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**Genetic variability, correlation and path analysis in ridge gourd**

**[*Luffa acutangula* (Roxb.) L.]**

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**ABSTRACT**

**The present investigation was made to determine variability, heritability, genetic advance and correlation of fruit**

**yield with 10 yield-contributing traits in ridge gourd. A wide variability was observed for days taken to first femaleflower**

**appearance, fruit length, fruit number/plant, fruit weight and fruit yield/ha. Phenotypic coefficient of variation**

**was higher than genotypic coefficient of variation for all the traits studied, indicating environmental influence on the**

**expression of these traits. However, high heritability (broad-sense), along with high genetic advance, was recorded in**

**node number at which first female-flower appeared, number of branches, fruit length, number of fruits/plant and fruit**

**weight, indicating presence of additive gene effects. Fruit yield/ha was significantly and positively associated with**

**peduncle length, fruit length, number of fruits/plant (at the phenotypic level), fruit weight and fruit yield/plant. Fruit**

**weight had the highest direct effect (0.847) on fruit yield/ha, followed by fruit yield/plant (0.793), fruit number**

**(0.344), peduncle length (0.237) and number of branches (0.216). Therefore, for yield improvement in ridge gourd,**

**emphasis may be laid on indirect selection using fruit parameters like fruit weight, number of fruits/plant and fruit**

**yield/plant.**

**Key words:** Ridge gourd, *Luffa acutangula* (Roxb) L., genetic variability, heritability, correlation path analysis

Therefore, the present study was undertaken to assess the

nature and magnitude of variability, heritability, correlation

coefficient and path analysis for various quantitative

parameters in ridge gourd. Information generated on these

aspects can greatly help formulate appropriate breeding

strategies for genetic upgradation of this crop.

**MATERIAL AND METHODS**

The experiments were carried out at Vegetable Farm,

ICAR-Indian Institute of Horticultural Research, Bengaluru,

during the *rabi*-summer season of the years 2011-12, 2012-

13 and 2013-14. The experiments were laid out in

Randomized Block Design, with 51 germplasm lines in two

replications, in all the three years. Ten plants per replication

were raised. Two-week-old seedlings were planted at 150cm

x 50cm spacing. Recommended agronomic practices were

applied to the crop. Observations were recorded on five

randomly-selected plants in each replication, on 10

quantitative traits (node number for first female-flower

appearance, days taken to first female-flower appearance,

vine length (m), number of branches, peduncle length (cm),

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fruit length (cm), fruit girth (cm), number of fruits /plant,

fruit weight (g), fruit yield/plant (kg) or fruit yield/ha (t).

Pooled data for the three years was analyzed as per

Panse and Sukhatme (1984) for Analysis of Variance

(ANOVA). Phenotypic and genotypic coefficient of variation

(PCV and GCV, respectively), heritability in a broad sense,

and genetic advance as per cent of mean, were calculated

as per Burton and De Vane (1953) and Johnson *et al* (1955).

Correlation co-efficient among all the possible character

combinations at genotypic (rg) and phenotypic (rp) levels

were estimated using the formula of Al-Jibouri *et al* (1958)

and path coefficient analysis was done as per Dewey and

Lu (1959). GENRES Statistical Software Package

(GENRES, 1994) was employed for analysis of variance

and estimation of correlation among traits.

**RESULTS AND DISCUSSION**

Mean, range and estimates for various genetic

parameters of 10 traits in 51 germplasm lines of ridge gourd

studied are presented in Table 1. Analysis of Variance

revealed significant difference among germplasm lines for

all the 10 traits studied. A wide range of variation was

observed for most of the traits like days taken to first femaleflower

appearance (37.0-66.4), fruit length (10.5-41.3cm),

number of fruits/plant (4.7-33.8), fruit weight (79.8-300.8g),

and fruit yield/ha (8.5-37.9 t). High variability present for

these parameters can form a basis for effective selection

of superior lines in ridge gourd. Such wide variability has

also been reported by Choudhary and Suresh Kumar (2011)

in this crop. The degree of variability seen in various

parameters can be judged by the magnitude of GCV and

PCV. GCV, which indicates the extent of genetic variability

present in a population, ranged from 11.0 (days taken to

first female-flower appearance) to 39.8 (number of fruits /

plant). Similar findings were reported by Varalakshmi *et al*

(1995), Singh *et al* (2002) and Choudhary *et al* (2008) in

ridge gourd. Table 1 shows that a considerable difference

exists between PCV and GCV values for all the traits under

study. This points to the presence of higher environmental

influence on expression of all these parameters, and, selection

may not be effective for improvement of ridge gourd.

