Character Association and Path Analysis in Ridge Gourd (*Luffa acutangula* (L.) Roxb.)

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ABSTRACT

A field experiment was conducted at All India Co-ordinated Research Project on Vegetable Crops, Odisha University of Agriculture and Technology, Bhubaneswar with Sixteen genotypes of ridge gourd (*Luffa acutangula* (L.) Roxb.) in Randomized Block Design with three replications during spring and summer season 2020. The result on phenotypic and genotypic correlation coefficient revealed that fruit yield per plant was significantly and positively correlated with number of fruit per plant and fruit stalk length at both phenotypic and genotypic level. However, internodal length, day to first fruit harvest, days to 50% flowering, days to first fruit set shows negative significant correlation with fruit yield per plant were significantly and negatively correlated with fruit yield per plant at both phenotypic and genotypic level. Further, path coefficient analysis partitioned the correlation into direct and indirect effects. Path analysis revealed that maximum positive direct effect on fruit yield per plant was exhibited through number of fruits per plant, fruit stalk length. These characters play a major role in recombination breeding and suggested that direct selection based on these traits will be rewarded for crop improvement of ridge gourd.

Keywords Ridge gourd, Character association, Path analysis, Yield attributing characters.

INTRODUCTION

Ridge gourd *Luffa acutangula* (L.) Roxb. is one of the very important cucurbitaceous vegetable grown in spring-summer and rainy season. It has essentially old world origin in subtropical Asian region including particularly India. Ridge gourd contains edible protein (82%), moisture 92.5 g, protein 0.5 g, fat 0.5 g, carbohydrate 3.4 g, energy 17 kcal, calcium 18 mg, vitamin C 5 mg, riboflavin 0.01 mg, phosphorus 26 mg, iron 0.5 mg and carotene 33 μg and seeds possess purgative, anthelmintic and emetic properties due to the secondary metabolite cucurbitacin. The juice of heated ridge gourd is used to cure adrenal type of Diabetes. Ridge gourd fruit traditionally used for the treatment of stomach ailment and fever.

It is an entrenched fact that yield is a complex character and largely depends upon its components characters coupled with an interaction with the en-

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Table 1. Phenotypic correlation coefficient (rp) between all pairs of 17 characters studied in ridge gourd genotypes. *Significance level @ 5% and ** Significance level @ 1%.

	Vine length	No. of pri. branch	Inter-modal l	No. of nodes	Days to 50% flowering	Nodes to 1st female flower	Sex ratio	Days to 1st fruit set
Vine length	1							
No.of pri.branch	0.069	1						
Intermodal l	0.139	0.328*	1					
No.of nodes	-0.130	0.019	-0.098	1				
Days to 50% flowering	-0.072	-0.132	0.193	-0.058	1			
Nodes to 1st female flower	0.078	-0.061	0.345*	-0.004	-0.078	1		
Sex ratio	0.243	0.458**	0.245	0.351*	-0.037	-0.152	1	
Days to 1st fruit set	-0.049	-0.079	0.200	0.036	0.892**	-0.177	-0.043	1
Days to 1st fruit harvest	0.006	-0.083	0.265	-0.126	0.809**	-0.036	-0.148	0.879**
Number of fruit/plant	0.143	-0.020	-0.282	0.187	-0.627**	0.033	0.148	-0.669**
Fr.l.	0.109	-0.283	0.142	-0.070	0.215	0.229	-0.163	0.323*
Fr.girth	-0.405**	-0.219	0.010	-0.331*	0.071	0.133	-0.482**	-0.022
Fr.wt.	0.160	-0.269	-0.257	0.224	-0.198	-0.046	0.123	-0.112
Fr.stalk length	0.348*	0.089	-0.368*	0.198	-0.513**	-0.280	0.223	-0.477**
Seed 1 fruit	-0.169	-0.100	-0.102	-0.155	0.149	0.131	-0.332*	0.165
Yield/plot	-0.004	0.013	-0.055	0.120	-0.696**	0.240	0.028	-0.697**
Yield/plant	0.024	-0.055	-0.378**	0.097	-0.611**	0.087	-0.047	-0.621**

Table 1. Continued.

