International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 10, Issue 5, 2018, pp.-5383-5386.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

HETEROSIS STUDIES FOR SEED YIELD AND ITS COMPONENTS IN SESAME (*Sesamum indicum* L.)

CHAUDHARY B.K.*, SOLANKI S.D., SINGH S., PRAJAPATI N.N. AND CHAUDHARY V.B.

Department of Genetics and Plant Breeding, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, 385506, Gujarat
*Corresponding Author: Email-bharatchaudhary34145@gmail.com

Received: March 07, 2018; Revised: March 12, 2018; Accepted: March 13, 2018; Published: March 15, 2018

Abstract- A study was conducted in sesame to assess the extent of heterosis for eleven traits including seed yield per plant. Heterosis was worked-out over better parent and standard variety, G.Til-2. The standard heterosis for seed yield per plant ranged from -25.23 to 43.75 %. The crosses GT 10 × GT 4, AT 308 × SKT 12-2, AT 314 × GT 4 and GT 10 × AT 319 were good heterotic combinations for seed yield per plant, which recorded 43.74, 40.44, 39.61 and 36.74 % standard heterosis, respectively.

Keywords-Sesame, Heterosis, Heterobeltiosis Standard heterosis

Citation: Chaudhary B.K., et al., (2018) Heterosis Studies for Seed Yield and its Components in Sesame (*Sesamum indicum* l.). International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 5, pp.-5383-5386.

Introduction

Sesame (*Sesamum indicum* L.) is a crop, which is cultivated in diverse agroecological situations. It is called as the "Queen of oil seeds" because of its excellent qualities of the seed, oil and meal. Sesame is highly nutritive (oil 50%, protein 25 %) and its oil contains an antioxidant called sesamol which imparts a high degree of resistance against oxidative rancidity. It is an important annual oilseed crop in the tropics and warm subtropics, where it is usually grown in small patches [1]. In India, Sesame crop is grown throughout the country round the year in area of about 18.6 lakh hectares with a total production of 6.3 lakh tonnes and productivity of 341kg/ha (Directorate of Economics and statistics, 2013). Diallel analysis can used for getting genetic information from various crops for breeding programs [2]. Heterosis a phenomenon of increased vigor, is obtained by hybridization of inbred lines. Mubashir *et al.* (2009) [3] conducted an experiment comprising of five parental lines and their ten crosses, recording 40.35–255.12% heterosis in yield-contributing components. The sesame plant has distinct features favourable for hybrid seed production. Heterosis of small amount for individual yield contributing characters may have an additive or synergistic effect on the end product [4]. Therefore, the present study was undertaken to study the extent of heterosis for quantitative traits in sesame.

Materials and Methods

The experimental materials consisted of 9 genotype *viz.* AT 324, AT 311, AT 316, AT 314, AT 319, AT 308, GT 10, GT 4and SKT 12-2, which were crossed in a 9×9 diallel mating design excluding reciprocals during kharif-2013and produce 36 cross combinations. All the 36 hybrids and their 9 patents and one standard check *viz.* GT 2 raised in a randomized Block Design with 3 replication at Main Castor-Mustard Research Station, S. D. Agricultural University, Sardarkrushinagar during kharif-2014, with inter and intra-row spacing 45 and 15 cm, respectively. The observations were recorded on five competitive plants selected from each genotype in each replication for days to flowering, days to maturity, plant height (cm), number of branches per plant, number of capsules per plant, number of seeds per capsule, seed yield per plant (gm), 1000 seed weight (gm), harvest index (%), oil content (%) and chlorophyll content. Oil content of each samples were estimated in percentage by using Nuclear Magnetic Resonance Technique (NMR) (Tiwari *et al.*, 1974)[5]. The chlorophyll content was measured at flowering stage of selected plant by using SPAD 502 meter [6]. The replication wise mean values of each genotype for various characters were subjected to statistical analysis as per the procedure of Randomized Block Design as suggested by Panse and Sukhatme, 198)[7].