Further, GCV values were low in magnitude compared to

PCV values for all the characters studied. This also indicates

that direct selection may not be effective for these traits,

and heterosis breeding may be resorted to for further

improvement.

With help from GCV alone, it is not possible to

determine the extent of variation heritable. Thus, estimates

for heritability indicate the effectiveness with which selection

can be expected for exploiting existing genetic variability.

Broad-sense heritability was high (>60%) for node number

for first female-flower appearance (74.3%), number of

branches (80.8%), fruit length (78.6%), number of fruits/

plant (66.7%) and fruit weight (72.8%). Similar findings were

reported by Varalakshmi *et al* (1995), Karuppaiah *et al*

(2002) and Singh *et al* (2002) in ridge gourd. Moderate

heritability (40-60%) was observed for days taken to first

female-flower appearance (49.2%), vine length (58.2%),

peduncle length (57.4%), fruit yield/plant (57.7%), and fruit

yield/ha (56.8%) (Table 1). Johnson *et al* (1955) reported

that heritability, along with genetic advance, was more useful

than heritability alone in predicting the effect of selecting

the best individual genotype, as, it suggests presence of

additive gene effects. In the present study, high heritability,

**Table 1. Mean, coefficient of variation, heritability and genetic advance for various traits in ridge gourd**

Sl. Trait Mean Range Genotypic Phenotypic Genotypic Phenotypic Herita- Genetic GA

No. Variance Variance Coefficient of Coefficient bility Advance as %

(GV) (PV) Variation of Variation (h2) (GA) Mean

(GCV) (PCV)

1 NFF 9.8 5.3- 19.9 8.6 11.5 29.9 34.7 74.3 5.2 53.1

2 DFF 47.7 37.0- 66.4 27.6 56.1 11.0 15.7 49.2 7.6 15.9

3 Vine length (m) 3.9 2.2- 6.5 0.8 1.4 23.6 30.9 58.2 1.4 37.0

4 Number of branches 6.9 2.9- 13.3 7.3 9.0 39.0 43.4 80.8 5.0 72.3

5 Peduncle length (cm) 8.2 4.9- 12.7 3.1 5.3 21.3 28.1 57.4 2.7 33.3

6 Fruit length (cm) 22.5 10.5- 41.3 60.9 77.5 34.7 39.1 78.6 14.2 63.4

7 Fruit girth (cm) 11.8 8.1- 16.9 2.8 8.8 14.1 25.2 31.5 1.9 16.4

8 Number of fruits /plant 13.6 4.7- 33.8 29.2 43.8 39.8 48.8 66.7 9.1 67.0

9 Fruit weight (g) 169.8 79.8-300.8 2915.4 4004.1 31.8 37.3 72.8 94.9 55.9

10 Fruit yield/plant (kg) 1.8 0.6- 2.8 0.2 0.4 26.6 35.0 57.7 0.7 41.7

11 Fruit yield/ha (t) 23.3 8.5- 37.9 37.3 65.8 26.2 34.8 56.8 9.5 40.7

NFF: Node number for first female flower appearance; DFF: Days taken to first female flower appearance

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along with a high genetic advance, was recorded in node

number for first female-flower appearance, number of

branches, fruit length, number of fruits/plant and fruit weight,

indicating the presence of additive gene effects. Thus,

selection can be employed for improvement in these

parameters in ridge gourd. Fruit yield/plant and fruit yield/

ha recorded moderate levels of heritability and genetic

advance. This suggests that environmental effects constitute

a major factor for total phenotypic variation, and therefore,

direct selection for these traits would be less effective.

