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Genetic Variability, Correlation and Path Analysis in F_6 Generation of Ridge Gourd (*Luffa acutangula* (Roxb) L.) for Yield and Quality

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A B S T R A C T

The study on genetic variability, correlation and path analysis in F_6 generation of ridge gourd (*Luffa acutangla* (Roxb) L.) for yield and quality was conducted at College Orchard, Department of Horticulture, Agricultural College and Research Institute, Madurai during the year 2019-2020. The aim of the present study is to develop high yielding, medium size fruit and good quality fruits of ridge gourd. The 11 selected ridge gourd accessions derived from two crosses *viz.*, Virudhunagar local x Periyakottai local (L3 x T1) and Virudhunagar local x Alathur local (L3 x T2) along with checks used for this study. The present study was laid out in Randomized Block design (RBD) with three replications. The results revealed that moderate GCV, PCV and high heritability along with high genetic advance as percentage of mean recorded for the character fruit length (13.14 %, 14.06 % and 87.44 %, 25.32 %). Whereas low GCV, PCV and low heritability along with low genetic advance was recorded for the characters node to first female flowering (3.62 %, 8.28 % and 19.15 %, 3.26 %) and rind thickness (5.21 %, 9.93 % and 22.74 %, 5.12 %). Regarding correlation studies, fruit yield was significantly and positively correlated with fruit weight and sex ratio. In the present study, path coefficient analysis showed that positive direct effect on vine length, days to first harvest, fruit weight, fruit length, rind thickness and number of fruits per plant. Of these traits, fruit weight exhibited the maximum positive direct effect on yield.

Introduction

Vegetables play an important role in the balanced diet by providing not only energy but also supplying vital protective nutrients like minerals and vitamins. They are called protective food as their consumption can prevent several diseases. Nowadays, Cucurbitaceous vegetables form an important and big group of vegetable crops in our diet. Ridge gourd (*Luffa acutangula* (L.) Roxb.) is an important vegetable crop belongs to the family Cucurbitaceae and luffa has essentially old world origin in sub-tropical Asian including India (Kalloo, 1993).

It has a chromosome number of 2n=2x=26. It is grown as mixed cropping in the river beds and as monocrop in the garden lands. It is cultivated as spring- summer and rainy season

in all over India. The genus derives its name from the product 'loofah', which is used in bathing sponge, scrubber pads, doormats, pillows, mattresses and also for cleaning utensils. The species contain a gelatinous compound called luffein. It's also called ribbed gourd and kalitori (Narasannavar *et al.*, 2014). Crop improvement is largely depends on existence of genetic variability. To improve the yield and other characters, information on genetic variability and inter-relationship among different traits is necessary. Genetic variability is perquisite for the meaningful selection and the heritability in conjunction with genetic advance which determines its success. With this background, the present investigation on genetic variability, correlation and path analysis in F_6 generation of ridge gourd for growth, yield and quality were carried out.

Materials and Methods

The present study was conducted at Department of Horticulture, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India during 2019-2020. The 11 selected cultures derived from crosses *viz.*, L3xT1 (Virudhunagar Local x Periyakottai Local) and L3xT2 (Virudhunagar Local x Alathur Local) and PKM1, CO1 varieties were used as genetic material for this study. The seeds were sown in pits taken at a spacing of 2m X 2m in Randomized Block Design (RBD) with three replications for F_6 generation. There were 195 plant populations and three seeds were sown in each pit and retained two plants in each selected cultures.

The observations were recorded on vine length (m), days to first male flowering (days), days to first female flowering (days), node to first male flower, node to first female flower, number of fruits per plant, sex ratio, days to first harvest (days), average fruit weight (g), fruit length (cm), fruit diameter (cm), rind thickness (mm), flesh thickness (mm), fruit yield per plant (kg), total soluble solids (TSS) (°Brix), dry matter content (g) and total crude fibre content (mg). The data were recorded statistically analysed for genotypic and phenotypic coefficient of variation (GCV and PCV) by Burton (1952), heritability suggested by Lush (1943), genetic advance as percent of mean, correlation (Singh and chaudhury (1985)) and path co-efficient analysis by Dewey and Lu (1959).

