GENETIC CONTROL OF PHENOTYPIC STABILITY IN INDIAN MUSTARD

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ABSTRACT

Combining ability analyses were conducted for stability parameters in Indian Mustard in a 13 x 4, line x tester mating design. The variances due to g.c.a. and s.c.a. were significant for stability of seed yield and 1000-seed weight only. Some of the high stability lines showed plasticity for the component traits like number of primary and/or secondary branches and/or main shoot length. The crosses showing high stability involved either one or both high stability parents. RL 18, an old widely adapted variety, showed the best combining ability for stability of seed yield but not the yield *per se*. The stability of performance seemed to be under a separate genetic control. Combining ability for stability of yield was not related with similar ability for yield components. Instability of yield components seemed to contribute towards stability of seed yield.

INTRODUCTION

Recent genetic analyses in a number of field crops showed that stability of phenotypic performance may be under a separate genetic control than the performance *per se* (Gupta *et al*. 1981). In the present investigation, nature of genetic control of phenotypic stability has been evaluated in Indian mustard for seed yield and its components.

MATERIAL AND METHODS

The progenies of a 13 x 4, line x tester mating design were grown in eight pertinent environments created by variation in fertilizer levels and dates of sowing. The regression of varietal means on the environmental index as observed on the Eberhart and Russell (1966) model was subjected to combining ability analysis following Kempthone's (1957).

RESULTS AND DISCUSSION

The analysis of variance for combining ability of regression coefficients is given in Table 1. The variance due to male parents was highly significant for seed yield, number of primary branches, siliquae on main shoot and 1000-seed weight, while that due to females for seed yield, number of primary branches, number of secondary branches, main shoot length and 1000-seed weight. The mean squares due to females x males was highly significant for seed yield, plant height, number of primary branches, main shoot length siliquae on main shoot, seeds per siliqua and 1000-seed weight. For oil content and siliqua length none of the variances were significant indicating that stability of these traits was not genetically transmissible as easily as for other traits.

The estimates of g.c.a. and s.c.a. effects are presented in Tables 2 & 3. RL 18 and RLM 29 were the best combiners for the stability of seed yield. None of these parents were high combiner for stability of yield components. Apparently, therefore, relative instability of yield components is important for imparting stability of seed yield per se as also observed by Gupta, et al. 1977. Likewise, RH 30 and RLM 198 as well as Pant Rai 1, Pant Rai 15, RLM 45 and RLM 82 which showed high g.c.a. for 1000-seed weight were average to low combiners for stability of seed yield. For another important yield component, namely plant height, Pant Rai 15, Pant Rai 1011 and RLM 514 showed high combining ability but were average combiners for stability of seed yield. RLM 240 had high combining ability for stability of number of secondary branches, but was average combiner for stability of seed yield. Similarly high combiners for stability of main shoot length, namely Pant Rai I & RH 7513 were the average general combiners for seed yield. Apparently, therefore, the gca estimates for stability parameters indicate that the phenotypic stability is under a separate genetic control for the seed yield versus yield components.

The s.c.a. for linear regression of seed yield were negative and significant in only eight crosses. Similar situation was observed in ten crosses for plant height, twenty three crosses for main shoot length, five crosses for siliquae on main shoot, four crosses for number of seeds per siliqua and twenty for 1000-seed weight. The general picture of these s.c.a. estimates is that there is a considerable heterosis for stability of performance. From the results presented in this text it could be inferred that the stability of performance for seed yield and its components in Indian mustard can be subjected to genetic analysis and manipulated to achieve genetic improvement in stability of performance.

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Table 1 : Analysis of variance of combining ability for regression coefficient.

