Journal of
Pharmacognosy & Natural Products

Patil and Lokesha, J Pharmacogn Nat Prod 2018, 4:1
DOI: 10.4172/2472-0992.1000151

Research Article Open Access

Estimation of Genetic Variability, Heritability, Genetic Advance, Correlations and Path Analysis in Advanced Mutant Breeding Lines of Sesame (*Sesamum indicum* L.)

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Received date: February 15, 2018; **Accepted date:** February 19, 2018; **Published date:** February 22, 2018

Abstract

Genetic variability, character association and path analysis between yield and its contributing traits were studied in 100 sesame advanced breeding lines (67 advanced mutant lines, 12 RIL's, 5 checks, 4 collections, 7 varieties, 3 parents, 2 land races). Analysis of variance revealed highly significant differences for 07 characters except number of branches per plant, capsule length, capsule weight, test weight and seed yield per plant. Higher estimates of PCV were observed for all the traits but the difference between PCV and GCV was narrow indicating lowest environmental influence and predominance of genetic factors controlling these traits. High heritability coupled with high genetic advance was observed for plant height and distance from ground to first capsule indicate that these traits are controlled by additive genes and phenotypic selection would be effective. Number of capsules per plant, number of branches per plant, capsule length, number of seeds per capsule, capsule weight and test weight had strong and significant positive association with seed yield per plant at both genotypic and phenotypic levels. Path coefficient analysis indicated that number of seeds per plant followed by number of capsules per plant were important traits to be considered for realizing the improvement in yield in sesame owe to their positive contribution. Days to maturity and capsule length were negative. Capsule weight influence seed yield negatively through most characters.

Keywords: Sesame; Sesamum indicum; Genetic variability; Heritability; Correlation; Path analysis; Advanced mutant breeding lines

Introduction

Sesame (*Sesamum indicum* L.) known as 'benni seed', 'gingelly', 'simsim', 'til' etc., is an important and perhaps the oldest and ancient oil seed crops known to man. It is cultivated extensively from tropical regions to the temperate zones in the world and its domestication is believed to be lost in the mists of antiquity. Sesame is described as the "Queen of oilseeds" because of its high oil content (38%-54%), protein (18%-25%), calcium, phosphorus, oxalic acid and excellent qualities of the seed oil and meal [1]. Sesame seed oil has long shelf life due to the presence of lignans (sesamin, sesaminol, sesamolinol), which have remarkable antioxidant function, resisting oxidation. Although sesame is widely used for different purposes, the productivity in Indian sub-continent has been miserably low. Selection for high yielding types with wider adaptability shall help in increasing the production both locally and globally. But the performance of crop is affected by such factors as climatic, nutrients, water availability, inter and intra specific competitions, pest and diseases, as well as socio-cultural and socio-economic factors.

The logical way to start any breeding programme is to assess the existing genetic variability, because, the assessment of variability forms the basis of any crop improvement program. It is necessary to study variability in respect of quantitative characters with reference to genetic parameters such as genotypic and, phenotypic variances, heritability (broad sense) and genetic advance. Understanding of relationship between yield and its components is fundamental for selection process and its relationship can be explained by means of correlation and path coefficient analysis. Correlation studies enable breeders to know the strength of the relationship between various characters as well as the direction of changes expected during selection because more often seed yield is a complex trait and do not get improved with simple selection. The path coefficient analysis provides a more realistic picture of the relationship as it considers direct as well as indirect effects of the variables by partitioning the correlation coefficients [2].

Mutation breeding proved to be a powerful tool to increase the spectrum of variation. Usually, an agronomically superior variety will be subjected to irradiation and generations are advanced to identify useful mutants in early generation such as earliness, high yielding, plant type, resistance to biotic and abiotic factors, pod length etc. Further, these lines are advanced to stabilize not only to achieve uniformity but also homogeneity among the families. Through a BARC/BRNS project, several mutants were developed using three varieties viz. E8 and DS-1 (white seeded types) and RCL (brown seeds). These mutants were advanced to M9 generation to achieve uniformity with a strict selection imposed to identify useful traits. But these lines were not subjected for estimation of genetic parameters. Hence, the present investigation was undertaken to study the genetic variability, relationship between various traits and their contribution to yield in advanced and highly stabilized mutant breeding lines along with a few collections, checks, parents, RILs that are being maintained in the department.

