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Gene Action and Combining Ability Analysis for Yield and Yield-Related Traits in Ridge Gourd [*Luffa Acutangula* (L.) Roxb.]

By Anand Narasannavar, V. D. Gasti, Sridhar, Sheela Malghan, & Kumara B. R
University of Horticultural Sciences, Bagalkot, India

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I. Introduction

Ridge gourd (*Luffa acutangula* (L.) Roxb.) is an important cucurbitaceous vegetable crop widely grown in tropical and subtropical parts of the world. It belongs to genus *Luffa* of Cucurbitaceae and has a chromosome number 2n=26. The genus derives its name from product 'loofah' which is used in bathing sponge, doormats, pillows and also cleaning utensils. In addition to culinary properties, it has therapeutic properties and is used for extraction of fibres [1]. Ridge gourd, being predominantly monoecious, is a cross pollinated crop and provides ample scope for utilization of the hybrid vigour. During recent years, the exploitation of hybrid vigour and selection of parents on the basis of combining ability have expanded a new alley in crop improvement. These studies are generally used to assess the performance of lines in hybridization programme and to understand the gene action involved in different characters.

Author α σ ρ: Department of Vegetable Science, KRCCH, Arabhavi. e-mail: anand0486@gmail.com
Author ω: Department of Vegetable Science, College of Horticulture Bagalkot.
Author ¥: Department of Plantation, Medicinal, Spices and Aromatic Crops, KRCCH, Arabhavi.

II. Materials and Methods

The experimental material consists of 20 parents *viz.* KRG-1, KRG-2, KRG-3, KRG-4, KRG-5, KRG-6, KRG-7, KRG-8, KRG-9, KRG-10, KRG-11, KRG-12, KRG-13, KRG-14, KRG-15, KRG-16, KRG-17 used as lines and three testers namely ASJ, ASM and PN and one standard check Naga. An experiment was carried out at Vegetable Science Department, K. R. C. College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot during summer and *kharif,* 2012. The experiment consists of 20 parents and 51 hybrids and were evaluated in randomized block design with two replications. A spacing of 1.2 m × 0.9 m was followed and other cultural practices were followed as per the package of practices of UAS, Dharwad [2]. Observations on five randomly selected plants were recorded for various growth, earliness, yield and quality parameters. The Line × Tester analysis is one of the most appropriate methods in preliminary screening of the breeding material for combining ability and data was analyzed as per the Kempthorne [3] to determine general and specific combining ability.

III. Results and Discussion

The analysis of variance (Table 1) for genotypes showed significant differences for all the characters. The estimates of mean sum of squares due to parents showed significant differences for all the characters except node to first female flower, per cent fruit set, number of fruits per vine and fruit yield per vine indicating the presence of sufficient variability among the parents studied. The magnitude if variance due to sca was greater than gca for all the characters and GCA: SCA less than unity also confirmed the preponderance of non-additive gene action for all the traits. These results are close conformity with Purohit[4] and Neeraja [5].

The estimates of *gca* effects of each parents are presented in Table 2. Among the 20 parents, seven parents showed significant and positive gca effects for fruit yield per vine, the highest was observed in the line KRG-3 (0.29) followed by KRG-11 (0.12), KRG-10 and KRG-2 (0.08). The parent KRG-3 was found to be good general combiner for all the character except number of

leaves 90 days after sowing (DAS), days to first female flower appearance, node to first female flower appearance, sex ratio, per cent fruit set, average fruit weight and flesh thickness.

The line KRG-5 (-2.99) and tester PN (-1.84) exhibited negative and significant *gca* effects for days to first female flower appearance. For days to first harvest significant and highest *gca* effects was observed in the parent KRG-5 (-5.62) followed by KRG-3 (-4.28) and PN (-1.69). These results are in agreement with Ahmed *et al.* [6]. The parents *viz.* KRG-5 and PN exhibited the significant and negative *gca* effects for both days to first female flower appearance and days to first harvest so, these parents may be used in breeding programme for earliness.

