



## Adaptability of Indian mustard (*Brassica juncea*) under irrigated uplands of Tripura\*

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The production and productivity of rapeseed-mustard is needed to increase in India to minimize the gap between domestic supply and demand. As a part of it expansion of areas under rapeseed-mustard has been targeted through identification and cultivation of suitable varieties in non-conventional areas like north-eastern states. But in north-eastern states, like Tripura, sowing of rapeseed-mustard without proper land preparation is quite frequent. This may be due to lack of time left after harvesting of long-duration rice varieties. Under such unfavourable conditions, association and individual contribution of yield attributes to seed yield are very important consideration for selection of superior genotypes. Adaptability of a variety is postulated from amount and magnitude of stable performance of yield and major yield attributing characters. Among the stability analysis models, though Eberhart and Russell model (Eberhart and Russell 1966) has been widely used in Indian mustard (Wani 1992; Rashid *et al.* 2002, Gupta and Aditya 2007, Yadava *et al.* 2010) for providing reliable and simple information about stability, but Freeman and Perkins model (Freeman and Perkins 1971) additionally provided independent estimation of mean performance and environment index. Moreover, Freeman and Perkins (1971) model not only provided almost similar rankings with respect to both response and stability but also gave similar results like ecovalence calculation (Robert and Denis 1996) in determining the stability of a genotype.

In the present study, seed yield and its attributing traits identified through correlation and path coefficient analysis were subjected to stability analysis to identify varieties for irrigated uplands of Tripura for their adaptability over environments.

\*Short note

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Thirteen varieties of Indian mustard such as Kranti, PCR 7, Vardan, Sarama, Bio 902, Pusa Bahar, Vaibhav, Pusa Bold, Rohini, RH 30, PL 1359, Varuna and RH 819 were sown at the end of November in three consecutive years (2004–06) under irrigated upland condition at Lembucherra farm of ICAR Research Complex for NEH Region, Tripura Center in randomized block design (RBD) with three replications. The plot size was 10 m<sup>2</sup> and row-to-row and plant-to-plant distances were 30–35 cm and 10 cm, respectively. Observations were taken from randomly selected 10 plants of each plot-on-plant height, number of primary branches/plant, number of siliquae/plant, siliquae length, number of seeds/siliquae, 1 000-seed weight and plot seed yield. Pooled data over three years were subjected to correlation and path coefficient analysis to find out main contributing characters to seed yield. The mean observation of each genotype for seed yield and important contributing characters over two replications were subjected to pooled analysis of variance. The data were subjected to analysis of variance as per the procedure suggested by Sukhatme and Amble (1989) in order to study G × E interaction and phenotypic stability and the remaining third replication was used for estimation of environmental index by following the model of Freeman and Perkins (1971).

Pooled analysis of variance indicated that all the genotypes significantly different from each others in respect to all the characters. While calculating correlation coefficients (Table 1) of all the characters estimated based on pooled data over three years of experimentation, it was observed that, plant height ( $r = 0.33$ ), number of siliquae/plant ( $r = 0.34$ ) and 1 000-seed weight ( $r = 0.29$ ) had significant positive effect on seed yield, while number of seeds/siliquae ( $r = -0.24$ ) and siliquae length ( $r = -0.16$ ) had significant negative effect on yield. Plant height had also positive effect on number of primary branches ( $r = 0.40$ ), number of siliquae/plant ( $r = 0.45$ ) and 1 000-seed weight ( $r = 0.31$ ), while number of primary branches/plant had positive effect on number of siliquae /plant ( $r = 0.52$ ). Wani and Zanger (1995)

also found plant height and siliquae/plant had significant contribution to seed yield. Path coefficient analysis revealed that number of siliquae/plant ( $r = 0.30$ ) had highest significant positive direct effect on yield. Plant height ( $r = 0.22$ ) also had significant direct effect on yield. Therefore, in upland situation of Tripura, higher plant height of mustard might be a good index of yield, followed by higher grain weight and higher number of siliquae/plant.

