Indian J. Genet., **65**(4): 325-326 (2005)

Short Communication

Combining ability and heterosis studies under rainfed conditions in castor (*Ricinus communis* L.)

P. Venkata Ramana, C. Lavanya and P. Ratnasree

Directorate of Oilseeds Research, Rajendranagar, Hyderabad 500 030

(Received: February 2005; Revised: September 2005; Accepted: November 2005)

Development of stable pistillate line VP-1, led to the release of several castor hybrids commercially *viz.*, GAUCH 1, GCH 2, GCH 4 etc., in India [1]. Several pistillate lines were developed at Directorate of Oilseeds Research using conventional and mutation breeding technique [1]. Information on combining ability and heterosis of the hybrids developed by utilizing new pistillate lines and male combiners is scanty. The present study is an attempt to study combining ability and identify good combiners for seed yield and its components like number of nodes to primary, effective spikes per plant, hundred seed weight and oil content. Majority of the male lines used in this study were resistant to Fusarium wilt (*Fusarium oxysporum* L.,) and thus one set of the resulting hybrids was evaluated in the wilt sick plot at DOR, Hyderabad to identify wilt resistant hybrids.

Three pistillate lines - DPC 9, DPC 10 and DPC 13 and nine wilt resistant pollen parents PCS 1, PCS 121, JI 220, JI 225, JI 240, JI 260, SKI 229, SKI 232 and SKI 233 were crossed in Line × Tester mating design in *rabi* 2000-01. The resulting 27 hybrids along with 12 parents and two standard checks - DCH 32 and GCH 4 were evaluated in a RBD with three replications in *Kharif* 2001-02 at Directorate of Oilseeds Research farm under rainfed conditions. Each entry was raised in 3.6 × 4.5 sq.m plot with 40 plants in each set and adopted a spacing of 90 × 45 cm. Observations were recorded on yield components *viz.*, number of nodes to primary spike, plant height upto primary spike (cm), effective spikes per plant, 100-seed weight (g) and oil content (%). Seed yield per plot was recorded picking wise and cumulated as total seed yield and expressed in kg/ha. Picking wise seed yield was recorded to identify hybrids with high yield potential at early duration. Heterosis over better parent (heterobeltiosis) and heterosis over checks (standard heterosis) was calculated as per standard formulae. Combining ability analysis was performed as per Kempthorne [2].

The same set of hybrids was evaluated in the wilt sick plot in single rows of two replications and data on wilt intensity was recorded at monthly intervals. The analysis of variance (Table 1) revealed highly significant differences for all the characters studied except for hundred seed weight in parents indicating presence of genetic diversity amongst parents. Highly significant differences for parents vs hybrids indicated the presence of heterosis for all the characters studied. The combining ability analysis revealed significant differences for all the characters except for the traits effective spikes per plant, seed yield at 90 DAS and oil content in testers. In lines only two traits *viz.*, seed yield at 90 DAS and oil content exhibited significant differences. Such significant differences for lines and testers indicated the role of additive variance for all the characters studied. Mean squares due to line x tester interaction was significant for number of nodes to primary raceme, effective spikes per plant and seed yield in all the three pickings indicating the role of dominance variance for these characters. Predictability ratios were near to unity for plant height, oil content or greater than one for hundred seed weight indicating the role of additive gene action [3].

Predictability ratios were less than one for number of nodes to primary spike, effective spikes per plant, seed yield at 90, 120 and 150 DAS indicating the presence of non additive gene action for their expression. It indicated the possibility of exploitation of heterosis in hybrids. The role of dominant gene action for seed yield, effective spikes/plant was earlier reported by [4].

The analysis of *gca* effects revealed that among females, DPC 10 was a good combiner for earliness, seed yield in all the three pickings and oil content (Table 2). DPC 9 is a good combiner for earliness and seed yield at early picking (90 DAS). Among males, JI 240 was a good combiner for seed yield, hundred seed weight and short height to primary raceme. Tester PCS 1 with desirable combining ability effect for high seed yield at early picking (90 DAS) can be used to develop early duration, high yielding hybrids. The *gca* effect and per se performance for the nodes to primary raceme and height to primary raceme were in agreement with each other as indicated by their positive association. Therefore, selection of parents for these traits can be done on the basis of mean performance also [5].

The estimates of specific combining ability effects revealed a very wide range of variation for all the characters. Two crosses DPC 10 × JI 225 and DPC

Table 1. Analysis of variance for combining ability for different characters in castor

Source	df	Number of nodes	Height up to primary raceme	Effective spikes per plant	100-seed weight (g)	Seed yield (kg/ha) at 90 DAS	Seed yield (kg/ha) at 120 DAS	Seed yield (kg/ha) at 150 DAS	Oil content (%)
Replications	2	7.17**	565.91*	38.93**	2.48	14325.47	217455.60	152567.20	21.73**
Parents	11	16.58**	1181.91**	12.04**	68.30	27110.54**	1512603.00**	1781647.00**	3.36**
Hybrids	26	4.38**	331.74*	1.11	45.28	45645.42**	760075.40**	986016.40**	1.80*
Parents *vs.* hybrids	1	3.91**	1036.05**	153.70**	500.81**	667558.40**	16314060.00**	18460890.00**	47.37**
Females	2	6.45	459.57	1.18	0.63	260825.60**	936336.60	1755569.00	7.83**
Males	8	8.34**	678.69**	0.61	86.78*	24607.54	1559870.00**	1588818.00*	1.81
Female × male	26	2.15**	142.29	1.35*	30.11	29266.80**	338145.50**	588421.40**	1.04
Error	116	0.45	117.71	0.63	33.65	8303.27	99409.74	95956.27	0.91
σ^2 *gca*		0.29	23.71	−0.03	0.76	6302.76	50553.22	60209.57	0.21
σ^2 *sca*		0.57	8.19	0.24	−1.18	6987.84	79578.56	164155.06	0.04
Predictability ratio		0.51	0.85	−0.27	4.55	0.64	0.56	0.42	0.91

