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Stability analysis of yield and its component traits in bread wheat (*Triticum aestivum* L.)

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Abstract
Experiment was conducted with twenty wheat genotypes for twelve yield and its contributing traits in four dates of sowing *viz*., 15 Nov (E1), 25 Nov (E2), 05 Dec (E3), 15 Dec (E4) during Rabi 2019-20 at Department of Seed Technology, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The genotypes and environment interaction tested against pooled error were significant at 5% probability level for all the characters except number of effective tillers per meter, number of effective tillers per plant, biological yield per meter, biological yield per plant and harvest index showing differential response of genotypes with environment. The genotype VA2019-26 was average stable for grain yield per meter, grain yield per plant and number of effective tillers per meter whereas genotype VA2019-29 was showing average stability for grain yield per meter and harvest index while the genotype VA2019-19 showed average stability for the traits thousand grain weight, biological yield per meter and biological yield per plant indicating adaptation to all the studied environments.

Keywords: Stability, environmental factor, biometrical model, population

Introduction
Wheat is a strong self-pollinating plant (autogamous) with cross pollination less than 1%. The species of wheat which is cultivated and its relatives belongs to diploid (genome AA), tetraploid (genome AABB) and hexaploid groups (genome AABBDD), with chromosome number 2n=14, 28 and 42 respectively. Naturally wheat grows up to a height of three feet and which normally completes life cycle around 130-140 days. Complete opening of flower requires around 20 minutes and anther dehiscence takes 2-3 minutes. Wheat is grown in wide range of diverse agro-climatic conditions with respect to rainfall, crop duration, soil temperature and other climatic factors which causes variation in yield and quality of the traits, so it is necessary to develop and identify the phenotypically stable genotype which could perform consistently over all kind of varied and fluctuated environments. Besides it is also important to identify suitable genotypes for favorable and unfavorable environments for sustainable wheat production.

The genotype will be considered more stable and adaptive one, if it shows high mean yield and low degree of fluctuation in yield contributing characters when grown in diverse environmental conditions. Wheat is grown across all over the world having varied agro climatic conditions causing variation in yield and yield related traits. Hence selection and identification of phenotypically stable genotypes performing consistently in varied environmental conditions is very much essential for sustained wheat production. The breeders and growers are primarily concerned with yield and stability of the cultivar. The expression of grain yield and its components are the function of genotype, environment and genotype and environment (G x E) interaction. The breeder's task is to screen out the varieties planted at different intervals to enable selection of those genotypes. The potential genotype may fail to express as an optimum phenotype in different environmental conditions due to high G x E interaction prevailing in its environment which decreases the correlation between genotype and phenotype. The concept of stability has been defined in several ways and different biometrical methods have been developed to access stability and among those most prominent one is Eberhart and Russell, 1966 model. The stability is defined by high mean yield and regression coefficient (b_i=1.0) and deviations from regression as less as possible (S^2d_i=0).

The main objective of any breeding programme is to develop high yielding varieties with stable performance across all environments as wheat is grown in diverse set of environments all over India.

Material and Methods

The experimental material comprised of 20 diverse wheat genotypes which was received from Wheat Research Station, Sardarkrushinagar Dantiwada Agricultural University, Vijapur. These genotypes were studied across four environments *viz*., 15 Nov (E1), 25 Nov (E2), 05 Dec (E3), 15 Dec (E4) during Rabi 2019-20 at Department of Seed Technology, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar which were grown in Randomized Block Design (RBD) with 3 replications. Each individual plot was of the size 1m x 2m, incorporating four individual rows for each genotype for each replication. The data were recorded for fifteen quantitative characters *viz*. days to 50% heading, days to maturity, grain filling period, plant height, number of effective tillers per meter, number of effective tillers per plant, spike length, number of grains per spike, grain weight per spike, grain yield per meter, grain yield per plant, thousand grain weight, biological yield per meter, biological yield per plant and harvest index. The Eberhart and Russell model (1966) was used for the stability analysis. They suggested three parameters i.e. mean, regression, and deviation from regression to characterize the stability of cultivars. A variety with higher mean ($\bar{x}$), unit regression co-efficient (b=1) and the deviation not significantly different from 0 (S^2d_i) was considered to be stable one.

