Original Research Article

"ASSESSMENT OF ELITE GENOTYPES OF LINSEED (*Linum usitatissimum* L.) FOR GENETIC VARIABILITY, CORRELATION STUDIES AND PATH COEFFICIENT ANALYSIS"

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 nineteen 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 indirect 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.

Key words : GCV, PCV, Path analysis, Linseed

Introduction

Linseed (*Linum usitatissimum* L.) is commonly called as alsi, a multipurpose oil seed crop. It's a member of genus *linum* of family *linaceae* with chromosome no (2n=30) and have its origin in

two centers. Viz; oil type originated in south west Asia and fibre in Mediterranean region. It is one of the most important oil seed crop in India with 33-45% (Paul *et al.,* 2020) of oil produced from its seeds and high quality linen (strongest and good quality fibre) is also extracted and is behaved to have self pollinated crop (Kumar *et al.,* 2016). Linseed having high nutritional quality of omega -3 (alpha Linolenic acid) and an essential poly unsaturated fatty acids along with omega -6 (Linoleic acid). Is also known to have medicinal properties which helps in reducing blood cholesterol, cancer, diabetics and heart diseases (Dash *et al.,* (2016). Due to its fast drying properties linseed oil is also used in manufacturing of paints, varnishes, printing ink, pad ink etc. Multi purpose oil seed crop *Linum usitatissimum* is the only economically significant species of the family with semi dehiscent and non dehiscent capsule type (Savita, 2011) 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 3.18 milloin tons and productivity of 1011.20 kg/ha. In India linseed is growing in an area of 0.32 milloin ha with annual production of 0.17 million tons and productivity 543 kg/ ha (Ronika Thakur *et al.*,2020) and is mainly grown in Madhya Pradesh, Karnataka, Maharashtra , Uttar Pradesh, Bihar (Sangeeta *et al.,* 2020).

Comment [Autor des1]: "million"

Comment [Autor des2]: "million"

Genetic variability plays a key role in plant breeding for crop improvement. Yield, a complex polygenic traits is influenced by a large number of factors. The genetic construction of economic yield have to sort out with the genetic situation of all other characters affecting it directly or indirectly. Therefore the study of genetic variability with the aid of suitable genetic variables such as genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance are necessary to start efficient breeding programme (Chandra et al., 1978). Interrelationship between major yield components with yield is best judge by correlation coupled with path coefficient analysis (Wright 1921). This procedure used in the crop improvement put to good use of the yield potential for increasing the productivity of the crop and develop high yielding improved varieties.

Materials and Methods

Testing location and layout of experiment

The experimental material constitute of 16 genotypes which were sown in randomized block design with 3 replication during rabi 2021-2022 at experimental farm of Genetics and Plant Breeding, SHUATS Prayagraj, Naini. The experimental plot of size 1x1 m^2 with plant to plant distance of 10cm respectively. The recommended practices was adopted for the proper growth of linseed. 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), oil content (%), Protein (%), carbohydrate (mg/100g) while Germination percentage (%), Initial plant stand, Final plant stand, Days to first flowering, Days to 50% flowering, Days to maturity, Relative water content(%), Chlorophyll(%) were recorded on plot basis.

Comment [Autor des3]: As the genotypic and environmental variances participate in the phenotypic variance components, the data related to the type of soil, its fertility conditions (as well as corrections and fertilization), climate of the region where the study was carried out (place would be better) as well as its geographic positioning must be included in the methodology.

Comment [Autor des4]: It is of interest to make reference to the cultivation procedure

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.

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 (1953) and Johnson *et al.,* (1955). Direct and In direct effects of component characters on seed yield were computed using appropriate correlation coefficient of different component characters as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

Results and Discussion

The analysis of variance revealed sufficient variability due to genotypes for all characters (Table?) indicating the presence of wide range of genetic variability and scope for selection. Similar results were also observed by Kumar *et al.,* (2015), Ronika *et al.,* (2020), Bindra *et al.,*

(2016), Kumar *et al.,* (2017), Ashok *et al.,* (2017). 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 19 traits has been represented in table What?. 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%), protein content (24.919%), carbohydrate (23.617%), number of primary branches (17.83%), final plant stand (18.19%), initial plant stand (16.945%), number of secondary branches (16.292%), germination percentage (16.898%), relative water content (13.583%), Yield per plant (14.295%), plant height (13.001%), oil content (7.745%), chlorophyll (7.142%), 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.,* (2016) observed high PCV for Plant height and Rajanna *et al.,* (2014) recorded high PCV in harvest index.