Similar findings were reported by Choudhary and Suresh

Kumar (2011) in ridge gourd.

All possible correlation coefficients between fruit

yield/ha and its component traits were estimated at the

genotypic (G) and phenotypic (P) level (Table 2). From these

associations, it appears that higher fruit yield/ ha was

significantly and positively associated with peduncle length,

fruit length, number of fruits/plant (at the phenotypic level

only), fruit weight and fruit yield/plant. In the present

investigation, interrelations among these parameters were

also seen to be positive and significant. Fruit length exhibited

a positive and significant association with fruit weight and

fruit yield/plant, and, a negative association with fruit girth

and number of fruits/plant. Number of fruits/plant had

significant positive association with fruit yield/plant, and fruit

weight/plant. This implies that indirect selection for all these

traits can help improve fruit yield in ridge gourd. These results

are in conformity with Varalakshmi *et al* (1995), Rao *et al*

(2000), Chowdhury and Sharma (2002), Prasanna *et al*

(2002), Choudhary *et al* (2008), Hanumegowda *et al* (2012)

and Rabbani *et al* (2012) in ridge gourd.

Though correlation analysis can quantify the degree

of association between any two characters, it does not

provide the reasons for such an association. Simple linear

correlation coefficient is designed to detect presence of linear

association between two variables. This does not imply

absence of any functional relationship between the two

variables. Path coefficient analysis resolves this mystery

by breaking the ‘total correlation’ into components of direct

and indirect effects. Thus, path analysis was performed to

assess direct and indirect effects of various characters on

fruit yield/ha (Table 3). Fruit weight had the highest direct

effect (0.847) on fruit yield/ha, followed by fruit yield/plant

(0.793), number of fruits/plant (0.344), peduncle length

(0.237) and number of branches (0.216) (Choudhary *et al*,

2008). Indirect effects of most other parameters through

**Table 2. Genotypic (rg) and phenotypic (rp) correlation coefficient among various traits in ridge gourd**

Trait NFF DFF Vine Number Peduncle Fruit Fruit Number Fruit Fruit Fruit

length of length length girth of fruits/ weight yield/ yield/

(m) branches (cm) (cm) (cm) plant (g) plant ha (t)

(kg)

NFF (rg) 1.000 0.790\*\* 0.674\*\* 0.513\*\* 0.461\*\* 0.508\*\* -0.280\* -0.580\*\* 0.646\*\* -0.135 -0.179

(rp) 1.000 0.522\*\* 0.478\*\* 0.396\*\* 0.311\* 0.439\*\* -0.145 -0.590\*\* 0.470\*\* -0.136 -0.180

DFF (rg) 1.000 0.500\*\* 0.465\*\* 0.381\*\* 0.372\*\* -0.296\* -0.600\*\* 0.519\*\* -0.137 -0.181

(rp) 1.000 0.261 0.346\* 0.257 0.265 -0.297\* -0.610\*\* 0.348\* -0.138 -0.182

Vine (rg) 1.000 0.599\*\* 0.717\*\* 0.682\*\* -0.298\* -0.620\*\* 0.780\*\* 0.240 0.195

length(m) (rp) 1.000 0.471\*\* 0.471\*\* 0.505\*\* -0.299\* -0.600\*\* 0.592\*\* 0.203 0.213

Number of (rg) 1.000 0.450\*\* 0.521\*\* -0.300\* -0.640\*\* 0.573\*\* -0.028 0.019

branches (rp) 1.000 0.299\* 0.399\*\* -0.301\* -0.650\*\* 0.480\*\* 0.043 0.078

Peduncle (rg) 1.000 0.902\*\* -0.302\* -0.660\*\* 0.919\*\* 0.529\*\* 0.503\*\*

length (cm) (rp) 1.000 0.755\*\* -0.303\* -0.670\*\* 0.682\*\* 0.377\*\* 0.392\*\*

