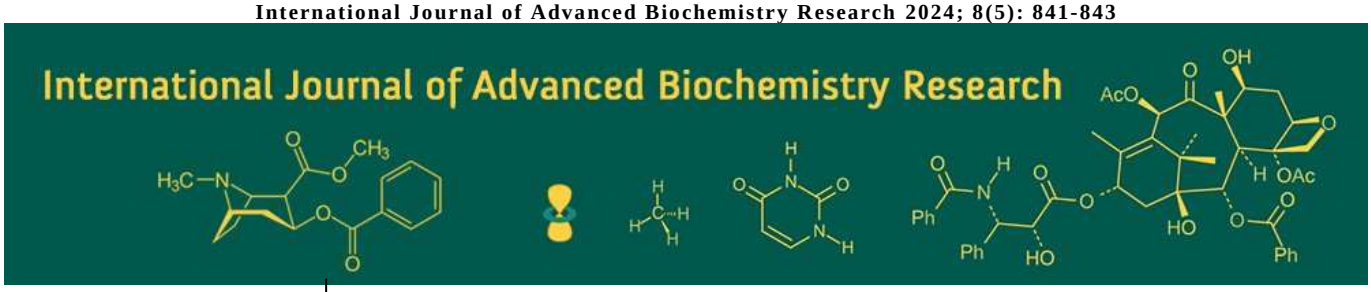

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Selection of suitable genotypes of linseed (*Linum usitatissimum* L.) for rainfed condition

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Abstract
A trial was conducted with 19 diverse genotypes of linseed under rainfed condition at research farm of TCA, Dholi, Muzaffarpur during rabi season of 2021-22 in order to detect genotypic variability, heritability and genetic advance for yield and yield attributing traits. Analysis of variance exhibited significant variability among all the genotypes for different traits under studied. Estimates of mean performance revealed that the entry SLS 139 had significant superiority over the best check i.e. T 397 in respect of days to flowering, days to maturity, oil content and germination percentage. The estimate of genetic parameter showed moderate to high GCV and PCV for traits like no. of Capsules per plant, Seed yield (kg./ha.) and oil content. Further analysis revealed high heritability for days to flowering, days to maturity and oil content while high heritability coupled with high genetic advance as percentage of mean were observed for the trait oil content. Selection of these traits may be more rewarding for improvement of drought tolerant genotypes in linseed under changed climatic conditions.

Keywords: Linseed, heritability, genetic advance and rainfed

Introduction
Linseed is an important oilseed crop of the tropical as well as temperate region of the world. It is one of the most important industrial oilseed crops of India. Next to rapeseed mustard in terms of cultivation and seed production in India, it is the second most significant Rabi oilseed crop. There are over 230 species in genus linum, but only one is economically significant and one of the earliest plants framed for fiber and oil is cultivated linseed or flax [Rowland *et al.* (1995), Tadesse *et al.* (2010)] [10, 14].

Linseed is basically an industrial oilseed crop and its each and every part has got industrial importance. The seeds of linseed contain about 33-45% oil. It is generally unsuitable for domestic purpose due to high linolenic acid content (47-58%) but an excellent source of Omega-3 and Omega-6 fatty acids. Farmers use roughly 20% of the total amount of Linseed oil produced in India.

Linseed is extensively cultivated throughout the world including Canada, Russia, and China etc. Globally, linseed is grown in an area of 32.63 lakh ha. accounting of 31.82 lakh tones with an average productivity of 975 kg per hectare (Anonymous, 2019) [1]. Canada is currently the world's leader in the production and export of flax seed and it has held this position since 1994. India ranks 5th in an area (1.7lakh ha.) and 6th in production (1.0 lakh ton) with average productivity of 574kg/ha (FAO, stat, 2019) [4]. Four states *viz*. Madhya Pradesh, Jharkhand and Odisha are the major linseed growing states accounting for 65% of an area and 64% of production, respectively (Anonymous, 2020) [2].

