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Periodic Research

# Combining Ability Studies in CMS Based Pigeonpea Hybrids and Their Parents

**G.S.Mhasal**
M.Sc(Agri) Student
Deptt of Agricultural Botany,
Dr.Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra.

**M.W.Marawar**
Assistant Professor
Deptt of Agricultural Botany,
Dr.Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra.

**A.C.Solanke**
M.Sc(Agri) Student
Deptt of Agricultural Botany,
Dr.Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra.

**Abstract**

The present investigation in pigeonpea hybrids was undertaken to estimate the combining ability effects and thereby to find out promising cross combinations using Line x Tester mating design. Among female parents, ICPA-2047A recorded significant gca effect for grain yield per plant, plant height, number of clusters, number of seed per pod, 100 seed weight. The male parent AKPR-324 was found to posses highest gca effect for plant height, number of clusters, 100 seed weight and grain yield per plant. The cross ICPA-2047A X AKPR-324 depicted positive sca effect and both the parents involved revealed high gca effects grain yield per plant. Another cross ICPA-2047A X AKPR-372 revealed high sca effect for grain yield per plant.

**Keywords:**Pigeonpea,Combining ability,Line x Tester Analysis, Cytoplasmic male sterility.

**Introduction**

Combining ability analysis help in identification of superior parents and cross combination. The gca effect reflects the breeding value of the parental genotypes and assists in identifying genotypes to be used for developing superior populations. Specific combining ability effects represent the non-reliable component of the genotypic value arising due to contribution from dominance deviation and interaction deviation. Hence, sca effect is the main cause for superiority of a cross.

**Material and Methods**

The experimental material for the present study comprised of 11 pigeonpea genotypes: 6 genotypes (AKCMS 81A, AKCMS 82-2A, AKCMS 83A, AKCMS 12A,AKCMS 93A, ICPA-2047) were used as alines and remaining 5 genotypes ( AKPR-303, AKPR-324, AKPR-364, AKPR-372, AKPR-057 were ued as a testers. These genotypes were crossed in a line x tester design. The resulting 30 hybrids along with 11 parents were grown in trhe randomised block design with three replications during kharif 2012-13. Each entry was grown in the two rows plot of 4 meter length with intra and inter row spacing of 20 cm and 60 cm respectively. Recommended crop management practices were followed during the crop growth period. The observations were recorded onfive randomly selected plants on nine characters. viz: days to 50% flowering,days to maturity,plant height,number of branches,number of clusters,number of pods,number of seed per pod,100 seed weight and grain yield per plant.The mean data were subjected to line x tester analysis to estimate combining ability (Kampthrone,1957).

**Results and Discussion**

The mean squares due to genotypes were highly significant for all the traits studied .This indicated the presence of substantial genetic variability among genotypes all the traits studied. Further partitioning of genotypic variance into components viz., parents, crosses and parents vs. crosses revealed that the parents differed significantly among themselves for all the characters under study. The mean square due to crosses also showed highly significant differences for all the traits.

The estimates of general combining ability effects of the female and male parents are presented in (Table 1). The GCA effects revealed that among the female parents AKCMS-93A (1.26) and AKCMS-82-2A (0.69) and among the male parents AKPR-372 (0.56) AKPR-057 (0.41) and AKPR-303 (0.35) were the best general combiners for number of branches. The female parents ICPA-2047A (3.53) and among the male parents AKPR-324 (2.17) and AKPR-364 (1.36) were the best general combiners for number of clusters. The female parents AKCMS-82-2A (15.44) and AKCMS-12A (5.05) and among the male parents AKPR-372 (13.34) were the best general combiners for number of pods. The female parents ICPA-2047A (0.20) and among the male parents AKPR-364 (0.22) and AKPR-372 (0.07) were the best general combiners for number of seed per pod.

he female parents ICPA-2047A (1.05), AKCMS-12A (0.58) and AKCMS-82-2A (0.20) and among the male parents AKPR-324 (0.27) were the best general combiners for 100 seed weight. The female parents ICPA-2047A (1.96) and among the male parents AKPR-324 (2.26) were the best general combiners for gran yield per plant.

