# COMBINING ABILITY ANALYSIS IN PIGEONPEA [*Cajanus cajan* (L.) MILLSP.]

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## *ABSTRACT*

***The present investigation was conducted in pigeonpea to study the combining ability of seed yield per plant and its component characters following diallel mating design comprising seven genotypes. Combining ability analysis revealed that both additive as well as non-additive effects were important in the inheritance of all traits studied. However, magnitudes of variances due to general combining ability (GCA) of varieties were smaller than the specific combining ability (SCA) variances for all the traits, indicating the preponderance of non-additive gene effects for all the characters. General combining ability effects revealed that the three parents viz., ICPL-87119, AGT-2 and GT-102 were the good general combiners for seed yield per plant, which also possessed the good general combining ability effects for the yield attributes like pods per plant, seeds per pod and 100-seed weight. Specific combining ability effects revealed that GT-102 x ICPL-87119 (12.10), BSMR-853 x GT-102 (11.81) and AGT 2 x GTR-11 (11.47) were the three best cross combinations expressed significant SCA effects for seed yield per plant involving good x good, poor x good and good x poor parental interaction, respectively. All these three cross combinations also recorded significant SCA effects for branches per plant, pods per plant, pod length and 100 seed weight.***

***KEY WORDS: additive, combining ability, diallel, GCA, gene action, non-additive, pigeonpea, SCA***

## 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

Seven genotypes were crossed in diallel fashion (excluding reciprocals) to obtain twenty one (21) $F_1$ hybrids. The emasculation and pollination was done as per method proposed by Ritchie *et al.* (1975). At the same time, all the seven lines were selfed, so as to get sufficient seeds for the experiment. After pollination, the flowers tagged and labeled properly. The seeds of twenty one (21) $F_1$ crosses and seven parents were collected separately. The experiment consist twenty eight (28) treatments comprising 7 parents and 21 $F_1$'s was laid out in randomized block design with three replications during *Kharif* 2011. The recommended agronomic practices and plant protection measures were adopted for raising a good crop. Observations were recorded on randomly selected five plants for ten quantitative traits viz., days to 50 per cent flowering, days to maturity, plant height (cm), branches per plant, pods per plant, pod length (cm), seeds per pod, 100 seeds weight (g), seed yield per plant (g) and protein content (%). The data were analyzed to compute combining ability analysis following Method-II, Model-I of Griffing (1956).

## RESULTS AND DISCUSSION

In any breeding programme, it is necessary to identify superior genotypes, which are to be used as parents in hybridization. In this context, the concept of combining ability is becoming important in plant breeding. The analysis of variance for combining ability of each character is presented in Table 1). It was observed that mean squares due to GCA as well as SCA were highly significant for all the characters studied, indicated that both additive as well as non-additive types of gene actions were involved in the inheritance of these traits. However, magnitudes of variances due to general combining ability (GCA) of varieties were smaller than the specific combining ability (SCA) variances for all the traits, indicating the preponderance of non-additive gene effects for all the characters.

The summary data of the general combining ability effects (Table 2) of the parents indicated that three parents *viz.*, ICPL-87119, AGT-2 and GT-102 were the good general combiners for seed yield per plant. Among these parents, ICPL 87119 and AGT 2 also found to be good general combiners for branches per plant, pods per plant, pod length, seeds per pod and 100 seed weight, while GT 102 was found good general combiner for branches per plant, pods per plant, pod length, seeds per pod, 100 seed weight and protein content. Therefore, these parents had the ability to produce higher yield and also higher pods per plant, more number of seeds per pod and boldness in the seeds by imparting desirable genes in the progeny on crossing with diverse lines. Narladkar and Khapre (1997), Aghav *et al.* (1998), Chandirakala and Raveendran (1998), Jaymala and Rathnaswamy (2000), Pawar and Tikka (2003), Phad *et al.* (2007), Yadav *et al.* (2008) and Shoba and Balan (2010) also reported the similar results.

Looking to the specific combining ability effects of the hybrids (Table 3), cross combination, GT-102 x ICPL-87119 (12.10) was found to be the best specific cross combination for seed yield per plant. The other best specific combinations with respect to seed yield per plant were BSMR-853 x GT-102 (11.81), AGT 2 x GTR-11 (11.47) and BSMR-853 x ICPL-87119 (11.10). Specific combining ability effects revealed that GT-102 x ICPL-87119, BSMR-853 x GT-102 and AGT 2 x GTR-11 were the three best cross combinations expressed significant SCA effects for seed yield per plant involving good x good, poor x good and good x poor parental interaction, respectively. The three best cross combinations on the basis of significant SCA effects for seed yield per plant, GT-102 x ICPL-87119, BSMR-853 x GT-102 and AGT 2 x GTR-11 recorded good *per se* performance for seed yield per plant, also noted significant SCA effects for branches per plant, pods per plant, pod length and 100 seed weight. Therefore, these three cross combinations may be utilized for heterosis breeding as well as for isolating the promising segregates in advanced generations as these crosses are under the control of additive gene effects which are fixable. Similar results were also reported by Singh and Singh (2009).

