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Combining Ability Studies in Ridge Gourd [*Luffa acutangula* (Roxb.) L.] for Quantitative and Qualitative Traits

V. Krishnamoorthy*

Horticulture Research Station, Tamil Nadu Agricultural University, Thadiyankudisai, Perumbarai (PO), Batlagundu (via), Dindugal District-624 212, Tamil Nadu, India

**Corresponding author*

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A B S T R A C T

An investigation was conducted at Department of Horticulture, Agricultural College and Research Institute, TNAU, Madurai to identify best general combiner and specific combiner in ridge gourd for yield and quality traits. Twenty four ridge gourd hybrids, six female parents (lines) and four male parents (Testers) were sown in the field during *kharif*, 2018. Based on the *gca* effects it was found that the female parent L3 (Virdhunagar local) is best combiner for narrow sex ratio (-0.57), days to harvest (-13.71), number of fruits per plant (3.04), fruit weight (21.67), yield per plant (0.61) and yield per hectare (2.44) and L5 (Arka Sujath) is best general combiner for high fruit length (5.93) and low moisture content (-1.62). L1 (PKM1) is best general combiner for early days to harvest (-2.44) and fruit length (2.15). L2 (CO1) is best general combiner for fruit weight (40.65), yield per plant and yield per hectare (1.01, 4.05). The male parent T1 (Periyakottai Local) is best general combiner for days to first male flower (-2.10), days to first female flower (-1.88), node to first male flower (-1.47), sex ratio (-0.43), The T2 (Alatur Local) for narrow sex ratio (-0.17), early days to harvest (-1.98), for low moisture content (-2.03), for fruit length (4.04), number of fruits per plant (1.67), for dry matter content (2.03), for yield per plant and yield per hectare in T2 (0.20, 2.11). The specific combing ability reveals that among the twenty four cross combination L3XT1 (Virdhunagar local X Periyakottai Local) and L3XT2 (Virdhunagar local X Alatur Local) are best combiner for early days to male flower (-3.18, -3.01), for days to female flower(-3.88,-2.52), for narrow sex ratio (-0.39,-0.42), for fruit weight (49.41, 56.65), for more number of fruits per plant (3.39, 4.06), high fruit yield per plant (1.28,1.21) and yield per hectare (4.32,4.21). The crosses L1XT1(PKM-1X Periyakottai Local) L2XT2 (CO1X Alathur Local), and L5XT4 Arka Sujath X Srirampuaram Local) are best combiner for early days to harvest (-15.33, -7.60,-7.44). L6XT4 (Arka Sumeet X Srirampuaram Local) (15.30), L5XT1 (Arka Sujath X Periyakottai Local) (11.05), L1XT3 (PKM1X Kannapatti Local) are best combiner for fruit length (15.30, 11.05, 7.21). L5XT3 (Arka Sujath X Kannapatti Local), L2XT1 CO2X Periyakottai Local) (3.49), L6XT2 (Arka Sumeet X Alathur Local) are best combiner for high dry matter content (3.89, 3.49, 3.35).

Introduction

Ridge gourd (*Luffa accutangula* L., 2n=26) a member of Cucurbitaceae family, is grown almost all the parts of world for its nutritive

value. It is commercially cultivated throughout India due to suitability of crop for growing under limited irrigation with substantial yield. The productivity of ridge gourd has to be improved. Hence, developing of new varieties and hybrids with high yield potential is required to increase the income of the farmer. For developing a suitable and efficient breeding programme, information regarding the nature and magnitude of genetic variation that exists in the breeding population is necessary. Although, ridge gourd is becoming a commercial crop but relatively less attention has been paid towards the improvement of existing germplasm available in different parts of the country. Information about combining ability of experimental breeding materials is imperative to a breeding program aiming to develop hybrids and varieties having high yield and quality. Combining ability studies aiming to identify inbred lines with good *gca* and *sca* effects rely on the availability of genetic diversity among groups of genotypes involved in a breeding program. Significant values of general combing ability (*gca*) and specific combining ability (*sca*) may be interpreted for indicating the involvement of additive and non-additive gene action, respectively. *Gca* enabled breeders to exploit the existing variability in the breeding materials, to identify individual genotypes conferring desirable attributes and to distinguish relatedness among genotypes. While *sca* is useful to determine heterotic patterns among populations or inbred lines, to identify promising single cross and to assign inbred lines into heterotic groups. A knowledge of general combining ability (*gca*) and specific combining ability (*sca*) helps to make choice of the parents of for hybridization and to know the nature of gene action. The present investigation therefore was undertaken to identify potential parental combinations in order to develop superior hybrids.