Among female parents, ICPA-2047A recorded significant gca effect for maximum six characters such as grain yield per plant, plant height, number of clusters, number of seed per pod, 100 seed weight and days to 50% flowering and the male parent AKPR-324 was found to posses highest gca effect for plant height, number of clusters, 100 seed weight and grain yield per plant. So these genotypes can be used as parent in hybridization programme for improvement of these traits. Similar results for these charcters were reported by Sunilkumar et al. (2003), Banu et al. (2006) and Kumar et al. (2009).

The estimates of specific combining ability effects of the crosses are presented in (Table 2). The highest significant desirable sca effect was observed for days to maturity in AKCMS-82-2A X AKPR-364 (-4.37), for number of branches in AKCMS-93A X AKPR-364 (2.45), for number of clusters in AKCMS-81A X AKPR-303 (6.00), for number of pods in AKCMS-81A X AKPR-364 (31.68), for number of seed per pods in ICPA-2047A X AKPR-324 (0.59), for 100 seed weight AKCMS-93A X AKPR-057 (1.23) and for grain yield per plant in ICPA-2047A X AKPR-372 (4.10).

The crosses viz, ICPA-2047A X AKPR-372 (number of branches, number of clusters, number of pods, grain yield per plant) AKCMS-83A X AKPR-303 (number of branches, number of clusters) AKCMS-93A X AKPR-303 (days to 50% flowering, days to maturity, number of pods) and AKCMS-93A X AKPR-057 (number of clusters, 100 seed weight) revealed significant desirable sca effect simultaneously for more than one characters studied. Hence, these crosses were found to be promising to exploit non-additive component for particular character and can be utilized in breeding programme. It was observed that the crosses with high and significant specific combining ability for grain yield per plant had also high specific combining ability for one or more other yield components suggesting that the improvement in grain yield per plant could be obtained by improving its component characters. Similar results were reported by Pawar and Tikka (2003), Sunilkumar et al. (2003), Banu et al. (2006) and Gupta et al. (2011).

Two promisings crosses were selected on the basis of gca and sca effects. The crosses ICPA-2047A X AKPR-324 andICPA-2047A X AKPR-372 were found to be the most promising crosses among all the 30 crosses studied.

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**Table 1.Estimates of General Combining Ability Effects of Parents**

| Parents | Days to 50 % flowering | Days to maturity | Plant height (cm) | Number of branches | Number of clusters | Number of pods | Number of seeds per pod | 100 seed weight (g) | Grain yield per plant (g) |
|---|---|---|---|---|---|---|---|---|---|
| **Females (Lines)** | | | | | | | | | |
| AKCMS- 81A | -0.59 ** | -1.87 ** | -5.40 ** | -0.58** | -0.71 ** | -3.38 ** | -0.21 ** | -0.38 ** | -1.06 ** |
| AKCMS-82-2A | 1.54 | 2.87 ** | -2.26 ** | 0.69 ** | -0.79 ** | 15.44** | 0.04 | 0.20 ** | -0.18 ** |
| AKCMS- 83A | 5.74 ** | 5.87 ** | -14.49 ** | -0.33 ** | -0.79** | -6.08 ** | -0.11 ** | -1.46 ** | -1.30 ** |
| AKCMS- 12A | -4.79 ** | -2.73 ** | -0.60 ** | -0.50 ** | -1.79 ** | 5.05** | 0.17 ** | 0.58 ** | 0.78 |
| AKCMS- 93A | -3.99 ** | -2.60 ** | 17.58** | 1.26 ** | 0.53 | -8.23 ** | -0.077 ** | 0.02 | -0.20** |
| ICPA- 2047A | 2.08** | -1.53 ** | 5.17** | -0.54 ** | 3.53 ** | -2.80 ** | 0.20 ** | 1.05 ** | 1.96** |
| SE (gi) ± | 0.87 | 0.66 | 2.28 | 0.24 | 0.92 | 2.06 | 0.11 | 0.16 | 0.81 |
| SE(gi-gj) ± | 1.23 | 0.93 | 3.23 | 0.35 | 1.30 | 2.92 | 0.15 | 0.23 | 1.14 |
| CD at 5 % | 1.74 | 1.32 | 4.57 | 0.49 | 1.85 | 4.13 | 0.22 | 0.33 | 1.61 |
| CD at 1 % | 2.32 | 1.76 | 6.09 | 0.65 | 2.46 | 5.49 | 0.29 | 0.44 | 2.15 |
| **Males (Testers)** | | | | | | | | | |
| AKPR-303 | -2.87 ** | -3.53 ** | -2.24 ** | 0.35* | -1.91 ** | -2.23 ** | -0.09 ** | -0.03 ** | -2.03 ** |
| AKPR-324 | 3.58 ** | 2.24 ** | 5.31** | 0.10 | 2.17** | -0.56 ** | 0.02 | 0.27 ** | 2.26 ** |
| AKPR-364 | -1.98 ** | -1.03 ** | -5.75 ** | -1.42 ** | 1.36 | -4.17 * | 0.22 ** | -0.02 ** | -0.54 ** |
| AKPR-372 | -0.20 ** | 1.86 ** | 1.22 | 0.56 ** | -0.71 ** | 13.34** | 0.07 ** | -0.07** | 1.07 |
| AKPR-057 | 1.47 | 0.47 | 1.47 | 0.41 ** | -0.90 ** | -6.38 ** | -0.22 ** | -0.14 ** | -0.76 ** |
| SE (gj) ± | 0.79 | 0.60 | 2.09 | 0.22 | 0.84 | 1.88 | 0.10 | 0.15 | 0.74 |
| SE (gi-gj) ± | 1.12 | 0.85 | 2.95 | 0.32 | 1.19 | 2.66 | 0.14 | 0.21 | 1.04 |
| CD at 5 % | 1.59 | 1.20 | 4.18 | 0.45 | 1.69 | 3.77 | 0.20 | 0.30 | 1.47 |
| CD at 1 % | 2.12 | 1.60 | 5.56 | 0.59 | 2.24 | 5.02 | 0.26 | 0.40 | 1.96 |

