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GENETIC ANALYSIS IN F_2 POPULATIONS OF LINSEED (*Linum usitatissimum* L.)

Yogesh P. Gite[1], Prema R. Manapure[2], Prashant V. Shende[3], Shanti R. Patil[4], Beena M. Nair[5] and Aambadas R. Aade[6]

ABSTRACT

Thirty crosses were attempted using 13 parents in line x tester fashion during *rabi* 2018-19. These thirty F_1 were raised along with parents during *rabi* 2019-20. Out of these twelve promising F_2crosses along with 13 parents were raised in randomized complete block design with two replications during *rabi,* 2020-21 and data were recorded on six characters *viz*., days to 50% flowering, days to maturity, plant height at maturity, number of primary branches plant^{-1}, number of capsules plant^{-1} and seed yield plant^{-1}. The analysis of variance for experimental design revealed significant genetic variability. The mean squares due to parents and crosses exhibited significant difference for all characters. Moderate to high values of PCV and GCV were observed for number of capsules plant^{-1}, seed yield plant^{-1}, number of primary branches plant^{-1} and low to moderate values for plant height.Moderate to high heritability observed for plant height, number of primary branches plant^{-1} and low to high for number of capsules plant^{-1} and seed yield plant^{-1}. The expected genetic advance among all F_2 populations indicated significant progress under selection for number of capsules plant^{-1} and plant height (cm) at maturity. The nine F_2 crosses were identified on the basis of high mean, genotypic coefficient of variation, heritability and genetic advance for economic traits like number of capsules plant^{-1}and seed yield plant^{-1} which were subjected to individual plant selection.

(Key words: Linseed, heritability, genotypic coefficient of variation and genetic advance)

INTRODUCTION

Linseed (*Linum usitatissimum* L.) is an important oilseed crop of the world grown during *rabi* season. It plays a major role in catering edible oil as well as industrial demand of the century. In India production of edible oil is grossly short of the requirements.

Consequently, large quantities have to be imported for making up the shortfall, which is turn, is a drain on foreign exchange resources. Designing efficient and desirable plant type requires the existence of genetic variability in the material. In order to incorporate desirable characters to maximize economic yields, the information on the nature and extent of genetic variability present in apopulation for desirable characters, their association and relative contribution to yield constitute the basic requirements. F_2 generation provide an active breeding material from which desirable plants may be selected. The knowledge of nature and magnitude of genetic variation present in population is desirable for improvement of yield. Heritability along with genetic variability provides a clear picture of the extent of genetic advance to be expected from selection (Kumar *et al.,*2019). The area under linseed in the world and in India is decreasing from last five decade. The future prospects for increasing area under linseed seem to be limited. The present study will help in identifying potential IPS for their use the developing high yielding linseed potential varieties.

MATERIALS AND METHODS

Thirty crosses were attempted using 13 parents in line x tester fashion during *rabi* 2018-19. These thirty F_1 were raised along with parents during *rabi* 2019-20. Out of these twelve promising F_2crosses and 13 parents were grown during *rabi,* 2020-21 in randomized complete block design with two replications. Four rows for each F_2 cross and one row for each parent were sown. Each row consisted of fifty plants. Sowing was taken up with spacing of 45 cm x 3 cm. The recommended cultural practices and plant protection measures were undertaken as per schedule to raise a healthy crop.The observations were recorded on 400 plants in each F_2 population and five randomly selected plant in each parent

1 and 6. P.G. Students, Agricultural Botany Section, College of Agriculture, Nagpur
2. Assoc. Professor (Professor Incharge), Agril. Botany Section, College of Agriculture,Nagpur
3. Assoc. Professor Agril. Botany section, College of Agriculture, Nagpur
4. Professor (CAS), Agril. Botany section, College of Agriculture, Nagpur
5. Linseed breeder, AICRP on linseed and mustard, College of Agriculture, Nagpur

for the six characters *viz.,* days to 50 per cent flowering (plot wise), days to maturity (plot wise), plant height at maturity (cm), number of primary branches plant^{-1}, number of capsules plant^{-1}, seed yield plant^{-1} (g). The observations recorded were subjected to the statistical and biometrical analysis *viz.,*analysis of variance (Panse and Sukhatme, 1954), F_2 variance, genotypic variance, environmental variance, phenotypic and genotypic coefficient of variation, heritability (broad sense) (%), genetic advance (GA) (Burton, 1952, Allard, 1960 and Johnson *et al*. 1955).

