International Journal of Plant & Soil Science

34(23): 1019-1024, 2022; Article no.IJPSS.93247
ISSN: 2320-7035

Assessment of Elite Genotypes of Linseed (*Linum usitatissimum* L.) for Genetic Variability, Correlation Studies and Path Coefficient Analysis

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i232511

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/93247

Original Research Article

Received 22 August 2022
Accepted 25 October 2022
Published 02 November 2022

ABSTRACT

An experiment was conducted to assess the induced genetic variability with a view to identify encouraging genotypes for yield and related traits in linseed. Sixteen linseed (*Linum usitatissimum* L.) genotypes were evaluated in randomized block design in three replications during *rabi* 2021-2022 for thirteen agro morphological characters to estimate the genetic parameters of variability. Analyses of variance specify presence of wide range of genetic variability among genotypes for all the characters. The higher phenotypic coefficient values than corresponding genotypic coefficient values depicted influence of environment in the expression of characters. Harvest index exhibited highest GCV and PCV (24.284 and 25.232) value while the lowest GCV and PCV was observed for days to maturity (4.998 and 5.757). High rate of PCV and GCV indicates sufficient variability, denotes the effectiveness of the selection of desirable types for development of such traits. The high expected genetic advance expressed as percentage of mean were recorded for final plant stand followed by initial plant stand, harvest index and capsules per plant. High heritability was observed for chlorophyll. Path analysis released, direct and in direct effect. Highest positive direct effect on seed yield per plant was shown plant height (0.371) followed by number of primary branches (0.39), final plant stand (0.245), days to first flowering (0.21) and harvest index (0.114). The obtained results could be used further in breeding programmes.

Keywords: GCV; PCV; path analysis; linseed.

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1. INTRODUCTION

Linseed (*Linum usitatissimum* L., 2n = 30) is commonly known as flax. It belongs to the family Linaceae and the genus Linum. It is originated in two centers' Viz., oil type in South West Asia as well as fibre type in Mediterranean region. It is one of the most important oil seed crops in India with 33-45% [1] of oil produced from its seeds and high-quality linen is also extracted and is behaved to have self-pollinated crop [2]. Linseed having high nutritional quality of omega -3 i.e. alpha linolenic acid, omega -6 i.e. Linoleic acid along with an essential poly unsaturated fatty acid. The medicinal properties of linseed helps in reducing blood cholesterol, cancer, diabetics and heart diseases [3]. Linseed oil plays an important role in manufacturing of paints, varnishes, printing ink, pad ink etc., due to the fast-drying properties it imparts [4]. 20% of oil which produced from linseed is used by farmers and the 80% of the oil goes to industries for manufacturing varnishes, oil cloths etc.

The production scenario comprises of area under linseed cultivation in globally which is 3.26 million ha with annual 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 543 kg/ ha. [5] and is mainly grown in Madhya Pradesh, Karnataka, Maharashtra, Uttar Pradesh, Bihar [6].

Genetic variability is the leading prerequisite for any breeding programme. The assessment of variability is important for economically important traits. Since, genetic parameters such as genotypic coefficient variation, phenotypic coefficient of variation, heritability and genetic advance are useful in identifying the amount of variability in germplasm [7]. Interrelationship between major yield components with yield is best judge by correlation coupled with path coefficient analysis [8]. Helps in portioning the correlation coefficient into direct and indirect effects, so the contribution of each component character to the end product yield could be estimated.

Objectives:

1) To study the magnitude of variability for yield and yield attributing traits in linseed
2) To study the correlation between yield and yield attributing traits

2. MATERIALS AND METHODS

The field experimental center and Seed Testing Laboratory, Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology, and Sciences conducted a study of correlation and path analysis in linseed for yield and yield attributing traits during Rabi 2021-2022 in a randomized block design with three replications. The testing location is located on the left side of the Allahabad Rewa Road. It is around 5 kilometers from Allahabad and quite close to the Yamuna River. The experimental area had consistent topography and homogeneous fertility, making it ideal for linseed cultivation. Data were recorded for five randomly selected competitive plants for characters such as Primary branches, Secondary branches, Plant height(cm), Capsules per plant, Seeds per capsule, Test weight (gm), Harvest index (%), Yield per plant(gm), while Germination percentage (%), Final plant stand, Days to first flowering, Days to 50% flowering, Days to maturity, were recorded on plot basis.

