sesame (*Sesamum indicum* L.) cultivars and lines

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ABSTRACT

Eight sesame lines were selected as parents from the sesame breeding program, Gedarif Research Station of the Agricultural Research Corporation (ARC), Sudan. The parents were crossed in all possible diallel combinations (without reciprocals) to produce 28 single-cross hybrids. The parents and 28 F_1 generatins were evaluated under rains for two consecutive seasons (2005 and 2006) at Gedarif Research Station. Four of the parents were released varieties *viz*: Ziraa-9, Kenana-2, Promo and Gedarif-1, and the other four were advanced lines. The experiment was arranged in a randomized complete block design with three replicates to elucidate general and specific combining ability for yield and yield components among 36 sesame genotypes. Data were recorded on days to 50% flowering; days to maturity; plant height; number of branches/plant; number of capsules/plant; height to first capsule; height to first branch; capsule length; 1000 seeds weight; seed yield/plant and seed yield/ha. Analysis of combining ability revealed the importance of both additive and non-additive gene action for inheritance of the measured traits. The magnitudes of general combining ability (GCA) variances were greater than the respective variances due to specific combining ability (SCA). Additive gene action was predominant for days to 50% flowering, days to maturity, plant height, height to first capsule, capsule length and 1000-seed weight. Non-additive gene action predominated seed yield/plant and seed yield/ha. The GCA effects revealed that Gd2002SPSN29, Ziraa-9 and Gedarif-1 were the best combiners, since they recorded significant GCA effects in either direction for most of the measured traits. The parent Gd2002SPSN53 was the poorest combiner of all the parents used in this study. Considerable number of crosses showed significant SCA effects. The cross combinations Gd2002SPSN.53 x Gedarif-1, Gd2002SPSN.53 x Promo and Gd2002SPSN.14 x Ziraa-9 exhibited significant positive SCA effects for seed yield/ha, with a reasonable yields of 1081, 841 and 810 kg/ha, respectively. The study suggested that further testing would be needed to confirm consistency of these crosses in term of their seed yield and stability.

INTRODUCTION

In the Sudan, sesame is the main cash crop of the rainfed sector and it may be one of the main agricultural exported commodity. The ultimate objective of sesame breeding program since its inception in the Sudan in the early 1950s has been the development of high yielding, non-shattering varieties for mechanized crop production. In many parts of the world breeding for indehiscency proved to be a difficult task. Thus the main objective of the sesame breeding program is the development of high yielding but dehiscent varieties. The shattering problem could be partially solved by breeding for uniform maturity (Khidir, 1969).

Hybridization is the most potent technique to enrich the genetic variation and for breaking yield barriers for producing varieties having built-in high yield potential (Singh and Narayanan, 2000). Yield is a polygenic trait (Allard, 1966). The knowledge of gene action (additive, dominance, etc.) for yield and yield attributes in sesame are of valuable importance for the breeder to choose appropriate breeding methods. The selection of suitable parents for hybridization is one of the most important steps in breeding programs. Selection of parents on the basis of phenotypic performance alone is not a sound procedure, since phenotypically superior lines may yield poor recombinants in the segregating generations (Singh and Narayanan, 2000). It is therefore, essential that the parents should be chosen on the basis of their genetic value. Thus the diallel cross is considered as essential procedure for evaluation of several single crosses. Genetic information about the nature of combining ability of genotypes is a pre-requisite for identifying the suitable parents either to use for heterosis breeding or evolve as desirable pure line varieties. Therefore this study was conducted to elucidate general and specific combining ability and nature of gene actions for yield and yield components among 36 sesame genotypes.

MATERIALS AND METHODS

Eight sesame parents with a wide range of variability were selected from the sesame breeding program, Gedarif Research Station, ARC, Sudan. These parents were obtained from selfed plants in the previous season to ensure their varietal purity (pure lines).

The parents were Gd2002SPSN.29, Gd2002SPSN.14, Ziraa-9, Gd2002SPSN.53, Gd2002OBN2.103, Gedarif-1, Kenana-2 and Promo. Four of these parents were released varieties *viz*: Ziraa-9, Kenana-2, Promo and Gedarif-1. Ziraa-9 resulted from a systematic purification and selection of a local material on basis of seed color. It is characterized by profuse branching, late flowering and maturity and white small seeds. Kenana-2,
a white seeded variety selected from an African introduction and released in 1991. Promo is a selection from introduced materials of temperate origin (Greece), characterized by high branching, medium duration, even maturity and delayed shattering (Ahmed, 1997; Ahmed, 2008). Gedarif-1, a variety selected from segregating materials of crosses between temperate and tropical cultivars. It is characterized by non-branching habit, medium to late duration to flowering and good vigorous habit of growth (Ahmed *et al*., 2003). The other four genotypes were advanced promising lines adapted to the Gedarif environment.

