J. Farm Sci., 33(3): (302-305) 2020

RESEARCH PAPER

Genetically potential sesame (*Sesamum indicum* L.) breeding lines

HUKUMCHAND AND S. G. PARAMESHWARAPPA

Department of Genetics and Plant Breeding, College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad - 580 005, Karnataka, India
E-mails: hukumc666@gmail.com: parameshwarappasg@uasd.in

(Received: December, 2019 ; Accepted: August, 2020)

Abstract: Ninety six advanced breeding lines of sesame were evaluated during *kharif* 2018 for assessing the genetic potential of breeding lines with regard to yield and it's component traits. Analysis of variance revealed highly significant differences among genotypes for all the ten characters. High genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for number of capsules per plant followed by seed yield per plant while it was moderate for plant height, height to first capsule and number of branches per plant. On the other hand, days to 50 per cent flowering, day to maturity, capsule length, 1000 seed weight and oil content showed low genotypic and phenotypic coefficient of variation. High heritability and genetic advance as per cent mean was observed for seed yield per plant, number of capsules per plant and height to first capsule where as moderate heritability with high genetic advance as per cent over mean was observed for number of branches per plant. Character such as 1000 seed weight showed high heritability and low genetic advance as per cent over mean. Moderate heritability with moderate genetic advance as per cent over mean for plant height, capsule length and moderate heritability with low genetic advance as per cent over mean for days to 50 per cent flowering, days to maturity and oil content was observed.

Key words: Breeding line, Genetic advance, Genetic variability, Heritability

Introduction

Sesame (*Sesamum indicum* L.) is the oldest indigenous oil crops with longest history of its cultivation in India. It is fifth important edible oil crop in India after groundnut, rapeseed-mustard, sunflower and soybean. Sesame seed contains on an average 50% oil, 23 % protein and 15 % carbohydrate. The crop is highly tolerant to drought, grows well in most of the well-drained soils and various agro climatic regions. Sesame oil has highest antioxidant content and contains several fatty acids such as oleic acid (43 %), linoleic acid (35 %), palmitic acid (11 %) and stearic acid (7 %). It has high commercial attributes by virtue of it being a rich source of quality edible oil enriched with proteins, vitamins, amino acids and antioxidants like sesamin, sesamolin and sesamol(Uzun and Cagirgan, 2008). Sesame seeds can be eaten raw, roasted or parched. They are used in various foods and in making items such as decorated bread, pastry, sweetmeats and halva. Sesame oil is of high quality mainly used for cooking purpose, it is well balanced with all types of fatty acids such as saturated, monounsaturated and polyunsaturated fatty acids. Low graded oil is also used to make paints, lubricants, illuminant, cosmetics and in insect formulations.

Sesame is cultivated in an area of 10.57 million ha around the world with a production of 6.10 million tonnes and productivity of 470 kg/ha. Among sesame producing Asian countries, India stands first in sesame production. In India among nine edible oilseeds, sesame ranks fifth (Anon., 2018). In India it is cultivated in an area of 16.66 lakh ha with production of 7.47 lakh tonnes and productivity of 448 kg/ha. It ranks second in area among sesame producing countries after Sudan (21.34 lakh ha). Among different sesame producing states in India, Karnataka stands fifth with an area of 0.35 lakh ha, production of 0.22 lakh tonnes with productivity of 629 kg/ha (Anon., 2018). In Karnataka among different sesame producing districts, Kalaburgi stands first followed by Koppal, Bagalkot, Chickmagalur, Mysore and Bidar (Anon., 2018). The main reason for low productivity in India is that this crop is cultivated in low and marginal soils under poor management practices and also use of local varieties besides biotic and abiotic stresses.