Results and Discussion

The analyses of variances for various economic traits are presented in [Table-1]. Analysis of variance showed significant differences among parents for all the eleven traits studied. This revealed the presence of significant variability in the experimental material. The crosses showed significant differences for all traits, which indicated the existence of variability among the crosses. The interaction between the parents and crosses recorded significant differences among all characters except days to flowering, 1000 seed weight, harvest index and chlorophyll content. These results are in agreement with the findings of Kumar *et al.* (2013) [8] and Vekariya *et al.* (2015) [9]. This indicated that average performance of hybrids significantly differed from that of the parents as a group of these traits suggesting the presence of sufficient variability for all these characters. The details on range of three types of heterosis, number of significant hybrids along with best three heterotic combinations are presented in [Table-2]. The extent of heterosis for days to 50 percent flowering had range varied from -6.73 to 8.49 percent when all the three types were considered. The hybrid AT 316 × GT 4 and AT 316 × AT 308 depicted high significantly all the three types of heterosis in desirable direction. Only one hybrid GT 4 × SKT 12-2 showed highest significant standard heterosis for earliness over standard check GT 2. None of the cross showed significant negative heterosis over MP, BP and SP for dwarfness. Standard heterosis for number of branches per plant had a range of -69.39 to

128.57 with 18 crosses showing more number of branches then the variety GT 2. The hybrid GT 10 × GT 4 (128.57%) registered high significant positive standard heterosis followed by GT 10 × AT 314 (112.24%) and GT 10 × AT 316 (110.20%). For number of capsules per plant the cross GT 10 × AT 316 showed highest significant positive relative heterosis (87.26%) and heterobeltiosis (72.87%). The cross GT 10 × AT 316 (96.25%) also showed highest significant positive standard heterosis followed by GT 10 × GT 4 (61.08%) and GT 10 × AT 319 (60.56%) than the variety GT 2. The trait, number of seeds per capsule showed a ranged of -17.04 to 32.77 with 19 crosses exceeded the value of GT 2. The cross AT 311 × SKT 12-2 and AT 324 × GT 10 registered high significant positive relative heterosis as well as heterobeltisis. The highest standard heterosis for number of seeds per capsules recorded by the cross AT 308 × SKT 12-2 (32.77%) followed by AT 311 × SKT 12-2(27.28) over the check GT 2. For seed yield per plant, the mid parent heterosis ranged from -18.69 to 75.24 percent, heterobeltiosis ranged from -38.52 to 67.90 whereas, standard heterosis varied from -25.23 to 43.75 percent with 12 crosses had more yield than the standard check GT 2. The highest significant positive heterobeltiosis was recorded by the cross AT 308 × SKT 12-2 (67.90%) followed by AT 311 × SKT 12-2 (53.58%) and GT 10 × GT 4 (47.95%) for seed yield per plant. The GT 10 × GT 4(13.33gm) was the best hybrid for seed yield per plant, which registered significantly higher standard heterosis (43.75%) which is followed by AT 308 × SKT 12-2 (40.44%), AT 314 × GT 4 (39.61%) and GT 10 × AT 319 (36.74%) than the check GT 2. The hybrid AT 311 × AT 316 registered the highest significant relative heterosis (24.59%), heterobeltiosis (19.21%) for test weight of the seed. This was also suggested by Ramesh *et al.* (2014)[10].

Table-1 *Analysis of variance for experimental design for various characters in Sesame.*

Source of variation	d.f.	Days to flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of capsules per plant	No. of seeds per capsule	Seed yield per plant (g)	1000 seed weight (g)	Harvest Index (%)	Oil content (%)	chlorophy ll content
Replications	2	5.72	2.10	74.32	0.21	218.13	8.40	16.18	0.53	152.04	3.64	157.73
Genotypes (G)	44	3.83**	15.27**	535.43**	6.66**	1324.65**	140.77**	10.39**	0.35**	123.77**	170.62**	13.04**
Parents (P)	8	2.34*	22.07**	195.09*	7.99**	352.50*	187.70**	16.68**	0.57**	147.19**	82.49**	13.29**
Hybrids (H)	35	4.27**	13.76**	361.15**	6.18**	1373.10**	131.30**	7.19**	0.31**	121.54**	191.74**	13.29**
Parent *vs.* Hybrids	1	0.01	14.02*	9358.34**	12.70**	7405.93**	96.94**	72.04**	0.06	14.30	136.41**	2.27
Error	88	0.87	2.86	94.88	0.18	151.72	13.16	1.49	0.06	12.92	1.62	2.28

* $P \leq 0.05$, ** $P \leq 0.01$

The highest relative heterosis (47.37%), heterobeltiosis (45.38%) and standard heterosis (36.54%) for the trait harvest index were recorded by the cross GT 10 × AT 319.Heterosis for oil content ranged from -54.93 to 28.08 percent with eighteen crosses had high oil content than the standard check GT 2. The cross AT 316 × AT 308 recorded highest positive significant standard heterosis (28.08%), followed by AT 308 × GT 4 (23.25%) and AT 314 × AT 319 (22.37%) over the check GT 2 for the trait oil content. With respect to the trait chlorophyll content the cross AT 314 × AT 319 showed highest positive significant relative heterosis (32.78%), heterobeltiosis (28.69%) and standard heterosis (22.57%).

