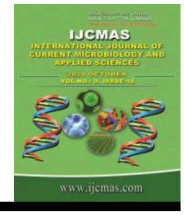
Int.J.Curr.Microbiol.App.Sci (2020) *9*(10): 2579-2586

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 10 (2020)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2020.910.310

Genetic Variability and Path Analysis for Yield and its related Traits in Linseed (*Linum usitatissimum* L.)

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Keywords

Variability, Heritability, Genetic advance, Linseed

Article Info

Accepted:
20 September 2020
Available Online:
10 October 2020

ABSTRACT

An experiment was conducted to study the nature and magnitude of genetic variability with a view to identify promising genotypes for yield and related traits in linseed. Eighteen diverse linseed (*Linum usitatissimum* L.) genotypes were evaluated in randomized block design in three replications during *rabi* 2019-20 for twelve agro morphological characters to assess the genetic parameters of variability. Analysis of variance indicated presence of a wide range of genetic variability among genotypes for all the traits. The higher phenotypic coefficient values than corresponding genotypic coefficient values depicted influence of environment in the expression of traits. Technical height exhibited highest GCV value while the lowest GCV was observed for days to 75% maturity. High estimates of PCV and GCV indicate sufficient variability, signifying the effectiveness of the selection of desirable types for improvement of such characters. The high expected genetic advance expressed as percentage of mean were recorded for technical height, aerial biomass per plant, plant height, primary branches per plant and secondary branches per plant. High heritability with moderate genetic advance was observed for technical height indicating the presence of additive and non-additive gene action. Path analysis revealed, direct and indirect effects of genotypic path coefficient were higher in magnitude than the corresponding phenotypic path coefficients. Highest positive direct effect on seed yield was shown harvest index followed by aerial biomass, plant height, secondary branches per plant and days to 75% maturity. The obtained results could be used further in breeding programmes.

Introduction

Linseed, *Linum usitatissimum* L. (n=15) is a member of genus *Linum* of family Linaceae. It is a self-pollinated species grown during *rabi* season and is one of the oldest plant species cultivated for oil and fibre (Lay and Dybing 1989). The center of origin of linseed is considered in India, from where it spreaded globally including Ethiopia (Wakjira *et al.*, 2004). Linseed is commercially grown for extraction of high quality fibre called 'linen' along with oil from its seeds. It contains a varying oil content of about 33-45 per cent. Linseed is unique among oilseeds and has gained new interest in recent past in emerging market of functional food due to the presence of high content of omega-3 i.e. alpha linolenic acid (36-57%), an essential polyunsaturated fatty acid along with omega-6 i.e. linoleic acid (18-24%) (Ganorkar and Jain 2013). The medicinal properties of linseed help in reducing blood cholesterol, heart diseases, rheumatoid arthritis along with some antioxidant properties due to lignans. Linseed oil plays an important role in the manufacturing of paints, varnishes, printing ink, pad ink, etc., due to the fast-drying properties it imparts.

Globally linseed covers an area of 3.26 million ha with the production of about 3.18 million tons and productivity of 1011.20 kg/ ha. India ranks fifth in the world with the area, production and productivity of 0.32 million ha, 0.17 million tons and 543.8 kg/ ha, respectively (FAOSTAT 2018). While in Himachal Pradesh, 0.80 thousand ha is under linseed cultivation with the production of 0.24 thousand ha and average productivity of 243 kg/ ha (Statistical year book of H.P 2018).

Variability is the foremost prerequisite for any breeding programme. The large extent of genetic variability in the segregating population depends on the amount of the genetic variability among genotypes and offer better scope for selection. Thus the assessment of variability is important for economically important traits. Since, genetic parameters such as genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance are useful in detecting the amount of variability in germplasm along with path analysis studies which represent the relative importance of each factor contributing towards economically important traits such as seed yield. Path co-efficient analysis developed by Wright (1921) helps in partitioning the correlation co-efficient into direct and indirect effects, so that contribution of each component character to the end product yield could be evaluated.