	Number of fruit/plant	Fr.l.	Fr.girth	Fr.wt	Fr. stalk length	Seed/fruit	Yield/plot	Yield/plant
Vine length								
No.of pri. branch								
Intermodal l								
No.of nodes								
Days to 50% flowering								
Nodes to 1st female flower								
Sex ratio								
Days to 1st fruit set								
Days to 1st fruit harvest								
Number of fruit/plant	1							
Fr. l.	-0.313*	1						
Fr.girth	-0.253	0.069	1					
Fr. wt.	0.139	0.194	0.026	1				
Fr. stalk length	0.485**	-0.232	-0.290*	0.216	1			
Seed/fruit	-0.403**	0.430**	0.437**	-0.027	-0.123	1		
Yield/plot	0.635**	-0.161	0.042	0.118	0.306*	-0.258	1	
Yield/plant	0.848**	-0.067	0.003	0.193	0.428**	0.025	0.590**	1

vironments. Other yield attributing traits like fruit yield per plot, sex ratio, number of nodes per plant are inherited quantitatively and their expression is governed by polygenes which are highly affected by environment and are less heritable. So selection based on yield components in place of yield itself is depend-able and may be achieved through the component approach of breeding. Thus to develop a stable variety it is necessary to get the information on the extent of genotype × environment (GE) interaction for yield and its component characters. In ridge gourd, yield per plant depends on number of fruits per plant, fruit

Table 2. Genotypic correlation coefficient (rg) between all pairs of 17 characters studied in ridge gourd genotypes. *Significance level at 5% and ** Significance level at 1%.

Characters	Vine length	No. of pri. branch	Inter-modal l	No of nodes	Days to 50% flow-ering	Nodes to 1st female flower	Sex ratio	Days to 1st fruit set	Days to 1st fruit harvest
Vine length	1								
No.of pri. branch	0.006	1							
Intermodal l	0.044	0.542**	1						
No.of nodes	0.065	0.174	0.060	1					
Days to 50% flow-ering	-0.065	-0.181	0.257	-0.241	1				
Nodes to 1st female flower	0.029	-0.036	0.483**	0.010	-0.132	1			
Sex ratio	0.179	0.753**	0.300*	0.857**	-0.146	-0.191	1		
Days to 1st fruit set	-0.054	-0.122	0.316*	-0.098	1.012**	-0.213	0.045	1	
Days to 1st fruit harvest	-0.041	-0.217	0.360*	-0.171	1.109**	-0.021	-0.067	1.019**	1
Number of fruit/plant	0.274	0.063	-0.311*	0.171	-0.801**	0.043	0.177	-0.859**	-0.835**
Fr.l.	0.101	-0.393**	0.146	-0.062	0.300*	0.283	-0.129	0.374**	0.373**
Fr. girth	-0.468**	-0.401**	-0.068	-0.618**	0.028	0.136	-0.703**	0.022	0.166
Fr.wt.	0.301*	-0.448**	-0.213	0.365*	-0.239	-0.093	0.244	-0.113	-0.222
Fr.stalk length	0.418**	0.057	-0.493**	0.470**	-0.635**	-0.409**	0.336*	-0.630**	-0.669**
Seed/fruit	-0.253	-0.089	-0.022	-0.037	0.157	0.125	-0.441**	0.282	0.336*
Yield/plot	-0.110	0.048	-0.153	-0.009	-1.067**	0.342*	-0.081	-1.093**	-1.080**
Yield/plant	0.098	-0.115	-0.382**	0.110	-0.805**	0.087	-0.118	-0.813**	-0.789**

Table 2. Continued.

Characters	Number of fruit plant	Fr.l.	Fr.girth	Fr.wt.	Fr.stalk length	Seed fruit	Yield/ plot	Yield/ plant
Vine length								
No.of pri.branch								
Intermodal l								
No.of nodes								
Days to 50% flowering								
Nodes to 1st female flower								
Sex ratio								
Days to 1st fruit set								
Days to 1st fruit harvest								
Number of fruit/plant	1							
Fr.l.	-0.323*	1						
Fr.girth	-0.385**	0.190	1					
Fr.wt.	0.125	0.218	0.009	1				
Fr.stalk length	0.695**	-0.291*	-0.330*	0.202	1			
Seed/fruit	-0.576**	0.507**	0.658**	-0.079	-0.252	1		
Yield/plot	0.897**	-0.228	0.073	0.173	0.440**	-0.264	1	
Yield/plant	0.853**	-0.041	-0.019	0.110	0.556**	-0.037	0.855**	1

length and fruit weight (Varalakshmi *et al.* 2015).

