

Phenotypic Stability in Isabgol (*Plantago ovata* Forsk.)

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Abstract: Twelve genotypes of isabgol (*Plantago ovata* Forsk.) were evaluated over four consecutive rabi seasons for stability parameters with respect to seed yield and other agronomical traits, viz. days to 50% flowering, days to maturity, number of spikes plant⁻¹, plant height, number of tillers plant⁻¹ and spike length (cm). Genotype x environment (g x e) interaction was significant for all the characters under study. Non-linear component of g x e variance was highly significant for all the characters except spike length. Genotypes RI 9808, RI 9709, RI 9701, RI 89 and GI 2 found promising as these were recorded higher seed yield, regression coefficient near unity and non-significant deviation from regression.

Key words: Genotypes, isabgol, stability, regression coefficient, interaction.

Blond psyllium, popularly known as isabgol (*Plantago ovata* Forsk.), has great commercial and medicinal importance. Its thin rosy husk (white membranous seed coating) and seed are used as bulk laxative, particularly in habitual constipation, diarrhoea and chronic dysentery diseases. The mucilage from husk may also be used as a substitute for agar, and stabilizing agent of icecream, an ingredient in chocolate, formation of pharmaceutical tablets, in cosmetics, etc. The seeds contain fatty oil, albuminous matter, a glucoside viz., aucubin, plantiose sugar and protein (Dhar *et al.*, 2000). India holds monopoly in the world trade and production of psyllium (Farooqi and Sreeramu, 2001) and earns foreign exchange from export of psyllium husk and seed. The important isabgol growing states in India are Rajasthan, Gujarat, Punjab, Haryana and to a small extent Maharashtra and Uttar Pradesh. In India, Rajasthan has the largest isabgol growing area of 81.5 thousand hectares

with production of 41.7 thousand tonnes (Anonymous, 2004-05). The average yield in the state is only 512 kg ha⁻¹. The reasons of low yield are lack of improved varieties, narrow genetic base of the crop, low response to inputs and susceptibility to diseases and pests. To increase the production it is necessary to develop suitable varieties with higher yield and consistent performance in different environments. Reports on this aspect are scanty in this crop (Lal *et al.*, 1999). Therefore, the present study was conducted to identify phenotypically stable and promising genotypes of isabgol for their further utilization in breeding programs.

Materials and Methods

In the present study 12 genotypes, (three released varieties, i.e. RI 89, GI 2 and HI 2, and nine promising lines developed through mutation breeding) were evaluated over four consecutive rabi seasons from 1998-99 to 2001-02 at Agricultural Research

Table 1. Pooled analysis of variance (mean squares) for different traits in *isabgol*

Source	df	Days to 50% flowering	Days to maturity	No. of spikes plant ⁻¹	Plant height	No. of tillers plant ⁻¹	Spike length	Seed yield
Genotypes (g)	11	5.49**	4.01**	33.26**	3.75**	0.57**	0.22**	64557.25**
Environments (e)	3	208.80**	145.28**	1192.41**	628.61**	3.71**	8.22**	724255.83**
g x e	33	1.71**	1.25**	15.47**	2.62**	0.20**	0.12**	9775.65**
e + (g x e)	36	18.96**##	13.25**##	113.55**##	54.79**##	0.48**##	0.79**##	69315.67**##
Environ. (linear)	1	626.41##	435.84##	3577.25##	1885.83##	11.14##	24.67##	2172767.50##
g x e (linear)	11	1.28	1.58	8.48	1.22	0.19	0.21#	9328.99
Pooled deviation	24	1.76**	0.99**	17.39**	3.05**	0.18**	0.07	9165.73**
Pooled error	88	0.15	0.20	2.93	0.89	0.08	0.05	3775.99

*, ** Significant against pooled error at P = 0.05 and P = 0.01, respectively and

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Station, Mandor, Jodhpur, following a Randomized Block Design with three replications. Each genotype had four rows of 4 m length at 30 cm row spacing and 10 cm plant-to-plant distance. Observations on days to 50% flowering, days to maturity and seed yield (kg ha⁻¹) were recorded on plot basis while number of spikes plant⁻¹, plant height (cm), number of tillers plant⁻¹, and spike length (cm) were recorded on ten randomly selected plants from each plot. Recommended cultural practices were followed to raise the crop. Stability analysis was carried out as per model given by Eberhart and Russell (1966).

Results and Discussion

Pooled analysis of variance for phenotypic stability (Table 1) showed highly significant differences among the genotypes and environments for all the characters, indicating the presence of variability among the genotypes and environments. The mean squares for genotype (g) x environment (e) interaction effect were highly significant for all the traits, indicating differential response of genotypes to changing

environments. These results are in accordance with the findings of earlier workers (Lal *et al.*, 1999). Partitioning of variance due to environment and g x e interaction into environment linear, g x e (linear) and g x e (non-linear) revealed that large part of g x e interaction was due to non-linear components for all the traits except spike length. The non-significant effects of g x e interaction (linear) for most of the traits against pooled deviation indicated that reliable predictions of g x e interaction for these characters could be difficult. For such unpredictable traits, predictions can be made on considering stability parameters of individual genotypes (Singh *et al.*, 1991). As per Eberhart and Russell (1966) a stable genotype is one that shows high mean, regression coefficient (b_i) near unity and non significant deviation from regression (s_{di}^2). Contrary to this, Jatsara and Paroda (1980) emphasized the use of deviation from regression alone as a measure of stability; whereas linear regression could be treated as varietal response. In the present study all the three parameters of stability (x_i , b_i and s_{di}^2) were