Results and Discussion

The extend of variability present in the selected culture of ridge gourd in F_6 generation were estimated for variability, heritability, genetic advance are presented in Table 1.

Genotypic and phenotypic variability

The present study result revealed that low percent PCV and GCV were recorded in the traits like vine length (6.57; 4.22), days to first male flowering (6.40; 4.62), days to first female flowering (9.57; 7.54), node to first male flower (7.83; 5.19), node to first female flower (8.28; 3.62), sex ratio (6.11; 5.73), days to first harvest (6.47; 4.72), number of fruits per plant (6.51; 5.16), fruit weight (9.38; 7.77), fruit diameter (8.47; 7.03), rind thickness (10.93, 5.21) and flesh thickness (9.22; 8.10). These characters will not be considered for selection. This agrees with the finding of Samadia (2011), Karthick *et al.*, (2017), Kannan *et al.*, (2019) in ridge gourd and Puddan (2000), Dey *et al.*, (2009) in bitter gourd. This indicates selection resulted in attaining homozygosity and further selection will not alter this traits.

The traits like fruit length (14.06; 13.14) and fruit yield per plant (10.65; 9.09) were exhibited moderate PCV and GCV. This is in

agreements with the findings of Kannan *et al.*, (2019), Karthick *et al.,* (2017) , Ananthan and Krishnamoorthy (2017), Samadia (2011) and Koppad *et al.,* (2015) in ridge gourd. This indicates the presence of medium amount of variability and improvement of these traits is possible up to some extent in further generation and to attain homozygosity.

Heritability and genetic advance

High heritability coupled with high genetic advance was recorded in fruit length (87.44; 25.32) characters. This confirms the presence of additive gene action and the trait was less influenced by environment and selecting the genotypes based on such characters could be worthwhile, which agrees with the findings of Kannan *et al.,* (2019), Singh *et al.,* (2002), Samadia (2011) in ridge gourd and Sharma and Sengupta (2013) in bottle gourd.

High heritability coupled with moderate genetic advance was recorded for the traits like days to first female flowering (62.22; 12.26), sex ratio (88.11; 11.09), fruit weight (68.64; 13.27), fruit diameter 69.09; 12.05), flesh thickness (77.20; 14.67) and fruit yield per plant (72.87; 15.99). This might be due to homozygous lines could be developed through continuous selection process and these results are similar to the findings of Kanimozhi *et al.,* (2015) in wax gourd.

High heritability coupled with low genetic advance was recorded in *viz.,* number of fruits per plant (63.00; 8.45). Moderate heritability coupled with low genetic advance was observed in vine length (41.27; 5.59), days to first male flowering (52.17; 6.88), node to first male flowering (43.88; 7.08) and days to first harvest (53.17; 7.11). Low heritability coupled with low genetic advance was recorded for node to first female flower (19.15; 3.26) and rind thickness 22.74; 5.12). This indicated the presence of certain degree of non-additive gene effect and selection of this traits may not be rewarding. This was supported by findings of Islam *et al.,* (1993) in cucumber and Sampath *et al.,* (2017) in pumpkin.

Correlation coefficient analysis

Correlation coefficient of selected ridge gourd culture of F_6 generation are presented in Table 2. Fruit yield was significant and positively correlated with fruit weight (0.799) and sex ratio (0.580). This indicated that fruit yield can be improved by making selection on the bases of yield attributing characters. Similar results were reported by Kannan *et al.,* (2019), Ananthan and Krishnamoorthy (2017) in ridge gourd and Sampath *et al.,* (2017) in pumpkin.