In year 2004, the eight parents were grown in rows 10 m long and 0.8 m apart for each genotype to ensure maximum potentiality of the genotypes. The area was weeded and irrigated when necessary to increase duration of flowering. In the same season all parents were crossed in all possible combination (without reciprocals) to produce 28 single-cross hybrids according to half diallel arrangement. Some flowers in each parent were selfed to maintain the purity of the parents.

The materials (parents and hybrids) were sown under rains for two seasons (2005 and 2006) at Gedarif Research Station, Sudan at latitude 14º 1'N, longitude 35º 21'E, and altitude 592 masl. The trial was arranged in a randomized complete block design with three replications. Each entry was grown on a row of 2 m long and 0.6 m apart. The seeds were sown in holes spaced 0.2 m apart within a row. After 3 weeks, seedlings were thinned to 3 plants/hole.

In the first season, the sowing date was 18th July; the first rain after sowing was on 24 July and the seedlings emerged on 30 July in the first season (2005). In the second season (2006), the experiment was sown on 19th July; first rain after sowing was on the same day and seedlings emerged on 22 July. The experiment was weeded before thinning and then whenever necessary. The data were recorded on: days to 50% flowering (DFPF), days to maturity (DTM), plant height (cm) (PHT), number of branches/plant (NBPP), number of capsules/plant (NCPP), height to first capsule (HTFC), height to first branch (HTFB), capsule length (cm) (CL), 1000 seeds weight (g) (1000-SW), seed yield/plant (g) (SYPP) and seed yield (kg/ha) (SY/Ha).

Biometrical analysis for the half diallel

The combining ability analysis was performed on the data according to Griffing's (1956) Method II, model I procedure of diallel analysis.

RESULTS AND DISCUSSION

Combining ability

The mean squares due to general combining ability (GCA) were significant for all traits measured in both seasons (Table 1). The mean squares due to the specific combining ability (SCA) varied significantly for most of the traits at least in one season. Plant height, height to first capsule and capsule length were not significantly different in both seasons.

Variances of GCA and SCA varied significantly for days to 50% flowering, days to maturity, number of branches/plant, height to first branch and seed yield/plant indicating the importance of both additive and non-additive gene actions in the inheritance of these characters. This suggests the use of biparental mating followed by reciprocal recurrent selection for exploiting both types of genetic variances. Zhong (1999) reported the importance of both additive and non-additive gene action for days to maturity and seed yield/plant in sesame. Significance of GCA variance alone, for the plant height, height to first capsule and capsule length as shown in Table 1, indicate the additive gene action in controlling these traits and the improvement for these traits could be done by single plant selection in early generations.

The magnitude of GCA variances were greater than the respective variances due to SCA indicating pre dominance of additive gene action. Similar results were reported by Pushpa *et al*. (2002) and Saravanan and Nadarajan (2003).

The ratio of the mean squares due to the GCA to that of SCA for days to 50% flowering, days to maturity, plant height, height to first capsule, capsule length, and 1000-seed weight were almost more than one in 2005 and 2006. These results indicate that the inheritance of these traits was due to the general combining ability effects and were mostly controlled by the additive gene action, with great possibility of genetic improvement of these traits through recurrent selection. These results agreed with those of Pushpa *et al.* (2002) and Saravanan and Nadarajan (2003) but contradicted with the findings of Solanki and Singh (2006) and Thiyagu *et al*. (2007) who reported non-additive gene action with major role in the inheritance of these traits in sesame.

The ratios were less than one in 2005 and 2006 for seed yield/plant and seed yield/ha, indicating that the inheritance of these traits was due to the non-additive gene action. These results revealed that dominance and epistatic gene actions play major roles in the inheritance of these traits. It also revealed the possibility of hybrid breeding for these characters. Similar results were reported by Solanki and Gupta (2001).

Table 1. Mean squares for combining ability analysis of 11 important characters of F_1 sesame hybrids and their parents grown at Gedarif Research Station during rainy seasons in 2005 and 2006.

Trait	DF	DFPF		DTM		PHT		NBPP		NCPP		HTFB	
S.O.V		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Reps	2	2.37	12.90	18.08	4.93	129.60	123.68	1.52	0.39	184.80	158.48	57.78	221.02
Entries	35	16.82***	25.81***	53.70***	34.31***	341.87***	306.57***	1.01***	1.34***	121.83**	199.97*	180.28***	179.04***
GCA	7	58.66**	101.44**	214.72**	128.25**	1420.93**	881.50**	3.47**	4.11**	375.46**	280.69*	645.95**	530.07**
SCA	28	6.35***	6.91*	13.45**	10.83**	72.10	162.83	0.39*	0.65**	58.42	179.79*	63.87**	91.28**
Error	70	1.84	3.58	4.96	3.61	47.94	117.91	0.23	0.26	54.47	107.15	19.29	42.06
GCA:SCA		1.26	2.94	2.47	1.73	5.68	1.70	2.03	0.99	8.13	0.24	1.41	0.99

*, **, *** Significant at 0.05, 0.01 and 0.001 probability levels, respectively.

