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Stability analysis for seed yield and its component characters in taramira (*Eruca sativa* Mill.)

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Abstract

Thirty genotypes of taramira were evaluated over three environments for analysis of stability parameters with respect to yield and associated characters viz., days to 50% flowering, days to maturity, plant height, primary branches per plant, siliquae per plant, number of seed per siliqua, biological yield per plant, 1000-seed weight and oil content. Genotypes RTM-46, RTM-48, RTM-66 and RTM-69 showed stability. Further these genotypes may be used in breeding programme for improvement in taramira. Genotypes RTM-62 and RTM-69 should be used as parent to develop high oil content and high yielding genotypes responsive to the favourable environment conditions, respectively.

Key words: *Eruca sativa, stability, variability, regression and environment interaction*

Introduction

Taramira (*Eruca sativa* Mill.L.), an important drought resistant oil seed crop, belongs to coeno-species of *Brassica*. It is successfully grown as a rainfed crop even on soils with moderate water retention capacity. The crop is especially suitable for the areas having inadequate or no irrigation facilities as it has efficient root system to extract moisture from deep soil horizons (Gupta *et al.*, 1998). During the periods of severe drought coupled with late *Rabi* rains, taramira is the only alternative available for sowing on soils having limited moisture supply. Till now not much work has been carried out on genetic improvement of taramira. Hence, it is imperative to develop high yielding varieties with high oil content in this crop. Besides yield potential, the variety should also possess stability in its performance over a range of environments. In the present investigation, thirty accessions of taramira were evaluated over three environments to identify stable genotypes with yield and high oil content.

Materials and Methods

Thirty accessions of taramira maintained in All India Coordinated Research Project on Oilseeds (Taramira) at S.K.N. College of Agriculture, Jobner were evaluated over three environments created by three different dates of sowing (26 Oct, 5 Nov and 15 Nov 2007). In each environment all the genotypes were evaluated in CRBD with three replications in the two-rowed 0.6 m x 4 m^2 plots. The row-to-row and plant-to-plant distances maintained were 30 cm and 10 cm, respectively. Recommended package and practices were followed to raise a good crop. Observations were recorded on ten randomly selected plants for plant height (cm), primary branches per plant, number of siliquae per plant, number of seed per siliquae, biological seed yield per plant, seed yield per plant, 1000-seed weight and oil content while data on days to 50% flowering, days to maturity were recorded on whole plot basis. Mean values of ten plants were used for stability analysis. Oil content was estimated by using NMR. Statistical analysis was carried out as per Eberhart and Russell (1966) model.

Results and Discussion

Environment-wise analysis of variance revealed significant differences among the genotypes under each environment for most of the characters. The pooled analysis of variance also revealed significant differences among genotypes for all the traits except harvest index. This indicates that environment also exerted greater influence on the expression of characters. The G x E interaction was also significant for all the traits except harvest index, which indicated differential response of genotypes to the environment. Kakani (1989) and Meena (1997) also found significant G X E interaction for seed yield and other traits in taramira. Joint regression analysis revealed significant differences among the genotypes for number of siliquae per plant, number of seeds per siliqua, seed yield per plant, biological yield per plant, 1000-seed weight and oil content (table 1).

Table 1: Joint regression analysis for different characters tested over three environments