Materials and Methods

Testing location and layout of experiment

The experimental material comprised of 18 genotypes, which were sown in randomized block design with 3 replications during *rabi* 2019-2020 at Experimental Farm of Genetics and Plant Breeding, CSK HPKV Palampur. The experimental plot of size 1×0.75 m^2 with three 1 meter long row, having inter-row and plant to plant distance of 25 cm and 5 cm, respectively. The recommended package of practices was adopted for the proper growth of the linseed. Data were recorded from 5 randomly selected competitive plants for traits such as; primary branches per plant, secondary branches per plant, plant height (cm), technical height (cm), number of capsules per plant, number of seeds per capsule, seed yield per plant (g), aerial biomass per plant (g), harvest index (%) and 1000-seed weight (g) while days to 50% flowering and days to 75% maturity were recorded on plot basis.

Experimental material

The experiment was conducted using 18 genotypes namely; KL-305, KL-306, KL-307, KL-308, KL-309, KL-310, KL-311, KL-312, KL-313, KL-314, KL-315, KL-316, KL-317, KL-318, KL-319, K 1 Raja, JRF-4 and Nagarkot.

Statistical analysis

The data obtained were subjected to analysis as per Panse and Sukhatme (1984). The genetic parameters phenotypic, genotypic and environmental coefficients of variation were analyzed as suggested by Burton and De Vane (1953) and Johnson *et al.,* (1955) along with heritability (h^2bs) which was calculated as a ratio of genotypic variance to the sum of genotypic and environmental variance. The expected genetic advance for various traits was calculated as per Burton and De Vane (1953) and Johnson *et al.*, (1955). Direct and indirect effects of component characters on seed yield were computed using appropriate correlation coefficient of different component traits as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

Results and Discussion

Analysis of variance revealed the significance of all the characters under investigation, indicating the presence of wide range of genetic variability among genotypes for yield and its related traits (Table 1). Payasi *et al.*, (2000), Singh (2001), Diederichsen and Fu (2008), Bibi *et al.*, (2013), Singh *et al.*, (2015), Kumar and Paul (2016), Patial *et al.*, (2018), Ankit *et al.*, (2019) and Banjare *et al.*, (2019), Paul *et. al* (2020) also reported a high amount of genetic variability for these traits.

Variability parameters such as phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in broad sense (h^2bs) and expected genetic advance expressed as per cent of mean for twelve morphological characters has been represented in table 2. The higher phenotypic coefficient values than corresponding genotypic coefficient values showed an important role of environment in the expression of these traits. The characters harvest index (33.47%), aerial biomass (27.22%), seed yield per plant (26.61%) and technical height (25.48%) exhibited high PCV values. The least PCV was recorded for days to 75% maturity (1.11%), days to 50% flowering (4.31%) and seeds per capsule (8.74%). Technical height exhibited the highest GCV (25.33%) value while the lowest GCV was observed days to 75% maturity (0.92%), days to 50% flowering (3.10%), seeds per capsule (6.16%) and 1000-seed weight (7.55%). These findings were in accordance with various researchers such as Payasi *et al.*, (2000) observed high GCV for fibre length; Savita (2006) recorded high PCV value for seed yield per plant. High PCV, high heritability and moderate genetic advance (15-30%) was recorded for aerial biomass per plant.