2.1 Experimental Material

The experiment was conducted using 16 genotypes namely; IC-15866, GSBG-(1022), GS 129(1018), EC-41665, EC-589, EC-571M, A-60(100), 1206-(153), RST(R)/120-RL/1019, GP(I)-29, BAU-13-01, BAU-14-09, BAU-2019-19, NEELAM, T-397 and UMA.

2.2 Statistical Analysis

The data acquire were subjected to analysis. The genetic parameters phenotypic, genotypic, environmental coefficient of variation and heritability (h^2bs) along with genetic advance were analyzed as suggested by Burton and De vane [9] and Johnson et al. [10]. Direct and Indirect effects of component characters on seed yield were computed using appropriate correlation coefficient of different component characters as suggested by Wright [8] and elaborated by Dewey and Lu [11].

3. RESULTS AND DISCUSSION

The analysis of variance revealed sufficient variability due to genotypes for all characters (Table 1) indicating the presence of wide range of genetic variability and scope for selection. Similar results were also observed by Kumar et al. [12], Ronika et al. [5], Bindra et al. [13], Kumar et al. [14], Ashok et al. [15]. Variability

parameters such as Phenotypic coefficient of variance (PCV), genotypic coefficient of variance (GCV), heritability (h^2bs) and genetic advance as percent of mean for 13 traits has been represented in table. The higher phenotypic coefficient values than corresponding genotypic coefficient values showed an important role of environment in the in the expression of these traits harvest index (25.232%), capsules per plant (25.068%), number of primary branches(17.83%), final plant stand (18.19%), number of secondary branches (16.292%), germination percentage (16.898%), Yield per plant (14.295%), plant height (13.001%), test weight (6.544%), seeds per capsule (5.787%), days to 50 % flowering (5.867%), days to first flowering (5.757), days to maturity (5.18%).These findings were in various researchers such as Paul et al. [16] observed high PCV for Plant height and Rajanna et al. [17] recorded high PCV in harvest index.

The estimation of heritability (%) in the broad sense for 13 characters studied, which ranged from 70 % to 93%. High heritability (broad sense) 93% capsules per plant followed by 92% for harvest index, 87% for number of primary branches, 84% for final plant stand and secondary branches, 82% for germination percentage and plant height, 79% for yield per plant and seeds per capsule, 76% days to 50% of flowering, 75% for days to first flowering, 73% for test weight and 70% for days to maturity exhibits high heritability which indicates the ability of genotypes to transmit genes to their offspring's similar results were reported by Singh et al. [18] Genetic advance was given by Lush [19].

Table 1. Analysis of variance for 13 characters of 16 Linseed genotypes

Source of Var.	Mean sum of squares		
	Replicate	Treatments	Error
	DF=2	DF=15	DF=30
Germination percentage	877.77	470.43*	84.75
Final plant stand	2095.19	1943.74*	302.28
Days to first flow	42.58	55.86*	13.76
Days to 50% flower	17.06	64.66*	15.97
Days to maturity	6.44	98.84**	24.39
Plant height	72.06	165.83*	29.78
Number of primary branches	0.60	2.06*	0.26
Number of secondary branches	56.33	24.68*	3.76
Seeds per capsule	0.03	0.74**	0.15
Capsules per plat	222.58	480.40*	33.76
Test weight	0.10	0.58*	0.15
Harvest index	13.21	739.89**	54.55
Yield per plant	0.19	0.11*	0.02

