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Research Article

Evaluation of sesame (*Sesamum indicum* L.) genotypes for genetic variability based on different traits under rainfed conditions

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Abstract
The present study was conducted to evaluate 24 sesame genotypes under rainfed conditions to determine the magnitude of variability and to understand the heritable component of variation for 10 agro-morphological characters. Analysis of variance revealed considerable variability among all the characters studied. The phenotypic coefficient of variation (PCV) was greater than genotypic coefficient of variation (GCV) for all the characters studied, this shows the influence of the environmental effect on the characters. High genetic advance coupled with high heritability (broad sense) were observed for number of branches/plants, biological yield/plant, harvest index and seed yield/plant as these characters were controlled by additive gene effects, and selection based on these characters would be effective for future sesame crop improvement programme for rainfed agriculture.

Keywords
Sesame, PCV, GCV, heritability, genetic advance

INTRODUCTION

Rainfed agriculture is practised on 80% of the world's agricultural land area that generates about 70% of the world's staple foods and India ranks first among the countries that practice rainfed agriculture under a variety of agro-climatic and rainfall conditions (Sharma *et al.* 2010). Rainfall amount and distribution during the growing season are considered the most serious environmental problem limiting crop production under rainfed conditions (Fahad *et al.*, 2017). Sesame is an important Kharif oilseed crop of India, mainly grown as a rainfed crop in the arid and semi-arid tropics (Singh *et al.* 2009). Sesame crop is rarely irrigated although it is a drought-tolerant plant, it is sensitive to drought at germination and seedling stages (Bahrami *et al.* 2012). In reality, sesame is mostly grown under moisture stress with low management input by smallholders(Pham *et al.* 2010). Despite the economic importance for food, oil and medicine, the yield potential of sesame is not spectacular due to its cultivation in sub-marginal lands and non-availability of superior high yielding varieties due to lack of an appropriate breeding program (Pandey *et al.* 2015). Effective and efficient breeding programs depend on the amount of variability existing in the genetic stocks of the crop so that, it can be exploited for crop improvement by geneticist and crop breeders. Genetic variation is the inherent variation which remains unchanged by the environmental factors and this type of variation is more useful to a breeder for exploitation by selection or hybridization (Bagheri *et al.*, 2017). Progress in any crop improvement project depends not only on the magnitude of genetic variability but also on the heritability and genetic advance under selection (Dutta *et al.* 2013). Heritability and genetic advance are very important selection parameters for the selection of best genotype from the base population. Heritability estimates the magnitude of variation present in a particular trait which is transmissible from the parent to the offspring which helps plant breeders for the selection of elite genotypes from diverse genetic populations (Patidar *et al.*, 2018). Since heritability is also influenced by environment, the information on heritability alone may not help in selecting characters on the basis of their phenotype (Nahak *et al.*, 2018). Therefore, the genetic advance is also considered important because high value of genetic advance is indicative of additive gene action which is the only genetic variance which response to the selection and it also provides information about the expected gain in a character from one cycle of selection (Dutta *et al.* 2013). Keeping in view of the above facts, the present study was carried out with the objectives to assess genetic variability, heritability and genetic advance among the 10 agro-morphological characters of sesame.

