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Variability studies in F₃ population of ridge gourd (*Luffa acutangula*) for yield and yield attributing traits

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Abstract

Different parameters were estimated to assess the magnitude of genetic variability in F₃ population of four crosses viz., cross-1 (VRG-24 x VRG-13), cross-2 (Swarna Manjari x Arka Prasan), cross-3 (Swarna Manjari x VRG-16) and (Arka Prasan x VRG-16). The analysis of variance indicated the prevalence of sufficient genetic variation among the genotypes from all the characters studied. The high phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed for node of first male flower, node of first female flower, number of male flowers per vine, sex ratio, fruit set percentage, average fruit weight, rind thickness, number of seeds per fruit, number of fruits per vine and fruit yield per vine. High heritability coupled with high genetic advance were observed for node of first male flower, node of first female flower, number of male flowers per vine, number of female flowers per vine, sex ratio, fruit set percentage, fruit length, fruit girth, average fruit weight, rind thickness, flesh thickness, number of seeds per fruit, number of fruits per vine and fruit yield per vine indicating these characters are governed by additive gene action. Hence, direct selection may be followed for the improvement of ridge gourd for these characters.

Keywords: Ridge gourd, variability, heritability and genetic advance

1. Introduction

Ridge gourd (*Luffa acutangula* (L.) Roxb.) is one of the important cucurbitaceous vegetables grown throughout India. It is considered to be an old-world species and is native to tropical Africa and the South-East Asian region, including India. It is widely grown in tropical and subtropical parts of the country. It belongs to the family Cucurbitaceae and the chromosome number is $2n=2x=26$. Ridge gourd is a monoecious and highly cross-pollinated crop. Such pollination mechanism can be exploited commercially for hybrid seed production. Variations such as shape, size and color of fruits are found to be conspicuous. Most of the ridge gourd hybrids released from India are large sized fruits which are not preferred by nuclear families. Hence, it is important to perform selection in the available germplasm lines or segregating populations for moderate length fruits with high nutrient contents. The length and diameter of the fruits are to be considered the important quantitative traits which are closely related to the exterior quality of ridge gourd. The genotypic and phenotypic coefficient of variation, heritability and genetic advance enable the breeders to study its genetic variability and potential progenies. Since, many economic traits are quantitative in nature and highly influenced by the environment, the progress of breeding is governed by the nature of genetic and non-genetic variations, it will be useful to partition the overall variability into its heritable and non-heritable components to know whether superiority of selection is inherited by the progenies. Therefore, the present investigation was undertaken to estimate the variability, heritability and genetic advance in F₃ generation of four crosses viz., cross-1 (VRG-24 x VRG-13), cross-2 (Swarna Manjari x Arka Prasan), cross-3 (Swarna Manjari x VRG-16) and (Arka Prasan x VRG-16)

2. Material and Methods

The experiment was carried out at College of Horticulture, Venkataramannagudem, Dr. YSR Horticultural University, West Godavari District, Andhra Pradesh, during summer 2021 in F₃ generation of four viz., cross-1 (VRG-24 x VRG-13), cross-2 (Swarna Manjari x Arka Prasan), cross-3 (Swarna Manjari x VRG-16) and (Arka Prasan x VRG-16). The crop received timely management practices as per recommended package of practices. The crop was maintained properly till last harvest and observations on yield as well as yield contributing characters was noted on F₃ progenies along with parents.

From each cross 150 plants were studied and taken data from all the plants. Genotypic and phenotypic coefficient of variation were calculated as per the formula suggested by Burton (1952) [2]. Heritability and expected genetic advance were calculated as per formula given by Jhon Wiley and Allard, 1960.

The observations on days to male flowering, days to female flowering, node of first male flower, node of first female flower, number of male flowers per vine, number of female flowers per vine, sex ratio (%), fruit set (%), fruit length (cm), fruit girth (cm), average fruit weight (g), rind thickness (mm), flesh thickness (cm), number of seeds per fruit, number of fruits per vine and fruit yield per vine (kg) were recorded. The details of crosses and progenies selected for F₃ generation are given in the table 1.

