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Heterosis and inbreeding depression in gobhi sarson (*Brasscia napus* L.)

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ABSTRACT
Twenty eight gobi sarson (*Brassica napus* L.) hybrids derived from crosses of eight diverse parent alongwith their F_1, F_2 and parents were evaluated to estimate heterosis and inbreeding depression. The manifestation of heterosis over better parents was maximum (191.62%) for seed yield expressed by the cross ISN-530 x NRCG-17 and minimum (-8.12%) for seed siliqua^{-1} expressed by cross NRCG-58 x NRCG-32. The high heterotic values of crosses in most of the traits might be due to the presence of different genes or gene groups separately in both the parents and when they were brought together, they nicked well gave high heterotic value for that particular character. In general, high heterosis for a trait was accompanied by significant inbreeding depression may be largely due to dominance and epistatic interaction involving dominance for controlling the characters. Based on these results, it is suggested that special breeding methods like recurrent selection or diallel selective mating etc may be employed for isolation of true breeding lines.

Key words : Heterosis, Inbreeding depression, Gobi sarson

INTRODUCTION

The magnitude of heterosis provides a basis for genetic diversity and a guide for the choice of desirable parents for developing superior F_1 hybrids so as to exploit hybrid vigour and/or for building gene pools to be employed in breeding programme. Study of heterosis and inbreeding depression has a direct bearing on the breeding methodology to be employed for varietal improvement. The present investigation aims to estimate the extent of heterosis and inbreeding depression is an eight parent non-reciprocal diallel set of gobhi sarson (*B. napus* L.)

MATERIALS AND METHODS

Eight elite genotypes were selected for a diallel cross analysis. The parental lines were NRCG-58, NRCG-32, NRCG-29, ISN-223, ISN-530, ISN-602, NRCG-57 and SGS-16. The parents and their 28 F_1 and F_2 were grown in randomized block design with three replications during 2003-04. Each parent and F_1 progeny were represented by a single row and F_2 by 3 row plots of 3 m length with 30 cm spacing between row and 10 cm between plants. Observations on plant height (cm), primary branches plant^{-1}, secondary branches plant^{-1}, siliquae on main raceme, siliquae plant^{-1}, seed siliquae^{-1}, 1000 seed weight (g), seed yield plant^{-1} (g) and oil content (%) were recorded on 10 random plants in the parents and F_1 generation, and 20 plants in F_2 generation form each plot. The magnitude of heterosis over better parent (BP) and inbreeding depression from F_1 to F_2 were calculated using the standard procedure.

RESULTS AND DISCUSSION

The present investigation provides information on the evaluation of gobi sarson hybrids and their parents through the estimates of heterosis and inbreeding depression. Twenty eight hybrids derived from crosses between eight diverse parents were analysis morphological, oil, yield and yield components, however, exploitation of heterosis is considered meaningless unless *per se* performance is also taken into account. Accordingly, detailed analysis of five top yielding hybrids was carried out for having an insight into the nature of gene action. The *per se* performance of the five top yielding hybrids in respect of morphological, oil, yield and its components is presented in Table 1. Hybrid ISN-530 x NRCG-57 was the highest yielder followed by NRCG-58 x NRCG-32, NRCG-58 x ISN-602., NRCG-32 x ISN-530 and NRCG-29 x ISN-530. The highest and second highest yielding crosses also maintained their ranks in respect of siliqua plant^{-1} and primary branches plant-1. heterosis over better parent exhibited positive and significant for seed yield and its important attributes except seed siliqua^{-1} viz. (NRCG-58 x NRCG-32, NRCG-58 x ISN-602 and NRCG-29 x ISN-530) and oil content (ISN-530 x NRCH-57) cross (Table 2). The magnitude of better parent heterosis for yield among the five crosses ranged from 75.95 – 191.62 per cent, which also directly associated with yield component they did not manifest heterosis equally. The maximum economic heterosis was expressed by ISN-530 x NRCG-57 (191.62%) and minimum was expressed by the crosses NRCG-58 x NRCG-32 for seed yield siliqua^{-1} (-8.12%). The results were in agreement with the studies of Labana et al. (1975). Dhillon *et al*. (1990), Thakur and Bhateria (1996), Yadav *et al*. (1997), Ghosh *et al*. (2003) and Parmar et al. (2004) where in yield heterosis from 108.48 to more than 200.00 per cent have been reported in different species of *Brassica*. The high heterotic values of crosses in most of the traits might be due to the presence of different genes or genes groups separately in both the parents and when they were brought together, they nicked well gave high heterotic value for that particular character. Thus can also be due to non-allelic interaction (dominance or epistatic or both). Heterosis in F_1 and inbreeding depression in F_2 considered together can give some idea about the genetic control of a character and thus helps in isolating high yielding pure lines from the promising crosses. An examination of data on inbreeding depression for seed yield plant^{-1} and other characters

Table 1 : *Per se* performance of five top hybrids for morphological, oil, yield and yield components in gobi sarson.