MATERIALS AND METHODS

The field experiment was conducted at the Research Farm of the Dryland Agriculture Unit, Department of Agronomy, CCSHaryana Agricultural University, Hisar (Haryana) during *Kharif* season, under the rainfed condition with no pre and post sowing irrigation. Monthly and date wise data of rainfall during Kharif, 2016 is given in **Table 1**. The experimental material for the present study consists of 24 diverse genotypes of sesame (*Sesamum indicum* L.) which were procured from the Oilseed Section, Department of Genetics & Plant Breeding, CCS Haryana Agricultural University, Hisar was laid out in Randomized Block Design (RBD) with three replications. The description of genotypes is given in Table 2. Each genotype was sown in five rows of 4m length spaced at 45cm with 10cm plant to plant distance. All the recommended package of practices suggested for dryland agriculture was adopted to raise a good crop. The observations were recorded for 10 agro-morphological characters *viz.* days to 50% flowering, days to maturity, plant height (cm), the number of branches per plant, the number of capsules per plants, the number of seeds per capsules, 1000-seeds weight (g), biological yield per plant (g), harvest index (%) and seed yield per plant (g). The data for days to flowering (50%) and days to maturity were recorded on plot basis for while rest of the traits *viz.* plant height (cm), the number of branches per plant, the number of capsules per plants, the number of seeds per capsules, 1000-seeds weight (g), biological yield per plant (g), harvest index (%) and seed yield per plant (g) were on the basis of five randomly selected plants in each genotype and each replication. Analysis of variance (ANOVA) for the observations recorded on different characteristics was carried out as per the standard procedure suggested by Panse and Sukhatme (1995). PCV and GCV were computed based on the methods given by Burton and Dewane (1953). The heritability was computed based on the methods given by Falconer (1981) and the genetic advance was estimated according to the formula given by Johnson *et al*., (1955). The GCV and PCV estimates were taken as low, medium and high as per the classification of Singh and Chaudhary, (1977) while the heritability and genetic advance as per cent of mean estimates were taken as low, medium and high as per the classification of Johnson *et al*., (1955).

Table 1. Rainfall during Kharif, 2016 at DLA Research Farm, CCS HAU, Hisar

Month	Date	Rainfall (mm)	
July 2016	3	53	
July 2016	4	13	
July 2016	15	14	
July 2016	16	34	
July 2016	19	11	
July 2016	28	25	
July 2016	29	39	
July2016	Total	189	(169.4*)
August 2016	18	4	
August, 2016	19	14	
August 2016	25	7	
August 2016	29	50	
August 2016	30	7.8	
August 2016	Total	82.8	(68.4*)
September 2016	25	7	
September 2016	Total	7	(30.4)
October 2016	3	30	
October 2016	Total	30	(4.9*)

*Normal Rainfall

RESULTS AND DISCUSSION

Rainfall is a very crucial factor for the successful crop production under rainfedsituation because the performance of crops is directly correlated to the rainfall received during the crop season (Beyer *et al.* 2016). The amount of rainfall received during this crop growing season was adequate and rainfall during the months July and August were above than normal rainfall. In fact, rainfall in July month, which is the most crucial for Kharif sowing, was approximately 7 per cent more than normal rainfall. Mean sum of squares due to genotypes were highly significant for all the characters which indicated the existence of substantial genetic variation among genotypes for all the characters understudied(**Table 3**).

Table 2. List of 24 Genotypes taken for the study

Sr. No.	Genotypes	Source	Sr. No.	Genotypes	Source
1.	CST 2001-9	CSAUA&T, Kanpur (U.P.)	13.	HT 9913	CCS HAU, Hisar (Haryana)
2.	RT 125	SKRAU, Jodhpur (Rajasthan)	14.	TKG 22	ZARS, Tikamgarh (M.P.)
3.	HT 15	CCS HAU, Hisar (Haryana)	15.	HT 9907	CCS HAU, Hisar (Haryana)
4.	HT 20	CCS HAU, Hisar (Haryana)	16.	T 78	CSAUA&T, Kanpur (U.P.)
5.	OC 201	OUA&T, Bhubaneswar (Odisha)	17.	HT 2000	CCS HAU, Hisar (Haryana)
6.	JLS 110-12	Jalagaon, Maharashtra	18.	HT 45	CCS HAU, Hisar (Haryana)
7.	OC 251	OUA&T, Bhubaneswar (Odisha)	19.	KMR 60	UAS, Dharwad (Karnataka)
8.	HT 24	CCS HAU, Hisar (Haryana)	20.	HT 9316	CCS HAU, Hisar (Haryana)
9.	RT 54	SKRAU, Jodhpur (Rajasthan)	21.	HT 1 (LC)	CCS HAU, Hisar (Haryana)
10.	Pragati	CSAUA&T, Kanpur (U.P.)	22.	HT 2 (LC)	CCS HAU, Hisar (Haryana)
11.	NC187	NAU, Navsari (Gujarat)	23.	HTC 1 (black)	CCS HAU, Hisar (Haryana)
12.	Shekhar	CSAUA&T, Kanpur (U.P.)	24.	KMR 41	UAS, Dharwad (Karnataka)

