JOURNAL OF AGROFORESTRY AND ENVIRONMENT
ISSN 1995 - 6983
journal homepage : www.jaebd.com

Correlation and path analysis in some ridge gourd genotypes

N. Mitu, M.S. Islam[1], D. Sharmin[2], M.A. Latif, and N.J. Methela[1]
Department of Genetics and Plant Breeding, Faculty of Agriculture, Patuakhali Science and Technology University, Patuakhali - 8602, Bangladesh; [1]Department of Agriculture, Faculty of Science, Noakhali Science and Technology University, Noakhali - 3814, Bangladesh; [2]Ibaraki University, College of Agriculture, Department of Bio resource Science, Ibaraki 300–0393, Japan; Email: methela.ag@nstu.edu.bd

Abstract: In the present investigation, 29 genotypes of ridge gourd were grown during 2016-2017 at the experimental field of Regional Horticulture Research Station, Patuakhali, Bangladesh. The experiment was laid out in randomized complete block design with three replications. Correlation coefficient study reveals that yield per plant had highly significant positive relationship with fruit length (rg = 0.43*, rp=0.40*), and individual fruit weight (rg = 0.69**, rp=0.67**). In general, genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients suggesting that the environmental influence reduces the relationship between yield and yield contributing characters of ridge gourd. On the other hand, plant height, fruit diameter and fruit thickness exhibited negative association with yield. Path co-efficient analysis showed that individual fruit weight exhibited the highest positive direct effect (0.8462) on yield followed by number of fruits per plant (0.7040). Therefore, emphasis should be given on these characters for enhancing the yield of ridge gourd.
Key words: correlation coefficient, path co-efficient, ridge gourd, genotype, yield.

Introduction

Ridge gourd [*Luffa acutangula* (L.)] is an important member of Cucurbitaceae family. The southern part of Bangladesh is an important region for the diversity of ridge gourd where different cultivars and uses are known. Yield is a complex character and is governed by polygenic system. Moreover, it is highly influenced by environmental fluctuations. Correlation analysis is a biometrical technique to find out the nature and degree of associations among various traits. The study of correlation between plant characters is of great importance to a plant breeder as it provides a measure of the degree of association between yield and other yield attributes. The path coefficient analysis is partitioned the correlation in direct and indirect effects and thus may be useful in choosing the characters that have direct and indirect effects on yield. Hence, study of correlations (genotypic and phenotypic) and path coefficient analysis of yield would be of help in selection of yield component traits in the genetic improvement of quantitative traits, which are positively correlated. For a successful planning of breeding improvement program, the analysis of variability among the traits and their association of a particular character in relation to yield and yield attributing traits it would be great importance [Methela *et al.* (2019), Ramesh *et al.* (2018), Ananthan and Krishnamoorthy (2017)] in ridge gourd. Keeping in the view of above facts, the objectives of the present investigation was to study the association of yield and its component traits and the direct and indirect effects of yield component traits on fruit yield in ridge gourd genotypes.

Materials and Methods

This experiment was conducted during the period of 2015-16 at Regional Horticulture Research Station (RHRS), Patuakhali, Bangladesh. The soil was silty clay loam having pH value of 6.8. In this experiment, twenty-nine genotypes were used as test crop. Of these, twenty genotypes (BD2982, BD2975, BD2978, BD2981, BD2985, BD2992, BD2883, BD2994, BD2995, BD2997, BD2999, BD3000, BD3001, BD3007, BD3012, BD3017, BD3018, BD3028, BD3031 and BD3040) were obtained from PGRC, BARI, Gazipur. Eight local genotypes (PK1, PK2, PK3, PK4, PK5, PK6, PK8, and PK9) were collected from different parts of southern Bangladesh and one (BARI Jhinga-1) check variety was collected from RHRS, Patuakhali. Treated seed were sowed and 15 days old seedlings were transplanted in the main field with recommended spacing (1.5×1.5 m^2) following RCBD with 3 replications. Standard management practices were done. Observation were recorded on five randomly selected plants per treatment for some qualitative and eleven quantitative characters viz., plant height, days to 1st male flowering, days to 1st female flowering, fruit length, diameter, thickness, number of fruits per plant, individual fruit weight, fruit yield per plant, weight of 100 seeds and total soluble solids (TSS).

