Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2020; 9(1): 1189-1192
Received: 16-11-2019
Accepted: 18-12-2019

Satish Paul
CSK Himachal Pradesh Agriculture University, Palampur, Himachal Pradesh, India

Pratik Satasiya
N.M College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Arjun Kumar
CSK Himachal Pradesh Agriculture University, Palampur, Himachal Pradesh, India

Corresponding Author:
Satish Paul
CSK Himachal Pradesh Agriculture University, Palampur, Himachal Pradesh, India

Genetic variability, correlation and path coefficient analysis of introduced genotypes of linseed (*Linum usitatissimum* L.) in mid-hills of North-West Himalayas

Satish Paul, Pratik Satasiya and Arjun Kumar

DOI: https://doi.org/10.22271/phyto.2020.v9.i1t.10618

Abstract
Present study comprises of 45 introduced and 2 indigenous genotypes of linseed which were evaluated at Experimental Farm of the Department of Crop Improvement, CSK HPKV, Palampur during rabi 2018-19. The experiment was carried out in RCBD with three replications. Each genotype was evaluated for 10 yield contributing characters. High heritability coupled with high genetic advance was recorded for primary branches, secondary branches, number of capsules, biological yield and seed yield. Seed yield showed highest significant positive correlation with biological yield (0.847) followed by plant height, primary branches and secondary branches. Significant negative correlation was observed for days to 50 per cent flowering and days to 75 per cent maturity. The results of path analysis revealed highest direct effect of biological yield (1.088) and harvest index (0.554) with seed yield, while primary branches, secondary branches and number of capsules showed higher indirect effects via biological yield.

Keywords: Linseed, variability, path analysis, GCV, PCV

Introduction
Linseed (*Linum usitatissimum* L., 2n=30) commonly known as Alsi, is one of the most important industrial oilseed crops of India as well as world, cultivated for both seed and fibre. Linseed is extensively cultivated throughout the world and India ranks second in terms of area after Canada and third in production in the world. *L. usitatissimum* is the sole cultivated species grown by man having 6,000-7,000 years of planting history. Every aerial part of the linseed plant is utilized commercially either directly or after processing. Linseed contains good percentage of oil varying from 33-42 per cent in different varieties and oil is the richest plant source of omega-3 (36-57%) and omega-6 (18-24%) (Ganorkar and Jain 2013). Any breeding programme rely on the variation present among the genotypes for different traits, which can be harnessed after evaluating various parameters of genetic variability like genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance. These parameters gives estimates of variation available for selection. The estimates of correlation and path coefficients provides us the direct and indirect effects of various characters on complex character like yield which can be useful for improving selection method for yield contributing traits. This selection criterion takes into account the information on relationships among characters.

Materials and Methods
During rabi season 2018-19, present investigation consisting of 45 introduced and 2 indigenous genotypes of linseed genotypes carried out at Experimental Farm of the Department of Crop Improvement, CSK HPKV, Palampur. The experiment was carried out in Randomized Complete Block Design (RCBD) with three replications. Each genotype was sown in three rows with the plot size of 1.0 × 0.75 m^2 with row to row and plant to plant spacing of 25 cm and 5 cm, respectively. The list of genotypes evaluated during experiment is presented in Table 1. The characters taken under consideration were days to 50 per cent flowering, days to 75 per cent maturity, plant height (cm), technical height (cm), primary branches per plant, secondary branches per plant, number of capsules per plant, biological yield per plant (g), seed yield per plant (g) and harvest index (%). The data was recorded on five randomly selected competitive plants in each replication except days to 50 per cent flowering and days to 75 per cent maturity, for which data was recorded on plot basis. In statistical analysis, heritability was calculated as per the method suggested by Allard (1960) [2],

Table 1: List of introduced and indigenous linseed genotypes evaluated in the study