Citation: Patil M and Lokesha R (2018) Estimation of Genetic Variability, Heritability, Genetic Advance, Correlations and Path Analysis in Advanced Mutant Breeding Lines of Sesame (*Sesamum indicum* L.). J Pharmacogn Nat Prod 4: 151. doi:10.4172/2472-0992.1000151

Materials and Methods

The investigation was conducted during the principal cropping season; kharif, 2015 at Agriculture College, Raichur, Department of Genetics and Plant Breeding, University of Agricultural Sciences, Raichur under protective irrigation and in red soil. The rainfall in 2015 kharif was very erratic. The material comprised of 100 advanced breeding lines of sesame (67 advanced mutant lines, 12 RIL's, 5 checks, 4 collections, 7 varieties, 3 parents and 2 land races) which were sown in a 10 × 10 Simple Lattice Design with two replications. Each genotype was sown in 5 m length of three rows with spacing of 30 cm between rows and 10 cm between plants. The recommended agronomic practices were followed to raise a good crop. Observations were recorded on days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, number of capsules per plant, distance from ground to first capsule (cm), capsule length (cm), number of seeds per capsule, capsule weight (g), test weight (g) and seed yield per plant (g). The estimates of genetic variability parameters, correlation and path coefficients analysis were calculated by analyzing data using INDOSTAT statistical package.

Results

Traits	Range		Mean ± SD	Variance		Coefficient of variation (%)		Heritability – broad sense (%)	Genetic advance	Genetic advance as percent of mean
	Minimum	Maximum		σ 2g	σ 2p	GCV	PCV			
1. Days 50% to flowering (days)	35	50.5	41.71 ± 2.62	6.43	6.84	6.08	6.27	94	5.06	-12.14
2. Days to maturity (days)	75.5	95.5	88.42 ± 3.36	10.75	11.28	3.71	3.8	95.4	6.6	-7.46
3. Plant height (cm)	48.7	126.3	84.12 ± 14.92	199.9	222.7	16.8	17.7	89.7	27.59	32.8
4. Number of branches per plant	1	5.15	3.16 ± 0.60	0.32	0.36	17.8	18.9	88.4	1.09	34.47
5. Number of capsules per plant	11.5	40.75	27.26 ± 6.36	39.5	40.44	23.1	23.3	97.7	12.8	49.94
6. Distance from ground to first capsule (cm)	12.5	67.9	45.53 ± 10.15	102.1	103	23.8	23.9	99.2	20.73	-48.75
7. Capsule length (cm)	1.78	3.25	2.48 ± 0.24	0.06	0.06	9.46	9.69	94.9	0.47	18.93
8. Number of seeds per capsule	48	92	66.66 ± 9.52	88.47	90.56	14.1	14.3	97.7	19.15	28.73
9.Pod weight (g)	0.17	0.44	0.28 ± 0.046	0.002	0.002	15.3	16.5	86.3	0.08	29.35
10. 1000 seed weight (g)	1.48	3.95	2.80 ± 0.53	0.2	0.23	15.8	17.1	84.8	0.84	29.91
11. Seed yield per plant (g)	0.13	2.34	0.93 ± 0.46	0.2	0.21	48.2	49	96.9	0.91	97.85

Table 1: Genetic parameters estimated for 11 quantitative traits in advanced mutant breeding lines of sesame.

In the present study, the analysis of variation showed highly significant differences among the genotypes for 07 characters except number of branches per plant, capsule length, capsule weight, test weight and seed yield per plant indicating the existence of considerable genetic variation in the advanced breeding lines of sesame. With advance in generations, several weak mutants were eliminated hence no much variability was seen for the above characters. Examination of the components of variance revealed that the phenotypic coefficient of variation (PCV) was higher than the corresponding genotypic coefficients of variation (GCV) for all the characters with a narrow difference indicates that environmental influence was least and preponderance of genetic factors controlling variability in these traits (Table 1). Seed yield/plant followed by distance from ground to first capsule and number of capsules/plant showed high PCV and GCV estimates. These results are in confirmation with those of [3] for seed yield/plant and number of capsules/plant. High coefficient of variation for distance from ground to first capsule was in confirmation with [4]. Higher PCV and GCV indicate the presence of greater variability for these traits which gives ample scope for improvement of these traits by simple selection. Moderate PCV and GCV were obtained for the characters viz., plant height and number of branches/plant, number of seeds/capsule, capsule weight and test weight. Similar results were reported by Rao [2]. Estimations of heritability, in broad sense, were high for all the traits studied. An estimated heritability value alone is less reliable as these values are getting altered with changes in the environment and experimental material [5]. Hence, use of high heritability coupled with high genetic advance is preferred and observed only for plant height and distance from ground to first capsule. Thus these traits are most likely controlled by additive gene action which is very useful in selection. Especially distance from ground to first capsule since most high yielding types bear pods very close to ground. Most land races are very low yielders and more often bear pods at greater heights. Similar results were reported [6].

