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STABILITY ANALYSIS IN INDIAN MUSTARD

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ABSTRACT

Ten genotypes were sown on four different sowing dates in Randomized Block Design with three replications for estimating the stability of genotypes for different characters. The data was subjected to statistical analysis by following the approach given by Eberhart and Russell (1966). In general, genotypic differences were found significant for all the eight characters indicating the presence of genetic diversity in the genotypes. Linear component of G x E interaction was significant for the characters *viz*., days to 50% flowering, days to maturity, number of siliquae plant^{-1}, siliquae density on main branch and 1000 seed weight. Whereas, pooled deviation were found significant for characters *viz.,* plant height, number of branches plant^{-1}, number of siliquae plant^{-1}, 1000 seed weight and seed yield plant^{-1}. The genotype ACN-237 showed average stability, whereas ACN-255 showed above average stability for earliness in flowering. Genotypes ACN-237 exhibited average stability for earliness in maturity. ACN-244 showed below average stable performance for plant height (cm). For branches plant^{-1} among all the genotypes ACN-255, TAM-108-1 showed wider adaptability. Genotypes ACN-226, ACN-250, ACN-237 showed the wider adaptability for number of siliquae plant^{-1} and siliquae density on main branch, whereas ACN-240 showed below average stability for siliquae density on main branch. The genotypes ACN-226, ACN-250, ACN-237 were showed average stability over all types of environments for 1000 seed weight and seed yield plant^{-1}. From this study genotypes ACN-226, ACN-237 and ACN-250 were identified as stable genotypes to be grown over all the environments.

(Keywords: Stability, mustard, analysis, genotype x environment interaction)

INTRODUCTION

Rapeseed-Mustard are important oilseed crop of the world being grown in 53 countries across the six continents. The crop is grown both in sub-tropical and tropical countries. Among different oilseed crops grown in India, the Rapeseed-Mustard (*Brassica spp.*) contributes 29.5% in the total production of oilseeds.

In Western Vidarbha Zone, farmer grow mustard crop in first or second fortnight of November. Similarly, in Eastern Vidarbha region, farmers are growing mustard crop in last week of November to second week of December after harvesting of paddy. Delayed planting leads to shortening of the vegetative phase, advances ûowering time and decreases seed development period resulting into shriveled seed. Similarly, incidence of powdery mildew occurs at flowering and siliqua development stage. Therefore, the area under mustard cultivation in Vidarbha is continuously going down. Considering the low production in Vidarbha region as compared to India, there is need of producing high yielding varieties with early maturity, high oil content, and powdery mildew resistance varieties which will perform stable in terminal heat shock (Raut *et al.,* 2021 and Sapkal *et al.,* 2021).

The stability of genotype with respect to varying environments has always been a matter of great concern to plant breeders. A number of statistic scales have been proposed to measure the phenotypic stability of different genotypes over the fluctuating environments. In Mustard breeding programme it is, therefore important to screen and identify the stable and widely adoptable genotypes in respect to yield and yield contributing characters, which could perform uniformly under different environmental condition.

MATERIALS AND METHODS

During *rabi* 2020, eight genotypes were raised along with 2 check varieties in randomized block design with 3 replications in four different date of sowings *viz.,* normal date of sowing (30th October), 15 days late than normal date of sowing (15th November), 30 days late than normal date of sowing (30th November) and 45 days late than normal date of sowing (15th December). Each genotype was sown in a plot of 45 x 10 cm^2 respectively. Recommended agronomical practices and plant protection measures were adopted to raise the good crop. The data were recorded in each genotype of each replication for following characters

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namely days to 50% flowering, days to maturity, plant height, number of branches plant^{-1}, number of siliquae plant^{-1}, siliquae density on main branch, 1000 seed weight and seed yield plant^{-1}. The observations recorded were subjected to the following statistical and biometrical analysis i.e. Analysis of variance (Panse and Sukhatme, 1954), Analysis of variance for stability (Eberhart and Russell, 1966), Estimation of stability parameter (Eberhart and Russell, 1966), Identification of stable genotype (Eberhart and Russell, 1966).