Statistical Analysis: The correlations were worked out as per methods suggested by Johnson et al. (1955) and path coefficient analysis as suggested by Dewey and Lu (1959). Pearson correlation coefficient and path coefficient among the parameters of ridge gourd accessions were estimated by using XLSTAT computer program.

Results and Discussion

Morphological characterization:

Different morphological characteristics were studied on the ridge gourd genotypes (Table 1). In consideration of flower color, it was observed that the flowers of each genotype were yellow in color. Fruit color of the genotypes BD2982, BD2975, BD2981, BD2992,BD2883, BD2994, BD3000, BD3012, BD3017, BD3018, BD3031, BD3040, PK1, PK2, PK4, PK5, PK6, PK8 and BARI Jhinga-1 were green in color, BD2978 ,BD2985, BD2997 had light green, whereas, BD2993, BD3007, PK3, BD2928, BD2995, BD3001, BD2999 and PK 9 were deep green in fruit color. In consideration of fruit shape, it was observed that the genotypes BD2985, BD2993, BD2972, BD3007, PK1, BD3018, BD3001, BD2995 and BD2981 showed elongate fruit shape. Whereas, BD3031, BD2992, BARI Jhinga-1, BD3040, BD3000, BD2997, BD3012 and PK4 were cylindrical in shape. The fruit shape of BD2994, BD3017, PK2, BD2975 and PK5 were club shape .While the genotypes PK9,BD2999, BD3028,PK6, PK3 showed elliptical fruit shape. The ridge of all ridge gourd were continuous.

Table 1. Morphological characteristics of 29 ridge gourd genotypes

Genotypes	Flower color	Fruit color	Fruit shape	Plant growth habit	Stem shape	Leaf margin	Leaf size	Stem pubescence	Leaf pubescence
BD2972	yellow	green	elongate	l.viny	angular	serrate	medium	Pubescence	Intermediate
BD2975	yellow	green	elongate	l.viny	angular	serrate	medium	Pubescence	Soft
BD2978	yellow	l.green	elongate	l.viny	angular	entire	small	Pubescence	Soft
BD2981	yellow	green	elongate	l.viny	angular	serrate	medium	Pubescence	Intermediate
BD2985	yellow	l.green	elongate	l.viny	angular	serrate	medium	Pubescence	Hard
BD2992	yellow	green	cylindrical	l.viny	angular	serrate	medium	Pubescence	Intermediate
BD2993	yellow	d.green	elongate	s.viny	rounded	entire	medium	Pubescence	Intermediate
BD2994	yellow	green	elongate	s.viny	angular	serrate	medium	Pubescence	Intermediate
BD2995	yellow	d.green	elongate	s.viny	angular	serrate	medium	Pubescence	Intermediate
BD2997	yellow	l.green	cylindrical	l.viny	angular	serrate	large	Pubescence	Hard
BD2999	yellow	d.green	elliptical	l.viny	angular	entire	large	Pubescence	Intermediate
BD3000	yellow	green	cylindrical	l.viny	angular	serrate	medium	Pubescence	Hard
BD3001	yellow	d.green	elongate	s.viny	angular	entire	medium	Pubescence	Hard
BD3007	yellow	d.green	elongate	s.viny	angular	serrate	medium	Pubescence	Soft
BD3012	yellow	green	cylindrical	s.viny	rounded	entire	large	Pubescence	Intermediate
BD3017	yellow	green	elongate	s.viny	angular	serrate	small	Pubescence	Intermediate
BD3018	yellow	green	elongate	s.viny	angular	serrate	medium	Pubescence	Intermediate
BD3028	yellow	d.green	elliptical	s.viny	angular	entire	medium	Pubescence	Intermediate
BD3031	yellow	green	cylindrical	l.viny	angular	serrate	medium	Pubescence	Intermediate
BD3040	yellow	green	cylindrical	s.viny	angular	serrate	large	Pubescence	Soft
PK1	yellow	green	elongate	s.viny	angular	entire	small	Pubescence	Intermediate
PK2	yellow	green	elongate	s.viny	angular	serrate	small	Pubescence	Soft
PK3	yellow	d.green	elongate	s.viny	angular	serrate	medium	Pubescence	Soft
PK4	yellow	green	elongate	s.viny	angular	serrate	medium	Pubescence	Intermediate
PK5	yellow	green	elongate	l.viny	angular	serrate	small	Pubescence	Hard
PK6	yellow	green	elliptical	s.viny	angular	serrate	medium	Pubescence	Intermediate
PK8	yellow	green	elongate	s.viny	angular	entire	medium	Pubescence	Soft
PK9	yellow	d.green	elliptical	s.viny	angular	serrate	medium	Pubescence	Intermediate
BARI1	yellow	green	cylindrical	s.viny	angular	serrate	medium	Pubescence	Soft

