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Combining ability for fruit yield and its component traits in ridge gourd (*Luffa acutangula* (Roxb.) L.)

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Abstract
Combining ability for fruit yield and its component traits in ridge gourd was studied using line x tester mating design involving three testers and seven lines. Analysis of variance for combining ability revealed that mean squares due due to lines were significant for all the characters except length of fruit, while mean squares due testers were significant for all characters except number of primary branches per vine, length of fruit, girth of fruit, rind thickness and number of seeds per fruit. Mean square due to lines x testers interaction, were also significant for all the characters except length of fruit, rind thickness, number of seeds per fruit and 100-seed weight. The results indicated the importance of both additive and non-additive genetic variances in the expression of these characters. The lines JRG-13-04, JRG-13-06 and JRG-13-07 and the testers Jaipur Long displayed high GCA effect and good *per se* performance for fruit yield per vine and some desirable traits could be utilized in multiple crossing programmes. The sca effect of the crosses indicated that eight hybrids manifested significant and positive sca effect for fruit yield per vine. The best three specific combiners were JRG-13-07 x Pusa Nasdar, JRG-13-06 x Arka Sujat and JRG-13-05 x Jaipur Long. These crosses also showed desirable sca effect for important yield traits. The crosses exhibiting high sca effect involved either good x poor general combiners for majority of characters indicating the presence of additive x dominance type of gene interactions.

Keywords: Combining ability, GCA and sca effects, yield attributes

Introduction
Ridge gourd (*Luffa acutangula* (Roxb.) L.) belongs to the family *Cucurbitaceae* which includes about 118 genera and 825 species. Ridge gourd or angled gourd is cultivated in all tropical regions of the world. In India, it is grown as summer and *kharif* season crop. The somatic chromosome number of ridge gourd is 2n=2x=26. It is a monoecious and cross pollinated annual crop characterized by long vines having branched tendrils.
During recent years, the exploitation of hybrid vigour and selection of potential parents on the basis of combining ability have expanded a new alley in crop improvement. Keeping this view, the present studies were undertaken to identify the genetic architecture of characters related to yield and its components. For improving fruit yield potential of varieties and hybrids, decision should be made about the choice of right type of parents for hybridization. This is very important for testing the parents for their combining ability because many times, high yielding parents may not combine well to give good segregants.

Materials and Methods
Experimental material consisting of 32 entries, three male lines (used as testers) *viz.*, Arka Sujat, Pusa Nasdar, Jaipur Long and seven female lines (used as lines) *viz.*, JRG-13-01, JRG-13-02, JRG-13-03, JRG-13-04, JRG-13-05, JRG-13-06, JRG-13-07 and their 21 hybrids developed through line x tester mating design along with standard check (GJRGH-1) were evaluated in a randomized block design with three replications. The 21 crosses made in line x tester mating design during *kharif*-2015 at Vegetable Research Station, Junagadh Agricultural University, Junagadh, which were evaluated during summer-2016 at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. The plants were spaced at a distance of 2.0 m between rows and 1.0 m within a row. Five plants per each entry in each replication were randomly selected before flowering and tagged for the purpose of recording the observations of different characters *viz.*, length of main vine (m), number of primary branches per vine, number of fruits per vine, fruit weight (g), length of fruit (cm), girth of fruit (cm), rind thickness (mm), flesh thickness (mm), fruit yield per vine (g), number of seeds per fruit and 100-seed weight (g). Heterosis was calculated as percentage of F_1 performance in the

favourable direction over better parent, the best parent and commercial check (GJRGH-1). The analysis of variance for experimental design was performed to test the significance of difference among the genotypes for all the characters model as suggested by Panse and Sukhatme (1985) [6]. Heterobeltiosis was estimated as per the procedure given by Fonseca and Patterson (1968) [1] using mean values for various characters over replications.

