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Phenotypic Stability for Yield and Some Quality Traits in *Brassica juncea* L.

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A B S T R A C T

The current investigation aims to determine the phenotypic stability and GxE interaction among the *Brassica juncea* L. genotypes. Fifteen released genotypes of *Brassica juncea* L. were evaluated in two different environments and two dates of sowing during Rabi 2014-2015 and 2015-2016. Analysis of variance indicated that all the genotypes exhibited significant genetic differences except forno. of secondary branches/plant, siliqua length, 1000 seed weight and oil content. The mean squares due to environment were significant for all the characters and GxE interactions were also observed to be significant for traits viz., no. of primary branches/plant, no. of secondary branches/plant, days to 50% flowering, days to 100% flowering and days to maturity. Considering high mean performance, unit regression and non-significant mean square deviations, the genotypes DRMRIJ-31 and Varuna are stable and suitable for high performance environment. The genotype PM-21 was considered as stable and suitable for low performance environment.

Introduction

Rapeseed-mustard is the third important oilseed crop in the world after soybean (*Glycine max*) and palm (*Elaeis guineensis Jacq*.) oil. Among the seven edible oilseed cultivated in India, rapeseed-mustard (*Brassica* spp.) contributes 28.6 per cent in the total production of oilseeds. In India, it is the second most important edible oilseed after groundnut sharing 27 per cent in the India's oilseed economy (Shekhawat *et al.*, 2012). World output of rapeseed and mustard has been increasing persistently and rather steeply during the past 15 years. The global output has doubled from about 36 million tons in 2001-02 to 66.15 million tons in 2016-2017.

India is the fourth largest producer of rapeseed-mustard after European Union, Canada and China. Production trends over the past two decades indicated that there was a significant shift in production levels from about 5-6 million tons until 2002-03 to around 6.8 million tons in 2106-2017 (USDA, May 2016).

Out of six species viz., *Brassica rapa* (AA, n=10); *Brassica oleracea* (CC, n=9) and *Brassica nigra* (BB, n=8); *Brassica juncea* (AABB, n=18), *Brassica napus* (AACC, n=19) and *Brassica carinata* (BBCC, n=17), *B. juncea* or Indian mustard or *raya* is predominantly grown in sub-tropical area and brown sarson in intermediate zone of the Jammu province.

Environmental factors greatly affect plant growth and yield. Sowing date is an important determinant of crop yield and it depends on the onset of significant rainfall, temperature and humidity of a region. Decreasing crop yield in delayed sowing date has been reported by many workers (Kohn and Storrier 1970; Doly and Marcellos 1974; Degenhardt and Kondra 1981; McDonald *et al.,* 1983). Therefore, yield and yield contributing traits of a crop are highly influenced by environment. Genotype-location interaction usually implies differential behavior of genotypes under different environments. The magnitude of components of genetic variation and genotype-environment interaction can help to select the promising and stable genotypes. It can also help the plant breeders to select the suitable genotypes either for specific environment or for a wide range of environments. The presence of genotype-environment (G×E) interaction confounds the selection of superior genotypes by altering their relative productiveness and makes it difficult to judge the genetic potential of a genotype.

The success of a crop variety depends not only on its high performance but also on its ability to perform consistently over environments as the phenotypic performance of a genotype of often reflected by diverse agro-ecological conditions. Some genotypes may perform well in some environments but not in others. Thus, G×E interactions are of great significance in plant breeding as they affect stability of genotypes across environments. Under such condition, it becomes necessary to identify the stable varieties from already released varieties which could show steady performance over the years under different environments.

Materials and Methods

The experiment was undertaken during *Rabi* 2014-2015 and 2015-2016 at the Research Farm of Division of Plant Breeding and Genetics, Faculty of Agriculture, Sher-e-Kashmir University of Agriculture Sciences and Technology, Jammu (SKUAST-J), Chatha. Chatha is located at latitude of 32° 40´ N and longitude of 78° 48´ E and altitude of 293 meters above mean sea level. The materials for present experiment consist of 15 recently released varieties enumerated in Table 1. All genotypes were selected on the basis of variation for yield, maturity, oil and erucic acid content. These varieties were evaluated in randomized block design with 3 replications. In each replication, each entry was sown in a plot of seven rows, each row consisting with 4 meters length, row to row distance was 30 cm and plant to plant distance was maintained at 10 cm by thinning after 20 days of sowing. The sowings were done during Rabi 2014-2015 and 2015-2016 in two different environments created by two dates of sowing, one on 23th October (E1) and other on 7th November (E2). A basal dose of fertilizer at rate of 80 Kg N, 40 Kg P and 40 Kg K was applied at the time of sowing. All the recommended cultural practices were followed for raising the crop. The multi-environmental data were subjected to stability analysis following the regression approach model of Eberhart and Russell (1966).