## CONCLUSION

The good combing parents viz., ICPL-87119, AGT-2 and GT-102 had the ability to produce higher yield and also higher pods per plant, more number of seeds per pod and boldness in the seeds by imparting desirable genes in the progeny on crossing with diverse lines. The specific cross combinations, GT-102 x ICPL-87119, BSMR-853 x GT-102 and AGT 2 x GTR-11 may be utilized for heterosis breeding as well as for isolating the promising segregates in advanced generations as these crosses are under the control of additive gene effects which are fixable.

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**Table 1: Analysis of variance for combining ability in pigeonpea**

| Sr. No. | Characters | Mean Squares | | | Variances | |
|---|---|---|---|---|---|---|
| | | GCA (6 d.f.) | SCA (21 d.f.) | Error (54 d.f.) | GCA | SCA |
| 1 | Days to 50 per cent flowering | 345.98** | 86.94* | 15.35 | 28.00 | 71.00 |
| 2 | Days to maturity | 404.61** | 63.92** | 26.12 | 37.00 | 37.80 |
| 3 | Plant height(cm) | 803.00** | 243.00** | 30.60 | 62.00 | 212.00 |
| 4 | Branches per plant | 3.80** | 2.20** | 2.23 | 0.17 | 1.96 |
| 5 | Pod per plant | 1070** | 569.7** | 25.13 | 55.00 | 544.00 |
| 6 | Pod length (cm) | 1.50** | 0.61** | 0.06 | 0.10 | 0.55 |
| 7 | Seeds per pod | 0.98** | 0.29** | 0.05 | 0.07 | 0.24 |
| 8 | 100 seed weight (g) | 1.30** | 0.74** | 0.09 | 0.06 | 0.68 |
| 9 | Seed yield per plant (g) | 403.00** | 82.00** | 10.86 | 35.64 | 71.61 |
| 10 | Protein content (%) | 0.90** | 0.67** | 0.11 | 0.02 | 0.55 |

** Significance at 5 % level* *** Significance at 1 % level*

**Table 2: Estimation of general combining ability (GCA) effects of parents for various characters in pigeonpea**

| Parents | Days to 50 Per Cent Flowering | Days to Maturity | Plant Height (cm) | Branches Per Plant | Pods Per Plant | Pod Length (cm) | Seeds Per Pod | 100 Seed Weight (g) | Seed Yield Per Plant (g) | Protein Content (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| BSMR-853 (Vaishali) | -3.18* | -3.44* | -6.86** | -0.63** | -7.93** | -0.13 | 0.10 | 0.01 | -1.47 | 0.21* |
| GT-102 | -3.53** | -2.56 | -0.28 | 0.56** | 7.95** | 0.50** | 0.34** | 0.29** | 3.53** | 0.45** |
| BDN-2 | 5.55** | 4.92** | 8.25** | 0.16 | -1.71 | -0.34** | -0.26** | -0.20** | -2.52* | -0.51** |
| BANAS | -3.58** | -3.79* | -9.57** | -0.50** | -7.38** | -0.30** | -0.23** | -0.40** | -5.84** | -0.23* |
| ICPL-87119 | 8.35** | 10.44** | 12.01** | 0.74** | 13.91** | 0.42** | 0.24** | 0.19** | 8.24** | 0.17 |
| AGT-2 | 4.87** | 3.86* | 7.65** | 0.50** | 10.36** | 0.34** | 0.37** | 0.59** | 7.51** | 0.038 |
| GTR-11 | -8.44** | -9.41** | -11.19** | -0.84** | -15.06** | -0.49** | -0.46** | -0.47** | -9.45** | 0.059 |
| **S.E. (gi) ±** | 1.20 | 1.52 | 1.70 | 0.15 | 1.50 | 0.07 | 0.06 | 0.09 | 1.07 | 0.10 |
| **S.E. (gi-gj) ±** | 1.84 | 2.40 | 2.60 | 0.24 | 2.30 | 0.12 | 0.10 | 0.14 | 1.55 | 0.16 |