Results and Discussion

The 20 genotypes studied over four environments were pooled and tested against pooled error showed significant difference among genotypes at 1% probability level indicated highly significant variation for all the characters studied. The environments in which observations were recorded were tested against pooled error exhibited highly significant variation for all the characters found the significance in changing environment. The genotypes and environment interaction tested against pooled error were significant at 5% probability level for all the characters except number of effective tillers per meter, number of effective tillers per plant, biological yield per meter, biological yield per plant and harvest index showing differential response of genotypes with environment. The E+(GxE) component showed significance at 1% probability level for all the characters except number of effective tillers per meter, number of effective tillers per plant, biological yield per meter, biological yield per plant and harvest index, which showed no significance at both 5% and 1% probability level suggesting the interaction between the genotypes on different conditions of sowing were considerable for majority of the traits (Table 1). In order to find the linear and non linear components of variation the E+(GxE) component is partitioned into E(linear), GxE (linear) and pooled deviations. The component E (linear) showed significance at 1% probability for all the characters found that the environments in which wheat were cultivated were random and different and were expressing their influence in the expression of these traits whereas the component GxE (linear) showed significance only for the characters number of grains per spike, grain weight per spike, grain yield per meter, grain yield per plant and thousand grain weight at 1% probability and for the characters days to 50% heading and grain filling period at 5% probability indicating the prediction of differential response of genotypes with in different environments. The component pooled deviation tested against pooled error showed significance only for the character days to maturity at 5% probability, found some portions of GxE interactions were unpredictable. Similar findings were reported by Koumber *et al.* (2011) [4], Hassan *et al.* (2013) [2] and Sidhi *et al.* (2018) [8].

Average stability

The genotypes VA2019-21 and VA2019-30 with lower mean for days to 50% heading, b_i closer to unity and $S^2d_i=0$ showed average stability (Table 2). Similar results were reported by Gulzar *et al.* (2015) [1] and Sidhi *et al*. (2018) [8]. The genotypes VA2019-18, VA2019-25 and VA2019-28 with lower mean, b_i closer to unity and $S^2d_i=0$ showed average stability with earliness towards days to maturity. Similar results were obtained by Gulzar *et al.* (2015) [1] and Pujer *et al.* (2020) [6]. The genotypes VA2019-18 and VA2019-25 with lower mean, b_i closer to unity and $S^2d_i=0$ showed average stability taking minimum number of days for grain filling than population mean (Table 2). Similar findings were reported by Sidhi *et al*. (2018) [8]. The genotypes VA2019-21 and VA2019-22 with b_i closer to unity and $S^2d_i=0$ were considered average stable with lower mean value for plant height. These results were in line with Gulzar *et al.* (2015) [1] reporting average stability for this character. The genotypes VA2019-16, VA2019-26 and VA2019-31 with b_i closer to unity and $S^2d_i=0$ exhibited average stability with maximum amount of tillers than population mean value (Table 2). Similar results were obtained by Pujer *et al.* (2020) [6]. The genotype VA2019-31 with b_i closer to unity and $S^2d_i=0$ was average stable adapted to all the environments with maximum number of tillers per plant than population mean. Similar findings were reported by Krupal *et al.* (2018) [5] and Gulzar *et al.* (2015) [1]. The genotypes VA2019-27 and VA2019-32 with b_i closer to unity and $S^2d_i=0$ recorded average stability with higher mean value than population mean for grain weight per spike. Similar findings were reported by Hassan *et al.* (2013) [2] and Sidhi *et al.* (2018) [8]. The genotypes VA2019-26 and VA2019-29 with b_i closer to unity and $S^2d_i=0$ were considered average stable and is adaptable to all environments with their higher mean yield than population mean. These results were in line with Gulzar *et al.* (2015) [1], Pujer *et al.* (2020) [6] and Singh *et al.* (2018) [9]. The genotype VA2019-26 with b_i closer to unity and $S^2d_i=0$ showed average stability and can be adapted to all the environments with its higher mean value for grain yield per plant. These results were in accordance with that of Sharma *et al.* (2019) [7] and Verman *et al.* (2015) [10]. The genotype VA2019-19 with b_i closer to unity and $S^2d_i=0$ were average stable with higher mean value for thousand grain weight. Similar results were obtained by Haydar *et al*. (2010) [3] and Singh *et al.* (2018) [9]. The genotypes VA2019-18, VA2019-19 and VA2019-30 with b_i closer to unity and $S^2d_i=0$ showed average stability with higher mean value than population mean for biological yield per meter. Similar results were reported by Pujer *at al.* (2020) [6] and Sidhi *et al.* (2018) [8]. The genotypes VA2019-18, VA2019-19 and DBW93 with b_i closer to unity and $S^2d_i=0$ were average stable with higher mean value than population mean for biological yield per plant. Similar findings were obtained by Sidhi *et al.* (2018) [8]. The genotypes VA2019-16, VA2019-27 and VA2019-29 with b_i closer to unity and $S^2d_i=0$ showed average stability with higher harvest index than population mean (Table 2). Similar results were reported by Krupal *et al.* (2018) [5], Verman *et al*. (2015) [10] and Gulzar *et al.* (2015) [1].