Table 1: Details of crosses and progenies selected for F₃ generation.

No.	Parents	Progenies
Cross 1	VRG-24 x VRG-13	15
Cross 2	Swarna Manjari x Arka Prasan	15
Cross 3	Swarna Manjari x VRG-16	15
Cross 4	Arka Prasan x VRG-16	15
	Total	60

3. Results and Discussion

The results of variability, heritability and genetic advance are presented in the tables 2, 3, 4 and 5. The variability analysis revealed that the magnitude of GCV and PCV were closer in all the four crosses viz. cross-1 (VRG-24 x VRG-13), cross-2 (Swarna Manjari x Arka Prasan), cross-3 (Swarna Manjari x VRG-16) and cross-4 (Arka Prasan x VRG-16) for majority of the characters. These results were suggesting that, little contribution of environmental effect on population. Similar findings were observed by Kannan and Rajamanickam (2019) [9] and Gautham and Balamohan (2018) [6] in ridge gourd.

High estimates of GCV and PCV were observed in the traits viz., node of first male flower, node of first female flower, number of male flowers per vine, sex ratio, fruit set percentage, average fruit weight, rind thickness, number of seeds per fruit, number of fruits per vine and fruit yield per vine in all four crosses viz., cross-1 (VRG-24 x VRG-13), cross-2 (Swarna Manjari x Arka Prasan), cross-3 (Swarna Manjari x VRG-16) and cross-4 (Arka Prasan x VRG-16). These results are indicating that there is a broad range of variability in the population and further selection is required. These results are in accordance with the findings of Gautham and Balamohan (2018) [6], Kannan *et al.* (2019) [10] and Kannan and Rajamanickam (2019) [9] in ridge gourd.

Traits namely, fruit length, fruit girth and flesh thickness exhibited moderate values of phenotypic co-efficient of variation and genotypic co-efficient of variation in all four

crosses. It implies that moderate amount of variability is present in the population and further selection would be possible up to some extent. Similar results were observed by Deepa and Mariappan (2013) [3] in snake gourd, Gautham and Balamohan (2018) [6] and Kannan and Rajamanickam (2019) [9] in ridge gourd.

Number of female flowers per vine exhibited moderate values of GCV and PCV in cross-1 (VRG-24 x VRG-13) and cross-2 (Swarna Manjari x Arka Prasan). Similar results were reported by Yadagiri *et al.* (2017) [17] in bitter gourd and Deepa *et al.* (2018) [4] in cucumber.

Lower estimates of PCV with corresponding low values of GCV were registered for the characters days to male flowering and days to female flowering in all the four crosses. This indicates limited scope for improvement of these traits due to low magnitude of variability and also it implies the population attained homozygosity for these traits and further selection will not alter them. Similar results were observed by Kanimozhi *et al.* (2014) [8] in wax gourd.

In the present investigation, high heritability estimates observed for all studied yield and yield attributing traits in all the four crosses. Results were on par with the findings of Doddamani *et al.* (2018) [5] in cucumber and Kannan and Rajamanickam (2019) [9] in ridge gourd.

Johnson *et al.* (1955) [7] pointed out that high heritability along with high genetic advance would be useful than heritability values alone in predicting the resultant effect of selecting the genotype.

In the present investigation, the traits viz., node of first male flower, node of first female flower, number of male flowers per vine, number of female flowers per vine, sex ratio, fruit set percentage, fruit length, fruit girth, average fruit weight, rind thickness, flesh thickness, number of seeds per fruit, number of fruits per vine and fruit yield per vine reported high heritability coupled with high genetic advance as per cent mean in four crosses. High heritability along with high genetic advance indicated the presence of flexible additive gene effects and will be a useful criterion for selection. Further these traits were less influenced by environment and selecting plants based on such characters could be worthwhile. Similar findings were observed by Sharma and Sengupta (2013) [15] in bottle gourd, Gautham and Balamohan (2018) [6] in ridge gourd.