The important characters in relation to yield namely, plant height, number of siliquae/plant, 1 000-seed weight along with seed yield selected on the basis of higher significant correlation and direct significant effect on seed yield were subjected to analysis of variance for stability. From the components of variance (Table 2) it could be well established that the genotypes as well as all environments were significantly differ from each other. While dividing the environmental effects, it was found almost non-linear except for number of siliquae/plant. The variance due to  $G \times E$  were significant for all the selected characters. The interactions were found linear for number of siliquae/plant, 1000 seed weight and seed yield, suggesting their performance could be predicted.

From Table 3, it was observed that, Varuna and Pusa Bahar with regression coefficient near unity and higher mean values with non-significant deviation from regression were found stable for plant height. Kranti with high mean value and regression coefficient near unity was found stable in

producing higher number of siliquae /plant. But prediction of performance was found difficult as it showed higher deviation from regression line. PL1359 with high mean value, significantly higher regression coefficient and higher deviation from regression revealed its suitability only in favourable condition for producing more number of siliquae/plant. Pusa Bold with high mean seed weight, but regression above unity and almost no deviation from regression could be highly adaptable in favourable environment. 'Varuna' with high mean, below unity regression coefficient value and near '0' deviation from regression could be adaptable for unfavourable environment in respect of seed weight. In contrary for the same trait, Kranti with moderate mean, near unity regression coefficient and deviation from regression near '0' could be stable for all environments.

Kranti with having high mean, near unity  $b_i$  and non-significant  $S^2_{di}$  could be stable yielder for changing environments. Though yield of Pusa Bold was also high but it could be only suitable in unfavourable environment as evident through its low  $b_i$  value. Varuna found suitable only in favourable environment as regression coefficient was above unity with significant deviation from regression. Vaibhav was found adaptable in various environments with its stable performance ( $b_i$  near unity). RH 30 could be suitable in unfavourable environment with above average seed yield, just below unity  $b_i$  value and below '0' deviation from regression.

Table 1 Correlation coefficients matrix of yield and yield-contributing characters of Indian mustard

Character	Plant height (cm)	Number of branch/plant	Siliquae/plant	Siliquae length (cm)	Seed/siliquae	1 000-seed wt. (g)
Plant height (cm)	1.00					
Number of branches/plant	0.40**	1.00				
Siliquae/plant	0.45**	0.52**	1.00			
Siliquae length (cm)	-0.10	0.02	-0.23**	1.00		
Seeds/siliquae	-0.17*	0.11	-0.20*	0.76**	1.00	
1000 seed weight (g)	0.31**	-0.04	0.18*	0.10	-0.20*	1.00
Plot yield (g)	0.33**	0.03	0.34**	-0.16*	-0.24**	0.29**

\*\* Significant at 1% level, \* Significant at 5% level

Table 2 ANOVA of genotype, environment and genotype  $\times$  environment effects

Variance	d f	Mean sum of square			
		Plant heigh(unit?)	Siliquae/plant	1 000-seed wt.	Plot yield (unit?)
Genotypes (G)	12	1696.73**	2162.08**	1.12**	27 752.7**
Environmental (E)	2	133.2*	2387.22**	1.39**	38 842**
Combined regression	1	11.84	4755.21**	2.74	76 196.8
Residual (1)	1	56.12	19.23	0.05	1 487
Interaction (G $\times$ E)	24	122.86*	2740.98**	0.15**	16 099**
Heterogeneity of regression	12	171.8	2188.24	0.27*	17 859
Residual (2)	12	73.89	3293.7**	0.04*	14 339**
Between replication	39	48.86	310.27	0.02	2 212.8