Sumathi and Muralidharan (2010), Menzir (2012), Khairnar and Monpara (2013), Vanishree *et al*. (2013), Ismaila and Usman (2014), Abate *et al*. (2015), Lal *et al*. (2016), Bamrotiya *et al*. (2016) and Teklu *et al*. (2017) also reported significant differences for these characters in sesame. The presence of sufficient variability indicated that the materials of sesame under study were good enough for further study.The phenotypic coefficient of variation (PCV) was greater than the genotypic coefficient of variation (GCV) for all the characters studied, which reflected the role of the environment in the expression of the observed traits. Similar results were also reported by Revathi *et al.* (2012), Abate *et al*. (2015), Meenakumari and Ganesamurthy (2015), Bamrotiya *et al*. (2016), Saxena and Bisen (2016), Soury *et al.* (2016) and Saxena and Bisen (2017) in sesame. In the present study, high PCV & GCV estimates were observed for harvest index and seed yield per plant which showed that there was the considerable possibility of further improvement of harvest index and seed yield per plant through hybridization followed by appropriate selection. High GCV and PCV values were also reported by Sumathi and Muralidharan (2010), Gangadhara *et al*. (2012), Khairnar and Monpara (2013), Vanishree *et al.* (2013), Mahmoud and Ghareeb (2015), Saxena and Bisen (2016), Soury *et al*. (2016), Bamrotiya *et al*. (2016), Saxena and Bisen (2017) and Teklu *et al*. (2017) in sesame.

Table 3. Analysis of variance for various agro-morphological traits in sesame

S.V.	d.f.	Mean sum of squares									
		DF	DM	PH	NBP	NCP	NSP	TW	BYP	HI	SYP
Replications	2	2.18	2.89	155.75	0.57	69.70	0.43	0.07	17.40	9.71	2.77
Genotypes	23	10.48*	21.28**	667.18**	2.98**	327.81**	82.31**	0.38**	613.79**	36.79**	22.15**
Error	46	5.56	6.12	120.74	0.52	107.27	12.94	0.03	55.87	5.00	4.00
C.V. (%)		5.70	2.72	7.71	11.56	13.81	7.02	5.43	9.09	15.48	15.95

**Significant at P = 0.01 Level, *Significant at P = 0.05 Level

DF = Days to flowering (50%), **DM** = Days to maturity, **PH** = Plant height (cm), **NBP** = No. of branches/plant, **NCP** = No. of capsules/plant, **NSC** = No. of seeds/capsule, **TW** = 1000-seed weight (g), **BYP** = Biological yield/plant (g), **HI** = Harvest index (%), **SYP** = Seed yield/plant (g)