`The female parent KRG-11 exhibited the maximum and significant *gca* effects for number of leaves at 90 DAS (6.77) and number of branches at 90 DAS (2.09) whereas the male parent ASJ for number of leaves at 90 DAS (6.43) and number of branches at 90 DAS (0.37) exhibited positive and significant *gca* effects. None of the parents exhibited positive and significant *gca* effects for per cent fruit set. For average fruit weight the line KRG-12 (75.28) exhibited maximum and significant *gca* effects whereas, KRG-1 (5.40) exhibited significant and maximum *gca* effects for fruit length. The line KRG-3 was the good general combiner for number of fruits per vine (1.20), fruit diameter (0.59), fruit yield per vine (0.29), fruit yield per plot (4.34) and fruit yield per hectare (13.52) whereas, KRG-2 exhibited the maximum and significant *gca* effects for flesh thickness (0.50).

However parents KRG-2, KRG-3, KRG-4, KRG-11, KRG-16, ASM and PN exhibited significant *gca* effects for the most of the traits. Due to predominant role of non-additive gene action for yield and its components, it is difficult to bring together desirable genes by pedigree method. In this situation formation of central gene pool by bringing together the multiple parents having the good *gca* effects suggested by Jensen [7] might prove to be useful.

The crosses having desired significant specific combining effects are presented in Table 3. Out of 51 crosses, 16 crosses exhibited positively significant and 15 crosses exhibited negatively significant sca effects for fruit yield per vine. Maximum and positively significant sca effects was observed in the cross KRG-9 x ASJ (0.24) followed by KRG-10 x PN (0.22), KRG-6 x ASM (0.16) and KRG-3 x ASJ (0.14).

The highest positive *sca* effects was exhibited (Table 3) by the cross KRG-11 x PN (90.46) followed by KRG-6 x PN (70.63) for number of leaves per vine. For number of branches significant *sca* effects and maximum *sca* effects (1.86) were exhibited by KRG-3 x ASM followed by KRG-11 x PN (1.68) and KRG-15 x PN (1.45). For days to first female flower appearance, the cross KRG-15 x ASJ (-7.35) followed by KRG-15 x PN (-6.82) and KRG-11 x ASM (-6.32) exhibited maximum negative and significant *sca* effects. Among the crosses only cross KRG-9 x ASJ (-5.31) was exhibited negative and significant *sca* effects for node to first female flower appearance which is desirable.

The cross KRG-12 x PN (-8.67) followed by KRG-17 x PN (-7.83) exhibited significant in desirable direction (negative) for sex ratio. For per cent fruit set the cross KRG-16 x PN (12.38) exhibited positive and significant *sca* effects. None of the testers and crosses exhibited positive and significant *sca* effects for number of fruits per vine. For average fruit weight maximum and significant sca effects was observed in the cross KRG-4 x ASM (85.99) followed by KRG-13 x PN (81.08) and KRG-6 x ASJ (75.70) whereas, the highest positive and significant *sca* effects was exhibited by the cross KRG-1 x ASJ (8.20) followed by KRG-12 x PN (5.48) and KRG-14 x ASM (4.45) for fruit length. Maximum and significant sca effects was observed in the cross KRG-12 x PN (1.10) for fruit diameter. Two crosses KRG-6 x ASJ (0.85) followed by KRG-1 x ASM (0.69) exhibited the positive and significant *sca* effects for flesh thickness.

It was interested to record that out of 51 crosses, showing high specific combining ability effects, two crosses were the product of one parent having a high general combining ability, one cross was the product of one parent having a low general combining ability and remaining one cross involved the both parents having high general combining ability. Similar results were also reported by Neeraja [5] in ridge gourd. The crosses involving parents with good general combining ability effects can be exploited effectively by conventional breeding procedure like pedigree method. However the crosses one good combiner and other average or poor combiner could produce desirable transgressive segregators if additive genetic system was operative in good combining parents and epistatic effects also act in the same direction.

