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# COMBINING ABILITY FOR YIELD AND YIELD TRAITS USING 'WA' CYTOPLASM IN RICE (*ORYZA SATIVA* L.)

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## Abstract

Thirty two hybrids developed from crossing two cytoplasmic male sterile lines (IR 79156A and Pusa6A) with 16 restores were studied along with two checks (BPT5204 and Arize 6444) for 15 yield and yield attributing characters. The analysis of variance for combining ability revealed variation for plant height; whereas, contribution of testers was significant in respects of majority of the traits. Among the male parental lines, MTU-7029, IET 22202, Danteswari, BPT 5204 and Akshaya Dhan were found to be best general combiners for grain yield and most of the component characters. The female line Pusa 6B was found to be good general combiner for grain yield and most of the component characters and average general combiner for 1000-grain weight whereas poor general combiner for panicle length and grain weight/panicle. The findings revealed that cross combinations Pusa 6A × Akshaya Dhan, Pusa 6A × HUR 8-1, IR 79156A × Vardhan, Pusa 6A × Type-3 and IR 79156A × IET 22218 exhibited high SCA effects for grain yield/plant and most of the yield component characters. None of the cross combinations showed high SCA effect for all the characters.

## Introduction

The combining ability of the genotypes provide information which helps in the selection of better parents for effective breeding. Its role is important to decide parents, crosses and appropriate breeding procedure to be followed to select desirable segregants (Salgotra *et al.* 2009). Good general combining parent results in higher frequency of heterotic hybrids than poor combining parent. From the genetic point of view, GCA measures additive gene effects and SCA measures non-additive gene effects, depending on genes with dominance (intra-allelic interactions) and epistasis (inter-allelic interactions). In a hybrid breeding programme, plant breeder generally identify parental lines with good GCA, and crosses with high SCA effect. Several workers like, Ramalingam *et al.* (1997), Ganeshan *et al.* (1997) Pradhan *et al*. (2006) and Gopikannan *et al.* (2013) have reported combining ability and gene action on several traits including yield. Therefore, the present investigation was carried out to estimate combining ability effects for yield and its components involving cytoplasmic male sterile lines and restorer lines in rice in the present environment.

## Materials and Methods

Thirty two $F_1$s obtained by line × tester mating along with their 16 pollen parents, 2 maintainer lines of IR79156A and Pusa6A and 2 checks (BPT 5204 and Arize 6444) were grown in single row of 3.0 m with three replications in randomized block design with spacing of 20 × 15 $cm^2$ during *kharif* 2013 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India. All the recommended agronomic practices were followed. Observations were recorded on 15 yield traits *viz*., days to 50% flowering, days to maturity, tillers/ plant, effective tillers/plant, panicle length (cm), spikelets/panicle, grains/panicle, sterile spikelets

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/panicle, pollen fertility (%), spikelet fertility (%), chlorophyll content, grain weight/ panicle (g), 1000 grain weight (g) and grain yield/plant (g). The combining ability analysis was made following the method outlined by Kempthorne (1957).

## Result and Discussion

Analysis of variance for combining ability (Table 1) revealed that the mean squares for grain yield due to females (lines) were significant only for plant height. The variance due to hybrids differed significantly for all the characters. The mean squares due to males (testers) were found significant for most of the traits including grain yield per plant except sterile spikelets/panicle, pollen fertility (%), spikelet fertility (%), grain weight/panicle (g) and 1000 grain weight (g). Combining ability analysis revealed that both GCA and SCA variances were important for inheritance of various traits studied. It further suggests the importance of additive and non-additive types of gene actions. The SCA variances were higher than the gca variances for all the characters. Predominance of non-additive gene action for grain yield and its components was also reported by Satyanarayanan *et al.* (2000), Singh *et al.* (2005), Venkatesan *et al.* (2007) and Saidaiah *et al.* (2010). An overall appraisal of GCA effects (Table 2) revealed that among female parental lines, Pusa 6B having 'Wild Abortive' type of cytoplasm was observed as a good general combiner for grain yield per plant, grain per panicle and number of spikelet per panicle, plant height, tillers/ plant and effective tillers/ plant, whereas, IR 79156B as good general combiner for days to maturity, panicle length (cm), grain yield per plant. Similar results were also reported by Yadav *et al.* (1999), Lavanya (2000) and Narasimman *et al.* (2007), Sahu *et al.* (2013), Patil *et al.* (2014). The data fairly showed that none of the parents was good general combiner for all the characters. However, it was noted that top two males (testers), MTU-7029 and IET 22202 proved to be the