Sr. no.	Genotypes	Sr. no.	Genotype	Sr. no.	Genotype	Sr. no.	Genotype
1	Hearmis	13	JRF-4	25	P4-211911-4	37	Kenya
2	Viking	14	JRF-2	26	Nataja	38	Wilden
3	Rejeena	15	JRF-1	27	Ariane	39	Barnes
4	Mariene	16	Birio	28	Belinka	40	Towner
5	Giza-5	17	Bolygolden	29	Faking	41	Bison
6	Giza-6	18	Linore	30	Flak-1	42	Ward
7	Giza-7	19	Kugene	31	KL-284	43	Victory
8	Giza-8	20	Williston	32	Coly	44	Polk
9	Canada	21	Cass	33	K1-Raja	45	Kota
10	Belinka-60	22	Cort land	34	Ottawa	46	Akmolinsk
11	Aoyagi	23	MB-12008-9	35	B4 x Burke	47	Lene
12	Nagarkot	24	Bombay	36	Stewart		

Genetic Advance (GA) as per method suggested by Johnson *et al*. (1955) [7], correlation coefficients and path analysis were carried out as per the equations of Burton (1952.) and Dewey and Lu (1959) [5], respectively with the help of software OP stat.

Results and Discussion

Genetic coefficient of variation (GCV) is found to be more effective for trait selection and formulating a successful breeding programme as it explains the genetic component of variation. By considering the phenotypic coefficient of variation (PCV) along with GCV to improve the efficiency of the breeding programme. Estimates of high GCV, PCV and heritability coupled with high genetic advance were recorded for primary branches per plant, secondary branches per plant, number of capsules per plant, biological yield per plant and seed yield per plant whereas low GCV and PCV for days to 50 per cent flowering and 75 with high heritability (>80%) and lower genetic advance (Table 2). These results indicates that the selection for these traits can be used for significant improvement in the breeding materials. Moderate GCV and PCV with high heritability (>80%) coupled with high genetic advance was observed for plant height. High PCV and moderate GCV along with high heritability (>80%) and genetic advance recorded for technical height. Higher heritability and genetic advance indicates the scope of selection to improve the genotypes for these traits. Harvest index showed moderate PCV, low GCV, heritability and genetic advance. In these results, the environmental influence can be noticed by the higher estimates of PCV than the GCV. Similar results were also observed by Kumar *et al*. (2013) [10], Paul *et al*. (2017a) [13], Paul *et al*. (2017b) [14] and Patial *et al*. (2018b) [12].

Table 2: Genetic parameters of variability for different characters in exotic collection of linseed.

Characters	Range	Mean ± S.E (d)	PCV	GCV	Heritability (bs)	Genetic Advance	GA (%)
50% flowering	148-175	166.149 ± 2.351	3.64	3.201	77.325	9.633	5.798
75% maturity	192-215	205.106 ± 1.93	2.879	2.638	83.977	10.215	4.98
Plant height	47.92-112.42	80.338 ± 2.152	15.676	15.329	95.62	24.806	30.878
Technical height	23.84-84.3	50.564 ± 2.211	20.499	19.787	93.174	19.895	39.345
Primary branches	3.32-11.56	6.305 ± 0.377	24.042	22.898	90.704	2.832	44.923
Secondary branches	5.17-13.7	7.782 ± 0.283	19.348	18.829	94.711	2.938	37.748
Number of capsules	13.2-61.46	34.125 ± 2.951	28.471	26.428	86.16	17.244	50.533
Biological yield	1.83-9.93	5.009 ± 0.726	36.789	32.219	76.697	2.911	58.125
Seed yield	0.44-2.59	1.484 ± 0.13	31.315	29.409	88.198	0.845	56.896
Harvest index (%)	19.37-44.48	30.721 ± 4.254	19.079	8.742	20.994	2.535	8.251

Seed yield per plant showed significant positive correlation with the characters namely, plant height, technical height, primary branches per plant, secondary branches per plant, number of capsules per plant, biological yield per plant and harvest index except days to 50 per cent flowering and days to 75 per cent maturity at phenotypic level (Table 3, Figure 1) showing that these characters can be used for selection criteria for high yield. Days to 50 per cent flowering showed significant positive correlation with days to 75 per cent maturity, plant height, technical height, primary branches per plant, secondary branches per plant, number of capsules per plant and biological yield whereas significant negative correlation.

Table 3: Phenotypic and genotypic correlation coefficients between different characters in linseed.

