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Research Article

COMBINING ABILITY ANALYSIS FOR GREEN FRUIT YIELD AND ITS COMPONENT TRAITS IN CHILLI (*CAPSICUM ANNUM* L.)

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ABSTRACT

Objectives: Chilli is classified under self-pollinated crops; natural cross pollination takes place up to the extent of 7–60%. The present study of combining ability analysis was conducted for identifying the superior parents for obtaining superior hybrid combinations in Chilli using male sterile lines.

Methods: This study was conducted at of Main Vegetable Research Station, Anand Agricultural University, Anand (Gujarat) during *Kharif-Rabi* 2011-2012 season with the objective of getting information on combining ability and nature of gene action for fruit yield and its component characters in chilli.

Results: Parents *viz.,* ACMS-4, 9907-9611 (B line), LCA 206, ACG 12, and RHRC PENDT were good general combiner for green fruit yield per plant and its related attributes.

Conclusion: The estimates of specific combining ability effect indicated that cross combinations ACMS-4 × 9955-15R, CCA-4759 × LCA 206, and ACMS-8 × RHRC PENDT were significant for green fruit yield per plant and its important component characters and, therefore, these can be further exploited for selection of hybrids and transgressive segregants.

Keywords: Combining ability, Crosses, Parents, Hybrids, Gene action.

INTRODUCTION

Chilli is classified under self-pollinated crops; natural cross pollination takes place up to the extent of 7–60% [1]. Patel *et al.* [2] reported that with natural outcrossing the average fruit set with male sterile plants varied from 30.22 to 35.99% and on an average it was 32.79%, which was about 118.60% higher than percent fruit set on continuous glucose monitoring systems (GMS) lines with hand pollination (14.44%). Therefore, a greater amount of variability is observed in this crop.

Combining ability analysis is used in crop plants for identifying the superior parents for obtaining superior hybrid combinations. Besides, it also helps in the characterization of nature and magnitude of gene action for various characters of economic importance. The concept of general and specific combining ability (SCA) is an especially useful testing procedure that involves the study and comparison the performance of homozygous inbred lines in cross combinations. The knowledge of gene action for characters helps in employing a suitable breeding methodology for their improvement.

METHODS

The present study was conducted at of Main Vegetable Research Station, Anand Agricultural University, Anand (Gujarat) during *Kharif-Rabi* 2011–2012 season with the objective of getting information on combining ability and nature of gene action for fruit yield and its component characters in chilli. Five females having two continuous GMS and three GMS viz., (9907-9611 [B line], PBC-483 [B line], ACMS-4, ACMS-6, ACMS-8) and 8 males *viz.,* (PBC 142, ACG 12, 9955-15R, LCA 206, LCA 436, RHRC PENDT, JCA 283, G 4) were crossed in line × tester fashion. The experimental materials with 40 F_1s and 13 parents (5 maintainer lines + 8 testers) were planted in RBD with three replications. Each experimental unit was represented by single row accommodating 15 plants with intra- and inter-row spacing 60 cm. However, an experimental unit of GMS lines was planted with two seedlings at every dibble and sterile plants were removed immediately after emergence of crown flower.

For recording observations, five competitive plants were randomly selected from each treatment in each replication and the average value per plant was computed for various quantitative traits *viz.,* days to flower initiation, plant height, primary branches per plant, secondary branches per plant, fruits per plant, fruit length, fruit girth, fruit weight, pericarp thickness, and green fruit yield per plant. Analysis of variance and estimation of combining ability effects were made as per Kempthorne (1957) [3].

RESULTS

Analysis of variance for combining ability (Table 1) revealed that the giant cell arteritis (GCA) variances and SCA variances were highly significant for all the characters except pericarp thickness. This indicates that sufficient variability exists for GCA effect in the parents and that for the SCA effect in the crosses. This also suggests that both additive and nonadditive gene actions were important for the inheritance of all the traits and all the traits used in the study could be improved by proper choice of the parents, their hybridization and by adopting suitable selection methods. The higher magnitude of SCA variance was observed for all the characters. High SCA variance for yield and other characters have also been reported in chilli by Patel [4], Reddy *et al.* [5] and Karthik *et al.* [6]. The variance ratio for general combining ability to specific combining ability indicating the role of both additive and nonadditive gene action in the inheritance of characters used in present study. This suggested that improvement of these traits could be possible by the simultaneous exploitation of both additive and nonadditive components.