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Table 1 : Analysis of variance (mean sum of squares) of Line × Tester analysis for various characters in ridge gourd

Sl. No.	Character	Replications	Genotypes	Parents	Parents vs Crosses	Crosses	Lines	Testers	Line × Tester	Error
	Degree of freedom	1	70	19	1	50	16	2	32	70
1	Number of leaves on 90 DAS	2992.11	2713.58**	2253.55**	2652.41**	2889.63**	4336.66NS	1707.65NS	2239.98**	159.91
2	Number of branches at 90 DAS	18.316	3.23**	3.25**	2.97**	3.23**	4.46NS	4.4.7NS	2.53**	0.163
3	Days to first female flowering	43.94	47.98**	54.95**	6.92NS	46.15**	55.74NS	89.01NS	38.68**	11.57
4	Node to first female flower	3.71	15.02*	12.73NS	2.08NS	16.15*	11.69NS	37.93NS	17.02*	9.40
5	Days to first harvest	156.34	39.32**	46.36**	0.88NS	35.99**	38.41NS	129.45*	28.93**	14.29
6	Sex ratio (%)	21.93	60.05**	68.32**	17.33NS	57.77**	42.18NS	259.45*	52.95*	30.66
7	Per cent fruit set	474.76	99.19*	93.23NS	62.95NS	102.19*	73.07NS	45.91NS	120.26*	62.94
8	Number of fruits per vine	12.30	1.23**	0.76NS	22.22**	0.98*	1.35*	3.54**	0.65NS	0.64
9	Average fruit weight (g)	108.86	4412.09**	3415.40**	35021.75**	29533.38**	4480.72NS	1076.19NS	4462.62**	285.14
10	Fruit length (cm)	5.70	40.10**	41.02**	358.34**	33.39**	46.25*	104.96*	22.49**	7.85
11	Fruit diameter (cm)	0.008	0.81**	0.98**	0.84NS	0.74**	0.76NS	1.87NS	0.67*	0.39
12	Fruit yield per vine (g)	0.003	0.054**	0.069NS	0.108**	0.108**	0.073*	0.037NS	0.035**	0.002
13	Fruit yield per plot (kg)	3.48	1.78**	1.44**	16.58**	1.61**	1.95**	0.43NS	1.51**	0.22
14	Fruit yield per hectare (q)	297.56	152.38**	123.37**	1417.86**	138.10**	167.06NS	37.59NS	129.90**	18.74
15	Flesh thickness (cm)	0.07	0.48**	0.53**	0.42NS	0.46**	0.56NS	1.13NS	0.37*	0.22

Table 2 : General combining ability effects of parents for growth, earliness, yield and quality parameters in ridge