Experimental Results and Discussion

Analysis of variance for combining ability revealed that the mean squares due to lines were significant for all the characters except length of fruit (cm), while mean squares due testers were significant for all characters except number of primary branches per vine, length of fruit (cm), girth of fruit (cm), rind thickness (mm) and number of seeds per fruit. In case of lines x testers interaction, the mean squares were also significant for all the characters except length of fruit (cm), rind thickness (mm), number of seeds per fruit and 100-seed weight (g). The results indicated the importance of both additive and non-additive genetic variances in the expression of these characters.

The summary of general combining ability effects of the parents (Table 1.2 and 1.3) revealed that none of the parents was found to be good general combiner for all the characters. An overall appraisal of GCA effect revealed that tester Jaipur Long and lines JRG-13-04, JRG-13-06 and JRG-13-07 were good general combiners for fruit yield per vine and some of its components. Either good or average general combining ability effect was also depicted by Jaipur Long for fruit weight. Poshiya (2011) [7] also reported Jaipur Long as good general combiner for fruit yield per vine. Likewise, JRG-13-04 for fruit weight, flesh thickness, girth of fruit and number of fruits per vine; JRG-13-07 for fruit yield per vine and good general combiner of for number of fruits per vine and number of seeds per fruit and JRG-13-06 for fruit yield per vine and number of fruits per vine were good general combiners. These parents were found desirable for fruit yield as well as fruit yield contributing components and could be exploited in future breeding program to develop high yielding cultivar in ridge gourd.

In general, it was observed that the parents having high *per se* performance for various characters also exhibited high general combining ability effects for respective characters. Such relationship will help in identifying good general combiners based on *per se* performance alone while selecting the parents for hybridization programme. Thus, if a character is unidirectionally controlled by set of alleles and additive effects are important, the choice of parents on the basis of *per se* performance may be more effective. Further the parents with high *per se* performance exhibited high general combining ability effects indicating close relationship of *per se* performance and GCA effects. Similar finding has also been reported by Rao *et al*. (1999) [11], Shaha *et al*. (1999) [13], Shaha and Kale (2003b) [12], Purohit *et al*. (2005b) [9], Prabhakar (2008) [8], Lodam *et al*. (2009) [3] and Poshiya (2011) [7].

The information on best three parents identified on the basis of *per se* performance and GCA effect for different characters is given in Table 1.5. It was observed that in general, the GCA effect of the parents was associated with *per se* performance for most of the cases. For instance, all the above said lines (JRG-13-04, JRG-13-07 and JRG-13-06) and testers, (Jaipur Long) which were identified as good general combiners for different traits also possessed good *per se* performance for majority of the characters. The same was also true for the remaining parents considered as good general combiners for one or the other traits. Thus, the present results indicated that *per se* performance might be useful for predicting the combining ability of a genotype and can be considered as a reliable criterion for selecting parents for hybridization. It would also save considerable time required to determine the GCA effects. Such a combination of high GCA and high *per se* performance had also been discovered by Shaha *et al*. (1999) [13], Shaha and Kale (2003b) [12], Purohit *et al*. (2007) [10], Prabhakar (2008) [8], Lodam *et al.* (2009) [3], Poshiya (2011) [7] and Dodiya *et al*. (2013).

The estimate of sca effects revealed (Table 1.4 and Table 1.5) that none of the crosses were consistently superior for all characters. Eight crosses exhibited significant and positive sca effects for fruit yield per vine. The highest yielding hybrid JRG-13-07 x Pusa Nasdar had also registered highest sca effect for fruit yield per vine. This could be due to good x poor general combiner parents. This cross also showed high sca effects for fruit weight and length of main vine. The high sca effect for both components were also accompanied by high heterosis as well as high *per se* performance. Likewise, the cross JRG-13-06 x Arka Sujat also had high sca for fruit yield per vine which was due to good x poor general combiner parents. This indicated the presence of additive x dominance epistatic gene action and such deviation could be attributed to the genetic diversity in the form of heterozygous loci. In the present study, cross combinations for fruit yield were JRG-13-06 x Arka Sujat (good x poor), JRG-13-07 x Pusa Nasdar (good x poor), JRG-13-05 x Jaipur Long (poor x good), JRG-13-04 x Arka Sujat (good x poor), JRG-13-02 x Jaipur Long (poor x good). These crosses may be expected to yield transgressive and stable performing segregants possessing enhance yielding ability.