		Days to 50% flowering	Days to 75% maturity	Plant height	Technical height	Primary branches	Secondary branches	Number of capsules	Biological yield	Seed yield	Harvest index (%)
Days to 50% flowering	P	1.00	0.282**	0.307**	0.362**	0.358**	0.303**	0.400**	0.492**	-0.451**	-0.180*
	G	1.00	0.320**	0.372**	0.402**	0.410**	0.378**	0.453**	0.620**	-0.540**	-0.387**
Days to 75% maturity	P		1.00	0.116	0.334**	0.056	0.003	-0.039	0.226**	-0.155	-0.171*
	G		1.00	0.106	0.364**	0.007	-0.018	-0.086	0.253**	-0.255**	-0.046
Plant height	P			1.00	0.800**	0.395**	0.362**	0.476**	0.443**	0.380**	-0.245**
	G			1.00	0.818**	0.430**	0.371**	0.529**	0.471**	0.414**	-0.380**
Technical height	P				1.00	0.278**	0.211*	0.232**	0.399**	0.312**	-0.292**
	G				1.00	0.306**	0.213*	0.254**	0.455**	0.351**	-0.542**
Primary branches	P					1.00	0.896**	0.714**	0.378**	0.379**	-0.133
	G					1.00	0.945**	0.758**	0.444**	0.439**	-0.215*
Secondary branches	P						1.00	0.695**	0.372**	0.373**	-0.132
	G						1.00	0.771**	0.423**	0.430**	-0.174*
Number of capsules	P							1.00	0.315**	0.304**	-0.092
	G							1.00	0.392**	0.343**	-0.285**
Biological yield	P								1.00	0.847**	-0.480**

	G								1.00	0.944**	-0.473**
Seed yield	P									1.00	0.018
	G									1.00	-0.163
Harvest index (%)	P										1.00
	G										1.00