Sl. No.	Parent	Number of leaves at 90 DAS	Number of branches at 90 DAS	Days to first female flowering	Node to first female flower	Days to first harvest	Sex ratio	Per cent fruit set	Number of fruit per vine	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield per vine (kg)	Fruit yield per plot (kg)	Fruit yield per hectare (q)	Flesh thickness (cm)
Lines																
1	KRG-1	-28.73**	-0.78**	-2.32	-1.41	-0.78	-0.87	2.92	-0.03	-10.18	5.40**	0.04	0.07**	-0.01	-5.21**	-0.19
2	KRG-2	-7.60	0.55**	-1.82	-2.11	-0.28	-0.91	-1.31	0.14	-35.10**	2.76*	0.56*	0.08**	-0.34	4.71**	0.50*
3	KRG-3	2.37	1.29**	-2.49	-1.37	-4.28**	-3.33	4.37	1.20**	-12.76	2.56*	0.59*	0.29**	4.34**	13.52**	0.3
4	KRG-4	-5.90	-0.15	-2.46	-0.97	-0.78	0.33	-1.39	0.17	22.50**	1.80	0.33	0.01	-0.84**	-0.64	0.01
5	KRG-5	-17.70**	-0.71**	-2.99*	-0.67	-5.62**	-3.38	-0.31	0.34	-14.67*	-3.50**	-0.12	0.04	-5.68**	-2.95	-0.13
6	KRG-6	0.77	-0.85**	2.68	-0.01	0.55	2.29	1.33	-0.46	28.61**	-4.62**	-0.57*	-0.07**	0.49*	-3.88*	0.21
7	KRG-7	11.10*	-0.48*	0.34	1.13	0.05	0.60	3.49	-0.36	-39.86**	-4.20**	0.31	-0.02	-0.01	-4.21*	0.31
8	KRG-8	5.24	-0.28	-2.16	0.43	-1.28	0.48	-3.47	0.1	-11.31	-1.47	0.05	0.07**	-1.18**	-0.38	0.21
9	KRG-9	-34.06**	-1.11**	-0.99	2.79*	-0.55	2.25	1.48	-0.33	5.48	-1.70	-0.15	-0.08**	0.49*	-5.51**	0.23
10	KRG-10	-11.03*	0.09	-2.82	-1.94	-0.95	4.18	2.48	0.14	4.88	-1.00	0.00	0.08**	-1.01**	7.04**	-0.06
11	KRG-11	66.64**	2.09**	6.18**	2.13	2.55	1.33	4.57	0.70*	-12.62	0.26	0.26	0.12**	2.49**	6.11**	-0.04
12	KRG-12	24.64**	0.99**	0.18	1.03	-1.12	0.96	-8.15*	-0.3	75.28**	0.46	0.27	-0.08**	-1.14**	-4.35*	0.34
13	KRG-13	-31.90**	-0.15	-2.49	-0.07	4.72**	-6.57**	-5.32	-0.66	17.18*	-1.70	-0.64*	-0.14**	4.16**	1.79	-0.61
14	KRG-14	-23.06**	-0.35*	4.51**	0.73	3.88*	-1.59	1.94	-0.43	-22.24**	0.20	-0.33	-0.10**	3.82**	-5.45**	-0.49*
15	KRG-15	4.64	1.02**	5.68**	-0.87	0.55	3.2	-1.42	-0.03	3.15	-0.60	-0.16	-0.07**	0.49*	-1.28	-0.15
16	KRG-16	-2.96	-0.11	0.84	-0.07	1.38	1.11	1.27	-0.46	16.84*	3.50**	-0.26	-0.12**	1.32**	-0.06	-0.24
17	KRG-17	47.67**	0.02	0.18	1.26	0.88	-0.09	-2.49	0.27	-15.20*	1.96	-0.18	-0.09**	0.82**	0.74	-0.20
	S.Em±	5.16	0.16	1.39	1.25	1.54	2.26	3.24	0.33	6.84	1.14	0.26	0.02	0.19	1.77	0.19
	CD at 5%	10.29	0.32	2.77	2.49	3.07	4.51	6.46	0.66	13.64	2.27	0.52	0.04	0.38	3.53	0.38
	CD at 1%	13.66	0.42	3.68	NS	4.08	5.98	NS	0.87	18.11	3.02	NS	0.05	0.5	4.69	0.5
Testers																
1	ASJ	6.43**	0.37**	1.19*	1.07*	2.14**	2.31*	0.94	-0.37*	4.6	1.93**	-0.08	-0.04**	-0.05	-0.43	0.02
2	ASM	1.17	-0.03	0.66	-0.03	-0.45	0.75	-1.3	0.15	1.68	-0.42	-0.19	0.01	-0.08	-0.77	-0.19*
3	PN	-7.60**	-0.35**	-1.84**	-1.04	-1.69*	-3.06**	0.36	0.22	-6.27*	-1.51**	0.26*	0.03*	0.13	1.2	0.17*
	S.Em±	2.17	0.07	0.58	0.53	0.65	0.95	1.36	0.14	2.9	0.48	0.11	0.01	0.08	0.74	0.08
	CD at 5%	4.33	0.14	1.16	1.06	1.30	1.89	NS	0.28	5.78	0.96	0.22	0.02	NS	NS	0.16
	CD at 1%	5.75	0.19	1.54	NS	1.72	2.52	NS	NS	NS	1.27	NS	0.03	NS	NS	NS

