Plant Archives Vol. 17 No. 1, 2017 pp. 407-411 ***ISSN 0972-5210***

CHARACTERIZATION AND GENETIC VARIATION STUDY AMONG LINSEED (*LINUM USITATISSIMUM* L.) GENOTYPES FOR SEED YIELD AND RELATED TRAITS IN MID-HILLS OF NORTH-WEST HIMALAYAS

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Abstract

Sixteen linseed genotypes were subjected to study the characterization and genetic variability at the Experimental Farm of the Department of Crop Improvement, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, during *rabi* 2015-2016. Analysis of variance revealed that the differences among all the genotypes were significant for all the traits. On the basis of mean performance KL-285 and KL-299 were found to be statistically superior with the best check Baner for seed yield per plant. High estimates of PCV and GCV were obtained for seed yield per plant, indicating a good deal of variability in this character and signifying the effectiveness of selection of desirable types for further genetic improvement. High heritability was observed for all the traits except seeds per capsule indicating that the characters under study are less influenced by environment in their expression. All the traits under study expressed low genetic advance. High heritability coupled with low genetic advance indicates non-additive gene action. The heritability exhibited due to favourable influence of environment rather than genotypes signifies that selection for such traits may not be rewarding. Three genotypes *viz*., KL-290, KL-296 and KL-300 were highly resistant to the rust while, all the gentoypes were highly resistant for powdery mildew. The cluster analysis showed that the genotypes were placed into four clusters, showing inter-cluster divergence, which is important for future hybridization programme.

Key words : *Linum usitatissimum* L., genetic variability, heritability, genetic advance.

Introduction

Linseed (*Linum usitatissimum* L.) belongs to the genus *Linum* is one of the earliest crop cultivated for its seeds and fibre. Almost every part of the linseed plant is utilized commercially either directly or after processing. Being an important oilseed crop, its average productivity in India is very low, because of various factors *viz*., narrow genetic base, non-availability of high yielding varieties and resistance to biotic and abiotic stresses, etc. The measurement of genetic variation and mode of inheritance of quantitative and qualitative traits are of prime importance in planning the breeding programme efficiently and effectively (Shah *et al*., 2015). Heritability of any trait depends upon genetic properties of breeding material and environmental conditions in which experiments are carried out (Falconer and Mackay, 1996). A character which has higher range of genetic variability, high heritability and high genetic advance would be an effective tool to improve economic yield (Aytac and Kinaci, 2009). Success of any breeding program depends upon the presence of substantial amount of genetic variability and heritability (Sidra *et al*., 2014; Laila *et al*., 2014), because the ultimate goal is to develop hybrid cultivars that can potentially use the total amount of heterosis available. Therefore, the present study was conducted with the objective to determine the genetic variability of different genotypes of linseed based on their agro-morphological traits.

Materials and Methods

Genetic variability for various agro-morphological traits was studied in 13 linseed genotypes *viz*., KL-285, KL-288, KL-289, KL-290, KL-293, KL-294, KL-295, KL-296, KL-297, KL-299, KL-300, KL-301 and KL-302 with three checks of namely Nagarkot, Baner and

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Himani during *rabi* 2015-16 at Experimental Farm of the Department of Crop Improvement, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India (32°8´ N, 76°3´E), which represents humid sub-temperate climate zone with an annual rainfall of 2500mm and acidic soil having pH of 5.0 to 5.6.

The experiment was conducted in complete randomized block design with three replications. Each replication consisted of three rows of each genotype. Row to row distance was 30 cm with row length of 1 meter and plant to plant distance was 10 cm was maintained by thinning. Normal cultural practices were carried out as recommended for linseed. Data was recorded on five randomly selected plants for all the characters except days to 50 per cent flowering and days to maturity which was recorded on plot basis.

Statistical analysis

The recorded data was subjected to analysis of variance (Panse and Sukhatme, 1985).

Genetic variability

Genotypic and phenotypic variances, genotypic (GCV), phenotypic coefficients of variance (PCV) and heritability (broad sense) were computed according to Burton and Devane (1953), Johnson (1955) and Singh & Chaudhary (1985).