The information regarding GCA effect (Table 2) of the parents is of prime importance as this would help in identification of suitable parents. The estimates of GCA effect revealed that the female parent ACMS-4 was found good general combiner for green fruit yield per plant as well

Table 1: Analysis of variance for combining ability for different characters

Sources	Day to flower initiation	Plant height	Primary branches per plant	Secondary branches per plant	Fruits per plant	Fruit length	Fruit girth	Fruit weight	Pericarp thickness	Green fruit yield per plant
GCA variance	8.31**	12.22**	0.006**	0.03**	90.18**	0.13**	0.03**	−0.01**	0.0003	1176.46**
SCA variance	13.92**	24.86**	0.03**	0.18**	300.27**	0.36**	0.06**	0.90**	0.0004	117886.30**
Error	4.41	22.79	0.06	0.09	87.14	0.30	0.02	0.34	0.03	2084.30
Variance Ratio (GCA/SCA)	0.6	0.5	0.2	0.17	0.30	0.36	0.5	−0.01	0.75	0.009

*, ** Significant at 5 and 1 per cent levels

Table 2: General combining ability effect of parents for different characters

Parents	Day to flower initiation	Plant height	Primary branches per plant	Secondary branches per plant	Fruits per plant	Fruit length	Fruit girth	Fruit weight	Pericarp thickness	Green fruit yield per plant
Female parents										
9907-9611 (B line)	−4.27**	1.33	0.05	0.18**	2.11	−0.03	0.04*	0.43**	0.04	42.47**
PBC-483 (B line)	−4.27**	−7.22**	−0.01	−0.18**	−17.44**	−0.78**	−0.10**	−0.09	0.01	−78.30**
ACMS 4	3.82**	1.39	0.00	−0.21**	11.67**	0.59**	0.14**	0.23*	0.03	75.14**
ACMS 6	4.36**	4.25**	0.07	0.15**	4.85**	0.09	−0.10**	−0.39**	−0.08*	−16.41*
ACMS 8	0.36	0.26	−0.11**	0.06*	−1.20	0.13	0.01	−0.19*	0.00	−22.91**
SE (gi) female	0.33	0.76	0.04	0.05	1.48	0.09	0.02	0.09	0.03	7.24
Male parents										
PBC 142	−0.71*	−2.80**	0.00	−0.09	6.98**	0.22*	−0.07*	−0.42**	−0.04	−14.15
ACG 12	−2.17**	3.32**	0.10*	−0.17**	−3.21	0.59**	0.19**	0.61**	0.06	42.63**
9955–15R	4.42**	−5.02**	−0.09*	−0.17**	−9.91**	0.29**	0.49**	0.17	0.07	−6.48
LCA 206	−2.78**	7.66**	0.00	0.22**	24.61**	−0.21*	−0.06*	0.03	−0.03	107.67**
LCA 436	2.03**	−3.95**	0.00	−0.45**	−13.81**	−0.07	0.01	−0.48**	−0.02	−98.38**
RHRC PENDT	2.16**	−0.15	0.15**	0.30**	8.25**	0.08	−0.09**	0.34**	0.01	67.83**
JCA 283	−3.04**	−0.84	0.08*	0.39**	−11.09**	−0.02	−0.26**	0.34**	−0.04	−26.87**
G 4	0.09	1.78	−0.24**	−0.04	−1.84	−0.89**	−0.21**	−0.58**	0.00	−72.25**
SE (gj) male	0.44	1.00	0.05	0.06	1.96	0.11	0.03	0.12	0.04	9.58