The estimation of heritability (%) in the broad sense for 19 characters studied, which ranged from 70 % to 94%. High heritability (broad sense) 94% for chlorophyll, 93% for oil content and capsules per plant followed by 92% for harvest index and protein content,91% for carbohydrate,88% for relative water content, 87% for number of primary branches,84% for final plant stand and secondary branches, 82% for germination percentage and plant height, 815 for initial plant stand, 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 offsprings similar results were reported by Singh *et al.,* (2015). Genetic advance was given by Lush (1949). Genetic advance and genetic advance as per percent of mean values Genetic advance ranged from 0.31 to 44.28. High genetic advance is recorded for final plant stand (44.281), initial plant stand (42.423), harvest index (29.966), capsules per plant (24.236), carbohydrate (21.38), germination percentage (21.149), protein (17.056), relative water content (16.66), 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), oil content (3.79), number of secondary branches (1.49), chlorophyll (1.04), number of seeds per capsule (0.81), test weight (0.66) and yield per plant (0.318). Rafiq *et al.,* (2014) 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

Comment [Autor des5]: 81%?

Comment [Autor des6]: >0,4?

the most of the traits which are reported by Singh *et al.,* (2001) for high heritability with low genetic advance for various traits such as chlorophyll and oil content.

Table:1 Analysis of variance for different characters in Linseed (*Linum usitatissimum* L.)

Source of Var.	Mean Sum of Squares		
	Replicate	Treatments	Error
	DF=2	DF=15	DF=30
germination percentage	877.77	470.43*	84.75
initial plant stand	3492.58	1891.11*	339.96
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
relative water con	45.90	252.35*	29.83
protein content	8.27	240.03*	17.85
carbohydrate	68.31	378.52*	28.78
0il content	12.35	11.57*	0.72
chlorophyll	0.03	0.88*	0.06
yield per plant	0.19	0.11*	0.02

Table:2 Genetic parameters for 19 characters of 16 linseed genotypes

Source of Var.	GCV	PCV	h^2 (Broad Sense)	Genetic Advancement 5%	Gen.Adv as % of Mean 5%
Germination percentage	15.301	16.898	82	21.149	28.54
Initial plant stand	15.347	16.945	81	42.423	28.632
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 branch	16.653	17.83	87	1.49	32.041
Number of secondary bran	15.001	16.292	84	5.009	28.453

Comment [Autor des7]: High magnitude!!

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
Relative water content	12.755	13.583	88	16.66	24.674
Protein content	23.975	24.919	92	17.056	47.516
Carbohydrate	22.701	23.617	91	21.38	44.952
Oil content	7.498	7.745	93	3.792	14.955
Chlorophyll	6.915	7.142	94	1.046	13.79
Yield per plant	12.762	14.295	79	0.318	23.47

