*Indian J. Genet.*, **60**(3): 411-414 (2000)

Short Communication

# HETEROSIS AND COMBINING ABILITY FOR STRAW AND SEED YIELD IN OPIUM POPPY

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**(Received: July, 1999; accepted: May, 2000)**

The opium poppy (*Papaver somniferum* L.) is a largely self- pollinated crop. However, out-crossing from 9-30% has been reported [1]. In addition to opium yield, straw and seed yield are also important traits since these add to the major source of income to the grower [2]. Poppy straw contains about 1.0% morphine (without lanced) and can be used directly in pharmaceuticals. The poppy seed oil contains largely unsaturated fatty acid and there is an apparent demand for this oil. It is imperative to improve seed yield [3] and also oil content in seeds.

Eight diverse strains (AP2, AP3, AP4, AP7, AP8, AP11, AP13 and AP14) developed from selected land races and exhibiting different morpho-physiological characters were crossed in a diallel mating design without reciprocals. These eight parents and 28 FIs were grown in a randomized complete block design with three replications. Each plot consisted of a single row of 4m length. Row were spaced at 50 cm. The crop was raised under normal cultural practices. The plot was fertilized with 120 Kg N, 80 Kg $P_2O_5$ and 60 Kg $K_2O$ per hectare. Irrigation was arranged as per requirement of the crop.

Observations were recorded on five random plants per plot, for number of days from sowing to maturity, plant height (cm), number of capsule per plant, straw yield per plant (g) and seed yield per plant(g). Statistical analysis of data was performed on mean values (average of the five samples of plants) for each trait. The realized heterosis was computed over the better parent (BP). Combining ability analysis was done by following method II model I of Griffing [4]

The parents AP8 and AP11 were good general combiners for all the characters except capsule number per plant where AP8 had negative value (Table 1). AP7 was a good choice for capsule number and seed yield. AP3 was good combiner for days

**Table 1. General combining ability effect and *per se* performance of the parents for 5 characters in opium poppy**

| Parents | Days to maturity | | Plant height (cm) | | Number of capsules per plants | | Straw yield per plants(g) | | Seed yield per plant (g) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | gca | *Per se* | gca | *Per se* | gca | *Per se* | gca | *Per se* | gca | *Per se* |
| AP2 | 0.92** | 104 | 1.57** | 86.5 | -0.35* | 3.20 | -0.36* | 13.3 | -0.80** | 13.2 |
| AP3 | -0.57* | 94 | 2.0** | 84.9 | 0.07 | 3.3 | -0.01 | 13.4 | -0.86** | 12.4 |
| AP4 | 0.10 | 97 | -2.24** | 81.8 | -0.17 | 3.4 | -0.49** | 13.1 | -0.74** | 12.7 |
| AP7 | 0.23 | 98 | 0.38 | 86.8 | 0.35** | 4.6 | -0.22 | 13.8 | 1.16** | 13.7 |
| AP8 | -1.13 | 97 | -1.6** | 87.5 | -0.05 | 3.5 | 0.59** | 16.8 | 1.24** | 16.7 |
| AP11 | 0.50 | 97 | -3.3** | 84.5 | 0.21** | 3.4 | -0.69** | 12.4 | 1.37** | 15.4 |
| AP13 | 0.53 | 103 | 2.43** | 99.0 | 0.13** | 3.4 | -0.15 | 13.8 | -1.18** | 14.2 |
| AP14 | 0.4 | 97 | 0.71 | 96.9 | -0.05 | 3.3 | -0.05 | 12.5 | -0.18 | 13.3 |

* = Significant at 5% level probability
** = Significance at 1% level probability

to maturity and AP4 for plant height. The mean values for morphological traits distinctly characterized each inbreds with differential values for different traits.

The hybrid AP14 × AP11 exhibits a high degree of heterosis for number of capsule per plant (88.2%) and for straw yield per plant (43.6%) and medium for seed yield per plant (22.7%) (Table 2). The hybrid AP13 × AP4 is more suitable for plant height on account of negative heterosis (-4.14%) and minimum *per se* performance (81cm). The *per se* performance of cross AP14 × AP11 for number of capsules per plant (6.4) and straw yield per plant (18.1 g) was recorded to be the maximum whereas seed yield per plant (18.9 g) was second in order of merit. Maximum heterosis (34.5%) over better parent for seed yield was recorded in hybrid AP14 × AP7 [5]

Only four out of 28 hybrids had significant heterosis for seed yield as well as higher seed yield (Table 2). These crosses involved the parents AP11, AP8 and AP7 which were good general combiner and had high *per se* performance. The four heterotic crosses had significant and positive specific combining ability effect.

The present study suggest that crossing the strains like AP8, AP11 and AP7 *inter se* and simulating random mating far only two generations would simultaneously permit greater combinations, breaking of unfavourable linkage and creation of a wide

**Table 2. Heterosis over better parents (Het. %), *per se* performance and SCA effects in eight hybrids of Opium poppy**

| Hybrids | Days to maturity | | | Plant height (cm) | | | No. of capsules per plant | | | Straw yield per plant (g) | | | Seed yield per plant (g) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Het% | *Per se* | SCA | Het% | *Per se* | SCA | Het% | *Per se* | SCA | Het% | *Per se* | SCA | Het% | *Per se* | SCA |
| AP2 × AP4 | 3.4 | 100.3 | 0.19 | 17.0 | 95.7 | 5.72 | 11.8 | 3.8 | 0.24 | 7.5 | 12.3 | 0.11 | 7.6 | 14.2 | 16.0** |
| AP3 × AP4 | 8.2** | 101.7 | 3.1** | 16.63 | 95.4 | 4.91** | 14.7 | 3.9 | 0.06 | 0.0 | 13.5 | 0.71* | 17.3 | 14.9 | 2.4* |
| AP3 × AP7 | 5.3* | 99.0 | 0.22 | 11.60* | 94.7 | 1.62 | 2.2 | 4.7 | 0.41* | 2.9 | 13.4 | 0.42 | 8.9 | 14.9 | 0.49 |
| AP14 × AP7 | 5.9** | 102.7 | 2.92** | 0.73 | 87.4 | 4.34** | 28.3** | 3.3 | 1.01** | 6.8 | 12.9 | 0.11 | 34.5** | 18.4 | 3.34** |
| AP14 × AP11 | 5.5** | 102.4 | 3.32** | 7.37** | 90.7 | 2.63** | 88.2 | 6.4 | 2.19** | 43.6** | 18.1 | 4.2** | 22.7** | 18.9 | 3.58** |
| AP7 × AP8 | 4.4* | 101.4 | 3.12* | 1.69 | 85.3 | 4.13** | 19.6* | 5.4 | 1.11** | 24.4* | 12.7 | 0.91 | 21.0** | 20.2 | 3.7** |
| AP7 × AP11 | 1.4 | 98.3 | 0.51 | 17.2** | 99.03 | 11.26** | 10.9 | 4.0 | 0.56** | 1.16 | 13.9 | 0.25 | 9.7 | 16.9 | 0.26 |
| AP13 × AP14 | 4.12* | 101.0 | 1.86** | 4.14* | 91.0 | 8.82 | 38.42** | 4.67 | 0.27 | 13.77* | 15.72 | 1.93* | 5.84 | 16.3 | 2.01** |

* = Sigficance at 5% level probability; ** = Significance at 1% level probability

genetic base in present material. The improvement in such traits would obviously lead to a significant increase in opium yield of the cultivars/hybrids since they are positively correlated.

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