S.O.V = Source of variation, DF = Degree of freedom, GCA = General combining ability, SCA = Specific combining ability, DFPF = Days to 50% flowering, DTM = Days to maturity, PHT = Plant height, NBPP = Number of branches/plant, NCPP = Number of capsules/plant and HTFB = Height to first branch.

Table 1. (Continued)

Trait	DF	HTFC		CL		1000-S W		SYPP		SYkg/ha	
S.O.V		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Reps	2	6.07	176.72	0.25	0.21	0.14	0.05	10.49	13.80	8953.78	78462.3
Entries	35	71.17***	113.35***	0.31***	0.17***	0.14***	0.09***	6.12***	5.01	123184.26***	103474.1**
GCA	7	301.41**	372.29**	1.37**	0.62**	0.42**	0.33**	16.61**	5.11*	2262832.00**	142265.4**
SCA	28	13.61	48.62	0.05	0.05	0.07	0.03*	3.50*	4.98	2048616.00*	93776.3*
Error	70	10.16	40.65	0.04	0.04	0.05	0.02	2.02	4.10	38164.20	48283.9
GCA:SCA		8.44	4.16	13.3	5.8	1.85	3.1	0.99	0.11	0.11	0.21

*, **, *** Significant at 0.05, 0.01 and 0.001 probability levels, respectively.

S.O.V = Source of variation, DF = Degree of freedom, GCA = General combining ability, SCA = Specific combining, ability, HTFC = Height to first capsule, CL = Capsule length, 1000-SW = 1000 seed weight, SYPP = Seed yield/plant and SYkg/ha = Seed yield kg/hectare.

Table 2. Estimates of general combining ability (GCA) effects for eight sesame parents grown at Gedarif Research Station during rainy seasons in 2005 and 2006.

Trait	DFPF		DTM		PHT		NBPP		NCPP		HTFB	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Parent												
Gd2002SPSN.29	-2.34**	-2.70**	-2.38**	-3.25**	-14.01**	-11.88**	-0.70**	-0.49**	-7.81**	-5.20**	-10.23**	-7.85**
Gd2002SPSN.14	0.06	0.50	-1.41**	-0.98	1.13	-0.08	0.01	-0.28**	0.37	-4.37*	4.03**	3.58**
Ziraa-9	2.23**	3.23**	2.26**	2.15**	6.09**	4.93**	0.23**	0.48**	0.81	1.03	4.12**	5.50**
Gd2002SPSN.53	0.23	-0.47	-0.28	-0.45	0.66	1.66	0.02	0.10	-1.17	3.21	1.39	1.63
Gd2002OBN2.103	-0.51*	-0.90**	0.06	0.42	0.39	-1.08	0.003	0.18*	0.71	0.97	0.25	-1.13
Gedarif-1	1.49**	1.83**	5.49**	3.45**	9.46**	5.99**	-0.22**	-0.49**	4.49**	0.93	-2.53**	-3.34**
Kenana-2	-0.74*	-1.03**	-1.64*	-0.12	-1.98	-0.28	0.39**	0.31**	1.69	1.27	1.28	-0.34
Promo	-0.41	-0.47	-2.11**	-1.22**	-1.74	0.73	0.26**	0.18*	0.92	2.17	1.69*	1.94
SE(gi)	0.23	0.32	0.38	0.32	1.18	1.85	0.08	0.09	1.26	1.77	0.75	1.11
SE(gi-gj)	0.55	0.49	0.57	0.49	1.79	2.80	0.12	0.13	1.91	2.67	1.13	1.67

*, ** Significant at 0.05 and 0.01 probability levels, respectively.

DFPF = Days to 50% flowering, DTM = Days to maturity, PHT = Plant height, NBPP = Number of branches/plant, NCPP = Number of capsules/plant and HTFB = Height to first branch.

Table 2. (Continued)

Trait	HTFC		CL		1000-SW		SYPP		SY kg/ha	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Parent										
Gd2002SPSN.29	-6.09**	-7.28**	-0.13**	-0.12**	0.26**	0.19**	-1.40**	-0.59	-116.5**	-106.9**
Gd2002SPSN.14	3.04**	2.27*	0.30**	0.16**	-0.01	0.06**	0.24	-0.45	36.9	-69.8
Ziraa-9	4.51**	4.75**	-0.04	0.01	-0.04	-0.12**	0.36	0.34	4.5	14.0
Gd2002SPSN.53	0.49	0.40	-0.10*	-0.06	0.03	0.004	0.03	0.49	73.4**	38.7
Gd2002OBN2.103	-1.53**	-1.78	0.21**	0.25**	-0.15**	-0.004	0.01	0.50	29.1	114.9**
Gedarif-1	0.57	1.64	-0.38**	-0.18**	-0.05	-0.11**	1.25**	-0.07	199.9**	34.4
Kenana-2	-0.06	-0.37	0.07	-0.03	0.01	0.06**	-0.40	-0.21	-84.8**	3.1
Promo	-0.94	0.38	0.06	-0.04	-0.06	-0.08**	-0.08	-0.02	-84.2**	28.4
SE(gi)	0.54	1.09	0.04	0.04	0.04	0.02	0.24	0.35	33.36	37.53
SE(gi-gj)	0.82	1.65	0.05	0.06	0.05	0.04	0.37	0.52	50.44	56.74

*, ** Significant at 0.05 and 0.01 probability levels, respectively.