Above average stability

The genotype VA2019-30 with lower mean, $b_i<1$ and $S^2d_i=0$ will be considered as above average stable and can be recommended for unfavourable environment for the trait days to maturity. The genotypes VA2019-17 and VA2019-33 with $b_i<1$ and $S^2d_i=0$ with higher mean values showed above average stability and can be adapted to unfavorable environment for number of grains per spike (Table 2). The genotype VA2019-30 with $b_i<1$ and $S^2d_i=0$ was above average stable with higher mean value for gain yield per meter. The genotype VA2019-30 with $b_i<1$ and $S^2d_i=0$ was also above average stable with higher mean value than population mean for grain yield per plant. The genotype VA2019-28 with $b_i>1$ and $S^2d_i=0$ showed above average stability with higher harvest index than population mean and can be adapted to favorable environment.

Below average stability

The genotypes VA2019-29 with lower mean, $b_i>1$ and $S^2d_i=0$ showed below average stability with high responsiveness to environmental changes. The genotypes VA2019-28 and VA2019-29 $b_i>1$ and $S^2d_i=0$ exhibited below average stability by taking more number of days for grain filling than population mean. The genotype VA2019-31 with $b_i>1$ and $S^2d_i=0$ showed below average stable with higher mean value and can be considered for favorable environment conditions for the trait plant height. The genotype VA2019-19 with $b_i>1$ and $S^2d_i=0$ showed stability for favourable environments with more number of tillers per meter than population mean values (Table 2). The genotype VA2019-19 with $b_i>1$ and $S^2d_i=0$ showed stability for favorable environments for effective tillers per plant. The genotype VA2019-16 with $b_i>1$ and $S^2d_i=0$ showed below average stability with more grain weight per spike than population mean. The genotype NI5439 with $b_i>1$ and $S^2d_i=0$ was below average stable but with higher mean value than population mean for grain yield per plant. The genotype VA2019-29 with $b_i>1$ and $S^2d_i=0$ showed below average stability with higher mean value than population mean and can be adapted to favorable environment for thousand grain weight. The genotype VA2019-25 with $b_i>1$ and $S^2d_i=0$ showed below average stability with higher mean value and can be adapted to favorable environment for biological yield per meter.