**, ** indicates 5% and 1% significant level*

Table 2. Genetic parameters for 13 characters of 16 linseed genotypes

Source of Var.	GCV	PCV	h² (Broad Sense)	Genetic Advance 5%	Gen. Adv as % of Mean 5%
Germination percentage	15.301	16.898	82	21.149	28.54
Final plant stand	16.716	18.19	84	44.281	31.644
Days to first flowering	4.998	5.757	75	6.699	8.937
Days to 50% flowering	5.091	5.867	76	7.201	9.101
Days to maturity	4.496	5.18	70	8.906	8.037
Plant height	11.776	13.001	82	12.566	21.973
Number of primary branches	16.653	17.83	87	1.49	32.041
Number of secondary branches	15.001	16.292	84	5.009	28.453
Seeds per capsule	5.167	5.787	79	0.818	9.505
Capsules per plant	24.172	25.068	93	24.236	48.012
Test weight	5.619	6.544	73	0.668	9.939
Harvest index	24.284	25.232	92	29.966	48.146
Yield per plant	12.762	14.295	79	0.318	23.47

Table 3. Phenotypic correlation coefficient for 13 characters of 16 linseed genotypes

Traits	Germination percentage	Final plant stand	Days to first flowering	Days to 50% flowering	Days to maturity	Plant height	Number of primary branches	Number of secondary branches	Seeds per capsule	Capsules per plant	Test weight	Harvest index	Yield per plant
Germination percentage	1												
Final plant stand	0.9498**	1											
Days to first flowering	0.2050*	0.4082*	1										
Days to 50% flowering	-0.1846	-0.2393	0.0953	1									
Days to maturity	-0.4098*	-0.5076*	-0.5739*	0.1619	1								
Plant height	-0.3426*	-0.3114*	-0.0439	0.2490*	0.0327	1							
Number of primary branches	-0.2761	-0.3131*	-0.3932*	-0.2069	0.0823	0.0801	1						
Number of secondary branches	0.1951	0.1582	-0.2726	-0.4194*	-0.2248	-0.072	0.2456*	1					
Seeds per capsule	0.2492*	0.2408*	-0.4308	-0.1441	0.2486	-0.0427	0.0741	0.2286*	1				
Capsules per plant	0.1766	0.4074*	0.6670**	-0.0529	-0.6190**	0.0226	-0.4682*	-0.1193	0.0302	1			
Test weight	0.1756	0.2461*	0.1074	-0.4573*	-0.3202*	-0.6147**	-0.0548	0.216	-0.0386	0.2907*	1		
Harvest index	0.3001*	0.4064*	0.4433*	-0.1867	-0.3845*	-0.0876	0.1177	0.2856*	0.0476	0.1608	0.1537	1	
Yield per plant	0.0261	0.1321*	0.3102*	-0.1359*	-0.2182	0.3035*	0.3643*	-0.0199	0.1706*	0.0005	-0.2379	0.2832*	1

Table 4. Path coefficient analysis for 13 characters of 16 linseed genotypes

	Germination percentage	Final plant stand	Days to first flowering	Days to 50% flowering	Days to maturity	Plant height	Number of primary branches	Number of secondary branches	Seeds per capsule	Capsules per plant	Test weight	Harvest index
Germination percentage	**-0.381**	0.5872	0.019	0.0034	0.0099	-0.0869	-0.0891	-0.0072	-0.0282	-0.0222	-0.017	0.0345
Final plant stand	-0.3521	**0.636**	0.0475	0.013	0.0136	-0.0664	-0.0969	-0.0083	-0.0331	-0.055	-0.0211	0.0475
Days to first flowering	-0.0486	0.203	**0.149**	0.0071	0.0152	-0.0213	-0.0957	0.0177	0.0238	-0.0885	-0.0018	0.0438
Days to 50% flowering	0.0129	-0.0827	-0.0106	**-0.1**	-0.0063	0.0552	-0.0363	0.0317	0.0353	0.0054	0.0297	-0.0161
Days to maturity	0.0839	-0.191	-0.0501	-0.014	**-0.045**	0.0147	0.0182	0.022	-0.0298	0.0635	0.0283	-0.0362
Plant height	0.106	-0.135	-0.0101	-0.0177	-0.0021	**0.313**	0.0015	0.0068	-0.0028	-0.0028	0.0496	-0.0101
Number of primary branches	0.1058	-0.1919	-0.0444	0.0113	-0.0025	0.0015	**0.321**	-0.0195	-0.0114	0.0609	0.0128	0.0111
Number of secondary branches	-0.0298	0.0571	-0.0285	0.0343	0.0108	-0.0232	0.0678	**-0.093**	-0.0369	0.0178	-0.0205	0.0399
Seeds per capsule	-0.0665	0.13	-0.0219	0.0219	-0.0083	0.0055	0.0227	-0.0211	**-0.162**	-0.0037	0.0105	0.0067
Capsules per plant	-0.0546	0.2248	0.0847	0.0035	0.0185	0.0056	-0.1257	0.0106	-0.0039	**-0.155**	-0.0217	0.0193
Test weight	-0.0604	0.1249	0.0026	0.0277	0.0119	-0.1444	-0.0384	-0.0177	0.0159	-0.0314	**-0.107**	0.0213
Harvest index	-0.0952	0.2173	0.0472	0.0117	0.0118	-0.023	0.0259	-0.0267	-0.0079	-0.0217	-0.0165	**0.138**
Yield per plant	0.0261	0.1321	0.3102	-0.1359	-0.2182	0.3035	0.3643	-0.0199	0.1706	8.0005	0.2379	0.2832