From the study of heterosis, it revealed that the majority of hybrids for most of the traits *viz.* seed yield per plant, number of branches per plant, number of capsule per plant, number of seeds per capsule, harvest index, 1000 seed weight, oil and chlorophyll content exhibited positive significant relative heterosis, thereby indicating that for these traits the genes with positive effect were dominant. While for traits such as plant height, days to flowering and days to maturity majority of the hybrids exhibited negative significant relative heterosis indicating that for these traits the genes with negative effects were dominant. The heterotic response over mid parent in sesame were also reported by Govindarasu *et al.* (2001) [11], Das *et al.* (2003)[12], Prajapati *et al.* (2006)[13], Jadhav and Mohrir (2013)[14]and Parimala *et al.* (2013)[15]. Fonseca and Patterson (1968)[16] coined the new term "heterobeltiosis" as an improvement of heterozygote in relation to better parent. It provides information about the presence of over dominance type of gene action in the expressions of various traits. In the present study the magnitude and number of hybrids exhibiting significant heterobeltiosis were variable. The maximum heterobeltiosis for seed yield per plant was exhibited by the hybrids AT 308 X SKT 12-2 (67.90 %) and AT 311 X SKT 12-2 (53.38 %) followed by GT 10 X GT 4 (47.95 %). The hybrid AT 311 X AT 316 (19.33 %) and AT 324 X AT 316 (13.92 %) detected high heterobeltiosis for 1000-seed weight, while hybrid GT 10 X AT 319 (45.38 %) and AT 314 X AT 308 (13.16 %) for harvest index. For oil content, hybrid GT 10 X AT 319 (22.84 %) was depicted high heterobeltisis. These findings were also supported by Baviskar*et al.* (1998)[17], Padmavathi (1998) [18], Kavitha *et al.* (2000)[19], Reddy *et al.* (2001)[20], Patel *et al.* (2005)[21], Salunke *et al.* (2013)[22] and Subashini *et al.* (2014)[23].

In case of standard heterosis, twelve hybrids were significant and desirable heterosis for seed yield per plant. The maximum significant and positive heterosis over check GT 2 was observed in hybrid GT 10 X GT 4 (43.75 %) followed by AT 308 X SKT 12-2 (40.44 %), AT 314 X GT 4 (39.61 %) and GT 10 X AT 319 (36.74 %). The heterotic response over the standard check in Sesame were also reported by Sakhare *et al.* (1998) [24], Kumar *et al.* (2000) [25], Manivan and Ganesan (2001) [26], Jadhav and Mohrir (2013)[14], Vavdiya *et al.* (2013)[27] and Subashini *et al.* (2014)[23]which are in accordance with the present findings.

Conclusion

It is clear from the above discussion that three crosses GT 10 X GT 4, AT 308 X SKT 12-2 and AT 314 X GT4 most promising for seed yield and other desirable traits. These crosses are utilizing by biparental mating or recurrent selection breeding approaches to obtain desirable segregants for development of further superior genotypes for seed yield and its component trait.

Application of research: Application for finding of best parent and cross

Research Category: Heterosis study

Abbreviations:
NMR: Nuclear Magnetic Resonance

Acknowledgement / Funding: Author thankful to Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, 385506, Gujarat

***Major Advisor: Dr S. D. Solanki**
University: Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, 385506, Gujarat
Research project name or number: MSc Thesis

Author Contributions: All author equally contributed

Author statement: All authors read, reviewed, agree and approved the final manuscript

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

References

[1] Bedigian D. and Harlan J.R. (1986) *Economic Botany*, 40(2), 137-154.

[2] Hill J., Wagoire W.W., Oritz R. and Stlen O. (2001) *Theoretical and Applied Genetics*, 102(6-7), 1076-1081.

[3] Mubashir A.K., Mirza M.Y., Akmal M., Rashid A., Mohmand A.S., Nawaz M.S., Nawaz N., Yousuf M. (2009) *Pakistan Journal of Agriculture Research*, 22, 127–131.