*,** Significant at 5% and 1% levels, respectively; DAS, Days after sowing

Table 2. General combining ability effects of lines and testers for different characters in castor

Genotype	Nodes to primary raceme	Height up to primary spike (cm)	Effective spikes per plant	Hundred seed weight (g)	Seed yield (kg/ha) at 90 DAS	Seed yield (kg/ha) at 120 DAS	Seed yield (kg/ha) at 150 DAS	Oil content (%)
Lines								
DPC 9	−0.3**	−2.1	0.1	0.0	24.9**	−106*	−185**	0.2
DPC10	−0.3**	−2.7	0.2	−0.2	83.4**	215**	291**	0.4**
DPC 13	0.6**	4.8**	−0.2*	0.1	−108.4**	−109**	−106**	−0.6**
S.E. (gi-gj)	0.09	1.42	0.10	0.76	11.91	41.22	80.65	0.13
Testers								
PCS 1	−0.1	−6.4*	0.1	−2.2	52**	−49	−143	0.6*
PCS 121	1.7**	16.6**	0.2	−1.8	−90.8**	319**	300**	0.1
JI 220	−0.3	−1.3	−0.5*	−5**	−10.1	142	180*	0.2
JI 225	−1.1**	−13.7**	0.1	2.5	−0.4	288**	169*	−0.9**
JI 240	0.1	−5.8*	−0.3	3.1*	47.8*	584**	518**	−0.1
JI 260	0.1	6.5*	0.3	−3.1*	−4.9	−371**	−439**	−0.4
SKI 229	−1.1**	4.1	−0.1	4.1**	5.6	−79	232**	0.1
SKI 232	1.2**	−1.5	0.2	1.3	−64.7**	−833**	−852**	0.5*
SKI 233	−0.6**	1.3	0.1	1.1	65.5**	−2	35	−0.1
S.E. (gi-gj)	0.18	2.84	0.21	1.52	23.83	82.45	158	0.25

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

13 × PCS 1 showed high specific combining ability for seed yield in all the three pickings. Crosses like DPC 9 × JI 220, DPC 10 × JI 225, DPC 13 × PCS 1 exhibited desirable sea effects for earliness (nodes to primary raceme) and seed yield at 90 DAS. Superiority of the hybrids in the present study may be better explained with effective spike length and number of capsules per plant. Positive and highly significant correlation between sea and mean of hybrids for all the characters studied indicated that either mean *per se* performance or *sca* effects of hybrids is a good indicator for selection of hybrids [5].

Heterosis for seed yield ranged from -43.6 (DPC 9 × SKI 229) to 124 per cent (DPC 10 × PCS 121), heterobeltiosis from -29.5 (DPC 9 × SKI 229) to 188 per cent (DPC 10 × JI 225) and standard heterosis over DCH 32 ranged from −42.58 (DPC 13 × SKI 232) to 48.3 per cent (DPC 10 × SKI 229). Among the 27 crosses studied, DPC 10 × SKI 229, DPC 10 × JI 240, DPC 10 × PCS 121, DPC 10 × JI 225 and DPC 10 × JI 220 exhibited high *per se* performance and also high per cent of heterosis, heterobeltiosis and standard heterosis for seed yield per plant.

Among the twenty-seven hybrids, two hybrids DPC 10 × JI 220 and DPC 13 × SKI 229 recorded low wilt incidence (< 20%) in wilt sick plot [6]. These two hybrids with significantly high heterobeltiosis (73.5** and 34.4**) and standard heterosis over GCH 4 (41.1** and 24.6** respectively) and resistance to *Fusarium* wilt have good commercial value.

References

1. **DOR.** 2003. Castor in India. Directorate of Oilseeds Research, Hyderabad, pp. 18-23.
2. **Kempthorne O.** 1957. An Introduction to genetic statistics. John Wiley and Sons. Inc. NY.
3. **Solanki S. S., Deora V. S. and Singh D. P.** 2004. Combining ability of new castor, *Ricinus communis* L. pistillate line: MCP-1-1. J. of Oilseeds Res., **21**: 274-276.
4. **Kavani R. H., Golakia P. R. and Dhaduk H. L.** 2001. Combining ability analysis in castor (*Ricinus communis* L.). J. Oilseeds Res., **18**: 24-27.
5. **Lavanya C. and Chandramohan Y.** 2003. Combining ability and heterosis for seed yield and yield components in castor. J. Oilseeds Res., **20**: 220-224.
6. **Anonymous.** 2002. Annual Progress Report, Castor, ed., Directorate of Oilseeds Research, Rajendranagar, Hyderabad.