Genetic advance and genetic advance as per percent of mean values Genetic advance ranged from 0.318 to 44.281. High genetic advance is recorded for final plant stand (44.281), harvest index (29.966), capsules per plant (24.236), germination percentage (21.149), plant height (12.56), days to maturity (8.906), days to 50% flowering (7.201), days to first flowering (6.699), number of secondary branches (5.009), number of secondary branches (1.49), number of seeds per capsule (0.81), test weight (0.66) and yield per plant (0.318). Rafiq et al. [20] reported high heritability with moderate to high level of genetic advance for all the traits. However, high heritability and the genetic advance was recorded for the most of the traits which are reported by Singh et al. [21] for high heritability with low genetic advance for various traits such as seeds per capsule and number of primary branches.

3.1 Correlation Analysis

Association analysis measures the inter-relationship between various traits and also find the component character which can be selected to improve yield. Final plant stand, days to first flowering, plant height, number of primary branches, seeds per capsule, harvest index. It exhibited negative and significant correlation with days to 50% flowering. It exhibited positive and non-significant correlation with germination percentage, capsules per plant. it exhibited negative and non-significant correlation with days to maturity, number of secondary branches, test weight. Related findings were carried out by Sharma et al. [22], Chaudhary et al. [23], Bibi et al. [24].

3.2 Path Coefficient Analysis

Path coefficients which are worked out from correlation coefficient are referred to as path coefficient analysis [25,26]. It splits the correlation coefficient into the measures of direct and indirect effect. Table 4 represents the results obtained by keeping seed yield as the dependent variable and the rest as independent variables at phenotypic level for quantitative traits, maximum positive direct effects was depicted by final plant stand (0.636), days to first flowering (0.149), plant height (0.313), number of primary branches (0.321), harvest index (0.138). Related findings were carried out by Akbar et al. [25], Paul et al. [16].

4. CONCLUSION

From the present investigation, it can be concluded that the final plant stand, days to first flowering, plant height, primary branches, seeds per capsule and harvest index were the major yield contributing characteristics which had a positive and significant association with yield per plant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Paul S, Satasiya P, Kumar A. 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. 2020:9;1189-1192.
2. Kumar N, Paul S. Selection criteria of linseed genotypes for seed yield traits through correlation, path coefficients and principal component analysis. The Journal of Animal and Plant Sciences. 2016:2(6): 1688-1695.
3. Dash J, Bhima S, Uma R. 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. International Journal of Advanced Research. 2016:4(1):799-811.
4. Savita S, Kenchanagoudar P. Correlation and path coefficient analysis for yield and yield components in linseed (*Linum usitatissimum* L.) germplasm. Karnataka Journal of Agricultural Sciences. 2011; 24(3):382-386.
5. Ronika T, Paul S, Satasiya P. Genetic variability and path analysis for yield and its related traits in linseed (*Linum usitatissimum* L.). International Journal of Current Microbiology and Applied Sciences. 2020:9(10):2579-2586.
6. Sangeeta SG. Design and implementation of crop yield prediction model in agriculture. International Journal of Scientific & Technology Research. 2020;8(1):544-9.
7. Chandra S. Studies of interrelationship between seed yield and its components in some exotic strains of linseed (*Linum*

