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Estimation of Ranking in Isabgol (*Plantago ovata* Frosk.) Genotypes over Diverse Environmental Conditions in Humid and Sub-humid Southern Plains of Rajasthan (India)

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ABSTRACT

Genotype x environment interaction was carried out with 18 genotypes of isabgol in a Completely Randomized Block Design with 3 replications over 3 different environments in Rajasthan during *Rabi* 2020 to identify stable genotypes for grain yield and contributing traits of genotypes in different environments. According to the Eberhart and Russell model for stability analysis, the mean squares due to genotypes or treatments were significant for all traits in the analysis of variance of phenotypic stability. The genotype UI-1 and HI-8 was superior in *per se* performance, a regression coefficient around one and non-significant deviation from regression. Stability under unfavorable environment for seed yield, while UI-2 exhibited its suitability under favorable environments for most of the characters. Besides this, some genotypes *viz.,* UI-11 and HI-8 for days to 50 per cent flowering, UI-3 for number of branches per plant and UI-2 for spike length were observed having regression coefficient around unity so these parents may be utilized in variable environmental conditions. These Genotypes were proven to be appropriate under diverse agro-climatic situations.

Key words*: Plantago, G x E Interaction, Stability, Regression coefficient*

Introduction

Isabgol (*Plantago ovata*) is a medicinal plant which is prescribed as a drug for certain ailments in Unani and Ayurvedic system of medicine. The thin, rosy-white, light membranous covering on the seed, called as the husk, is of enormous economic and medical value. Isabgol used as laxative, emollient and demulcent (Rohilla *et al*., 2012). The genus Plantago, from which the plant we often call "blond psyllium," belongs to the plantaginaceae family, and largely cross-pollinated annual herb (Kaswan *et al*., 2013). The flowers are bisexual, tetramerous, animophilous and protogynous in nature and such favours out crossing. It is a very good dietary fiber, which stimulates peristalsis and helps in bowel clearance. The husk, which is about 25 to 30% of the seed, has the property of absorbing and retaining water and hence, it works as an anti-diarrheal drug. The relative performance of genotypes for quantitative characteristics changes by environment, and the interaction of genotypes with environments have significant impact on yield improvement. As a result, significant testing is necessary to choose genotypes with the least genotype and environment interactions and hence behave consistently in different environmental conditions.

Materials and Methods

For the current study, eighteen genotypes of isabgol were collected from the All India Coordinated Research Project on Medicinal and Aromatic Plants, Department of Genetics and Plant Breeding, RCA, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan). The eighteen genotypes *viz*., UI-1, UI-2, UI-6, UI-7, UI-10, UI-11, UI-16, UI-25, UI-29, UI-62, UI-62, UI-121, UI-130, HI-1, HI-8, HI-9, UI-2-1, UI-3 and UI-124 were used for the study. These genotypes were evaluated during *Rabi* 2020 in RBD with three replications at Instructional Farm, RCA, Udaipur (E1), KVK- Badgaon and KVK- Banswara (E3).

Separately environment wise analysis of variance for each character and each genotype was subjected to pooled analysis of variance (Singh, 1985). The data collected from these separate sites was submitted to a stability analysis using Eberhart and Russell's model (1966). Its simply based on regression. The basic model employed is as follows: $Y_{ij} = \beta_{0i} + \beta_i I_j + \delta_{ij}$ where Y_{ij} is repercussion of i^{th} of variety in j^{th} locations, β_{0i} is respond of genotype i, β_i is regression coefficient of i^{th} variety to varying environments indices. Ij is the coded environmental index; δ_{ij} is the regression deviation and three additional parameters were calculated namely mean (μ_i), regression coefficient (b_i) and non-significant variation (S^2d_i) from regression line.

Results

According to Eberhart and Russell (1966), the bi or regression coefficient is the measure of responsiveness of genotype, whereas deviation from regression (S^2d_i) is the measure of stability of the genotype. The regression coefficient of 1.0 indicates average stability and general adaptation. Regression coefficient above 1.0 describes genotypes with increasing sensitivity to environmental changes. Regression coefficients below 1.0 provide a measure of greater resistance to environmental changes.