Results and Discussion

The joint regression analysis indicated a high genetic variability among the genotypes included in this study for all the characters.

The magnitude of G×E interaction and stability parameters for various characters were estimated according to Eberhart and Russell (1966) and presented in Table 2. Scrutiny of Table 2 exhibited that the G×E interactions were significant for number of primary branches/plant, number of secondary branches/plant, days to 50 per cent flowering, days to 100 per cent flowering, days to maturity and oil content indicating the variable performance of genotypes for different characters in different environments. Significant G×E interaction for various traits have also been reported by various workers in India mustard (*B. juncea* L.) genotypes by Rajender Singh, (2014) and Gupta and Pratap, (2007), in Brown sarson (*B. rapa* L.*)* by Gazal *et al.,* (2013), in Canola (*B. napus* L.) by Tahira *et al.,* (2013) and in White mustard (*B. Alba* L.) by Abou El-Nasr *et al.,* (2006). All of the characters were highly influenced by environments due to year to year variations as suggested by significant environmental variation for these characters. The Env. + (Geno. × Env.) Interactions were significant for all the characters except number of siliquae on main shoot and 1000-seed weight, indicating that these characters were unstable and fluctuated in their expression with change in environment. The G×E (linear) was significant for number of primary branches/plant, number of secondary branches/plant, seed yield/plant, days to 50 per cent flowering, days to 100 per cent flowering and days to maturity, indicating that for these characters therefore, genotypes differed from each other with respect to their linear response and prediction can be made easily. Pooled deviation was also significant for all the traits except plant height, 1000 seed weight, days to 50% and 100% flowering and days to maturity, suggesting that a substantial portion of G×E interaction was due to some factor other than the regression. The mean squares due to G×E (linear) were significantly higher in magnitude for number of primary branches/plant, number of secondary branches/plant, seed yield/plant, days to 50 per cent flowering, days to 100 per cent flowering, days to maturity and oil content as compared to the mean squares due to pooled deviation. It indicated that there was predominance of G×E (linear) for number of primary branches / plant, number of secondary branches/plant, seed yield/plant, days to 50% flowering, days to 100% flowering, days to maturity and oil content and prediction can be possible for these characters.

According to Eberhart and Russell (1966), the regression of the variety mean on environmental index and function of the squared deviations from this regression would provide estimate of the desired stability parameters. The term stable variety has been used for a variety that performs above average in all environments. Hence, the stable variety has high mean ($\overline{X}i$), unit regression ($b_i = 1$) and the deviation from regression as small as possible ($S^2d_i = 0$). Genotypes with lowest or non-significant mean square deviation being most stable and vice-versa. The three parameters $\overline{X}$, b_i and S^2d_i together gave an idea of adaptability of genotypes across the environments. The data related to stability parameters are presented in Table 3. Regression co-efficient (growth response index) measures response to increment in an improving environment. Genotypes with values of b_i greater than one ($b_i>1$) were described as better performance in better environment, whereas genotypes with values of b_i less than one ($b_i<1$) were described as better performance in less environment showing above average responsiveness and b_i value equal to one ($b_i=1$) described as most stable. But also, Lerner (1954), first time suggested a simple measure of phenotypic stability which is termed stability factor (S. F.) and later on the term stability was originally used by Finlay and Wilkinson (1963) to refer to the slopes of the regression lines.

