean value indicating that poorly adapted to all environmental condition for days to anthesis. The results are in agreement with Gulzar *et al.*, (2015), Thakare *et al.*, (2014), Yadava (2003) who reported significance of both linear and non-linear components and indicated the presence of both predictable and unpredictable components of G×E. Thakare *et al.*, (2014) and Kashte (2013) has reported the predominance of linear and non-linear components which are in agreement with the present findings.

NDVI at anthesis

Among stable genotypes, the genotypes, DDK 1025, HW 1098, BMZ 15-16-10 and BMZ 15-16-5 were found to have high mean value and average response (b_i = 1) indicating their adoptability over all the environments. The genotype BMZ 15-16-9 with below average responsiveness indicated that specific adaption to favorable environmental condition. The genotypes NAIW 34, UAS 415, DDK 1029 and BMZ 15-16-7 recorded high mean value, bi< 1 and significant S^2_{di} values indicated the presence of non-linear portion of G x E interaction, which makes it specifically adapted to unpredictable under varying environment conditions.

Remaining all the genotypes was found to be unadapted to tested environments. The genotypes *viz.*, GJHV 500 and F 2177 were found to have earliness and average response (b_i = 1) indicated their adoptability over all the environments. The genotype GW 322 shows average responsiveness and lower mean value indicating that poorly adapted to all environmental conditions.

CT at anthesis

The out of eighteen genotypes five genotypes *viz.*, GW 322, HD 3090, UAS 415, UAS 428 and BMZ 15-16-6 possessed above average mean with b_i> 1 indicating their suitability to favourable environments. The genotype HW 1098 shows higher average mean value and non-significant for both b_i and S^2_{di} indicating suitability for unfavourable environmental condition.

Chlorophyll at anthesis

The genotypes, BMZ 15-16-10 and BMZ 15-16-7 had above average mean values with b_i> 1 indicated Specific adaption to favorable environments. The genotypes, NI 5439, UAS 415 and BMZ 15-16-9 recorded highest mean value with above average responsiveness (b_i<1) indicated it's specific adaption to unfavorable environments.

Days to maturity

The genotype BMZ 15-16-10 exhibited higher mean value and b_i =1 indicating their average stability over all environments. The lines *viz*., UAS 415 and UAS 428 had high mean value with regression coefficient less than unity indicating their adaptability to tested environments. Whereas, the genotype, BMZ 15-16-9 recorded above average mean value for this character with b_i> 1 indicating that these are sensitive to environmental changes but adapted to favourable environments. The genotype HW 1098 shows average responsiveness and lower mean value indicating that poorly adapted to all environmental conditions.

Spike length (cm)

The genotype, BMZ 15-16-6 depicted above average mean value and b_i > 1 indicating their specific adaptability to favorable environments. The genotypes UAS 304, BMZ 15-16-10, BMZ 15-16-9 and BMZ 15-16-7 shows above average mean value and b_i<1 indicated specific adoption to unfavourable environmental conditions. These results are in agreement with those obtained by Menshawy (2007).

Number of spikelets

Genotypes HD 3090, BMZ 15-16-7 and BMZ 15-16-6 depicted above average mean value and b_i > 1 indicated their specific adaption to favorable environments. The genotypes GW 322, UAS 304, BMZ 15-16-10 and BMZ 15-16-2 shows above average mean value and b_i<1 indicated specific adoption to unfavourable environmental conditions.

Number of tillers/m

The out of eighteen genotypes, DDK 1029 and HW 1098possessed above average mean with b_i> 1 indicating their suitability to favourable environments. The genotypes *viz.*,BMZ 15-16-9, and BMZ 15-16-2 shows higher average mean value and non-significant for both b_i and S^2_{di} indicating suitability for unfavourable environmental condition The results are in agreement with Gulzar *et al.*, (2015), Thakare *et al.*, (2014), Yadava R. (2003).

