



Comparison of Different Stability Parameters in Soybean [*Glycine max* (L.) Merrill]

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ABSTRACT

The Study of different stability parameters involving twelve soybean genotypes in three environments indicated that stability parameters like Wricke's (1962) ecovalence, mean variance due to genotype-environment interaction of Plaisted and Peterson (1959) and variance of ranks over environments gave similar results to that of the deviation from regression ($S^2_{d_i}$) of Eberhart and Russell (1966) and Shukla's stability variance whose calculation is cumbersome. All these methods indicated more stable genotypes, JS 93-05, RKS 18 and JS 95-60 for number of pods per plant, MRSB 345, JS 335 and LSb 36 for protein content, LSb 1, LSb 13 and LSb 36 for oil content and JS 93-05, JS 95-60 and RKS 18 for seed yield per plant over environments.

Key words : Soybean, Stability

Soybean is an important pulse and oilseed crop, which accounts for approximately 50% of total product of oil seed crops in the world. Varieties are known to differ generally for their stability across environments. Knowledge on the genotype-environment interactions is the basic requirement to a plant breeder for successful crop improvement (Lewis, 1954). Identification of widely adapted genotypes to be used as parents in the hybridization programme is an integral programme aiming to evolve high yielding and stable genotypes and ultimately to stabilize the crop production. The present study was undertaken employing different models to estimate stability of yield and its components in elite soybean genotypes.

MATERIAL AND METHODS

Twelve genotypes of soybean were grown on three sowing dates *i.e.*, 30-07-2006, 17-11-2006 and 2-12-2006 during *kharif*, *rabi* and late *rabi* at Regional Agricultural Research Station, Lam, Guntur in Andhra Pradesh to assess the stability of the twelve genotypes of soybean over three environments. Each genotype was replicated thrice in all the three environments by adopting inter- and intra-row spacing of 30 × 7.5 cm. Data were recorded on ten randomly selected plants from each genotype in each replication on plant height (cm), number of branches per plant, number of pods per plant, pod length (cm), number of seeds per pod, biological yield per plant (g), seed yield per plant (g). Days to 50% flowering, days to maturity, protein content (%), oil content (%) and harvest index (%) were recorded on plot basis. The data were subjected to stability analysis as per procedure outlined by Eberhart and

Russell (1966), stability factor (Lewis, 1954), ecovalence (Wricke, 1962) method, pair-wise analysis (Plaisted and Peterson, 1959), genotypic stability (Hanson, 1970), stability variance (Shukla, 1972), mean, variance of each genotype over environments, mean of ranks of each genotype over environments and variance of ranks of each genotype over environments. Rank correlation (Spearman, 1904) was used to compare the stability parameters.

RESULTS AND DISCUSSION

A comparison of different stability parameters was made based on rank correlation coefficients between pairs of these parameters (Table 1) and by empirically comparing the stable (or) desirable genotypes under each of these parameters (Table 2).

In the present study, the mean and mean of ranks were significantly and positively correlated for all the characters considered in the study as they are similar calculations and have same criteria for defining a stable genotype. The genotypes classified as more or less stable are the same in both these cases. Mean did not show positive association with all other stability parameters except mean of ranks. Huhn and Leon (1985) reported numerically low (or) intermediate rank correlation coefficients between mean of the lines and different stability parameters like variance, ecovalence, genotypic stability, regression coefficient, sum of squared deviations from the regression and mean rank difference.

The variance over environments showed close positive association with stability factor and Hanson's (D^2) genotypic stability for all the characters studied. This was confirmed by almost

Table 1: Rank correlation between paires of different stability parameteras in soybean
[*Glycine max* (L.) Merrill]