Table.1 Genotypes, pedigree and their distinguishing feature

S. No.	Genotypes	Pedigree	Distinguishing Features
1	PM-21	Pusa bold × ZEM 2	High yielding and contains low erucic acid and low glucosinulate content.
2	RSPR-03	Kranti × Pusa bold	Contains oil content of 40 % and matures in 145 days with average yield of 15 q/ha.
3	Kranti	Selection from varuna	Contains oil content of 40 % and matures in 125-130 days with average yield of 15-18 q/ha. This variety is tolerant to Alternaria blight than varuna and more resistant to downy mildew.
4	RSPR-69	RLM -198 × Varuna	High yielding and contains 42% oil content.
5	PusaTarak	Agra local × Poorbi Raya	High yielding contains 40% oil content and matures in 130-135 days.
6	RL-1359	RLM -514 × Varuna	Tolerant to aphid and has oil content of 43% with average yield of 19-21 q/ha.
7	CS-56	ZH851 × Pusa Bold	Suitable for late sown condition and salinity condition.
8	Nov Gold	Bio-902 × BM-185-11	High yielding with perfused branching contains 42% oil content.
9	NRCDR-2	MDOC-43 × NBPGR-36	High yielding variety with seed size of 5-5.8 g. It contains 40.2% oil and matures in 141 days with average yield of 16.69 q/h.
10	DRMRIJ-31		High yielding variety with seed size of 5-5.8 g. It contains 40.2% oil and matures in 143 days. Its average yield is 17.5q/ha.
11	Urvash	Varuna × Kranti	High yielding and matures in 140 days.
12	RSPR-01	*Brassica juncea* × *Diplotaxixmuralis*	It is high yielding with oil content of 40% and the average yield is 19-20 q/h.
13	Pusa Bold	Varuna × BIC 1780	High yielding with seed size of 6.0-7.0 g, It contains oil content of 42%.
14	Varuna	Pure selection from varansi local	It is high yielding variety with seed size of 5-6.5 g. Its average yield is 20-22 q/ha.
15	RB-55	Selection from RB-2001	High yielding and suitable for rain fed condition.

Table.2 Joint regression analysis for seed yield and its components following Eberhart and Russell (1966)

Source	d.f.	Mean squares											
		PH	NPB/P	NSB/P	NSMS	NS/S	SL	TSW	SY/P	DFF	DHF	DM	OC
Genotypes (M_1)	14	308.51**	2.31**	9.3	41.97**	3.14*	0.09	0.82	13.43**	39.04**	44.1**	39.4**	12.52*
Environments	3	3265.37**	17.22**	228.58**	170.25**	23.05***	0.6**	2.46*	518.06**	1194.21**	1519.81**	5.8*	117.54**
Geno.×Env.	42	45.72	0.75**	7.6*	10.46	1.03	0.04	0.65	3.62	6.94**	6.36**	1.97*	7.36
Env. + (Geno. × Env.)	45	269.36**	1.85**	22.35**	21.28	2.5*	0.08*	0.77	37.91**	86.09**	107.26**	2.22*	14.7**
Environments (linear)	1	9796.12**	51.67**	685.74**	510.77**	69.15***	1.81**	7.37*	1554.19**	3582.62**	5459.42**	17.4**	352.64**
Geno.×Env. (linear) M_2	14	52.72	1.72**	15.46**	3.28	0.62	0.06	0.34	5.56*	19.02**	17.76**	3.79**	10.4
Pooled deviation (M_3)	30	39.4	0.25**	3.46**	13.37**	1.16***	0.04**	0.75	2.47**	0.84	0.62	0.99	5.57**
Pooled error (M_4)	112	5.76	0.07	0.25	0.56	0.22	0.01	0.84	0.29	1.93	2.18	1.8	0.002

***, ** significant at 0.05 and 0.01 respectively.PH= Plant Height, NPB/P= No. of Primary Branches per Plant, NSB/P = No. of Secondary Branches per Plant, NSMS = No. of Siliquae on Main Shoot, NS/S = No. of Seed per Siliquae, SL = Siliqua Length, TSW = 1000 Seed Weight, SY/P = Seed yield per Plant, DFF = Days to 50% Flowering, DHF = Day to 100% Flowering, DM = Days to Maturity, OC = Oil Content.**

Table.3 Stability parameters ($\bar{X}$, b_i, S^2d_i) for seed yield and its component traits in *B. juncea* L.