* - Significant at 5 % level of significant
** - Significant at 1 % level of significance

**Table 2**
**Estimates of Specific Combining Ability Effects for Crosses**

| Sr.No. | Crosses | Days to 50% flowering | Days to maturity | Plant height (cm) | Number of branches | Number of clusters | Number of pods | Number of seeds per pod | 100 seed weight(g) | Grain yield per plant(g) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | AKCMS -81A X AKPR-303 | 0.20 | -0.47 | 1.51 | -0.28 | 6.00 ** | -6.06 | 0.18 | 0.43 | 1.68 |
| 2 | AKCMS -81A X AKPR -324 | 0.42 | 2.42 | -1.44 | -0.90 | 1.46 | -11.40 * | -0.13 | -0.17 | -3.80 * |
| 3 | AKCMS -81A X AKPR -364 | -0.36 | -0.97 | 1.02 | 0.89 | -3.34 | 31.68 ** | -0.33 | 0.01 | 2.80 |
| 4 | AKCMS -81A X AKPR -372 | -1.47 | -1.19 | -4.02 | -0.43 | -1.53 | -7.63 | 0.02 | -0.03 | -2.62 |
| 5 | AKCMS -81A X AKPR -057 | 1.20 | 0.20 | 2.93 | 0.72 | -2.60 | -6.58 | 0.25 | -0.24 | 1.95 |
| 6 | AKCMS -82-2A X AKPR-303 | -1.27 | -0.87 | 1.17 | -0.09 | -1.71 | -7.80 | 0.20 | 0.78* | -3.00 |
| 7 | AKCMS -82-2A X AKPR -324 | 0.29 | 0.69 | -1.05 | -0.41 | -4.16 * | 7.45 | -0.25 | -0.24 | 1.05 |
| 8 | AKCMS -82-2A X AKPR -364 | -0.49 | -4.37 ** | -3.19 | 1.35 * | 0.74 | -8.07 | 0.02 | 0.53 | 1.12 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | AKCMS -82-2A X AKPR -372 | 1.07 | 0.74 | 0.10 | -0.17 | 2.09 | 2.09 | -0.10 | -0.02 | -0.30 |
| 10 | AKCMS -82-2A X AKPR -057 | 0.40 | 3.80 * | 2.98 | -0.68 | 3.05 | 6.34 | 0.13 | -1.06 ** | 1.13 |
| 11 | AKCMS -83A X AKPR-303 | 0.20 | 2.80 | 1.40 | 0.40 | 4.22 * | 12.45 ** | 0.21 | 0.13 | 1.39 |
| 12 | AKCMS -83A X AKPR -324 | -0.58 | -0.31 | -3.69 | 1.18 * | 1.00 | 8.51 | 0.03 | 0.16 | -1.43 |
| 13 | AKCMS -83A X AKPR -364 | 1.64 | 0.30 | 2.67 | -2.23 ** | 3.94 | -7.55 | -0.43 | -0.24 | -0.36 |
| 14 | AKCMS -83A X AKPR -372 | 1.20 | -0.92 | 1.07 | -0.55 | -6.38 ** | -11.72 * | -0.02 | -0.13 | -2.58 |
| 15 | AKCMS -83A X AKPR -057 | -2.47 | -1.87 | -1.45 | 1.20 * | -2.79 | -1.68 | 0.21 | 0.07 | 2.99 |
