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Stability study for seed yield and yield attributes in linseed under rainfed condition.

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Abstract : Genotype x environment interaction was studied for seed yield and its component characters in 19 genotypes of linseed under five different environment from 1990-91 to 1994-95. Genotype (G) and environment (E) interaction were observed to be significant for all the characters. Most of the characters were influenced by non-linear components of GxE inteactions except days to 50 per cent flowering and number of capsules per plant where both linear and non-linear components were significant but magnitude of linear components were greater than non-linear. On the basis of stability of linear components characters the genotypes BAU 65-2, RLC 195-4 and BAU 286-5 were found to be most stable with high grain yield over different environment. (***Key words** :Stability, Linseed, Linum usitatissimum L., Rainfed.)*

Linseed (*Linum usitatissimum L.*) is an important oilseed crop grown in India. There are great fluctuations in its productivity together with low yield level in plateau region of Bihar. Hence identification of stable and high yielding varieties is very important for commercial cultivation as well as for breeding purpose. In present study an attempt has been made to isolate genotype with high seed yield adaptability and stability under rainder condition.

Materials and Methods

Nineteen promising genotypes of linseed were grown in randomised block design with three replications at Zonal Research Station, Darisai (Birsa Agricultural University, Ranchi) during winter seasons of 1990-91 to 1994-95 for five years under rainfed condition. Each plot consisted of 5 rows of 4m length and distance between rows and plants was maintained as 30 cm and 10 cm respectively. Five randomly selected competitive plants were utilized to record the data for seven quantitative characters *viz;* days to 50 per cent flowering, plant height, days to maturity, number of primary branches/plant, number of secondary branches/plant, number of capsules/ plant and seed yield/plant (g). Stability parameters were estimated as per Eberhart and Russel (1966).

Results and Discussion

The mean square due to genotypes and environment were significant for all the characters studied when tested against pooled error suggesting the presence of variation among genotypes as well as environments for all the characters (Table 1). The mean square due to GxE interactions were also highly significant for all the characters. It may therefore be inferred that the genotypes interacted considerably with the environment in the expression of the characters. The result confirms the findings of environment in the expression of the characters. The result confirms the findings of Haque *et al.*(1996), Mahto *et al.* (1995) and Mahto (1995). The partitioning of environment + genotype x environment interaction into different components revealed that the environment (linear) was significant for all the characters as expected, indicating that the response for environments was predicatable. Rao and Singh (1984) and Mahto *et al.* (1995) reported similar results in linseed. Genotype x environment (linear) interaction was significant only for days to 50 per cent flowering and number of capsules per plant. While the pooled deviation from regression were significant for all the characters. The parameters. The parameters S^2d_j may be comparatively more important for interpreting the stability status of all the characters.

The mean squares due to genotypes when tested against pooled deviation were significant for most of the characters except number of primary branches and number of capsules/plant. E + (GxE) was highly significant for all the characters except days to 50 per cent flowering where it was only significant. Highly significant pooled deviation indicating that genotypes differ considerably for its stability. The pooled analysis of variance (Table 1) revealed that both linear and non-linear components of GxE interaction were significant for days to 50 per cnet flowering and number of capsules per plant but the magnitude of linear components were higher than non-linear indicating that predication of performance for these two characters was possible in different environment. But for the other characters *viz.*, days to maturity, plant height, number of primary brånches/plant, number of secondary branches/plant and seed yield/plant non-linear component of GxE interaction were significant indicated thereby that the prediction of performance would be difficult over environments. Mahto (1995) reported similar types of result for days tomaturity and seed yield in linseed. The environment V (1994-95) was observed to be favourable for most of the

Table 1 Pooled analysis and variance for different characters in Linseed under rainfed condition