Cluster analysis

Cluster analysis was carried out through SPSS 16.0 using wards method.

Results and Discussion

Mean performance of genotypes

A thorough probe into mean data (table 2) revealed that days to 50% flowering ranged from 135.67 to 149.33 days with maximum contribution from KL-295 while minimum contribution by KL-300. Days to 75% maturity ranged from 209.33days (KL-302) to 216.67 days (KL-294). KL-295 had maximum plant height (81.44) followed by KL-296 (74.44) and KL-285 (74.32). Maximum number of primary branches per plant were produced by KL-294 (7.00) followed by KL-299 (6.60) and KL-300 (6.53), where as minimum value was observed for Himani (4.20). The secondary branches per plant ranged from 3.20 (KL-302) to 4.93 (KL-294 & KL-299). Maximum number of capsules per plant were 47.53 by KL-299 and minimum by KL-302 (25.20). Seeds per capsule ranged from 7.13 to 8.47 and the maximum contribution was by KL-294. Contemplation of mean values for seed yield per plant demonstrated that cultivars KL-297 was found poor with lowest contribution and KL-299 recorded highest contribution of 2.30grams.

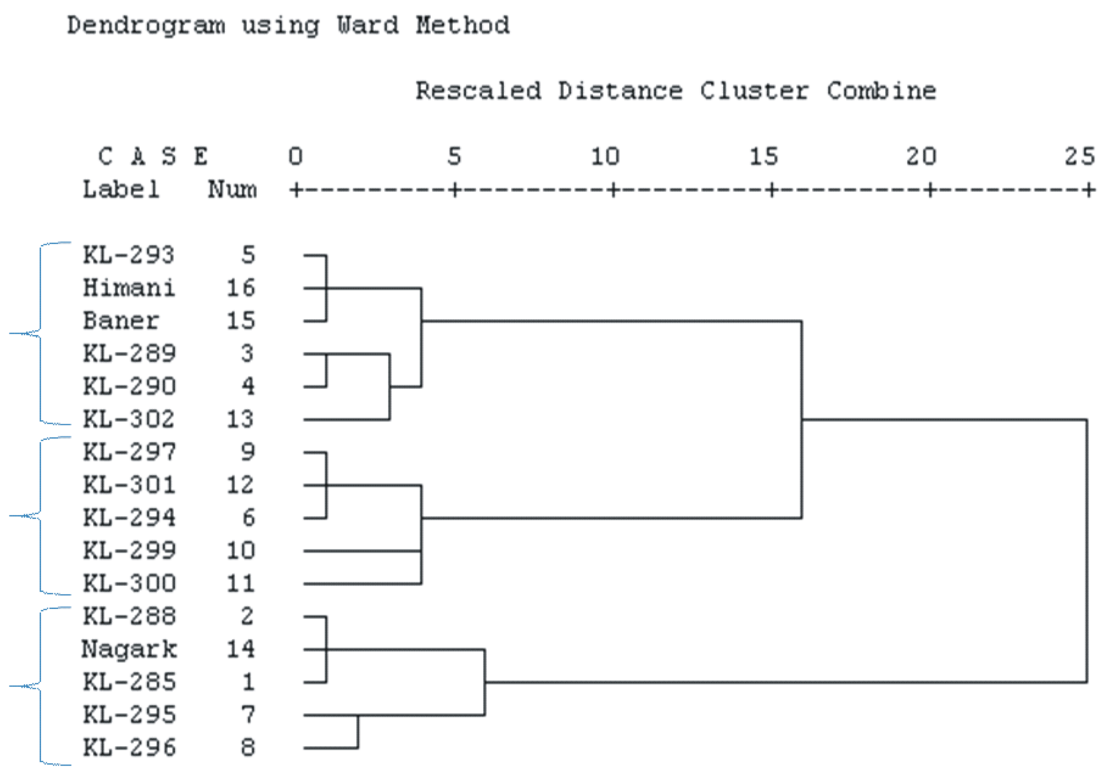

Fig. 1 : Relationship among 16 linseed genotypes revealed by cluster analysis based on eight traits.

Table 1 : Analysis of variance for agro-morphological traits in linseed.