[4] Sasikumar B. and Sardana S. (1990) *Indian Journal Genetics*, 50(1), 45-49.

[5] Tiwari P.N., Gambier P.N. and Rajan T.S. (1974) *Journal of American Chemical Society*, 51,104-109.

[6] Minolta (1989) Instruction Manual. Minolta Co., Ltd., Radiometric Instruments Operations, Osaka, Japan.

[7] Panse V.G. and Sukhatme P.V. (1985) Statistical Methods for Agricultural Workers. ICAR, New Delhi.

[8] Kumar Narendra, Tikka S. B. S., Dagla M.C., Ram Bhagirathand Meena H. P. (2013) *The Bioscan*, 8(4), 1503-1509.

[9] Vekaria D.M., Dobariya K.L., Rajani C.J. and Patel M.B. (2015) *The bioscan*, 10(2), 857-861.

[10] Ramesh, Shekhawat N., Macwanas. s., Choudhary R. and Patel B. R. (2014) *The Bioscan,* 9(4), 1657-1660.

[11] Govindarasu R., Subramanian M. and Ramamoorthi N. (2001) *Madras Agricultural Journal*, 86 (7-9), 479-481

[12] Das K., Chaudhary R. K. and Roy A. (2003) *PKV Res. Journal,* 24 (1), 9-11.

[13] Prajapati K.P., Patel K.M., Patel C.J. and Thakkar D.A.(2006) *Journal of Oilseeds Research,* 23 (2), 292-294.

[14] Jadhav R.S. and Mohrir M.N.(2013) *Electronic Journal of Plant Breeding,* 4(1), 1056-1060.

[15] Parimala K., Devi I. S., Bharathi V., Raghu B., Srikrishnalatha K. and Reddy A.V.(2013) *Inter. J. of App. Bio.and Pharm.Tech.,* 4 (4), 65-68.

[16] Fonseca S. and Patterson F. L. (1968) *Crop Science,* 8, 85-88.

[17] Baviskar A.P., Shinde Y.M., Badhe P.L. and Shinde G.C. (1998) *Journal Maharastra Agricultural Uni*versity, 23 (1), 65-66.

[18] Padmavanthi N. (1998) *Indian Journal of Agriculture Science*, 68 (11), 750-751.

[19] Kavitha M., Ramalingam R.S., Raveendran T.S. and Punitha D. (2000) *Crop Research,* 19(1), 165-169.

[20] Reddy S.S.L., Sheriff R.A., Ramesh S. and Rao A.M. (2001) *Mysore Journal of Agriculture Science,* 35(1), 55-57.

[21] Patel M.A., Patel J.S., Patel D.H., Fatteh U.G. and Sriram S. (2005) *Crop Research*, 29 (2), 259-264.

[22] Salunke D.P., Lokesha R. and Banakar C.K. (2013) *Bioinfolet,* 10(1A), 68-71.

[23] Subashini G., Chimmli S.R. and Yadav P.R. (2014) *Biochemical and Cellular Archives,* 14 (2), 471-473.

[24] Sakhare S.B., Narkhede M.N. and Ghorpade P.B. (1998) *Annals of Plant Physiology*, 12(2), 115-118.

[25] Kumar P., Senthil K. S. and Ganesan J. (2000) *Agriculture Science Digest*, 24(4), 292-294.

[26] Manivan N. and Ganesan J. (2001) *Madras Agricultural Journal*, 88 (7-9), 427-430.

[27] Vavdiya P.A., Dobariya K.L., Babariya C.A. and Sapovadiya M.V.(2013) *Electronic Journal of Plant Breeding*, 4(3), 1246-1250.

Table-2 *Range of heterosis for yield and yield components, number of crosses showing desirable heterotic performance and best heterotic combination*