Materials and Methods

The experiment was under taken at Department of Horticulture, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai during *kharif* season of 2018 (August- November). The experiment consists of 10 genetically diverse genotypes of ridge gourd. Six genotypes were used as female parents as lines (L) are L1 (PKM-1), L2 (CO1), L3 (Virdhunagar local), L4 (Seranmadevi Local), L5 (Arka Sujath), L6 (Arka Sumeet) and four genotypes were used as male parents as testers are T1 (Periyakottai Local), T2 (Alathur Local), T3 (Kannapatti Local), T4 (Srirampuaram Local) crossed in Line X Tester matting design. The crossing was effected by covering the staminate flowers in testers and pistillate flowers in the lines separately with butter paper covers on the previous day evening, prior to anthesis. On the next day morning, the collected pollen grains from the bagged staminate flowers were dusted on the bagged female flowers of the lines between 6.00 and 8.30 am. The dusted pistillate flowers were covered with butter paper covers and labeled with the details of the cross and the date of pollination. Twenty four crosses were generated from Line X Tester matting design. All the hybrids and their parents were raised in randomized block design with three replications and evaluated against the standard check hybrid. The observations on various traits registered are days to first male flower, days to first female flower, node to first male flower, node to first female flower, sex ratio, vine length (m), days to harvest, fruit weight (g), fruit length (cm), fruit girth (cm), rind thickness (mm), flesh thickness (mm), no. of fruits/ plant, yield/plant (g), yield/ha (t/ha), total soluble solids (TSS), dry matter content (%), moisture content (%), total crude fiber (mg/100g). The data recorded on various traits were subjected to analysis of variance

by following procedure of Kempthorne (1957)[6] to determine general and specific combining ability.

Results and Discussion

The analysis of variance for female and male parents exhibited (Table 1) significant difference for all the traits. The estimates of mean sum of squares due to Lines showed significant differences for all the traits except fruit rind thickness, fruit flesh thickness, fruit girth, total soluble solids (TSS) and total crude fiber content and in the male parents apart from these traits node to first female flower, sex ratio, vine length also indicating the presence of sufficient variability among the parents studied. The variance due to general combing ability (*gca*), specific combining ability (*sca*), *gca*/*sca* ratio, contribution of lines, contribution of tasters, and interaction of lines and testers are given in the Table 2.

The magnitude of variance due to *sca* was greater than *gca* for all the traits and *gca*/sca ratio less than unity also confirmed the preponderance of non additive gene action for all the traits. Ridge gourd is cross pollinated crop exhibits the predominance of dominance genetic variance in comparison to additive component. Yamuna *et al.,* (2018)[11] observed same type results in sponge gourd. The *gca* to sca ratio was observed from 0.011 to 0.50. The low ratio was found in dry matter content (0.011), flesh thickness (0.032), yield per plant (0.034), yield per hectare (0.52). The *gca/sca* ratio recorded in rind thickness (0.50), total crude fiber (0.333), vine length (0.107) and days to first female flower (0.100). Similar findings were also reported by Bhatt *et al.,* (2017)[2] in bitter gourd. Percent contribution of Line X Tester interaction was higher for the traits *viz*. fruit length (63.94%), dry matter content (56.78%), node to first female flower appearance (63.94), vine length (48.67%), node to first male flower appearance (45.96%), yield per plant (45.53) compared to lines and testers. Hence there is great scope for heterosis breeding to exploit the non additive genetic variance observed for yield components. Narasannavar *et al.,* (2018)[8] reported same type findings in ridge gourd.