HTFC = Height to first capsule, CL = Capsule length, 1000-SW = 1000 seed weight, SYPP = Seed yield/plant and SYkg/ha = Seed yield kg/hectare.

Estimates of GCA effects, magnitudes and their directions are presented in Table 2. Generally, the parent Gd2002 SPSN53 appeared to be the poorest combiners for most of the traits measured in both seasons. It did not exhibit significant GCA effect for most of the measured traits in both seasons. The best combiners were Gd2002SPSN29, Ziraa-9 and Gedarif-1, since they recorded significant GCA effects for most of the measured traits.

The parent Gd2002SPSN29 was a good combiner for days to 50% flowering, with high negative significant GCA effect, while Ziraa-9 and Gedarif-1 were good combiners for days to 50% flowering with significant positive GCA effects. This result could be attributed to the parent, i.e. Gd2002SPSN29 which was the earliest parent while Ziraa-9 and Gedarif-1 were the latest parents. The parents that showed consistent and significant general combining ability effects in days to maturity were Gd2002SPSN29, Gd2002SPSN14, Zirra-9, Gedarif-1 and Promo. Gd2002SPSN29, Gd2002SPSN14 and Promo were good combiners for short maturity with significant negative GCA effects, while Ziraa-9 and Gedarif-1 were good combiners for late maturity with significant positive GCA effects. The data on earliness revealed that the parent Gd20002SPSN29 is the best one for reducing days to flowering and maturity through the transfer of genes of earliness to their offspring. Using early maturing cultivars may allow the crop to complete its life cycle (or at least the critical growth stage) before the onset of drought later in the season.

Gd20002SPSN29 showed significant negative general combining ability effect for plant height in both seasons indicating that it was the best combiner for shorter stature. Ziraa-9 and Gedarif-1 showed significant positive general combining ability effects in both seasons with the indication that they were the best combiners for tall stature.

The parents Gd2002SPSN29 and Gedarif-1 were the best combiners with significant negative general combining ability effects for number of branches/plant and this result could be attributed to the fact that the two genotypes are non-branching. Highly significant positive general combining ability effects in both seasons for branches/plant were exhibited by Ziraa-9 and Kenana-2. Parents Gd2002SPSN29 and Gedarif-1 could be utilized in reducing branches/plant whereas, the problem in mechanical harvest of sesame originate from the habit of growth of the plant (branching) that contribute to non-uniformity in maturity and drying of pods. Georgiev *et al*. (2008) stated limited number of branches/plant in sesame as mechanical harvest criteria.

Gedarif-1 recorded significant positive GCA effect in season 2005 and positive effect in 2006 for number of capsules/plant indicating that this parent increases number of capsules in its generation. The result could be attributed to the character of 3 capsules/leaf axil possess by this parent.

In regard to height to first capsule and height to first branch, the parent Gd2002SPSN29 exhibited maximum negative significant GCA effect, indicating that this parent was the best combiner for earlier capsule setting. While Ziraa-9 and Gd2002SPSN14 were the best combiners with significant positive GCA effects in both seasons with late capsule setting.

The parents Gd2002SPSN14 and Gd2002OBN2, 103 recorded highly significant positive GCA effects for the capsule length in both seasons showing that these parents were the best combiners for long capsule.

Gd2002SPSN29 showed highly significant positive GCA effect in both seasons for the 1000-seed weight, indicating that this parent was the best combiner for large seed. Ziraa-9, Gd2002SPSN14, Gd2002OBN2.103, Gedarif-1, and Promo exhibited significant negative GCA effects for 1000-seed weight at least in one season with same direction in the second season.

For seed yield/ha, the parents Gedarif-1, Gd2002OBN2.103 and Gd2002SPSN53 exhibited highly significant positive GCA effects in one season and positive effect in the other season indicating that they were the best combiners for seed yield/ha.

Table 3 shows the estimates of SCA effects for 28 crosses. Considerable number of crosses showed significant SCA effects and were inconsistent across the two years.

The cross combination Gd2002SPSN.29 x Gedarif-1 showed significant negative SCA effects for days to 50% flowering and maturity in both seasons. These results indicated the possibility of obtaining early maturing combinations that would be suitable for avoidance of late season drought spells. Similar results were reported by Mishra and Sikarwar, (2001) and Solanki and Gupta (2003) in sesame.