**Table 1. Analysis of variance (mean squares) for combining ability for different characters in rice.**

| Source of variations | df | Days to 50% flowering | Days to maturity | Plant height(cm) | Tillers/ plant | Effective tillers/ Plant | Panicle length (cm) | Spikelets/ panicle |
|---|---|---|---|---|---|---|---|---|
| Replicates | 2.00 | 73.72** | 95.70** | 57.64** | 5.51* | 9.42** | 4.43* | 147.64* |
| Crosses | 31.00 | 182.38** | 173.56** | 580.77** | 27.41** | 24.19** | 31.82** | 6252.58** |
| Line effect | 1.00 | 12.04 | 84.38 | 1220.58* | 13.85 | 19.37 | 16.01 | 1568.17 |
| Tester effect | 15.00 | 342.12** | 324.42** | 1005.59** | 49.03** | 41.97** | 45.82* | 9925.50* |
| Line × tester eff. | 15.00 | 34.00** | 28.64** | 113.30** | 6.70** | 6.72** | 18.87** | 2891.94** |
| Error | 62.00 | 5.73 | 6.34 | 5.95 | 1.06 | 0.81 | 0.77 | 28.50 |
| Total | 95.00 | 64.81 | 62.79 | 194.61 | 9.75 | 8.62 | 10.98 | 2062.02 |

**Table contd. (right side).**

| Grains/ panicle | Sterile spikelets/ panicle | Pollen fertility (%) | Spikelet fertility (%) | Chlorophyll content | Grain weight/ Panicle (g) | 1000 - grain weight | Grain yield/ plant (g) |
|---|---|---|---|---|---|---|---|
| 78.78 | 82.20* | 6.19 | 5.13 | 8.34* | 0.01 | 2.33 | 1.51 |
| 5068.07** | 222.60** | 30.19** | 31.52** | 14.86** | 2.73** | 45.45** | 180.49** |
| 1855.04 | 8.17 | 11.23 | 22.76 | 1.64 | 0.23 | 9.72 | 58.72 |
| 7902.93* | 256.06 | 21.33 | 23.89 | 22.35* | 3.90 | 53.94 | 300.66* |
| 2447.42** | 203.43** | 40.31** | 39.74** | 8.26** | 1.74** | 39.34** | 68.45** |
| 49.87 | 25.66 | 3.33 | 4.84 | 2.20 | 0.05 | 1.29 | 2.24 |
| 1688.00 | 91.11 | 12.16 | 13.55 | 6.46 | 0.92 | 15.72 | 60.39 |

*Significant at 5% level and **significant at 1% level.

**Table 2. GCA effects of parents (males and females) for yield and yield associated traits in rice.**

| Sl. No. | Parents | Days to 50% flowering | Days to maturity | Plant height (cm) | Tillers/ plant | Effective tillers/plant | Panicle length (cm) | Spikelets/ panicle |
|---|---|---|---|---|---|---|---|---|
| 1. | IR 79156B | –0.35 | –0.94* | 3.57** | –0.38* | –0.45** | 0.41** | –4.04** |
| 2. | Pusa 6B | 0.35 | 0.94* | –3.57** | 0.38* | 0.45** | –0.41** | 4.04** |
| | S.E. | 0.42 | 0.45 | 0.40 | 0.16 | 0.15 | 0.15 | 0.80 |
| 1. | IET 21519 | –11.88** | –11.10** | –12.52** | –2.30** | –1.90** | –3.44** | –26.79** |
| 2. | IET 22218 | –0.88 | –1.10 | –3.88** | 0.69 | 0.98* | –0.39 | –2.46 |
| 3. | IET 22228 | –5.38** | –5.60** | –1.53 | –2.20** | –1.93** | –0.94* | –60.63** |
| 4. | IET 22202 | 6.79** | 6.23** | 17.57** | –1.27** | –1.59** | 1.71** | 15.04** |
| 5. | IET 20524 | –1.88 | –1.27 | 8.91** | –4.70** | –4.46** | 1.60** | –18.13** |
| 6. | IET 21542 | 6.63** | 6.40** | –6.50** | –3.37** | –2.90** | –2.40** | 36.38** |
| 7. | Vardhan | –2.38* | –3.27* | –0.46 | –2.17** | –1.28** | 3.36** | 27.88** |
| 8. | Akshaya Dhan | 1.96 | 1.23 | 6.57** | 1.45** | 0.76 | 5.00** | –14.29** |
| 9. | Rajendra Kasturi | –1.71 | 0.23 | 21.69** | 3.07** | 2.88** | –1.95** | 107.88** |
| 10. | Sarjoo- 52 | –6.54** | –6.77** | –9.55** | –2.68** | –2.98** | 0.28 | –46.63** |
| 11. | HUR-8-1 | 0.46 | 1.73 | 0.13 | 0.08 | –0.19 | 0.43 | 4.04 |
| 12. | BPT 5204 | 9.29** | 9.56** | –9.61** | 4.30** | 3.81** | –2.70** | 19.54** |
| 13. | RPBIO-226 | 12.13** | 11.06** | –10.55** | 4.05** | 3.78** | –2.55** | –1.29 |
| 14. | Type-3 | 5.29** | 5.06** | 26.45** | –0.91* | –0.82 | 5.06** | –45.63** |
| 15. | MTU-7029 | 4.13** | 3.73** | –8.63** | 3.15** | 3.04** | 0.20 | 27.54** |
| 16. | Danteswari | –16.04** | –16.10** | –18.08** | 2.80** | 2.78** | –3.25** | –22.46** |
| | S.E | 1.17 | 1.27 | 1.13 | 0.46 | 0.43 | 0.40 | 2.26 |