*,**Significant at 5 and 1% levels of significance, respectively

Table 3: Specific combining ability effect of crosses for different characters

Hybrids	Day to flower initiation	Plant height	Primary branches per plant	Secondary branches per plant	Fruits per plant	Fruit length	Fruit girth	Fruit weight	Pericarp thickness	Green fruit yield per plant
CCA-4759 X PBC 142	0.67	−6.67**	−0.08	−0.07	−0.23	−0.33	−0.01	−0.34	0.01	−31.38
CCA-4759 X ACG 12	−1.87*	−1.18	0.30**	0.34**	−13.55**	0.00	−0.19**	0.37	−0.12	−34.67
CCA-4759 X 9955-15R	−3.13**	−5.01*	0.02	0.41**	−4.10	−0.22	0.92**	−1.28**	−0.02	−141.13**
CCA-4759 X LCA 206	−0.93	9.08**	−0.01	0.16	41.43**	0.57*	−0.08	−0.21	0.03	151.70**
CCA-4759 X LCA 436	3.93**	−11.58**	−0.21*	−0.71**	0.47	−0.02	−0.31**	0.22	0.01	15.32
CCA-4759 X RHRC PENDT	1.13	8.29**	0.18	0.21	11.91**	0.13	−0.18**	0.62*	0.18*	128.82**
CCA-4759 X JCA 283	1.33	0.81	−0.16	−0.02	−16.50**	0.46*	−0.08	0.59*	0.00	−28.56
CCA-4759 X G-4	−1.13	6.25**	−0.04	−0.32**	−19.45**	−0.59*	−0.08	0.02	−0.10	−60.10**
CCA-4758 X PBC 142	1.33	1.98	−0.02	0.16	−5.76	−0.57*	0.06	0.08	0.01	−3.08
CCA-4758 X ACG 12	1.13	−0.33	−0.05	−0.76**	4.34	0.06	−0.02	−0.68**	−0.16*	−46.03*
CCA-4758 X 9955-15R	−6.13**	6.74**	0.27**	0.10	14.37**	0.00	−0.31**	0.13	0.11	47.94*
CCA-4758 X LCA 206	2.73**	−1.21	−0.09	0.12	−26.64**	−0.30	−0.08	−0.13	0.05	−122.76**
CCA-4758 X LCA 436	−4.40**	−2.03	−0.09	−0.22	14.61**	−0.17	0.07	0.23	−0.01	81.42**
CCA-4758 X RHRC PENDT	4.13**	0.43	−0.03	0.10	−13.28**	0.04	0.07	−0.08	−0.04	−65.87**
CCA-4758 X JCA 283	3.67**	−0.47	0.10	0.94**	12.89**	0.56*	0.10	−0.49*	0.10	21.59
CCA-4758 X G-4	−2.47**	−5.10*	−0.11	−0.43**	−0.53	0.38	0.10	0.93**	−0.05	86.78**
ACMS 4 X PBC 142	−4.42**	4.80*	0.37**	0.11	5.71	−0.74**	0.00	0.47	−0.04	65.68**
ACMS 4 X ACG 12	1.72*	6.46**	−0.25*	0.06	−0.02	0.57*	−0.09	0.79**	0.10	78.66**
ACMS 4 X 9955-15	3.12**	−7.80**	0.00	−0.01	15.01**	1.23**	0.18**	2.82**	0.01	345.99**
ACMS 4 X LCA 206	−3.02**	−0.92	−0.23*	−0.39**	−4.17	−0.36	0.00	0.90**	0.09	80.28**
ACMS 4 X LCA 436	6.85**	5.39**	−0.03	0.87**	−4.26	−0.35	0.09	−0.48	−0.04	−72.01**
ACMS 4 X RHRC PENDT	−2.95**	−4.41*	0.23*	−0.21	−16.48**	−0.94**	0.11	−1.88**	−0.08	−257.49**
ACMS 4 X JCA 283	−5.42**	−3.42	−0.11	−0.63**	1.53	0.04	−0.13*	−1.91**	−0.05	−173.72**
ACMS 4 X G-4	4.12**	−0.11	0.01	0.19	2.69	0.56*	−0.17**	−0.71**	−0.01	−67.40**
ACMS 6 X PBC 142	−1.96*	0.85	−0.03	−0.64**	4.70	−0.27	0.13**	0.38	−0.03	43.64*
ACMS 6 X ACG 12	2.51**	−1.27	0.35**	0.44**	−9.78**	−0.40	0.19**	−0.66**	−0.03	−98.03**
ACMS 6 X 9955-15R	5.91**	4.57*	−0.27**	−0.30*	−13.42**	−0.04	−0.55**	−0.78**	0.02	−127.05**
ACMS 6 X LCA 206	−0.56	0.89	0.24*	−0.08	29.94**	0.24	0.12*	0.26	−0.03	117.66**
ACMS 6 X LCA 436	−2.69**	6.83**	0.04	0.32**	−6.93	−0.18	−0.02	−0.5	−0.01	−54.42**
ACMS 6 X RHRC PENDT	1.17	−5.5**	−0.31**	0.30*	−5.45	0.67**	−0.05	0.87**	−0.05	57.49**
ACMS 6 X JCA 283	−3.96**	−1.41	−0.04	−0.39**	3.52	0.00	0.03	0.73**	0.08	90.74**

(Contd...)