Stability parameters	Characters	Variance	Mean of ranks	Variance of rank	Stability factor	Mean variance due to g'e(+)	Ecov- lence	S ² di	Bi	Hanson's genotypic stability	Shukla's Vari- ance
Mean	No.of pods per plant	-0.81*	0.96**	0.15	-0.27	0.04	-0.16	-0.38	-0.80**	-0.79**	-0.16
	Protein content	0.54	0.97**	-0.23	0.56	0.27	-0.09	0.04	0.62*	0.5	-0.09
	Oil content	-0.08	0.97**	-0.21	-0.00	-0.11	-0.06	0.29	0.16	0.14	-0.06
	Seed yield per plant	-0.90*	0.98**	0.18	-0.35	-0.22	-0.08	-0.29	-0.86**	-0.85**	-0.08
Variance	No.of pods per plant		-0.76**	-0.13	0.48	0.06	0.20	0.42	0.88**	0.97**	0.20
	Protein content		0.50	0.08	0.09	-0.00	0.24	0.36	0.83**	0.94**	0.24
	Oil content		-0.08	0.46	0.97**	-0.37	0.91**	0.78**	0.48*	0.80*	0.91**
	Seed yield per plant		0.86**	0.04	0.55	0.41	0.23	0.42	0.86**	0.90**	0.23
Mean of ranks	No.of pods per plant			0.12	-0.12	-0.02	-0.24	-0.39	-0.75	-0.74	-0.24
	Protein content			-0.33	0.52	0.42	-0.18	-0.01	0.58*	0.46	-0.18
	Oil content			-0.21	0.00	-0.15	-0.02	0.33	0.03	0.06	-0.02
	Seed yield per plant			0.23	-0.34	-0.18	-0.05	-0.24	-0.86**	-0.84**	-0.50
Variance of rank	No.of pods per plant				0.22	0.87**	0.81**	0.06	-0.48	-0.03	0.81**
	Protein content				0.06	-0.33	0.59	0.28	-0.18	0.22	0.59**
	Oil content				0.44	0.33	0.52	0.45	0.05	0.29	0.52
	Seed yield per plant				0.35	0.64*	0.73**	0.80**	-0.36	0.19	0.73**
Stability factor	No.of pods per plant					0.25	0.21	0.47	0.28	0.56	0.21
	Protein content					-0.00	0.22	0.34	0.85*	0.93*	0.22
	Oil content					-0.43	0.88**	0.80**	0.51	0.81**	0.88**
Mean variance due to g'e(+)	Seed yield per plant					0.55	0.39	0.53	0.39	0.62*	0.94**
	No.of pods per plant						0.95**	0.81**	-0.32	0.18	0.95**
	Protein content						-0.48	-0.34	0.11	-0.16	0.48
	Oil content						-0.41	-0.45	-0.06	-0.21	-0.41
Ecovlence	Seed yield per plant						0.94**	0.83**	0.02	0.63*	0.94**
	No.of pods per plant							0.86**	-0.15	0.32	1.00**
	Protein content							0.65*	-0.18	0.48	1.00**
	Oil content							0.85**	0.16	0.54	1.00**
S ² di	Seed yield per plant							0.81**	-0.16	0.48	1.00**
	No.of pods per plant								0.08	0.55	0.86**
	Protein content								-0.07	0.56	0.65**
	Oil content								0.20	0.55	0.52**
bi	Seed yield per plant								0.02	0.62	0.81**
	No.of pods per plant									0.80**	-0.51
	Protein content									0.67*	-0.18
	Oil content									0.89**	0.16
Hanson's genotypic stability	Seed yield per plant									0.72**	-0.16
	No.of pods per plant										0.32
	Protein content										0.48
	Oil content										0.54
	Seed yield per plant										0.48

* = Significant 5% probability level ** = Significant 1% probability level

(+) = Mean variance due to Gx E(according to Plasted and Peterson, 1959)

similarity of spotting the more and less stable genotypes by these parameters. For example for 100 seed weight genotypes 11, 5 and 2 were ranked as highly stable and genotypes 4, 1 and 9 ranked as less stable according to these two parameters. Variance positively associated with regression coefficient and Hanson's (D^2_i) genotypic stability for all characters and with stability factor for protein content and oil content. It showed significant positive association with ecovlence and S^2d_i for oil content

and with mean of ranks for seed yield per plant. Mean of ranks showed positive association with regression coefficient for protein content.