**Table contd. (right side)**

| Grains/ panicle | Sterile spikelets/ panicle | Pollen fertility (%) | Spikelet fertility (%) | Chlorophyll content | Grain weight/ panicle (g) | 1000 grain weight | Grain yield/ plant (g) |
|---|---|---|---|---|---|---|---|
| –4.40** | 0.29 | –0.34 | –0.49 | 0.13 | 0.05 | –0.32 | –0.78** |
| 4.40** | –0.29 | 0.34 | 0.49 | –0.13 | –0.05 | 0.32 | 0.78** |
| 0.94 | 0.73 | 0.27 | 0.33 | 0.22 | 0.04 | 0.17 | 0.24 |
| –22.90** | –3.96 | –0.40 | –0.43 | 1.77** | –0.64** | 0.98* | –10.50** |
| 1.27 | –3.79 | 1.32 | 1.68 | –0.98 | –0.33** | 0.92 | –5.05** |
| –52.90** | –7.79** | –1.22 | –1.24 | 2.81** | 0.57** | 3.80** | –8.10** |
| 12.10** | 2.88 | 0.39 | 0.26 | 3.77** | 1.20** | 3.48** | 8.24** |
| –22.73** | 4.54* | –3.12** | –3.45** | 2.51** | 0.16 | –2.03** | –11.12** |
| 28.60** | 8.71** | –0.09 | –0.24 | 1.17 | 1.39** | –0.39 | 1.02 |
| 32.10** | –4.29* | 3.35** | 3.38** | –1.73** | 0.26** | 0.69 | 0.88 |
| –11.56** | –2.79 | –0.17 | 0.02 | –1.56* | 0.62** | 1.32** | 6.08** |
| 98.44** | 9.38** | 3.52** | 3.22** | 0.79 | –0.89** | –6.59** | 3.03** |
| –38.06** | –8.63** | –0.07 | 0.34 | –0.63 | –1.14** | 1.75** | –6.12** |
| –0.23 | 4.21* | –0.87 | –1.21 | –1.53* | 0.30** | –0.77 | –2.75** |
| 6.27* | 13.21** | –3.66** | –3.79** | –1.78** | –0.02 | –3.24** | 7.23** |
| 1.10 | –2.46 | 0.53 | 1.17 | –1.86** | –0.55** | –5.58** | 2.78** |
| –38.56** | –7.13** | –0.19 | –0.74 | –2.28** | –1.42** | 2.61*** | –4.59** |
| 26.94** | 0.54 | 1.27 | 1.73 | 0.56 | 0.70** | 1.57** | 11.05** |
| –19.90** | –2.63 | –0.60 | –0.69 | –1.07 | –0.23* | 1.45** | 7.92** |
| 2.66 | 2.06 | 0.74 | 0.90 | 0.62 | 0.10 | 0.47 | 0.67 |

*Significant at 5% level and **significant at 1% level.

