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HETEROSIS FOR EARLINESS AND COMPONENT TRAITS IN SOYBEAN (*GLYCINE MAX* L. MERRILL)

Preeti Painkra*, Sunil K. Nag, Nandan Mehta and Rajshree Shukla

Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur-492 012 (C.G.), India.

Abstract

A study was conducted in soybean to estimate the magnitude of heterosis for earliness and components traits. Ten F_1 hybrids were derived from crosses between five genotypes using half diallel and these F_1 s along with parents were evaluated during *Kharif* 2013 using Randomized Block Design. Out of ten hybrids, nine had showed significant negative standard heterosis for earliness. The heterosis over standard parent for days to maturity ranged from -0.96 to –7.69%. Parents MAUS-504 and MACS-1340 and hybrid MACS-1140 × MACS-1336, JS-97-52 × MACS-1336, MAUS-504 × MACS-1340 and MACS-1140 × MACS-1340 had showing the desirable performance for earliness. These hybrids also showed the desirable performances for plant height (cm), number of primary branches per plant, pod bearing length (cm), number of pod bearing nodes and number of seeds per pod. The highest heterotic genotypes can be used in future breeding programs.

Key words : Soybean, heterosis, standard heterosis, half diallel, earliness.

Introduction

Soybean (*Glycine max* L. Merrill) is a short-day plant in terms of flowering and time to maturity, with reproductive responses to short-day photoperiods being quantitative rather than qualitative. It is a miraculous crop due to its extraordinary qualities; it contains about 37-42% good quality protein, 6% ash, 29% carbohydrate and 17-24% oil, comprising 85% poly-unsaturated fatty acid with two essential fatty acids (lenoleic and linolenic acid), which are not synthesized by the human body (Antalina, 2000; Balasubramaniyan and Palaniappan, 2003). The commercial exploitation of heterosis led to the remarkable yield advances in several cross pollinated crops. In self pollinated crops, it is now well recognized that heterosis is very useful to increase the productivity (Pali and Mehta, 2014). The heterosis or hybrid vigor can be defined as the superiority of individuals of the F_1 generation in relation to their parents (Fehr, 1987). Heterosis breeding is an important crop improvement method adopted in many crops all over the world. It is a quick and convenient way of combining desirable characters which has assumed greater significance in the production of F_1 hybrids (Ramesh *et al*., 2013). In breeding for a certain area of production, genotypes have to be selected, which should fit to the proposed region in their time to maturity. Consequently, early maturity is an important breeding goal and a prerequisite for adapting soybeans to short-season environments. The values of heterosis in soybean are very variable for the different agronomic traits, other than seed yield per plant. The studies of heterosis in soybean have also been reported by Pandini *et al.* (2002), Ramana and Satyanarayana (2006), Sudaric *et al.* (2009) and Samant *et al.* (2014).

In general, most of the studies in soybean for heterosis is mostly concentrated for seed yield trait, so looking to this fact our main objective of the present investigation was to identify the early dwarf plant type with minimum foliage. So, the problem of low pod setting can be understood. Hence, looking to the facts present investigation was carried out to get early F_1s with low foliage plant type.

Materials and Methods

The experimental material used in the present study consisted of 5 diverse genotypes *viz*., JS 97-52, MACS 1336, MAUS 504, MACS 1140 and MACS 1340. All the parents were crossed in all possible combination in a half diallel fashion. The crosses were attempted during *Kharif* 2012. The parents and 10 F_1 were grown in a Randomized Complete Block Design (RBD) in three replications during

***Author for correspondence :** E-mail: painkrapreeti@gmail.com

Kharif -2013. The experimental was conducted at Research cum Instructional Farm Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), India. Each entry was grown in a single row of 2 m length spaced at 30 cm and 20 cm between plants. All the recommended package of practices was adopted to raise the normal crop.