General Combining Ability

The general combining ability of female parents reveals that significantly negative effect for sex ratio in L3 (-0.57) and L2 (-0.34), for days to harvest in L3 (-13.71) and L1 (-2.44), for moisture content in L5 (-1.62) and L6 (-1.26). Significantly positive values were registered for fruit length in L1 (2.15) and L5 (5.93), for fruit weight L2 (40.65) and L3 (21.67), for number of fruits per plant in L3 (3.04), for dry matter content L5 (1.62), L6 (1.26), yield per plant and yield per hectare in L2 (1.01, 4.05) and L3 (0.61, 2.44). Similar results were obtained by Mallikarjunarao *et al.,* (2018)[7] in bitter gourd and Narasannavar *et al.,* (2018)[8] in ridge gourd.

Among the four genotypes used as male parents (tester) the significant and negative effects were register for days to first male flower in T1 (-2.10), for days to first female flower in T1 (-1.88), for node to first male flower in T1 (-1.47), T4 (1.57), for sex ratio in T1 (-0.43), T2(-0.17), for days to harvest in T2 (-1.98), for moisture content in T2 (-2.03), T3 (-0.45). Significantly positive effects were found for fruit length in T2 (4.04), number of fruits per plant in T2 (1.67), for dry matter content in T2 (2.03), T3 (0.45) for yield per plant and yield per hectare in T2 (0.20, 2.11), T3 (0.39, 1.11). These results are in corroboration with the findings of Acharya *et al.,* (2019)[1] in bitter gourd and Jayanth *et al.,* (2019)[5] in bottle gourd (Table 3 and 4).

Table.1 Analysis of variance for combining ability of Ridge gourd (*Luffa acutangula* L.)

SI.No.	Character	Replications	Crosses	Lines	Testers	Line x Tester	Error
	Degrees of Freedom	2	23	5	3	15	23
1	Days to first male flower	2.755	10.489 **	8.860 *	29.777 **	7.175 **	2.500 *
2	Days to first female flower	0.015	21.838 **	50.440 *	21.631 **	13.346 **	5.177 **
3	Node to first male flower	0.015	12.807 **	19.637 *	20.578 **	9.068 **	5.177 **
4	Node to first female flower	0.015	7.866 **	15.650 *	1.800	6.484 **	5.177 **
5	Sex ratio	0.142	0.854	1.644 **	1.611	0.439	0.060
6	Days to harvest	0.137	189.092 **	463.290 *	45.450 **	126.420 **	5.180 **
7	Vine length (m)	0.001	1.790	3.282 *	1.575	1.336	0.005
8	Rind thickness (cm)	0.000	0.025	0.041	0.003	0.024	0.002
9	Flesh thickness (cm)	0.003	0.323	0.298	0.761	0.244	0.059
10	Fruit length (cm)	9.990	118.980 **	129.550 *	112.990 **	116.660 **	3.145 **
11	Fruit diameter (cm)	0.003	0.495	0.277	0.265	0.614	0.059
12	Fruit weight (g)	98.900**	5468.830 **	10049.880 *	6806.590 **	3674.260**	44.370 **
13	Total soluble Solids (TSS)	0.003	0.876	0.961	0.303	0.963	0.059
14	No. of fruits/plant	9.990	9.000 **	20.250 *	20.570 **	2.930 *	3.150 **
15	Yield (kg/plant)	0.003	1.700	3.380 *	1.480	1.190	0.059
16	Yield /ha (tone)	9.965	29.997 **	54.219 *	44.152 **	19.093 **	3146 **
17	Dry matter content (%)	0.003	17.479 **	14.910 *	33.061 **	15.218**	0.059
18	Moisture content (%)	0.003	17.479 **	14.910 *	33.061 **	15.218**	0.059
19	Total crude fiber (mg/100g)	0.001	0.004	0.007	0.002	0.003	0.001

Significant at 5% level ** Significant at 1 % level

Table.2 Variance due to general combining ability and specific combining ability for yield characters in growth, yield and quality parameters in ridge gourd