Estimates of heritability in broad sense (h^2bs) ranged from 19.24% in 1000-seed weight to 98.88% in technical height. Days to 75% maturity (69.07%), primary branches per plant (96.70%), secondary branches per plant (97.73%), plant height (98.73%), technical height (98.88%), capsules per plant (98.54%) and aerial biomass (65%) exhibited high heritability which indicates the ability of genotypes to transmit genes to their offsprings. Similar results were reported earlier by Singh *et al.*, (2015) and Bhushan *et.al* (2019). Moderate heritability was recorded for characters days to 50 % flowering (51.77%), seeds per capsule (49.80%) and harvest index (37.51%). Moderate to high heritability estimates for all characters were observed by Yadav and Gupta (1999). The high expected genetic advance expressed as percentage of mean were recorded for technical height (51.89%), aerial biomass per plant (36.44%), plant height (34.20%), primary branches per plant (33.82%) and secondary branches per plant (33%). The traits capsules per plant (29.67%) and harvest index (25.86%) exhibited moderate genetic advance as percentage of mean whereas, low estimates for genetic advance were reported for seed yield per plant (13.52%), seeds per capsule (8.96%), 1000-seed weight (6.78%), days to flowering (4.60%) and days to 75% maturity (1.57%). High heritability with moderate genetic advance was observed for technical height indicating the presence of additive and non-additive gene action. Pali and Mehta (2013) found high heritability with moderate genetic advance for oil content and all fatty acid components. Leelavathi and Mogali (2018) reported high heritability with moderate to high level of genetic advance for all characters. However, high heritability and the low genetic advance was recorded for most of the characters which are in agreement with Bibi *et al.*, (2013) who reported high heritability with low genetic advance for various traits such as days to 50% flowering and days to 75% maturity.

Table.1 Analysis of variance for yield and related traits in linseed

Sr.No.	Characters	Mean Sum of Squares		
		Replication	Treatments	Error
	d.f.	2	17	34
1	Days to 50%fowering	9.47	15,721.60*	6.321
2	Days to 75% maturity	25.09	9,555.46*	10.074
3	Primary branches per plant	5.09	15,440.27*	11.062
4	Secondary branches per plant	16.43	9,573.82*	4.362
5	Plant height (cm)	31.18	15,062.10*	7.610
6	Technical height (cm)	45.83	9,437.74*	7.668
7	Capsules per plant	23.22	15,000.90*	10.781
8	Seeds per capsule	137.72	9,771.28*	35.701
9	Seed yield per plant (g)	0.71	15,242.07*	3.784
10	Aerial biomass per plant (g)	16.23	9,310.86*	5.495
11	Harvest index (%)	47.86	15,183.72*	14.988
12	1000-seed weight (g)	87.20	9,552.99*	16.507

Table.2 Genetic parameters of variability for different yield and related traits in linseed

Characters	Mean± SE	Range		PCV	GCV	h^2 (bs)	GA	GAM (%)
		Mini.	Max.					
Days to 50% flowering	144.93± 3.54	134.00	157.00	4.31	3.10	51.77	6.62	4.60
Days to 75% maturity	211.54± 1.06	206.00	214.00	1.11	0.92	69.07	3.32	1.57
Primary branches/plant	6.32± 0.16	4.00	8.30	16.99	16.80	96.70	2.14	33.82
Secondary branches/plant	8.77± 0.18	6.20	10.93	16.40	16.20	97.73	2.89	33.00
Plant height (cm)	75.68± 1.17	56.55	111.12	16.82	16.70	98.73	25.88	34.20
Technical height (cm)	45.22± 0.99	27.45	75.23	25.48	25.33	98.88	23.46	51.89
Capsules per plant	37.06± 0.54	29.93	48.56	14.62	14.51	98.54	10.99	29.67
Seeds per capsule	7.54± 0.39	6.90	8.77	8.74	6.16	49.80	0.67	8.96
Seed yield per plant (g)	2.82± 0.53	1.92	4.11	26.61	13.21	24.67	0.32	13.52
Aerial biomass per plant (g)	41.01± 5.40	31.95	73.82	27.22	21.95	65.00	14.94	36.44
Harvest index	7.23± 1.56	4.60	12.26	33.47	20.50	37.51	1.89	25.86
1000-seed weight (g)	7.07± 0.89	4.99	8.13	17.12	7.55	19.24	0.48	6.78

Table.3 Estimates of direct and indirect phenotypic (P) and genotypic (G) effects of different traits on seed yield in linseed