Crosses	Plant height (cm)	Primary branches plant^{-1}	Secondary branches plant^{-1}	Siliquae raceme^{-1}	Siliquae plant^{-1}	Seed siliqua^{-1}	1000-seed weight (g)	Seed yield plant^{-1} (g)	Oil content (%)
ISN-530 x NRCG-57	123.27	6.77	11.77	59.03	185.90	15.30	8.50	19.03	46.25
NRCG-58 x NRCG-32	133.90	6.57	10.43	57.40	169.73	15.00	7.79	17.78	45.21
NRCG-58 x ISN-602	130.77	6.07	11.40	51.65	142.25	16.82	8.00	16.30	47.32
NRCG-32 x ISN-530	120.50	5.57	9.07	58.07	147.31	16.52	7.71	16.00	46.70
NRCG-29 x ISN-530	129.40	6.40	10.47	45.25	151.30	14.57	7.25	15.65	47.32

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Table 2 : Better parent (BP) heterosis, inbreeding depression (ID) and parental gca (P) in per se performance of five top hybrids for orphological, oil, yield and yield components in gobhi sarson.

Characters		ISN-530 x NRCG-57	NRCG-58 x NRCG-32	NRCG-58 x ISN-602	NRCG-32 x ISN-530	NRCG-29 x ISN-530
Plant height (cm)						
	BP	8.86**	14.38**	17.06**	6.35**	1.07**
	ID	1.1	1.29	3.3	0.57	-0.10
	P	L x L	H x H	H x H	H x L	H x L
Primary branches plant^{-1}						
	BP	30.46**	39.04**	35.82**	9.18	79.44**
	ID	28.70**	31.80**	26.00**	15.30*	27.70**
	P	L x H	H x L	H x L	L x L	L x L
Secondary branches plant^{-1}						
	BP	38.98**	28.33**	39.10**	10.57**	13.36**
	ID	33.40**	21.90**	30.40**	2.01*	8.32*
	P	L x H				
Siliquae raceme^{-1}						
	BP	13.16**	44.83**	28.26**	39.81**	26.32**
	ID	11.70*	29.20**	23.20*	28.40**	18.30*
	P	H x H	L x H	L x L	H x H	
Siliquae plant^{-1}						
	BP	68.50**	71.79**	26.48**	54.43**	73.05**
	ID	32.50**	40.00**	35.50**	45.50**	28.90*
	P	H x H	H x H	H x H		
Seed siliqua^{-1}						
	BP	17.06**	-8.12**	-3.39**	7.05**	-0.68**
	ID	2.80	-6.10	-3.01	5.22*	0.09
	P	L x L	H x H	H x L	H x L	L x L
1000-seed weight (g)						
	BP	26.95**	19.74**	24.73**	1.81*	74.54**
	ID	5.13	7.20	4.72	0.75	30.50**
	P	L x H	L x L	L x L	L x L	L x L
Seed yield plant^{-1} (g)		191.62	102.90**	121.83**	75..95**	167.65**
	BP	198.25	54.40**	80.23**	50.62**	72.50**
	ID	L x H	H x L	H x L	L x L	L x L
	P					
Oil content (%)						
	BP	-3.65**	2.26**	10.08**	0.34**	22.26**
	ID	1.45	0.75	2.25	0.05	3.75*
	P	L x H	H x L	H x L	L x L	L x L

L = Low gca ; H = high sca *,* Significant at 5% and 1% levels, respectively.

indicated that, in general, mean expression of F_2 was lower than that of F_1, may be largely due to dominance and epistatic interaction involving dominance. Isolation of true breeding lines, as good as or better than the heterotic hybrids, may be a difficult proposition in such crosses unless special breeding methods like recurrent selection., diallel selective mating etc. are employed. Parallel relationship between heterosis in F_1 and inbreeding depression was supported by earlier findings of Hirve and Tiwari (1995) and Thakur and Bhateria (1996) in Indian mustard.

Significant economic heterosis without inbreeding depression for seed yield and siliquae plant^{-1} in the cross SGS-16 x ISN-223 (Other than five top yielding) implied that mostly additive type epistatic interaction may be involved in this case. Such crosses have the potential to generate desirable recombinants in the segregating generations which can be handled through pedigree breeding method.

The components of variance indicated preponderance of sca variance for all the traits as observed in other findings by Kaur *et al*. (1998) and Wani *et al.* (1993) in gobi sarson. Depending on the gca effects of parents for a particular character, they were categorized as good or poor combiners. Interestingly, all the five top yielding hybrids were mostly the result of high x low general combiners. However, none of parents/crosses was found to be good general/specific combiners for seed yield and its component traits. It is therefore, suggested multiple crossing programme among these top yielding hybrids followed by relative intermating approach appears to be the most appropriate for the best use of the present material aimed at further genetic upgradation of the crop.

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