RESULTS AND DISCUSSION

The data regarding analysis of variance are presented in Table 1. The mean squares due to genotypes (crosses + parents) were highly significant for all the characters studied indicating a presence of substantial genetic variation among the genotypes. This reveals that the genetic parameters can be estimated for all the six characters which further indicated the existence of significant variability among the genotypes (F_2 crosses and parents) for all the mentioned characters in linseed.The crosses NL-495 x Neelam, NL-497 x T-397, NL-494 x CI-2006, NL-501 x RLC-157 and NL-503 x NL-97 exihibited highGCV, high heritability with moderate genetic advance along with high F_2 variance for plant height.Pawar *et al*. (2019) was also reported high GCV, PCV, heritability and genetic advance for plant height in F_2 population of soybean. The genetic parameters calculated for number of primary branches plant^{-1} revealed that the crosses NL-494 x CI-2006,NL-496 x RLC-157, NL-497 x T-397, NL-499 x NL-287 and NL-505 x NL-97 exhibited maximum F_2 variance, genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance.In accordance to this result Rajeev Ranjan *et al*. (2007) also observed high heritability and high genetic advance for number of primary branches plant^{-1} in F_3 population of lathyrus. High heritability coupled with high genetic advance was observed for number of capsules plant^{-1}in the crosses NL-494 x CI-2006, NL-495 x Neelam, NL-498 x NL-333, NL-502 x NL-333 and NL-501 x RLC-157 which indicates the lesser influence of environment in expression of this characters and prevalence of additive gene action in their inheritance. High heritability with lower value of genetic advance and high genetic coefficient of variation estimates observed in the crosses NL-505 x NL-97, NL-504 x Neelam, NL-496 x RLC-157 and NL-497 x T-397 for seed yield plant^{-1}.High heritability was also reported by Meena *et al*. (2020) and Ahmed (2017) for seed yield plant^{-1}in linseed. High heritability coupled with low genetic advance indicated the presence of non additive gene action so that the selection of superior plants in F_2 generation for seed yield would not be rewarding. The magnitude of genotypic coefficient of variation was moderate to high for number of capsules plant^{-1} (13.81 - 59.58%), seed yield plant^{-1} (12.36 - 43.38%), number of primary branches plant^{-1} (19.20 - 29.44%) and low to moderate for plant height (9.80 - 13.98%). The estimates of phenotypic coefficient of variation was moderate to high for number of capsules plant^{-1} (48.76 - 67.24%),

Table 1. Analysis of variance for six characters in linseed

Source of variation	d.f.	Mean Square					
		Days to 50% Flowering	Days to maturity	Plant height (cm)	No of primary branches plant^{-1}	No of capsules plant^{-1}	Yield plant^{-1} (g)
Replications	1	2.348	0.255	4.586	0.087	70.112	0.257
Genotypes	24	5.093**	45.075**	43.144**	2.697**	176.574**	0.220**
Error	24	0.641	2.413	6.434	0.146	65.902	0.081

**= significance at 5% and 1% level respectively

Table 2. Estimation of genetic parameters for plant height (cm) at maturity, number of primary branches plant^{-1}, number of capsules plant^{-1} and seed yield plant^{-1}

	Plant height (cm) at maturity						Number of primary branches plant^{-1}					
F_2 crosses/ Parents	Mean SE(m)±	Range	VF_2	GCV (%)	h2 (%)	G.A.	Mean SE (m)±	Range	VF_2	GCV (%)	h2 (%)	G.A.
NL-494 x CI-2006	50.21 ± 8.87	49(25-74)	78.81	14.33	65.71	12.01	5.18 ± 1.93	11(1-12)	3.72	28.16	57.22	2.27
NL-495 x Neelam	47.03 ± 9.46	49(24-73)	89.65	17.98	79.78	15.56	4.70 ± 1.72	10(1-11)	2.81	26.01	50.18	1.78
NL-496 x RLC-157	51.65 ± 8.17	39(32-71)	66.76	12.63	63.75	10.73	4.81 ± 1.67	10(1-11)	2.79	25.57	54.30	1.87
NL-497 x T-397	52.37 ± 8.14	40(28-68)	66.31	13.00	70.01	11.74	5.09 ± 1.73	10(1-11)	3.00	24.51	51.94	1.85
NL-498 x NL-333	47.05 ± 6.81	32(30-62)	46.46	10.08	48.46	6.68	5.31 ± 1.64	11(1-12)	2.70	21.02	46.10	1.56
NL-499 x NL-287	49.68 ± 7.06	60(15-75)	49.95	10.54	54.91	7.99	4.80 ± 1.85	9(1-10)	3.43	29.44	58.36	2.22
NL-500 x GS-61	53.97 ± 7.81	48(25-73)	58.00	10.85	59.13	2.73	4.17 ± 1.61	10(1-11)	2.60	28.07	52.59	1.75
NL-501 x RLC-157	51.25 ± 7.90	37(30-67)	62.50	12.18	62.35	10.15	5.25 ± 1.54	10(1-11)	2.40	21.42	52.77	1.68
NL-502 x NL-333	50.22 ± 6.66	32(33-65)	44.38	9.80	54.83	7.52	4.95 ± 1.48	8(1-9)	2.19	19.20	41.20	1.25
NL-503 x NL-97	48.83 ± 7.78	40(30-70)	60.56	12.98	66.37	10.64	5.11 ± 1.53	9(1-10)	2.34	20.31	46.17	1.45
NL-504 x Neelam	52.24 ± 7.42	50(30-80)	55.16	11.19	62.04	9.49	5.09 ± 1.63	8(1-9)	2.68	23.82	54.80	1.85
NL-505 x NL-97	47.45 ± 6.65	34(30-64)	44.32	11.45	66.62	9.13	4.94 ± 1.52	9(1-10)	2.31	25.27	67.40	2.11