Broad sense heritability ranged from 22.81 (Days to 50% flowering) to 77.55 (1000-seeds weight) per cent (**Table 4**). Heritability (broad sense) was found higher for plant height, the number of branches per plant, the number of seeds per capsule, 1000-seed weight, biological yield per plant, harvest index and seed yield per plant, which indicated that these characters were least influenced by the environmental effects and high capacity of the characters for transmission to subsequent generation. Similar results for one or more character were also reported by Sumathi and Muralidharan (2010), Jadhav and Mohrir (2012), Khairnar and Monpara (2013), Meenakumari and Ganesamurthy (2015), Soury *et al.* (2016), Bamrotiya *et al*. (2016), Saxena and Bisen (2016) and Saxena and Bisen (2017) in sesame. High genetic advance coupled with high heritability was observed for the number of branches per plant, biological yield per plant, harvest index and seed yield per plant which indicated that these traits were governed largely through additive effects of genes and improvement in these characters could be achieved through simple phenotypic selection. Similar finding was also reported by Gangadhara *et al*. (2012), Khairnar and Monpara (2013), Siva *et al.* (2013), Vanishree *et al*. (2013), Soury *et al.* (2016), Saxena and Bisen (2016), Bamrotiya *et al*. (2016) and Saxena and Bisen (2017) for one or more of these characters in sesame.

Table 4. Estimates of mean performance, range, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (broad sense) and genetic advance (GA) as per cent of mean for different traits in sesame

Traits	Mean ± SE	Range	Coefficient of variation (%)		Heritability (%) (broad sense)	Genetic advance as per cent of mean (%)
			Genotypic (GCV)	Phenotypic (PCV)		
DF	41.39±1.93	36.00-45.00	3.10	6.48	22.81	3.05
DM	91.07±2.02	82.00-95.00	2.45	3.67	45.21	3.42
PH	142.50±8.97	116.10-167.00	9.47	12.21	60.14	15.13
NBP	6.25±0.59	4.63-7.93	14.47	18.52	61.03	23.29
NCP	74.98±8.46	56.20-92.70	11.44	17.93	40.67	15.02
NSC	51.28±2.94	43.53-60.23	9.38	11.71	64.12	15.47
1000-SW	3.36±0.15	2.75-4.14	10.10	11.47	77.55	18.32
BYP	82.45±6.10	59.32-107.62	16.54	18.86	76.90	29.88
HI	15.56±1.83	8.56-21.37	20.93	25.39	67.94	35.54
SYP	12.54±1.63	8.18-17.73	19.61	25.28	60.19	31.34

DF = Days to flowering (50%), **DM** = Days to maturity, **PH** = Plant height (cm), **NBP** = No. of branches/plant, **NCP** = No. of capsules/plant, **NSC** = No. of seeds/capsule, **1000-SW** = 1000-seeds weight (g), **BYP** = Biological yield/plant (g), **HI** = Harvest index (%), **SYP** = Seed yield/plant (g)

Days to maturity exhibited moderate heritability with low genetic advance may be due to non-additive gene action and moderate heritability being exhibited might be due to favorable influence of environment rather than genotypes and selection for days to maturity might not be effective. Similar observations were also made by Abate *et al*. (2015) and Bamrotiya *et al*. (2016) for days to maturity in sesame. High heritability coupled with moderate genetic advance was observed for plant height, the number of seeds per capsule and 1000-seed weight indicating equal importance of additive and non- additive gene actions. Similar observations were reported by Sumathi and Muralidharan (2010) and Saxena and Bisen (2016) for one or more of these characters in sesame. Moderate heritability accompanied with moderate genetic advance was observed for the number of capsules per plant which indicated the role of non-additive gene action in the expression of these traits and selection might not be effective at the early stage. Similar results were reported in sesame by Meenakumari and Ganesamurthy (2015) and Soury *et al.* (2016).

Considering the forgoing discussion, based on the high genotypic coefficient of variation, high heritability (broad sense) along with high genetic advance which were observed here for the number of branches per plant, biological yield per plant, harvest index and seed yield per plant, indicating their usefulness in genetic amelioration in sesame. These characters can be used further in selection programme for the development of high yielding variety of sesame.

REFERENCES

Abate, M., Mekbib, F., Ayana, A. and Nigussie, M. 2015. Genetic Variability and Association of Traits in Mid altitude Sesame (*Sesamum indicum* L.) Germplasm of Ethiopia. *Am. J. Exp. Agric.*, **9**(3): 1-14.