For plant height, the cross combination Gd2002SPSN.29 x Ziraa-9 exhibited positive SCA effects in both seasons with a significant level in season 2005. A similar result was reported by Solanki and Gupta (2003). The cross combination Ziraa-9 x Promo exhibited significant negative specific combining ability (SCA) effects in both seasons indicating the possibility of obtaining shorter stature combination as compared to the parents. Short stemmed sesame is generally early maturing (Weiss, 1983).

Consistent and significant positive SCA effects were exhibited by the crosses Gd2002SPSN.14 x Ziraa-9 and Ziraa-9 x Gd2002OBN2.103 in both seasons for number of branches/plant. Therefore, branching habit could compensate in case of low plant population. In numerous yield analysis of sesame, Langham (2007) reported little differences in the yield of populations between 10-26 plants/m^2 with lines that produce more branches in low populations.

The cross combination that exhibited high significant positive SCA effect for 1000-seed weight was Gd2002OBN2.103 x Gedarif-1. In seed yield/plant, the crosses Ziraa-9xGd2002SPSN.53 and Gd2002SPSN.53x Gd2002OBN2.103 exhibited significant positive SCA effects in one season and positive effect in the other season.

Table 3. Estimates of specific combining ability effects for yield and yield components of F_1 sesame hybrids grown at Gedarif Research Station during the rainy seasons in 2005 and 2006.

Cross	DFPF		DTM	
	2005	2006	2005	2006
Gd2002SPSN.29 x Gd2002SPSN.14	0.68	-0.54	-1.41	0.66
Gd2002SPSN.29 x Ziraa-9	-1.49*	0.06	1.26	-1.81
Gd2002SPSN.29 x Gd2002SPSN.53	-1.49*	-1.57	0.46	1.13
Gd2002SPSN.29xGd2002OBN2.103	0.58	-0.47	2.12	-1.07
Gd2002SPSN.29 x Gedarif-1	-1.75*	-2.21*	-4.31**	-4.44**
Gd2002SPSN.29 x Kenana-2	-1.52*	1.66	0.49	1.46
Gd2002SPSN.29 x Promo	-1.19	2.43*	0.29	1.56
Gd2002SPSN.14 x Ziraa-9	-0.55	-1.47	0.96	0.93
Gd2002SPSN.14 x Gd2002SPSN.53	-0.89	1.89	-0.84	1.19
Gd2002SPSN.14xGd2002OBN2.103	-0.82	-0.34	-1.18	-0.67
Gd2002SPSN.14 x Gedarif-1	-0.15	1.93	2.72*	2.63**
Gd2002SPSN.14 x Kenana-2	0.08	-2.21*	-1.14	-2.81**
Gd2002SPSN.14 x Promo	0.42	-0.44	2.32*	-0.04
Ziraa-9 x Gd2002SPSN.53	-0.05	0.16	1.49	2.73**
Ziraa-9 x Gd2002OBN2.103	1.35	-1.41	2.82*	-0.47
Ziraa-9 x Gedarif-1	-1.65*	0.19	-1.94	-0.84
Ziraa-9 x Kenana-2	-0.75	0.39	-0.48	-0.61
Ziraa-9 x Promo	1.25	-0.17	1.32	1.16

Gd2002SPSN.53 xGd2002OBN2.103	0.02	0.29	3.02**	0.46
Gd2002SPSN.53 x Gedarif-1	0.35	-0.11	0.92	0.76
Gd2002SPSN.53 x Kenana-2	-1.09	-1.24	-0.28	-2.67**
Gd2002SPSN.53 x Promo	-0.09	2.47*	-0.14	-2.24*
Gd2002OBN2.103 x Gedarif-1	1.08	-1.34	1.92	-0.44
Gd2002OBN2.103 x Kenana-2	-0.02	0.19	-2.94*	0.46
Gd2002OBN2.103 x Promo	-3.02**	-1.04	-2.48*	-0.77
Gedarif-1 x Kenana-2	3.32**	1.79	3.62**	3.09**
Gedarif-1 x Promo	0.65	2.56**	-2.58*	2.19*
Kenana-2 x Promo	0.88	-0.57	-0.11	-2.24*
SE(s_{ii})	0.71	0.99	1.17	0.99
SE(s_{ii}-s_{jj})	0.86	1.20	1.41	1.20

*, ** Significant at 0.05 and 0.01 probability levels, respectively.
DFPF = Days to 50%flowering and DTM = Days to maturity.

Table 3. (Continued).