Observations on quantitative traits were recorded on single plant basis from five randomly selected competitive plants of each genotypes *viz*., days to 50% flowering, days to maturity, plant height (cm), number of primary branches per plant, pod bearing length, number of pod bearing nodes, number of pods per plant, number of seeds per pod, 100 seed weight (g), protein content (%), oil content (%) and seed yield per plant (g). The mean values were calculated and used for statistical analysis. The data obtained from the individual plants were statistically analyzed as per the procedure given by Cochran and Cox (1957). Heterosis was estimated for standard parent heterosis over JS-97-52 check for all the twelve characters. Standard heterosis was calculated deviation of variety values from the Standard check variety as per Tysdal *et al.* (1962) and Rai (1979), this is (JS 97-52) in the present study and given as under :

$$d_{iii} = \frac{\overline{F_1 - Standard\ Check\ Variety}}{\overline{Standard\ Check\ Variety}} \times 100$$

Whereas, d_{iii} = Standard heterosis *i.e.* heterosis over standard check variety

$\overline{Standard\ Check\ Variety}$ = Mean performance of standard check variety (JS 97-52) in the respective cross combinations.

The significance of different types of heterosis was carried out by adopting 't' test as suggested by Wynne *et al.* (1970). Standard heterosis by Tysdal *et al.* (1962) and Rai (1979), respectively.

$$\text{t (standard heterosis)} = \frac{\overline{F_{1ij} - Standard\ Check}}{\sqrt{(3/8Me)}}$$

Whereas,

$\overline{F_{1ij}}$ = Mean of i × jth cross,

$\overline{BP_{ij}}$ = Mean of the better parent for i × jth cross and

$\overline{Standard\ Check\ Variety}$ = Mean of check variety (JS 97-52)

Me = Estimate of error variance.

Results and Discussion

The results showed standard parent heterosis for components is given in table 1. Early flowering is desirable trait to achieve more crops per year. Days to 50% flowering ranged from -20.83 (MAUS-504 × MACS-1336 and MACS-1340 × MACS-1336) to 2.08% (MAUS-504 × MACS-1140). Nine hybrids out of ten showed significant standard parent heterosis for this trait. Eight hybrids showed significant early and only one hybrid showed significant late standard heterosis for this trait .Days to maturity ranged from -7.69% (MACS-1140 × MACS-1336) to -0.96% (JS-97-52 × MACS-1140). The hybrid MACS-1140 x MACS-1336 (-7.69%) showed the highest significant early heterosis. Similarly, significant heterosis for plant height is desirable and it was observed in the cross JS-97-52 × MAUS-504(15.88%). Out of ten hybrids three hybrids showed significant positive and two hybrids showed significant negative standard parent heterosis. Ranged from –27.27% (JS-97-52 × MACS-1140 and JS-97-52 × MACS-1336) to -6.06% (MACS-1140 × MACS-1336) for number of primary branches per plant. Eight hybrids out of ten hybrids showed significant standard parent heterosis. No one exhibited significant positive standard parent heterosis for this trait while, eight hybrids exhibited significant negative standard parent heterosis. Present findings are in agreement with the findings of Ramana and Satynarayana (2006).

For pods bearing length ranged from -39.33% (MACS-1140 × MACS-1336) to 17.93% (JS-97-52 × MAUS-504) in which JS-97-52 × MAUS-504(17.93%) and MAUS-504 × MACS-1340 (17.00%) showed the highest positive standard heterosis. There is only one hybrid MACS-1140 × MACS-1340 (23.2%) showed significant positive standard heterosis for number of pods bearing nodes, which ranged from -36% (JS-97-52 × MACS-1140) to 23.2% (MACS-1140 × MACS-1340). Number of pods per plant ranged from -26.20% (MAUS-504 × MACS-1340) to -7.14% (MAUS-504 × MACS-1336). Five hybrids showed significant negative standard parent heterosis for this trait. Number of seed per pod was observed from -18.52% (JS-97-52 × MACS-1336) to -3.70% (MACS-1140 × MACS-1336) in which nine hybrids showed negative standard parent heterosis. Similar findings for both numbers of pods per plant as well as number of seed per pod were also reported by Sudaric *et al*. (2009). The hybrid MACS-1140 × MACS-1340(22.98%) showed significant positive standard heterosis 100 seed weight which ranged from -14.20% (JS-97-52 × MACS-1140 and MAUS-504 × MACS-1140) to 22.98% (MACS-1140 × MACS-1340).

Table 1 : Standard parent heterosis (%) for earliness and component traits in soybean.