The pooled ANOVA revealed that highly significant mean squares for all the traits due to environments affirmed that they differed in agro-climatic conditions and played a dominant role in character expression under investigation. The MSS due to [E+ (G x E)] was found to be highly significant for all traits. The MSS due to the second component (G x E linear component) was also found to be significant for most of the traits except for number of florets

Table 1. Mean values and stability parameters (b_i and S^2d_i) of the isabgol genotypes for various traits

Genotypes	No. of branches per plant			Number of effective spikes per plant			Number of florets per spike		
	Mean	b_i	S^2 di	Mean	b_i	S^2 di	Mean	b_i	S^2 di
UI-2-1	5.38	0.42	-0.04	23.50	0.40	-1.11	48.11	1.09	-5.86
UI-3	5.36	0.99	-0.03	27.16	1.74	0.25	49.20	1.59	-4.67
UI-124	4.57	0.53	-0.04	24.26	0.62	-1.07	48.49	0.62	-5.59
UI-1	3.78	0.64	-0.04	21.49	1.86	0.83	53.81	1.27	-5.86
UI-2	4.94	1.05	-0.04	23.54	1.16	-0.30	48.84	0.54	-3.21
UI-6	4.36	0.42	-0.04	22.46	0.58	-0.98	46.20	0.60	-5.83
UI-7	5.64	-0.13	0.08	26.64	0.66	-0.68	56.34	0.69	-5.75
UI-10	4.01	0.53	-0.04	29.98	1.50	-0.21	45.31	0.62	-5.85
UI-11	4.21	1.00	-0.04	23.56	-0.34	-0.83	49.53	1.26	-5.62
UI-16	5.49	-0.00	-0.04	29.60	0.02	1.43	46.96	1.09	-5.64
UI-25	4.48	0.37	-0.04	21.40	1.10	-0.19	48.43	1.16	-5.00
UI-29	4.01	1.14	0.04	20.32	-0.50	-1.11	59.86	1.57	-5.75
UI-62	4.79	1.63	-0.03	26.98	0.03	-0.99	58.52	1.05	-3.83
UI-121	4.68	0.42	-0.04	22.68	0.72	-0.73	49.48	1.11	-5.44
UI-130	6.21	0.63	-0.04	29.99	0.69	-0.88	51.29	1.20	-3.97
HI-1	6.79	0.63	-0.04	28.19	0.24	0.12	48.34	2.01	-3.35
HI-8	5.18	1.18	-0.00	25.14	0.12	-0.27	60.56	1.15	-5.84
HI-9	4.99	1.23	0.00	24.38	0.03	-1.08	49.04	1.29	-5.42
Pop. mean	4.94	1	25.07	1	51.02	1			

*, ** = Significant at 5% and 1% levels, respectively

and seed yield per plant under study. The predictable response across the environments was evident in 15 genotypes out of 18 genotypes, as they showed non-significant deviations from regression for seed yield per plant. Among them UI-121, UI-130 and HI-8 have higher population mean along with regression coefficient (bi=1) close to unity, it indicates that absolute stable for grain yield per plant and suitable for cultivation in different kind of environments. Genotypes UI-2, UI-7, UI-29 and UI-62 found better for low yielding environments as they possessed non-significant deviations from regression (b_i<1) with mean higher than the overall mean. Genotype UI-25 showed poor stability and poor adapted to all environments for seed yield per plant. The only 2 genotypes, HI-8 and UI-11 were found to express non-significant deviations, bi values close (1.07 and 0.92) to unity and a mean (60.00 and 59.33) lower than the grand mean for days to 50 per cent flowering (60.84), indicating their average sensitivity to changing environments. For quality traits, genotype UI- 11 (1.13) and UI-62 (0.98) characterized stable as they divulged non-significant deviations from regression values (bi=1) with mean greater than grand mean for hush per cent. Genotype UI-2-1 and UI-2 had shown absolutely stable for crude fiber and suitable for cultivation in different environments. None of the genotype showed higher mean value with the regression coefficient equivalent to unity for swelling factor. For yield contributing traits, the genotype UI-3, UI-2 and HI-8 for number of branches per plant, UI-124 and UI-6 for spike length, UI-62 and HI-8 for no. of florets per plant and none of the genotype for effective spikes per plant shown higher mean value then the population mean and non-significant deviation from regression along with the regression coefficient equivalent to unity (bi=1) indicating that these genotypes are absolutely stable in different environments.