	Traits	gca	*sca*	*gca/sca*	Contribution of Lines	Contribution of Testers	Contribution of Lines X Testers
1	Days to first male flower	0.125	2.319	0.054	18.36	37.03	44.61
2	Days to first female flower	0.359	3.584	0.100	50.21	12.92	36.87
3	Node to first male flower	0.144	1.946	0.074	33.18	20.86	45.96
4	Node to first female flower	0.052	0.654	0.080	43.24	2.99	53.77
5	Sex ratio	0.016	0.189	0.085	41.85	24.61	33.54
6	Days to harvest	2.371	60.618	0.039	53.26	3.14	43.60
7	Vine length (m)	0.071	0.666	0.107	39.85	11.48	48.67
8	Rind thickness (mm)	0.006	0.012	0.500	36.10	1.53	62.37
9	Flesh thickness (mm)	0.003	0.093	0.032	20.09	30.68	49.23
10	Fruit length (cm)	0.088	56.757	0.002	23.67	12.39	63.94
11	Fruit girth	-0.005	0.277	-0.018	12.18	6.99	80.84
12	Fruit weight (g)	67.887	1814.94	0.037	39.95	16.23	43.82
13	TSS (brix)	-0.003	0.452	-0.007	23.83	4.51	71.66
14	No.of fruits/ plant	0.229	-0.104	-2.202	48.90	29.81	21.28
15	Dry matter content (%)	0.086	7.579	0.011	18.54	24.67	56.78
16	Moisture content (%)	0.086	7.579	0.011	18.54	24.67	56.78
17	Total crude fiber (mg/100g)	0.006	0.018	0.333	43.81	7.56	48.62
18	yield / plant (g)	0.019	0.566	0.034	43.10	11.37	45.53
19	Yield/ha (t/ha)	0.413	7.973	0.052	39.29	19.20	41.51

Table.3 General combining ability effects of female parents (Lines) and male parents (Testers) of ridge gourd yield and quality parameters

Parents	Days to first male flower	Days to first female flower	Node to first male flower	Node to first female flower	Sex ratio	Days to harvest	Vine length (m)	Rind thickness (mm)	Flesh thickness (mm)	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	TSS (brix)	No. of fruits/ plant	Dry matter content (%)	Moisture content (%)	Total crude fiber (mg/100g)	yield / plant (g)	Yield/ha (t/ha)
Lines																			
L1	-0.15	0.1	-0.28	0.88	-0.14	-2.44**	0.71**	0.66*	0.13	2.15**	-0.21*	8.92**	-0.17	-2.01	-0.59**	0.59**	-0.01**	-0.34**	-1.36*
L2	-0.5	-1.15	-0.28	0.23	-0.34**	3.69**	-0.61**	-0.01*	0.20*	0.58	0.26**	40.65**	0.68**	1.54*	0.1	-0.1	0.01*	1.01**	4.05**
L3	-0.2	-2.25*	-0.33	-0.37	-0.51**	-13.71**	-0.48**	0.01	-0.35**	-3.85**	-0.14	21.67**	-0.12	1.04	-2.17**	2.17**	0.03**	0.61**	2.44**
L4	-1.40*	0.6	-1.63	-0.67*	0.78**	-0.27	-0.30**	-0.04**	-0.02	-5.1	-0.04	-56.08**	-0.27**	0.94	-0.22*	0.22*	0.03**	-0.63**	-2.52**
L5	1.72**	4.60**	3.02**	2.13*	0.1	5.76**	-0.21**	-0.04**	0.08	5.93**	-0.06	12.67**	0.03	-2.01**	1.62**	-1.62**	-0.02**	-0.32**	-1.30**
L6	0.54	-1.90*	-0.48	-1.22	0.1	6.97**	0.90**	0.14**	-0.05	0.28	0.19*	-27.83**	-0.15	0.44	1.26**	-1.26**	-0.04**	-0.33**	-1.31*
SEd	0.79	1.13	1.14	1.14	0.12	1.14	0.03	0.01	0.12	0.88	0.12	3.33	0.12	0.88	0.12	0.12	0.01	0.12	0.88
CD @ 5%	1.65	2.35	2.35	2.35	0.25	2.35	0.07	0.02	0.25	1.83	0.25	6.89	0.25	1.83	0.25	0.25	0.01	0.25	1.83
Tester																			
T1	-2.10**	-1.88**	-1.47*	0.07	-0.43**	2.49**	-0.54**	0.01*	-0.1	-0.02	-0.18*	-33.09**	0.14	0.05	-0.58**	0.58**	-0.02**	-0.37**	-1.89**
T2	-0.24	0.78	-0.57	0.27	-0.17*	-1.98**	0.21**	-0.02	0.16*	4.04**	0.17	10.58**	0.14	1.67**	2.03**	-2.03**	0.01	0.20**	2.11**
T3	1.01	1.12	-0.47	0.23	0.22**	-1.01	0.14**	-0.02**	-0.30**	-3.40**	-0.05	22.25**	-0.15*	-0.21	0.45**	-0.45**	0.01**	0.39**	1.11*
T4	1.36**	-0.02	1.57*	-0.57	0.38**	0.05	0.19**	-0.01*	0.25**	-0.62	0.05	0.26	-0.13	-1.51**	-1.90**	1.90**	-0.01	-0.22**	-1.33*
SEd	0.65	0.93	0.93	0.93	0.1	0.93	0.03	0.01	0.09	0.72	0.09	2.72	0.09	0.72	0.09	0.09	0.01	0.09	0.72
CD @ 5%	1.35	1.9	1.92	1.92	0.2	1.92	0.06	0.01	0.2	1.49	0.21	5.63	0.21	1.49	0.2	0.2	0.01	0.2	1.49