		Replication	Genotypes	Error
	df	2	15	30
Days to 50% flowering		2.31	50.47**	2.11
Days to 75% maturity		1.13	16.63**	1.77
Plant height		3.76	167.14**	5.11
Primary branches per plant		0.29	2.07**	0.05
Secondary branches per plant		0.16	1.15**	0.07
Capsules per plant		3.11	123.07**	5.00
Seeds per capsule		0.07	0.43**	0.13
Seed yield per plant		0.08	0.43**	0.02

* P≤ 0.005 and ** P≤ 0.001

values and range showed great variation for all the traits indicating sufficient variability in material. Coefficients of variation studies indicated that the estimates of PCV were higher than the corresponding estimates of GCV for all the traits studied indicating that the apparent variation is not only due to genotypes but also because of the influence of environment, therefore, caution has to be exercised in making selection for these characters on the basis of phenotype alone as environmental variation is unpredictable in nature. All the genetic variations are heritable and can be exploited in any breeding programme as reported by Akbar *et al*. (2003).

Table 2 : Estimates of the mean values of linseed genotypes.

	Days to 50% flowering	Days to 75% maturity	Plant height	Primary branches per plant	Secondary branches per plant	Capsules per plant	Seeds per capsule	Seed yield per plant
KL-285	145.00	212.00	74.32	5.53	3.93	25.27	8.33	2.08
KL-288	141.00	210.33	72.26	5.00	3.47	30.40	7.60	1.55
KL-289	136.67	211.33	62.98	5.07	3.33	30.67	7.73	1.63
KL-290	138.67	213.67	62.99	4.67	3.47	28.27	7.33	1.18
KL-293	147.00	215.67	65.10	5.27	3.40	28.47	7.13	1.22
KL-294	147.00	216.67	59.33	7.00	4.93	36.00	8.47	1.13
KL-295	149.33	212.67	81.44	5.27	4.07	39.17	7.73	1.74
KL-296	145.33	216.33	74.44	5.47	4.13	37.53	8.07	1.76
KL-297	147.33	212.00	60.92	5.73	3.80	40.07	7.80	0.99
KL-299	145.00	212.33	55.03	6.60	4.93	47.53	7.60	2.30
KL-300	135.67	215.67	60.61	6.53	4.73	40.47	8.07	1.20
KL-301	145.67	211.33	58.73	6.47	4.60	35.73	8.13	1.12
KL-302	144.00	209.33	57.30	4.60	3.20	25.20	7.87	1.11
Nagarkot*	145.67	209.67	72.83	4.73	3.40	31.33	7.67	1.53
Baner*	146.00	211.67	65.30	4.73	3.40	28.20	7.20	1.63
Himani*	148.67	214.67	63.63	4.20	3.27	28.20	8.00	1.26
GM	144.25	212.83	65.45	5.43	3.88	33.28	7.80	1.46
S.Em.±	0.84	0.77	1.31	0.13	0.15	1.29	0.21	0.08
C.D. 5%	2.42	2.22	3.77	0.37	0.43	3.73	0.59	0.23
C.V (%)	1.01	0.62	3.45	4.09	6.70	6.72	4.54	9.43

*Checks

Genetic variability parameters

The analysis of variance (table 1) revealed highly significant differences among the genotypes for all the characters indicating sufficient variability in the present material selected for the study and signifying the scope for selection of suitable initial breeding material for crop improvement.

Range of genotypes studied are given in Table 3 Mean

The highest PCV and GCV values were found particularly for seed yield per plant due to very high variability available in this traits (table 3). Higher estimates of PCV and GCV (>25%) are obtained for seed yield per plant. Moderate PCV and GCV (15 - 25%) values for primary branches per plant, secondary branches per plant and capsules per plant. Low PCV and GCV (<15) for days to 50% flowering, days to 75% maturity, plant height and seeds per capsule indicating less variability

Table 3 : Genetic parameters of variability for different agro-morphological traits of linseed.