In contrast to general combining ability effects, the specific combining ability effects represent dominance and epistatic components of variation which are not fixable in nature. But if the crosses showing high sca effect involving either both or one good general combiner parents, they could be successfully exploited for varietal improvement and expected to throw stable performing transgressive segregants carrying fixable gene effects. The cross combination which was either due to good x poor or poor x good crosses besides exhibited favourable high additive effects of the parents and manifested the complementary interaction effects and thus higher sca effect.

On the other hand, three cross combinations *viz.*, JRG-13-01 x Pusa Nasdar, JRG-13-03 x Arka Sujat, JRG-13-03 x Pusa Nasdar involving both poor combining parents (poor x poor) offer still better possibilities of exploitation as these are expected to yield stable segregants in the advance generations and thus, need further exploitation in the breeding programme. The crosses *viz*., JRG-13-07 x Pusa Nasdar, JRG-13-06 x Arka Sujat, JRG-13-05 x Jaipur Long, which recorded significant sca effect for fruit yield, resulted from good x poor or poor x good combiners. This indicated the inconsistent expression of sca effect in specific crosses irrespective of GCA effect of the parents. Similar result reported by Niyaria and Bhalala (2001), Purohit *et al*. (2005b) [9], Lodam *et al*. (2009) [3], Poshiya (2011) [7] and Narasannavar *et al*. (2014b) [4].

A summarized account of best performing parents, best general combiners, *per se* performance, standard heterosis and

best sca effects (Table 5.4) indicated that in majority of the characters studied, the best performing parent was also found to be best general combiners through their relative ranking were quite different. Further, best general combiners may not always produce best cross combinations for most of the characters.

Table 1.1: Analysis of variance for combining ability and variance components for different characters in ridge gourd

Source	D.F.	Days to first picking	Length of Main vine	Number of primary branches per vine	Number of fruits per vine	Fruit weight
Replications	2	0.43	0.02	0.15	0.54	21.06
Lines	6	109.42^{**++}	0.03**	0.43**	4.46^{**++}	2009.28^{**+}
Testers	2	45.97**	0.03*	0.05	1.51**	3967.09^{**++}
Lines x Testers	12	17.77**	0.06**	0.23**	0.41**	479.83**
Error	40	6.29	0.06	0.07	0.06	38.02
Variance components						
σ^2l		11.45**	0.03	0.03	0.48**	219.02*
σ^2t		1.88	0.01	-0.09	0.06	187.09**
σ^2lt		3.82**	0.01**	0.05**	0.11**	147.27**
σ^2gca		4.76**	0.01	0.01	0.19**	196.67**
σ^2sca		3.82**	0.01**	0.05**	0.11**	147.27**
σ^2GCA / σ^2sca		1.24	0.05	0.20	1.68	1.33

Source	D.F.	Length of fruit	Girth of fruit	Rind thickness	Flesh thickness	Fruit yield per vine	Number of seeds per fruit	100- seed weight
Replications	2	4.96	2.53	0.17	5.02	424.90	5.49	1.02
Lines	6	4.66	14.41^{**+}	0.14^{**+}	259.37**	31991.13^{**+}	1079.80^{**++}	2.20^{**++}
Testers	2	6.11	0.78	0.06	259.87**	61542.36^{**++}	16.15	0.41*
Lines x Testers	12	3.44	3.71**	0.04	102.78**	7834.40**	13.36	0.14
Error	40	3.41	1.28	0.03	22.14	149.09	6.69	0.11
Variance components								
σ^2l		0.13	1.45*	0.01*	26.35	3538.00*	119.23**	0.23**
σ^2t		0.12	-0.02	0.01	11.32	2923.48**	0.45	0.01
σ^2lt		0.07	0.81**	0.04	26.88**	2561.77**	2.22	0.01
σ^2gca		0.13*	0.42	0.04**	15.83**	3107.84**	36.08**	0.08**
σ^2sca		0.07	0.81**	0.04	26.88**	2561.77**	2.22	0.01
σ^2GCA / σ^2sca		18.71	0.51	1.00	0.58	1.21	16.24	8.00