Table.4 Specific combining ability effects of ridge gourd hybrids for yield and quality parameters

	Crosses	Days to first male flower	Days to first female flower	Node to first male flower	Node to first female flower	Sex ratio	Days to harvest	Vine length (m)	Rind thick ness (mm)	Flesh thick ness (mm)	Fruit length (cm)	Fruit Girth (cm)	Fruit weight (g)	TSS (brix)	No.of fruits/ plant	Dry matter content (%)	Moisture content (%)	Total crude fiber (mg/100g)	yield / plant (g)	Yield/ha (t/ha)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	L1 X T1	-0.16	0.13	-1.08	-0.42	0.52**	-15.33**	-1.07**	0.06**	-0.25	-0.17	0.03	13.06*	0.39*	0.91	3.19**	-3.19**	-0.01	0.41*	1.65
2	L1 X T2	1.74	0.07	3.22	-0.22	0.66**	-3.84*	1.92**	-0.02	-0.01	1.53	-0.92**	9.40	-0.51**	-0.36	-1.24**	1.24**	-0.02	0.06	0.24
3	L1 X T3	0.22	-0.47	-2.02	1.42	-0.44*	10.89**	0.21**	-0.01	0.35	7.21**	0.60**	-7.27	-0.43*	-0.82	-2.60**	2.60**	0.03**	-0.34	-1.36
4	L1 X T4	-1.36	0.27	-0.12	-0.78	-0.76**	8.28**	-1.07**	-0.04**	-0.10	-8.57**	0.30	-15.19**	0.55**	0.27	0.65**	-0.65**	-0.01	-0.13	-0.53
5	L2 X T1	0.83	1.38	0.52	-0.37	0.37*	5.58**	0.33**	0.01	-0.32	-4.50**	-0.05	-46.66**	-0.06	-1.04	3.49**	-3.49**	0.02*	-1.04**	-4.16**
6	L2 X T2	1.86	-0.88	-1.98	1.23	-0.04	-7.60**	-0.14**	0.03*	0.29	-1.10	-0.50**	-24.33**	0.94**	0.29	0.27	-0.27	0.02*	-0.27	-1.10
7	L2 X T3	-0.56	0.18	-1.62	-1.73	0.12	-1.54	0.09	-0.05**	0.38**	-4.21**	0.12	46.00**	-0.28	0.42	-0.74**	0.74**	-0.02*	0.91**	3.66**
8	L2 X T4	1.59	-0.68	3.08	0.87	-0.45*	3.56*	-0.28**	0.01	0.23	-9.80**	0.42*	24.99**	-0.60	0.33	-3.02**	3.02**	-0.02	0.40**	1.60
9	L3 X T1	3.18**	3.88*	2.77	4.23*	-0.39*	2.01	0.29**	-0.11**	0.23	-0.97	0.05	49.41**	-0.46*	4.06**	-0.42*	0.42*	0.07**	1.28**	4.32**
10	L3 X T2	3.01*	2.58*	-0.13	-4.17	-0.42*	0.87	0.27**	-0.20**	0.14	1.13	-0.20	56.65**	0.94**	3.39**	-1.03**	1.03**	0.03**	1.21**	4.21**
11	L3 X T3	-0.86	-3.72*	-1.17	0.27	0.27	-4.19*	0.17**	-0.08**	-0.47*	4.31**	-0.18	-38.02**	-0.08	-0.08	1.26**	-1.26**	-0.03**	-0.64**	-2.56