	Number of capsules plant^{-1}						Seed yield plant^{-1}					
F_2 crosses/ Parents	Mean SE(m)±	Range	VF_2	GCV (%)	h2 (%)	G.A.	Mean SE (m)±	Range	VF_2	GCV (%)	h2 (%)	G.A.
NL-494 x CI-2006	37.06±23.93	168(2-170)	572.96	59.58	85.10	41.96	1.52 ± 0.74	4.50 (0.20-0.70)	0.55	30.40	39.04	0.59
NL-495 x Neelam	40.55± 24.56	133(4-137)	603.29	47.69	62.02	31.38	1.42 ± 0.74	4.25 (0.05-4.30)	0.55	35.25	45.09	0.69
NL-496 x RLC-157	38.73± 23.61	129(3-132)	557.42	44.19	53.23	25.88	1.47 ± 0.68	4.40 (0.30-4.70)	0.46	38.17	68.61	0.96
NL-497 x T-397	31.88± 21.13	135(4-139)	446.47	47.49	51.35	22.35	1.52 ± 0.71	3.80 (0.20-4.00)	0.51	38.26	66.59	0.98
NL-498 x NL-333	47.39± 52.83	164(3-167)	683.54	53.24	62.69	33.76	1.39 ± 0.70	4.10 (0.10-4.20)	0.49	37.95	56.96	0.82
NL-499 x NL-287	33.50±16.33	86(5-95)	260.90	26.58	29.72	10.00	1.36 ±0.70	3.70 (0.10-3.80)	0.49	36.17	48.91	0.71
NL-500 x GS-61	29.26±17.23	112(3-115)	297.10	32.24	29.97	10.64	1.40 ± 0.66	3.60 (0.20-3.80)	0.44	22.44	22.74	0.31
NL-501 x RLC-157	37.78±23.47	128(2-130)	551.07	52.11	70.34	34.01	1.38 ± 0.59	3.80 (0.20-4.00)	0.35	12.36	7.89	0.09
NL-502 x NL-333	40.50±23.33	111(6-117)	544.32	48.98	72.31	34.75	1.44 ± 0.68	4.80 (0.20-5.00)	0.46	28.73	37.21	0.52
NL-503 x NL-97	34.55±20.19	122(3-125)	437.47	13.81	5.21	2.24	1.39 ± 0.71	4.10 (0.10-4.20)	0.50	40.79	64.64	0.94
NL-504 x Neelam	42.95±25.90	131(5-136)	670.84	39.50	42.91	22.89	1.53 ± 0.74	4.60 (0.10-4.70)	0.54	40.81	71.18	1.08
NL-505 x NL-97	42.40±24.43	123(3-126)	596.91	35.70	38.39	19.32	1.59 ± 0.77	4.10 (0.20-4.30)	0.59	43.38	80.21	1.27

seed yield plant^{-1} (44.00 - 52.49%), number of primary branches plant^{-1} (29.49 -38.71%) and low to moderate for plant height (13.26 - 20.13%).The estimates of heritability (h^2) in broad sense was moderate to high for plant height (48.46 -79.78%) , number of primary branches plant^{-1} (41.20 - 67.40%) and low to high for number of capsules plant^{-1} (5.21 - 85.10%) and seed yield plant^{-1} (7.89 - 80.21%). The expected genetic advance among all F_2 populations indicated significant progress under selection for number of capsules plant^{-1} (2.24 – 41.96%) and plant height (cm) at maturity (7.52 – 15.56%).On the basis of high mean, genotypic coefficient of variation,heritability and genetic advance for economic traits like number of capsules plant^{-1}, seed yield plant^{-1} nine crosses *viz*., NL-494 x CI-2006, NL-495 x Neelam,NL-496 x RLC-157, NL-497 xT-397, NL-498 x NL-333, NL-501 x RLC-157, NL-502 x NL-333, NL-504 x Neelam and NL-505 x NL-97 were identified as the potential crosses for obtaining segregants and hence were subjected to individual plant selection.

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