The characters days to male flowering and days to female flowering exhibited high heritability coupled with moderate genetic advance as per cent of mean in all the four crosses. This results were revealed that, presence of certain degree of non-additive gene effect and selection may not be effective. Similar findings in bottle gourd were observed by Kumar *et al.* (2007) [12], Samadiya (2011) [14] in ridge gourd and Kanimozhi *et al.* (2015) [8] in wax gourd.

Table 2: Mean, GCV, PCV, heritability, genetic advance and per cent mean of genetic advance in F₃ population of cross-1 (VRG-24 x VRG-13)

Sr. No	Character	Mean	GCV (%)	PCV (%)	h ² _{bs} (%)	GA	GAM (%)
1	Days to male flowering	30.12	7.62	8.31	84.05	4.33	14.39
2	Days to female flowering	39.62	5.81	6.34	84.13	4.35	10.98
3	Node of first male flower	2.46	32.53	38.35	71.93	1.40	56.83
4	Node of first female flower	11.14	23.74	24.40	97.84	2.80	25.13
5	Number of male flowers per vine	263.11	22.73	22.74	99.91	123.14	46.80
6	Number of female flowers per vine	31.62	18.85	20.58	83.94	11.25	35.58
7	Sex ratio (%)	8.73	27.86	31.83	76.58	4.38	50.22
8	Fruit set (%)	51.99	23.70	23.80	99.17	25.27	48.61
9	Fruit length (cm)	22.70	18.08	18.45	96.01	8.29	36.50
10	Fruit girth (cm)	12.82	14.83	15.10	96.33	3.84	29.98

11	Average fruit weight (g)	230.54	34.98	35.00	99.88	166.05	72.03
12	Rind thickness (mm)	5.33	30.83	31.05	98.60	3.36	63.06
13	Flesh thickness (cm)	3.55	16.29	17.00	91.83	1.14	32.16
14	Number of seeds per fruit	125.36	29.87	29.90	99.79	77.05	61.46
15	Number of fruits per vine	17.74	24.73	25.05	97.47	8.92	50.29
16	Fruit yield per vine (kg)	3.63	36.03	36.11	99.56	2.69	74.06

Table 3: Mean, GCV, PCV, heritability, genetic advance and per cent mean of genetic advance in F₃ population of cross-2 (Swarna Manjari x Arka Prasan)

Sr. No	Character	Mean	GCV (%)	PCV (%)	h ² _{bs} (%)	GA	GAM (%)
1	Days to male flowering	30.60	6.13	6.71	83.40	3.53	11.53
2	Days to female flowering	39.08	6.62	6.86	93.05	5.14	13.16
3	Node of first male flower	2.96	23.58	29.99	61.84	1.13	38.20
4	Node of first female flower	10.93	27.44	28.04	95.74	6.04	55.30
5	Number of male flowers per vine	245.13	26.64	26.65	99.93	134.50	54.87
6	Number of female flowers per vine	32.65	19.68	19.80	98.80	13.16	40.31
7	Sex ratio (%)	7.60	24.93	25.02	99.28	3.89	51.17
8	Fruit set (%)	54.21	24.03	24.18	98.77	26.67	49.19
9	Fruit length (cm)	22.85	19.19	19.34	98.46	8.96	39.23
10	Fruit girth (cm)	11.57	13.34	13.55	96.95	3.13	27.05
11	Average fruit weight (g)	202.58	38.97	39.03	99.70	162.40	80.16
12	Rind thickness (mm)	5.38	31.73	31.75	99.88	3.51	65.32
13	Flesh thickness (cm)	3.15	13.63	14.31	90.75	0.84	26.74
14	Number of seeds per fruit	132.18	36.02	36.04	99.89	98.02	74.16
15	Number of fruits per vine	17.29	21.14	21.53	96.39	7.39	42.76
16	Fruit yield per vine (kg)	3.37	35.72	35.84	99.37	2.48	73.36

Table 4: Mean, GCV, PCV, heritability, genetic advance and per cent mean of genetic advance in F₃ population of cross-3 (Swarna Manjari x VRG-16)