The main reasons for low productivity of linseed in the country are inherent low yielding capacity of existing varieties and late maturity, lack of stability of yield and cultivation of crop under poor agronomic management on marginal lands. The development of superior varieties than the existing ones mainly depends on judicious selection of promising parents from the gene pool for hybridization to obtain transgressive segregants. Thus, for assessing the existing genetic variability among genotypes studied for yield and its contributing characters along with quality parameters was the aim of the present investigation.

Research Procedure

The present investigation was undertaken to obtain information on means, components of genetic variance, heritability and genetic advance for some quantitative and qualitative traits. The basic materials for the present investigation comprised of nineteen genotypes of linseed and evaluated along with two checks (T 397 & Shekhar) in Randomized Block Design with three replications at Research Farm of TCA, Dholi, Muzaffarpur during *Rabi* season of the year 2021-22. Recommended package and practices for linseed were adopted to raise good crop under Rainfed condition. Observations were recorded on eight quantitative and qualitative characters *i.e.* days to flowering, days to maturity, number of capsules per plant, number of seeds per capsule, 1000 seed weight (g), seed yield (kg./ha.), oil content (%) and germination percentage.

Result and Discussion

Analysis of variance revealed that significant genotypic differences were observed for all the traits indicating that there were sufficient genetic variations among all the genotypes under studied presented in table-1. Similar findings were also observed by Tadesse *et al.* (2010) [14]; Belate *et al*. (2013) [3] and Sharma *et al*. (2016) [13]. Estimate of mean performance of 19 genotypes for eight characters (Table-2) revealed that the highest range was recorded for seed yield (kg./ha) and lowest for 1000-seed wt.(g.).The entry SLS 139 showed significant superiority for the traits like days to flowering, days to maturity, oil content and germination percentage over the best check (T 397). Most of the entries were recorded at par values for the traits no. of capsules per plant, 1000-seed wt. and seed yield (kg./ha.) over the best check i.e. T 397. The estimate of GCV and PCV (table-3) reflects that the PCV values were higher than their corresponding GCV values for all the traits which reflect the influence of environment on the expression of these characters. High values of PCV than their corresponding GCV were also observed by earlier workers [Kumar *et al.* (2013) [8] and Sahu *et al.* (2014)] [12]. The moderate GCV values were observed for oil content, seed yield (kg./ha.) and no. of capsules per plant and rest characters showed low GCV values. Moderate GCV values for seed yield were reported by Paul and kumar (2018) [11]. The higher magnitude of PCV was observed for seed yield (kg./ha.) followed by oil content and no. of capsules per plant which was also reported by Tyagi *et al.* (2014) [15]. Estimates of heritability in broad sense were ranged from 23.20 to 81.20. Maximum heritability were recorded oil content followed by days to flowering, days to maturity and germination percentage. Present result are in agreement with the findings of Nakhlawy (2006) [9]; Kumar *et al*. (2012) [7]; Ahmad *et al.* (2014) [3] and Tyagi *et al.* (2014) [15]. High heritability estimates would be rewarding for development of superior genotypes on the basis of phenotypic performance of that particular traits. However, Johanson *et al.* (1955) [6] reported that h^2 estimates along with genetic advance as percentage of mean were more rewarding than the heritability alone while selecting the best genotypes. High heritability coupled with high genetic advance as percentage of mean was observed for the trait oil content. This demonstrates the presence of additive gene effects indicating more rewarding in selection on the basis of phenotypic performance for oil content.

Table 1: Analysis of variance for eight morpho-physiological traits in Linseed genotypes grown under rainfed condition.

Characters	Mean sum of square		
	Replication (d.f.=3)	Treatment (d.f.=18)	Error (d.f.=36)
Days to flowering	2.263	7.031**	0.800
Days to maturity	3.912	4.984**	0.615
No. of Capsules per plant	10.105	96.095**	38.142
No. of seeds per Capsules	7.000	2.438*	1.277
1000 seed wt.	5.905	2.261*	1.006
Seed yield kg./ha	15625.000	8913.225**	3449.074
Oil content	0.842	58.403**	4.175
Germination %	26.754	20.869**	3.772

**,*= indicate significance of value at P=0.01 & 0.05 respectively.

Table 2: Estimates of Mean performance of eight morpho-physiological traits in Linseed genotypes grown under rainfed condition.