Grain yield (kg/ha)

As regard of grain yield, genotypes as well as genotypes and environment interaction was non-significant, indicating no genetic difference among genotypes for environmental response. The genotype BMZ 15-16-9 with highest mean value (3255.33Kg/ha) showed the presence of only non-linear portion of G X E interaction which makes its performance unpredictable under varying environments. Among three stable genotypes *viz*., NIAW 34, HW 1098 and BMZ 15-16-2 possessed above average mean value with regression coefficient b_i = 1 indicating their adoptability to different environments Similar trends have been reported in other multi-locations or multi environments field experiments by Yan *et al.*, (2010) and Rakshit *et al.*, (2012), Motamedi *et al.*, (2012), Kant *et al.*, (2014), Thakare *et al.*, (2015), Lodhi *et al.*, (2015). HD 3090 were found to have low mean value and average response (b_i = 1) indicating their poorly adoptable to all the environmental conditions. Similar findings were also reported by Gowda *et al.*, (2010), Meena *et al.*, (2014), Singh and Tyagi (2014) and Kumar *et al.*, (2014). The genotypes GW 322, UAS 415 and DDK 1029 recorded high mean values with above average response (b_i> 1) indicating their suitability to favourable environments. The genotype, BMZ 15-16-5 possessed b_i< 1 and above the mean value indicated that specific adoption to unfavourable environmental conditions.

Biomass (kg/ha)

The genotypes NI 5439, GW 322, UAS 304, UAS 415, DDK 1029 and HW 1098 depicted above average mean value and b_i > 1 indicating their specific adaptability to favorable environments. The genotypes NI 5439 with high biomass (kg/ha) significant responsiveness (b_i> 1) indicating that adoptability to favorable environments.

The genotypes HD 3090 and UAS 428 possessed below average mean and bi = 1 indicating poorly adaptability to all the environments. The genotype BMZ 15-16-10 depicted above average mean value and b_i = 1 indicated well adaptability to all the environments. The genotypes BMZ 15-16-5, BMZ 15-16-7 and BMZ 15-16-6shows above average mean value and b_i<1 indicated specific adoption to unfavourable environmental conditions.

1000 grain weight (g)

The joint regression analysis (Table 1) showed t highly significant GE interaction. The heterogeneity of regression Ms was not significantly against the error, whereas, the remainder from regression Ms was highly significant indicating that non-linear component of GE interaction was operating.

Kaya *et al.,* (2002) reported that there were significant differences between wheat genotypes as well as GE in yield and yield components; a genotype with the lowest or non-significant deviation from regression being the most stable. The only one genotype, *viz*., HD 3090 has higher mean value, average responsiveness (b_i=1) indicating their adoptability to all the four environments. Similar finding was reported by Meena *et al.,* (2014) and Kumar *et al.,* (2014). The genotype DDK 1025 showed significant regression coefficient deviating from unity indicating unpredictable performance of these genotypes across the environment. The other set of genotypes *viz*., UAS 347, NI 5439, GW 322, HI 944, UAS 428, DDK 1029, BMZ 15-16-5, BMZ 15-16-2, BMZ 15-16-7 and BMZ 15-16-6 were found to be unstable for expression of this trait.

The genotype, NIAW 34 recorded lower mean value with average responsiveness (b_i = 1) indicating, poorly adoptable to all the four environments. The genotypes, UAS 415 were found having high mean value and b_i<1 indicated specific adaption to unfavourable environmental conditions.

The genotypes, UAS 304, HW 1098 and BMZ 15-16-10shows higher mean value and b_i> 1 (below average) indicated specific adaption to favorable environments. Similar findings were reported by Sharma *et al.,* (2012), Swami (2012), Arain *et al.,* (2011), Al-Otayk (2010) Aydin *et al.,* (2010) Kirigwi *et al.,* (2004) and Sial *et al.,* (2000).

Grains/spike

The genotype, BMZ 15-16-6 exhibited higher mean value and b_i =1 indicating their average stability over all environments. The lines *viz*., UAS 347, NI 5439, BMZ 15-16-5 and BMZ 15-16-2 had high mean value with regression coefficient less than unity indicating their adaptability to tested environments. The genotype (BMZ 15-16-6) with more number of grains/spike (56.83), b_i = 1 and non-significant for S^2di value indicated that suitability in all types of environments similar report obtained by El-Morshidy (2001) and Abdel-Majeed (2005).

Whereas, the genotype UAS 304 recorded above average mean value for this character with b_i> 1 indicating that these are sensitive to environmental changes but adapted to favourable environments (Table 2–5).