Source	d.f.	Mean sum of squares			
		Seed/ siliquae	Seed yield/ plant	Test weight	Oil content
Varieties (Var.)	29	5.00**	0.48**	0.08**	39.70**
Environments (Env.)	2	30.30**	4.46**	1.82**	0.38
Var. x Env.	58	3.06**	0.15	0.12**	0.41
Env. + (Var. x Env.)	60	3.97**	0.30*	0.19**	0.41
Env. (linear)	1	60.58**	8.91**	3.64**	0.75
Var. x Env. (linear)	29	2.81	0.16	0.14**	0.38
Pooled deviation	30	3.20**	0.15	0.11**	0.44
RTM-40	1	1.93	0.06	0.03**	0.04
RTM-41	1	7.91**	0.07	0.07**	1.80**
RTM-42	1	1.15	0.06	0.28**	0.04
RTM-43	1	8.35**	0.19	0.04**	1.73**
RTM-44	1	2.59	0.18	0.01	0.54
RTM-45	1	0.00	0.44**	0.00	1.26**
RTM-46	1	1.62	0.02	0.12**	0.10
RTM-47	1	4.35**	0.18	0.05**	0.0
RTM-48	1	2.92**	0.17	0.01	0.19
RTM-49	1	0.22	0.05	0.20**	1.51**
RTM-50	1	1.94	0.40**	0.02**	1.36**
RTM-51	1	0.01	0.85**	0.21**	0.15
RTM-52	1	0.55	0.02	0.32**	0.11
RTM-53	1	3.57**	0.10	0.09**	0.31
RTM-54	1	0.27	0.03	0.22**	0.00
RTM-55	1	1.63	0.01	0.0	0.00
RTM-56	1	0.57	0.03	0.17**	0.07
RTM-57	1	0.52	0.07	0.54**	1.07**
RTM-58	1	0.07	0.02	0.19**	0.27
RTM-59	1	24.94**	0.13	0.00	0.26
RTM-60	1	0.30	0.01	0.04**	0.49
RTM-61	1	0.26	0.03	0.14**	0.26
RTM-62	1	11.62**	0.79**	0.03**	0.06
RTM-63	1	3.50**	0.00	0.08**	0.61
RTM-64	1	1.41	0.24	0.02**	0.32
RTM-65	1	5.50**	0.05	0.26**	0.06
RTM-66	1	0.21	0.01	0.02**	0.45
RTM-67	1	4.70**	0.00	0.02**	0.03
RTM-68	1	1.32	0.17	0.01	0.05
RTM-69	1	1.66	0.01	0.15**	0.00
Pooled error	174	1.89	0.19	0.01	0.48
Pooled error for testing pooled deviation	177	0.63	0.06	0.00	016

*significant at P<0.005; **significant at P<0.001; d.f.: degrees of freedom

Table 2: Mean values and stability parameters (b and S^2d) of the taramira genotypes for seed yield and components

Genotypes	Number of seed/ siliqua			Seed yield/ plant			Number of siliquae/ plant		
	x	b	S^2d	x	b	S^2d	x	b	S^2d
RTM-40	15.77	1.64	1.29	2.65	-0.28	-0.01	65.97	2.58**	-25.75
RTM-41	16.02	0.57	7.28**	1.59	0.85	0.01	48.97	2.07**	-33.33
RTM-42	13.52	0.75	0.52	1.72	1.04	-0.01	35.71	0.14	8.75
RTM-43	14.76	0.87	7.72**	1.97	1.73*	0.13	39.87	0.90	-33.92
RTM-44	16.50	-0.47	1.96	1.87	1.32	0.11	45.30	-0.12	100.49
RTM-45	16.52	0.20	-0.63	2.75	3.19**	0.37**	36.46	0.47	-6.18
RTM-46	16.52	1.50	0.99	1.51	0.85	-0.04	37.37	1.28*	-35.26
RTM-47	16.04	-0.91	3.72**	1.80	2.11**	0.12	51.74	1.57**	-12.99
RTM-48	16.50	1.22	2.29**	1.94	0.95	0.11	39.48	0.27	58.70
RTM-49	14.32	1.94	-0.41	1.73	0.86	-0.01	50.81	2.99**	133.02*
RTM-50	13.42	1.48	1.31	1.71	0.36	0.033**	40.16	0.62	-216.15
RTM-51	14.96	1.14	0.62	2.10	0.40	0.78**	40.53	0.43	590.55**
RTM-52	13.32	2.60*	-0.08	1.72	0.50	-0.05	38.59	0.48	-29.98
RTM-53	14.39	2.82*	2.94*	1.86	0.12	0.03	34.31	0.59	0.31
RTM-54	14.29	1.04	-0.36	1.68	0.26	-0.04	38.18	-0.39	-21.54
RTM-55	17.76	3.39**	1.00	1.68	0.77	-0.05	43.72	0.51	-8.98
RTM-56	16.53	0.14	-0.06	1.54	1.13	-0.03	31.90	1.05	-4.24
RTM-57	14.91	2.44	0.19	1.82	0.72	0.01	40.12	1.65**	-35.31
RTM-58	15.90	-1.043	-0.56	1.76	1.20	-0.04	35.90	1.07*	-30.32
RTM-59	16.97	0.37	24.31**	2.01	1.30	0.07	50.66	2.26**	-34.47
RTM-60	16.04	-1.03	-0.34	1.89	0.79	-0.05	42.40	0.40	-15.48
RTM-61	16.73	0.66	-0.37	1.63	0.90	-0.04	37.94	1.62**	-34.76
RTM-62	17.98	2.21	10.99**	1.91	0.38	0.72**	36.44	0.24	-30.34
RTM-63	17.23	1.21	2.87	1.59	1.06	-0.06	34.01	-0.67	34.92
RTM-64	16.29	1.23	0.78	1.72	0.56	0.18	33.37	0.07	-27.71
RTM-65	17.40	0.50	4.87**	1.79	0.60	-0.01	38.90	0.24	-0.38
RTM-66	16.20	2.09	-0.42	2.14	1.05	-0.06	46.19	1.51**	-1.77
RTM-67	16.44	-0.12	4.07**	1.87	1.49*	-0.06	45.08	1.72**	-28.53
RTM-68	16.94	-0.18	0.69	2.24	1.00	0.11	44.89	1.51**	.30.43
RTM-69	17.36	2.14	1.03	3.39	2.80**	-0.05	62.87	2.94**	-27.46
Popn. Mean	15.91	1.00	-	1.91	1.00	-	42.26	1.00	-
SEm±	1.26	1.26	-	0.27	0.70	-	4.93	0.50	-

