International Journal of Agricultural Sciences
Volume 9 | Issue 1| January, 2013 | 252-255

***RESEARCH PAPER***

# Combining ability for yield and yield contributing characters in pigeonpea

S.K. ARBAD*, I.A. MADRAP AND P. JADHAV
Department of Agricultural Botany, College of Agriculture, Marathwada Krishi Vidyapeeth, PARBHANI (M.S.) INDIA (Email : arbadseema03@gmail.com)

**Abstract :** Combining ability and genetic variance for nine quantitative traits in pigeonpea [*Cajanus Cajan* (L.) Millsp] were estimated through line x tester analysis involving four male sterile lines, 23 testers and 92 $F_1$ crosses. The analysis of variance revealed there were significant differences among the parents for all characters and for hybrids except for number of seeds per pod. Non additive gene effects were predominant for all characters. The parents ICPA-2092, ICPA-20108, ICPA-2047, BDN-2, ICP-12320 were good general combiner for grain yield and pods per plant. The two crosses ICPA-2092 x ICP-12057 and ICPA-2047 x BSMR- 253A exhibited high SCA effects for grain yield per plant. The study was carried out during 2009-10 to 2010-11 under International Central Research Institute for Semi Arid Tropics funded project at Department of Agricultural Botany, M.K.V., Parbhani.

**Key Words :** GCA, SCA, Line x tester, Pigeonpea

**View Point Article :** Arbad, S.K., Madrap, I.A. and Jadhav, P. (2013). Combining ability for yield and yield contributing characters in pigeonpea. *Internat. J. agric. Sci.*, **9**(1): 252-255.

**Article History : Received :** 23.08.2012**; Revised :** 20.10.2012**; Accepted :** 07.12.2012

## INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millsp] is a predominant pulse crop of Indian subcontinent and constitutes a very important source of protein in the vegetarian diets. It ranks second to chickpea in area and production. Combining ability studies are very useful for the breeders as it helps in the selection of parents and hybrids which can provide the superior inbreeds for the characters(s) under consideration. It also furnishes the information on gene effects of genetic variances present in material for the characters under study. The main objective of this investigation was to identify good general and specific combiners for yield and yield attributing traits in pigeonpea.

## MATERIALS AND METHODS

Four CGMS based male sterile lines were crossed with 23 testers in a line x tester mating design in *Kharif* 2009-2010 to generate crosses for this study. The present study comprised of four lines *i.e.* ICPA-2043, ICPA-2047, ICPA-2078 and ICPA-2092 and 23 testers *i.e.* ICP-7192, ICP-9939, ICP-12320, ICP-12057, ICP-1482, ICPL-20108, ICPL-20120, BSMR-846, BSMR-736, BDN-2, BSMR-198, BSMR-571, BSMR-243, BSMR-174, BSMR-175, BSMR-253A, BWR-153, BSMR-539, BSMR-528, BWR-133, BWR-154, BWR-553 and BWR-123. All the twenty seven parents (four lines and 23 testers) together with 92 crosses and a standard check BSMR – 736 and one promising hybrids ICPH – 2671 were evaluated during *Kharif* 2010-2011 at Department of Agricultural Botany. Each genotype was grown in one row of three meters length at 75cm x 30cm spacing adopting randomized block design and replicated twice. The recommended fertilizer dose of 25:50:00 NPK kg/ha was applied. Cultural practices like weeding and plant protection measures were followed as and when required. The data were recorded on days to 50 per cent flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per plant, 100 seed weight,

*** Author for correspondence and Present Address :** Department of Genetics and Plant Breeding, College of Agriculture, Marathwada Krishi Vidyapeeth, PARBHANI (MS) INDIA

and grain yield per plant. The combining ability analysis was done according to Kempthorne (1957).

## RESULTS AND DISCUSSION

The analysis of variance for all characters is given in Table 1. The analysis of variance for all the traits studied was highly significant indicating the sufficient variation in the materials studied. The analysis of variances revealed significant differences among the parents for all traits under consideration. It expressed the presence of significant variability in the parents. Among the crosses significant differences were observed for all traits except for the number of seeds per pod. Presence of significant differences among parents and crosses revealed to develop superior crosses and exploitation of hybrid vigour for all characters.