Table.1 Analysis of variance for stability parameter of seed cotton yield and important yield components (Eberhert and Russell, 1966)

Sources of variance	DF	Days to anthesis	NDVI at anthesis	CT at anthesis	Chlorophyll at anthesis	days to maturity	spike length (cm)	No. of spiklets	tillers/m	Grain yield (Kg/ha)	Biomass (Kg/ha)	1000 GW (g)	Grain/ Spike
Varieties	17	48.03 ***	0.003*	1.74**	8.84**	44.502**	5.73***	9.68***	280.75**	92362.18**	548024.4***	5.567	69.84***
Env.+ (Var.* Env.)	36	12.389	0.003**	1.77 **	5.61**	31.204**	0.26	0.84	88.51	481782.8 ***	460191.8***	16.535	16.181
Environments (Lin.)	1	141.73 ***	0.094***	33.12***	43.29***	692.36***	0.41	0.47	456.23 *	15751650.00***	12820730***	167.00***	232.62 ***
Var.* Env.(Lin.)	17	9.39	0.001	1.28*	6.42	13.949	0.13	0.46	77.70	68702.910*	150379.1*	13.74	6.00
Pooled Deviation	18	8.03***	0.001**	0.49**	2.74***	10.77***	0.39***	1.21***	78.28***	23588.08**	66096.16**	10.81***	13.76 ***
Pooled Error	51	1.063	0	0.20	0.65	1.195	0.07	0.32	5.45	8697.12	39592.13	0.62	3.06

Table.2 Estimates of stability parameters of individual genotypes for days to anthesis, NDVI at anthesis and CT anthesis

S.N	Genotypes	Days to anthesis			NDVI at anthesis			CT at anthesis		
		Mean($\bar{X}$)	b_i	S^2_{di}	Mean($\bar{X}$)	b_i	S^2_{di}	Mean($\bar{X}$)	b_i	S^2_{di}
1	UAS 347	62.50	-1.134	4.325*	0.59	0.869	0.0004	25.46	1.993	-0.064
2	NI 5439	69.16	1.255	-0.776	0.56	1.343	-0.0003	26.91	1.88	1.358*
3	GW 322	67.833	2.07	0.374	0.59	0.993	0.0001	26.60	1.217	-0.026
4	UAS 304	71.16	1.837	7.055**	0.59	1.508	0.0003	26.21	1.72**	-0.239
5	HI 944	59.16	-0.835	20.624***	0.64	1.097	0.0019 *	25.11	1.362	0.351
6	NIAW 34	59.33	-1.219	19.911***	0.62	0.756	0.0004	24.98	-0.34	1.274*
7	HD 3090	69.50	1.461	0.158	0.60	0.504	0.0029 **	25.81	1.984	0.044
8	UAS 415	69.50	0.243	-1.013	0.62	0.429	0.0000	26.53	1.399	0.082
9	UAS 428	68.83	2.07	0.374	0.58	0.951	0.0021 **	25.9	1.147	-0.127
10	DDK 1025	70.50	1.49	9.961**	0.67	0.924	0.0007	25.21	-0.712	0.18
11	DDK 1029	69.50	1.265	-0.141	0.67	0.802	0.0003	24.58	0.392	0.599
12	HW 1098	66.66	0.898	1.265	0.64	1.026	0.0003	26.45	0.544	-0.139
13	BMZ 15-16-10	68.50	1.621	2.763	0.62	1.049	0.0001	24.86	-0.238	-0.212
14	BMZ 15-16-5	61.33	0.354	19.134***	0.62	0.958	0.0003	24.65	0.466	0.206
15	BMZ 15-16-9	69.83	1.435	28.901***	0.62	1.132	-0.0003	25.16	1.339	-0.177
16	BMZ 15-16-2	68.16	1.077	-0.006	0.60	1.446**	-0.0003	25.16	1.628	0.615
17	BMZ 15-16-7	69.66	1.92	-0.897	0.63	0.591	-0.0001	26.81	0.593	1.066*
18	BMZ 15-16-6	72.16	2.193	13.748***	0.60	1.621	0.0010	25.78	1.626	-0.233
Population mean		**67.40**			**0.61**			**25.68**		

Table.3 Estimates of stability parameters of individual genotypes for chlorophyll at anthesis, days to maturity and spike length (cm)