Traits / Genotypes	Days to flowering	Days to maturity	No. of Capsules per plant	No. of seeds per Capsules	1000 seed wt.	Seed yield kg./ha.	Oil content	Germination %
BAU-2021-12	71.66	126.66	39.66	8.33	8.85	275.00	27.00	98.00
BRLS109-2	70.66	126.00	45.66	8.00	5.13	225.00	15.00	95.00
BRLS109-5	70.66	125.33	39.66	7.33	7.30	275.00	19.00	97.33
BRLS111-2	70.33	125.33	35.33	8.00	7.54	316.66	23.00	95.00
DLV-73	72.33	127.33	44.00	6.33	7.95	158.33	17.00	98.00
LCK2132	69.33	124.33	34.66	9.00	8.42	300.00	31.00	95.00
LCK2140	71.33	126.66	45.00	7.66	7.91	241.66	24.00	98.66*
LMS-2019-R-4	71.33	126.33	38.33	8.00	7.63	200.00	18.00	93.33
LMS-2019-R-8	67.66	123.33*	38.33	8.00	8.39	191.66	24.00	98.66*
NL 371	69.33	124.66	32.33	8.66	8.05	308.33	22.00	93.00
NL-369	71.33	126.33	31.33	9.00	7.65	166.66	17.00	95.00
RL 18102	71.00	126.00	28.00	8.66	7.92	358.33	25.00	98.66*
RL 18112	72.33	127.33	34.00	8.33	9.6	291.66	19.00	98.66*
RLC–189	71.00	126.00	28.66	9.66	8.47	258.33	17.00	94.00
RLC–190	71.33	126.33	37.00	9.33	7.75	250.00	24.00	92.00
SLS 139	66.33*	122.33*	43.33	7.66	7.72	175.00	29.00	98.66*

SLS 140	71.00	126.00	29.66	9.66	7.17	225.00	19.00	94.00
T 397 (NC)	69.00	124.66	44.33	10.00	8.01	250.00	22.00	95.00
Shekhar (ZC)	70.00	125.33	38.66	8.333	7.66	233.33	19.00	90.00
Mean	70.421	125.596	37.263	8.421	7.852	247.368	21.631	95.649
S.E.(m±)	0.516	0.453	3.565	0.652	0.579	33.907	1.179	1.121
C.D. (5%)	1.481	1.299	10.227	1.871	1.661	97.251	3.383	3.216
C.V.(%)	1.270	0.624	16.573	13.423	12.779	23.741	9.446	2.030

* = Significant over best check

Table 3: Estimates of Genetic parameter for eight morpho-physiological traits in Linseed genotypes grown under rainfed condition.

Characters	σ^2_g	σ^2_p	GCV	PCV	h^2 (Broad sense) %	GA as % of Mean
Days to flowering	2.077	2.8772	2.047	2.409	72.20	3.582
Days to maturity	1.456	2.072	0.961	1.146	70.30	1.659
No. of Capsules per plant	19.318	57.46	11.795	20.342	33.60	14.088
No. of seeds per Capsules	0.387	1.665	7.387	15.322	23.20	7.336
1000 seed wt.	0.418	1.425	8.236	15.203	23.90	9.191
Seed yield kg./ha	1821.394	5270.468	17.253	29.348	34.60	20.893
Oil content	18.076	22.251	19.655	21.807	81.20	36.492
Germination %	5.699	9.472	2.496	3.218	60.20	3.988

Conclusion

The estimate of GCV and PCV reflects that the PCV values were higher than their corresponding GCV values for all the traits which reflect the influence of environment on the expression of these characters. Maximum heritability was recorded for oil content followed by days to flowering, days to maturity and germination percentage while High heritability coupled with high genetic advance as percentage of mean was observed for the trait oil content indicating that these traits may be more effective in selection of superior genotypes on the basis of phenotypic performance.

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