*,** Significant at against error mean square at 5% and 1% levels, respectively

+, ++ Significant against L X T interaction at 5% and 1% level of probability

Table 1.2: General combining ability effects for length of main vine (m), number of primary branches per vine, number of fruits per vine, fruit weight (g), length of fruit (cm), girth of fruit (cm), rind thickness (mm), flesh thickness (mm), fruit yield per vine (g), number of seeds per fruit and 100-seed weight (g) in ridge gourd

S. No.	Parents	Length of main vine	Number of primary branches per vine	Number of fruits per vine	Fruit weight	Length of fruit	Girth of fruit	Rind thickness	Flesh thickness	Fruit yield per vine	Number of seeds per fruit	100-seed weight
Lines												
1	JRG-13-01	0.08	0.36*	-0.73**	-17.23**	-0.34	-0.23	-0.09	-1.01	-69.48**	-8.02**	-0.30
2	JRG-13-02	-0.04	0.06	-0.71**	-4.56	0.14	-0.50	0.07	-1.84	-16.59*	-7.07**	-0.18
3	JRG-13-03	0.04	0.10	-0.31*	-8.61*	-0.28	-0.53	0.07	-2.01	-35.04**	-5.20**	-0.24
4	JRG-13-04	0.06	-0.23	1.13**	28.38**	-1.05	2.75**	0.20	9.65**	112.46**	15.88**	0.63**
5	JRG-13-05	-0.04	-0.19	-0.31*	-8.95*	-0.15	-1.10	-0.17	-7.34**	-36.37**	-4.78**	-0.31
6	JRG-13-06	-0.02	-0.19	0.54**	4.60	1.23	0.07	0.04	3.92	20.07**	16.01**	0.79**
7	JRG-13-07	-0.08	0.09	0.39*	6.38	0.46	-0.45	-0.07	-1.34	24.96**	-6.82**	-0.38
	SE(g_i)	0.03	0.12	0.12	2.90	0.87	0.53	0.08	2.21	5.75	1.21	0.15
Testers												
1	Arka Sujat	0.04	-0.03	-0.18	-10.96**	-0.61	0.08	-0.02	-2.44	-43.45**	0.63	0.15
2	Pusa Nasdar	-0.01	-0.02	-0.12	-4.46	0.24	-0.22	-0.03	-1.58	-17.19*	0.36	-0.02
3	Jaipur Long	-0.03	0.05	-0.30*	15.42**	0.37	0.13	0.06	4.03	60.64**	-1.00	-0.12
	SE(g_j)	0.02	0.08	0.07	1.90	0.57	0.35	0.05	1.45	3.76	0.79	0.10

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

Table 1.3: Summary of general combining ability effect of the parents for seventeen characters in ridge gourd

Parents	Length of main vine	Number of primary branches per vine	Number of fruits per vine	Fruit weight	Length of fruit	Girth of fruit	Rind thickness	Flesh thickness	Fruit yield per vine	Number of seeds per fruit	100-seed weight
Lines											
JRG-13-01	A	G	P	P	A	A	A	A	P	G	A
JRG-13-02	A	A	P	A	A	A	A	A	P	G	A
JRG-13-03	A	A	P	P	A	A	A	A	P	G	A
JRG-13-04	A	A	G	G	A	G	A	G	G	P	P
JRG-13-05	A	A	P	P	A	A	A	P	P	G	A
JRG-13-06	A	A	G	A	A	A	A	A	G	P	P
JRG-13-07	A	A	G	A	A	A	A	A	G	G	A
Testers											
Arka Sujat	A	A	A	P	A	A	A	A	P	A	A
Pusa Nasdar	A	A	A	A	A	A	A	A	P	A	A
Jaipur Long	A	A	P	G	A	A	A	A	G	A	A