S. no.	Hybrid	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Pod bearing length (cm)	Number of pod bearing nodes
		SPH (%)	SPH (%)	SPH (%)	SPH (%)	SPH (%)	SPH (%)
1.	JS-97-52 x MAUS-504	-10.41**	-2.88*	15.88**	-18.18**	17.93**	-25.6**
2.	JS-97-52 x MACS-1140	-4.16**	-0.96	-1.30	-27.27**	-1.49	-36**
3.	JS-97-52 x MACS-1340	-10.41**	-4.80**	10.80*	-24.24**	12.20*	-23.2**
4.	JS-97-52 x MACS-1336	-6.25**	-6.73**	1.47	-27.27**	1.66	-14.4**
5.	MAUS-504 x MACS-1140	2.08*	-4.80**	-7.20	-15.15**	-8.13	-18.4**
6.	MAUS-504 x MACS-1340	-16.66**	-6.73**	15.05**	-15.15**	17.00**	-26.4**
7.	MAUS-504 x MACS-1336	-20.83*	-5.76**	1.31	-9.09*	1.48	-30.4**
8.	MACS-1140 x MACS-1340	0.00	-6.73**	-16.70**	0.00	-18.85**	23.2**
9.	MACS-1140 x MACS-1336	-12.5*	-7.69**	-35.35**	-6.06	-39.93**	-27.2**
10.	MACS-1340 x MACS-1336	-20.83**	-3.84**	-8.67	-9.09*	-9.80	-32**

*, ** Significant at 5% and 1% level, respectively

Table 1 contd…

S. no.	Hybrid	Number of pods per plant	Number of seeds per pod	100 seed weight (g)	Protein content (%)	Oil content (%)	Seed yield per plant (g)
		SPH (%)	SPH (%)	SPH (%)	SPH (%)	SPH (%)	SPH (%)
1.	JS-97-52 x MAUS-504	-23.80**	-7.41**	7.97**	-5.72*	-9.26**	-25.66**
2.	JS-97-52 x MACS-1140	0.00	-11.11**	-14.20**	-8.27**	-7.24**	-25.66**
3.	JS-97-52 x MACS-1340	0.00	-14.81**	-10.42**	2.78	-13.74**	-24.78**
4.	JS-97-52 x MACS-1336	-19.05**	-18.52**	4.19	-4.46	-9.95**	-32.74**
5.	MAUS-504 x MACS-1140	-11.90	-11.11**	-14.20**	-1.13	-3.45	-35.40**
6.	MAUS-504 x MACS-1340	-26.20**	-14.81**	1.43	-0.88	-10.09**	-36.28**
7.	MAUS-504 x MACS-1336	-7.14	-7.41**	15.22**	-0.08	0.39	-2.50
8.	MACS-1140 x MACS-1340	-19.05**	-11.11**	22.98**	-0.63**	0.74	-13.27*
9.	MACS-1140 x MACS-1336	-11.90	-3.70	3.78	-0.30	-9.80**	-14.16*
10.	MACS-1340x MACS-1336	-21.43**	-7.41**	7.97**	1.38	-9.50**	-23.00**

*, ** Significant at 5% and 1% level, respectively.

Protein content was observed from –8.27% (JS-97-52 × MACS-1140) to 2.78% (JS-97-52 × MACS-1340). Three hybrids showed significant negative standard parent heterosis. Similar findings were also reported by Perez *et al*. (2009). For oil content (%) seven hybrids showed significant standard heterosis out of ten hybrids. The range observed from -13.74% (JS-97-52 × MACS-1340) to 0.74% (MACS-1140 × MACS-1340). Nine hybrids out of ten had significant negative standard parent heterosis for seed yield per plant. It was observed from - 36.28% (MAUS-504 × MACS-1340) to -2.5% (MAUS-504 × MACS-1336). Present findings are in agreement with the findings of Ramana and Satynarayana (2006).

Conclusion

Based on data of standard heterosis, it can be concluded that, MAUS-504 × MACS-1340 and MACS-1140 × MACS-1340 hybrids showed the desirable performances for most of the characters. Parents MAUS-504 and MACS-1340 or MAUS-504 × MACS-1336 hybrid showed the best performances for days to 50% flowering and earliness. The result indicated that the crosses exhibited high heterotic effect for earliness and its important attributes, might possibly be useful in heterosis breeding programmes for further improvement.

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