Table 3 : Specific combining ability effects of hybrids for growth, earliness yield and quality parameters

Sl. No.	Cross	Number of leaves 90 DAS	Number of branches 90 DAS	Days to first female flowering	Node to first female flower	Days to first harvest	Sex ratio	Per cent fruit set	Number of fruits per vine	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield per vine (kg)	Fruit yield per plot (kg)	Fruit yield per hectare (q)	Flesh thickness (cm)
1	KRG-1 × ASJ	5.30	0.53	1.65	0.19	-1.30	-0.07	2.95	0.07	19.57	8.20**	0.24	0.03	0.71*	6.55*	-0.18
2	KRG-1 × ASM	2.87	-0.37	-1.82	-1.30	-3.72	1.81	3.45	0.05	-8.96	-5.75**	0.73	0.09**	0.05	0.49	0.69*
3	KRG-1 × PN	-8.17	-0.15	0.18	1.11	5.02	-1.74	-6.40	-0.12	-10.62	-2.46	-0.97*	-0.13**	-0.76*	-7.04*	-0.51
4	KRG-2 × ASJ	21.27*	0.39	-0.85	1.89	3.20	-2.44	-8.87	-0.4	-0.51	3.14	0.07	0.01	-0.80*	-7.40*	0.13
5	KRG-2 × ASM	-17.87*	-0.51	1.18	-1.90	0.78	-1.4	4.04	0.78	-0.66	1.59	0.01	0.07*	1.20**	11.12**	-0.19
6	KRG-2 × PN	-3.40	0.12	-0.32	0.01	-3.98	3.84	4.82	-0.38	1.17	-4.72*	-0.07	-0.09**	-0.40	-3.72	0.06
7	KRG-3 × ASJ	-10.6	-1.74**	2.81	1.36	4.70	0.75	-0.22	-0.46	-43.26**	-3.96*	0.28	0.14**	-1.04**	-9.61*	-0.08
8	KRG-3 × ASM	5.67	1.86**	-0.66	0.17	-1.22	3.83	-5.18	-0.29	11.95*	-0.61	-0.17	0.07*	0.95**	9.25**	0.00
9	KRG-3 × PN	4.93	-0.12	-2.16	-1.53	-3.48	-4.58	5.39	0.75	31.94**	4.58*	-0.11	0.03	0.92**	8.56**	0.08
10	KRG-4 × ASJ	-1.73	1.39**	-1.69	-3.04	-3.80	-2.47	8.13	0.47	-51.56**	1.6	-0.16	0.12**	0.63	5.84	0.07
11	KRG-4 × ASM	-1.67	-0.21	-2.66	0.47	1.28	-5.44	-12.70*	0.15	85.99**	0.85	0.4	-0.07*	0.30	2.81	0.09
12	KRG-4 × PN	3.40	-1.18**	4.34	2.57	2.52	7.91*	4.57	-0.62	-34.43**	-2.46	-0.24	-0.05	-0.93**	-8.65**	-0.15
13	KRG-5 × ASJ	-4.33	-1.24**	2.81	1.56	-2.47	-1.05	-1.79	-0.10	11.69	-1.6	-0.27	-0.15**	-0.55	-5.04	-0.31