RESULTS AND DISCUSSION

Analysis of variance for stability as shown in Table 1 represents component analysis of environment + (G x E) is partitioned into linear and non linear components. The mean sum of squares due to environment (linear) were found significant for all eight characters. Therefore, it is concluded that the environments were random and different variation could have arisen due to the linear response of regression. The significance of linear component of variance due to environment has also been reported by Kumari *et al.* (2019) and Priyamedha *et al*. (2017). The mean sum of squares due to G x E (linear) were significant for five characters *viz.,* days to 50% flowering, days to maturity, number of siliquae plant^{-1}, siliquae density on main branch and 1000 seed weight. Data revealed that the behaviour of the genotypes could be predicted over the environment more precisely. However, the magnitude of linear component i.e., environment (linear) and genotype x environment (linear) was many times higher than the non-linear component (pooled deviation) for all the eight characters. Data revealed that the prediction of stability could be reliable though it may get affected to some extent. In accordance to this result, Nasr (2006) and Kumari *et al.* (2019) also reported significant and non-significant pooled deviation for characters *viz.,* days to 50% flowering, days to maturity, number of siliquae plant^{-1}, siliquae density on main branch, 1000 seed weight data, seed yield plant^{-1} and number of branches plant^{-1}.

The stability parameters estimated for different traits are presented in Table 2 helped to identify genotypes with general and specific adaptability. The genotypes with higher mean values, regression coefficient value of unity (bi=1) and non-significant deviations from linear regression deviation ($S^2di=0$) were considered as stable for the traits and adaptable to varied environmental conditions studied in the present investigation. However, genotypes with a higher mean value with non-significant deviations from linear regression and regression coefficient near to unity were considered to be responsive and suitable for favorable environmental conditions.

For the trait days to 50 % flowering, two genotypes ACN-255 (46.33 days) and ACN-237(46.94 days) exhibited non-significant deviation from regression, lower mean than mean of population (49.65 days) with regression coefficient close to unity and thus they were considered to have average stability. For days to maturity one genotype ACN-237 (106.83) showed early maturity than rest of the nine genotypes. Thus, expressed its suitability for all environments. For plant height, one genotype ACN-244 exhibited regression coefficient more than unity with mean plant height of 146.62 cm expressed its suitability for rich environment. Genotypes ACN-255 and TAM-108-1(Check) both exhibited non-significant deviation from regression, regression coefficient about unity, showed their suitability for all environments for number of branches plant^{-1}. Three genotypes *viz.,* ACN-226 (210.59 g), ACN-250 (202.77 g) and ACN-237 (205.44 g) showed higher mean than the population mean (173.86 g) for number of siliquae plant^{-1}. These three genotypes exhibited non-significant deviation from regression and thus were considered to have average stability. For the trait, siliquae density on main branch, four genotypes *viz.,* ACN-226 (0.66), T-9 (0.66) and ACN-237 (0.64) showed higher mean than the population mean (0.59) and were suitable for all environments but one genotype ACN-240 depicted higher mean (0.60) regression coefficient more than unity thereby showed its suitability for rich environment.

For the traits, 1000 seed weight and seed yield plant^{-1} genotypes ACN-226 (5.23 g) (17.34 g), ACN-250 (4.97 g) (15.45) and ACN-237 (5.15 g) (16.79 g) showed higher mean than the population mean (4.44 g) and (12.99 g) exhibited non-significant deviation from regression, regression coefficient about unity and thus showed their suitability for all environments.

Shekhawat (2020), Priyamedha *et al.* (2017), Rashid *et al*. (2002), Nasr (2006), Kumari *et al.* (2018) and Yadava (2010) also reported stable genotypes for characters *viz.,* days to 50% flowering, days to maturity, plant height, number of branches plant^{-1}, number of siliquae plant^{-1}, siliquae density on main branch, 1000 seed weight and seed yield plant^{-1}.

