IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN(P): 2347-4580; ISSN(E): 2321-8851
Vol. 5, Issue 5, May 2017, 133-140

COMBINING ABILITY STUDIES FOR GROWTH AND YIELD CHARACTERS IN RIDGE GOURD (*LUFFA ACUTANGULA* (L) ROXB)

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ABSTRACT

The investigation was carried out to get the information on combining ability in ridge gourd. Eight different parental lines were selected; they were mated in half diallel fashion. Twenty eight crosses were developed. Among parents and crosses, significant variations due to GCA and SCA were observed for growth and yield traits, which indicates the predominance of additive and non additive gene action and which suggested that ample scope for direct selection or heterosis breeding. Out of eight parents, DMRG-25, DMRG-36 and DMRG-22 were found to be best general combiners. The crosses DMRG-25 × DMRG-1 (0.29) and DMRG-25 x Arka Sumeet (0.29) exhibited the high SCA effect for fruit yield per vine and for fruit length. The next cross, as per fruit yield per vine is found in the cross DMRG-36 × Arka Sumeet (0.25) and followed by DMRG-22 × DMRG-15 (0.23). Performance of selected hybrids with respect to total yield is attributed by significant standard heterosis in the desired direction.

KEYWORDS: Combining Ability, Yield, Growth, Parents and Crosses

INTRODUCTION

Ridge gourd [*Luffa acutangula* (L.) Roxb.], the genus derives its name from the product "loofah' which is used in bathing sponges, scrubber pads, door mats and commonly known as silky gourd, ribbed gourd and angled loofah. Ridge gourd belongs to genus *Luffa* of Cucurbitac family and has a chromosome number 2n = 26, and is native to India. It contains a gelatinous compound called 'luffein'' and has medicinal importance. Tender fruits are green in colour, which are used in soups and curries or as a cooked vegetable. It is one of the important tropical cucurbitaceous vegetable grown throughout India and South-East Asia. Ridge gourd is monoecious and cross pollinated crop. The staminate flowers with five stamens (synandry) are borne in 10-20 flowered racemes while pistillate flowers are solitary, short or long pedunculate and fragrant. The concept of combining ability for the evaluation of parents of a crossing program is the best method for selecting suitable parents. It has been originated through the intensive hybridization work in maize, this hybridization method is used for breaking yield related barriers and evolving crosses or varieties having high yielding potential. Selection of parents on the basis of phenotypic performance alone is not an appropriate technique, since phenotypically superior lines or crosses may not lead to expected degree of heterosis and combining ability. It is one of the potential tools for identifying appropriate parents for hybridization and shifting productive hybrids from a set of crosses in F_1 generation is the analysis of combining ability (Griffing, 1956). Therefore, the present study was undertaken in ridge gourd to get information about estimates of combining ability. The combining ability estimates were calculated by using Sprague and Tatum (1942).

MATERIAL AND METHODS

The present investigation was carried out at the Department of Vegetable Science, K.R.C. College of Horticulture, the Arabhavi, University of Horticultural Sciences, Bagalkot during *kharif* and *Rabi*, 2014. The experimental material consisted of eight parental lines *viz.*, KRCCH-1, DMRG-22, Arka Sumeet, DMRG-1, DMRG-36, DMRG-25, DMRG-15 and DMRG-44. They were crossed in a half diallel fashion excluding reciprocals during *Kharif,* 2014. The resultant 28 F_1 hybrids along with eight parents were evaluated in randomized block design with two replications and spacing of 1.2 x 0.9 m. Observations were recorded on five randomly selected plants from each plot for growth and yield characters.

RESULTS AND DISCUSSIONS

The pooled analysis of variance for combining ability revealed that mean scores due to *gca* and *sca* effects were highly significant for early and yield traits, indicated the importance of both additive and non-additive genetic components for most of the traits. Similar results were reported by Rao *et al.* (2000b) and Shaha and Kale (2003b) in ridge gourd. Mean squares due to interactions of gca and *sca* were also significant for early and yield traits (Table 1). The *gca* effects of parents were significant for most of the characters, which indicated the existence of variability among the parents. Which help in selection of parents for hybridization (Table 2). Assessment of parents by considering *gca* effects of the characters studied. Results indicate that selection of suitable parents, *viz.,* DMRG-22, DMRG-36 and DMRG-25 as good combiners for the most of the characters and among parents. Information regarding *gca* effect of the parent is of prime importance as it helps in successful prediction of genetic potentiality of hybrids. The parent DMRG-22 exhibited significant *gca* effects in the desirable direction for vine length at 45 DAS, number of leaves at 90 DAS, fruit length, fruit yield per plot, fruit yield per vine and fruit yield per hectare. DMRG-25 had highest mean values for fruit yield per vine, vine length at 45 DAS. Hence, DMRG-25 can be used in the ridge gourd breeding program. These parents with good gca for a character also exhibited good *per the* performance. Similar results for some characters were reported by Laxuman *et al*. (2012) in bitter gourd, Uma and Haribabu (2005) in pumpkin and Naliyadhara *et al*. (2007) in sponge gourd. So, the lines DMRG-22, DMRG-36 and DMRG-25 where the best general combiner for most of the growth and yield traits.