14	KRG-5 × ASM	5.63	-0.14	-1.16	-3.23	1.12	-5.46	2.75	0.18	-15.72	-1.15	0.15	0.15**	0.12	1.07	0.24
15	KRG-5 × PN	-1.30	1.38**	-1.16	1.67	1.35	6.51	-0.96	-0.08	4.04	2.74	0.13	0.00	0.43	3.96	0.07
16	KRG-6 × ASJ	-33.10**	-0.01	0.65	-1.81	3.86	3.00	2.97	-0.70	75.70**	-0.08	-0.79	-0.22**	-0.88*	-8.16**	0.85*
17	KRG-6 × ASM	-37.53**	-1.21**	-3.32	0.50	-2.55	-4.99	-1.11	-0.12	1.21	-1.63	-0.02	0.16**	0.63	5.82	-0.81
18	KRG-6 × PN	70.63**	1.22**	2.68	1.31	-1.31	1.99	-1.87	0.82	-76.90**	1.71	0.82	0.07*	0.25	2.35	-0.04
19	KRG-7 × ASJ	-23.63*	0.03	-3.02	-1.84	-2.14	1.12	8.54	-0.10	-1.14	0.6	0.36	-0.02	-0.51	-4.73	0.08
20	KRG-7 × ASM	35.33**	0.63*	2.01	1.97	0.45	-3.71	-10.89	0.28	4.28	-1.35	-0.07	0.03	0.46	4.25	0.03
21	KRG-7 × PN	-11.70	-0.65*	1.01	-0.13	1.69	2.59	2.34	-0.18	-3.14	0.74	-0.29	-0.01	0.05	0.48	-0.11
22	KRG-8 × ASJ	-10.86	0.83**	1.48	4.46*	-0.80	4.06	-0.85	0.34	45.08**	1.37	0.51	0.10**	0.80*	7.42*	0.3
23	KRG-8 × ASM	10.80	0.43	-1.99	-2.43	1.78	-2.89	-2.12	0.21	-17.45	-0.48	0.03	0.01	0.12	1.14	-0.01
24	KRG-8 × PN	0.06	-1.25**	0.51	-2.03	-0.98	-1.17	2.97	-0.55	-27.63*	-0.89	-0.54	-0.11**	-0.92**	-8.56**	-0.29
25	KRG-9 × ASJ	31.94**	0.36	-6.19*	-5.31*	-8.64**	1.37	-5.58	0.47	5.61	0.6	0.79	0.24**	0.77*	7.10*	0.43
26	KRG-9 × ASM	-21.50*	-0.24	3.34	9.20**	2.45	3.26	9.37	-0.15	-17.50	-1.05	-0.92*	-0.12**	-0.74*	-6.88*	-0.08
27	KRG-9 × PN	-10.44	-0.12	2.84	-3.89	6.19*	-4.63	-3.79	-0.32	11.89	0.44	0.13	-0.12*	-0.03	-0.22	-0.36
28	KRG-10 × ASJ	37.30**	0.76*	0.65	0.63	5.36*	-1.39	-3.52	0.00	11.67	-0.8	-0.63	-0.05	0.52	4.88	-0.57
29	KRG-10 × ASM	-19.13*	-0.94	1.68	-1.57	1.45	6.61	6.01	-0.72	18.44	1.05	0.51	-0.17**	-1.64**	-15.20**	0.38
30	KRG-10 × PN	-18.17*	0.18	-2.32	0.94	-6.81*	-5.22	-2.48	0.72	-30.11*	-0.26	0.12	0.22**	1.11**	10.32**	0.19