S.N	Genotypes	Chlorophyll at anthesis			Days to maturity			Spike length (cm)		
		Mean($\bar{X}$)	b_i	S^2_{di}	Mean($\bar{X}$)	b_i	S^2_{di}	Mean($\bar{X}$)	b_i	S^2_{di}
1	UAS 347	49.75	0.091	1.028	89.33	0.262	12.322**	8.15	1.917	-0.042
2	NI 5439	51.45	-0.335	-0.603	96.00	0.814	9.79**	7.26	2.765	0.69**
3	GW 322	48.56	3.818	-0.503	91.33	1.181	9.833**	8.26	0.472	-0.023
4	UAS 304	48.6	2.621	2.688*	98.33	1.89	7.52**	9.12	-0.168	-0.063
5	HI 944	48.36	-0.9	4.585**	86.00	-0.018	-0.721	7.26	-0.809	0.008
6	NIAW 34	50.10	-1.111	0.629	86.00	0.107*	-1.145	7.23	0.267	0.021
7	HD 3090	49.73	1.539	1.269	95.66	0.926	15.963***	8.20	-0.468	0.071
8	UAS 415	53.08	-2.543	-0.061	94.83	0.419	2.21	6.31	8.182	0.799***
9	UAS 428	50.12	1.289	-0.428	94.33	0.58	-0.961	5.10	-1.812	0.402**
10	DDK 1025	51.15	1.059	1.952*	97.16	1.818	49.821***	7.90	2.478	2.817***
11	DDK 1029	52.73	3.711*	-0.613	96.50	1.865	39.504***	8.55	2.385	0.203*
12	HW 1098	51.30	2.572	20.488***	91.50	1.063	0.796	8.43	-0.275	0.661**
13	BMZ 15-16-10	54.30	1.876	0.452	94.50	0.993	-1.135	10.10	0.604	-0.012
14	BMZ 15-16-5	48.98	1.149	0.76	88.16	0.84	-1.151	8.15	2.86	-0.063
15	BMZ 15-16-9	52.97	0.855	-0.024	97.33	1.715	2.306	10.43	-0.941	-0.037
16	BMZ 15-16-2	49.65	0.73	4.102**	91.66	0.962	6.34*	10.55	-2.114	0.57**
17	BMZ 15-16-7	50.88	1.275	0.321	93.50	0.921	8.181**	9.25	0.37	-0.062
18	BMZ 15-16-6	50.98	0.306	1.943*	96.33	1.663	12.609**	8.83	2.289	-0.056
Population mean		**50.70**			**93.25**			**8.28**		

Table.4 Estimates of stability parameters of individual genotypes for Number of spikelets, no. tiller/m and grain yield (Kg/ha)

S.N	Genotypes	Number of spikelets			No. Tillers/m^2			Grain yield (Kg/ha)		
		Mean($\bar{X}$)	b_i	S^2_{di}	Mean($\bar{X}$)	b_i	S^2_{di}	Mean($\bar{X}$)	b_i	S^2_{di}
1	UAS 347	17.56	3.77	-0.163	68.66	1.547	45.588**	2618.33	0.938	82760.102**
2	NI 5439	18.93	4.169	-0.286	76.83	-1.555	33.985*	3070.00	1.281*	-10101.34
3	GW 322	22.06	-4.768	-0.185	78.66	3.099	211.916***	3162.00	1.231	14466.395
4	UAS 304	20.83	-4.893	0.204	94.00	0.081	228.437***	3129.00	1.293**	-10149.625
5	HI 944	17.60	6.816	1.413*	69.33	0.673	97.786***	2747.83	0.69*	-10050.722
6	NIAW 34	16.96	-0.125	0.845	65.00	-2.161	146.277***	2965.67	0.99	-10060.895
7	HD 3090	20.40	2.846	-0.271	72.33	1.611	-5.53	2804.17	0.97	4855.796
8	UAS 415	18.83	10.311	1.165*	78.66	0.866	18.277*	3038.33	1.28	6874.943
9	UAS 428	17.80	3.745	0.055	83.33	1.539	176.702***	2662.17	0.711	32333.943*
10	DDK 1025	21.61	-3.383	2.213**	74.33	3.419	13.991	2892.83	1.637	26902.873
11	DDK 1029	22.43	-3.545	5.159***	82.66	3.912	0.925	3090.17	1.173	-6040.389
12	HW 1098	19.38	3.308	1.996**	82.33	1.242	-0.356	3131.50	1.016	5131.91
13	BMZ 15-16-10	21.06	-1.398	0.055	62.50	-1.732	14.105	2901.67	0.802	16966.899
14	BMZ 15-16-5	18.76	3.245	0.072	72.50	1.343	35.919*	3014.17	0.734	5538.952
15	BMZ 15-16-9	21.63	-1.448	3.011**	94.16	0.164	16.585	3255.33	1.043	121174.382***
16	BMZ 15-16-2	22.30	-3.52	0.937	91.83	-0.301	-2.023	3037.67	0.991	-9253.291
17	BMZ 15-16-7	21.13	1.248	0.145	71.33	3.215	20.356*	2990.17	0.59*	-9943.305
18	BMZ 15-16-6	20.83	1.623	-0.223	66.16	1.038	249.977***	2859.50	0.63*	-9603.431
Population mean		**20.00**			**76.92**			**2965.02**		