| 16 | AKCMS -12A X AKPR-303 | 3.73 | 2.73 | -1.55 | 0.30 | 0.09 | 1.05 | 0.13 | -0.82 * | -0.69 |
| 17 | AKCMS -12A X AKPR -324 | -1.04 | -3.04 * | -0.04 | 0.55 | -0.26 | -8.83 | 0.02 | 0.15 | 2.10 |
| 18 | AKCMS -12A X AKPR -364 | -2.49 | 4.90 ** | 2.49 | -1.03 | 2.28 | -6.88 | 0.35 | 0.24 | -1.67 |
| 19 | AKCMS -12A X AKPR -372 | 2.40 | -2.66 | -1.42 | 0.75 | 2.29 | 19.14 ** | -0.50 * | -0.49 | 2.28 |
| 20 | AKCMS -12A X AKPR -057 | -2.60 | -1.93 | 0.53 | -0.56 | -4.39 * | -4.48 | 0.00 | 0.92 * | -2.02 |
| 21 | AKCMS -93A X AKPR -303 | -0.73 | -1.07 | -4.61 | -0.46 | -3.57 | 15.87 ** | -0.16 | -0.68 | 2.75 |
| 22 | AKCMS -93A X AKPR -324 | 2.16 | -0.51 | 3.64 | -0.47 | 0.42 | 8.99 | -0.27 | -0.11 | -1.50 |
| 23 | AKCMS -93A X AKPR -364 | -2.62 | -1.90 | -0.03 | 2.45 ** | -0.58 | 2.26 | 0.43 | -0.69 | 0.54 |
| 24 | AKCMS -93A X AKPR -372 | -3.40 | 3.21 * | -1.41 | -0.80 | -1.10 | -27.18 ** | 0.15 | 0.24 | -0.88 |
| 25 | AKCMS -93A X AKPR -057 | 4.60 * | 0.27 | 2.41 | -0.72 | 4.83 * | 0.07 | -0.16 | 1.23** | -0.91 |
| 26 | ICPA -2047A X AKPR -303 | -2.13 | -3.13 * | 2.07 | 0.14 | -5.03 * | -15.50 ** | -0.57 * | 0.15 | -2.13 |
| 27 | ICPA -2047A X AKPR -324 | -1.24 | 0.76 | 2.59 | 0.05 | 1.55 | -4.71 | 0.60 * | 0.21 | 3.58 |
| 28 | ICPA -2047A X AKPR -364 | 4.31 * | 2.03 | -2.95 | -1.42 * | -3.04 | -11.44 * | -0.04 | 0.15 | -2.42 |
| 29 | ICPA -2047A X AKPR -372 | 0.20 | 0.81 | 5.67 | 1.19 * | 4.63 * | 25.32 ** | 0.44 | 0.42 | 4.10 * |
| 30 | ICPA -2047A X AKPR -057 | -1.13 | -0.47 | -7.38 | 0.04 | 1.89 | 6.34 | -0.43 | -0.92 * | -3.13 |
| | SE (Sij) ± | 1.95 | 1.47 | 5.11 | 0.55 | 2.06 | 4.61 | 0.24 | 0.37 | 1.80 |
| | SE (Sij-Skl) ± | 3.90 | 2.08 | 7.23 | 0.77 | 2.92 | 6.52 | 0.34 | 0.52 | 2.55 |
| | SE ( Sij-Sik) ± | 5.18 | 2.47 | 8.55 | 0.91 | 3.45 | 7.72 | 0.40 | 0.62 | 3.02 |
| | CD at 5 % | 2.75 | 2.95 | 10.23 | 1.09 | 4.13 | 9.23 | 0.48 | 0.74 | 3.61 |
| | CD at 1 % | 3.26 | 3.93 | 13.61 | 1.45 | 5.49 | 12.29 | 0.64 | 0.98 | 3.61 |