Electronic Journal of Plant Breeding, 5(3): 327-330 (Sep 2014)
ISSN 0975-928X

Research Article

Combining ability in watermelon (*Citrullus lanatus* (Thunb.) Mansf.)

Sapovadiya M. H., Mehta D. R.,* Dhaduk H. L and Babariya C. A.

Department of Genetics and Plant Breeding
Junagadh Agricultural University, Junagadh-362 001 (Gujarat), India
Email: drmehta@jau.in

(Received: 24 Jan 2014; Accepted:05 Jun 2014)

Abstract

In the present investigation, the nature and magnitude of combining ability effects in twenty-eight crosses of watermelon involving eight parents were studied for fruit yield and its components. The variances due to specific combining ability were higher in magnitude than that of general combining ability variances for all the characters (except for total soluble solids) indicating predominance role of non-additive gene action for all the traits. Parents, RW-187-2, GP-42 and GP-10(b) were good general combiner for all the four traits. The cross combination *viz*., GP-42 x GP-42 (b), RW-187-2 x Sonam, GP-42 x Sonam, GP-42 (b) x Sonam, RW-187-2 x GP-42 (b), GP-10 (b) x RW-187-2,GP-10 (b) x GP-42, GP-33 x GP-1-27, GP-10 (b) x Durgapura Lal, RW-187-2 x Durgapura Lal and RW-187-2 x GP-42 were found to be good specific cross combiners for fruit yield per plant. The crosses exhibiting high specific combining ability for fruit yield also have high or average combining ability for yield components. The crosses showing high specific combining ability involved at least one high general combining parent.

Key words:
Watermelon, combining ability, diallel analysis, TSS

Introduction:

Constant efforts are being made to improve fruit yield and quality of watermelon by hybridization. Development of high yielding F_1 hybrid with high total soluble solids (T. S. S.) and methods for commercial production of hybrid watermelon seed are also receiving considerable emphasis. For development of good hybrids, the information regarding the combining ability of the parents and the resulting crosses is very essential. The information on such aspect is very scanty in watermelon (Avramescu *et al.* 1972). In the present study, diallel analysis of eight genotypes of different geographical origin has been used to determine combining ability of fruit yield and its components along with total soluble solids.

Material and methods

The experimental material comprised of eight parents *viz.*, GP-10 (b), RW-187-2, GP-42, GP-42 (b), GP-33, Sonam, GP-1-27 and Durgapura Lal and their 28 F_1s developed by crossing in a diallel fashion excluding reciprocals during summer-2011 at Botanical Garden, Motibaug, Junagadh Agricultural University, Junagadh. The evaluation experiment was laid out in a randomized block design with three replications during *rabi*/summer-2011-12 at Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. The plants were spaced at a distance of 2.5 m between rows and 1.0 m within a row. Five plants of each parents and hybrids were selected randomly for recording observations for four characters *viz.*, number of fruits per plant, average fruit weight (kg), fruit yield per plant (kg) and total soluble solids (TSS). The combining ability effects were estimated as per Method-2 Model-I of Griffing's (1956).

Results and discussion

The analysis of variance revealed significant mean squares differences due to genotypes, parents and hybrids for all the four characters indicating sufficient amount of genetic variability for the traits studied (Table I). The variance due to general and specific combining ability were also significant for all the four characters which indicated that both additive and non-additive type of gene effects played a vital role in the inheritance of all these traits. However, the magnitude of GCA and SCA variances revealed that the SCA variances were higher than their respective GCA variances for all the characters (except for total soluble solids) indicating major role played by non-additive type of gene action in the expression of the characters studied. The ratio of σ^2 GCA/σ^2SCA less than unity also confirmed the preponderance of non-additive gene action for all the traits except total soluble solids. These results are in close conformity with those of Brar and Sukhija (1977). Sachan and Nath (1976) and Brar and Sidhu (1977) also reported that both general and specific combining ability variances were important for fruit yield and its component characters in watermelon.