Bagheri, M., Kahrizi, D. and Zebarjadi, A., 2017. Study on genetic variation and morphophenologic traits in Common bean (Phaseolus vulgaris L.). *Biharean Biol*, **11**(1): 43-47.

Bamrotiya, M.M., Patel, J.B., Malav, A., Chetariya, C.P., Ahir, D. and Kadiyara, J. 2016. Geneticvariability, character association and path analysis in sesame (*Sesamum indicum* L.). *Int. J. Agric. Sci.*, **8**(54): 2912-2916.

Beyer, M., Wallner, M., Bahlmann, L., Thiemig, V., Dietrich, J. and Billib, M., 2016. Rainfall characteristics and their implications for rain-fed agriculture: a case study in the Upper Zambezi River Basin. *Hydrolog. Sci. J.*, *61*(2): 321-343.

Burton, G.W. and Dewane, E.H. 1953. Estimating heritability in tall Fasciae (*Fescuta arundinacea* L.) from replicated clonal material. *Agron. J.,* **45**: 478-481.

Dutta, P., Dutta, P.N. and Borua, P.K. 2013. Morphological traits as selection indices in rice: A statistical view. *Univers. J. Agric.*, **1**(3): 85-96.

Falconer, D.S. 1981. "*Introduction to Quantitative Genetics".* 2nd edition. Oliver and Boyd, Edinburg, London, UK, p: 316.

Gangadhara, K., Chandra Prakash, J., Badiger, B., Shadakshari, T.V., Yathish, K.R., and Rajesh, A.M.2012. Genetic Divergence, Genetic Advance and Heritability in Sesame (*Sesamum indicum* L.). *Bioinfolet.,* **9**(4A): 457-462.

Ismaila, A. and Usman, A. 2014. Genetic variability for yield and yield components in sesame (*Sesamum indicum* L.). *Int. J. Sci. Res.*, **3**(9): 63-66.

Jadhav, R.S. and Mohrir, M.N., 2012. Genetic variability studies for quantitative traits in sesame (Sesamum indicum L.). *Electron. J. Plant Breed.*, **3**(4): 1009-1011.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmentalvariability in soybean. *Agron. J.,* **47**: 314-318.

Khairnar, S.S. and Monpara, B.A. 2013. Identification of potential traits and selection criteria foryield improvement in sesame (*Sesamum indicum* L.) genotypes under rainfed conditions. *Iran. J. Genet. Plant Breed.*, **2**(2): 01-08.

Lal, M., Dutta, S., Saikia, D. and Bhau, B.S. 2016. Assessment of selection criteria in sesame byusing correlation and path coefficient analysis under high moisture and acidic stress soil condition. *Indian J. Sci. Technol.*, **9**(4): 1-5.

Fahad, S., Bajwa, A.A., Nazir, U., Anjum, S.A., Farooq, A., Zohaib, A., Sadia, S., Nasim, W., Adkins, S., Saud, S. and Ihsan, M.Z., 2017. Crop production under drought and heat stress: plant responses and management options. *Front. Plant Sci.*, **8**: 1147.

Mahmoud, M.W.S. and Ghareeb, Z.E. 2015. Variability of yield and some morphological traits insixteen sesame genotypes. *Egypt. J. Plant Breed.*, **19**(4):1031-1045.

Meenakumari, B. and Ganesamurthy, K. 2015. Studies on variability, correlation and path analysis in sesame (*Sesamum indicum* L.). *Adv. Appl. Sci. Res.*, **7**(2): 116-120.

Menzir, A. 2012. Phenotypic variability, divergence analysis and heritability of characters in sesame (*Sesamum indicum* L.) genotypes. *Nat.& Sci.*, **10**(10): 117-126.

Nahak, S.C., Nandi, A., Sahu, G.S., Tripathy, P., Dash, S.K., Patnaik, A. and Pradhan, S.R., 2018. Studies on variability, heritability and genetic advance for yield and yield contributing characters in chilli (Capsicum annuum L.). *J. Pharma. Phytochem.*, **7**(1): 2506-2510.