Cross	PHT		NBPP		NCPP	
	2005	2006	2005	2006	2005	2006
Gd2002SPSN.29 x Gd2002SPSN.14	4.58	8.39	0.07	0.64*	0.50	5.63
Gd2002SPSN.29 x Ziraa-9	9.76**	9.72	-0.62*	0.02	2.59	3.56
Gd2002SPSN.29 x Gd2002SPSN.53	1.38	-1.68	-0.15	0.13	-0.43	-0.81
Gd2002SPSN.29xGd2002OBN2.103	2.26	2.39	-0.26	-0.62*	2.42	0.29
Gd2002SPSN.29 x Gedarif-1	-6.35	-5.35	-0.03	-0.08	-1.56	6.14
Gd2002SPSN.29 x Kenana-2	-1.11	-1.42	0.42	0.26	-0.89	-1.87
Gd2002SPSN.29 x Promo	-4.48	5.59	-0.05	0.58*	-1.72	-0.64
Gd2002SPSN.14 x Ziraa-9	0.02	7.59	0.54*	0.81**	3.11	7.15
Gd2002SPSN.14 x Gd2002SPSN.53	-3.22	-0.48	-0.12	-0.22	0.52	-6.17
Gd2002SPSN.14xGd2002OBN2.103	5.85	-5.75	0.04	-0.50	4.44	-3.01
Gd2002SPSN.14 x Gedarif-1	0.98	-7.15	0.13	-0.02	5.06	-6.29
Gd2002SPSN.14 x Kenana-2	-4.91	5.79	-0.02	0.04	-5.80	5.77
Gd2002SPSN.14 x Promo	5.39	3.12	0.38	-0.30	2.10	-1.07
Ziraa-9 x Gd2002SPSN.53	0.96	11.19*	0.06	0.36	1.68	23.30**
Ziraa-9 x Gd2002OBN2.103	2.90	5.59	0.55*	1.02**	3.93	5.53
Ziraa-9 x Gedarif-1	5.89	5.85	0.38	-0.24	7.55	-5.83
Ziraa-9 x Kenana-2	5.46	2.12	-0.24	-0.31	3.82	-1.10
Ziraa-9 x Promo	-7.51*	-12.55*	0.02	-0.58*	-4.61	-10.07
Gd2002SPSN.53 xGd2002OBN2.103	-1.75	1.19	-0.05	0.12	0.25	-1.98
Gd2002SPSN.53 x Gedarif-1	4.05	7.45	0.45	0.73**	0.13	10.40
Gd2002SPSN.53 x Kenana-2	5.22	-3.28	0.37	0.06	7.01	-1.34
Gd2002SPSN.53 x Promo	4.46	5.39	0.10	-0.01	0.57	-2.44
Gd2002OBN2.103 x Gedarif-1	-0.01	3.52	0.40	0.38	-0.55	6.84
Gd2002OBN2.103 x Kenana-2	-2.51	2.45	0.12	-0.15	-2.61	-1.51
Gd2002OBN2.103 x Promo	-2.60	-1.88	0.05	0.04	2.35	4.13
Gedarif-1 x Kenana-2	1.02	4.05	-0.45	0.26	1.67	0.28
Gedarif-1 x Promo	3.79	-4.62	0.28	-0.08	4.64	-4.49
Kenana-2 x Promo	0.03	-9.68	-0.34	-0.28	-2.69	-7.43
SE(s_{ii})	3.62	5.68	0.25	0.27	3.86	5.42
SE(s_{ii}-s_{jj})	4.38	6.87	0.30	0.32	4.67	6.55

*, ** Significant at 0.05 and 0.01 probability levels, respectively.
PHT = Plant height, NBPP = Number of branches/plant and NCPP = Number of capsules/plant.

Table 3. (Continued).