Estimation of *scale* effects for 28 crosses has resulted in the identification of good specific combiner for various traits as given in (Table 3). Among crosses, the cross DMRG-36 × DMRG-22 (0.44) exhibited maximum and significant *sca* effects for vine length at 45 DAS (Days after sowing). Significant *sca* effects for vine length were also reported by Naliyadhara *et al*. (2007). The cross DMRG-25 × DMRG-22 (1.27) exhibited maximum significant *scale* effects and good specific combiner for vine length at 90 DAS, it was also reported by Uma and Haribabu (2005) in their studies. Maximum significant *scale* effects in the cross DMRG-25 × DMRG-1 (0.29) for fruit yield per vine are high, similar results were also reported by Neeraja (2008) and Purohit *et al*. (2007) in ridge gourd. The cross DMRG-25 × DMRG-1 (9.52) exhibited maximum significant *scale* effects and good specific combiner for the number of leaves at 90 DAS, similar results were also observed by Yadav *et al*. (2008) in bitter gourd. Maximum and significant *scale* effects in the cross DMRG-22 × DMRG-15 (0.92) for a number of branches at 90 DAS, similar significant sca effects for a number of branches at 90 DAS also reported by Naliyadhara *et al*. (2007) in sponge gourd and Purohit *et al*. (2007) in ridge gourd. Estimates of specific combining ability effects are DMRG-25 × DMRG-1, DMRG-36 × DMRG-22 DMRG-25 × Arka Sumeet, DMRG-36 × Arka Sumeet and was showing significant *sca* effects for almost all important yield contributing characters.

The best crosses showing positive significant *sca* effects for different characters were DMRG-25 × DMRG-1 and DMRG-25 × Arka Sumeet, DMRG-36 × Arka Sumeet and DMRG-22 × DMRG-15 for fruit yield per vine, DMRG-36 × Arka Sumeet followed by DMRG-22 × DMRG-15 for fruit yield per plot, DMRG-36 × Arka Sumeet followed by DMRG-22 × DMRG-15 for fruit yield per hectare. Hence, crosses with higher specific combining ability effects are useful to derive high performing hybrids. These crosses involved parents with high x high, high x low and low x low general combining ability effects indicating presence of additive, dominance and epistatic gene actions for controlling these characters. Similar results were also reported by Niyaria and Bhalala (2001) in ridge gourd and Laxuman *et al.* (2012) in bitter gourd. However, high x low general combining ability combinations are suitable for heterosis breeding. High x high general combining ability combinations can be considered for developing superior variants through pedigree selection method.

CONCLUSIONS

Out of eight points, DMRG-25, DMRG-36 and DMRG-22 were found to be best general combiners. Among 28 crosses, DMRG-25 × DMRG-1 (0.29), DMRG-25 x Arka Sumeet (0.29), DMRG-36 × Arka Sumeet (0.25) and DMRG-22 × DMRG-15 (0.23), were exhibited high SCA effect for fruit yield per vine and for fruit length.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Associate Professor, University of Horticultural Sciences, Bagalkot, Department of Vegetable Science, K.R.C. College of Horticulture, Arabhavi, for help in conducting the research successfully, technical support during the research work.

Author Contributions

- K. Muthaiah – Conception and design of the research program, data collection, crossing work, data analysis and interpretation, critical revision of the article, drafting the article, final approval of the version to be published and acted as corresponding author.
- V.D. Gasti – Helped during crossing work, data collection, data analysis and interpretation,
- Sanganamoni Mallesh– Critical revision of the research article
- Sumalatha Akkalareddy– Critical revision of the research article
- Arindam Das – Critical revision of the research article

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Table 1: Analysis of Variance Due to General Combining Ability and Specific Combining Ability for Different Parameters in Ridge Gourd