Analysis of variance for combining ability due to replication significance differences were observed for all characters except days to maturity, number of primary branches per plant and test weight. Analysis of variance due to lines had significant differences for all characters. The testers showed significant differences for characters days to 50 per cent flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, number of pod per plant, test weight and yield per plant except for number of seeds per pod. This indicated the good level of genetic differences brought out by the both lines and testers. These results support the findings of Kumar *et al.* (2001), Jahagirdar (2003), Pandey (2004), Reddy *et al.* (2004), Phad *et al.* (2007).

The estimates of gca are given in Table 2. The line ICPA – 2092 showed high gca effects for plant height (7.53), number of pods per plant (30.24**) number of seeds per pod (0.10**) and yield per plant (18.30**). The line ICPA – 2047 showed high gca for plant height (8.51**), number of secondary branches per plant (1.19*) and test weight (0.22*). And line ICPA-2078 showed high gca for days to 50 per cent flowering (-0.38*) and test weight (1.18**). The tester ICPL-20108 was identified with high gca effects for days to 50 per cent flowering (-1.83**), plant height (17.18**), number of primary branches per plant (1.24**), number of secondary branches per plant (3.78**), number of pods per plant (59.43**) and yield per plant (30.61**). The tester BDN-2 showed high gca for days to 50 per cent flowering (-5.58*), days to maturity (-5.07**), plant height (8.55**), number of pods per plant 47.98** and yield per plant (24.24**). The tester ICP-12320 showed high gca for number of pods per plant (22.22*) and yield per plant (17.07**). The tester BSMR-571 showed high gca for number of pods per plant (50.94**) and yield per plant (14.55**). The tester BSMR-175 showed high gca for number of secondary branches per plant (3.20*), number of pods per plant (38.18**), test weight (0.36*) and yield per plant (15.28**). The crosses with high gca of parents could produce superior segregants in $F_2$ as well as in latter generation. The line ICPA-2092 and line ICPA-2047 and tester ICPL-20108, BDN-2, BSMR-175 and ICPL-1482 recorded high *per se* and gca for different yield contributing characters studied. Therefore, these parents may be utilized in the hybridization programme for selecting superior recombinants, such suggestions have been suggested by Jahagirdar (2003), Pandey (2004) and Acharya *et al.* (2009).

The crosses showing desirable sca effects given in Table 3. The cross ICPA-2043 x BWR-133 (-4.73) and ICPA-2092 x ICP – 1482 (-2.57) exhibited high sca for days to 50 per cent flowering, the cross ICPA-2043 x BWR-133 (-4.73) exhibited high sca for days to maturity.

The cross ICPA – 2043 x BWR – 154 (28.57) exhibited high sca for plant height. The cross ICPA – 2043 x BDN – 2 (2.71) exhibited high sca for number of primary branches per plant. The cross ICPA- 2092 x ICP – 1482 (101.88) exhibited high sca for number of pods per plant. Cross ICPA- 2047 X ICP – 12320 (0.37) exhibited high sca effects for number of seeds per pod. The cross ICPA – 2078 x ICPL – 20108 (1.73) high sca for test weight.

The cross ICPA- 2092 x ICP 12057 (62.54) exhibited highest sca and also ICPA – 2047 BMSR- 253 (45.59), ICPA-2047 x BWR -154 (40.55). Combination of favorable genes from the parents for the corresponding traits might have resulted

**Table 1: Analysis of variances for combiming ability**

| | Replication df = 1 | Line df = 3 | Tester df = 22 | L x T df = 66 | Error = 118 |
|---|---|---|---|---|---|
| Days to 50% flowering | 6.391* | 4.049** | 20.304** | 4.004** | 1.382 |
| Days to maturity | 9.282 | 18.768** | 35.169** | 13.151** | 3.1205 |
| Plant height | 454.380** | 4326.565** | 575.861** | 313.683** | 47.181 |
| Number of primary branches/plant | 1.626 | 6.603** | 2.213** | 1.717** | 0.8817 |
| Number of secondary branches/plant | 236.303** | 54.054** | 30.598* | 15.371 | 12.8793 |
| Number of pod/plant | 12753.492** | 21632.952** | 6146.896** | 3683.561** | 853.845 |
| Number of seed/plant | 0.933** | 0.246 | 0.038 | 0.043 | 0.078 |
| Test weight | 0.531 | 37.789** | 6.714* | 1.709** | 0.170 |
| Yield per plant | 584.513* | 7053.297** | 1624.980** | 1401.246** | 115.921 |