G = Good; A = Average; P = Poor

Table 1.4: Specific combining ability effects for length of main vine (m), number of primary branches per vine, number of fruits per vine, fruit weight (g), length of fruit (cm), girth of fruit (cm), rind thickness (mm), flesh thickness (mm), fruit yield per vine (g), number of seeds per fruit and 100-seed weight (g) in ridge gourd

S. No.	Crosses	Length of main vine	Number of primary branches per vine	Number of fruits per vine	Fruit weight	Length of fruit	Girth of fruit	Rind thickness	Flesh thickness	Fruit yield per vine	Number of seeds per fruit	100- seed weight
1	JRG-13-01 x Arka Sujat	0.05	-0.30	-0.61**	-5.98	-0.74	-0.15	0.08	3.44	-24.32**	-3.66*	0.11
2	JRG-13-01 x Pusa Nasdar	-0.10*	0.29	0.49**	12.01**	-0.69	-0.36	0.03	-3.24	47.41**	2.01	0.09
3	JRG-13-01 x Jaipur Long	0.04	0.01	0.12	-6.03	1.44	0.51	-0.04	-0.19	-23.08**	1.64	-0.20
4	JRG-13-02 x Arka Sujat	-0.11*	-0.26	0.42**	-5.98	1.06	-0.28	0.04	1.27	-26.54**	0.25	0.26
5	JRG-13-02 x Pusa Nasdar	0.07	0.29	-0.66**	-4.98	-0.21	-0.70	0.02	-8.24**	-16.14*	2.26	-0.23
6	JRG-13-02 x Jaipur Long	0.04	-0.02	0.23	10.96**	-0.84	0.98	-0.06	6.96*	42.69**	-2.51	-0.02
7	JRG-13-03 x Arka Sujat	0.08	0.52**	0.22	5.40	-0.04	-0.03	-0.09	2.44	21.23**	-0.41	0.12
8	JRG-13-03 x Pusa Nasdar	-0.12*	-0.25	-0.06	6.90	0.17	0.20	-0.17	1.75	26.96**	-1.94	0.01
9	JRG-13-03 x Jaipur Long	0.03	-0.26	-0.16	-12.31**	-0.16	-0.16	0.26*	-4.19	-48.19**	2.35	-0.12
10	JRG-13-04 x Arka Sujat	-0.15**	-0.10	0.08	5.73	-1.13	2.39**	0.08	3.11	23.06**	-0.10	-0.07
11	JRG-13-04 x Pusa Nasdar	0.01	0.09	-0.10	-1.42	0.12	-0.58	-0.04	-3.07	-4.03	-0.29	0.05
12	JRG-13-04 x Jaipur Long	0.13**	0.01	0.02	-4.31	1.01	-1.80**	-0.04	-0.03	-19.03*	0.40	0.02
13	JRG-13-05 x Arka Sujat	-0.02	-0.01	0.09	1.23	0.64	-0.77	-0.12	-4.38	4.56	0.56	-0.07
14	JRG-13-05 x Pusa Nasdar	-0.11*	-0.08	0.17	-13.92**	-0.93	-0.04	0.12	-0.74	-56.36**	-1.29	-0.13
15	JRG-13-05 x Jaipur Long	0.11*	0.09	-0.26	12.69**	0.28	0.81	-0.01	5.13	51.80**	0.73	0.20
16	JRG-13-06 x Arka Sujat	0.09	0.05	0.03	13.84**	0.26	-0.36	0.02	-1.16	59.45**	1.89	-0.38
17	JRG-13-06 x Pusa Nasdar	0.10*	-0.02	-0.05	-14.81**	-0.05	0.91	0.06	8.64**	-62.14**	-0.49	0.32
18	JRG-13-06 x Jaipur Long	-0.19**	-0.03	0.01	0.96	-0.21	-0.54	-0.09	-7.47**	2.69	-1.40	0.06
19	JRG-13-07 x Arka Sujat	0.04	0.10	-0.25	-14.26**	-0.08	-0.78	0.04	-4.72	-57.43**	1.47	0.02
20	JRG-13-07 x Pusa Nasdar	0.14**	-0.31	0.22	16.23**	1.60	0.57	-0.02	4.92	64.30**	-0.25	-0.09
21	JRG-13-07 x Jaipur Long	-0.18**	0.21	0.02	-1.97	-1.51	0.20	-0.02	-0.19	-6.86	-1.22	0.07
	SE±	0.10	0.35	0.34	8.22	2.46	1.51	0.23	6.27	16.28	3.45	0.44