Inter correlations among yield attributing components

The present study revealed that days to first male flower exhibited significant and positive correlation with days to first female flower (0.692), node to first male flower (0.734), days to first harvest (0.622) and fruit length (0.711). Days to first female flower showed significant and positive correlation with node to first male flower (0.909), node to first female flower (0.709) and days to first harvest (0.909). The results are in agreement with the findings of Kannan *et al.,* (2019) in ridge gourd and Tamilselvi, (2010) in pumpkin. Node to first male flower was found to be significant and positively correlated with node to first female flower (0.709) and days to first harvest (0.909). Node to first female flower showed significant and positive correlation with days to first harvest (0.793). Similar results were reported by Chowdhury and Sharma, (2002) in ridge gourd. Fruit diameter recorded significant and positive correlation with rind thickness (0.562) and flesh thickness (0.962). Number of fruits per plant

showed significant and positive correlated with sex ratio (0.944). These results were conformity with the finding of Lakshmi *et al.*, (2000) in pumpkin.

Path coefficient analysis

Path coefficient analysis of the present experiment are presented in Table 3. Path analysis results revealed that vine length (0.112), days to first harvest (0.232), fruit weight (0.956), fruit length (0.152), rind thickness (0.059) and number of fruits per plant (0.549) exhibited positive and direct effects on fruit yield at genotypic level indicating their true positive significant association with fruit yield. Among these traits, fruit weight (0.956) contributed the maximum positive direct effect followed by number of fruits per plant (0.549) and days to first harvest (0.232).The traits like days to first male flower (-0.164), days to first female flower (-0.517), node to first male flower (-0.059), node to first female flower (-0.105), fruit diameter (-0.288), flesh thickness (-0.117) and sex ratio (-0.423) exhibited negative direct effect on fruit yield at genotypic level. Fruit weight, flesh thickness, fruit length, fruit diameter, sex ratio and number of fruits per plant showed indirectly and positively influenced by fruit yield. Because of these traits were the most important yield determinants. Similar results were reported by Kannan *et al.*, (2019), Narasannavar *et al.*, (2014), Ananthan and Krishnamoorthy (2017) in ridge gourd.

Table.1 Estimates of mean, components of variance, heritability and genetic advance for growth, yield and quality parameters of selected ridge gourd culture

S. No	Characters	Mean	PCV (%)	GCV (%)	h^2 (%)	GAM (%)
A.	**Growth traits**					
1.	Vine length (m)	10.21	6.57	4.22	41.27	5.59
B.	**Flowering Traits**					
1.	Days to 1stmale flowering	34.42	6.40	4.62	52.17	6.88
2.	Days to 1stfemale flowering	43.50	9.57	7.54	62.22	12.26
3.	Nodes to 1stmale flower	7.83	7.83	5.19	43.88	7.08
4.	Nodes to 1st female flower	20.21	8.28	3.62	19.15	3.26
5.	Sex ratio	5.40	6.11	5.73	88.11	11.09
6.	Days to first harvest	57.19	6.47	4.72	53.27	7.11
C.	**Yield Traits**					
1.	Number of fruits per plant	15.21	6.51	5.16	63.00	8.45
2.	Fruit weight (g)	391.34	9.38	7.77	68.64	13.27
3.	Fruit length(cm)	30.72	14.06	13.14	87.44	25.32
4.	Fruit diameter (cm)	5.38	8.47	7.03	69.06	12.05
5.	Rind thickness (cm)	0.84	9.93	5.21	22.74	5.12
6.	Flesh thickness (cm)	4.51	9.22	8.10	77.20	14.67
7.	Fruit yield per plant (kg)	5.92	10.65	9.09	72.87	15.99
D.	**Quality Traits**					
1.	Total Soluble Solids (TSS)	1.34	33.34	32.82	96.88	66.54
2.	Total Crude Fibre Content (mg)	0.47	4.74	3.89	67.33	6.58
3.	Dry Matter Content (g)	29.36	7.56	3.73	24.45	3.80