Table.5 Estimates of stability parameters of individual genotypes for Biomass (Kg/ha), 1000 Grain Weight (g) and Grain/ spike

S.N	Genotypes	Biomass (Kg/ha)			1000 Grain Weight (g)			Grain/ spike		
		Mean ($\bar{X}$)	b_i	S^2_{di}	Mean ($\bar{X}$)	b_i	S^2_{di}	Mean ($\bar{X}$)	b_i	S^2_{di}
1	UAS 347	4224.83	1.574	176654.997*	40.00	1.506	33.797***	54.16	0.793	-0.877
2	NI 5439	5660.67	1.237	-27932.936	40.43	2.142	6.127**	52.33	0.402	7.154
3	GW 322	5611.83	1.129	-20301.284	41.16	3.254	3.481*	54.33	0.403	12.143*
4	UAS 304	5519.00	1.398	24950.999	41.13	2.14	-0.144	51.83	1.587	1.712
5	HI 944	4792.83	0.886	-20091.641	40.86	0.459	32.267***	49.00	1.189	3.32
6	NIAW 34	5192.00	0.884	-19889.289	39.83	0.906	-0.135	48.33	0.393	7.253
7	HD 3090	4823.67	1.064	46344.93	41.68	1.054	-0.524	53.00	2.377	22.044**
8	UAS 415	5528.83	1.451	-25125.173	42.25	-0.001	-0.197	50.66	2.826	70.026***
9	UAS 428	5082.17	0.912	-31463.045	39.15	0.208	5.627**	44.33	0.734	3.275
10	DDK 1025	4792.83	1.87	154466.576*	40.15	-0.877*	-0.515	43.16	0.964	-1.756
11	DDK 1029	5591.33	1.1	-38048.299	40.35	-1.27	8.54***	49.33	1.425	11.987*
12	HW 1098	5637.83	1.159	-11342.185	42.68	1.174	-0.104	47.33	1.078	-2.781
13	BMZ 15-16-10	5388.17	1.039	-24616.196	43.06	1.192	1.432	59.83	0.574	14.984*
14	BMZ 15-16-5	5888.17	0.846	-34855.891	41.16	-0.6	5.674**	52.66	0.626	-1.822
15	BMZ 15-16-9	5783.00	0.67	348853.301**	41.71	1.092	-0.591	62.16	0.465	46.951***
16	BMZ 15-16-2	5269.50	0.492	-37160.584	37.75	1.834	5.397**	52.50	0.684	-0.959
17	BMZ 15-16-7	5490.50	0.412	-39967.628	42.53	2.817	20.945***	49.33	0.567	-2.405
18	BMZ 15-16-6	5306.50	-0.122	8946.96	42.28	0.971	62.868***	56.83	0.913	4.978
Population mean		**5310.20**			**41.07**			**51.73**		

The present study suggest that October 25 is the most optimum time of planting of wheat crop, because the crop sown on October 25 produced the maximum grain yield, number of tillers per meter row and grains per spike. The rate of reduction after October 25 planting for grain yield, number of grain per spike, 1000 grain weight and number of tiller per meter row. Similar findings were reported by earlier research workers Chaudhry *et al.*, (1995), Iqbal *et al.*, (2001) and Ahmad *et al.*, (1996). The wheat variety BMZ 15-16-2 is most stable for grain yield, tillers/m^2, number of spikelets, grains per spike, early maturity and spike length and HW 1098 most stable for tillers /m^2, 1000 grain weight, high biomass and days to maturity.

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