The means and the estimates of general combining ability effects of the parents are presented in (Table II). The parent RW-187-2 had the highest mean value for fruit yield and average fruit weight; Durgapura Lal had the highest mean value for number of fruits per plant and GP-42 had the highest mean value for T. S. S. Among the parents, RW-187-2, GP-10 (b) and GP-42 were found to be good general combiners for all the four traits.

It may be inferred that RW-187-2 could contribute positively towards increase in number of fruits per plant, average fruit weight and finally toward increased in fruit yield, while GP-42 towards total soluble solids. Overall good combiners RW-187-2, GP-42 and Durgapura Lal contributed positively towards fruit yield and quality. On the other hand GP-33, Sonam, and GP-1-27 were poor combiner for all the four traits. The diversity in the *gca* effects of eight parents could be attributed to genetic as well as geographic diversity present in the material. High *gca* effects observed for different characters may be helpful to sort out outstanding parents with favourable alleles for genetic improvement of fruit yield in watermelon.

From mean and specific combining ability effects (Table III), it was observed that out of 28 cross combinations, 12 crosses for number of fruit per plant< average fruit weight and fruit yield per plant and 16 crosses for total soluble solid exhibited significant *sca* effect in desirable direction. The cross combinations *viz.*,GP-42 x GP-42 (b), RW-187-2 x Sonam, GP-42 x Sonam, GP-42 (b) x Sonam, RW-187-2 x GP-42 (b), GP-10 (b) x RW-187-2, GP-10 (b) x GP-42, GP-33 x GP-1-27, GP-10 (b) x Durgapura Lal, RW-187-2 x Durgapura Lal and RW-187-2 x GP-42 showed significant and positive specific combining ability effects for fruit yield. Five crosses such as GP-42 x GP-42 (b), RW-187-2 x GP-42 (b), GP-10 (b) x RW-187-2, GP-10 (b) x GP-42 and RW-187-2 x GP-42 involved both parents with good *gca* effects for fruit yield. This might be due to additive x additive types of gene interaction which are fixable in nature. Likewise, GP-10 (b) x RW-187-2, GP-10 (b) x GP-42, GP-10 (b) x Durgapura Lal, RW-187-2 x Durgapura Lal and RW-187-2 x GP-42were good combiners for T. S. S. These crosses hold considerable promise for realizing desirable segregants in subsequent generations. High *gca* effects of the parents, therefore, seems to be reliable criteria for the prediction of specific combining ability. On the other hand, RW-187-2 x Sonam, GP-42 x Sonam, GP-42 (b) x Sonam, GP-10 (b) x Durgapura Lal, RW-187-2 x Durgapura Lal were the hybrids of low x high combiners for fruit yield. Heterosis observed in this case might be due to dominance x additive type of interaction, while cross GP-33 x GP-1-27 involved both the poor combining parents, which might be due to dominance x dominance epistasis.

The crosses *viz.*, GP-33 x GP-1-27, GP-1-27 x Durgapura Lal, GP-42 x GP-42 (b), RW-187-2 x GP-42, GP-10 (b) x Durgapura Lal and RW-187-2 x Sonam, which recorded significant *sca* effect for fruit yield, resulted from poor x poor or good x good or good x poor combiners for fruit yield. This indicated the inconsistent expression of *sca* effect in specific crosses irrespective of gca effect of the parents. Similar results reported by Brar and Sukhija (1977), Sidhu and Brar (1977), Gill and Kumar (1989), Gurav *et al.*(2000) and Choudhary *et al.* (2006).

References

Avramescu, A., Enachescu, G., Barbulesculose, T. and Dinescu, I. 1972. F_1 hybrids of watermelon. *Analel Institute de corecetavipentru Legumiculture S. Floriculture.*, **2:** 37-46. (Pl. Br. Abstr. **2:** 1169).

Brar, J. S. and Sidhu, A. S 1977. Heterosis and combining ability of earliness and quality characters in watermelon (*Citrullus lanatus* Thunbs. Mansf.). Part II. *J. Res.* (PAU)., **14:** 272-278.

Brar, J. S. and Sukhija, B. S. 1977. Line x tester analysis for combining ability in watermelon (*Citrullus lanatus* Thunbs. Mansf.). *Indian J. Hort.,* **34:** 410-414.