	Mean	Range	GCV	PCV	Heritability	% GA
Days to 50 % flowering	144.25	135.67-149.33	2.78	2.96	88.41	7.78
Days to 75 % maturity	212.83	209.33-216.67	1.05	1.22	73.68	3.94
Plant height	65.58	55.03-81.44	11.21	11.72	91.36	14.47
Primary branches per plant	5.43	4.20-7.00	15.12	15.66	93.17	1.63
Secondery branches per plant	3.88	3.20-4.93	15.48	16.86	84.23	1.14
Capsules per plant	33.28	25.20-47.53	18.85	20.01	88.74	12.17
Seeds per capsule	7.80	7.13-8.47	4.09	6.12	44.82	0.44
Seed yield per plant	1.47	0.99-2.30	25.19	26.89	87.71	0.71

Table 4 : Clustering pattern of 16 linseed genotypes.

S. no.	Clusters	No. of genotypes	Genotypes
1.	I	6	KL-293, Himani, Baner, KL-289. KL-290, KL-302
2.	II	5	KL-297, KL-301. KL-294, KL-299, KL-300
3.	III	5	KL-288, Nagarkot, KL-285, KL-295, KL-296

Table 5 : Scoring of different linseed genotypes to rust and powdery mildew under natural epiphytotic conditions.

S. no.	Entries	Disease Score	
		Rust	Powdery mildew
1.	KL-285	1	0
2.	KL-288	1	0
3.	KL-289	1	0
4.	KL-290	0	0
5.	KL-293	1	0
6.	KL-294	1	0
7.	KL-295	3	0
8.	KL-296	0	0
9.	KL-297	2	0
10.	KL-299	1	0
11.	KL-300	0	0
12.	KL-301	1	0
13.	KL-302	5	0
14.	NAGARKOT	1	0
15.	BANER	1	0
16.	HIMANI	1	0

existed in these characters.

The estimates of heritability help the plant breeder in selection of elite genotypes from diverse genetic population. Therefore, high heritability helps in effective selection for a particular character. Heritability is classified as low (below 30%), medium (30-60%) and high above 60%). Except seeds per capsule (44.81%), all the characters studied in the present investigation expressed high heritability. High heritability values indicate that the characters under study are less influenced by environment. High heritability indicates the scope of genetic improvement of these characters through selection. Similar results have been reported by RamaKant *et al.* (2005).

Heritability in conjunction with genetic advance would give a more reliable index of selection value (Johnson *et al*., 1955). Present study revealed that all the traits under study showed low genetic advance (<15) ranging from 0.44 to 14.47. High heritability coupled with low genetic advance indicates non-additive gene action. The heritability exhibited due to favourable influence of environment rather than genotypes and selection for such traits may not be rewarding.

Cluster analysis

The cluster analysis showed that the genotypes were placed into three clusters (table 4) of which the first encompasses the largest number of genotypes (6), while the second and third each contains five genotype (fig. 1), showing wide divergence *i.e.* inter-cluster divergence, which is desirable for future hybridization programme for getting desirable transgressive segregants, as earlier reported by Srivastava *et al*. (2009), Kandil *et al*. (2011) and Kant *et al*. (2011).

Diseases reaction to genotypes

Sixteen linseed genotypes along with checks were screened under natural epiphytotic conditions for reaction to prevalent diseases *viz.,* rust and powdery mildew during *rabi* 2015-16. The scoring data for each genotype is given in table 5. Three genotypes *viz.,* KL-290, KL-296 and KL-300 were highly resistant to the rust disease, however, seven genotypes with three checks *viz.,* KL-285, KL-288, KL-289, KL-293, KL-294, KL-299, KL-301, Nagarkot, Baner and Himani were resistant to the rust disease and KL-299 expressing moderately resistance. In case of powdery mildew all the genotypes in the study were found to be highly resistant.

Present investigation signified that seed yield per plant expressed high GCV and PCV, high heritability indicating the presence of sufficient variability a pre requisite for any successful breeding programme. Hence, the present material can be further subjected to breeding endeavours by utilizing both additive and non additive gene effects simultaneously. Cluster analysis indicating wide divergence, which is desirable for future hybridization programme. Three genotypes for rust and all the genotypes under study were highly resistant to the powdery mildew disease. Signifying the importance of these genotypes for further utilization in resistance breeding programme.

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