12	L3 X T4	-1.31	1.42	-1.47	-2.13	0.41*	5.32**	0.29**	-0.01	0.38*	-4.47**	0.32	-28.04**	-0.40*	-2.37	0.19	0.19	-0.07**	-1.00**	-5.98**
13	L4 X T1	0.68	-3.17	0.07	-1.67	-0.54**	10.80**	0.47**	-0.06**	0.20	1.28	0.25	28.06**	0.69**	-0.64	-2.19**	2.19**	-0.04**	0.22	0.91
14	L4 X T2	-0.61	3.17	-0.03	0.33	-0.26	1.71	-0.08	0.05**	0.54**	1.28	0.40*	-25.50**	0.09	0.09	2.69**	-2.69**	-0.01	0.40*	-1.60
15	L4 X T3	-1.46	0.63	-0.67	-0.43	0.05	-5.66**	-0.48**	0.07**	-0.20	1.76	-0.18	47. 73**	-0.03	0.83	-0.43*	0.43*	0.01	0.98**	3.91**
16	L4 X T4	1.39	-0.63	0.63	1.77	0.74**	-6.86**	0.09	-0.06**	-0.55**	-4.32**	-0.48*	-54.29**	-0.75**	-0.27	-0.07	0.07	0.04**	-0.80**	0.22**
17	L5 X T1	-2.85*	-0.77	-1.58	-0.67	0.16	-1.54	-0.02	0.04**	0.20	11.05**	-0.42*	-50.69**	-0.11	0.71	-2.17**	2.17**	-0.02	-0.47*	-1.89
18	L5 X T2	0.07	0.77	-1.08	0.93	-0.03	9.23**	-1.12**	-0.05**	-0.26	2.75*	1.23**	40.65**	0.41*	-1.56	-4.04**	4.04**	-0.01	0.14	0.58
19	L5 X T3	3.11*	-1.37	3.88*	0.77	-0.07	-0.25	-0.10*	0.07**	0.01	-6.06**	-0.15	-10.92*	0.17	-1.02	3.89**	-3.89**	0.01	-0.40*	-1.62
20	L5 X T4	-0.33	1.37	-1.22	-1.03	-0.06	-7.44**	1.24**	-0.06**	0.05	-7.75**	-0.65**	20.96**	0.35	1.87	2.32**	-2.32**	0.02	0.73**	2.93*
21	L6 X T1	-1.66	-1.47	-0.68	-1.12	-0.12	2.50	-0.01	0.06**	-0.07	-6.70**	0.13	6.81	-0.44*	-0.99	-1.90**	1.90**	-0.02*	-0.10	-0.41
22	L6 X T2	1.66	-1.53	0.22	0.08	-0.05	-0.38	-0.41**	-0.22**	0.16	-5.60**	-0.02	-16.85**	-1.04**	0.14	3.35**	-3.35**	-0.01	-0.19	-0.75
23	L6 X T3	-0.01	4.73**	1.58	-0.28	0.05	0.75	0.11*	-0.01	-0.07	-3.01*	-0.20	-41.52**	0.65**	0.67	-1.37**	1.37**	-0.01	-0.51**	-2.03
24	L6 X T4	0.01	-1.73	-0.92	1.32	0.12	-2.87	0.30**	0.16**	-0.02	15.30**	0.10	-51.56**	0.83**	0.17	-0.08	0.08	0.03	0.80**	3.19*
	S.Ed.	1.60	2.27	2.27	2.27	0.25	2.27	0.07	0.01	0.24	1.77	0.24	6.66	0.24	1.77	0.24	0.24	0.01	0.24	1.77
	CD@5%	3.31	4.71	4.71	4.71	0.51	4.71	0.14	0.03	0.50	3.67	0.50	13.78	0.50	3.67	0.50	0.50	0.02	0.50	3.67