l.green = light green, d.green = deep green, l.viny = long viny, s.viny = short viny.

In plant growth habit, the genotypes BD2985, BD2972, BD2931, BD2992, BD2999, BD3000, BD3018, BD2997 and PK5 were long viny plant. While BD3012, BD3017, BD3028, PK1, PK9, BD2994, BD2995 were medium viny plant and others were short viny plant. In stem pubescence of ridge gourd, it was observed that the stem of all genotypes were pubescent in nature. In stem shape of ridge gourd was recorded that BD3012 and BD2993 were rounded and the other genotypes were angular.

The leaf margin of genotypes BD2993, BD3028, BD3001, BD2999, PK1, BD2981, PK2, BD2978, PK8, BD3012 were entire and the rest were serrate. The leaf size of genotypes BD2982, BD2975, BD2981, BD2985, BD2992, BD2883, BD2994, BD2995, BD3000, BD3001, BD3007, BD3018, BD3028, BD3031, PK3, PK4, PK6, PK8, PK9 and BARI Jhinga-1 were medium. While BD3012, BD3040, BD2997, BD2999 were large in size and the leaf of genotypes PK1, PK2, BD2978, PK5, BD3017, BD2978 were small. The leaf pubescence of genotypes BD3000, BD3001, BD2985, BD2997, PK5 were hard .The genotypes BD3007, PK3, BARI Jhinga-1, BD3040, PK2, PK8, BD2975, BD2978 were soft and others were intermediate type.

Morphological characterization has been used for assessment of relationships and estimating genetic diversity among *Luffa acutangula* genotypes (Choudhary *et al*., 2007 & 2009). The genotype used in the present study showed a wide variation in morphological traits viz., fruit shape (cylindrical, elongate, elliptical and club shape), color (green, light green and dark green). In qualitative parameters such as leaf shape, fruit shape, fruit skin color, etc. had showed significant frequencies in different categories among the genotypes due to their inherent genetic diversity.

Correlation Matrix

The correlation studies revealed that in general an estimate of genotypic correlation coefficient was higher than corresponding phenotypic correlation coefficient, which indicated a strong inherent association among different traits under study. The lower phenotypic values might be due to environmental interactions (Table 2). Similar observations were noticed in ridge gourd earlier (Karuppaiah *et al*., 2005; Rao *et al*., 2000).

Plant height had significant and positive association with days to first female flower (0.36). It had positive but non-significant association with fruit diameter (0.27, 0.20). Days to first male flower had positive and significant association with days to first female flower (0.44, 0.42) and highly significant association with individual fruit weight (0.52). Significant and negative association was found with number of fruits per plant (-0.36). In case of Days to first female flower had positive and significant

association with individual fruit weight (0.36) and non-significant association with fruit diameter (0.27).