		Days to 50% flowering	Days to 75% maturity	Primary branches	Secondary branches	Plant height (cm)	Technical height (cm)	Capsules per plant	Seeds per capsule	Aerial biomass (g)	Harvest index (%)	1000 seed weight (g)	Correlation with seed yield per plant
Days to 50% flowering	P	**-0.0207**	-0.0004	-0.0019	-0.0075	0.1068	-0.0638	0.0128	0.0001	0.0836	0.0446	0.0069	0.1606
	G	**-0.3984**	-0.0356	0.0839	0.1530	-0.5194	0.6720	0.0389	0.0339	0.3503	-0.0524	-0.0187	0.3075
Days to 75%maturity	P	0.0004	**0.0229**	-0.0064	0.0213	-0.2376	0.1681	-0.0115	0.0002	-0.1762	-0.1590	0.0067	-0.3711
	G	0.0313	**0.4537**	0.1858	-0.3450	1.0359	-1.5881	-0.0314	0.0195	-0.5793	-0.2033	0.0013	-1.0196
Primary branches per plant	P	-0.0013	0.0049	**-0.0303**	0.0872	-0.0660	0.0167	-0.0336	-0.0005	0.0960	-0.3323	-0.0156	-0.2748
	G	-0.0421	0.1061	**0.7946**	-1.1695	0.2456	-0.1396	-0.0709	-0.0340	0.2212	-0.3461	-0.0339	-0.4687
Secondary branches per plant	P	0.0015	0.0049	-0.0263	**0.1007**	-0.0428	0.0012	-0.0446	-0.0004	0.1514	-0.3583	0.0008	-0.2118
	G	0.0463	0.1190	0.7066	**-1.3152**	0.1528	-0.0031	-0.0941	-0.0237	0.4004	-0.4216	0.0035	-0.4288
Plant height (cm)	P	-0.0053	-0.0130	0.0048	-0.0103	**0.4164**	-0.2710	-0.0100	0.0002	0.3056	0.1332	0.0042	0.5548
	G	-0.1403	-0.3187	-0.1323	0.1363	**-1.4747**	2.1286	-0.0207	0.0143	0.7630	0.1388	0.0116	1.1059
Technical height (cm)	P	-0.0047	-0.0138	0.0018	-0.0004	0.4057	**-0.2782**	-0.0069	0.0001	0.3058	0.1143	0.0000	0.5237
	G	-0.1238	-0.3331	-0.0513	0.0019	-1.4512	**2.1630**	-0.0148	0.0052	0.7558	0.1425	0.0014	1.0956
Capsules per plant	P	0.0027	0.0027	-0.0104	0.0460	0.0426	-0.0196	**-0.0976**	0.0000	0.1614	-0.2690	0.0432	-0.0981
	G	0.0773	0.0711	0.2812	-0.6176	-0.1524	0.1592	**-0.2004**	0.0018	0.4026	-0.2953	0.0997	-0.1728
Seeds per capsule	P	-0.0012	0.0023	0.0067	-0.0163	0.0363	-0.0149	0.0012	**0.0024**	0.0524	-0.0720	0.0238	0.0208
	G	-0.1274	0.0836	-0.2547	0.2937	-0.1984	0.1058	-0.0035	**0.1059**	0.2066	0.0253	0.0629	0.2998
Aerial biomass (g)	P	-0.0030	-0.0070	-0.0050	0.0264	0.2204	-0.1473	-0.0273	0.0002	**0.5775**	-0.3980	-0.0030	0.2339
	G	-0.1199	-0.2258	0.1510	-0.4524	-0.9665	1.4042	-0.0693	0.0188	**1.1641**	-0.4975	0.0436	0.4504
Harvest index (%)	P	-0.0010	-0.0039	0.0108	-0.0386	0.0594	-0.0340	0.0281	-0.0002	-0.2461	**0.9340**	0.0146	0.7231
	G	0.0320	-0.1415	-0.4221	0.8509	-0.3142	0.4729	0.0908	0.0041	-0.8889	**0.6516**	-0.0350	0.3006
1000 seed weight (g)	P	0.0013	-0.0014	-0.0042	-0.0007	-0.0156	0.0001	0.0378	-0.0005	0.0153	-0.1222	**-0.1115**	-0.2019
	G	-0.0661	-0.0053	0.2396	0.0415	0.1515	-0.0278	0.1776	-0.0592	-0.4521	0.2030	**-0.1125**	0.0902