Sources of variation	d.f.	Mean Square: Days to 50% flowering	Plant height (cm)	Days to maturity	No. of primary branches / plant	No. of secondary branches / plant	No. of capsules / plant	Seed yield / plant (g)
Genotypes (G)	18	64.469**++	16.182**+	39.514**++	0.396*	7.214**+	83.634**	0.074**+
Environment (E)	4	54.305**++	1277.899**++	416.156**++	16.244**++	431.632**++	5544.766**++	2.955**++
G x E	72	4.688**	8.789**	3.724**	0.382**	3.213**	63.604**	0.039**
E+ G x E	76	7.299**++	75.584**++	25.431**++	1.216**++	25.761**++	352.087**++	0.193**++
E (Linear)	1	217.219**++	5111.594**++	1664.625**++	64.975**++	1726.527**++	22179.060**++	11.819**++
G x E (Linear)	18	7.796**	9.532	5.003	0.409	3.665	88.847*	0.019
Pooled Deviation	57	3.457**	8.092**	3.124**	0.353*	2.901*	52.285**	0.044**
Pooled error	190	0.808	4.376	0.411	0.223	1.732	25.587	0.010

*, ** Significant at 5% and 1% level, respectively (Pooled error).

+, ++ Significant at 5% and 1% level, respectively (Pooled deviation).

Table 2 Environment index for different charcters in linseed under rainfed condition.

Characters	1990-91	1991-92	1992-93	1993-94	1994-95
Days to 50% flowering	-1.793	1.733	-1.565	1.663	-0.030
Plant height (cm)	8.795	0.737	-12.602	-2.181	5.251
Days to maturity	-4.232	-0.407	-4.863	4.137	5.365
No. of primary branches/plant	0.730	-0.421	-0.937	-0.591	1.218
No.of secondary branches/plant	7.462	-2.236	-3.474	-3.755	2.003
No.of capsules/plant	13.824	-4.035	-17.067	-14.279	21.558
Grain yield/plant (g)	-0.039	0.219	-0.655	0.116	0.360

characters followed by environment I (1990-91) (Table 2).

All three parameters of stability the mean (x), regression coefficient (b_i) and deviation from regression (S^2d_i) for all the characters have been presented in Table 3. Out of nineteen genotypes only two BAU 3 and BAU 65-2 were found highly stable and adaptable over environments for days to 50 per cent flowering since their regression coefficient (b_i) were close to unity and deviation from regression (S^2d_i) was not significant. The mean were also below average which is desirable for earliness.

All genotypes, except LCK 8657, BAU 9, BAU 95-1 and RLC 33 were found to be stable for plant height as their regression were nearer to unity and deviation from regression were non-significant. Out of these stable genotypes T 397, BAU 135, BAU 150, RLRC 165, BAU 189-2 and Shubhra were found to be widely adaptable and highly stable for wide range of environment conditions, since these genotypes had low mean value (shorter height) and zero S^2d_i. For the character days to maturity. Out of nineteen genotypes, only two *viz;* BAU 3 and BAU 147 were found to be most stable since their mean were below average (Earlier), b_i nearer to unity and S^2d_i were non-significant.

Table 3. Estimates of stability parameters for seven characters in linseed under rainfed condition.

