Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(2): 87-91
Received: 03-01-2017
Accepted: 04-02-2017

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Studies on evaluation and mean performance associated with seed yield and related traits of linseed (*Linum usitatissimum* L.) genotypes

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Abstract
Twenty five linseed genotypes were subjected to evaluation for various agro-morphological traits during *rabi* 2013-14 at Experimental Farm of the Department of Crop Improvement, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India. The analysis of variance revealed that highly significant differences among the genotypes for all the characters indicating sufficient variability existed in the present material selected for the study and indicating the scope for selection of suitable initial breeding material for crop improvement. KL-232, KL-233 & KL-234 were found to be early maturing and Nagarkot was high yielding variety so these variety could be used in further breeding programme for the development of new varieties.

Keywords: Linseed, seed yield, evaluation, mean performance

Introduction
Linseed (*Linum usitatissimum* L.) is a oilseed as well as a fiber crop and belongs to genus *Linum* and family Linaceae with chromosome number 30. Linseed contains 32% - 34% oil in seed and obtained from the dried ripe seeds [1]. It is used in varnishes, paints and cloth and linoleum. It's by-product oil cake or meal is used as cattle feed and as manure for giving prolonged fertility to soil. Due to oil and fibres linseed has a great economic value for the commercial utility. Linseed has numerous medicinal uses. Linseed oil is used in local medicines as demulcent, emollient and laxative and is taken orally in bronchial infection and diarrheal. It has many other economic importance like in soap factories [2]. It has been a rich source of 2 essential fatty acids, alpha-linolenic acid and linoleic acid [3-5]. which on metabolism lead to the synthesis of DHA (docosa hexaeenoic acid), an indispensible metabolite for the optimal development of nervous system and maturation of visual acuity in infants [6, 7]. Across the world it covers 2270.35 thousand hectare area with production of 2238.94 thousand tons having productivity of 986.16 kg per hectare, whereas in India it covers 338 thousand hectares area and 147 thousand tons production with the productivity of 434.91 kg per hectare [8]. Being an important oilseed crop, its average productivity in India is very low, because of various factors viz., narrow genetic base, raising of crop by the resource poor farmers in marginal and sub-marginal areas, non-availability of high yielding varieties and resistance to biotic and abiotic stresses, etc. Success of any breeding program depends upon the suitable parent so selection of the best genotypes among the population is very important for the development of new high yielding varieties. The present study was carried out for the evaluation of linseed genotypes for seed yield and related traits performance.

Materials and Methods
Evaluation for various agro-morphological traits was studied in twenty five genotypes (Table 1) of Linseed during *rabi* 2013-14 at Experimental Farm of the Department of Crop Improvement, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India (32°8´ N, 76°3´ E) represents humid sub-temperate climate zone with annual rainfall of 2500mm and acidic soil with pH of 5.0 to 5.6. The experiment was conducted using randomized complete block design (RCBD) with two replications each replication consisted of three rows of each genotype. Row to row distance was 30 cm with row length of 3 meter and plant to plant distance was 10 cm was maintained by thinning. The recommended package of practices were followed for raising a good crop. Data was recorded on five randomly selected plants in each replication except for days to 50 per cent flowering and75 per cent days to maturity which was recorded on plot basis. For plant height data was recorded by measuring the distance from the soil to the tip of the plant, at a stage when crop reached physiological maturity,

Technical height recorded from the ground surface to the point from where the primary branches start at the stage of physiological maturity, Primary branches per plant is the numbers of branches emerging from the main stem were counted for each plant at maturity and then averaged, Secondary branches per plant was counted of branches arising from primary branches in selected plants of each genotype were recorded and mean value was obtained, Capsules per plant were counted total numbers of capsules in the plant and mean value was obtained, Seeds per capsule were counted in ten randomly selected capsules and then averaged, Biological yield was recorded by weighing five selected plant before threshing and then averaged Straw yield per plant was recorded by weighing five selected plant after threshing and then averaged, Seed yield per plant was recorded by weighing seed of five selected plant and averaged, 1000- seed per entry per replication were also weighed.

Results and Discussion

Analysis of variance indicated that highly significant differences among the genotypes for all the traits indicating sufficient variability present in the present material selected for the study and indicating the scope for selection of suitable initial breeding material for crop improvement.

A thorough probe into mean data (Table 2) revealed that Days to 50% flowering ranged from 114 to 125 days with maximum contribution from DPL-19 & Garima while minimum contribution by KL-233. Days to 75% maturity ranged from 176 days (KL-232 & 234) to 185 days (DPL-32). DPL-17 had maximum plant height (84.9) followed by LC 185 (76.5) and Baner (75.2). Maximum number of primary branches per plant were produced by DPL-32 (7.3) followed by DPL-17 (6.9) and DPL-19 (6.9), where as minimum value was observed for NP 65 & Garima (4.9). The secondary branches per plant ranged from 2.9 (NP 65) to 5.3 (DPL-32). Maximum number of capsules per plant were 42.5 by DPL-32 and minimum by NP 65 (26.5). Seeds per capsule ranged from 6.6 to 8.4 and the maximum contribution was by KL-226. Biological yield per plant ranged from 1.38 to 5.65 g with maximum contribution from KL-225, while minimum contribution by Baner. Highest straw yield per plant was found in KL-226 (3.11) followed by HimAlsi-2 (2.72) and Nagarkot (2.51), where as minimum value was observed for Baner (0.67). KL-226 had maximum fibre yield per plant (0.62) followed by HimAlsi-2 (0.52) and KL-230 (0.43).