Discussion

The mean squares due to genotypes or treatments were significant for all traits in the analysis of variance of phenotypic stability. The environment + (genotypes x environments) were reported significant for all the characters under study, indicating significant genotype-environment interactions. All of the traits had significant mean squares due to linear components, *i.e.*, G x E (linear) interactions except number of florets per spike and seed yield per plant. Sharma (2013) found significant G x E interactions in isabgol. The environment linear component of genotype x environment interaction (G x E) was

Table 3. Mean values and stability parameters (b_i and S^2_{di}) of the isabgol genotypes for various traits

Genotypes	Seed yield per plant			Husk yield per plant		
	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
UI-2-1	3.37	2.00	-0.05	0.89	0.32	-0.00
UI-3	3.60	0.88	0.02	1.32	1.89	0.01
UI-124	3.89	0.58	0.06	1.01	1.82	0.01*
UI-1	5.10	0.88	-0.05	0.82	1.28	-0.00
UI-2	4.47	0.21	-0.06	0.85	0.08	-0.00
UI-6	4.37	0.81	0.30*	0.93	1.44	-0.00
UI-7	5.23	0.35	-0.07	1.33	-0.03	-0.00
UI-10	3.70	0.53	0.04	1.03	0.27	-0.00
UI-11	4.21	-0.60	-0.04	1.16	0.67	0.01*
UI-16	3.62	1.43	0.47**	1.23	1.40	-0.00
UI-25	3.75	1.54	-0.05	0.84	0.20	-0.00
UI-29	6.23	0.11	-0.06	1.12	0.48	-0.00
UI-62	5.15	0.57	-0.05	0.88	1.22	0.04**
UI-121	4.05	1.02	-0.07	0.88	0.83	-0.00
UI-130	3.93	1.06	-0.05	1.68	0.33	-0.00
HI-1	3.71	0.72	0.16	1.41	0.89	-0.00
HI-8	5.42	0.98	-0.00	0.96	1.88	-0.00
HI-9	4.36	0.66	0.95**	0.95	1.66	-0.00
Pop. Mean	4.34	1		1.07	1	

*, ** = Significant at 5% and 1% levels, respectively

found significant for all the traits under study which further confirms that environments under study differs.

The analysis of these genotypes for phenotypic stability shown that the genotype $L_{11,}$ L_{12} and L_{14} was identified as superior for seed yield per plant and have greater adaptability to diverse environmental condition. The genotype UI-2, UI-7, UI-29 and UI-62 shown the higher mean values then the along with the regression coefficient less then unity (b_i<1) exhibiting their stable performance in unfavourable environments for seed yield per plant. Genotype UI-25 showed poor stability and poor adapted (b_iˆ1) to all environments for seed yield per plant. Similar rustles were reported by Sharma (2013), Mishra *et al*. (2014). Among the genotypes, HI-8 and UI-11 for days to 50 per cent flowering found absolutely stable over different environments. For yield related traits, genotype UI-3, UI-2 and HI-8 for number of branches per plant, UI-124 and UI-6 for spike length, UI-62 and HI-8 for no. of florets per spike were found absolutely stable in different environments. Similar findings were reported by Beniwal *et al*. (2007), Sharma (2013), Lal, (2015). The genotypes found stable over the different environments for grain yield and yield related traits should be subjected to multi-location trials, before its release for commercial cultivation.

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