* and ** Indicates significance of values at P=0.05 and 0.01, respectively

**Table 2: Estimates of gca effects for different traits in parents**

| Sr. No. | Parents/ crosses | Days to 50 per cent flowering | Days to maturity | Plant height (cm) | Number of primary branches per plant | Number of secondary branches per plant | Number of pods per plant | Number of seeds per pod | Test weight (g) | Yield per plant (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| Female parents | | | | | | | | | | |
| 1. | ICPA-2043 | -0.07 | -0.89** | -11.52** | 0.16 | 0.62 | -11.24* | -0.07 | -0.82** | -5.47** |
| 2. | ICPA-2047 | 0.13 | 0.04 | 8.51** | 0.20 | 1.19* | 0.23 | -0.02 | 0.22** | -8.97** |
| 3. | ICPA-2078 | -0.38* | 0.24 | -4.51** | -0.57** | -0.66 | -19.24** | -0.01 | 1.18** | -3.86* |
| 4. | ICPA-2092 | 0.32 | 0.61** | 7.53** | 0.20 | -1.14* | 30.24** | 0.10** | -0.59** | 18.30** |
| Male parents | | | | | | | | | | |
| 5. | ICP-7139 | -0.20 | 1.55** | -0.76 | 0.76* | 2.07 | -7.38 | -0.12 | 0.11 | -11.93** |
| 6. | ICP-9939 | 0.42 | 1.43** | 0.93 | -0.41 | -1.97 | -15.34 | 0.03 | 1.56** | 6.24 |
| 7. | ICP-12320 | -0.20 | 0.05 | 1.09 | 0.49 | 1.99 | 22.22* | 0.01 | -1.09** | 17.07** |
| 8. | ICP-12057 | -0.33 | -0.07 | 4.89 | 0.45 | 0.24 | -16.94 | 0.02 | -0.26 | 4.28 |
| 9. | ICP-1482 | 1.55** | 2.80** | 4.05 | 0.32 | -0.80 | -15.24 | -0.13 | 0.20 | 1.70 |
| 10. | ICPL-20108 | -1.83** | 1.30** | 17.18** | 1.24** | 3.78** | 59.43** | -0.04 | 0.21 | 30.61** |
| 11. | ICPL-20120 | 1.17** | 2.43** | 14.18** | -0.47 | 1.86 | 35.93** | -0.03 | -0.37* | 2.53 |
| 12. | BSMR-736 | 1.42** | 0.93* | 8.14** | -0.15 | -2.01 | -17.19 | 0.07 | -0.82** | -17.84** |
| 13. | BDN-2 | -5.58** | -5.07** | 8.55** | 0.69 | 2.32 | 47.98** | -0.01 | -1.02** | 24.24** |
| 14. | BSMR-198 | -0.70 | -0.20 | -3.45 | 0.20 | 1.82 | 24.35* | 0.03 | 0.14 | 15.07** |
| 15. | BSMR-571 | 0.92* | 1.43** | -8.45** | -0.01 | -1.59 | -50.94** | -0.02 | 0.67** | -14.55** |
| 16. | BSMR-243 | -0.33 | 2.30** | -0.80 | -0.62 | -1.07 | -24.36* | 0.04 | -0.33* | -11.76** |
| 17. | BSMR-846 | 0.92* | 0.30 | -11.20** | -0.28 | -1.05 | 2.62 | 0.03 | -0.42** | -5.01 |
| 18. | BSMR-174 | -0.70 | 1.05* | -12.49** | -0.01 | 0.24 | -1.74 | -0.08 | 1.83** | -10.68** |
| 19. | BSMR-175 | 1.42 | -0.70 | 1.93 | 0.16 | 3.20* | 38.18** | -0.04 | 0.36* | 15.28** |
| 20. | BSMR-253A | 0.42 | -3.57** | -13.78** | -0.56 | -3.39** | -27.78* | -0.08 | -1.03** | -14.68** |
| 21. | BWR-153 | -1.45** | -4.07** | -2.36 | -0.55 | -2.30 | 13.93 | 0.04 | -0.97** | -6.18 |
| 22. | BSMR-539 | 0.80 | -2.95** | 9.64** | -1.01** | -1.85 | 9.27 | 0.07 | -0.32* | 5.66 |
| 23. | BSMR-528 | 1.05* | -1.20** | -10.60** | -0.20 | -0.03 | -18.32 | 0.08 | -1.00** | 3.57 |
| 24. | BWR-133 | 1.05* | 0.93* | -7.11** | -0.26 | -1.30 | -16.61 | 0.06 | -0.10 | -18.93** |
| 25. | BWR-154 | 0.92* | 0.43 | -6.28* | -0.10 | -1.51 | -34.73** | 0.11 | 2.01** | -21.30** |
| 26. | BSMR-853 | 1.05* | 0.05 | 6.76** | 0.49 | 1.24 | 0.47 | -0.11 | 1.11** | -1.34** |
| 27. | BWR-123 | -1.83 | 0.80 | -0.03 | -0.14 | 0.11 | -7.84 | 0.08 | -0.45** | 7.95* |
| | SE ± Gi (line) | 0.1848 | 0.1797 | 1.0661 | 0.1480 | 0.5183 | 4.5694 | 0.0365 | 0.0671 | 1.6266 |
| | SE ± Gj (tester) | 0.4431 | 0.4310 | 2.5565 | 0.3549 | 1.2428 | 10.9570 | 0.0876 | 0.1608 | 3.9004 |