MATERIALS AND METHODS

The experiment was conducted at the All India Coordinated Research Project on Vegetable Crops, Odisha University of Agriculture and Technology, Bhubaneswar during spring and summer season, 2020 with sixteen genotypes of ridge gourd. The experiment was laid out in Randomized Block Design (RBD) with three replications. In each replication, each entry was grown in a plot having four basins with

Table 3. Estimate of direct (diagonal) and indirect effect of component characters on yield in ridge gourd genotypes. Residual effect -0.09407.

	Vine length	No. of primary branch	Intermo-dal length	Number of nodes	Days to 50% flow-ering	Node to 1st female flower	Sex ratio	Days to first fruit set	Days to first fruit harvest
Vine length	**-0.21024**	0.00095	0.01065	0.00189	-0.01794	-0.00826	-0.08676	-0.00878	-0.0099
No.of primary branch	-0.00131	**0.153**	0.13035	0.0051	-0.0502	0.01033	-0.36432	-0.02003	-0.05216
Intermodal length	-0.00931	0.08287	**0.24065**	0.00176	0.07101	-0.13838	-0.14546	0.05165	0.08679
Number of nodes	-0.01358	0.02659	0.01447	**0.02932**	-0.06672	-0.00288	-0.41486	-0.01604	-0.04109
Days to 50% flow-ering	0.01363	-0.02775	0.06173	-0.00707	**0.27682**	0.03773	0.07047	0.16554	0.26703
Node to first female flower	-0.00606	-0.00552	0.11624	0.00029	-0.03645	**-0.2865**	0.09244	-0.03488	-0.00504
Sex ratio	-0.03768	0.11514	0.07231	0.02513	-0.04029	0.05471	**-0.48409**	0.00733	-0.01625
Days to first fruit set	0.01128	-0.01873	0.07597	-0.00288	0.28009	0.06107	-0.0217	**0.16361**	0.24535
Days to first fruit harvest	0.00864	-0.03313	0.0867	-0.005	0.30687	0.006	0.03265	0.16665	**0.24088**
Number of fruit/plant	-0.05768	0.00957	-0.07485	0.00503	-0.2218	-0.01244	-0.08562	-0.1405	-0.20105
Fruit length	-0.02117	-0.06005	0.03524	-0.00183	0.08316	-0.08117	0.06263	0.06118	0.08994
Fruit girth	0.09849	-0.06131	-0.01632	-0.01812	0.00766	-0.03883	0.34019	0.00352	0.04002
Fruit weight	-0.06329	-0.06853	-0.05131	0.01072	-0.06604	0.02669	-0.1182	-0.01846	-0.05341
Fruit stalk length	-0.0879	0.00873	-0.11868	0.01378	-0.17581	0.11724	-0.16247	-0.10303	-0.16121
Seed/fruit	0.05314	-0.01364	-0.00523	-0.0011	0.04345	-0.03573	0.21363	0.04614	0.08096
Yield per plot	0.02302	0.00728	-0.03691	-0.00027	-0.29542	-0.09791	0.03945	-0.1789	-0.26003

Table 3. Continued.

	Number of fruit/plant	Fruit length	Fruit girth	Fruit weight	Fruit stalk length	Seed/ fruit	Yield/ plot	Yield / plant
Vine length	0.48712	-0.01228	0.19374	0.11253	-0.0608	-0.25757	-0.03648	0.098
No.of primary branch	0.1111	0.04786	0.16572	-0.16745	-0.0083	-0.09083	0.01586	-0.115
Intermodal length	-0.55229	-0.01785	0.02805	-0.0797	0.07173	-0.02213	-0.05111	-0.382
Number of nodes	0.30436	0.00759	0.25558	0.13662	-0.06836	-0.03806	-0.00305	0.110
Days to 50% flow-ering	-1.42269	-0.03663	-0.01144	-0.08918	0.09237	0.15996	-0.35556	-0.805
Node to first female flower	0.07708	-0.03454	-0.05605	-0.03482	0.05952	0.12708	0.11386	0.087
Sex ratio	0.31407	0.01577	0.29064	0.09127	-0.04881	-0.44969	-0.02715	-0.118
Days to first fruit set	-1.52483	-0.04559	-0.0089	-0.04218	0.09158	0.28739	-0.3643	-0.813
Days to first fruit harvest	-1.482	-0.04552	-0.06872	-0.08288	0.09733	0.34251	-0.35966	-0.789
Number of fruit/plant	**1.77564**	0.03937	0.15936	0.04655	-0.10109	-0.58666	0.29869	0.853
Fruit length	-0.57339	**-0.12192**	-0.07878	0.0814	0.04227	0.51707	-0.07598	-0.041
Fruit girth	-0.68419	-0.02322	**-0.41358**	0.00346	0.04798	0.67083	0.02423	-0.019
Fruit weight	0.2211	-0.02655	-0.00383	**0.37381**	-0.02931	-0.08067	0.05766	0.110
Fruit stalk length	1.2342	0.03543	0.13644	0.07534	**-0.14544**	-0.25699	0.14652	0.556
Seed/fruit	-1.02223	-0.06186	-0.27226	-0.02959	0.03668	**1.01904**	-0.08799	-0.037
Yield per plot	1.59187	0.02781	-0.03007	0.06469	-0.06396	-0.26914	**0.33317**	0.855