Fruit length had positive and highly significant association with individual fruit weight (0.60, 0.58) and significant association with fruit yield per plant (0.43, 0.40). Negative and non-significant association was observed with number of fruits per plant and TSS. Fruit diameter had negative but highly significant relation to number of fruits per plant (-0.63, -0.44). It had positive and non-significant association with TSS. Fruit thickness had non-significant and negative association with all the parameters. Number of fruits per plant had non-significant and positive relationship with fruit yield per plant. Correlation between the traits like days to first male flower, days to first female flower, individual fruit weight, fruit length, number of fruit per plant and fruit yield indicates that positive change of one of them will be positive for others and these are the important traits to increase yield. Shah and Kale (2002) reported significant correlations for fruit number per vine with number of female flowers per vine; branch number with vine length, internodal length and number of male flowers per vine; internodal length with average fruit weight. Strong and highly significant for fruit weight, fruit length and fruit width also described by El Madidi and Hakimi (2015).

Table 2. Genotypic and phenotypic correlation among the characters in 29 ridge gourd genotypes

Parameters		Days to first male flower	Days to first female flower	Fruit length (cm)	Fruit diameter (cm)	Fruit thickness (cm)	Number of fruits per plant	Individual fruit weight (g)	Fruit Yield per plant (kg)	Total soluble solid (%)
Plant height	rg	0.33	**0.36***	-0.19	0.27	0.01	-0.29	0.15	-0.04	-0.15
(cm)	rp	0.17	0.20	-0.18	0.20	0.01	-0.28	0.15	-0.04	-0.14
Days to first	rg		**0.44***	0.06	0.14	-0.14	**-0.36***	**0.52****	0.25	-0.24
male flower	rp		**0.42***	0.03	0.05	-0.07	-0.18	0.27	0.13	-0.12
Days to first	rg			-0.10	0.27	-0.12	-0.26	**0.36***	0.11	-0.18
female flower	rp			-0.05	0.11	-0.06	-0.14	0.20	0.06	-0.09
Fruit length	rg				0.12	-0.03	-0.29	**0.60****	**0.43***	-0.15
(cm)	rp				0.09	-0.03	-0.27	**0.58****	**0.40***	-0.13
Fruit diameter	rg					0.18	**-0.63****	0.15	-0.25	0.26
(cm)	rp					0.13	**-0.44****	0.11	-0.18	0.18
Fruit thickness	rg						-0.16	-0.01	-0.07	-0.20
(cm)	rp						-0.14	-0.01	-0.07	-0.18
Number of	rg							-0.35	0.35	-0.06
fruits per plant	rp							-0.33	0.32	-0.05
Individual fruit	rg								**0.69****	-0.25
weight (g)	rp								**0.67****	-0.23
Fruit Yield per	rg									-0.19
plant (kg)	rp									-0.17

Individual fruit weight had highly significant and positive association with fruit yield per plant (0.69, 0.67). And fruit yield per plant had negative and non-significant association with TSS. Shah and Kale (2002) reported that fruit weight/vine was positively and significantly correlated with the fruit number/vine, average fruit weight indicating the close association and dependency of yield on these characters. Rao *et al*. (2000) reported that yield/vine exhibited significant positive correlation with fruits/vine both phenotypic and genotypic levels. Shah and Kale (2002) reported that the fruit weight per vine was positively and significantly correlated with the fruit number per vine and average fruit weight. Similar high positive correlation of fruit size and number of fruit with fruit yield was described by Rakesh and Todd (2011).

Path co-efficient analysis screens the components of correlation into direct and indirect effects. The results of path co-efficient using genotypic correlation are presented in Table 3.