Table 1: List of linseed accessions/lines and their parentage/source used in the study

S. No.	Genotype	Source/Pedigree
1	KL-225	-
2	KL-226	Aoyogi × JRF-2
3	KL-227	Flak-1 × Janaki
4	KL-228	Polf-22 × KL-31
5	KL-229	-
6	KL-230	Aoyogi × RL-33-4
7	KL-231	Polf-16 × KL-1
8	KL-232	Polf-16 × Janki
9	KL-233	Flax purple × Gaurav
10	KL-234	Polf-22 × Jeevan
11	KL-235	-
12	KL-236	Jeevan × Janaki
13	KL-237	-
14	KL-238	Aoyogi × Nagarkot
15	KL-239	Polf-27 × RL-33-4
16	Nagarkot	New River × LC-216
17	Jeevan	Summit × LC-216
18	Him Alsi-2	EC-21741 × LC-216
19	DPL-17	EC 21741 × LC.216·
20	DPL-19	-
21	DPL-32	-
22	Baner	EC 21741 × LC 216
23	LC 185	NP (RR)-37 × Kangra local
24	NP 65	-
25	Garima	-

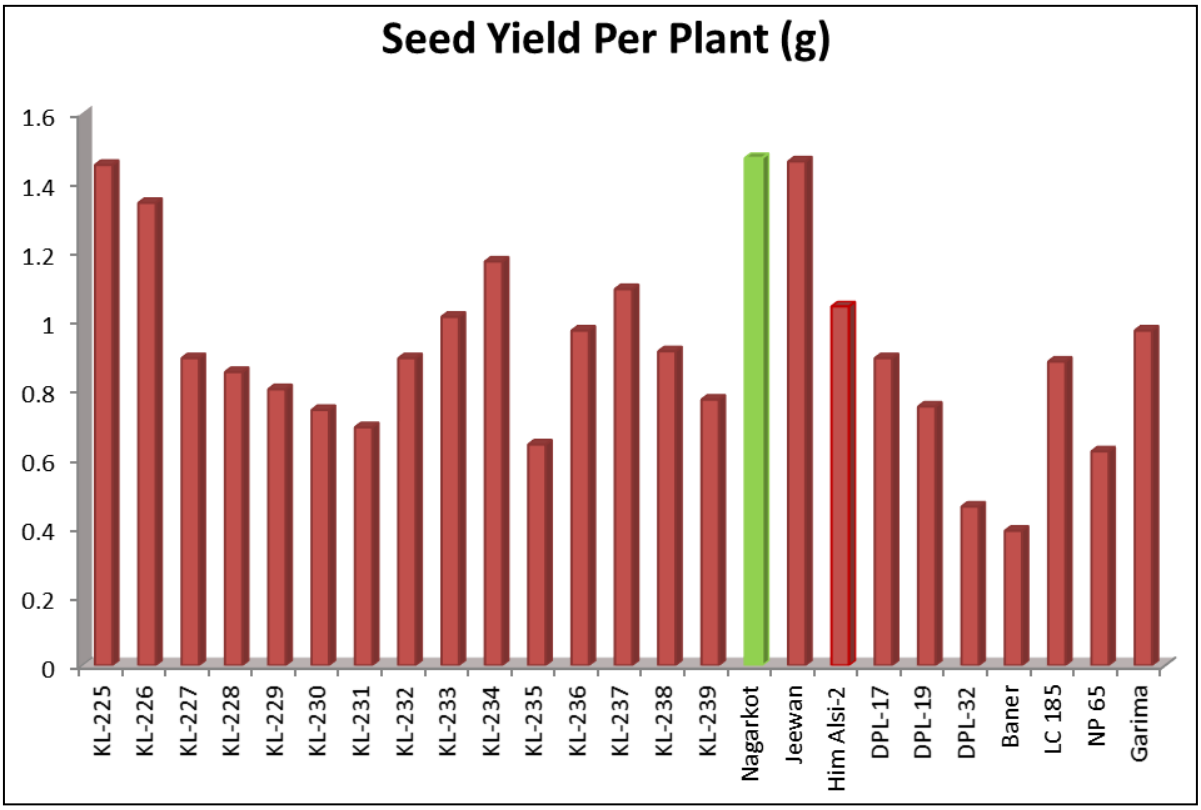

Fig 1: Genotypes and mean of seed yield studied with check cultivars

Table 2: Estimates of the mean values of linseed genotypes

	Days to 50% flowering	Days to 75% maturity	Plant Height (cm)	Technical Height (cm)	Primary Branches Per Plant	Secondary Branches Per Plant	Capsules Per Plant	Seeds Per Plant	Biological Yield Per Plant (g)	Straw Yield Per Plant (g)	Fibre Yield Per Plant	1000 Seed Weight (g)	Seed Yield Per Plant (g)
KL-225	121.00	182.00	43.00	19.40	6.40	4.70	34.00	7.95	5.65	1.95	0.38	9.00	1.45
KL-226	118.00	182.00	53.00	22.20	6.40	4.30	31.50	8.40	5.04	3.11	0.62	9.90	1.34
KL-227	121.00	181.00	64.70	41.80	5.90	3.80	33.00	7.80	3.33	1.48	0.30	9.55	0.89
KL-228	122.00	180.00	62.80	38.90	5.70	4.10	32.00	7.85	3.02	1.38	0.27	8.90	0.85
KL-229	116.00	180.00	65.80	38.40	5.60	4.40	33.00	6.90	3.92	1.39	0.27	8.90	0.80
KL-230	119.00	179.00	64.30	38.20	5.30	3.90	33.00	7.75	3.17	2.13	0.43	8.95	0.74
KL-231	118.00	181.00	72.60	43.60	5.40	3.90	31.00	7.40	2.26	1.09	0.22	9.70	0.69
KL-232	115.00	176.00	72.10	38.90	5.90	4.30	34.50	7.90	3.81	1.41	0.29	9.80	0.89
KL-233	114.00	177.00	66.60	44.30	5.40	4.60	33.75	8.20	3.79	1.72	0.39	9.60	1.01
KL-234	120.00	176.00	71.00	41.10	5.60	4.00	36.00	7.10	4.20	1.85	0.37	8.90	1.17
KL-235	120.00	179.00	70.70	42.00	5.30	3.90	33.00	7.70	2.58	1.33	0.27	9.70	0.64