*significant at P<0.005; **significant at P<0.001; d.f.: degrees of freedom; x: genotype mean; b: regression value; S^2d: deviation from the linearity

Table 3: Mean values and stability parameters (b and S^2d) of the taramira genotypes for seed yield and components

Genotypes	1000-seed weight			Oil content			Harvest index		
	x	b	S^2d	x	b	S^2d	x	b	S^2d
RTM-40	2.78	1.45	0.02**	35.18	-2.77	-0.12	21.26	-13.37	83.09
RTM-41	2.95	2.58**	0.07**	36.41	3.61	1.64**	24.20	-8.20	-15.61
RTM-42	2.78	1.52	0.28**	33.55	3.25	-0.12	27.54	4.04	-15.67
RTM-43	2.89	1.00	0.03**	31.53	5.03	1.57**	26.43	-4.36	-18.61
RTM-44	2.99	2.18*	0.01	35.44	-2.28	0.38	26.74	3.53	-10.05
RTM-45	2.66	1.21	0.00	33.56	8.19	1.10**	28.14	3.55	-24.54
RTM-46	2.81	-0.67	0.12**	36.49	0.99	-0.06	28.31	5.41	19.62
RTM-47	2.92	-0.36	0.05**	34.61	-6.46	-0.16	23.23	14.59	-24.49
RTM-48	3.07	1.57	0.01	34.66	-8.71	0.03	29.62	-8.29	-24.15
RTM-49	2.83	1.55	0.19**	34.01	-5.13	1.35**	26.21	11.66	19.51
RTM-50	2.67	0.51	0.02**	30.77	-1.14	1.20**	27.84	2.85	-19.54
RTM-51	2.45	0.47	0.21**	33.13	3.21	-0.01	30.10	-13.85	4.31
RTM-52	3.13	1.51	0.31**	36.86	0.65	-0.05	25.61	-1.99	-17.06
RTM-53	2.74	1.40	0.08**	28.85	2.15	0.15	26.28	8.72	0.73
RTM-54	2.66	1.58	0.21**	25.84	4.68	-0.16	27.88	-4.55	-19.72
RTM-55	3.03	1.78	0.00	27.58	1.85	-0.16	23.17	-2.00	-23.82
RTM-56	2.77	1.43	0.17**	35.57	1.80	-0.09	26.37	-6.05	-21.58
RTM-57	2.68	1.58	0.53**	34.24	5.60	0.91**	28.44	1.05	-6.75
RTM-58	2.90	-0.13	0.19**	36.45	2.63	0.11	23.24	-21.22	-19.95
RTM-59	3.07	3.44**	0.00	35.45	3.41	0.10	23.82	-1.76	-22.62
RTM-60	2.91	-0.32	0.04**	28.05	3.97	0.33	28.63	21.42	-21.23
RTM-61	2.68	2.00	0.13**	34.42	3.78	0.10	24.82	7.26	14.00
RTM-62	2.95	0.33	0.02**	34.21	4.97	-0.10	32.67	15.62	96.06**
RTM-63	2.82	1.39	0.08**	27.30	-2.17	0.45	32.34	16.41	-22.46
RTM-64	2.87	0.42	0.02**	28.57	0.94	0.17	26.96	6.31	-23.24
RTM-65	2.51	1.42	0.26**	35.18	-3.05	-0.10	25.69	10.00	-15.30
RTM-66	2.76	1.20	0.02**	37.12	1.83	0.29	30.20	40.14**	-21.58
RTM-67	2.74	0.60	0.01	35.78	1.01	-0.13	26.30	-8.35	42.23
RTM-68	2.62	-1.16	0.01	38.71	-3.43	-0.11	24.47	6.68	19.12
RTM-69	2.97	-1.48	0.15**	35.59	2.81	-0.16	28.75	-17.49	-22.22
Popn. Mean	2.82	1.00	-	33.17	1.01	-	26.84	0.99	-
SEm±	0.24	0.96	-	0.47	4.18	-	3.17	13.77	-