* and ** indicates significance at 5 and 1 per cent level, respectively

**Table 3: Crosses showing desirable sca effects**

| Characters | Crosses | SCA effects |
|---|---|---|
| Days to 50% flowering | ICPA-2092 x BSMR-175, ICPA-2092 x ICP-1482 | (-3.45**), (-2.57**) |
| Days to maturity | ICPA-2043 x BWR-133, ICPA-2047 x ICPL-20120 | (-4.73**), (-4.67**) |
| Plant height | ICPA-2043 x BWR-154, ICPA-2078 x BSMR-853 | (28.57**), (20.35**) |
| No. of primary branches/plant | ICPA-2043 x BDN-2, ICPA-2078 x ICP-7139 | (2.71**), (1.71**) |
| No. of secondary branches/plant | ----- | |
| No. of pods per plant | ICPA-2092 x ICP-1482, ICPA-2043 x ICP-12320 | (101.88**), (79.89**) |
| No. of seeds/plant | ICPA-2043 x ICP-12320 | (0.3**7) |
| Test weight | ICPA-2078 x ICPL-20108, ICPA-2043 x ICP-7139 | (1.73**), (1.72**) |
| Grain yield per plant | ICPA-2092 x ICP-12057, ICPA-2047 x BSMR-253, ICPA-2047 x BWR-154 | (62.54**), (45.59**), (40.55**) |

* and ** Indicates significance of values at P= 0.05 and 0.01, respectively

in high sca effects. In the per cent study, hybrids were identified with significant and high sca effects for different characters. Many of these hybrids were from either one of the parents with high gca for eg. ICPL-20108(30.61) and BDN-2 (24.24) or parents with low X low general combiners for eg. BWR-154 (-21.30) and BWR-133 (-18.93). Hence, the evidence of that the parents with high gca or low gca would have greater probability to have good complimentary with other parents. Similar results have been reported by Kumar *et al.* (2001), Reddy *et al.* (2004), Acharya *et al.* (2009), Sarode *et al.* (2009).

## REFERENCES

**Acharya, S., Patel, J.B., Tank, C.J. and Yadav, A.S. (2009).** Heterosis and combining ability studies in Indo-African crosses of pigeonpea. *J. Food Legumes.,* **22**(2): 91-95.

**Jahagirdar, J.E. (2003).** Line x tester analysis for combining ability in pigeonpea. *Indian J. Pulses Res.,* **16** (1): 17-19.

**Kempthorne, O. (1957).** *An introduction to genetic statistics.* John Wiley and Sons, Inc., NEW YORK, U.S.A.

**Kumar, Ajay, Srivastava, D.P., Singh, I.P. and Dixit, G.P. (2001).** Combining ability analysis of male sterile lines and hybrids in pigeonpea. *Legume Res.,* **24** (3): 178-181.

**Pandey, N. (2004).** Line x tester analysis in long duration hybrid pigeonpea. *Legume Res.,* **27** (2): 79-87.

**Phad, D.S., Madrap, I.A. and Dalvi, V.A. (2007).** Study of combining ability analysis in pigeonpea under different environments for yield contributing characters. *Legume Res.,* **30** (2): 123-127.

**Reddy, S.M., Singh, S.P., Mehra, R.B. and Govil, J.N. (2004).** Combining ability and heterosis in early maturing pigeonpea [*Cajanus cajan* (L.) Mill] hybrids. *Indian J. Genet.,* **64**(3): 212-216.

**Sarode, S.B., Singh, M.N. and Singh, U.P. (2009).** Heterosis in long duration pigeonpea [*Cajanus cajan* (L.) Mill sp.]. *Internat. J. Plant Sci.,* **4**(1): 106-108.

*_*_*_*_*_*