

Stability analysis of lentil varieties under rainfed ecosystem

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ABSTRACT

Thirteen varieties of lentil were evaluated for stability of grain yield and its component traits under rainfed conditions. Significant genotype x environment (GE) interactions were observed. The linear component of GE interaction was significant for number of branches/plant, number of pods/plant and 100-seed weight, whereas non-linear component was significant for all the characters except number of branches/plant. Of the 13 varieties, JL 3 had given the highest yield followed by PL 639, DPL 62, HPL5 and PL 4 over the years. These genotypes have, thus, wider stability for grain yield over the years.

Keywords: Lentil, *Lens culinaris*, Rainfed ecosystem, Stability

Lentil (*Lens culinaris* Medik) is an important pulse crop under rainfed conditions. It is grown in diverse agro-ecological situations from hills to plains and even under poor management. Its productivity is very low and unstable because of its cultivation under moisture stress and low fertility conditions. Genotype-environmental (GE) interaction parameters have been useful in measuring stability of varieties over the years. It is, therefore, essential to breed high yielding varieties which may perform consistently well over years under different farming conditions. In the present investigation, an attempt was made to identify stable varieties of lentil for hybridization programme and also for commercial cultivation.

MATERIALS AND METHODS

Thirteen varieties of lentil were grown in a randomized complete block design with three replications during 1999-2000, 2000-01 and 2001-02 under rainfed conditions. Each variety was grown in a ten-row plot of 5-meter length with 22 cm row-to-row distance. Recommended agronomical practices

were followed. The data were recorded on ten random plants for yield contributing characters. The middle eight rows in each plot were utilized for grain yield. The stability analysis was done according to the model presented by Eberhart and Russell (2)

RESULTS AND DISCUSSION

Mean square value from the pooled analysis of variance are presented in Table 1. Highly significant variance due to varieties tested against pooled error and pooled deviation revealed the presence of genetic variability for all the characters under investigation. The component GE interaction plus environment was highly significant indicated that the varieties interacted considerably with environmental condition prevailing during different years. The significant variance due to environment (linear) indicated differences among environments at the same location and influenced the characters under investigation. The variance due to GE (linear) was highly significant for number of branches plant⁻¹ number of pods plant⁻¹ and 100-seed weight suggesting that a major portion of GE interaction was attributable to linear component in respect to these traits. Significant variance due to pooled deviation for all the characters, except number of branches/plant indicated that the genotypes differed considerably with respect to their stability. This also suggests that predication for these attributes would be difficult.

Mean performance and stability parameters for grain yield and its components are presented in Table 2. Variety JL 3 showed the highest grain yield (19.42 q⁻¹ ha) over years followed by PL 639, DPL 62, HPL 5 and PL 4, whereas Vipasha gave the lowest grain yield (8.05 q ha⁻¹). The magnitude of regression co-efficient and deviation from regression varied from variety to variety, indicating that varieties were responsive

Table 1. Pooled analysis of variance for yield and its components in lentil

Source	DF	Mean sum of square				
		Grain yield (q ha ⁻¹)	Plant height (cm)	No. of branches plant ⁻¹	No. of pods plant ⁻¹	100-seed weight (g)
Genotype	12	33.76**	13.89**	0.97**	400.22**	0.61**
Env + (G E)	26	30.13**	43.82**	1.51**	1054.42**	0.33**
Environment (linear)	1	531.47**	919.94**	23.13**	19195.47**	2.49**
G E (linear)	12	8.06	8.44	1.32**	541.01**	0.41**
Pooled deviation	13	11.92**	9.09**	0.02	132.87**	0.10**
Pooled error	78	5.00	3.4	0.27	57.21	0.03

** , * Significant at 1% and 5%

Table 2. Estimates of stability parameters for grain yield and its components in lentil