PCV=Phenotypic coefficient of variance GCV = Genotypic coefficient of variance
h2 = Heritability (broad sense) GAM = Genetic advance (per cent mean)

Table.2 Correlation coefficient analysis of selected ridge gourd cultures of F_6 generation

	VL	DFMF	DFFF	NFMF	NFFF	DFH	FW	FL	FD	RT	FT	NFPP	SR	TSS	CFC	DM	FY
VL	1.000	0.277	0.221	0.171	-0.203	0.140	-0.090	0.440	-0.112	-0.409	0.044	-0.064	-0.041	-0.403	0.253	-0.221	-0.127
DFMF		1.000	0.692**	0.734**	0.340	0.622**	-0.155	0.711**	-0.714**	-0.389	-0.679*	-0.525	-0.283	-0.125	0.103	-0.249	-0.435
DFFF			1.000	0.909**	0.709**	0.909**	0.216	0.421	-0.311	-0.115	-0.280	-0.881**	-0.735**	0.078	0.067	0.042	-0.338
NFMF				1.000	0.776**	0.892**	0.070	0.475	-0.523	-0.152	-0.528	-0.853**	-0.683*	-0.070	-0.028	-0.183	-0.449
NFFF					1.000	0.793**	-0.113	-0.093	-0.233	0.386	-0.360	-0.847**	-0.840**	-0.068	-0.020	0.055	-0.598*
DFH						1.000	-0.019	0.186	-0.326	0.038	-0.321	-0.879**	-0.788**	0.045	0.180	0.135	-0.537
FW							1.000	0.309	0.306	-0.303	0.409	-0.080	0.012	0.385	-0.090	0.128	0.799**
FL								1.000	-0.595*	-0.783**	-0.463	-0.111	0.166	-0.133	-0.052	-0.371	0.207
FD									1.000	0.562*	0.962**	0.101	-0.121	0.428	0.267	0.247	0.318
RT										1.000	0.375	-0.252	-0.495	0.258	0.342	0.066	-0.418
FT											1.000	0.176	-0.012	0.450	0.330	0.271	0.446
NFPP												1.000	0.944**	-0.029	-0.105	0.013	0.531
SR													1.000	-0.037	-0.186	-0.052	0.580*
TSS														1.000	0.278	-0.041	0.313
CFC															1.000	-0.023	-0.149
DM																1.000	0.149
FY																	1.000

**Correlation is significant at 1% level

*Correlation is significant at 5% level

VL - Vine length

DFMF - Days to first male flowering

DFFF- Days to first female flowering

NFMF - Node to first male flowering

NFFF- Node to first female flowering

DFH - Days to first harvest

FW- Average fruit weight

FL - Fruit length

FD- Fruit diameter

RT - Rind Thickness

FT - Flesh Thickness

NFPP - No. of fruits per vine

ER- Sex Ratio

TSS - Total Soluble Solids

CFC- Crude Fibre content

FY - Fruit yield

Table.3 Path coefficient analysis of selected ridge gourd culture of F_6 generation