Table:3 Phenotypic correlation coefficient

Traits	germination percentage	initial plant stand	final plant stand	days to first flowering	days to 50% flowering	days to maturity	plant height	number of primary	number of secondary branches	seeds per capsule	capsules per plat	test weight	harvest index	relative water con	protein content	carbohydrate	0il content	chlorophyll	yield per plant
germination percentage	1																		
initial plant stand	1	1																	
final plant stand	0.9498**	0.9496**	1																
days to first flow	0.2050*	0.2031*	0.4082*	1															
days to 50% flower	-0.1846	-0.1872	-0.2393	0.0953	1														
days to maturity	-0.4098*	-0.4088*	-0.5076*	-0.5739*	0.1619	1													
plant height	-0.3426*	-0.3427*	-0.3114*	-0.0439	0.2490*	0.0327	1												
number of primary	-0.2761	-0.2744	-0.3131*	-0.3932*	-0.2069	0.0823	0.0801	1											
number of secondary branches	0.1951	0.1973	0.1582	-0.2726	-0.4194*	-0.2248	-0.072	0.2456*	1										
seeds per capsule	0.2492*	0.2522*	0.2408*	-0.4308	-0.1441	0.2486	-0.0427	0.0741	0.2286*	1									
capsules per plat	0.1766	0.175	0.4074*	0.6670**	-0.0529	-0.6190**	0.0226	-0.4682*	-0.1193	0.0302	1								
test weight	0.1756	0.1745	0.2461*	0.1074	-0.4573*	-0.3202*	-0.6147**	-0.0548	0.216	-0.0386	0.2907*	1							
harvest index	0.3001*	0.3003*	0.4064*	0.4433*	-0.1867	-0.3845*	-0.0876	0.1177	0.2856*	0.0476	0.1608	0.1537	1						
relative water con	-0.1492	-0.1508	-0.0071	0.4670*	0.0932	0.1891	-0.1373	-0.2312	-0.5061	-0.3092*	0.2489	0.0548	-0.2675	1					
protein content	0.0676	0.0655	-0.0603	-0.0525	0.2659	0.058	0.095	-0.0727	0.1285	-0.4054*	-0.2178*	-0.1749	-0.4920*	0.1867	1				
Carbohydrate	-0.2837	-0.2806*	-0.2618	-0.2087	-0.4261*	-0.0027	0.1409*	0.5818	0.3159*	0.1646	-0.2599	-0.2703	0.2376	-0.2627	-0.3134	1			
0il content	-0.0738	-0.075	-0.0663	0.1687*	0.2787	0.2233*	0.4626*	-0.4213*	-0.3195*	-0.0597	-0.0082	-0.4492	-0.0749	0.0606	0.231	-0.0606	1		
Chlorophyll	-0.2874*	-0.2857*	-0.3934*	-0.2868	0.0952	0.5115**	-0.1425	0.0501	0.2034*	-0.1585	-0.4391*	-0.2606	-0.3458*	0.227	0.3725*	-0.0215	-0.2648	1	
yield per plant	0.0261	0.0275	0.1321*	0.3102*	-0.1359*	-0.2182	0.3035*	0.3643*	-0.0199	0.1706*	0.0005	-0.2379	0.2832*	0.3240*	-0.1929	0.3468*	-0.2466	0.0166	

Table:4 Path coefficient analysis

Traits	FPS	DFF	PB	S/C	HI	PH
FPS	0.245	0.067	-0.1179	-0.0296	0.0388	-0.0788
DFF	0.0781	0.21	-0.1164	0.02133	0.036	-0.0253
PB	-0.0738	-0.0626	0.39	-0.0102	0.0092	0.0018
S/C	0.05	-0.0309	0.0276	-0.145	0.0055	0.0065
HI	0.0836	0.0665	0.0315	-0.0071	0.114	-0.0273
PH	-0.0519	-0.0143	0.0019	-0.0025	-0.0083	0.371
Y/P	0.1321	0.3102	0.3643	0.1706	0.2832	0.3035

Correlation analysis

Association analysis measures the interrelationship 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, relative water content, carbohydrate. It exhibited negative and significant correlation with days to 50% flowering. It exhibited positive and non significant correlation with germination percentage, initial plant stand, capsules per plant, chlorophyll. it exhibited negative and non significant correlation with days to maturity, number of secondary branches, test weight, protein content, oil content. Related findings were carried out by Sharma et al., (2016), chaudhary et al., (2016), Bibi et al., (2013).

Path coefficient analysis

Path coefficients which are worked out from correlation coefficient are referred to as path coefficient analysis. It splits the correlation coefficient into the measures of direct and indirect effect. Table 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 (0.245), days to first flowering (0.210), number of primary branches (0.390), harvest index (-0.114), seeds per capsule (-0.145), plant height (0.371). Related findings were carried out by Akbar et al., (2001), Paul et al., (2016).

Conclusion

References

Comment [Autor des8]: Just to formalize the parts of a scientific article, the authors could conclude that: the variables analyzed allow the possibility of practices regarding the improvement of plants in the sense of promoting the parameters of physiological and economic interest (suggestion!!!)

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