Choudhary, B. R., Fageria, M. S., Sudhakar, Pandey and Mathura, Rai. 2006. Combining ability studies for economic attributes in muskmelon (*Cucumis melo* L.). *Veg. Sci*., **33**(2)**:** 185-187.

Gill, B. S. and Kumar, J. C. 1989. Combining ability analysis for fruit and quality characters in watermelon. *Annals of Biology* (Ludhiana)., **5**(1)**:** 49-53.

Griffing, B. 1956. Concepts of general and specific combining ability in relation to diallel crossing system. *Austr. J. Biol. Sci.,* **9:** 463-493.

Gurav, S. B., Wavhal, K. N. and Navale, P. A. 2000. Heterosis and combining ablity in muskmelon (*cucumis melo* L.). *J. Maharashtra Agric. Univ. (India).,* **25**(2) **:** 149-152.

Sachan, S. C. P. and Nath, P. 1976. Combining ability of quantitative characters in 10 x 10 diallel crosses of watermelon (*Citrullus lanatus* Thunbs. Mansf.). *Egypt. J. Genet. Cytol.,* **5:** 65-79.

Sidhu, A. S. and Brar, J. S. 1977. Heterosis and combining ability of yield and its components in watermelon (*Citrullus lanatus* (Thunb.) Mansf.). *J. Res.* (P.A.U)., **14**(1)**:** 52-58.

Electronic Journal of Plant Breeding, 5(3): 327-330 (Sep 2014)
ISSN 0975-928X

Table 1. Analysis of variance (mean squares) for the design and combining ability for different character in watermelon

Source of variation	D.F.	Mean source			
		Number of fruits per plant	Average fruit weight (kg)	Fruit yield per plant (kg)	Total soluble solids (TSS)
Analysis for the design					
Replications	2	0.004	0.012	0.07	0.057**
Genotypes	35	0.40**	1.51**	23.83**	3.68**
Parents	7	0.32**	0.55**	8.71**	3.88**
Hybrids	27	0.43**	1.72**	27.49**	3.48**
Parents Vs Hybrids	1	0.05*	2.39**	30.92**	7.55**
Error	70	0.01	0.005	0.08	0.010
Analysis for combining ability					
GCA	7	0.37**	1.60**	25.17**	5.04**
SCA	28	0.07**	0.23**	3.63**	0.27**
ERROR	70	0.003	0.002	0.03	0.003
σ^2 GCA		0.04	0.16	2.51	0.50
σ^2SCA		0.07	0.23	3.61	0.27
σ^2GCA/σ^2SCA		0.51	0.70	0.70	1.88

*,** significant at 5% and 1% levels, respectively

Table 2.Means and estimates of general combining ability effects of the parents for different characters in watermelon

Parents	Number of fruits per plant		Average fruit weight (kg)		Fruit yield per plant (kg)		Total soluble Solids (TSS)	
	Mean	gca effects	Mean	gca effects	Mean	gca effects	Mean	gca effects
GP-10 (b)	3.13	0.16**	2.64	0.09**	8.26	0.61**	8.26	0.09**
RW-187-2	3.07	0.23**	2.85	0.50**	8.75	2.16**	8.43	0.49**
GP-42	2.87	0.05**	2.76	0.48**	7.92	1.51**	10.01	1.15**
GP-42 (b)	2.93	0.018	1.98	0.15**	5.81	0.49**	7.18	-0.54**
GP-33	2.67	-0.23**	1.89	-0.54**	5.05	-2.13**	7.06	-0.46**
Sonam	2.47	-0.10**	2.00	-0.02	4.93	-0.29**	7.14	-0.69**
GP-1-27	2.40	-0.30**	1.78	-0.56**	4.28	-2.33**	7.01	-0.72**
Durgapura Lal	3.33	0.17**	2.07	-0.09**	6.89	-0.01	9.22	0.68**
SE(gi)		0.02		0.01		0.05		0.02
SE(gi-gj)		0.03		0.02		0.07		0.03

*,** significant at 5% and 1% levels, respectively.