Plant height had low positive direct effect (0.0031) on yield. Positive indirect effect was observed through days to first male flower, fruit diameter, and individual fruit weight in ridge gourd. Days to first male flower had positive direct effect (0.2154) on yield/plant. It showed positive indirect effect through plant height, days to first male flower, fruit length, fruit diameter, individual fruit weight, fruit yield per plant, 100 seed weight. On contrary, days to first female flower had negative direct effect (-0.2140) on yield/plant. It showed negligible negative indirect effect through fruit length, fruit thickness, number of fruits per plant, total soluble solid. Days to first female flower showed positive indirect effect through plant height, days to first male flower, fruit diameter, individual fruit weight, fruit yield per plant, 100 seed weight, in ridge gourd.

Fruit length, diameter and thickness had positive direct effect (0.1349, 0.0094 and 0.0575, respectively) on yield/plant. Fruit length showed negligible positive indirect effect through days to first female flower, days to first male flower, fruit length, fruit diameter and individual fruit weight. And fruit diameter showed negligible positive indirect effect through plant height, days to first male flower, fruit length, individual fruit weight and total soluble solid. Rind thickness showed negligible positive indirect effect through plant height, days to first female flower, fruit diameter and individual fruit weight.

Path analysis revealed that, number of fruits per plant and individual fruit weight both had positive direct effect

(0.7040 and 0.8462, respectively) on yield/plan. Number of fruits per plant showed negligible positive indirect effect through days to first female flower and weight of 100 seeds. Individual fruit weight showed negligible positive indirect effect through, plant height, days to first male flower, fruit diameter, fruit length, rind thickness in ridge gourd.

Table 3. Partitioning of genotypic correlation with fruit yield into direct (bold) and indirect effect of yield contributing traits in 29 ridge gourd genotypes

	ph	dmf	dff	frlen	frdia	frth	nfrp	ifrw	hsw	tss	fryld
ph	**0.0031**	0.0538	-0.0600	-0.0262	0.0024	-0.0001	-0.2089	0.1298	-0.0076	-0.0171	-0.038
dmf	0.0008	**0.2154**	-0.1776	0.0064	0.0009	-0.0061	-0.1904	0.3327	0.0031	-0.0198	0.192
dff	0.0009	0.1788	**-0.2140**	-0.0104	0.0018	-0.0054	-0.1394	0.2369	0.0050	-0.0150	0.081
frlen	-0.0006	0.0102	0.0165	**0.1349**	0.0010	-0.0010	-0.2068	0.5200	-0.0050	-0.0165	0.435
frdia	0.0008	0.0198	-0.0409	0.0147	**0.0094**	0.0089	-0.3960	0.1159	-0.0213	0.0259	-0.228
frth	0.0000	-0.0228	0.0202	-0.0024	0.0014	**0.0575**	-0.1082	0.0002	-0.0006	-0.0227	-0.059
nfrp	-0.0009	-0.0582	0.0424	-0.0396	-0.0053	-0.0088	**0.7040**	-0.2962	0.0213	-0.0067	0.349
ifrw	0.0005	0.0847	-0.0599	0.0829	0.0013	0.0000	-0.2465	**0.8462**	-0.0091	-0.0274	0.709
hsw	-0.0004	0.0119	-0.0193	-0.0122	-0.0036	-0.0006	0.2687	-0.1385	**0.0557**	-0.0203	0.070
tss	-0.0005	-0.0388	0.0291	-0.0202	0.0022	-0.0119	-0.0426	-0.2106	-0.0103	**0.1102**	-0.191

Residual Effect^2 = 0.03472532

ph = plant height (cm), dmf = days to first male flowering, dff = days to first female flowering, frlen = fruit length (cm), frdia = fruit diameter (cm), frth = fruit thickness (cm), nfrp = number of fruit per plant, ifrw = individual fruit weight (g), hsw = hundred seed weight (g), tss = total soluble sugar (%), fryld = fruit yield per plant (kg)

Path analysis also revealed that weight of 100 seeds and TSS both had positive direct effect (0.0557 and 0.01102, respectively) on yield/plant. Weight of 100 seeds showed negligible positive indirect effect through, number of fruits per plant, fruit yield per plant and days to first male flower. And TSS showed negligible positive indirect effect through days to first female flower and fruit diameter.