Variance of ranks and mean variance due to genotype-environment interaction (Plasted and Peterson, 1959) were positively associated for number of pods per plant and seed yield per plant. Variance of ranks also positively associated with ecovlence for number of pods per plant. It also positively associated with deviation from regression

Table 2. More and less stable genotypes according to different stability parameters of soybean [*Glycine max* (L.) Merrill]

Character	Mean		Variance		Mean of ranks		Variance of ranks		Stability factor		Mean variance due to GxE(+)		Ecovalence		S ² di		bi		Hanson's genotypic stability		Shukla's variance		
	MS	LS	MS	LS	MS	LS	MS	LS	MS	LS	MS	LS	MS	LS	MS	LS	MS	LS	MS	LS	MS	LS	
Days to 50% flowering	11,6,9	7,1,12	1,7,12	11,6,9	11,9,6,7,12,1	12,7,3	9,11,10	1,7,12	11,6,9	1,7,12	11,6,9	3,2,4	11,1,6	2,3,4	11,1,6	2,1,12	9,6,10	1,7,12	11,6,9	1,7,12	11,6,9	2,3,4	11,16
Days to maturity	4,9,11	1,12,7	10,7,12	6,11,3	4,9,11	1,11,7	1,9,7	6,11,10	10,7,4	8,11,3	8,2,12	1,6,11	2,12,8	1,6,11	11,10,12	1,5,6	1,10,7	6,11,3	1,10,7	6,11,3	2,12,8	1,6,11	
Plant height(cm)	8,5,4	7,11,3	11,1,9	8,4,12	5,8,4	7,3,9	7,2,4	1,3,11	11,5,1	8,4,12	7,2,3	8,4,1	2,7,3	1,4,1	11,2,3	8,1,10	11,1,9	8,4,12	11,5,6	8,4,12	2,7,9	8,4,3	
No.of branches per plant	8,5,3	1,6,7	5,1,11	4,8,2	3,8,10	6,1,7	9,12,6	5,4,3	5,1,11	4,2,8	10,12,6	4,8,5	12,10,9	4,8,5	9,12,6	8,7,3	5,1,11	4,2,8	5,1,11	4,8,2	12,10,9	4,8,5	
No.of pods per plant	10,2,3	1,7,3	1,3,7	6,10,2	10,2,6	7,3,1	12,2,7	4,12,11	1,3,12	4,8,6	12,9,7	4,1,6	7,12,9	4,1,6	9,7,12	4,6,10	1,3,4	6,2,10	1,3,7	6,10,2	7,12,9	4,1,6	
Pod length(cm)	12,10,1	6,8,5	6,11,1	5,9,7	12,10,1	1,8,5	6,3,12	2,9,11	11,6,1	9,7,8	12,3,5	8,7,9	3,5,4	9,2,1	3,5,6	2,8,4	1,6,11	9,7,10	12,11,1	9,7,8	3,5,4	9,2,3	
No.of seeds per pod	10,12,2	6,11,5	10,2,1	3,9,6	10,12,4	6,11,8	6,10,12	9,5,4	2,10,12	9,6,7	7,12,10	9,3,6	2,10,12	9,6,3	8,12,2	9,3,6	8,6,4	1,7,12	8,10,4	7,11,9	2,10,12	9,8,3	
100 seed weight(g)	11,7,10	2,4,1	11,5,2	4,1,9	11,7,10	2,4,3	2,10,11	9,8,1	11,5,2	4,1,9	3,12,11	9,4,1	11,5,10	9,1,4	11,10,5	1,4,8	9,7,2	4,3,6	9,7,2	4,3,6	11,5,10	9,1,4	
Protein content(%)	2,12,10	9,8,6	12,2,10	5,8,9	2,12,4	9,8,6	5,4,6	9,8,2	12,2,7	5,8,9	4,2,8	9,3,11	3,11,7	3,11,6	12,3,11	4,10,6	12,6,2	5,8,9	12,7,2	5,8,4	3,11,7	5,6,10	
Oil content(%)	11,6,9	1,8,5	2,4,7	3,1,10	6,12,2	1,8,7	1,4,2	3,10,5	3,10,1	3,1,10	1,3,8	7,10,12	4,2,12	3,1,9	2,6,4	3,1,10	11,7,9	6,3,12	2,7,11	3,6,1	4,2,12	3,1,9	
Biological yield per plant(g)	10,2,6	1,4,7	1,3,10	1,3,10	10,2,8	1,5,4	1,10,12	4,6,11	4,6,11	6,8,7	12,10,9	6,4,3	12,10,9	6,3,11	12,9,1	11,4,5	3,1,11	6,9,7	1,3,9	6,8,9	12,10,9	1,3,11	
Harvest index(%)	12,6,11	3,5,8	6,9,7	8,10,4	2,6,11	3,5,8	3,5,7	8,11,4	8,11,4	8,10,4	7,5,3	8,6,9	7,5,12	8,6,9	7,5,10	8,4,11	9,12	10,2,8	6,9,7	8,10,4	7,5,12	8,6,9	
Seed yield per plant(g)	10,2,6	1,3,5	1,3,5	6,10,2	10,2,6	3,1,5	12,2,7	11,4,8	8,4,7	8,4,7	12,7,9	4,6,8	7,12,5	4,6,11	7,12,3	4,11,8	1,3,4	6,10,2	3,1,5	6,10,2	7,12,5	4,6,11	