Sl. No.	Variety	Days to 50% flowering			Plant height (cm)			Days to maturity			Number of primary branches / plant		
		Mean	b_j	S^2d_j	Mean	b_j	S^2d_j	Mean	b_j	S^2d_j	Mean	b_j	S^2d_j
1	BAU 189-2	63.60	0.438	-0.591	50.64	0.793	-1.259	121.27	1.234	2.710**	4.23	0.759	-0.126
2	BAU 135	73.40	1.238	2.448**	46.95	0.993	-1.717	124.53	1.032	9.106**	4.19	0.778	0.590*
3	BAU 159-4	61.40	1.430	3.608**	51.32	0.911	2.457	119.87	0.994	3.056**	4.33	0.824	0.187
4	BAU 3	63.07	1.131	1.190	49.41	0.903	3.089	121.00	0 943	0.479	4.19	1.447	0.048
5	BAU 8	66.00	1.027	2.610**	48.03	1.016	0.744	124.53	0.707	1.291**	4.52	0.904	0.070
6	T 397	67.47	-0.511**	2.495**	47.97	0.993	-3.852	120.93	0.954	0.709*	4.24	1.294	-0.202
7	BAU 195-4	64.13	0.874	3.982**	48.85	0.900	3.907	123.73	0.684	5.625**	4.21	0.884	0.246
8	BAU 65-2	71.27	1.404	0.183	50.32	1.312	9.418	123.93	1.321	2.959**	4.27	1.045	0.306
9	LCK 8657	63.87	1.315	8.663**	48.55	0.867	15.774*	121.47	1.032	4.458**	4.08	1.172	-0.173
10	BAU 147	65.00	2.315*	5.608**	51.16	1.399*	2.519**	120.53	1.252	0.449	4.60	1.461	-0.172
11	BAU9	68.00	-0.073	3.097**	47.32	0.925	9.453*	122.53	1.025	1.070*	4.16	0.616	0.056
12	BAU 160	68.40	-0.449	3.520**	48.45	0.984	-2.663	124.40	0.596*	0.402	4.65	0.932	-0.164
13	BAU 95-1	63.00	1.176	7.287*	47.73	0.946	20.834**	119.53	1.241	2.306**	3.80	0.169*	0.129
14	Shubhra	63.00	0.314	0.474	47.68	1.200	-1.052	119.13	1.432*	1.153*	4.49	1.123	0.240
15	RLC 33	60.73	4.090	-0.013	52.52	0.597*	1.933	115.33	1.045	2.264**	4.73	1.240	0.300
16	RLC 165	66.60	57.424*	1.283	49.01	0.932	-2.049	124.60	0.986	6.391**	4.01	0.844	-0.192
17	Sweta	67.33	55.113*	0.449	51.17	1.149	3.169	125.47	0.848	3.639**	4.07	0.799	0.065
18	BAU 286-5	66.27	10.977	-0.303	51.80	0.950	3.563	125.53	0.591*	1.273**	4.92	1.013	1.211**
19	BAU 138	72.67	53.102	3.541**	52.35	1.230	1.710	126.40	1.084	1.777**	4.57	1.693*	0.067
	Population mean	66.07	1.00	-	49.54	1.000	-	122.35	1.000	-	4.33	1.000	-
	Sem±	0.930	0.550	-	1.423	0.173	-	0.884	0.189	-	0.297	0.321	-

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

Table 3. contd.

Sl. No.	Variety	No. of secondary branches / plant			Number of capsules / plant			Seed yield / plant (g)			Stable for different characters
		Mean	b_j	S^2d_j	Mean	b_j	S^2d_j	Mean	b_j	S^2d_j	
1	BAU 189-2	11.79	0.926	-0.898	38.69	0.643	-4.053	1.45	0.720	0.093**	4
2	BAU 135	12.73	1.003	-1.452	44.60	1.026	-24.591	1.42	0.954	0.017*	3
3	BAU 159-4	12.42	0.897	3.274	38.19	0.811	16.185	1.42	1.050	0.007	3
4	BAU 3	9.84	0.905	-0.069	36.84	0.946	19.392	1.28	1.044	0.025*	6
5	BAU 8	12.32	1.066	4.665*	41.29	0.894	6.251	1.40	1.342	-0.002	4
6	T 397	12.03	1.061	-0.375	37.80	0.964	-20.870	1.35	0.939	0.033**	4
7	BAU 195-4	11.28	0.870	-0.171	39.33	-0.901	-15.506	1.32	0.965	0.003	5
8	BAU 65-2	12.85	1.295	1.775	38.13	0.919	3.713	1.29	0.871	0.014	6
9	LCK 8657	11.95	1.041	0.197	42.19	0.912	13.121	1.53	1.000	0.048**	3
10	BAU 147	13.09	1.097	3..721	46.43	1.564**	-24.189	1.40	1.214	0.107**	3
11	BAU9	12.15	1.111	0.569	38.87	1.024	4.798	1.35	0.788	0.019*	3
12	BAU 160	11.60	0.831	-0.956	41.05	0.839	-18.532	1.47	1.015	0.017*	4
13	BAU 95-1	11.83	0.875	-1.085	38.31	0.709	-17.967	1.40	1.050	0.139**	2
14	Shubhra	12.12	0.728	1.076	40.67	0.739	43.585*	1.45	1.062	0.024*	3
15	RLC 33	10.05	0.719	3.296*	38.95	1.150	132.659	1.20	0.607	0.011	2
16	RLC 165	10.29	0.756	-1.132	32.24	0.792	-14.950	1.36	1.239	-0.005	5
17	Sweta	13.10	1.392*	1.041	43.47	1.320	42.176*	1.56	1.095	0.041**	1
18	BAU 286-5	14.92	1.035	5.107**	51.60	1.156	127.146**	1.76	1.104	0.015	2
19	BAU 138	10.84	1.392*	1.803	46.04	1.690**	211.884**	1.31	0.938	0.021**	1
	Population mean	11.96	1.000	-	40.88	1.000	-	1.41	1.000	-	
	Sem±	0.852	0.179	-	3.615	0.212	-	0.105	0.265	-	