usitatissimum L.). Acta Agronomica Hungarica. 1978;27:74-80.
8. Wright S. Correlation and causation. Journal of Agricultural Research. 1921;20: 557-585.
9. Burton G, De vane E. Estimating heritability in tall fascue (Restuca arundian) from replicated clonal material. Agronomy Journal. 1953;1:478-481.
10. Johnson H, Robinson F, Comstock R. Estimates of genetic and environmental variability in soybean. Agronomy Journal. 1955;4(7):314-318.
11. Dewey D, Lu K. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agronomy Journal. 1959;51:515-518.
12. Kumar B, Singh CM, Jaiswal KK. Genetic variability, association and diversity studies in bread wheat (*Triticum aestivum* L.). The Bioscan. 2013;8(1):143-7.
13. Ashok K, Shailesh M, Anam F. Genetic variability and character association for seed yield in linseed (*Linum usitatissimum* L.) under rainfed conditions. Journal of Pharmacogn Phytochem. 2017;6(5):457-460.
14. Kumar A, Kerkhi S, Kumar R. Studies on heritability, genetic advance and character association analysis in linseed (*Linum usitatissimum* L.). The Pharma Innovation Journal. 2017;6(8):310-314.
15. Bindra S, Paul S. Genetic variability and association studies in linseed (*Linum usitatissimum* L.). The Bioscan. 2016;11(3):1855-1859.
16. Paul S, Kumari A, Sharma D. Estimation of phenotypic divergence in linseed (*Linum usitatissimum* L.) for yield-related traits under changed climate in mid-hills of North-West Himalayas. Bangladesh Journal of Botany. 2016;45(5):1163-1171.
17. Rajanna B, Biradar S, Ajithkumar K. Correlation and path coefficient analysis in linseed (*Linum usitatissimum* L.). The Bioscan. 2014;9(4):1625-1628.
18. Singh A, Prashant K, Arvind K, Shailesh M, Yadav P. Study on variability, heritability and correlation coefficient among linseed (*Linum usitatissimum* L.) genotypes. Pelagia Research Library Advances in Applied Science Research. (2015):6(10): 14-17.
19. Lush JL. Heritability of quantitative characters in farm animals. Heritability of quantitative characters in farm animals; 1949.
20. Rafiq A, Ibrar D, Yasin M, Talat M, Khan M, Iqbal M, Munir A. Genetic variability, heritability and genetic advance in some genotypes of linseed (*Linum usitatissimum* L). Journal of Agriculture Research. 2014;52(1).
21. Singh P, Rajamani V. REE geochemistry of recent clastic sediments from the Kaveri floodplains, Southern India: Implication to source area weathering and sedimentary processes. Geochimica et Cosmochimica Acta. 2001 Sep 15;65(18): 3093-108.
22. Sharma D, Paul S, Patial R. Correlation and path coefficient analysis of seed yield and yield related traits if linseed (*Linum usitatissimum* L.) in mid hills of North-West Himalayas. An International Quarterly Journal of Life Sciences. 2016;11(4):3049-3053.
23. Chaudhary M, Rahul V, Singh V, Chauhan M. Correlation and path coefficient analysis for yield and yield related traits in linseed (*Linum usitatissimum* L.). The Bioscan. 2016;11(2):939-942.
24. Bibi T, Mahmood T, Mirza,Y, Mahmood, Hasan E. Correlation studies of some yield related traits in linseed (*Linum usitatissimum* L.). Journal of Agriculture Research (Lahore). 2013;51(2):121-132.
25. Akbar M, Tariq M, Anwar M, Ali MS, Salim J. Linseed Improvement through genetic variability, correlation and path coefficient analysis. International Journal of Agriculture and Biology. 2003;05(3):303-305.
26. Vikas P, Nandan M. Studies on genetic variability, correlation and path analysis for yield and its attributes in linseed (*Linum Usitatissimum* L.). Plant Archive. 2013;13: 223-227.

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