Cross	HTFB		HTFC		CL	
	2005	2006	2005	2006	2005	2006
Gd2002SPSN.29 x Gd2002SPSN.14	1.37	6.18	2.61	5.40	0.15	0.12
Gd2002SPSN.29 x Ziraa-9	-12.05**	3.56	-1.46	1.92	-0.02	0.21
Gd2002SPSN.29 x Gd2002SPSN.53	-4.42	-1.30	-1.24	-3.07	-0.07	0.14
Gd2002SPSN.29xGd2002OBN2.103	-4.18	7.43*	-1.76	1.38	-0.16	-0.06
Gd2002SPSN.29 x Gedarif-1	-0.07	-6.66*	-2.72	-6.51	-0.06	-0.01
Gd2002SPSN.29 x Kenana-2	4.88*	0.34	1.44	-0.90	0.08	-0.01
Gd2002SPSN.29 x Promo	9.88**	5.75	0.99	3.35	0.06	-0.03
Gd2002SPSN.14 x Ziraa-9	0.29	-0.64	-0.08	5.78	0.32**	-0.17
Gd2002SPSN.14 x Gd2002SPSN.53	-0.88	3.77	-0.70	0.39	-0.11	-0.04
Gd2002SPSN.14xGd2002OBN2.103	3.92	-5.11	1.39	-2.29	-0.05	0.07
Gd2002SPSN.14 x Gedarif-1	3.83	1.00	0.62	-4.51	-0.22	0.09
Gd2002SPSN.14 x Kenana-2	-5.28*	-2.73	-4.69**	0.36	0.06	0.07
Gd2002SPSN.14 x Promo	-0.75	-3.11	0.93	-0.32	-0.16	0.07
Ziraa-9 x Gd2002SPSN.53	1.83	-2.38	2.11	2.18	-0.11	0.24*
Ziraa-9 x Gd2002OBN2.103	0.13	-2.76	1.65	0.49	-0.06	-0.04
Ziraa-9 x Gedarif-1	3.61	11.09**	-2.05	4.74	0.08	0.12
Ziraa-9 x Kenana-2	1.17	-4.41	1.32	-3.92	-0.06	-0.12
Ziraa-9 x Promo	-2.17	-0.16	-1.94	-3.40	-0.07	0.02
Gd2002SPSN.53xGd2002OBN2.103	-0.63	-0.98	-2.40	-1.16	-0.06	0.06
Gd2002SPSN.53 x Gedarif-1	5.74*	5.76	4.91**	4.15	0.07	0.01
Gd2002SPSN.53 x Kenana-2	2.37	-3.44	2.13	-2.71	0.03	0.03
Gd2002SPSN.53 x Promo	-1.47	5.91	-1.72	6.08	0.06	0.06
Gd2002OBN2.103 x Gedarif-1	0.55	2.08	-0.88	-0.60	-0.03	0.08
Gd2002OBN2.103 x Kenana-2	-3.23	1.15	-2.39	-0.06	0.22	0.09
Gd2002OBN2.103 x Promo	-4.10	-5.30	-1.24	-4.34	-0.02	-0.17
Gedarif-1 x Kenana-2	1.01	10.83**	0.15	9.32**	-0.11	0.15
Gedarif-1 x Promo	3.54	-1.42	1.40	-3.09	0.17	-0.15
Kenana-2 x Promo	-2.40	-2.99	0.96	-3.42	0.15	0.07
SE(s_{ii})	2.30	3.40	1.67	3.34	0.11	0.11
SE(s_{ii}-s_{jj})	2.78	4.10	2.02	4.04	0.13	0.14

*, ** Significant at 0.05 and 0.01 probability levels, respectively.
HTFB = Height to first branch, HTFC = Height to first capsule and CL = Capsule length.

Table 3. (Continued)

Cross	1000-S W		SYPP		SYkg/ha	
	2005	2006	2005	2006	2005	2006
Gd2002SPSN.29 x Gd2002SPSN.14	-0.07	0.01	-0.003	2.91**	72.0	203.9
Gd2002SPSN.29 x Ziraa-9	0.26*	0.003	1.14	0.13	138.7	117.1
Gd2002SPSN.29 x Gd2002SPSN.53	-0.11	0.05	-0.33	-0.76	118.8	-8.3
Gd2002SPSN.29xGd2002OBN2.103	0.12	0.12	1.03	-0.37	19.3	-43.8
Gd2002SPSN.29 x Gedarif-1	0.02	-0.003	-1.75*	0.30	-210.7*	-99.0
Gd2002SPSN.29 x Kenana-2	0.16	-0.15*	0.70	-0.46	107.7	-182.6
Gd2002SPSN.29 x Promo	0.07	-0.19**	-0.26	0.75	51.4	50.2
Gd2002SPSN.14 x Ziraa-9	-0.03	0.09	0.20	1.29	62.0	305.0**
Gd2002SPSN.14 x Gd2002SPSN.53	0.11	0.04	-0.67	-0.90	-290.6**	-159.4
Gd2002SPSN.14xGd2002OBN2.103	-0.16	0.02	1.29	-1.64	169.8	-119.2
Gd2002SPSN.14 x Gedarif-1	0.33**	-0.05	0.41	-0.57	128.2	-174.7
Gd2002SPSN.14 x Kenana-2	0.002	0.03	-0.81	0.13	-130.7	117.6
Gd2002SPSN.14 x Promo	0.17	0.03	0.94	0.01	71.7	-70.9
Ziraa-9 x Gd2002SPSN.53	-0.05	0.03	0.64	3.25**	-50.5	-109.9
Ziraa-9 x Gd2002OBN2.103	0.20	0.02	0.63	0.28	79.9	164.0
Ziraa-9 x Gedarif-1	-0.05	-0.02	2.12**	-0.55	55.0	124.1
Ziraa-9 x Kenana-2	-0.03	0.05	0.53	0.28	130.7	-59.2
Ziraa-9 x Promo	0.003	0.04	-0.39	-0.64	-152.6	-66.0
Gd2002SPSN.53xGd2002OBN2.103	0.09	-0.05	0.76	2.09*	90.4	97.9
Gd2002SPSN.53 x Gedarif-1	0.06	0.10	0.32	0.69	371.1**	178.4
Gd2002SPSN.53 x Kenana-2	0.07	-0.03	1.03	-0.34	133.5	42.8
Gd2002SPSN.53 x Promo	0.06	0.06	1.24	0.24	79.5	336.9**
Gd2002OBN2.103 x Gedarif-1	0.10	0.26**	-0.09	0.82	-248.8*	214.6
Gd2002OBN2.103 x Kenana-2	0.13	-0.04	-1.08	0.09	-161.1	25.9
Gd2002OBN2.103 x Promo	-0.02	-0.003	0.37	0.23	76.3	-29.6
Gedarif-1 x Kenana-2	0.04	0.17*	0.55	0.89	-8.0	317.1**
Gedarif-1 x Promo	-0.20	-0.07	-0.04	-0.001	-127.3	-182.4
Kenana-2 x Promo	0.01	0.05	-0.30	-1.03	-59.3	-169.1
SE(s_{ii})	0.11	0.07	0.74	1.06	102.27	115.04
SE(s_{ii}-s_{jj})	0.13	0.09	1.01	1.28	123.55	138.97