Source of variation	d.f.	Seed yield	Oil content	Plant height	Primary branches	Secondary branches	Main shoot	Siliquae of main shoot	Siliqua length	Seeds/ siliqua	1000-seed weight
Males	3	0.55**	0.10	0.47	0.68**	0.09	0.10	0.97*	0.04	0.24	1.99**
Females	12	0.30*	0.07	0.84**	0.15	0.38*	0.57*	0.57	0.07	0.39	1.49**
Females x Males	36	0.39**	0.07	0.20**	0.13	0.36**	0.25**	0.51**	0.10	0.69**	1.11**
Error	136	0.14	0.09	0.19	0.18	0.19	0.24	0.37	0.12	0.40	0.02

* *Significant at P = 0.05*

** *Significant at P = 0.01*

Table 2 : General combining ability effects

Parents	Seed yield	Primary branches	Siliquae on main shoot	1000-seed-weight
Males				
RH 30	0.23	0.11	0.12	–0.25
RL 18	–0.22	0.19	–0.05	0.57
RIM 198	0.12	0.01	0.28	–0.25
Varuna	–0.11	–0.32	–0.36	–0.08
S.E.	0.10	0.12	0.17	0.04

Females	Seed yield	Plant weight	Secondary branches	Main shoot length	1000-seed weight
P. Rai 1	–0.29	–0.26	0.25	–0.55	–0.66
P. Rai 15	–0.06	–0.50	–0.04	–0.10	–1.04
P. Rai 1011	–0.05	–0.56	0.05	–0.32	–0.05
P 11/7-1	0.60	0.32	0.27	–0.14	–0.04
RH 75-1	0.06	0.13	–0.19	0.46	0.61
RH 7513	–0.23	0.54	–0.05	–0.58	1.42
RIM 29	–0.36	0.72	–0.36	0.27	0.04
RIM 45	0.45	–0.05	0.39	–0.23	–0.43
RIM 82	–0.01	0.32	0.04	0.71	–0.41
RIM 185	0.18	0.27	0.04	0.14	0.24
RIM 240	–0.18	0.24	–0.69	0.18	0.04
RIM 514	0.03	–0.47	–0.34	–0.07	–0.10
RIM 528	–0.09	0.71	0.47	0.24	0.37
S.E.	0.19	0.22	0.22	0.25	0.07

Table 3 : Specific combining ability effects

Crosses	Seed yield	Plant height	Secondary branches	Main shoot length	Siliquae on main shoot	Seeds/ siliqua	1000-seed weight
1	2	3	4	5	6	7	8
P. Rai 1 x RH 30	–0.30	–0.43	0.82	0.16	0.19	0.09	0.90
P. Rai 15 x RH 30	0.17	0.34	0.43	0.30	0.35	–0.33	1.42
P. Rai 1011 x RH 30	0.03	–0.25	0.91	0.21	0.08	0.83	–0.43
P 11/7-1 x RH 30	1.94	–0.07	–0.07	0.35	0.94	–0.58	2.05
RH 75-1	–0.63	–0.64	–0.80	–0.83	–0.65	0.25	–0.82
RH 7513	0.71	0.32	0.17	–0.18	–0.21	–0.01	–0.36
RIM 29	0.35	0.61	0.38	–0.31	0.34	1.04	–0.35
RIM 45	0.07	–0.01	0.42	–0.02	–0.09	0.59	–0.14
RIM 82	–0.54	0.21	0.49	–0.14	0.23	–0.20	0.20
RIM 185	–1.06	–0.17	–0.47	–0.44	–0.15	–0.50	0.51
RIM 240	0.28	0.10	–1.85	–0.25	–0.82	–0.60	1.67
RIM 514	–0.55	0.27	–0.01	0.74	–0.01	–0.20	–0.01
RIM 528 x RH 30	–0.52	0.59	–0.39	0.42	0.40	–0.34	1.20
P. Rai 1 x RL 18	0.50	0.60	0.64	0.79	0.69	–0.67	–0.65
P. Rai 15 x RL 18	–0.29	0.41	–0.04	–0.23	0.08	0.22	–0.11
P. Rai 1011 x RL 18	–0.25	0.55	–0.25	–0.03	–0.14	–1.07	1.87
P 11/7-1 x RL 18	–0.71	–0.01	–0.07	0.37	1.83	–0.49	–0.83
RH 75-1	0.17	–0.07	0.71	0.03	0.62	0.04	1.11
RH 7513	–0.37	–0.02	–0.34	–0.04	0.18	0.04	–0.76
RIM 29	0.04	0.74	–0.04	0.15	–0.21	0.18	0.41
RIM 45	–0.31	–0.08	–0.34	–0.03	0.75	–0.05	0.80
RIM 82	0.14	–0.03	0.05	0.22	0.25	–0.17	–0.37
RIM 185	1.44	–0.01	0.36	–0.40	–0.76	0.62	–0.34
RIM 240	–0.38	–0.03	0.32	–0.31	0.62	1.79	0.40