Table 1: Pooled analysis of variance over environments for different characters in bread wheat

Sl. No.	Source of variation df	Genotypes 19	Environments 3	GxE 57	E+(GxE) 60	E(linear) 1	GxE(linear) 19	Pooled deviation 40	Pooled error 152
1	Days to 50% heading	69.44**	108.57**	1.59*	6.94**	325.71**	1.83*	1.40	1.05
2	Days to maturity	9.39**	482.48**	2.46*	26.46**	1447.45**	2.43	2.35*	1.51
3	Grain filling period	45.97**	144.38**	2.88*	9.96**	433.15**	3.14*	2.62	1.80
4	Plant height	214.89**	140.75**	8.64*	15.25**	422.25**	9.95	7.59	6.06
5	Number of effective tillers per meter	172.39**	730.73**	16.17	51.90	2192.18**	33.10	7.34	47.41
6	Number of effective tillers per plant	0.05**	0.28**	0.01	0.02*	0.85**	0.01	0.00	0.01
7	Spike length	4.35**	4.02**	0.17*	0.36**	12.05**	0.18	0.15	0.12
8	Number of grains per spike	173.07**	231.55**	7.25*	18.46**	694.64**	11.99**	4.63	5.07
9	Grain weight per spike	0.32**	1.88**	0.04*	0.13**	5.63**	0.06**	0.02	0.02
10	Grain yield/meter	3563.68**	66248.27**	926.04*	4192.15**	198744.80**	1501.55**	606.37	622.93
11	Grain yield/plant	0.95**	17.63**	0.26*	1.13**	52.89**	0.40**	0.18	0.18
12	Thousand grain weight	65.92**	387.75**	9.23*	28.15**	1163.26**	17.64**	4.77	6.30
13	Biological yield per meter	24730.95**	56220.80**	3727.47	6352.13	168662.41**	4837.90	3013.57	5625.75
14	Biological yield per plant	7.02**	21.87**	0.96	2.01	65.61**	1.16	0.82	1.60
15	Harvest index	25.96**	323.37**	5.53	21.42**	970.11**	8.22	3.97	7.11

* Significant at 5% probability level, when tested against pooled error ** Significant at 1% probability level, when tested against pooled error

Table 2: Stability parameters for yield and yield attributing characters of wheat

	Genotypes	Days to 50% heading			Days to maturity			Grain filling period			Plant height (cm)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	VA2019-16	56.25	1.14	0.26	102.42	0.74	1.28	46.25	0.49	1.60	92.64	1.59	1.01
2	VA2019-17	60.50	1.28	5.53**	105.08	1.34	1.77	44.58	1.43	10.91**	87.07	0.69	-0.39
3	VA2019-18	59.50	0.98	0.58	102.83	0.99	3.98	43.25	0.96	1.91	81.38	0.75	0.91
4	VA2019-19	57.00	1.69	1.78	102.75	1.01	4.36*	45.83	0.58	0.43	83.46	0.76	0.41
5	VA2019-20	51.33	1.72	0.60	99.42	1.18	1.29	48.00	0.78	2.05	83.33	0.46	5.01
6	VA2019-21	52.83	0.98	0.82	103.50	0.94	0.18	50.67	0.80	3.19	87.94	1.00	6.90
7	VA2019-22	50.58	1.22	0.63	102.58	1.21	4.63	52.33	1.23	0.99	80.53	0.98	2.71
8	VA2019-23	54.92	0.64	0.59	103.92	1.10	7.97**	49.17	1.33	10.69**	87.62	-0.08	4.84
9	VA2019-24	54.42	1.18	1.38	103.08	1.22	0.79	48.50	1.34	0.56	89.56	0.94	6.13
10	VA2019-25	58.17	0.84	0.80	102.17	0.96	1.13	43.83	1.05	-0.34	81.12	1.56	-1.20
11	VA2019-26	56.33	1.15	0.95	104.17	0.83	0.13	47.83	0.50	0.11	90.25	-0.32	8.02
12	VA2019-27	58.83	0.88	-0.21	103.42	0.85	0.07	44.58	0.80	0.11	81.67	0.63	7.88
13	VA2019-28	53.17	0.54	0.23	103.08	1.02	-0.09	50.08	1.27##	-0.59	83.30	1.27	-0.95
14	VA2019-29	48.75	0.64	0.89	101.67	1.24#	-0.42	52.92	1.76#	-0.43	81.17	0.19	6.78
15	VA2019-30	55.17	0.95	1.87	103.00	0.73#	-0.23	47.92	0.43	1.12	87.66	0.45	3.76
16	VA2019-31	56.33	1.11	1.73	100.58	0.98	6.24*	44.17	0.74	1.47	90.42	2.16#	-1.16
17	VA2019-32	63.42	0.95	2.35	104.33	0.97	2.40	40.83	1.18	5.43*	94.77	1.99	5.42
18	VA2019-33	60.92	1.01	-0.31	104.75	0.98	-0.34	44.00	0.86	-0.33	96.55	1.60	0.39
19	NI5439	61.67	0.68	0.15	105.67	1.06	2.32	44.00	1.60	1.21	109.03	1.73	13.79
20	DBW93	63.42	0.44	0.45	105.17	0.66##	-0.45	42.00	0.87	0.27	99.36	1.67	41.15**
Population mean		56.68			103.18			46.54			88.94		