***, ** significant at 5 per cent and 1 per cent levels of significance, respectively.***

**Table: 3 Estimation of specific combining ability (SCA) effects of hybrids for various characters in pigeonpea**

| Sr. No. | Cross | Days to 50 Per Cent Flowering | Days to Maturity | Plant Height (cm) | Branches Per Plant | Pods Per Plant | Pod Length (cm) | Seeds Per Pod | 100 Seed Weight (g) | Seed Yield Per Plant (g) | Protein Content (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BSMR-853 x GT-102 | -1.82 | 3.50 | 9.45 | 0.82* | 16.17** | 1.70** | 0.66** | 0.93** | 11.81** | 0.27 |
| 2 | BSMR -853 X BDN-2 | 7.89* | 7.60 | 18.92** | -0.77* | 2.80 | -0.38 | 0.04 | 0.92** | -0.32 | 0.23 |
| 3 | BSMR-853 X BANAS | -18.97** | -13.10** | -28.25** | -0.27 | -13.49** | -0.78** | -0.31 | -1.30** | -8.68** | -0.41 |
| 4 | BSMR-853 X ICPL 87119 | 4.98 | 3.99 | -0.07 | 1.04* | 20.88** | 0.18 | 0.56** | -0.40 | 11.10** | 0.54 |
| 5 | BSMR-853 X AGT-2 | 4.53 | 5.63 | 6.51 | -0.61 | 1.70 | -0.13 | 0.04 | 0.82** | 1.83 | -0.07 |
| 6 | BSMR-853 X GTR-11 | 2.41 | -3.47 | -16.63** | -0.26 | -15.75** | -0.76** | -0.35 | -0.77** | -9.45** | 0.61* |
| 7 | GT-102 X BDN-2 | 5.85 | 7.69 | -3.36 | 0.88* | 29.95** | -0.46 | -0.26 | -0.13 | 8.20** | 0.17 |
| 8 | GT-102 X BANAS | 6.63 | 2.42 | 9.19 | 1.72** | -1.05 | 0.58* | 0.86** | -0.07 | -3.81 | 0.19 |
| 9 | GT-102 X ICPL-87119 | 7.30* | -4.54 | 3.00 | 0.74* | 34.28** | 0.72** | 0.11 | 0.97** | 12.10** | -0.03 |
| 10 | GT-102 X AGT-2 | -9.22** | 7.69 | 17.93** | 1.18** | -17.15** | -1.00** | -0.33 | -0.66* | -5.02* | 1.20** |
| 11 | GT-102 X GTR-11 | -10.77** | -13.35** | -25.21** | -1.40** | -8.60 | -0.35 | -0.23 | -0.10 | -4.82* | -0.54 |
| 12 | BDN-2 X BANAS | 6.26 | 9.36* | 16.36** | 2.29** | 20.28** | 0.73** | 0.61** | 1.40** | 9.38** | 0.80** |
| 13 | BDN-2 X ICPL-87119 | 10.29** | 9.79* | 13.03** | 0.31 | -17.09** | -0.59** | -0.24 | -0.76** | -7.68** | -0.29 |
| 14 | BDN-2 X AGT-2 | 1.74 | -9.66* | -12.60* | -0.24 | 12.54** | 0.28 | 0.30 | -0.19 | 3.80 | -1.50** |
| 15 | BDN-2 X GTR-11 | 0.79 | -0.44 | 1.28 | 0.84* | -13.97** | -0.14 | 0.04 | -0.59* | -1.32 | -0.33 |
| 16 | BANAS X ICPL-87119 | 13.35** | 3.51 | 9.33 | -1.60** | 12.62** | -0.46* | -0.29 | -0.52 | 3.77 | 0.61* |
| 17 | BANAS X AGT-2 | -6.99* | -6.02 | 5.69 | 0.91* | 38.17** | 0.72** | 0.48* | -0.01 | 6.56* | -1.20** |
| 18 | BANAS X GTR-11 | -6.84* | -6.59 | -19.92** | -1.50** | -26.34** | -0.82** | -0.45* | 0.87** | -3.83 | 0.62* |
| 19 | ICPL-87119 X AGT-2 | -9.00* | -6.31 | 6.40 | 0.23 | 21.88** | 0.81** | 0.49* | 1.43** | 5.78 | 0.89** |
| 20 | ICPL-87119 X GTR-11 | 2.21 | 10.04** | 17.38** | 2.90** | 0.69 | 1.10** | 0.90** | 0.31 | 8.47** | -0.69* |
| 21 | AGT-2 X GTR-11 | 0.16 | 5.50 | 7.64 | 1.45** | 7.90 | 0.53* | 0.60** | 0.93** | 11.47** | 1.10** |
| **S.E. (sij)±** | | 3.50 | 4.53 | 4.92 | 0.46 | 4.52 | 0.23 | 0.20 | 0.27 | 2.92 | 0.30 |
| **S.E. (sij-sik)±** | | 5.21 | 6.82 | 7.30 | 0.69 | 6.60 | 0.34 | 0.29 | 0.40 | 4.30 | 0.45 |
| **S.E. (sij-skl)±** | | 4.82 | 6.30 | 6.84 | 0.64 | 6.22 | 0.32 | 0.27 | 0.37 | 4.11 | 0.42 |

***, ** significant at 5 per cent and 1 per cent levels of significance, respectively.***

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