*, ** significant at 5% and 1% level, respectively

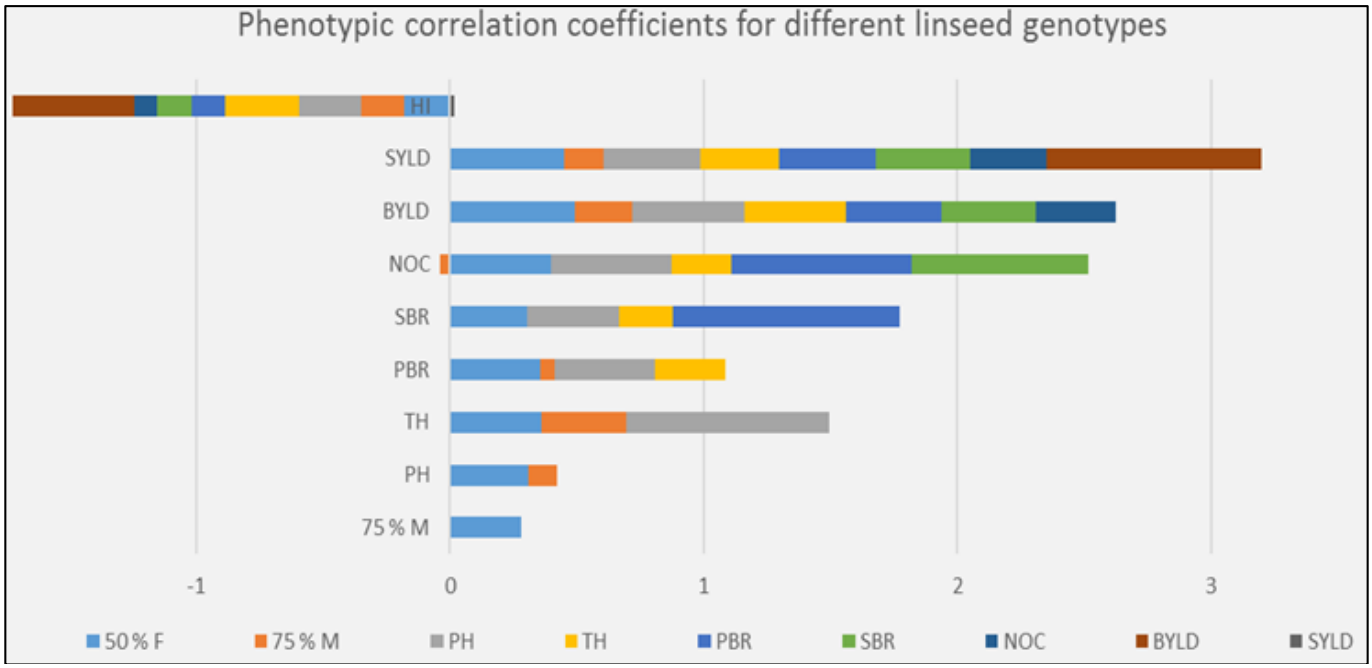

Fig 1: Diagrammatic representation of correlation coefficients for different characters in exotic lines of linseed

Table 4: Direct and indirect effects of different characters to seed yield in different exotic lines of linseed.

		Days to 50% flowering	Days to 75% maturity	Plant height	Technical height	Primary branches	Secondary branches	Number of capsules	Biological yield	HI	Total
Days to 50% flowering	P	-0.0027	-0.0035	0.0017	0.0117	0.0102	0.0115	-0.019	0.5355	-0.0998	0.4512
	G	-0.0296	-0.0152	-0.0357	0.0671	-0.0144	0.0175	0.0139	0.6988	-0.1625	0.5398
Days to 75% maturity	P	0.0007	-0.0124	0.0006	0.0108	0.0016	0.0001	0.0018	0.2459	-0.0946	0.1546
	G	-0.0094	-0.0476	-0.0101	0.0608	-0.0002	-0.0008	-0.0026	0.2849	-0.0194	0.2554
Plant height	P	0.0008	-0.0014	0.0056	0.0259	0.0113	0.0138	-0.0225	0.4824	-0.1360	0.3800
	G	-0.0110	-0.0050	-0.0960	0.1361	-0.0152	0.0171	0.0162	0.5304	-0.1594	0.4135
Technical height	P	0.0009	-0.0041	0.0045	0.0324	0.0079	0.0080	-0.0109	0.4347	-0.1620	0.3115
	G	-0.0119	-0.0173	-0.0785	0.1669	-0.0108	0.0098	0.0078	0.5122	-0.2273	0.3509
Primary branches	P	0.0009	-0.0007	0.0022	0.0090	0.0287	0.0342	-0.0338	0.4114	-0.0735	0.3785
	G	-0.0121	-0.0003	-0.0413	0.0511	-0.0353	0.0437	0.0232	0.5004	-0.0903	0.4390
Secondary branches	P	0.0008	-0.0000	0.0020	0.0068	0.0257	0.0382	-0.0329	0.4053	-0.0733	0.3727
	G	-0.0112	0.0008	-0.0356	0.0356	-0.0333	0.0462	0.0236	0.4765	-0.0729	0.4298
Number of capsules	P	0.0011	0.0004	0.0026	0.0075	0.0205	0.0265	-0.0474	0.3432	-0.0508	0.3038
	G	-0.0134	0.0040	-0.0507	0.0424	-0.0267	0.0356	0.0306	0.4413	-0.1197	0.3434
Biological yield	P	0.0013	-0.0028	0.0025	0.0129	0.0108	0.0142	-0.0149	1.0888	-0.2662	0.8467
	G	-0.0184	-0.0120	-0.0452	0.0759	-0.0156	0.0195	0.0120	1.1265	-0.1985	0.9441
HI	P	-0.0004	0.0021	-0.0013	-0.0095	-0.0038	-0.0050	0.0043	-0.5229	0.5542	0.0175
	G	0.0114	0.0022	0.0365	-0.0904	0.0076	-0.0080	-0.0087	-0.5329	0.4196	-0.1627

Residual effects: 0.0461 (P) and -0.00088 (G)