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

Table 1.5: Information on best three parents on the basis of *per se* and GCA effect as well as three best crosses on the basis of *per se*, heterobeltiosis, standard heterosis and sca effect for various characters in ridge gourd

S. No.	Character	Best parents		Best crosses			
		per se	GCA effects	*per se*	Heterobeltiosis	Standard heterosis	sca effects
1	Length of main vine (m)	JRG-13-01	-	JRG-13-01 x Arka Sujat	JRG-13-07 x Jaipur Long	JRG-13-07 x Jaipur Long	JRG-13-07 x Pusa Nasdar
		JRG-13-02	-	JRG-13-04 x Jaipur Long	JRG-13-06 x Jaipur Long	JRG-13-06 x Jaipur Long	JRG-13-04 x Jaipur long
		JRG-13-06	-	JRG-13-06 x Arka Sujat	JRG13-01 x Pusa nasdar	JRG13-04 x Jaipur Long	JRG-13-05 x Jaipur long
2	Number of primary branches per vine	JRG-13-03	JRG-13-01	JRG-13-01 x Pusa Nasdar	JRG-13-01 x Pusa Nasdar	JRG-13-01 x Pusa Nasdar	JRG-13-03 x Arka Sujat
		Arka Sujat	-	JRG-13-03 x Arka Sujat	JRG-13-01 x Jaipur Long	JRG-13-03 x Arka Sujat	-
		JRG-13-07	-	JRG-13-01 x Jaipur Long	JRG-13-05 x Jaipur Long	JRG-13-01 x Jaipur Long	-
3	Number of fruits per vine	JRG-13-06	JRG-13-04	JRG-13-04 x Jaipur Long	JRG-13-04 x Jaipur Long	JRG-13-04 x Jaipur Long	JRG-13-01 x Pusa Nasdar
		JRG-13-01	JRG-13-06	JRG-13-04 x Arka Sujat	JRG-13-04 x Arka Sujat	JRG-13-04 x Arka Sujat	JRG-13-02 x Arka Sujat
		JRG-13-02	JRG-13-07	JRG-13-04 x Pusa Nasdar	JRG-13-04 x Pusa Nasdar	JRG-13-04 x Pusa Nasdar	-
4	Fruit weight (g)	Arka Sujat	JRG-13-04	JRG-13-04 x Jaipur Long	JRG-13-07 x Pusa Nasdar	JRG-13-04 x Jaipur Long	JRG-13-07 x Pusa Nasdar
		JRG-13-04	-	JRG-13-04 x Arka Sujat	JRG-13-04 x Jaipur Long	JRG-13-04 x Arka Sujat	JRG-13-06 x Arka Sujat
		Jaipur Long	-	JRG-13-04 x Pusa Nasdar	JRG-13-02 x Jaipur Long	JRG-13-04 x Pusa Nasdar	JRG-13-05 x Jaipur long
5	Length of fruit (cm)	JRG-13-03	-	JRG-13-07 x Pusa Nasdar	JRG-13-02 x Pusa Nasdar	JRG-13-07 x Pusa Nasdar	JRG-13-07 x Pusa Nasdar
		Jaipur Long	-	JRG-13-01 x Jaipur Long	JRG-13-07 x Pusa Nasdar	-	JRG-13-02 x Jaipur long
		JRG-13-07	-	JRG-13-06 x Pusa Nasdar	JRG-13-06 x Pusa Nasdar	-	JRG-13-03 x Arka Sujat