**Table 3. Estimates of specific combining ability (SCA) effects of 32 hybrids for yield and yield associated traits in rice.**

| Sl. No. | Crosses | Days to 50% flowering | Days to maturity | Plant height (cm) | Tillers/ Plant | Effective tillers/ plant | Panicle length (cm) |
|---|---|---|---|---|---|---|---|
| 1. | IR 79156A × IET 21519 | 2.35 | 2.27 | 2.16 | 0.95 | 1.15 | –3.36** |
| 2. | IR 79156A × IET 22218 | –2.31 | –1.40 | 3.65* | –0.14 | 0.51 | 1.12 |
| 3. | IR 79156A × IET 22228 | 3.85* | 2.77 | 2.57 | –1.81** | –1.96** | 0.94 |
| 4. | IR 79156A × IET 22202 | –0.31 | –0.06 | –1.00 | –0.97 | –0.85 | –0.01 |
| 5. | IR 79156A × IET 20524 | –2.98 | –3.23 | –2.66 | 0.78 | –0.12 | 1.64** |
| 6. | IR 79156A × IET 21542 | 1.52 | 1.10 | 0.90 | 1.40* | 1.21* | 3.58** |
| 7. | IR 79156A × Vardhan | 2.19 | 0.44 | 4.60** | –1.30* | –1.12 | 0.44 |
| 8. | IR 79156A × Akshaya Dhan | 4.52** | 4.60* | –0.43 | –0.29 | –0.72 | –0.26 |
| 9. | IR 79156A × Rajendra Kasturi | –2.15 | –2.40 | –2.25 | 0.47 | 0.01 | 2.06** |
| 10. | IR 79156A × Sarjoo- 52 | –3.31* | –2.06 | –7.65** | –1.20 | –1.43* | –1.87** |
| 11. | IR 79156A × HUR-8-1 | –0.31 | 1.10 | 9.51** | –1.53* | –1.02 | 0.61 |
| 12. | IR 79156A × BPT 5204 | –0.81 | 0.27 | 2.51 | 0.40 | 0.87 | –0.19 |
| 13. | IR 79156A × RPBIO-226 | –0.65 | -2.56 | 0.32 | 0.45 | 0.53 | –1.41* |
| 14. | IR 79156A × Type-3 | 1.19 | 0.77 | –7.52** | 1.35* | 1.51* | –0.39 |
| 15. | IR 79156A × MTU-7029 | –1.98 | –2.23 | –1.90 | 0.49 | 0.67 | –0.13 |
| 16. | IR 79156A × Danteswari | –0.81 | 0.60 | –2.82 | 0.95 | 0.74 | –2.77** |
| 17. | Pusa 6A × IET 21519 | –2.35 | –2.27 | –2.16 | –0.95 | -1.15 | 3.36** |
| 18. | Pusa 6A × IET 22218 | 2.31 | 1.40 | –3.65* | 0.14 | -0.51 | –1.12 |
| 19. | Pusa 6A × IET 22228 | –3.85* | –2.77 | -2.57 | 1.81** | 1.96** | –0.94 |
| 20. | Pusa 6A × IET 22202 | 0.31 | 0.06 | 1.00 | 0.97 | 0.85 | 0.01 |
| 21. | Pusa 6A × IET 20524 | 2.98 | 3.23 | 2.66 | –0.78 | 0.12 | –1.64** |
| 22. | Pusa 6A × IET 21542 | –1.52 | –1.10 | –0.90 | –1.40* | –1.21* | –3.58** |
| 23. | Pusa 6A × Vardhan | –2.19 | –0.44 | –4.60** | 1.30* | 1.12 | –0.44 |
| 24. | Pusa 6A × Akshaya Dhan | –4.52** | –4.60* | 0.43 | 0.29 | 0.72 | 0.26 |
| 25. | Pusa 6A × Rajendra Kasturi | 2.15 | 2.40 | 2.25 | 0.47 | –0.01 | –2.06** |
| 26. | Pusa 6A × Sarjoo- 52 | 3.31* | 2.06 | 7.65** | 1.20 | 1.43* | 1.87** |
| 27. | Pusa 6A × HUR-8-1 | 0.31 | –1.10 | –9.51** | 1.53* | 1.02 | –0.61 |
| 28. | Pusa 6A × BPT 5204 | 0.81 | –0.27 | –2.51 | –0.40 | –0.87 | 0.19 |
| 29. | Pusa 6A × RPBIO-226 | 0.65 | 2.56 | –0.32 | –0.45 | –0.53 | 1.41* |
| 30. | Pusa 6A × Type-3 | –1.19 | –0.77 | 7.52** | –1.35* | –1.51* | 0.39 |
| 31. | Pusa 6A × MTU-7029 | 1.98 | 2.23 | 1.90 | –0.49 | –0.67 | 0.13 |
| 32. | Pusa 6A × Danteswari | 0.81 | –0.60 | 2.82 | –0.95 | –0.74 | 2.77** |
| | S.E. | 1.65 | 1.80 | 1.60 | 0.64 | 0.60 | 0.57 |