The variability for the characters of economic importance is the basic prerequisite for improvement of any crop species. Lack of adequate variability has been implicated as one of the major limitations in improving the productivity of sesame. The advanced breeding lines is an ideal material for assessing the exact nature of diversity, which helps in inferring about the extent of diversity in the entire breeding lines derived from the carefully chosen parents from indigenous and exotic germplasm lines evaluated for *per se* and made crosses among them. The level of variability and the magnitude of diversity for useful traits present in the material is important for development of improved varieties/hybrids. Always yield is a complex character which is controlled by numerous genes (polygenic), which is affected by environment by a greater extent. Therefore, emphasis should be given to traits which are less affected by environment. Wide range of variability there in advanced breeding lines derived from diverse crosses. In order to know the extent of variability the material has to be evaluated to choose genetically potential lines for the trait of interest, which will be used in hybridization as parents or can be released as varieties, which further leads to increase in productivity level. Therefore, in this study 96 advanced breeding lines were evaluated for variability and other genetic parameters.

Material and methods

Ninety six breeding lines along with checks (JTS-8, TKG-22, GT-10 and DS-5) were evaluated at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (Karnataka) during *kharif,* 2018 in a Randomized Complete Block Design with two replications. Each genotype was sown in a single row of 3 m length at a distance of 30 cm between the rows and 15 cm between the plants within the rows. Five plants in each row were selected at random and the data on ten characters *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), height to first capsule (cm), number of branches per plant, number of capsules per plant, capsule length (cm), 1000 seed weight (g), oil content (%) and seed yield per plant (g) were analyzed based on the formula given by Lush (1940) for heritability. Heritability in the broad sense was derived based on the formula given by Hansan *et al*. (1956). Genetic advance was obtained by the formula prescribed by Johnson *et al*. (1955). The method adopted by Burton and Devane (1953) was used to calculate phenotypic and genotypic co-efficient of variation. Analysis was done using Indostat statistical package.

Results and discussion

The sesame germplasm lines include indigenous and exotic collections were evaluated for yield and yield contributing traits and selected the promising lines for hybridization programme. The selected potential lines were crossed with the agronomically superior varieties. Based on F1 yield performance, the promising heterotic cross combinations were advanced to next generation and further segregating material was handled through pedigree method of selection to get stable breeding lines.In the present study, 96 advanced breeding lines of sesame have been evaluated to know the genetic potential with regard to yield and it's component traits. Due to geo ecological differences and differential breeding procedure from which they have been originated, we can expect variability in different traits of sesame. Therefore all the breeding lines have shown significant quantity of differences in the mean performance with concerning to all the traits considered (Table 1). The lines under the study were significantly diverse this was indicated by highly significant mean sum of squares for those studied characters which will be helpful in identifying and selecting the desired and superior lines for further advancement of the crop. The estimation of the heritable and non heritable components of total variability is important in using appropriate breeding method.

By working on different parts of variation such as coefficients of phenotypic and genotypic variances, heritability and genetic advance, the heritability part of overall observed variation can be calculated (Table 2). There was very narrow gap between GCV and PCV this indicates that the trait under the study had very low environmental impact. Despite phenotypic coefficient of variation (PCV) was found to be greater than genotypic coefficient of variation (GCV) for all the traits studied, there was a small difference between GCV and PCV for the characters such as days to 50 % flowering, days to maturity, height to first capsule , number of capsules/plant, capsule length, 1000 seed weight, oil content and seed yield per plant, suggesting that the traits were less influenced by the environment and for further advancement selection process can be applied.

The PCV and GCV were higher for the trait seed yield/plant, number of capsules per plant and branches per plant indicating significant amount of variability for those traits and are under the genetic control and are less affected by environment, so it can be dependable on such traits and selection will be practised for further advancement. The outcomes are in accordance with Solanki and Gupta (2003), Parameshwarappa *et al*. (2009a) and Jadhav and Mohrir (2012), Soudharya (2016), Vina *et al.* (2017) and Singh *et al.* (2018). The traits such as plant height, height to first capsule and capsule length had moderate GCV and PCV. These findings were in accordance with Ashok Shindhe (2009) for trait height to first capsule and plant height, Tripati *et al.* (2014) for plant height and Sudhakar *et al.* (2007), Parameshwarappa *et al.* (2009a), Mohamoud (2015) and Singh *et al.* (2018) for capsules per plant.