Table 3 Stability parameters in Indian mustard in irrigated uplands of Tripura

Variety	Plant height (cm)			Siliquae/plant			1 000-seed weight (g)			Plot yield (g)		
	X	bi	S <sup>2</sup> di	X	bi	S <sup>2</sup> di	X	bi	S <sup>2</sup> di	X	bi	S <sup>2</sup> di
Kranti	158.35	-0.11	-42.67	162.67	1.46	1383.1	4.03	0.92	-0.02	855.0	1.21	34.8
PCR 7	138.52	-1.16	-38.56	141.27	0.27	-299.57	3.68	0.44	-0.01	746.7	3.77	-2165.7
Vardan	134.98	-2.15	41.18	120.87	0.10	-243.11	3.22	0.27	0.02	616.7	6.04	-771.7
Sarama	139.03	0.99	-10.39	143.23	-0.97	-260.12	3.57	1.86	-0.01	716.7	3.35	2586.12
Bio 902	119.00	0.79	-48.26	112.38	4.02	-310.28	4.4	-0.06	-0.01	748.3	1.6	16539.8**
Pusa Bahar	152.68	1.99	-7.66	149.07	-2.35	-240.17	3.72	0.46	-0.02	668.3	0.67	231.07
Vaibhav	134.15	-0.45	-19.41	127.05	1.59	-12.1	3.48	0.51	-0.01	758.3	1.13	-2081.2
Pusa Bold	156.05	-3.78	59.44	163.58	-3.45	42.46	4.45	3.38	0.01	798.3	-0.23	-587.06
Rohini	142.15	-0.16	-27.43	137.14	0.42	918.97	3.78	0.37	0.01	651.7	-1.94	16775.5**
RH 30	147.35	0.07	-44.2	127.97	1.05	-132.04	4.1	0.55	0.02	751.7	0.75	-1950.6
PL 1359	155.62	2.44	-18.56	177.67	5.16	6888.1**	3.78	1.71	-0.02	751.7	-2.3	436.67
Varuna	154.98	1.27	-22.20	139.12	1.89	3888.4**	4.58	0.69	-0.01	781.7	2.27	18159.3**
RH 819	99.75	1.94	14.86	122.9	3.90	4115.5**	3.32	-0.11	0.1*	645.0	-0.03	7435.9
Average	140.97	0.129	-12.60	140.38	1.01	84.71	3.85	0.85	-0.0	730.0	1.31	653.93

In mustard G x E interaction were found significant for all the characters of Indian mustard, studied by Gupta and Aditya (2007) and Brar *et al.* (2007). In this experiment also all characters under stability analysis were revealed significant G x E interaction. Rashid *et al.* (2002) found that regression coefficient was the most useful stability statistics for the selection of mustard cultivars adapted to wide range or specific environment. In the present study also genotypes were detected for stability mainly on the basis of regression coefficient values. Wani and Zanger (1995) found in Indian mustard that no single variety showed stability for all the traits under different environmental situation. In the present investigation similar trend was observed. Although, variety like Kranti showed stability in siliquae/plant, seed weight and mean seed yield along with high mean values, could be considered as most stable variety in irrigated upland situation of Tripura.

#### SUMMARY

Thirteen varieties of Indian mustard such as 'Kranti', PCR 7, Vardan, Sarama, Bio 902, Pusa Bahar, Vaibhav, Pusa Bold, Rohini, RH 30, PL 1359, Varuna and RH 819 were grown for consecutive three years to identify adaptable varieties for irrigated uplands of Tripura on the basis of yield contributing characters and seed yield. Based on correlation and path coefficient analysis, identified major traits like plant height, number of siliquae/plant, 1 000-seed weight along with seed yield were identified and were subjected to analysis of variances for stability using Freeman and Perkins stability analysis model. G x E interaction was linear for number of siliquae/plant, 1 000-seed weight and seed yield, suggesting their performance could be predicted. Based on stability parameters, varieties were identified for stable performance in component characters. Kranti with high mean value, near unity regression coefficient and non-significant

deviation from regression in number of siliquae/plant, 1 000-seed weight and seed yield could be adapted for various environments. Varuna only was found suitable only for favourable environment while 'Pusa Bold' was identified for unfavourable condition.

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