Path coefficient analysis allows the partitioning of the correlation coefficients into components of direct and indirect effects. Table 3 represents the results obtained by keeping seed yield as the dependent variable and rest as independent variable. The direct and indirect effects of genotypic path coefficient were higher in magnitude than the corresponding phenotypic path coefficients. The results were in accordance with Gauraha and Rao (2011) and Reddy *et al.,* (2013). The residual effect for path coefficients was (0.097). At phenotypic level, harvest index followed by aerial biomass, plant height, secondary branches per plant and days to 75% maturity had highest positive direct effect on seed yield. This indicated significant role of accumulation of harvest index and its partitioning into seed yield. The significant positive correlation of days to 50% flowering with seed yield was mainly due to indirect effects via plant height, aerial biomass per plant and harvest index. Similarly, significant positive correlation of technical height with seed yield was mainly due to indirect effects via plant height and aerial biomass per plant whereas, indirect effects via other traits were low in magnitude. Significant positive correlation of seeds per capsule with yield was mainly due to indirect effects via aerial biomass per plant, plant height, 1000-seed weight and primary branches per plant. Harvest index exhibited the highest direct effect with seed yield per plant. The above results were also reported by Chimurkar *et al.,* (2001) and Patial *et al.,* (2018).

In conclusion, high estimates of PCV and GCV indicate the presence of sufficient variability among genotypes for different characters studied, signifying the effectiveness of selection of desirable types for improvement of such characters. High heritability accompanied with high genetic advance for technical height revealed additive gene effects in inheritance of these traits. Whereas, high heritability coupled with moderate genetic advance indicates the presence of additive and non-additive gene effects. High positive direct effects of characters such as harvest index, aerial biomass, plant height, secondary branches per plant and days to 75% maturity would be helpful to improve economically important characters such as seed yield.

References

Ankit, Kerkhi S.A., Singh S.P., Singh V.K., Tiwari A. and Singh A. 2019. Estimation of genetic variability, heritability and genetic advance among the genotypes/lines for seed yield and other economic traits in linseed (*Linum usitatissimum* L.). *Journal of Pharmacognosy and Phytochemistry* 8: 390-394.

Banjare A.K., Marker S., Verma R.K. and Tiwari A. 2019. Genetic variability analysis for plant selection in linseed (*Linum usitatissimum* L.). *Journal of Pharmacognosy and Phytochemistry* 8: 555-558.

Bhushan S., Ram S., Kumar S., Choudhary A.K., Choudhary V.K. and Ahmad E. 2019. Genetic variability and selection response for yield and its component traits in linseed (*Linum usitatissimum* L.). *Journal of Agriculture Search* 6: 46-49.

Bibi T., Mahmood T., Mirza Y., Mahmood T. and Ejaz-ul-Hasan. 2013. Correlation studies of some yield related traits in linseed (*Linum usitatissimum* L.). *Journal of Agricultural Sciences* 51: 121-132.

Burton G.W. and Devane E.H. 1953. Estimating heritability in tall fescue *(Festuca arundinaceia)* from replicated clonal material. *Agronomy Journal* 45: 478-481.

Chimurkar H.C., Shanti P and Rathod D.R.

2001. Character association studies in linseed (*Linum usitatissimum* L.). *Annals of Plant Physiology* 15: 72-76.

Dewey D.R. and Lu K.H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agronomy Journal* 51: 515–518.

Diederichsen A. and Fu Y.B. 2008. Flax genetic diversity as the raw material for future success. In: International Conference on Flax and Other Bast Plants.