Table 3. Continued…

Sl. No.	Cross	Number of leaves	Number of branches	Days to first female flowering	Node to first female flower	Days to first harvest	Sex ratio	Per cent fruit set	Number of fruits per vine	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield per vine (kg)	Fruit yield per plot (kg)	Fruit yield per hectare (q)	Flesh thickness (cm)
		90 DAS	90 DAS													
31	KRG-11 × ASJ	-57.46**	-1.54**	4.15	-3.44	2.86	-0.80	3.16	0.54	-48.98**	1.04	-0.28	-0.04	-0.89**	-8.22**	0.31
32	KRG-11 × ASM	-33.00**	-0.14	-6.32*	0.67	-2.05	-4.48	3.79	-0.39	27.06*	-0.71	-0.41	-0.11**	-0.34	-3.13	-0.11
33	KRG-11 × PN	90.46**	1.68**	2.18	2.77	-0.81	5.28	-6.95	-0.15	21.88	0.32	0.69	0.15**	1.22**	11.36**	0.42
34	KRG-12 × ASJ	15.84	0.86**	3.65	2.06	4.03	4.00	2.77	-0.06	-45.17**	-7.06**	-1.17*	0.16**	0.67*	6.18*	-0.96
35	KRG-12 × ASM	18.80*	0.06	-0.82	-1.43	-0.88	4.68	7.89	-0.49	-3.01	1.59	0.07	-0.15**	-0.71*	-6.56*	0.03
36	KRG-12 × PN	-34.64**	-0.92**	-2.82	-0.63	-3.15	-8.67*	-10.66	0.55	48.18**	5.48**	1.10*	-0.01	0.04	0.04	0.93
37	KRG-13 × ASJ	-15.03	1.29**	4.82*	0.96	-0.30	-5.88	-5.14	0.10	18.24	0.2	0.33	-0.01	0.76*	7.02*	-0.04
38	KRG-13 × ASM	11.73	-0.61*	-4.66	-0.33	0.78	2.32	-3.28	0.58	-99.33**	-0.05	-0.23	0.09**	0.41	3.83	0.07
39	KRG-13 × PN	3.30	-0.68*	-0.16	-0.63	-0.48	3.57	8.42	-0.68	81.08**	-0.16	-0.1	-0.08**	-1.17**	-10.85**	-0.03
40	KRG-14 × ASJ	-11.46	-1.31**	-1.19	-0.34	-1.97	3.62	-1.19	-0.63	18.64	-1.40	0.23	-0.08**	-0.90**	-8.35**	0.17
41	KRG-14 × ASM	8.20	0.59*	1.84	2.27	-0.88	-0.26	-6.75	0.85	-54.55**	4.45*	-0.06	0.04	0.01	0.10	-0.18
42	KRG-14 × PN	3.26	0.72*	-0.66	-1.93	2.85	-3.36	7.99	-0.22	35.92**	-3.06	-0.17	0.04	0.89**	8.24**	0.01
43	KRG-15 × ASJ	35.24**	-0.37	-7.35**	1.76	-2.64	-0.05	5.34	0.77	-43.26**	1.8	0.26	0.04	0.83*	7.73*	0.16
44	KRG-15 × ASM	-0.90	-1.07**	14.18**	0.17	-0.05	-0.60	6.35	-0.75	60.04**	1.35	0.24	-0.09**	-0.61	-5.65	0.14
45	KRG-15 × PN	-34.34**	1.45**	-6.82**	-1.93	2.69	0.65	-11.69*	-0.02	-16.78	-3.16	-0.50	0.05	-0.23	-2.08	-0.30
46	KRG-16 × ASJ	-10.76	-0.24	-0.52	0.56	3.03	-7.47	-3.18	0.20	25.86*	-0.70	0.47	0.04	-0.06	-0.57	0.40
47	KRG-16 × ASM	36.90**	1.06**	0.51	-1.73	-0.88	2.60	-9.21	-0.42	25.26*	1.05	-0.24	0.04	0.38	3.5	-0.30
48	KRG-16 × PN	-26.14**	-0.82**	0.01	1.17	-2.15	4.87	12.38*	0.22	-51.12**	-0.36	-0.23	-0.08**	-0.32	-2.93	-0.10
49	KRG-17 × ASJ	32.10**	0.03	-1.85	0.33	-2.97	3.70	-3.54	-0.53	1.79	-3.00	-0.23	-0.03	-0.07	-0.67	-0.14
50	KRG-17 × ASM	-4.33	0.83**	-1.32	-1.47	2.12	4.13	7.61	0.25	-16.42	0.85	-0.02	-0.09**	0.24	2.24	0.01
51	KRG-17 × PN	-27.77**	-0.85**	3.18	1.14	0.85	-7.83*	-4.07	0.28	14.63	2.14	-0.25	0.12**	-0.17	-1.57	0.13