* Significant at 5 % level ** Significant at 1 % level

Based on the *gca* effects the female parent L3 Virdhunagar local is best combiner for narrow sex ratio, early days to harvest, yield per plant and yield per hectare and L5 (Arka Sujath) is best general combiner for high fruit length, number of fruits per plant and dry matter content.

Specific Combining Ability

The specific combining ability of significantly negative effect is desired for days to first male flowering, days to first female flowering, node to first male and female flowering and days to harvest for earliness, rind thickness and moisture content. Significantly negative effect for days to first male flower appearance in the cross L5XT1 (-2.85), for days to first female flower appearance in L3XT3 (-3.72), for sex ratio in L3XT1 (-0.39), L4XT1 (0.54), L1XT4 (-0.76), L2XT4 (-0.45), L1XT3(-0.44), days to harvest in L1XT1 (-15.33), L2XT2 (-7.60), L5XT4 (-7.44), L4XT4 (-6.86), L4XT3 (-5.66). Chikezie *et al.*, (2019) [4] registered same kind of results in cucumber and Venugopalareddy *et al.*, in (2019) [10] in sponge gourd.

The significant positive specific combining ability favorable for number of fruits per plant, fruit length, dry matter content, yield per plant and yield per hectare. Significantly positive effects for number of fruits per plant was registered in L3XT2 (3.39) and L3XT1 (4.06), for fruit length in the crosses L6XT4 (15.30), L5XT1 (11.05), L1XT3 (7.21), L3XT3 (4.31), L5XT2 (2.75), for fruit weight L3XT2 (56.65), L3XT1 (49.41), L4XT3 (47.73), L2XT3 (46.00), L5XT2 (40.65), for dry matter content the crosses L5XT3 (3.89), L2XT1 (3.49), L6XT2 (3.35), L1XT1 (3.19), L4XT2 (2.69), L5XT4 (2.32). Among the 24 crosses the significant positive *sca* effects for fruit yield per plant and yield per hectare was observed in the crosses viz. L3XT1 (1.28, 4.32), L3XT2 (1.21,4.21) L4XT3 (0.98, 3.91), L2XT3 (0.91, 3.66), L6XT4 (0.80, 3.19), L5XT4 (0.73, 2.93). Main objective of any breeding programme is getting best cross for maximum yield. Hence the crosses L3XT1, L3XT2, L4XT3, L2XT3, L6XT4, L5XT4 can be used for development of hybrids. Chandan *et al.*, (2019) [3] in ridge gourd and Sudhanshu *et al.*, (2019) [9] in bottle gourd documented akin results of specific combing ability effect.

Among the twenty four cross combination L3XT1 (Virdhunagar local X Periyakottai Local) and L3XT2 (Virdhunagar local X Alatur Local) are best combiner for early days to male flower, for days to female flower, for narrow sex ratio, for fruit weight, for more number of fruits per plant, high fruit yield per plant and yield per hectare. The crosses L1XT1 (PKM-1X Periyakottai Local), L2XT2 (CO1X Alathur Local), and L5XT4 Arka Sujath X Srirampuaram Local) are best combiner for early days to harvest. L6XT4 (Arka Sumeet X Srirampuaram Local), L5XT1 (Arka Sujath X Periyakottai Local), L1XT3 (PKM1X Kannapatti Local) are best combiner for fruit length. L5XT3 (Arka Sujath X Kannapatti Local), L2XT1 CO2X Periyakottai Local), L6XT2 (Arka Sumeet X Alathur Local) are best combiner for high dry matter content.

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