	VL	DFMF	DFFF	NFMF	NFFF	DFH	FW	FL	FD	RT	FT	NFPP	SR	TSS	CFC	DM	FY(r)
VL	0.112	-0.052	-0.167	-0.002	0.038	0.045	-0.034	0.081	0.039	-0.032	-0.007	-0.039	0.033	-0.091	-0.013	0.008	-0.127
DFMF	0.035	-0.164	-0.424	-0.054	-0.065	0.184	-0.198	0.129	0.241	-0.042	0.091	-0.324	0.128	-0.026	-0.004	-0.002	-0.435
DFFF	0.036	-0.135	-0.517	-0.074	-0.141	0.225	0.203	0.066	0.108	-0.009	0.038	-0.543	0.345	0.013	-0.002	0.003	-0.338
NFMF	0.004	-0.147	-0.639	-0.060	-0.155	0.284	0.163	0.086	0.185	-0.016	0.074	-0.588	0.372	-0.015	0.003	-0.002	-0.449
NFFF	-0.041	-0.102	-0.693	-0.089	-0.105	0.307	-0.221	-0.027	0.074	0.059	0.065	-0.853	0.562	-0.021	-0.001	0.002	-0.598
DFH	0.022	-0.131	-0.502	-0.073	-0.139	0.232	-0.011	0.025	0.100	0.012	0.040	-0.593	0.402	0.005	-0.005	-0.002	-0.537
FW	-0.004	0.034	-0.110	-0.010	0.024	-0.003	0.957	0.052	-0.092	-0.029	-0.050	-0.012	-0.016	0.077	0.003	-0.002	0.799
FL	0.059	-0.139	-0.225	-0.034	0.019	0.037	0.326	0.153	0.189	-0.066	0.059	-0.057	-0.071	-0.026	0.002	0.012	0.207
FD	-0.015	0.137	0.194	0.038	0.027	-0.080	0.305	-0.100	-0.289	0.041	-0.114	0.081	0.053	0.086	-0.014	-0.003	0.318
RT	-0.060	0.118	0.077	0.016	-0.105	0.048	-0.461	-0.171	-0.199	0.059	-0.056	-0.218	0.288	0.072	-0.024	-0.015	-0.418
FT	0.007	0.128	0.168	0.038	0.058	-0.078	0.406	-0.076	-0.279	0.028	-0.117	0.131	0.002	0.089	-0.016	-0.002	0.446
NFPP	-0.008	0.097	0.512	0.064	0.163	-0.251	-0.020	-0.016	-0.042	-0.024	-0.028	0.549	-0.435	-0.007	0.003	-0.002	0.531
SR	-0.009	0.050	0.422	0.053	0.140	-0.220	0.037	0.026	0.036	-0.040	0.001	0.565	-0.423	-0.007	0.007	0.002	0.58
TSS	-0.055	0.023	-0.036	0.005	0.012	0.006	0.400	-0.022	-0.135	0.023	-0.056	-0.022	0.017	0.184	-0.011	0.001	0.313
CFC	0.040	-0.019	-0.022	0.005	-0.002	0.033	-0.066	-0.010	-0.106	0.038	-0.050	-0.045	0.081	0.054	-0.037	-0.001	-0.149
DM	-0.034	-0.011	0.053	-0.003	0.006	0.021	0.085	-0.071	-0.028	0.034	-0.009	0.051	0.024	-0.009	-0.002	0.027	0.149

Residual effect : 0.0937

VL - Vine length
DFFF- Days to first female flowering
NFFF- Node to first female flowering
FW- Average fruit weight
FD- Fruit diameter
FT - Flesh Thickness
ER- Sex Ratio
CFC- Crude fibre content

DFMF - Days to first male flowering
NFMF - Node to first male flowering
DFH - Days to first harvest
FL - Fruit length
RT - Rind Thickness
NFPP - No. of fruits per vine
TSS - Total Soluble Solids
FY - Fruit yield

In the present study, residual effects of path coefficient analysis were found to be low in some of the traits indicating that most of the traits have respectable correlation with yield. These results are in conformity with the findings of Kannan *et al.,* (2019) in ridge gourd, Dey *et al.,* (2009) in bitter gourd.

In the present study, it was concluded that moderate PCV and GCV with high heritability and high genetic advance were observed in fruit length. Low PCV and GCV with low heritability and low genetic advance were noticed in node to first female flower and rind thickness. Fruit yield was significantly and positively correlated with fruit weight and sex ratio. Path coefficient analysis results revealed that vine length, days to first harvest, fruit weight, fruit length, rind thickness and number of fruits per plant exhibited high positive direct effect on fruit yield. The selected cultures showed higher yield with high heritability and it can be promising in providing better source of population for commercial utilization.

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