*, ** Significant at 0.05 and 0.01 probability levels, respectively.

1000-SW = 1000 seed weight, SYPP = Seed yield/plant and SYkg/ha = Seed yield kg/hectare.

These results indicate that the two crosses are the best for the production of hybrids with high seed yield/plant.

For the seed yield/ha, the crosses Gd2002SPSN.53 x Gedarif-1, Gd2002SPSN.53 x Promo and Gd2002SPSN.14 x Ziraa-9 exhibited significant positive SCA effects with a reasonable yields of 1081, 841 and 810 kg/ha, respectively. This suggested that they could be used for exploitation of heterosis and further testing to confirm consistency of their seed yield.

This study revealed that parents Gd2002SPSN29, Ziraa-9 and Gedarif-1 which were the best combiners could be used in recurrent selection to incorporate their desirable characters in other materials. The cross Gd2002SPSN.53xGedarif-1, Gd2002SPSN.53xPromoand Gd2002SPSN.14 x Ziraa-9 which exhibited significant positive SCA effects for seed yield/ha., with a reasonable yields could be used for exploitation of heterosis for seed yield/ha

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القدرة التوافقية للانتاج ومكوناته فى بعض أصناف وسلالات السمسم

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الخلاصة

تم اختبار ثمانية اباء من برنامج تربية السمسم، محطة بحوث القضارف، السودان. هجنت الاباء الثمانية من جهة واحدة مع بعضها للحصول على 28 هجين. تم تقويم ثمانية طرازاً وثمانية وعشرين هجيناً فى موسمين مطريين متتاليين 2005 و 2006 بمحطة بحوث القضارف. الأصناف زراعة-9، كنانة-2، برومو وقضارف-1 مجازة. أما الأربعة أباء الاخرين تمثل طرز متقدمة. نفذت التجربة باستخدام القطاعات العشوائية الكاملة بثلاث مكررات لمعرفة القدرة التوافقية العامة والخاصة للانتاجية ومكوناتها بين 36 سلالة من السمسم. قيست البيانات التالية: عدد الأيام حتى 50% ازهار، عدد الأيام حتى النضج، طول النبات، عدد الفروع فى النبات، عدد الكبسولات فى النبات، ارتفاع أول فرع، ارتفاع أول كبسولة، طول الكبسولة، وزن ال 1000 بذرة، الانتاجية للنبات والانتاجية للهكتار. أظهر تحليل القدرة التوافقية اهمية كل من الفعل الجينى الاضافى والفعل الجينى غير الاضافى فى توريث الصفات المقاسة. كان التباين فى القدرة التوافقية العامة اكبر من التباين فى القدرة التوافقية الخاصة والفعل الجينى الاضافى سائدا فى صفات عدد الايام حتى 50% ازهار، عدد الايام حتى النضج، طول النبات، ارتفاع اول كبسولة، طول الكبسولة ووزن 1000 بذرة. اما الفعل الجينى غير الاضافى فقد كان سائدا فى صفة الانتاجية للنبات والانتاجية للهكتار. أظهر أثر القدرة التوافقية العامة ان الأباء Gd2002SPSN29, Ziraa-9 وGedarif-1 هم الافضل للقدرة التوافقية العامة، حيث انها سجلت اثرا معنويا للقدرة التوافقية العامة فى اى من الاتجاهين لمعظم الصفات المقاسة. الاب Gd2002SPSN53 هو الاضعف للقدرة التوافقية العامة. أظهرعدد مقدر من الهجن اثرا معنويا فى القدرة التوافقية الخاصة. فالهجن Gd2002SPSN.53 x Gedarif-1, Gd2002SPSN.53 x Promo and Gd2002SPSN.14 x Ziraa-9 اظهرت اثرا معنويا موجبا فى القدرة التوافقية الخاصة لصفة الانتاجية للهكتار، بانتاجية مناسبة قدرها 1081، 841 و810 كجم/هكتار على التوالى. تقترح الدراسة الحوجة لمزيد من الاختبارات لتأكيد ثبات انتاجية هذه الهجن فى المواسم والمواقع المختلفة.