Table 3. Means and specific combining ability estimates of the crosses for different characters in watermelon

Parents	Number of fruits per plant		Average fruit weight (kg)		Fruit yield per plant (kg)		Total soluble Solids (TSS)	
	Mean	sca effects	Mean	sca effects	Mean	sca effects	Mean	sca effects
GP-10 (b) x RW-187-2	3.40	0.11*	3.56	0.45**	12.12	1.87**	8.31	-0.80**
GP-10 (b) x GP-42	3.20	0.09	3.58	0.49**	11.46	1.85**	10.26	0.49**
GP-10 (b) x GP-42 (b)	3.00	-0.07	2.40	-0.35**	7.21	-1.37**	8.21	0.12*
GP-10 (b) x GP-33	2.87	0.04	1.84	-0.23**	5.28	-0.68**	8.45	0.29**
GP-10 (b) x Sonam	2.60	-0.36**	2.46	-0.13**	6.41	-1.40**	8.21	0.28**
GP-10 (b) x GP-1-27	2.67	-0.09	1.92	-0.13**	5.13	-0.63**	8.22	0.31**
GP-10 (b) x Durgapura Lal	3.67	0.44**	2.54	0.02	9.32	1.23**	9.50	0.20**
RW-187-2 x GP-42	3.47	0.29**	3.53	0.03	12.25	1.10**	10.93	0.76**
RW-187-2 x GP-42 (b)	3.27	0.12*	3.63	0.46**	12.11	1.98**	9.35	0.86**
RW-187-2 x GP-33	2.67	-0.23**	2.31	-0.17**	6.16	-1.35**	9.44	0.87**
RW-187-2 x Sonam	3.33	0.30**	3.66	0.66**	12.20	2.85**	8.48	0.14*
RW-187-2 x GP-1-27	2.60	-0.23**	2.23	-0.23**	5.80	-1.51**	8.54	0.23**
RW-187-2 x Durgapura Lal	3.53	0.23**	3.06	0.13**	10.82	1.18**	9.82	0.12*
GP-42 x GP-42 (b)	3.27	0.30**	4.17	1.02**	13.62	4.13**	8.72	-0.42**
GP-42 x GP-33	2.67	-0.05	2.03	-0.44**	5.40	-1.46**	9.72	0.50**
GP-42 x Sonam	3.07	0.21**	3.56	0.58**	10.92	2.21**	8.78	-0.21**
GP-42 x GP-1-27	2.80	0.15**	2.02	-0.43**	5.48	-1.18**	8.73	-0.23**
GP-42 x Durgapura Lal	2.45	-0.72**	3.13	0.21**	7.50	-1.48**	11.14	0.78**
GP-42 (b) x GP-33	2.53	-0.15**	1.96	-0.17**	4.96	-0.88**	7.52	-0.01
GP-42 (b) x Sonam	3.07	0.25**	3.20	0.55**	9.82	2.13**	7.25	-0.06
GP-42 (b) x GP-1-27	2.53	-0.09	1.87	-0.25**	4.73	-0.91**	7.20	-0.07
GP-42 (b) x Durgapura Lal	2.73	-0.35**	3.00	0.42**	8.19	0.23	8.80	0.13*
GP-33 x Sonam	2.40	-0.17**	1.84	-0.12**	4.42	-0.65**	7.05	-0.33**
GP-33 x GP-1-27	2.60	0.23**	1.65	0.22**	4.28	1.26**	7.25	-0.10
GP-33 x Durgapura Lal	2.73	-0.11*	1.92	0.03	5.47	0.13	8.63	-0.12*
Sonam x GP-1-27	2.36	-0.11*	1.82	-0.12**	4.37	-0.50**	7.14	0.02
Sonam x Durgapura Lal	3.33	0.36**	1.96	-0.45**	6.52	-0.67**	8.72	0.20**
GP-1-27 x Durgapura Lal	2.73	-0.04	2.08	0.20**	5.68	0.54**	8.50	0.01
SE(Sij)		0.05		0.04		0.15		0.05
SE(Sij-Sik)		0.08		0.06		0.22		0.08
SE(Sij-Skl)		0.07		0.05		0.20		0.08

*,** significant at 5% and 1% levels, respectively