Table 3: ***(Continued)***

Hybrids	Day to flower initiation	Plant height	Primary branches per plant	Secondary branches per plant	Fruits per plant	Fruit length	Fruit girth	Fruit weight	Pericarp thickness	Green fruit yield per plant
ACMS 6 X G-4	−0.42	−4.97*	0.01	0.37**	−2.57	−0.02	0.15*	−0.3	0.05	−30.03
ACMS 8 X PBC 142	4.38**	−0.96	−0.25*	0.45**	−4.42	1.90**	−0.19**	−0.59*	0.05	−74.86**
ACMS 8 X ACG 12	−3.49**	−3.68	−0.35**	−0.07	19.01**	−0.24	0.11	0.17	0.21**	100.08**
ACMS 8 X 9955-15R	0.24	1.5	−0.03	−0.21	−11.87**	−0.97**	−0.24**	−0.89**	−0.12	−125.75**
ACMS 8 X LCA 206	1.78*	−7.85**	0.08	0.21	−40.55**	−0.14	0.04	−0.81**	−0.14*	−226.88**
ACMS 8 X LCA 436	−3.69**	1.39	0.28**	−0.26*	−3.89	0.73**	0.17**	0.53*	0.05	29.69
ACMS 8 X RHRC PENDT	−3.49**	1.19	−0.07	−0.41**	23.30**	0.10	0.05	0.46	−0.02	137.04**
ACMS 8 X JCA 283	4.38**	4.48*	0.20*	0.10	−1.44	−1.05**	0.07	1.07**	−0.13*	89.95**
ACMS 8 X G-4	−0.09	3.92*	0.12	0.19	19.86**	−0.33	0.00	0.05	0.10	70.75**
Range minimum	−6.13	−11.58	−0.35	−0.76	−40.55	−1.05	−0.55	−1.91	−0.16	−257.49
Maximum	6.85	9.08	0.37	0.94	41.43	1.90	0.92	2.82	0.21	345.99
SE (Sij)±	0.88	2.00	0.10	0.12	3.92	0.23	0.06	0.25	0.07	19.16

*,**Significant at 5 and 1% levels of significance, respectively

as for fruits per plant, fruit length, fruit girth, and fruit weight. While female parent 9907-9611 (B line) was found good general combiner for green fruit yield per plant as well as for days to flower initiation, secondary branches per plant, fruit girth, and fruit weight. Among the male parents, LCA 206 was a good general combiner for green fruit yield per plant as well as for days to flower initiation, plant height, secondary branches per plant, and fruits per plant. Another male parent, ACG 12 was appeared to be a good general combiner for green fruit yield per plant as well as for days to flower initiation, plant height, primary branches per plant, fruit length, fruit girth, and fruit weight. Other male parent, RHRC PENDT was also good general combiner for fruit yield per plant as well as for primary branches per plant, secondary branches per plant, fruits per plant, and fruit weight.

Among the hybrids, ACMS-4 × 9955-15R, CCA-4759 × LCA 206, and ACMS-8 × RHRC PENDT exhibited significant SCA effect for green fruit yield per plant and it is important component characters. The estimates of SCA effect (Table 3) revealed that CCA-4758 × 9955-15R for days to flower initiation, CCA-4759 × LCA 206 for plant height, ACMS-4 × PBC for primary branches per plant, CCA-4758 × JCA 283 for secondary branches per plant, CCA-4759 × LCA 206 for fruits per plant, ACMS-8 × PBC 142 for fruit length, CCA-4759 × 9955-15R for fruit girth, ACMS-4 × 9955-15R for fruit weight, and ACMS-8 × ACG 12 for pericarp thickness were the best specific cross combinations. The results are in conformity with those obtained earlier by Reddy *et al.* [5] and Karthik *et al.* [6] The knowledge of combining ability of parents and hybrids can be of much help in further breeding programs.

CONCLUSION

The estimates of SCA effect indicated that cross combinations ACMS-4 × 9955-15R, CCA-4759 × LCA 206 and ACMS-8 × RHRC PENDT were significant for green fruit yield per plant and it is important component characters and, therefore, these can be further exploited for selection of hybrids and transgressive segregants.

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