Table 1. Analysis of variance for stability for different traits

Sources of Variation	d.f.	Mean sum of squares			
		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches plant^{-1}
Environment + (G x E)	30	17.488**	15.605**	69.035**	1.476**
Environment (Linear)	1	296.011**	258.619**	532.159**	37.996**
G x E (Linear)	9	16.121*	18.875**	58.867	0.154
Pooled deviation	20	4.178	1.983	50.454*	0.245**
Pooled error	72	3.181	1.037	22.758	0.057

Sources of Variation	d.f.	Mean sum of squares			
		No. of siliquae plant^{-1}	Siliquae density on main branch	1000 seed weight	Seed yield plant^{-1}
Environment + (G x E)	30	965.04**	0.0022**	0.98**	15.25**
Environment (Linear)	1	12178.07**	0.02**	16.83**	145.00**
G x E (Linear)	9	1517.65**	0.0044**	1.11**	12.00
Pooled deviation	20	155.71*	0.0003	0.13**	10.23**
Pooled error	72	68.97	0.0009	0.04	5.47

Note: **Significant at 1% and *Significant at 5%

Table 2.Estimation of stabilityparameters

Sr. No.	Genotypes	Days to 50% flowering			Days to maturity			Plant height (cm)			No. of branches plant^{-1}		
		Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
1	ACN-240	47.81	0.64	1.84	108.12	0.70	3.07	151.93	0.42	40.83	4.14	1.25*	0.25**
2	SKM-1626	52.20	1.27	2.13	111.71	1.49	-0.05	150.10	2.75*	92.79*	3.97	1.33*	0.10
3	ACN-226	51.71	2.08**	6.92*	111.96	2.17**	0.94	154.65	1.01	-5.97	4.00	0.72*	0.12*
4	ACN-244	51.29	2.04**	-0.69	110.65	2.07**	0.34	146.62	1.49	-21.61	3.42	1.18	0.08
5	ACN-250	57.76	1.12	-2.92	115.81	1.27	0.61	165.79	0.50	63.56	3.98	0.94	-0.002
6	ACN-255	46.63	0.54	-3.02	105.43	0.02*	0.33	150.70	1.95	17.11	4.02	0.93	-0.019
7	T-9	44.83	0.17*	4.57	104.13	-0.30**	0.07	155.72	1.75	-9.43	3.74	1.00	0.46**
8	ACN-237	46.94	1.10	-2.71	106.88	0.85	0.03	148.88	1.06	25.79	3.65	0.83	0.45**
9	PM-26 (C)	49.58	-0.21**	1.82	110.23	0.17*	4.60*	141.94	-0.15	8.95	4.23	0.80	0.31**
10	TAM-108-1 (C)	47.72	1.20	2.01	111.40	1.52	-0.51	152.31	-0.80*	64.94	4.74	0.96	0.08
Population Mean		49.65			109.63			151.86			3.99		
Average of Check		48.65			110.81			147.12			4.48		

Sr. No.	Genotypes	No. of siliquae plant^{-1}			Siliquae density on main branch			1000 seed weight			Seed yield plant^{-1}		
		Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
1	ACN-240	142.58	1.90	339.98	0.60	1.58	-0.001	4.59	1.95	0.13	14.62	0.41	19.12**
2	SKM-1626	174.95	1.70	102.31	0.53	-1.75**	-0.001	4.57	0.32**	0.08	11.53	1.26	48.61**
3	ACN-226	210.59	1.01	-68.90	0.66	1.02	-0.001	5.23	1.02	-0.04	17.34	1.19	-1.82
4	ACN-244	156.38	2.75	37.15	0.54	1.71	-0.001	3.98	1.80	-0.01	13.07	2.96	8.92**
5	ACN-250	202.77	1.02	-68.84	0.62	1.04*	-0.001	4.97	1.00	-0.04	15.45	1.07	-1.72
6	ACN-255	171.93	2.47	92.18*	0.64	1.97	-0.001	4.03	1.63	0.63	9.12	1.56	-0.03
7	T-9	157.72	0.97	55.18	0.66	1.14	0.001	4.20	1.33	-0.02	12.66	0.56	1.02
8	ACN-237	205.44	1.23	-68.92	0.64	1.06	-0.001	5.15	1.34	-0.04	16.79	1.00	-1.82
9	PM-26 (C)	136.19	0.17**	81.86**	0.58	3.27*	-0.000	3.88	1.65	0.06	9.90	1.94	1.54
10	TAM-108-1 (C)	180.10	0.03	365.37**	0.48	2.19**	-0.001	3.83	1.28	0.12	9.42	1.54	1.10
Population Mean		173.86			0.59			4.44			12.99		
Average of Check		158.14			0.53			3.86			9.66		

Note: **Significant at 1% and *Significant at 5%

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