Pandey, S.K., Das, A., Rai, P. and Dasgupta, T., 2015. Morphological and genetic diversity assessment of sesame (*Sesamum indicum* L.) accessions differing in origin. *Physiol. Mol. Biol. Plant,* **21**(4): 519-529.

Panse, V.G. and Sukhatme, P.V. 1995. "*Statistical methods for agricultural workers*". ICAR Publication, New Delhi. India. p: 68-75.

Patidar, M., Sharma, H. and Haritwal, S., 2018. Genetic variability studies in Blackgram (Vigna mungo (L.) Hepper). *Int. J. Chemical Studies*, **6**(2): 1501-1503.

Pham, T.D., Thi Nguyen, T.D., Carlsson, A.S. and Bui, T.M., 2010. Morphological Evaluation of Sesame (*Sesamum indicum* L.) Varieties from Different Origins. *Aust. J. Crop Sci.*, **4**(7): 498.

Revathi, S., John Joel, A. and Manivannan, N., 2012. Genetic variability in sesame (Sesamum indicum L.). *Electron. J. Plant Breed.*, **3**(1): 692-694.

Saxena, K. and Bisen, R. 2016. Genetic variability, correlation and path analysis studies for yield andyield component traits in sesamum (*Sesamum i*ndicum L.). *Int. J. Agric. Sci.,* **8**(61): 3487-3489.

Saxena, K. and Bisen, R. 2017. Genetic variability, heritability and genetic advance for thephenotypic traits in sesame (*Sesamum indicum*L.). *Int. J. Pure App. Biosci.*, **5**(2): 1126-1131.

Sharma, B.R., Rao, K.V., Vittal, K.P.R., Ramakrishna, Y.S. and Amarasinghe, U. 2010. Estimating the potential of rainfed agriculture in India: Prospects for water productivity improvements. *Agric. Water Manage.* **97**(1): 23-30.

Singh, P., Aggarwal, P.K., Bhatia, V.S., Murty, M.V.R., Pala, M., Oweis, T., Benli, B., Rao, K.P.C. and Wani, S.P.2009. Yield gap analysis: modelling of achievable yields at farm level. *rainfed Agriculture: Unlocking the potential*, *81*.

Singh, R.K. and Choudhary, B.D. 1977. "*Biometrical methods in quantitative genetic analysis".* Kalyani Publishers, New Delhi, p: 178-185.

Siva, P.Y.V.N., Krishna, M.S.R. and Venkateswarlu, Y. 2013. Correlation, path analysis and geneticvariability for economical characteristics in F2 and F3 generations of the cross AVT 3 × TC25 in Sesame (*Sesamum indicum* L.). *J. Environ. and Applied Biores.,* **1**(2): 14-18.

Soury, H.F.E., Bashir, G.E. and Ginaro, M.K. 2016. Phenotypic and genotypic coefficients ofvariation and other growth attributes in sesame genotype under rain-fed conditions. *Adv. Agric. &Agric. Sci.*, **2**(3): 79-84.

Sumathi, P. and Muralidharan, V. 2010. Analysis of genetic variability, association and path analysisin the hybrids of sesame (*Sesamum indicum* L.). *Tropical Agric. Res. and Ext.*, **13**(3): 63-67.

Teklu, D.H., Kebede, S.A. and Gebremichael, D.E. 2017. Assessment of genetic variability, geneticadvance, correlation and path analysis for morphological traits in sesame genotypes. *Int. J. Nov. Res. Life Sci.,* **4**(2): 34-44.

Vanishree, R.L., Goudappagoudar, R. and Banakar, C.N. 2013. Analysis of genetic variability for yield and its components in sesame (*Sesamum indicum* L.). *ýInt. J. Plant Sci.*, **8**(1): 91-93.