Table 3 : *(Contd...)*

Crosses	Seed yield	Plant height	Secondary branches	Main shoot length	Siliquae on main shoot	Seeds/ siliqua	1000-seed weight
1	2	3	4	5	6	7	8
RIM 514	–0.21	–0.48	–0.37	–0.73	0.19	0.52	–0.06
RIM 528 x RL 18	0.20	–0.64	0.59	0.15	–0.05	0.78	0.05
P. Rai 1 x RLM 198	–0.16	–0.15	–0.18	–0.50	–1.05	1.14	0.48
P. Rai 15 x RLM 198	–0.11	–0.26	–0.33	0.16	–0.70	–0.96	0.29
P. Rai 1011 x RIM 198	0.48	–0.19	0.16	–0.17	–0.32	–0.32	–0.53
P 11/7-1 x RIM 198	–0.89	–0.06	–0.04	–0.08	0.85	–0.03	–0.20
RH 75-1	0.24	0.44	0.20	0.18	0.33	1.07	0.39
RH 7513	–0.17	–0.05	–0.08	0.01	–0.09	–0.13	–0.29
RIM 29	–0.25	0.82	0.35	0.29	0.45	1.06	0.29
RIM 45	0.63	0.34	0.24	0.12	0.18	–0.38	1.32
RIM 82	0.09	–0.09	–0.96	–0.05	0.18	0.13	0.59
RIM 185	0.11	0.18	–0.28	–0.19	–0.36	0.25	–0.63
RIM 240	–0.36	0.24	0.98	0.39	0.51	0.30	–0.58
RIM 514	0.49	–0.42	0.19	–0.77	–0.13	–0.02	0.01
RIM 528 x RIM 198	–0.17	0.18	–0.17	0.06	0.18	–0.40	–0.64
P. Rai 1 x Varuna	–0.05	–0.04	0.02	–0.46	0.26	–0.40	1.33
P. Rai 15 x Varuna	0.21	0.17	–0.05	–0.25	0.27	1.07	0.20
P. Rai 1011 x Varuna	–0.29	–0.11	–0.80	–0.04	0.40	0.55	–0.27
P11/7-1	–0.37	0.10	0.19	–0.64	0.39	1.10	0.48
RH 75-1	0.21	0.23	–0.09	0.61	0.24	–1.36	–0.69
RH 7513	–0.18	0.78	0.17	0.19	0.12	0.11	1.43
RIM 29	–0.15	–0.21	–0.67	–0.13	–0.39	–0.74	–0.35
RIM 45	–0.41	–0.26	–0.33	–0.07	–0.85	–0.18	0.49
RIM 82	0.30	–0.11	0.44	–0.06	–0.64	0.23	0.76
RIM 185	–0.50	–0.04	0.40	1.09	1.27	–0.36	0.46
RIM 240	0.44	–0.35	0.54	–0.34	–0.32	0.28	–0.97
RIM 514	0.25	0.61	0.18	0.76	–0.03	–0.31	0.07
RIM 528 x Varuna	0.48	–0.15	–0.01	–0.64	–0.54	–0.03	–0.60
S.E.	0.21	0.25	0.24	0.18	0.35	0.36	0.08