(+) = Mean variance due to genotype x environment (Plaisted and Peterson, 1959) MS= More stable genotypes, LS=Less stable genotypes

1 = LSb 1 3 = LSb 13 5 = LSb 21 7 = JS 95-60 9 = RKS 18 11 = PK 1029
 2 = JS 335 4 = MRSB 345 6 = LSb 3 8 = LSb 36 10 = LSb 23 12 = JS 93-05

(S^2d) for number of pods per plant and seed yield per plant. Variance of ranks was positively associated with Shukla's (s^2_i) stability variance for all the characters except oil content.

Stability factor had positive association with ecovalence for oil content. It also showed positive association with deviation from regression for oil content. Stability factor was positively associated with Hanson (D^2_i) genotypic stability for all characters except number of pods per plant and Shukla's (s^2_i) stability variance for oil content.

Mean variance due to genotype-environment interaction had positive association with ecovalence and deviation from regression for number of pods per plant and seed yield per plant. It also positively associated with Shukla's (s^2_i) stability variance for number of pods per plant and seed yield per plant and Hanson's (D^2_i) genotypic stability for number of pods per plant. Ecovalence showed positive association with deviation from regression, Shukla's (s^2_i) stability variance for all characters.

Deviation from regression showed positive association with Shukla's (s^2_i) stability variance for all the four characters. Regression coefficients had positive association with Hanson's (D^2_i) genotypic stability for all characters under study. No relationship existed between X and b , X and S^2d , b and S^2d which are components of Eberhart and Russell (1966) model, in accordance with Yadav and Kumar (1983) in black gram.

LITERATURE CITED

- Eberhart S A and Russell W A 1966.** Stability parameters for comparing crop varieties. *Crop Science* 6 : 36- 40.
- Hanson W D 1970.** Genotypic stability. *Theoretical and Applied Genetics* 40: 226-231.
- Huhn M and Leon J 1985.** Genotype x environment interactions and phenotypic stability of *Brassica napus*. *ZpfilanZenZuchtg* 95: 135-146.
- Lewis D 1954.** Genotype-environment interaction. A relationship between dominance, heterosis, phenotypic stability and variability. *Heredity* 8 : 333 – 356.
- Plaisted R L and Peterson L C 1959.** A technique of evaluating the ability of selections to yield consistency in different seasons or locations. *American Potato Journal* 36 : 381 – 385.
- Shukla G K 1972.** Some statistical aspect of partitioning GE components of variability. *Heredity* 29: 237-245.
- Spearman C 1904.** Rank correlations. In *Statistical Methods* by Snedecor G W (1946). Iowa State College Press, Ames, Iowa, U.S.A
- Wricke O 1962.** Uber eine Method Zur Effassung derkologiechen strenb reite in Feidversuchen *ZpflanzZuchtg* 47 : 144 – 145.
- Yadav I S and Kumar D 1983.** Association between stability parameters of productive traits in blackgram. *Madras Agricultural Journal* (4) : 331-333.

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