3 plants basin^{-1}. From randomly selected 5 plants per each plot observations were recorded for seventeen characters viz., vine length (cm), number of primary branches, internodal length (cm), number of nodes, days to 50% flowering, node at which first female flower appear, sex ratio, days to first fruit set, days to first fruit harvest, number of fruit per plant, fruit length (cm), fruit girth (cm), fruit weight (g), fruit stalk length (cm), number of seeds per fruit, fruit yield per plant (kg) and fruit yield per hectare (q). The data were statistically analyzed for computation of character association and path analysis.

RESULTS AND DISCUSSION

Correlation of fruit yield per plant with other yield components

According to the results of the present investigation, it was found that the phenotypic correlation coefficients were lower than the respective phenotypic correlation coefficients as presented in Tables 1–2. Indicating a strong inherent association among the various characters studied. The yield per plant exhibited highly significant positive correlation with fruit yield per plot, number of fruit per plant, fruit stalk length at both phenotypic and genotypic level. These results are in accordance with the findings of (Varalakshmi *et al.* 2015). These findings indicate the importance of these traits in selection for simultaneous improvement of aforesaid traits along with fruit yield per plant in ridge gourd. Low positive correlation with yield per plant was observed with fruit girth, seed per fruit, sex ratio at phenotypic level and plant height, number of nodes, node to first female flower, fruit weight both phenotypic and genotypic level. Similar trend was observed by (Ara *et al.* 2014).

Some attributes like internodal length, days to first fruit harvest, days to 50% flowering, days to first fruit set shows negative significant correlation with fruit yield per plant at both genotypic and phenotypic level suggesting that these characters will be taken into consideration for improvement of ridge gourd for earliness. Some attributes like fruit length, number of primary branches, sex ratio showed negative correlation with yield per plant which implies least importance for effective selection based on these

characters. Similar trend was observed by Rabbani *et al.* 2012 and Koppad *et al.* 2015.

From the preceding discussion of correlation, it may be deduced that with days to 50% flowering, days to first fruit set, days to first fruit harvest, number of fruit per plant, fruit stalk length and fruit weight are the important correlated characters effect on yield per plant among which number of fruit per plant seems to have predominant effect on fruit yield per plant and simultaneous improvement in this character will be helpful in ridge gourd improvement program.

Correlation coefficient which measures the association between any two characters may not give a true comprehensive picture in a complex situation which makes it tough to decide on a breeding procedure to use or making simultaneous selection for crop improvement. Path analysis helps in identifying the most promising components and minimizes undesired characters in selection process through partitioning the total correlation into direct and indirect effects of different components.

In the present study as per the data presented in Table 3, it was found that number of fruits per plant, fruit stalk length exerted maximum direct positive direct effect on yield per plant and indirect positive effect via dependent variables like number of primary branches, number of nodes, fruit length, fruit girth, fruit weight, yield per plot. This suggested that direct selection based on these traits would be rewarding for crop improvement. This result was also reported by Ramesh *et al*. 2018, Panigrahi *et al.* 2018 and Rashid *et al.* 2020.

Sex ratio showed negative direct effect on yield per plant and it exhibited negative correlation with yield via positive indirect effects of traits like number of primary branches, internodal length, number of nodes, node to first female flower, days to first fruit set, number of fruit per plant, fruit length, fruit girth, fruit weight. This result was also reported by Rabbani *et al.* 2012 and Radha Rani *et al.* 2015.

From the correlation and path analysis it can be concluded that characters such as number of nodes, number of fruits per plant, yield per plot which

showed significant positive correlation and also had positive direct effect on fruit yield per plant. However, the trait like days to first fruit set, days to first fruit harvest recorded significant negative correlation and also had negative direct effect on fruit yield per plant. Therefore, these characters rewarding to give more focus while selection of genotypes for increasing yield of ridge gourd crop.

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