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

A simultaneous consideration of the three parameters (mean, b_i & S^2d_i) revealed that all the genotypes, except BAU 135, BAU 95-1, BAU 286-5 and BAU 138 had shown stability over environment for number of primary branches. Out of these six *viz;* LCK 8657, RLC 165, BAU 189-2, BAU 147, T 397 and BAU 160 had shown high stability for wider range of environmental conditions. Similarly, for number of secondary branches per plant 14 genotypes had shown stability over environment. Out of which two, namely BAU 135 and T 397 had shown high stability and adaptability with high mean, unit bj and zero S^2b_j

For number of capsules per plant thirteen genotypes had shown their stability over wide range of environment as their b_j were close to unity and S^2d_j were non-significant. But out of these stable genotypes BAU 135, T 397, BAU 195-4, BAU 160, BAU 95-1, RLC 165 and 189-2 were found highly stable and adaptable as their deviation from regression were zero.

The genotypes, BAU 286-5, BAU 159-4, RLC 8, BAU 195-4, BAU 65-2 and RLC 33 were found to be highly stable to unfavourable environmental conditions for seed yield as these had b_j close to unity and non-significant S^2d_j. The most stable and adaptable genotypes were BAU 286-5, BAU 159-4 and BAU8 because their mean for seed yield were also high. While other six genotypes viz; Sweta, LCK 8657, BAU 160, BAU 189-2, Shubhra and BAU 135 had produced high yield of seed but their deviation from regression were significant and thus unstable and suitable only for favourable environment.

On the basis of stability results of different characters the genotypes, namely BAU 65-2, RLC 165 and BAU 195-4 were found to be stable for most of the characters with higher seed yield. The genotypes BAU 286-5 although stable only for a few characters produced the highest and stable seed yield. Thus these genotypes can be suggested for commercial cultivation in wide range of environmental conditions and can be used in further breeding programme.

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Combining ability estimates in groundnut (*Arachis hypogaea* L.)

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Abstract : Accurate identification of promising parents is crucial for groundnut (*Arachis hypogaea* L.) cultivar development. Six cultivars, namely, ICGS 44, Ginar 1, ALR 2, JL 24, GG 2 and CO 2 were intermated in all possible combinations in a full diallel mating design. The 30 reciprocal F_1 hybrids and six parents were utilized for the study. Five traits, namely, number of mature pods, kernel weight, pod yield, shelling outturn and oil content were recorded for the estimation of general combining ability (*gca*) and specific combining ability (*sca*) effects. The greater SCA variance than GCA variance for the number of mature pods, pod yield, shelling outturn and oil content, whereas, the reverse is true for kernel weight. The crosses ALR 2 x JL 24 and ICGS 44 x JL 24 had greater *sca* effects for pod yield. Hence the gene action