Table 1. Analysis of variance for ten quantitative characters in sesame

Source of variation	d.f.	Mean sum of squares: Days to 50 % flowering	Days to maturity	Plant height (cm)	Height to first capsule (cm)	Number of branches per plant	Number of capsules per plant
Genotypes	95	5.77**	5.50**	289.31**	145.26**	1.41**	391.80**
Replications	1	3.38	3.88	178.62	60.35	1.20	0.17
Error	95	1.62	1.56	87.19	18.23	0.41	26.51
C.D. at 5 %		2.52	2.48	18.54	8.48	1.27	10.22
CV (%)		2.92	1.41	9.55	8.93	15.24	14.24

Source of variation	d.f.	Mean sum of squares: Capsule Length (cm)	1000 Seed weight (g)	Oil content (%)	Seed yield per plant (g)
Genotypes	95	0.12**	0.12**	18.66**	23.36**
Replications	1	0.002	0.03	4.37	1.97
Error	95	0.04	0.01	8.73	0.623
C.D. at 5 %		0.42	1.57	0.16	5.87
CV (%)		8.81	6.16	2.80	12.57

**Significant at 1% level of probability

Days to 50 % flowering, days to maturity, 1000 seed weight and oil content traits have shown low GCV and PCV indicating there is significantly less quantity of variability present among the lines, so they are unfit for the simple selection process. These results are in accordance with findings of Tripathi *et al.* (2014) for the traits like days to maturity, oil content and capsule length. Parameshwarappa *et al*. (2009a) for oil content and Bandilla *et al.* (2011) for 1000 seed weight and number of branches,Soudharya (2016) for days to 50 % flowering, days to maturity, capsule length. But on the other hand, Parameshwarappa *et al*. (2009a) revealed that moderate PCV and GCV for capsule length and days to 50 % flowering. In order to estimate real variability, GCV is more preferred because it only has heritable portion (Allard, 1960). The computed GCV is same as that of PCV for all the traits except for capsule length, number of branches and plant height, hence from this it is clear that except these characters all other characters had very less environmental influence so phenotypic variability is used as a criterion for making selection.

Heritability indicates the heritable part of variation. It helps to a breeder to find out direction of selection procedure to be followed in a particular condition, nevertheless heritability coupled with genetic advance is promising (Johnson *et al.,* 1955) and helps in planning the selection procedure. In the present study, estimation of broad sense heritability was high for traits such as height to first capsule, capsules/plant, 1000 seed weight and seed yield/plant. The traits such as days to 50 per cent flowering, days to maturity, plant height, branches per plant and capsule length were having moderate heritability values and oil content had low heritability value (Table 2). To know potency of selection in improving the traits, genetic advance as per cent of mean (GAM) is more dependable index since it gives a clear idea about potency of selection for improving the plant traits. In this study, high genetic advance as per cent of mean was seen for the traits such as height to first capsule, branches per plant, number of capsules/plant and seed yield/plant and had moderate GAM for plant height and capsule length. High heritability does not indicate high genetic gain always it has to be followed by high genetic advance as per cent of mean (Noor *et al.,* 2004). High heritability along with heritable genetic advance specifies that there is low influence of environment and presence of additive gene action, they are amenable for simple selection. Yield is influenced by many factors and it is a complex character.

In the present study, high heritability followed by high genetic advance per cent of mean was recorded for traits such as seed yield/plant. This may be due to low mean value recorded for seed yield per plant. Similar results were reported by Sudhakar *et al.* (2007), Parameshwarappa *et al.* (2009a), Jadhav and Mohrir (2012), Narayanan and Murugan (2013), and Soundharya (2016) for seed yield per plant, Sudhakar *et al.* (2007), Parameshwarappa *et al.* (2009a), Narayanan and Murugan (2013), Soundharya (2016) and Vina *et al.* (2017) for number of capsules per plant.