*significant at P<0.005; **significant at P<0.001; d.f.: degrees of freedom; x: genotype mean; b: regression value; S^2d: deviation from the linearity

Environmental variances were significant for all the characters except days to flowering, oil content and harvest index. The variance due to environment + (G + E) component was significant for all the characters except plant height, days to flowering, oil content and harvest index. Partitioning of this variability indicated divergent linear response to the environmental changes. However, the significant G X E (linear) component for siliquae per plant, days to maturity and 1000-seed weight also indicated divergent linear response to environmental changes. Pooled deviations were also significant for number of seeds per siliqua, days to flowering and 1000-seed weight. On the basis of stability analysis (table 2 &3) stable genotypes have been identified for seed yield and oil content. Estimates of S^2d for seed yield per plant were non-significant for most of the genotypes except RTM-45, RTM- 50, RTM- 51 and RTM- 62. Thus, these genotypes were unstable for seed yield. Genotypes RTM-66 and RTM- 68 were stable (b=1) and had mean value of 2.14 g and 2.24 g for seed yield per plant respectively, which is greater than the population mean (µ=1.91 g). Genotypes RTM-43 and RTM-69 showed below average stability (b>1) with higher mean seed yield (1.97g and 3.39g, respectively) than population mean. Thus, these genotypes were responsive to favourable environment.

Seed yield is positively associated with number of siliquae per plant (Nehra, 1988; Kumhar, 2007). In the present study too, genotypes RTM-66 and RTM-68 exhibited stability for number of siliquae per plant and mean siliquae per plant which was higher for both the genotypes than population mean.

Among all genotypes, only RTM-44, RTM-45, RTM-48, RTM-55, RTM-59 and RTM-68 exhibited stability for test weight on the basis of higher mean value than general mean and non-significant S^2d estimates. S^2d estimates for oil content were non-significant for most of the genotypes except for the genotypes RTM-41, RTM-43, RTM-45, RTM-49, RTM-50 and RTM-57. Genotypes RTM-46 and RTM-67 were stable (b=1) for oil content and also had mean oil content greater than the population mean (µ=33.17%). Genotypes RTM-57 and RTM-62 showed below average stability (b>1) for oil content. Thus, it was responsive to favourable environmental conditions. These genotypes also had higher mean value than the population mean. Genotypes RTM-46 and RTM-67 had shown stable performance for oil content with higher mean than population mean. On the basis of this investigation, it can be concluded that genotypes RTM-46, RTM-58, RTM-66 and RTM-68 could be used as parents to breed stable and high yielding genotypes along with higher oil content.

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