**Table contd. (right side)**

| Spikelets/ panicle | Grains/ panicle | Sterile spikelets/ Panicle | Pollen fertility (%) | Spikelet fertility (%) | Chloro-phyll content | Grain weight/ panicle (g) | 1000 grain weight | Grain yield/ plant (g) |
|---|---|---|---|---|---|---|---|---|
| 14.38** | 23.06** | –8.63** | 5.25** | 5.68** | –0.80 | 0.08 | –2.22** | 3.23** |
| 11.71** | 15.90** | –4.13 | 2.66* | 2.76* | –0.45 | 0.96** | 3.55** | 3.78** |
| –10.79** | –1.94 | –8.79** | 4.24** | 3.95** | 1.00 | –0.57** | 2.76** | –0.82 |
| –20.79** | –13.60** | –7.13* | 1.71 | 1.51 | –0.60 | –0.42** | 2.02** | –0.34 |
| 32.38** | 25.90** | 6.54* | 0.37 | 0.10 | 0.97 | 0.93** | 1.33* | 2.50** |
| –10.13** | –6.77 | –4.29 | 0.53 | 0.66 | –0.13 | –0.37** | –2.68** | –3.13** |
| 49.04** | 42.73** | 6.38* | –0.23 | –0.20 | –1.86* | 0.86** | –1.92** | 4.92** |
| –22.79** | –23.27** | 0.54 | –2.81** | –2.19 | –1.70 | –0.54** | –4.29** | –6.14** |
| –14.29** | –9.94* | –4.29 | 1.15 | 0.88 | –0.28 | –0.41** | 1.37* | 1.69 |
| –13.79** | –12.10** | –1.63 | –0.86 | –0.54 | 0.30 | –0.70** | –3.89** | 2.74** |
| 34.54** | 27.73** | 6.88* | 0.05 | –0.12 | –1.30 | 0.33* | 2.28** | –5.93** |
| –7.29* | –8.44* | 1.21 | –1.31 | –1.14 | 0.49 | 0.14 | 1.67* | –0.03 |
| –0.79 | –6.94 | 6.21* | –2.79** | –2.79* | 1.74* | 0.15 | 2.26** | –1.42 |
| –19.46** | –19.60** | 0.21 | –1.99 | –2.31 | 2.45** | –0.15 | 1.30 | –3.94** |
| –9.96** | –18.44** | 8.54** | –4.30** | –3.92** | 0.12 | –0.07 | –1.72* | 0.98 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| –11.96** | –14.27** | 2.38 | –1.67 | –2.33 | 0.04 | –0.22 | –1.81** | 1.91* |
| –14.38** | –23.06** | 8.63** | –5.25** | –5.68** | 0.80 | –0.08 | 2.22** | –3.23** |
| –11.71** | –15.90** | 4.13 | –2.66* | –2.76 | 0.45 | –0.96** | –3.55** | –3.78** |
| 10.79** | 1.94 | 8.79** | –4.24** | –3.95** | –1.00 | 0.57** | –2.76** | 0.82 |
| 20.79** | 13.60** | 7.13* | –1.71 | –1.51 | 0.60 | 0.42** | –2.02** | 0.34 |
| –32.38** | –25.90** | –6.54* | –0.37 | –0.10 | –0.97 | –0.93** | –1.33* | –2.50** |
| 10.13** | 6.77 | 4.29 | –0.53 | –0.66 | 0.13 | 0.37** | 2.68** | 3.13** |
| –49.04** | –42.73** | –6.38* | 0.23 | 0.20 | 1.86** | –0.86** | 1.92** | –4.92** |
| 22.79** | 23.27** | –0.54 | 2.81** | 2.19 | 1.70 | 0.54** | 4.29** | 6.14** |
| 14.29** | 9.94* | 4.29 | –1.15 | –0.88 | 0.28 | 0.41** | –1.37* | –1.69 |
| 13.79** | 12.10** | 1.63 | 0.86 | 0.54 | –0.30 | 0.70** | 3.89** | –2.74** |
| –34.54** | –27.73** | –6.88* | –0.05 | 0.12 | 1.30 | –0.33* | –2.28** | 5.93** |
| 7.29* | 8.44* | –1.21 | 1.31 | 1.14 | –0.49 | –0.14 | –1.67* | 0.03 |
| 0.79 | 6.94 | –6.21* | 2.79** | 2.79* | –1.74* | –0.15 | –2.26** | 1.42 |
| 19.46** | 19.60** | –0.21 | 1.99 | 2.31 | –2.45** | 0.15 | –1.30 | 3.94** |
| 9.96** | 18.44** | –8.54** | 4.30** | 3.92** | –0.12 | 0.07 | 1.72* | –0.98 |
| 11.96** | 14.27** | –2.38 | 1.67 | 2.33 | –0.04 | 0.22 | 1.81** | –1.91* |
| 3.20 | 3.76 | 2.92 | 1.05 | 1.30 | 0.87 | 0.13 | 0.67 | 0.94 |