Genotype	Grain yield (q ha ⁻¹)			Plant height			No. of branches plant ⁻¹			No. of pods plant ⁻¹			100-seed weight (g)		
	\bar{X}	b_i	S^2d_z	\bar{X}	b_i	S^2d_z	\bar{X}	b_i	S^2d_i	\bar{X}	b_i	S^2d_i	\bar{X}	b_i	S^2d_i
PL 639	18.88	0.53	-2.44	40.27	1.67	1.81**	3.49	1.21	-0.24	85.76	1.57	-45.4	2.01	0.84	-0.01
JL 3	19.42	0.60	0.01	43.48	1.34	8.74	3.62	2.31	-0.30	79.38	0.59	299.39**	2.78	1.53	-0.01
HPL 5	17.73	0.75	-1.97	40.81	1.27	1.80	4.27	2.94**	-0.25	58.24	-0.01**	-57.21	2.47	0.21	0.75*
LL 147	13.40	1.28	12.33**	35.23	0.66	-3.43	3.42	1.5	-0.27	58.27	1.01	159.11**	1.82	2.63*	0.09**
PL 4	16.45	0.77	0.32	40.53	0.57	-1.22	3.11	0.81	-0.18	58.80	0.37*	-31.47	1.97	2.68*	0.03*
DPL 504	13.28	1.30	14.50**	40.01	0.88	2.47	3.18	1.25	-0.24	45.76	0.94	73.33*	1.64	2.05	-0.03
DPL 62	18.50	0.60	-1.53	38.76	1.03	-1.91	3.24	1.07	-0.26	69.54	1.61	-9.68	1.86	1.95	-0.03
K 75	13.48	1.81	4.84*	39.56	1.10	1.99	2.20	-0.25**	-0.23	53.71	0.89	-4.11	2.43	0.21	0.16**
LL 56	14.23	1.89	16.77**	42.01	1.27	-0.18	2.62	0.22**	-0.25	73.09	1.69*	53.89	2.77	-0.53*	-0.02
PL 406	13.06	0.95	-0.65	39.53	1.23	23.28**	3.07	0.43**	-0.22	73.47	2.15**	86.29**	1.87	2.32	-0.03
L 9-12	11.13	0.90	1.06	38.13	0.69	1.23	2.71	0.39	-0.25	61.80	0.78	384.00**	3.19	-2.21**	-0.01
JL 1	12.82	0.76	35.57**	40.47	0.61	26.56**	3.02	1.08	-0.27	64.27	0.90	172.48**	2.41	-0.37	-0.03
Vipasha	8.05	0.87	11.10	37.10	0.69	11.96	2.82	0.41**	-0.27	51.68	0.51	11.00	2.41	0.63	0.00
Mean	14.65	1.00	-	39.71	1.00	-	3.14	1.00	-	64.14	1.00	-	2.20	1.00	-
SEM ±	2.44	0.54	-	2.13	0.36	-	0.01	0.1	-	8.15	0.03	-	0.22	0.72	-

**,* Significant at 1 and 5% levels

to environmental variation in different years even at the same location. The simultaneous consideration of three parameters of stability (Table 2) for individual varieties showed that out of 13 varieties, two had regression coefficient near to one, four more than one and seven less than one, and could be categorized as average, above-average and below-average sensitive to environmental conditions. The high yielding varieties JL3, PL 639, DPL 62, HPL 5 and PL 4 had above average grain yield, regression coefficient less than one and deviation from regression around zero indicating not only wider stability but also suitability for grain yield over the years as suggested by Eberhart and Russell (2). The adverse condition under poor environment identified the high yielding lines suitable for poor environment as well as improved environments. This theory finds support from the findings of Borlaug (1) and Hurd (3) in wheat and St. Pierre *et al.* (7) in barley. Since cultivation of lentil is restricted to low fertility and rainfed condition, these varieties may be recommended for general cultivation.

The stability parameters in respect of four quantitative traits (Table 2) revealed that DPL 62 and PL 4 for plant height, PL 639, LL 147, PL 4, DPL 62, JL 1 and JL 3 for number of branches/plant, PL 4, DPL 62, HPL 5, LL 147 and JL 3 for number of pods/plant and PL 639, JL 3 and PDL 8 for 100-seed weight were stable having regression coefficient near unity and deviation from regression around zero. It is evident from the present findings that the high yielding varieties like JL 3, PL 639, DPL 62, HPL 5 and PL 4 which were responsive and

stable for yield were also found to be responsive and stable for their component traits. This has also been reported by Malhotra *et al.* (4) in lentil, Singh and Kandalkar (6) in cowpea and Mishra and Jain (5) in chickpea.

Hence, it is evident that many lentil varieties bred recently are not only high yielding but also responsive and stable. Varieties JL3, PL 639, DPL 62, HPL 5 and PL 4 have stability for grain yield and can be recommended for general cultivation over wide range of environmental conditions and can also be utilized in breeding programme to develop stable and high yielding varieties of lentil.

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