Genotypes	No. of seeds / siliqua			No. of siliquae on main shoot			1000- seed weight (gm)			Yield / plant (gm)			Oil content (%)		
	$\bar{X}$	b_i	S^2d_i	$\bar{X}$	b_i	S^2d_i	$\bar{X}$	b_i	S^2d_i	$\bar{X}$	b_i	S^2d_i	$\bar{X}$	b_i	S^2d_i
PM-21	13.27	0.72	2.78**	42.98	1.46	-0.52	3.85	0.91	-0.77	14.04	0.8	-0.04	34.03	0.71*	0.06**
RSPR-03	14.67	0.97	-0.1	36.68	0.72	3.68*	3.51	1.21	-0.71	14.66	0.9	8.65**	34.66	0.77	16.58**
Kranti	13.44	1.51	0.68	40.12	1.12	-0.37	3.31	0.38	-0.71	14.94	1.32	2.74**	39.79	-0.38	7.71**
RSPR-69	12.82	0.82	0.11	44.15	1.21*	-0.98	3.84	0.72	-0.71	10.91	0.74**	-0.28	36.18	1.04	0.08**
PusaTarak	14.71	1.33	1.83**	36.52	1.23	136.36**	4.28	2.61	1.81*	12.18	0.81	1.45**	33.46	1.91**	0.02**
RL-1359	12.27	1.17	0.12	43.6	1.35	1.26	3.27	0.69	-0.76	15.27	1.15	1.53**	35.95	0.82	1.19**
CS-56	12.5	0.97	0.03	37.12	0.47	17.29**	3.73	0.32	-0.76	13.14	0.82	0.62	35.31	0.62	0.89**
Nov Gold	11.86	1.26	0.6	41.03	1.12	11.02**	4.11	1.11	-0.66	15.22	1.31	1.13*	33.35	1.66	2.72**
NRCDR-2	13.07	1.46	-0.13	38.12	0.88	-0.77	3.43	0.16	-0.78	15.33	1.07	2.28**	34.78	1.48	7.13**
DRMRIJ-31	12.73	0.56	2.64**	38.55	0.46	8.97**	3.75	0.82	-0.76	16.49	1.3*	-0.07	36.02	0.72	1.38**
Urvashi	13.72	1.03	-0.18	41.83	1.06	0.88	4.03	0.86	-0.69	10.79	0.79	0.77*	37.57	0.53	18.64**
RSPR-01	13.55	1.02	0.1	46.4	1.38*	-0.81	3.52	0.94	-0.79	12.99	0.75	6.17**	36.45	1.52	0.57**
Pusa Bold	11.92	0.39	1.06*	39.77	0.87	0.95	4.99	2.99	6.84**	14.11	1.15	5.96**	33.66	2.25	4.69**
Varuna	14.11	1.4	1.33*	36.28	0.81	4.06**	3.48	1.33	-0.73	16.41	1.29	0.27	35.45	0.71	0.79**
RB-55	13.46	0.39	0.79	36.62	0.83	3.81*	3.41	-0.06	-0.72	11.98	0.82	0.96*	37.49	0.46	21.02**
General Mean =	13.21			39.98			3.77			13.9			35.61		
S.E.m =	0.62			2.11			0.5			0.91			1.36		

*, ** significant at 0.05 and 0.01 respectively.

Genotypes with most gentle slopes being referred as most stable in contrast to the genotypes having the steepest slopes which were the least-stable. In (1958), Lerner has also reported that building in stability (development of homeostasis) appears to be a different question. However, various reports indicated that the stability to some extent is under the genetic control (Williams, 1960; Perkins and Jinks, 1986b; Ramanujam and Gupta, 1973). According to these three parameters, three genotypes Varuna, PM-21 and DRMRIJ-31 exhibited stability for seed yield. The genotype PM-21 recorded significantly higher seed yield (14.04 g) in comparison to the mean seed yield over all the genotypes (13.9 g), regression coefficient (0.8) and non-significant deviation from regression S^2d_i. This genotype was superior and suited for low performance environment and hence proved its potential to be released for commercial cultivation in the region. The genotype Varuna had higher seed yield (16.41 g), regression coefficient (1.29) and non-significant deviation from regression S^2d_i.This genotype was superior and suited for high performance environment. Also, the genotype DRMRIJ-31 exhibited higher seed yield (16.49 g), regression coefficient (1.3) and non-significant deviation from regression S^2d_i. This variety was superior and suited for high performance environment.