Table 1.5: (*Continue…..*)

S. No.	Character	Best parents		Best crosses			
		per se	GCA effects	*per se*	Heterobeltiosis	Standard heterosis	sca effects
6	Girth of fruit (cm)	JRG-13-04	JRG-13-04	JRG-13-04 x Arka Sujat	JRG-13-04 x Arka Sujat	JRG-13-04 x Arka Sujat	JRG13-04 x Arka Sujat
		Jaipur Long	-	JRG-13-04 x Pusa Nasdar	JRG-13-06 x Pusa nasdar	JRG-13-04 x Pusa Nasdar	-
		JRG-13-02	-	JRG-13-04 x Jaipur long	JRG-13-07 x Pusa nasdar	JRG-13-04 x Jaipur Long	-
7	Rind thickness (mm)	Pusa Nasdar	-	JRG-13-05 x Arka Sujat	JRG-13-05 x Arka Sujat	JRG-13-05 x Arka Sujat	-
		JRG-13-02	-	JRG-13-03 x Pusa Nasdar	-	-	-
		JRG-13-07	-	JRG-13-07 x Pusa Nasdar	-	-	-
8	Flesh thickness (mm)	JRG-13-04	JRG-13-04	JRG-13-04 x Jaipur Long	JRG-13-06 x Pusa Nasdar	JRG-13-04 x Jaipur Long	JRG-13-06 x Pusa Nasdar
		Jaipur Long	-	JRG-13-06 x Pusa Nasdar	JRG-13-07 x Pusa Nasdar	JRG-13-06 x Pusa Nasdar	JRG-13-02 x Jaipur long
		JRG-13-02	-	JRG-13-04 x Arka Sujat	JRG-13-02 x Pusa Nasdar	JRG-13-04 x Arka Sujat	-
9	Fruit yield per vine (g)	Arka Sujat	JRG-13-04	JRG-13-04 x Jaipur Long	JRG-13-07 x Pusa Nasdar	JRG-13-04 x Jaipur Long	JRG-13-07 x Pusa Nasdar
		JRG-13-04	JRG-13-07	JRG-13-04 x Arka Sujat	JRG-13-04 x Jaipur Long	JRG-13-04 x Arka Sujat	JRG-13-06 x Arka Sujat
		Jaipur Long	JRG-13-06	JRG-13-04 x Pusa Nasdar	JRG-13-02 x Jaipur Long	JRG-13-04 x Pusa nasdar	JRG-13-05 x Jaipur long
10	Number of seeds per fruit	Arka Sujat	JRG-13-01	JRG-13-01 x Arka Sujat	-	-	JRG-13-01 x Arka Sujat
		JRG-13-07	JRG-13-02	JRG-13-02 x Jaipur Long	-	-	-
		JRG-13-02	JRG-13-07	JRG-13-07 x Jaipur Long	-	-	-
11	100-seed weight (g)	JRG-13-05	JRG-13-07	JRG-13-01 x Jaipur Long	-	-	-
		Jaipur Long	JRG-13-05	JRG-13-03 x Jaipur Long	-	-	-
		JRG-13-07	JRG-13-01	JRG-13-02 x Pusa Nasdar	-	-	-

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