Source of Variation	Mean Sum of Squares			σ^2_g	σ^2_s	$\sigma^2_g : \sigma^2_s$
	GCA	SCA	Error			
Degree of freedom	**7**	**28**	**35**			
Growth parameters						
Vine length at 45 DAS	0.06**	0.02**	0.00	0.00	0.02	0.27
Vine length at 90 DAS	0.43**	0.25**	0.01	0.04	0.23	0.17
Number of leaves at 90 DAS	34.96**	16.98**	1.68	3.32	15.29	0.21
Number of branches at 90 DAS	0.39**	0.30**	0.05	0.03	0.25	0.13
Yield parameters						
Fruit length	14.74**	10.41**	1.25	1.34	9.16	0.14

Table 1: Condt.,

Fruit yield per vine	0.07**	0.02**	0.00	0.00	0.02	0.31
Fruit yield per plot	4.94**	1.34**	0.45	0.44	0.88	0.50
Fruit yield per hectare	4.23**	1.15**	0.39	0.38	0.76	0.50

* and ** indicates significance of value at p= 0.05 and p=0.01, respectively. DAS: Days after sowing

GCA - General combining ability SCA - Specific combining ability σ^2_g - Variance due to GCA=GA σ^2_s - Variance due to GCA=VD

Table 2: General Combining Ability Effects for Growth and Yield Parameters in Ridge Gourd

Parent	Growth Parameters						Yield Parameters			
	Vine Length		No. of Leaves Per Plant		No. of Branches		Fruit Length	Fruit Yield Per Vine	Fruit Yield Per Plot	Fruit Yield Per Hectare
	45 DAS	90 DAS	45 DAS	90 DAS	45 DAS	90 DAS				
DMRG-36	0.10**	0.01	0.95*	1.13**	0.11	0.10	1.92 **	0.09 **	0.94 **	0.87 **
DMRG-25	0.06**	0.24**	0.47	2.85**	0.10	0.22	0.61	0.078 **	0.35	0.32
KRCCH-1	-0.02	-0.20**	-1.26**	-1.74**	-0.14	-0.20	-0.56	-0.06 **	-0.01	-0.00
DMRG-22	0.09**	0.26**	1.72**	1.11**	0.24	0.21	1.27 **	0.11 **	0.88 **	0.81 **
Arka Sumeet	-0.04*	0.15**	-0.62	0.48**	-0.05	0.08	-1.50 **	-0.02	-0.42 *	-0.39 *
DMRG-1	-0.03	0.00	0.27	0.46**	0.06	0.05	-0.12	0.01	-0.10	-0.09
DMRG-15	-0.04*	-0.18**	-0.94**	-1.48**	-0.13	-0.22	-1.40 **	-0.08 **	-0.59 **	-0.54 **
DMRG-44	-0.11**	-0.28**	-0.57	-2.84**	-0.20	-0.25*	-0.20	-0.11 **	-1.05 **	-0.97 **
S. E.M	0.02	0.62	0.10	0.05	0.58	0.10	0.50	0.02	0.30	0.27
CD at 5 (%)	0.04	0.08	0.97	0.90	0.16	0.15	0.78	0.04	0.47	0.43
CD at 1 (%)	0.06	0.12	1.44	1.34	0.24	0.23	1.15	0.06	0.69	0.64*

* And ** indicates significance of value at p= 0.05 and p=0.01, respectively. DAS: Days after sowing

Table 3: Specific Combining Ability Effects for Growth and Yield Parameters in Ridge Gourd

Hybrids	Growth Parameters						Yield Parameters			
	Vine Length		No. of Leaves Per Plant		No. of Branches		Fruit Length	Fruit Yield Per Vine	Yield Per Plot	Yield Per Hectare
	45 DAS	90 DAS	45 DAS	90 DAS	45 DAS	90 DAS				
DMRG-36 × DMRG-25	0.31 **	0.05	0.21	-0.04	1.90	0.48 *	2.36 *	0.17 **	1.67 *	1.55 *
DMRG-36 × KRCCH-1	-0.18 **	-0.46 **	-0.23	-1.24	-2.05	-0.08	-3.31 **	-0.00	-1.45 *	-1.34 *
DMRG-36 × DMRG-22	0.44 **	0.29*	0.38	4.49 **	1.24	0.59 **	3.96 **	0.114	0.16	0.14
DMRG-36 × Arka Sumeet	0.11	0.48 **	0.97 **	6.12 **	3.30 *	0.62 **	2.43 *	0.25 **	1.98 **	1.83 **
DMRG-36 × DMRG-1	-0.18 **	-0.56 **	-0.44*	-2.75 *	0.60	-0.84 **	-3.53 **	-0.18 **	-1.66 *	-1.53 *
DMRG-36 × DMRG-15	-0.07	-0.14	-0.34	-4.10 **	-1.97	-0.26	-0.65	-0.12 *	-0.67	-0.62
DMRG-36 × DMRG-44	-0.17 **	-0.30 **	-0.37	-6.04 **	-5.84 **	-0.33	2.13 *	-0.07	-0.40	-0.37
DMRG-25 × KRCCH-1	-0.16 **	-0.26 *	-0.22	-4.96 **	-1.97	-0.50 *	2.21 *	-0.13 *	-0.12	-0.11
DMRG-25 × DMRG-22	0.00	1.27 **	0.48 *	1.97	0.52	0.47 *	1.40	0.16**	1.31 *	1.21*
DMRG-25 × Arka Sumeet	0.20 **	0.96 **	0.38	4.70 **	3.08 *	0.80 **	4.75 **	0.29 **	1.02	0.94
DMRG-25 × DMRG-1	0.11	0.70 **	0.66 **	9.52 **	1.38	0.63**	2.49 *	0.29 **	1.13	1.05
DMRG-25 × DMRG-15	-0.07	-0.59 **	-0.14	-2.42 *	-1.09	-0.28	-2.34 *	-0.18 **	-0.22	-0.20
DMRG-25 × DMRG-44	-0.06	-0.34 **	-0.36	0.53	-1.56	-0.35	-4.24 **	-0.06	-0.17	-0.15