KL-236	120.00	179.00	70.90	40.20	5.70	4.20	33.50	6.80	3.92	2.24	0.42	7.30	0.97
KL-237	120.00	182.00	70.10	46.30	5.80	4.50	36.00	8.20	4.95	1.38	0.28	9.90	1.09
KL-238	120.00	178.00	68.50	40.50	5.50	4.50	33.50	8.00	3.55	1.84	0.37	9.50	0.91
KL-239	121.00	177.00	65.10	34.70	5.70	4.40	35.50	6.60	2.67	1.12	0.21	9.70	0.77
Nagarkot	117.00	178.00	65.10	34.10	4.90	3.90	27.00	7.15	5.48	2.51	0.48	9.95	1.47
Jeewan	121.00	180.00	70.50	42.30	5.70	4.80	33.00	7.90	3.95	1.08	0.21	9.65	1.46
Him Alsi-2	122.00	181.00	73.50	42.60	5.30	3.90	29.00	7.50	4.43	2.72	0.52	10.10	1.04
DPL-17	121.00	182.00	84.90	44.30	6.90	5.10	40.75	8.00	3.17	1.32	0.26	7.70	0.89
DPL-19	125.00	180.00	43.50	19.30	6.90	4.70	35.50	7.00	2.49	1.42	0.28	8.45	0.75
DPL-32	122.00	185.00	69.30	38.00	7.30	5.30	42.50	8.00	2.16	1.08	0.22	8.85	0.46
Baner	124.00	182.00	75.20	41.70	6.10	5.00	37.00	7.70	1.38	0.67	0.13	8.70	0.39
LC 185	121.00	177.00	76.50	35.60	5.10	3.90	32.50	7.30	3.14	1.31	0.26	9.90	0.88
NP 65	121.00	181.00	69.80	42.10	4.90	2.90	26.50	6.95	1.56	0.98	0.20	8.60	0.62
Garima	125.00	177.00	69.80	41.40	4.90	3.10	32.75	7.80	2.69	1.55	0.31	9.00	0.97
GM	120.16	179.68	67.17	38.08	5.74	4.24	33.59	7.59	3.45	1.60	0.32	9.21	0.93
S.E. (m)±	0.55	0.46	1.84	1.47	0.13	0.11	0.70	0.10	0.23	0.12	0.02	0.14	0.06
CV(%)	0.98	0.69	1.82	2.04	2.19	1.75	1.48	1.09	1.56	2.55	5.27	1.02	1.78
C.D. 5%	2.43	2.57	2.52	1.60	0.25	0.15	1.03	0.17	0.11	0.08	0.03	0.19	0.03

Maximum 1000 seed weight contributed by HimAlsi-1 (10.2) followed by KL-237 & LC 185 (9.9), whereas lowest found in KL-236 (7.3). Contemplation of mean values for seed yield per plant demonstrated that cultivars Baner was found poor with lowest contribution and Nagarkot recorded highest contribution of 1.47grams (Fig 1).

Present study revealed that KL-232, KL-233 & KL-234 early maturing varieties and Nagarkot was high yielding variety so these variety could be used in further breeding programme for the development of new varieties.

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