*, ** Significant at 5% and 1% levels, respectively.

#, ## Significant at 5% and 1% levels, respectively, when H_0: b=1

Table 2: Cont….

	Genotypes	No. of effective tillers per meter			No. of effective tillers per plant			Spike length (cm)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	VA2019-16	109.42	1.01	-11.94	1.82	1.18	-0.003	9.74	0.04	0.15
2	VA2019-17	103.92	0.53	-8.32	1.76	0.39	0.009	9.33	0.92	0.00
3	VA2019-18	104.58	0.69	-7.83	1.79	0.76	0.003	9.01	0.42	0.15
4	VA2019-19	107.50	2.29##	-15.41	1.82	2.04#	-0.003	10.83	0.77	0.08
5	VA2019-20	105.83	0.26	-4.45	1.82	0.38	0.003	8.45	1.37	0.00
6	VA2019-21	103.25	0.28	-4.01	1.76	0.29	0.001	8.79	1.56	0.10
7	VA2019-22	115.75	0.46	-9.50	1.93	0.91	0.001	8.72	1.83	0.21
8	VA2019-23	88.75	0.84	9.43	1.52	1.21	0.007	9.74	0.80	0.19
9	VA2019-24	106.33	0.84	-11.24	1.84	0.83	0.002	10.52	1.86	0.02
10	VA2019-25	104.00	1.35	-3.92	1.74	1.50	-0.002	9.14	1.27	0.07
11	VA2019-26	110.17	1.01	-5.32	1.87	1.12	0.000	8.34	1.18	0.06
12	VA2019-27	101.50	1.16+	-10.41	1.73	1.05	-0.001	8.46	1.57	0.18
13	VA2019-28	100.25	1.95##	-15.77	1.70	1.78##	-0.004	9.38	0.94	0.00
14	VA2019-29	108.58	0.61	-8.99	1.85	0.45	-0.004	8.09	1.48	0.02
15	VA2019-30	108.75	0.60	-13.76	1.85	0.65	-0.004	9.87	1.13	0.41*
16	VA2019-31	108.83	0.97	-8.28	1.86	1.04	0.005	7.89	0.54	-0.03
17	VA2019-32	92.92	1.49	-13.87	1.57	1.32	-0.002	10.48	0.25	0.24
18	VA2019-33	95.17	1.78	-9.22	1.60	1.48#	-0.004	11.36	1.35	0.46*
19	NI5439	112.75	1.17	-13.95	1.92	1.07	-0.001	9.14	0.58#	-0.03
20	DBW93	103.17	0.68	-2.60	1.78	0.58	-0.001	11.37	0.16	0.03
Population mean		104.57			1.78			9.43		

*, ** Significant at 5% and 1% levels, respectively.
#, ## Significant at 5% and 1% levels, respectively, when H_0: b=1

Table 2: Cont….