Sr. No	Character	Mean	GCV (%)	PCV (%)	h ² _{bs} (%)	GA	GAM (%)
1	Days to male flowering	29.77	6.80	7.39	84.52	3.83	12.87
2	Days to female flowering	39.48	5.49	5.88	87.02	4.16	10.54
3	Node of first male flower	2.62	29.48	36.12	66.59	1.30	49.55
4	Node of first female flower	11.11	23.89	24.89	92.16	5.25	47.25
5	Number of male flowers per vine	237.40	24.42	24.43	99.93	119.38	50.29
6	Number of female flowers per vine	32.81	23.58	23.68	99.17	15.87	48.38
7	Sex ratio (%)	7.91	42.39	42.42	99.84	6.91	87.25
8	Fruit set (%)	55.09	31.15	31.25	99.35	35.24	63.96
9	Fruit length (cm)	22.74	17.42	17.86	95.15	7.96	35.00
10	Fruit girth (cm)	11.96	14.56	14.74	97.58	3.54	29.62
11	Average fruit weight (g)	211.38	36.78	36.86	99.55	159.79	75.59
12	Rind thickness (mm)	7.20	18.95	18.97	99.77	2.81	39.00
13	Flesh thickness (cm)	3.31	17.70	17.96	97.03	1.19	35.91
14	Number of seeds per fruit	143.85	38.61	38.63	99.91	114.36	79.50
15	Number of fruits per vine	17.27	24.54	25.11	95.48	8.53	49.39
16	Fruit yield per vine (kg)	3.49	30.30	30.77	96.97	2.15	61.46

Table 5: Mean, GCV, PCV, heritability, genetic advance and per cent mean of genetic advance in F₃ population of cross-4 (Arka Prasan x VRG-16)

Sr. No	Character	Mean	GCV (%)	PCV (%)	h ² _{bs} (%)	GA	GAM (%)
1	Days to male flowering	30.06	6.33	6.95	82.83	3.57	11.86
2	Days to female flowering	39.14	7.08	7.31	93.89	5.53	14.13
3	Node of first male flower	2.69	24.76	32.06	59.67	1.06	39.40
4	Node of first female flower	11.90	21.61	22.41	92.97	5.11	42.93
5	Number of male flowers per vine	243.17	21.74	21.76	99.90	108.87	44.77
6	Number of female flowers per vine	30.13	24.82	24.89	99.47	15.37	51.00
7	Sex ratio (%)	8.76	39.23	39.27	99.80	7.07	80.73
8	Fruit set (%)	56.58	24.25	24.30	99.59	28.20	49.84
9	Fruit length (cm)	24.53	15.93	16.34	95.02	7.85	31.99
10	Fruit girth (cm)	12.43	16.08	16.23	98.16	4.08	32.83
11	Average fruit weight (g)	230.92	35.93	35.97	99.76	170.70	73.92
12	Rind thickness (mm)	5.50	33.93	33.96	99.85	3.84	69.84
13	Flesh thickness (cm)	3.41	18.55	18.97	95.65	1.27	37.37
14	Number of seeds per fruit	147.26	39.38	39.40	99.88	119.39	81.07
15	Number of fruits per vine	16.95	21.46	21.98	95.31	7.31	43.16
16	Fruit yield per vine (kg)	3.57	26.42	26.92	96.30	1.91	53.40

4. Conclusion

The maximum PCV and GCV was observed for characters viz., node of first male flower, node of first female flower, number of male flowers per vine, sex ratio, fruit set percentage, average fruit weight, rind thickness, number of seeds per fruit, number of fruits per vine, fruit yield per vine in all the crosses which indicates wide range of variation and selection based on these characters provide ample scope for desirable plant types. The characters viz., node of first male flower, node of first female flower, number of male flowers per vine, number of fruits per vine, sex ratio, fruit set percentage, fruit length, fruit girth, average fruit weight, rind thickness, flesh thickness, number of seeds per fruit, number of fruits per vine and fruit yield per vine were reported high heritability along with high genetic advance as per cent of mean in all the four crosses which indicates the presence of flexible additive gene effect and will be useful criterion for selection.

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