The traits such as number of branches per plant had moderate heritability and high genetic advance per cent of mean, this shows that there is presence of additive gene action and hence simple phenotypic selection applied for improvement. These findings are in concordance with Narayanan and Murugan (2013) for branches per plant and plant height. Traits such as 1000 seed weight has high heritability but has lower genetic advance per cent of mean (GAM), These results are in accordance with Siva *et al.* (2013) for oil content. High heritability with moderate genetic advance was reported by Abate *et al.* (2015). Moderate heritability along with moderate genetic advance as per cent of mean for traits such as capsule length and plant height, moderate heritability and low genetic advance per cent of mean for the traits such as days to 50 % flowering and days to maturity was seen. Both additive and non additive gene action is observed in capsule length and plant height but for the trait days to 50 % flowering and days to maturity, non additive gene action is concluded. It has substantial amount of environmental influence so these traits are not suitable for simple phenotypic selection. These results are in accordance

Table 2. Genetic parameters for ten quantitative characters in sesame

Sl. No.	Characters	Range		Mean	Variance		Coefficient of variation		Broad sense heritability (h^2) (%)	Genetic advance (GA)	Genetic advance per cent mean (GAM)%
		Min.	Max.		Genotypic	Phenotypic	Genotypic (GCV)	Phenotypic (PCV)			
1	Days to 50 % flowering	39.00	47.00	43.54	2.07	3.70	3.30	4.42	56.10	2.22	5.11
2	Days to maturity	84.00	92.00	88.56	1.97	3.53	1.59	2.12	55.80	2.16	2.44
3	Plant height (cm)	70.00	133.17	97.74	101.06	188.25	10.29	14.04	53.70	15.17	15.52
4	Height to first capsule (cm)	31.75	67.37	47.80	63.52	81.75	16.67	18.92	77.70	14.47	30.28
5	Number of branches per plant	2.40	6.34	4.19	0.50	0.91	16.94	22.79	55.20	1.08	25.93
6	Number of capsules per plant	14.00	78.83	36.16	182.65	209.16	37.38	40.00	87.30	26.01	71.95
7	Capsule length (cm)	1.74	2.93	2.38	0.04	0.81	9.07	11.94	45.60	0.27	11.22
8	1000 seed weight (g)	2.59	3.62	2.97	0.02	0.03	5.29	5.98	78.00	0.29	9.62
9	Oil content (%)	38.97	51.37	48.18	2.47	11.20	5.27	6.98	22.00	1.52	3.17
10	Seed yield per plant (g)	3.13	19.39	6.28	11.37	11.99	53.73	55.18	94.80	6.76	77.70

with Iqbal *et al.* (2016), on the contrary high heritability and moderate genetic advance was reported by Chowdhary *et al.* (2010).

Conclusion

In the present study,considerably high variability was observed for most of the productivity related traits. This was evidenced by high range of mean performance for different traits. Moderately high heritability and genetic advance (GA) was observed for many productivity related traits which indicates that these advanced breeding material is very good to begin hybridization programme.The study concluded that, the traits such as branches per plant, number of capsules and seed yield per plant showing additive gene action in order to improve this trait simple phenotypic selection can be applied in the future for improving yield of sesame.

References

Abate M, Mekbib F, Ayana A and Nigussie M, 2015, Genetic variability and association of traits in midaltitude sesame (*Sesamum indicum* L.). Germplasm of Ethiopia. *American Journal of Experimental Agriculture*, 9(3): 1-14.

Allard R W, 1960, *Principles of Plant Breeding*, John Wiley and Sons Inc. New York, USA, p. 236.

Anonymous, 2018, *Directorate of Economics and Statistics*, 2017-18.

Ashok Shindhe, 2009, Phenotypic and molecular characterization of mutants of M_3 generation for selected characters in sesame (*Sesamum indium* L.). *M. Sc. (Agri) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Bandila S, Ghanta A, Natarajan S and Subramaniam S, 2011, Determination of genetic variation in Indian sesame (*Sesamum indicum*) genotypes for agro- morphological traits. *Indian Journal of Agricultural Sciences*, 7(2): 88-99.

Burton G W and Devane E M, 1953, Estimating heritability in tall fescue (*Festucacircunclinaceae*) from replicated clonal material. *Agronomy Journal,* 45: 478-481.