* And ** indicates significance of value at p= 0.05 and p=0.01, respectively. DAS: Days after sowing

Table 3 condt...

Hybrids	Growth Parameters						Yield Parameters			
	Vine Length		No. of Leaves Per Plant		No. of Branches		Fruit Length	Fruit Yield Per Vine	Yield Per Plot	Yield Per Hectare
	45 DAS	90 DAS	45 DAS	90 DAS	45 DAS	90 DAS				
KRCCH-1 × DMRG-22	-0.15 *	-0.32**	-2.63 *	-2.72 *	-0.369	-0.69 **	-2.04	-0.17**	-1.15	-1.07
KRCCH-1 × Arka Sumeet	-0.00	-0.02	-0.97	0.50	-0.165	-0.16	-0.56	-0.07	0.10	0.09
KRCCH-1 × DMRG-1	-0.05	-0.20	-0.27	-1.67	-0.285	-0.03	-4.04 **	-0.05	-0.77	-0.72
KRCCH-1 × DMRG-15	0.08	0.10	0.54	-0.92	-0.085	-0.05	1.23	0.01	0.68	0.64
KRCCH-1 × DMRG-44	0.05	0.26 *	2.87 *	0.53	0.09	0.67 **	1.23	0.10	-0.17	-0.16
DMRG-22 × Arka Sumeet	-0.18**	-0.34 **	1.02	-1.75	-0.255	-0.38	-3.56 **	-0.22 **	-1.39 *	-1.28 *
DMRG-22 × DMRG-1	0.04	-0.16	2.72 *	2.46 *	0.325	0.74**	2.06	0.10	1.19	1.10
DMRG-22 × DMRG-15	0.09	0.16	2.84 *	7.11 **	0.52 *	0.92 **	5.97 **	0.23 **	1.91 **	1.76 **
DMRG-22 × DMRG-44	-0.04	-0.33 **	-2.72 *	-1.22	-0.2	0.35	-2.71 *	-0.02	-0.59	-0.55
Arka Sumeet × DMRG-1	-0.08	-0.24 *	-2.01	-4.70 **	-0.18	-0.42 *	0.89	-0.13 *	-0.13	-0.12
Arka Sumeet × DMRG-15	-0.14*	-0.63 **	1.30	0.94	0.02	-0.14	0.93	-0.04	0.23	0.22
Arka Sumeet × DMRG-44	0.06	0.08	-0.86	2.00	0.29	-0.21	-6.03**	-0.01	-0.16	-0.14
DMRG-1 × DMRG-15	-0.01	0.25 *	-3.49**	-1.43	-0.15	-0.11	-1.30	-0.08	-0.85	-0.79
DMRG-1 × DMRG-44	0.06	0.16	-0.86	-1.87	-0.12	-0.38	1.88	-0.11 *	-0.37	-0.34
DMRG-15 × DMRG-44	0.04	0.15	-0.74	1.37	0.37	-0.20	-0.78	0.00	0.13	0.12
S. E.M	0.08	1.37	0.31	0.15	1.74	0.30	1.50	0.08	0.90	0.83
CD at 5 (%)	0.12	0.22	2.59	2.42	0.43	0.42	2.08	0.12	1.26	1.16
CD at 1 (%)	0.16	0.29	3.50	3.26	0.58	0.57	2.81	0.16	1.70	1.57

* And ** indicates the significance of value at p= 0.05 and p=0. 01, respectively. DAS: Days after sowing