FAOSTAT. 2018. Food and Agriculture Organization. http://www.fao.org/faostat/en/#data/QC

Ganorkar P.M. and Jain R.K. 2013. Flaxseed - a nutritional punch. *International Journal of Food Research* 20: 519-525.

Gauraha D. and Rao S.S. 2011. Association analysis for yield and its characters in linseed (*Linum usitatissimum* L.). *Research Journal of Agricultural Sciences* 2: 258-260.

Johnson H.W., Robinson H.F. and Comstock R.E. 1955. Estimates of genetic and environmental variability in soybean. *Agronomy Journal* 47: 314-318.

Kumar N. and Paul S. 2016. Selection criteria of linseed genotypes for seed yield traits through correlation, path coefficients and principal component analysis. *The Journal of Animal and Plant Sciences* 26: 1688-1695.

Lay C.L. and Dybing C.D. 1989. Linseed. Oil crops of the world. McGraw-Hill, New York.

Leelavathi T.M. and Mogali S.C. 2018. Genetic variability, character association and path analysis for yield and yield components in mutant population of linseed. *Journal of Farm Science* 31: 17-20.

Pali V. and Mehta N. 2013. Studies on genetic variability, correlation and path analysis for yield and its attributes in linseed (*Linum usitatissimum* L.). *Plant Archives* 13: 223-227.

Panse V.G. and Sukhatme P.V. 1984. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi.

Patial R., Paul S. and Sharma D. 2018. Correlation and path coefficient analysis for improvement of seed yield in linseed (*Linum usitatissimum* L.). *International Journal of Current Microbiology and Applied Science* 7: 1853-1860.

Patial R., Paul S., Sood V.K., Sharma D. 2018. A comparative analysis of genetic variability in linseed (*Linum usitatissimum* L.) under normal and late sown conditions. *Journal of Pharmacognosy and Phytochemistry* 7: 3956-3958.

Paul S., Satasiya P. and Kumar A. 2020. Genetic variability, correlation and path coefficient analysis of introduced genotypes of linseed (*Linum usitatissimum* L.) in mid-hills of North-West Himalayas. *Journal of Pharmacognosy and Phytochemistry* 9: 1189-1192.

Payasi S.K., Bose U.S. and Singh A.K. 2000. Pooled analysis of genetic parameters in linseed (*Linum usitatissimum* L.). *Advances in Plant Sciences* 13: 559-562.

Reddy M.P., Reddy R.B., Arsul B.T. and Maheshwari J.J. 2013. Character association and path coefficient studies in linseed. *International Journal of Current Microbiology and Applied Science* 2: 250-254.

Savita S.G. 2006. Diversity of linseed germplasm for yield and yield components. M.Sc thesis, Department of Genetics and Plant Breeding, University of Agricultural Sciences, Dharwad, India.

Singh A., Rai P.K., Kumar A., Marker S. and Yadav P.K. 2015. Study on variability, heritability and correlation coefficient among linseed (*Linum usitatissimum* L.) genotypes. *Advances in Applied Science Research* 6: 14-17.

Singh D.N. 2001. Heritability and genetic advance in linseed. *Journal of Research* 13: 73-74.

Statistical year book of Himachal Pradesh. 2018. https://himachalservices.nic.in/economics/en-IN/publications.html .

Wakjira A., Maryke T.L. and Arno H. 2004. Variability in oil content and fatty acid composition of Ethiopian and introduced cultivars of linseed. *Journal of Science Food Agriculture* 84: 1- 8.

Wright S. 1921. Correlation and causation. *Journal of Agricultural Research* 20: 557-585.

Yadav R.K. and Gupta R.R. 1999. Genetic analysis of yield and related components in linseed (*Linum usitatissimum* L.). *Crop Res*earch 18: 404-408.

How to cite this article:

Ronika Thakur, Satish Paul and Pratik Satasiya. 2020. Genetic Variability and Path Analysis for Yield and its Related Traits in Linseed (*Linum usitatissimum* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(10): 2579-2586. doi: https://doi.org/10.20546/ijcmas.2020.910.310