Critical examination of Table 3 showed that one genotype CS-56 was found stable for plant height as it exhibited high mean performance, unit regression coefficient and non-significant deviation from regression. Two genotypes CS-56 and Nov Gold were stable for number of primary branches/plant. None of the genotypes was stable for number of secondary branches/plant and siliqua length. Stable genotypes for number of siliquae on main shoot were Urvashi and Kranti. Three genotypes Urvahsi, RSPR-03 and RSPR-01 were stable for number of seeds/siliqua and two genotypes Nov Gold and PM-21 were stable for 1000-seed weight. None of genotypes was stable siliqua length. Three genotypes Varuna, PM-21 and DRMRIJ-31 exhibited stability for seed yield/plant. The genotype DRMRIJ-31, Nov Gold and PM-21 were stable for days to 50 per cent flowering. Three genotypes RSPR-03, RL-1359 and DRMRIJ-31were stable for days to 100 per cent flowering, none of genotypes was stable for days to maturity and oil content. In seed yield/plant, the genotypes Kranti was found most responsive as whereas RSPR-69 was least responsive to the different environments.

References

Abou El-Nasr, T. H. S., Ibrahim, M. M. and Aboud, K. A. 2006. Stability parameters in yield of white Mustard (*Brassica alba L*.) in different environments. *World J. Agric. Sci.*, 2(1): 47-55.

Anonymous, 2016.United States Department of Agriculture.

Degenhardt, D. F. and Kondra, Z. P. 1981. The influence of seeding date and seeding rate on seed yield and yield components of five genotypes of *Brassica napus*. *Can. J. Plant Sci.*, 61: 175-183.

Doly, A. D. and Marcellos, H. 1974. Time of sowing and wheat yield in northern New South Wales. *Aust. J. Exp. Agric. Anim. Husb*., 14: 93-102.

Eberhart, S. A. and Russell, W. L. 1966. Stability parameters for comparing varieties. *Crop Sci.*, 6: 36-40.

Finlay, K. W. and Wilkinson, G. N. 1963. The analysis of adaptation in a plant breeding programme. *Aust. J. Agric. Res.*, 14: 742-754.

Gazal, A., Dar, Z. A., Zafar, G. and Habib, M. 2013. Stability analysis for yield and its contributing traits in Brown sarson (*Brassica rapa L*.) under Kashmir conditions in India. *J. Oilseed Brassica*, 4(1): 33-38.

Gupta, S. K. and Pratap, A. 2007. Phenotypic stability of Indian mustard (*Brassica juncea)* genotypes developed from intervarietal and intergeneric crosses. *Indian J. Crop Science*, 2(2): 379-382.

Kohn, G. D. and Storrier, R. R. 1970. Time of sowing and wheat production in Southern New South Wales. *Aust. J. Exp. Agric. Anim. Husb.*, 10: 604-609.

Lerner, I. M. 1954. Genetic Homoeostasis. *John Wiley and Sons. Inc*. New York.

Lerner, I. M. 1958. The genetic basis of selection. *John Wiley and Sons. Inc.* New York.

McDonald, G. K., Sutton, B. G. and Ellison, F. W. 1983. The effect of time of sowing on the grain yield of irrigated wheat in the Namoi Valley, New South Wales. *Aust. J. Exp. Agric. Anim. Husb*., 34: 229-240.

Perkins, J. M. and Jinks, J. L. 1968. Environmental and genotype × environment components of variability. VI. Diallel set of crosses. *Heredity*, 23: 339-356.

Ramanujam, S. and Gupta, V. P. 1973. Stability of yield and its components in bangal gram. Abstract, SABRAO. *Second Genetic congress*, 167.

Tahira, A, R., Ahmad Khan, M. and Amjad, M. 2013. Stability analysis of canola (*Brassica napus*) genotypes in Pakistan. *Glo. Adv. Res. J. Agric. Sci.*, 2(10): 270-275.

Williams, W. 1960. Relative variability of inbred lines and F1 hybrids in *Lycopersicum esculentum*. *Genetics*, 45: 1457-1465.

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