	Genotypes	No. of grains per spike			Grain weight per spike (g)			Grain yield per meter (g)			Grain yield per plant (g)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	VA2019-16	47.08	1.12	2.22	2.20	1.62#	-0.004	375.42	1.22	439.07	6.41	1.32	0.24
2	VA2019-17	46.65	0.46#	-1.33	2.39	0.42	0.008	343.75	0.34+##	-168.15	5.88	0.36##	-0.05
3	VA2019-18	38.88	0.60	0.33	1.80	0.82	0.005	326.50	1.14	565.23	5.57	1.13	0.10
4	VA2019-19	39.75	0.74	-0.59	2.03	1.03	0.005	368.75	0.27#	-2.56	6.29	0.29	0.03
5	VA2019-20	30.65	0.22##	-1.49	1.64	0.28#	-0.004	336.42	1.01	245.62	5.76	0.98	0.06
6	VA2019-21	38.83	1.12	5.98	1.84	0.47	0.016	327.33	0.49#	-129.30	5.54	0.51#	-0.03
7	VA2019-22	41.30	1.03	3.40	1.70	1.14	0.004	356.17	0.59	-87.55	6.03	0.56	-0.03
8	VA2019-23	48.65	0.72	0.85	2.47	2.03	0.028	338.92	1.22	325.06	5.79	1.22	0.13
9	VA2019-24	43.30	2.56	28.83**	1.90	0.36	0.002	362.08	0.84	-156.90	6.13	0.83	-0.03
10	VA2019-25	43.73	0.57	-1.04	2.01	0.79	0.009	367.75	1.55	485.06	6.28	1.57	0.19
11	VA2019-26	49.03	0.43	0.15	1.99	0.71	0.000	411.08	1.01	1.50	7.00	1.02	0.02
12	VA2019-27	46.27	0.94	-1.50	2.10	0.96	0.023	334.83	0.79	-118.79	5.77	0.70	-0.04
13	VA2019-28	39.87	1.88#	-0.36	2.00	1.20	0.069*	337.17	1.31	766.99	5.81	1.14	0.22
14	VA2019-29	37.20	0.27	-0.13	2.05	0.83	-0.003	385.33	1.07	154.05	6.62	1.15	0.07
15	VA2019-30	47.08	1.56	0.72	2.01	0.76	-0.001	388.08	0.72#	-191.72	6.60	0.72#	-0.05
16	VA2019-31	47.83	1.28	10.80	2.21	1.28	-0.003	377.58	1.11	410.90	6.42	1.18	0.05
17	VA2019-32	49.42	1.38	-0.43	2.30	1.07	0.017	339.00	1.35	4639.61**	5.80	1.33	1.32**
18	VA2019-33	61.80	0.48#	-1.50	2.90	1.16	-0.004	404.58	1.44	38.63	6.86	1.49	-0.02
19	NI5439	48.05	1.11	5.45	2.17	1.65	0.039	412.58	1.68	53.75	6.98	1.65#	-0.01
20	DBW93	51.82	1.52	8.44	2.02	1.43	0.080*	311.17	0.88	704.09	5.40	0.84	0.15
Population mean		44.86			2.09			360.23			6.15		

*, ** Significant at 5% and 1% levels, respectively.
#, ## Significant at 5% and 1% levels, respectively, when H_0: b=1

Table 2: Cont….