*Significant at 5% level and **significant at 1% level.

best general combiners for grain yield/plant, 1000-grain weight, grain weight/ panicle, chlorophyll content, grains/panicle, tillers/plant, effective tillers/ plant, panicle length (cm), spikelets/panicle and plant height and poor performance in days to 50% flowering and days to maturity. Whereas Danteswari was best general combiner for grain yield/plant, 1000-grain weight, tillers/ plant, effective tillers/plant, days to 50% flowering, days to maturity, and plant height, BPT 5204 for grain yield/plant, 1000-grain weight, grains/panicle, tillers/plant, effective tillers/plant, spikelets/ panicle and plant height, Akshaya Dhan for grain yield/plant, 1000-grain weight, grain weight/ panicle, tillers/plant and panicle length. These findings are in agreement with those reported by Yadav *et al.* (1999), Shunmugavalli *et al.* (1999) and Bhadru *et al.* (2013), Sahu *et al.* (2013), Patil *et al.* (2014). In general, it was observed (Table 2) that among female Pusa 6B and among males MTU-7029, IET 22202, Danteswari, BPT 5204 and Akshaya Dhan were good general combiner for yield and most of the yield contributing characters. Therefore, these parents may be extensively used in future hybrid rice breeding programme.

High SCA effect results (Table 3) mostly from dominance and interaction effects existed between the parents used in hybridization. In the present study positive significant high SCA effects for grain yield per plant exhibited by best 5 crosses *viz.*, Pusa 6A ×Akshaya Dhan, Pusa 6A × HUR 8-1, IR 79156A × Vardhan, Pusa 6A × Type-3 and IR 79156A × IET 22218 indicated the preponderance of non-additive gene action involving good × good and good × poor and poor × poor combining parents. Shivani *et al*. (2009) and Saidaiah *et al.* (2010) also reported about interaction between positive and positive alleles in crosses involving high × high combiners which can be fixed in subsequent generations, if no repulsion phase linkages are involved. The desirable performance of combinations like high × low may be ascribed to the interaction between dominant alleles from good combiners and recessive alleles from poor combiners (Dubey 1975). Involvement of both poor combiners also produced superior specific combining hybrids has been attributed to over dominance and epistasis interaction which has been suggested by Singh *et al*. (2005) and Dalvi and Patel (2009). The desirable SCA effect of Pusa 6A × Akshaya Dhan for grain yield/plant was accompanied by desirable SCA effects for 1000 grain weight, pollen fertility, grains/panicle, spikelets/panicle, days to 50% flowering and days to maturity. Desirable SCA effect of Pusa 6A × HUR 8-1 for grain yield/plant was found to be related with tillers/plant, plant height sterile spikelets/panicle. Desirable SCA effect of IR 79156A × Vardhan 1 for grain yield

/plant was found to be related with grains/panicle, grain weight and spikelets/panicle. Similar pattern of association between SCA effects for grain yield/plant with other yield attributing traits were reported by Singh (2002), Kumar *et al.* (2007) and Thakare *et al.* (2011), Sahu *et al.* (2013), Patil *et al.* (2014). From the present study it is reflected that parental lines among females, Pusa6A; among males, MTU-7029, IET 22202 and combinations, Pusa 6A ×Akshaya Dhan, Pusa 6A × HUR 8-1, IR 79156A ×Vardhan, Pusa 6A × Type-3 and IR 79156A × IET 22218 could be exploited in future rice breeding programme.

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