Traits		Days to 50% Flowering	Days to Maturity	Plant height	Number of branches/ plant	Number of capsules/ plant	Distance from ground to first capsule	Capsule length	Number of seeds/ capsule	Capsule weight	Test weight	Seed yield/ plant
1. Days to 50% flowering	G	1.000	0.603**	0.258**	0.001	-0.061	0.132	-0.114	-0.039	0.016	-0.035	-0.043
	P	1.000	0.572**	0.240**	0.009	-0.064	0.131	-0.111	-0.041	-0.001	0.093	-0.049
2. Days to maturity	G		1.000	0.171**	0.241**	0.086	0.109	0.007	0.075	0.161*	0.101	0.089
	P		1.000	0.148*	0.213**	0.080	0.108	0.009	0.074	0.152*	0.093	0.084
3. Plant height	G			1.000	0.020	0.190**	0.706**	0.172*	0.113	0.156**	0.139*	0.157*
	P			1.000	-0.003	0.181*	0.665**	0.157*	0.101	0.149*	0.140*	0.140*
4. Number of Branches/plant	G				1.000	0.771**	-0.120	0.716**	0.802**	0.722**	0.820**	0.840**
	P				1.000	0.738**	-0.116	0.681**	0.766**	0.642**	0.715**	0.803**
Number of capsules per plant	G					1.000	0.025	0.811**	0.952**	0.906**	0.924**	0.924**
	P					1.000	0.026	0.789**	0.918**	0.843**	0.840**	0.917**
Distance from ground to first capsule	G						1.000	0.048	-0.023	-0.070	0.052	-0.002
	P						1.000	0.044	-0.022	-0.062	0.044	-0.002
Capsule length	G							1.000	0.841**	0.747**	0.795**	0.811**
	P							1.000	0.818**	0.694**	0.715**	0.784**
Number of seeds per capsule	G								1.000	0.839**	0.928**	0.943**
	P								1.000	0.782**	0.843**	0.938**
Capsule weight	G									1.000	0.872**	0.845**
	P									1.000	0.749**	0.781**
Test weight	G										1.000	0.945**
	P										1.000	0.857**
*Significance at 0.05 level of probability **Significance at 0.01 level of probability												

Table 2: Genotypic (G) and Phenotypic (P) correlation coefficients between yield attributing traits with seed yield in advanced mutant breeding lines of sesame.

Highly significant positive correlation was recorded between seed yield with number of seeds/capsule, number of capsules/plant, number of branches/plant, capsule length, capsule weight and test weight both at phenotypic and genotypic levels. The magnitude of correlation with seed yield was highest in case of number of seeds/capsule at both phenotypic and genotypic levels (Table 2). Similar results were obtained [7,8]. This clearly indicates that increasing seeds/plant alone will increase seed yield and hence, while making selection for yield, more emphasis should be given to this character. Both the genotypic and phenotypic correlations were in the similar direction, although the levels of genotypic correlation coefficients were superior in extent than the corresponding phenotypic correlation coefficients. This low degree of phenotypic correlation may be due to effect of the environment on the phenotype of the plants. This is in accordance with findings of [9].

Discussion and Conclusion

Path coefficient analysis (Table 3) revealed that number of seeds/capsule had maximum direct effect on seed yield/plant followed by number of capsules/plant, number of branches/plant and test weight had almost same positive magnitude. Vanishree [6] also found similar observations in advanced generations. This indicates that, if other characters are held constant, improvement in these characters shall reflect in an increased seed yield. This is in accordance with the findings of Patil and Sheriff [10]. In the present study, the residual effect (0.286) was medium in magnitude which showed that some other important yield contributing characters which may contribute to yield might have missed. This was in accordance with Sumathi [11].

From the above results, it could be concluded that the characters, number of seeds/capsule, number of capsules/plant, number of branches/per plant and test weight be supposed to be given prime importance as they revealed a significant positive correlation and a high positive direct effect compared to other traits. It was interesting that through capsule weight had positive significant association with seed yield, it's contribution was negative both directly and through several traits indirectly. Contrary, days to maturity was no way related with seed yield yet it also had negative contribution through most traits. This indicates that capsule weight and days to maturity are also to be considered, negatively, to increase the yield.