With harvest index at phenotypic level. Significant positive correlation of technical height and biological yield was observed with days to 75 per cent maturity while significant negative correlation with harvest index. Significant positive correlation of technical height with primary branches per plant, secondary branches per plant, number of capsules per plant and biological yield while significant negative correlation with harvest index. Primary branches showed significant positive correlation with secondary branches, number of capsules per plant and biological yield at phenotypic level. Number of capsules per plant showed significant positive correlation with biological yield. Significant negative correlation of biological yield was observed with harvest index. These results are in accordance with the results of earlier workers viz., Kumar and Paul (2016) [9], Patial *et al*. (2018a) [11] and Kasana *et al*. (2018) [8]. Results of path analysis gives idea about the cause and effect relationship between the characters and helps in identifying the traits which are directly or indirectly involved in seed yield. The results revealed highest direct effect of biological yield (1.088) and harvest index (0.554) with seed yield per plant whereas negative effects with days to 50 per cent flowering (-0.00274) and days to 75 per cent maturity (-0.01244) (Table 4). Concluding that the direct selection for

biological yield and HI can be used to improve yield while negative selection for days to 50 per cent flowering and days to 75 per cent maturity can be used to improve the seed yield. The direct effects of the other characters on seed yield were having low magnitude. Similar findings also reported by Dash *et al*. (2016) [4] and Akbar *et al*. (2003) [1]. The residual effects were very low (0.0461), hence the characters taken for the study were enough to calculate the direct and indirect effects to the seed yield per plant.

References

1. Akbar M, Mahmood T, Anwar M, Ali M, Shafiq M Salim J. Linseed improvement through genetic variability, correlation and path coefficient analysis. Int. J Agri. Bio. 2003; 5(3):303-305.
2. Allard RW. Principles of Plant Breeding. John Wiley and Sons., New York, 1960, 485.
3. Burton GW. Quantitative inheritance in grasses. Proceedings of the 6th International Grassland Congress, 1952, 277-283.
4. Dash J, Naik BS, Mohapatra UB. Variability, correlation and path- coefficient analysis in linseed (*Linum usitatissimum* L.) under late sown conditions in the north central plateau zone of Odisha in India. Int. J Adv. Res. 2016; 4(1): 799-811.
5. Dewey JR, Lu KH. A correlation and path coefficient analysis of components of crested wheat seed production. Agron. J. 1959; 51:515-518.
6. Ganokar PM, Jain RK. Flaxseed - a nutrional punch. International Food Research Journal 2013; 20:519-525.
7. Johnson HW, Robinson HF, Comstock RE. Genotypic and phenotypic correlation in soybean and their implications in selection. Agron. J. 1955; 47(10):177-183.
8. Kasana RK, Singh PK, Tomar A, Mohan S, Kumar S. Selection parameters (heritability, genetic advance, correlation and path coefficient) analysis in linseed (*Linum usitatissimum* L.). The Pharma Innovation Journal. 2018; 7(6):16-19.
9. Kumar N, Paul S. Selection criteria of linseed genotypes for seed yield traits through correlation, path coefficient and principal component analysis. The Journal of Animal and Plant Sciences. 2016; 26:1688-1695.
10. Kumar PK, Singh PK, Satyendra, Kumar S. Evaluation of genetic variability, heritability and genetic advance for seed yield and alternaria blight resistance in linseed (*Linum usitatissimum* L.). Int. J Engineering & Science Res. 2013; 3(12):708-713.
11. Patial R, Paul S, Sharma D. Correlation and path coefficient analysis for improvement of seed yield in linseed (*Linum usitatissimum* L.). International Journal of Current Microbiology and Applied Sciences. 2018a; 7(3):1853-1860.
12. Patial R, Paul S, Sood VK, Sharma D. A comparative analysis of genetic variability in linseed (*Linum usitatissimum* L.) under normal and late sown conditions. Journal of Pharmacognosy and Phytochemistry. 2018b; 7(2):3956-3958.
13. Paul S, Kumar N, Chopra P. Genetic variation and characterization of different linseed genotypes (*Linum usitatissimum* L.) for agro-morphological traits. Journal of Applied and Natural Science. 2017a; 9(2):754-762.
14. Paul S, Kumar N, Kumar A. Characterization and genetic variation study among linseed (*Linum usitatissimum* L.) genotypes for seed yield and related traits in Mid-Hills of North-West Himalayas. Plant Archives. 2017b; 17(1):407-411.