Chowdhury S, Datta A K, Saha A, Sengupta S, Paul R, Maity S and Das A, 2010, Traits influencing yield in sesame (*Sesamum indium* L.) and multilocational trials of yield parameters in some desirable plant types. *Indian Journal of Science and Technology,* 3(2): 163- 166.

Hanson G H, Robinson H F and Comstock R E, 1956, Biometrical studies of yield in segregating populations of Koren Lespedeza. *Agronomy Journal*, 48: 268-272.

Iqbal A, Akhtar R, Begum T and Dasgupta T, 2016, Genetic estimates and diversity study in Sesame (*Sesamum indicum* L*.). Journal of Oil Seed Research,* 8 (1): 01-05.

Jadhav R S and Mohrir M N, 2012, Genetic variability studies for quantitative traits in sesame (*Sesame indicum* L.). *Electronic Journal of Plant Breeding,* 3(4): 1009-1011.

Johnson H W, Robinson H F and Comstock R E, 1955, Estimates of genetic and environmental variability in soybean. *Agronomy Journal*, 47: 311-318.

Lush J L, 1940, Intra-sire correlation and regression of offspring on dams as a method of estimating heritability of characters. *Proceedings of American Societyof Animal Production*, 33: 293-301.

Mahmoud M W S, Abo-Elezz A A and Hassan T H A, 2015, Genetic variability, heritability and correlation coefficients of yield and its components in sesame (*Sesamum indicum* L.). *Egyptian Journal of Plant Breeding,* 19 (4):1101-1116.

Narayanan R and Murugan S, 2013, Genetic variability, heritability, divergence and stability analysis in sesame (*Sesamum indicum L.*). *International Journal of Advanced Research*, 2(11): 16-19.

Noor S A, Akram Z and Mirza M Y, 2004, Genetic variability and correlation studies in linseed. *M. Sc. (Hons) Agri.* Dissertation. Department of Plant Breeding and Genetics, University of Arid Agriculture, Rawalpindi, Pakistan.

Parameshwarappa S G, Palakshappa M G, Salimath P M and Parameshwarappa K G, 2009a, Studies on genetic variability and character association in germplasm collection of sesame (*Sesamum indicum* L.). *Karnataka Journal Agricultural Sciences,* 22 (2): 252-254.

Singh A, Rajani B and Akanksha T, 2018, Genetic variability and character association in sesame (*Sesamum indicum* L.) genotypes, *International Journal of Current Microbiology and Applied Sciences,* (2018) 7(11): 2407-2415.

Siva P Y V N, Krishna M S R and Yadavalli V, 2013, Correlation, path analysis and genetic variability for economical characteristics in F_2 and F_3 generations of the cross AVT 3 × TC 25 in sesamum (*Sesamum indium* L.). *Journal* of *Environmental Applied Biology*, 1(2): 14-18.

Solanki Z S and Gupta S, 2003, Variability and character association among quantitative characters of sesame. *Journal of Oil Seed Research*, 20(2): 276-277.

Soundharya, 2016, Genetic diversity studies in sesame (*Sesamum indicum* L.) genotypes. *M.Sc.(Agri.) Thesis,* Professor Jayashankar Telangana state Agricultural University, Hyderabad.

Sudhakar N, Sridevi O and Salimath P M, 2007, Variability and character association analysis in sesame (*Sesamum indium* L.). *Journal of Oil Seed Research*, 24(1): 56-58.

Tripathi A, Rajani Bisen, Ravindra P, Ahirwal, Seema Paroha, Roshni Sahu and Ranganatha A R G, 2014, Study on genetic divergence in sesame (*Sesamum Indicum* L.) Germplasm based on morphological and Quality traits. *An International Quarterly Journal of Life Sciences,* 8(4): 1387-1391.

Uzun B and Cagirgan M I, 2008, Identification of molecular markers linked to determinate growth habit in sesame. *Euphytica*, 166 (3): 379-384.

Vina E A and Rani A W, 2017, Genetic variability, standardized multiple linear regression and principal component analysis to determine some important sesame yield components. *AGRIVITA Journal of Agricultural Sciences,* 39(1): 83-90.