Traits	**Days to 50% flowering**	**Days to maturity**	**Plant height**	**Number of branches/plant**	**Number of capsules/plant**	**Distance from ground to first capsule**	**Cap-sule Length**	**Number of seeds/capsule**	**Cap-sule weight**	**Test wei-ght**	**Correlation with Seed yield per plant**
Days to 50% flowering	-0.014	-0.008	-0.004	-0.0001	0.001	-0.002	0.002	0.001	0.0	0.0002	-0.049
Days to maturity	-0.011	-0.019	-0.003	-0.004	-0.002	-0.002	-0.0002	-0.001	-0.003	-0.002	0.084
Plant Height (cm)	0.011	0.007	0.044	-0.0001	0.008	0.030	0.007	0.005	0.007	0.006	0.140*
Number of branches/plant	0.002	0.039	-0.001	0.184	0.136	-0.021	0.125	0.141	0.118	0.131	0.803**
Number of capsules/plant	-0.016	0.021	0.046	0.183	0.255	0.007	0.201	0.234	0.215	0.214	0.917**
Distance from ground to first capsule (cm)	-0.001	-0.001	-0.005	0.001	-0.0002	-0.007	-0.006	0.0002	0.0004	-0.0003	-0.002
Capsule length (cm)	0.003	-0.0003	-0.005	-0.021	-0.024	-0.001	-0.031	-0.025	-0.021	-0.022	0.784**
Number of seeds/capsule	-0.020	0.0357	0.049	0.371	0.444	-0.011	0.395	0.483	0.378	0.408	0.938**
Capsule weight (g)	0.0	-0.001	-0.0012	-0.005	-0.007	0.001	-0.006	-0.006	-0.008	-0.006	0.781**
Test weight (g)	-0.002	0.012	0.018	0.091	0.107	0.006	0.091	0.096	0.095	0.127	0.857**

Residual effect=0.286

*Significance at 0.05 level of probability **Significance at 0.01 level of probability

Table 3: Direct (diagonal) and indirect effects of yield attributing traits on seed yield, at phenotypic level, in advanced mutant breeding lines of sesame.

Acknowledgements

Corresponding author wish to acknowledge BARC/BRNS for a project; completed during 2010 and PC Unit, Jabalpur and GOK for financial support.

References

1. Prasad R (2002) Field crops production. Indian Council of Agricultural Research, New Delhi, p: 821.
2. Rao VT, Bharathi D, Mohan C, Venkanna V, Bhadru D, et al. (2013) Genetic variability and association analysis in sesame (*Sesamum indicum* L.). Crop Res 46: 122-125.
3. Parameshwarappa SG, Palakshappa MG, Salimath PM, Parameshwarappa KG (2009) Studies on genetic variability and character association in germplasm collection of sesame (*Sesamum indium* L.). Karnataka J Agric Sci 22: 252-254.
4. Bakheit BR, Mahdy EE (1988) Genetic variability and correlations in a world collection of sesame. Australian J Agric Sci 19: 228-240.
5. Swarup S, Chaugle BS (1962) Studies on genetic variability in sorghum; phenotypic variation and heritable component in some quantitative characters contributing towards yield. Indian J Genet Pl Breed 22: 31-36.
6. Vanishree (2011) Phenotypic characterization of F4 progenies of cross between E8 and TNL and inheritance study on phyllody resistance in sesame (*Sesamum indicum* L). M.Sc (Agri.) Thesis, University of Agricultural Sciences, Raichur, India.

7. Abate M, Mekbib F, Ayana A, Nigussie M (2015) Genetic variability and association of traits in midaltitude sesame (*Sesamum indicum* L). Germplasm of Ethiopia. American J Exper Agril 9: 1-14.

8. Fazal A, Mustafa HSB, Hasan E, Anwar M, Tahir MHN, et al. (2015) Interrelationship and path coefficient analysis among yield and yield related traits in sesame (*Sesamum indicum* L). Nat Sci 13: 27-32.

9. Rajanna B, Biradar SA, Ajithkumar K (2014) Correlation and path coefficient analysis in linseed (*Linum usitatissimum* L). The Bioscan 9: 1625-1628.

10. Patil RR, Sheriff RA (1994) Genetic divergence in sesame (*Sesamum indium* L). Mysore J Agric Sci 28: 106-110.

11. Sumathi P, Muralidharan V, Manivannan N (2007) Trait association and path coefficient analysis for yield and yield attributing traits in sesame (*Sesamum indium* L). Madras Agril J 94: 174-178.