Table 2. Estimates of stability parameters for different traits in isabgol

Genotypes	Days to 50% flowering			Days to maturity			No. of spikes plant ⁻¹			Plant height (cm)		
	Mean (\bar{x})	b_i	s^2_{di}	Mean (\bar{x})	b_i	s^2_{di}	Mean (\bar{x})	b_i	s^2_{di}	Mean (\bar{x})	b_i	s^2_{di}
RI 9701	71.58	0.82	0.22	118.40	1.31	0.80**	31.88	0.80	7.93*	35.62	1.00	3.70*
RI 9703	70.25	0.86	2.89**	118.20	1.00	1.00**	29.35	1.02	-0.46	33.84	0.95	0.04
RI 9705	70.50	0.99	0.67**	118.00	0.94	1.20**	28.37	0.86	-2.97	34.58	1.01	0.32
RI 9709	71.58	0.84	0.53*	118.90	1.16	0.30	34.08	1.21	39.35**	35.57	1.12	-0.49
RI 9804	70.66	0.76	0.86**	118.30	0.97	0.10	31.05	0.89	-2.24	35.91	1.05	4.46**
RI 9808	69.08	0.96	0.15	118.70	0.91	0.70*	38.26	1.19	46.79**	37.33	1.00	1.68
RI 9809	70.25	1.23	4.03**	117.90	0.62*	1.00**	31.90	0.97	13.32*	33.62	1.02	3.45*
RI 9812	71.91	1.04	0.50*	119.60	1.00	0.00	29.15	1.16	43.82**	35.64	1.06	6.02**
RI 9813	67.66	1.10	1.71**	115.50	0.67	2.40**	31.66	1.27	10.73*	35.41	1.02	2.43*
RI 89	70.50	1.19	0.96**	118.80	1.02	0.20	31.70	0.81	11.22*	34.97	1.06	1.48
GI 2	70.50	1.03	0.86**	118.60	1.09	0.50*	29.50	0.96	1.02	35.28	0.91	0.45
HI 2	71.25	1.16	5.76**	119.00	1.29	1.10**	27.55	0.84	-3.22	35.22	0.98	0.28
GM	70.48	1.00		118.30	1.00		31.20	1.00		35.25	1.00	
SEm±	0.76	0.18		0.60	0.20		2.41	0.24		1.01	0.14	

Table 2 contd.

Genotypes	No. of tillers plant ⁻¹			Spike length (cm)			Seed yield (kg ha ⁻¹)		
	Mean (\bar{x})	b _i	s ² _{di}	Mean (\bar{x})	b _i	s ² _{di}	Mean (\bar{x})	b _i	s ² _{di}
RI 9701	5.75	0.97	0.13	4.69	1.13	0.02	1651.10	0.80	1065
RI 9703	5.28	1.44	0.06	3.93	0.93	-0.02	1468.90	1.03	-298
RI 9705	5.56	0.89	-0.07	4.31	1.03	0.00	1432.80	0.62*	3651
RI 9709	5.85	0.65	0.06	4.59	0.73	-0.04	1712.10	1.00	5192
RI 9804	5.02	1.11	0.14	4.74	1.38*	-0.03	1480.70	0.83	8279
RI 9808	6.18	0.02*	0.13	4.73	0.61*	0.06	1805.30	1.23	8065
RI 9809	5.33	0.91	0.23*	4.30	0.57*	0.05	1376.00	1.09	16492**
RI 9812	5.02	1.79	-0.04	4.33	0.96	-0.05	1501.70	1.43*	11603*
RI 9813	4.96	1.44	0.26	4.31	0.91	0.04	1449.00	1.17	13370*
RI 89	5.35	0.67	0.16	4.61	1.71*	0.13*	1579.70	0.88	-3699
GI 2	5.51	1.08	-0.07	4.35	0.85	0.01	1544.70	0.78	-541
HI 2	5.10	1.01	0.01	4.39	1.17	-0.04	1456.80	1.12	674
GM	5.41	1.00		4.44	1.00		1538.20	1.00	
SEm±	0.25	0.44		0.15	0.18		55.30	0.20	

* Significant at P = 0.05, ** Significant at P = 0.01

considered simultaneously for individual genotype.

Considering the mean seed yield of the genotypes over the environments, five genotypes i.e., RI 9808, RI 9709, RI 9701, RI 89 and GI 2, in order of merit, recorded higher seed yield. These genotypes had non-significant deviation from regression (s^2_{di}) with average response ($b_i \approx 1$) to the changing environment (Table 2) and hence were considered as stable and adapted to all the four types of environment. In addition to seed yield these genotypes also exhibited adaptability and stability for three to five other yield attributing agronomic traits i.e., number of tillers plant⁻¹, spike length, plant height, days to flowering and days to maturity.

Estimates of stability parameters for other agronomical traits revealed that three genotypes (RI 9709, RI 9808, and GI 2) for plant height, four genotypes (RI 9701, RI 9705, RI 9709 and GI 2) for number of tillers plant⁻¹, two genotype (RI 9701 and RI 9709) for spike length had above mean performance (\bar{x}), regression coefficient near unity (b_i) and least deviation from regression (s^2_{di}) indicating their suitability in breeding program for stabilizing these three important traits. Genotype RI 9808 for days to 50% flowering and RI 9804 for maturity exhibited lower mean compared to grand mean with average

responsiveness ($b_i \approx 1$) and non-significant s^2_{di} values suggest their utility as good donor parent for stabilizing these two important traits. Improvement of seed yield *per se* is not easy, as it is a complex trait and is greatly amenable to environmental influences. These findings suggest that selection for higher and stable seed yield is possible using number of spikes plant⁻¹ as selection criteria.

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