Fruit length (rg) 1.000 -0.304\* -0.680\*\* 0.961\*\* 0.401\*\* 0.391\*\*

(cm) (rp) 1.000 -0.305\* -0.690\*\* 0.823\*\* 0.277\* 0.279\*

Fruit girth (rg) 1.000 -0.700\*\* -0.239 -0.085 -0.186

(cm) (rp) 1.000 0.174 -0.201 0.027 -0.187

Number of (rg) 1.000 -0.745\*\* 0.143 0.223

fruits /plant (rp) 1.000 -0.551\*\* 0.282\* 0.328\*

Fruit (rg) 1.000 0.292\* 0.279\*

weight (g) (rp) 1.000 0.276\* 0.284\*

Fruit yield/ (rg) 1.000 0.948\*\*

plant (kg) (rp) 1.000 0.903\*\*

Fruit yield/ (rg) 1.000

ha (t) (rp) 1.000

\*\*Significant at *P=0.01,* \*Significant at *P=0.05*

NFF- Node number for first female-flower appearance; DFF- Days taken to first female-flower appearance

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**Table 3. Direct and indirect effects of various traits on fruit yield/plant at the genotypic level in ridge gourd**

Trait NFF DFF Vine Number of Peduncle Fruit Fruit Number Fruit Fruit Genotypic

length branches length length girth of fruits/ weight yield/ correlation

(m) (cm) (cm) (cm) plant (g) plant (kg)

NFF **-0.144** -0.036 -0.211 0.111 0.110 -0.300 0.051 -0.200 0.547 -0.107 -0.179

DFF -0.114 **-0.045** -0.157 0.100 0.091 -0.220 0.053 -0.206 0.439 -0.272 -0.181

Vine -0.097 -0.023 **-0.313** 0.129 0.170 -0.402 0.049 -0.170 0.661 0.190 0.195

length (m)

Number of -0.074 -0.021 -0.188 **0.216** 0.107 -0.307 -0.004 -0.172 0.485 -0.022 0.019

branches

Peduncle -0.067 -0.017 -0.225 0.097 **0.237** -0.532 0.021 -0.210 0.779 0.419 0.503\*\*

length (cm)

Fruit -0.073 -0.017 -0.214 0.112 0.214 **-0.590** 0.048 -0.221 0.814 0.317 0.391\*\*

length (cm)

Fruit 0.040 0.013 0.085 0.005 -0.028 0.156 **-0.181** -0.008 -0.202 -0.067 -0.186

girth (cm)

Number of 0.084 0.027 0.155 -0.108 -0.145 0.379 0.004 **0.344** -0.631 0.114 0.223

fruits /plant

Fruit -0.093 -0.023 -0.245 0.124 0.218 -0.567 0.043 -0.257 **0.847** 0.232 0.279\*

weight (g)

Fruit yield/ 0.019 0.016 -0.075 -0.006 0.126 -0.236 0.015 0.049 0.248 **0.793** 0.948\*\*

plant (kg)

\*\*Significant at *P=0.01*, \*Significant at *P=0.05*

Figures on the diagonal in bold font indicate direct effect

NFF- Node number for first female-flower appearance; DFF- Days taken to first female-flower appearance

these stated parameters were also positive. Similarly, Rabbani

*et al* (2012) from Bangladesh reported fruit weight and

number of fruits as having the maximum direct effect on

fruit yield in ridge gourd. Rest of the parameters such as

node-number for first female-flower appearance, days taken

to first-flower appearance, vine length, fruit length and fruit

girth exhibited a negative direct effect on fruit yield/ha;

indirect effects via these parameters were also negative

for several of the traits. Positive direct and indirect effects

of fruit weight, fruit yield/plant and fruit number lead to the

significant and positive correlation with fruit yield/ha. This

indicates that the positive selection for these parameters is

going to contribute to higher fruit yields in ridge gourd.

Therefore, for yield improvement in ridge gourd,

emphasis is to be laid on indirect selection using fruit

parameters like fruit weight, fruit number and fruit yield/

plant.

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