No.	Character Name	Range of Heterosis			No. of significant hybrids on the basis of			Best heterotic combination over					
		MP	BP	SP	MP	BP	SP	MP	BP	SP	MP	BP	SP
								Cross No.	Value	Cross No.	Value	Cross No.	Value
1	Days to flowering	-6.73 to 7.98	-5.45 to 8.49	-6.36 to 5.45	4	2	8	AT 316 × AT 308	-6.73	AT 316 × AT 308	-5.45	AT 316 × GT 4	-6.36
								AT 316 × GT 4	-5.50	AT 316 × GT 4	-4.63	AT 316 × AT 308	-5.45
								AT 308× SKT 12-2	-5.02	-	-	AT 308× SKT 12-2	-5.45
								AT 316 × AT 314	-4.59	-	-	AT 316 × AT 314	-5.45
2	Days to maturity	-2.31 to 4.25	-2.14 to 8.88	-3.36 to 6.34	0	0	1	-	-	-	-	GT 4 × SKT 12-2	-3.36
3	Plant height	3.28 to 38.21	3.35 to 53.18	3.11 to 37.44	0	0	0	-	-	-	-	-	-
4	Branch/plant	-36.17 to 161.02	-44.44 to 97.44	-69.39 to 128.57	18	5	18	AT 324 × AT 311	161.02	AT 324 × AT 311	97.44	GT 10 × GT 4	128.57
								AT 311 × SKT 12-2	100	AT 324 × AT 308	61.54	GT 10 × AT 314	112.24
								AT 324 × AT 308	90.19	AT 311 × SKT 12-2	47.62	GT 10 × AT 316	110.2
5	No. of capsule /plant	-17.34 to 87.26	-22.43 to 72.87	-26.96 to 96.25	16	11	12	GT 10 × AT 316	87.26	GT 10 × AT 316	72.87	GT 10 × AT 316	96.25
								AT 324 × AT 311	79.31	AT 324 × AT 311	67.48	GT 10 × GT 4	61.08
								AT 324 × AT 314	57.85	AT 316 × AT 314	46.82	GT 10 × AT 319	60.56
6	No. of seeds/capsule	-10.40 to 24.26	-17.04 to 22.33	-10.83 to 32.77	10	5	19	AT 311 × SKT 12-2	24.26	AT 324 × GT 10	22.33	AT 308× SKT 12-2	32.77
								AT 324 × GT 10	22.67	AT 311 × SKT 12-2	19.86	AT 311 × SKT 12-2	27.28
								AT 308× SKT 12-2	20.72	GT 10 × AT 319	12.29	AT 319 × AT 308	20.90
7	Seed yield/plant	-18.69 to 75.24	-38.52 to 67.90	-25.23 to 43.75	20	9	12	AT 308× SKT 12-2	75.24	AT 308× SKT 12-2	67.90	GT 10 × GT 4	43.75
								AT 324 × GT 10	66.89	AT 311 × SKT 12-2	53.58	AT 308× SKT 12-2	40.44
								AT 324 × SKT 12-2	58.76	GT 10 × GT 4	47.95	AT 314 × GT 4	39.61
8	1000 seed weight	-15.90 to 24.59	-23.22 to 19.33	-15.70 to 29.21	4	2	4	AT 311 × AT 316	24.59	AT 311 × AT 316	19.33	AT 311 × AT 316	29.21
								AT 324 × AT 316	19.00	AT 324 × AT 316	13.92	AT 311 × AT 319	20.27
								AT 311 × AT 319	10.30	AT 311 × AT 319	9.53	AT 319 × SKT 12-2	14.84
9	Harvest Index (%)	-41.60 to 47.37	-48.56 to 45.38	-34.97 to 36.54	8	5	4	GT 10 × AT 319	47.37	GT 10 × AT 319	45.38	GT 10 × AT 319	36.54
								AT 314 × AT 308	34.61	AT 314 × AT 308	26.86	AT 311 × GT 4	20.51
								GT 10 × SKT 12-2	33.94	GT 10 × SKT 12-2	23.51	AT 324 × AT 319	20.29
10	Oil Content	-47.90 to 26.11	-54.93 to 22.84	-54.14 to 28.08	23	13	18	GT 10 × AT 319	26.11	GT 10 × AT 319	22.84	AT 316 × AT 308	28.08
								AT 311 × GT 10	23.19	AT 316 × AT 308	19.16	AT 308 × GT 4	23.25
								AT 314 × AT 319	21.59	AT 314 × AT 319	18.04	AT 314 × AT 319	22.37
11	Chlorophyll content	-32.75 to 32.78	-39.70 to 28.69	-38.32 to 22.57	5	3	3	AT 314 × AT 319	32.78	AT 314 × AT 319	28.69	AT 314 × AT 319	22.57
								AT 308× SKT 12-2	27.70	AT 308× SKT 12-2	26.01	GT 10 × AT 316	17.31
								AT 311 × SKT 12-2	26.65	AT 311 × SKT 12-2	20.73	GT 4 × SKT 12-2	16.82