The negative effect of days to first female flowering is desirable because this fruit is beneficial and contribute indirectly positively to the yield per vine. Similar results were reported by Prabha *et al*., (2008) in ridge gourd.

Conclusion: It is concluded that sufficient genetic variability is present for all traits studied. Therefore, crop improvement could be made on the basis of this genetic variability. In view of character association and path coefficients for yield and its contributing characters, it can also be concluded that breeders should give attention on characters like days to appear first female flower, fruit length, number of fruit per plant and individual fruit weight while selecting high yielding genotypes in ridge gourd.

References

Ananthan, M. and Krishnamoorthy, V. 2017. Genetic Variability, Correlation and Path Analysis in Ridge Gourd (*Luffa acutangula* (Roxb) L.). *Int. J. Curr. Microbiol. App. Sci*., 6(6): 3022-3026.

Choudhary, B.R., Pandey, S., Yadav, D.S. and Rai, M. 2007. Satputia (*Luffa acutangula* var. hermaphrodita): A high potential cucurbit for eastern India. In: Ind Indian Horticulture Congress. ICAR Research Complex for North Eastern Region, Umaim, Shillong, Meghalaya, 183.

Choudhary, B.R., Pandey, S. and Singh, R. 2009. Genetic diversity evaluation in satputia (*Luffa hermaphrodita*). In: Proc. Int. l. Conf. Hort., Bangalore India, 379-381.

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J*., 51: 515-518.

El Madidi S. and Hakimi F. 2015. Genotypic variation in fruit characters in some genotypes of watermelon cultivated in Morocco. *Int. Jor. of Agr. and Agri. Res.*, 6(4): 130-137.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimation of genetic and environmental variability in soybeans. *Agron. J.*, 47: 314-318.

Karuppaiah, P., Kavita, R. and Kumar, P.S. 2005. Correlation and path analysis in ridge gourd. *Crop Res.*, 29 (3): 490-494.

Methela N. J., Islam, M. S., Mitu, N. and Latif, M. A. 2019. Mean performance and heritability studies of some ridge gourd (Luffa acutangula L.) genotypes. Res. Agric. Livest. Fish. 6(1): 45-55.

Prabha, R.J., Latha, T.P., Sankar, C.R. and Rao, V.S. 2008. Character association and path coefficient studies in ridge gourd [Luffa acutangula (Roxb.) L.]. The Andhra Agrl. J., 55(1): 63-67.

Rao, B.N., Rao, P.V. and Reddy, Y.N. 2000. Correlation and path analysis in the segregating population of ridge gourd [*Luffa acuangula* (Roxb.) L.]. *Crop Res.*, 20 (2): 338-342.

Rakesh K. and Todd, C. W. 2011. Inheritance of fruit yield in two watermelon populations in North Carolina. *Euphytica*, 182:275–283.

Ramesh, N.D., Praveen, C., Radhelal, D., Pushpa, S.G., Priyanka, P. L. and Kalyan, S.S. 2018. Correlation and Path Analysis Study in Studied in Ridge Gourd (*Luffa acutangula* (L.) Roxb.). *Int.J.Curr.Microbiol.App.Sci.* 7(08): 1511-1519.

Rao, B.N., Rao, P.V. and Reddy, B.M.M. 2000. Correlation and path analysis in the segregating population of ridge gourd (*Luffa acutangula* L.). *Crop Res. Hisar.*, 20(2): 338-342

Shah, S.R. and Kale, P.N. 2002. Yield component association analysis in ridge gourd. *J. Maharashtra Agril. Univ.*, 27(2): 197-198.

XLSTAT, Version 2.02, 2010. Addinsoft SARL, Paris, FRANCE.