	Genotypes	1000 grain weight (g)			Biological yield per meter (g)			Biological yield per plant (g)			Harvest index (%)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	VA2019-16	46.48	1.56	-0.22	1059.50	1.78	10976.70	17.60	1.81	2.24	35.49	0.95	-1.08
2	VA2019-17	51.45	0.24	3.45	1118.25	0.50	-1461.38	18.73	0.72	-0.07	30.65	0.28##	-2.22
3	VA2019-18	46.38	0.96	-0.39	1113.67	1.01	-1509.56	18.52	1.06	-0.27	29.24	1.15	1.88
4	VA2019-19	50.74	1.09	-0.29	1120.33	1.02	-299.42	18.64	0.98	-0.20	32.90	0.10#	-0.47
5	VA2019-20	53.21	0.18	1.24	959.17	0.33	-1378.93	16.14	0.49##	-0.53	35.00	1.42	1.72
6	VA2019-21	52.37	1.18	-1.54	953.50	0.26	-1126.48	16.12	0.29	0.13	34.26	0.59	0.65
7	VA2019-22	42.65	1.74	2.97	1073.50	0.56	411.65	18.24	0.64	-0.43	33.26	0.48#	-2.11
8	VA2019-23	50.63	2.30	13.73	1045.25	0.24#	-1757.57	17.74	0.36	-0.24	32.19	1.50	4.91
9	VA2019-24	46.59	0.43	0.72	1086.25	-0.17	-984.51	18.27	0.31	0.04	33.38	1.07	3.83

10	VA2019-25	45.96	0.76	3.19	1070.67	2.48##	-1763.81	17.89	1.95	-0.36	33.98	1.14	-0.67
11	VA2019-26	40.01	0.89	1.07	1078.25	0.89	7646.20	17.94	0.82	1.36	38.18	1.33	0.68
12	VA2019-27	45.89	0.99	9.48	964.00	0.40	-1596.08	15.99	0.41	-0.41	34.73	1.04	-1.49
13	VA2019-28	47.90	1.14	3.29	961.33	0.51	343.72	16.27	0.62	0.02	34.76	1.63#	-1.58
14	VA2019-29	54.87	1.23##	-2.09	1001.58	1.38	404.53	16.72	1.25	-0.09	38.27	0.98	-1.91
15	VA2019-30	42.91	-0.01	1.56	1144.00	0.96	1408.41	19.24	1.25	1.03	33.94	0.71	0.07
16	VA2019-31	46.66	0.85	11.09	999.42	0.39	-1021.75	16.60	0.44	-0.02	37.65	1.31	5.26
17	VA2019-32	45.83	0.80	0.65	971.17	1.63	7100.39	16.27	1.62	1.34	33.93	1.29	17.07
18	VA2019-33	46.73	1.00	-1.68	1118.83	2.23	6008.24	18.90	1.75	1.36	35.98	1.29	1.64
19	NI5439	44.86	1.62	2.57	1260.33	2.26	-349.86	21.17	2.17	-0.23	32.44	1.10	0.79
20	DBW93	40.48	1.05	4.52	1062.83	1.35	1715.95	18.00	1.04	1.02	29.07	0.65	4.96
Population mean		47.13			1058.09			17.75			33.97		

*, ** Significant at 5% and 1% levels, respectively.

#, ## Significant at 5% and 1% levels, respectively, when H_0: b=1

Conclusion

The genotype VA2019-26 was average stable for grain yield per meter, grain yield per plant and number of effective tillers per meter. The genotype VA2019-29 was showing average stability for grain yield per meter and harvest index. The genotype VA2019-19 showed average stability for the traits thousand grain weight, biological yield per meter and biological yield per plant, whereas the genotype VA2019-27 for the traits grain weight per spike and harvest index showed average stability and VA2019-30 for days to 50% heading and biological yield per meter indicated average stability. The genotype VA2019-29 showed below average stability characteristics for days to maturity and thousand grain weight, indicating adaptation to favourable environments for these traits and VA2019-30 showed above average stability for grain yield per meter and grain yield per plant showing adaptation to adverse environmental conditions.

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