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Path coefficient analysis for yield and yield attributing traits in ridge gourd (*Luffa acutangula* (L.) roxb.)

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Abstract
In the present investigation, 14 genotypes will be grown in the during *rainy* season 2016-2017 at the field experimentation centre of the Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences (Formerly Allahabad Agricultural Institute), Allahabad (U.P.). The correlation would only indicate the overall relationship of independent trait with dependent trait but does not provide cause and effect of relationship. Using path analysis, it is possible to resolve the correlations, which provide clue about such relationship. In ridge gourd 16 important growth, earliness, yield and quality parameters were subjected to Genotypic and Phenotypic path coefficient analysis. Fruit yield per plot had high positive direct effect on yield. Positive indirect effect was observed through node to first male flowering, days to last harvest, number of fruits per plant, average fruit weight, fruit length and fruit diameter. Negative indirect effect were observed through vine length 90 days after sowing, days to first female flowering, days to first male flowering, node to first female flowering, days to 50 per cent flowering, days to first harvest, and sex ratio.

Keywords: ridge gourd (*Luffa acutangula* (L.) Roxb.), pod and seed yield and path analysis

Introduction
Cucurbits form an important and big group of vegetable crops Ridge gourd (*Luffa acutangula* L) is one of the important members of this group. The name "Luff" or "Loofah" is an Arabic origin and refers to the spongy characteristic of the mature fruit.

Ridge gourd has been cultivated for centuries in tropical, sub tropical and milder portions of temperate zones. Ridge gourd is popularly known as kalitori and also called as angled gourd, angled loofah, chinese okra, silky gourd and ribbed gourd. It is grown as mixed crop in the river bed areas and as mono crop is the garden land. Besides their use as vegetables, it is also used for various purposes. The fiber obtained from the mature dry fruit is used in industry for filters of various sorts, good pot holders, table mats, bath room mats, slipper and shoe soles. The fiber is also proved to be a good insulator for various purposes. Sometimes the dry fruits which gave good storability are used for ornamental purposes also. It is emetic and traditionally used for the treatment of stomach ailment and fever (Chakravarthy, 1959) [3]. Path co-efficient analysis was developed by Wright (1921) [7] has been employed in many vegetables in order to overcome the unreliability of correlation co-efficient, this technique involves effective partitioning of the correlation co-efficient in to measures of direct and indirect effects on yield.

Materials and Methods
In the present investigation, 14 genotypes was grown in the during *rainy* season 2016-2017 at the field experimentation centre of the Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology & Sciences (Formerly Allahabad Agricultural Institute), Allahabad (U.P.).

Fourteen genotypes of ridge guard was grown in a randomized block design with three replications. The sowing of experimental material was done on 26/07/2016 during the year 2016-2017. Recommended dose of fertilizers *i.e.* 20:60:60 NPK kg/ha. Five competitive plants was selected at randomly tagged from each plot to record observation on various characters. The average value of each character was calculated on the basis of five plants for each genotype in every replication.

Results and Discussion
The mean sum of squares in ANOVA revealed high variability among 14 varieties for all characters at 5 and 1 per cent probability levels.

The highly significant differences might be endorsed to their genetic makeup of germplasm lines and various regions from where they have been collected.

Days to first male flower had direct negative effect (-0.2239) on yield. Negative indirect effect were seen through vine length 90 days after sowing (-0.0903), days to first female flowering (-0.2154), node to first female flowering (-0.1262), days to 50 per cent flowering (-0.2163), days to first harvest (-0.1267), sex ratio (-0.042), Days to Last harvest (-0.051), Fruit Length cm (-0.044), Flesh Thickness cm (-0.0252), Fruit Diameter (-0.008) and Average Fruit Weight (g) (-0.047).

Days to first female flower had high negative direct effect (-0.413) on yield. Negative indirect effect were seen through vine length 90 days after sowing (-0.161), number of leaves 45 days after sowing (-0.030), days to first male flowering (-0.024), node to first female flowering (-0.078), days to 50 per cent flowering (-0.169), days to first harvest (-0.383) and sex ratio (-0.033).

Days to 50 per cent flowering had low negative direct effect (-0.178) on yield. Negative indirect effect were observed through vine length 90 days after sowing (-0.138), number of leaves 45 days after sowing (-0.026), days to first female flowering (-0.492), days to first male flowering (-0.010), node to first female flowering (-0.071), days to first harvest (-0.402) and sex ratio (-0.035).

Node to first male flower had low positive direct effect (0.119) on yield. Positive indirect effect was observed through vine length at 45 days after sowing (0.018), days to last harvest (0.145), number of fruits per plant (0.472), fruit yield per plot (0.348), average fruit weight (0.352), fruit length (0.018) and fruit diameter (0.055).

Node to first female flower had low negative direct effect (-0.010) on yield. Negative indirect effect were observed through vine length 90 days after sowing (-0.115), days to first female flowering (-0.489), days to first male flowering (-0.012), days to 50 per cent flowering (-0.01), days to first harvest (-0.405) and sex ratio (-0.035).

Sex ratio had low negative direct effect (-0.073) on yield. Negative indirect effect were observed through vine length 90 days after sowing (-0.123), days to first female flowering (-0.324), days to first male flowering (-0.056), node to first female flowering (-0.058), days to 50 per cent flowering (-0.124), days to first harvest (-0.312) and sex ratio (-0.073).

Vine length at 90 days after sowing had direct negative effect (-0.120) along with negative indirect effect through days to first female flowering (-0.224), days to first male flowering (-0.077), node to first female flowering (-0.043), days to 50 per cent flowering (-0.101), days to first harvest (-0.205) and sex ratio (-0.056).

Days to first harvest had high negative direct effect (-0.375) on yield. Negative indirect effect were observed through vine length 90 days after sowing (-0.160), days to first female flowering (-0.418), days to first male flowering (-0.014), node to first female flowering (-0.052), days to 50 per cent flowering (-0.151) and sex ratio (-0.039).

Days to last harvest had positive direct effect (0.160) on yield. Positive indirect effect was observed through node to first male flowering (0.194), number of fruits per plant (0.450), fruit yield per plot (0.271), average fruit weight (0.280), fruit length (0.011) and fruit diameter (0.057).

Number of fruits per plant had high positive direct effect (0.486) on yield. Positive indirect effect was observed through node to first male flowering (0.114), days to last harvest (0.176), fruit yield per plot (0.260), average fruit weight (0.306), fruit length (0.017) and fruit diameter (0.086).

Fruit yield per plot had high positive direct effect (0.293) on yield. Positive indirect effect was observed through node to first male flowering (0.176), days to last harvest (0.195), number of fruits per plant (0.490), average fruit weight (0.304), fruit length (0.012) and fruit diameter (0.103).

Average fruit weight had high positive direct effect (0.318) on yield. Positive indirect effect was observed through node to first male flowering (0.106), days to last harvest (0.189), number of fruits per plant (0.555), fruit yield per plot (0.297), fruit length (0.011) and fruit diameter (0.103). Similar results were reported by Prabha *et al*., (2008) [5] in ridge gourd, Shivananda *et al*., (2013) [6] in pumpkin.

Fruit length had low positive direct effect (0.012) on yield. Positive indirect effect was observed through node to first male flowering (0.155), days to last harvest (0.203), number of fruits per plant (0.355), fruit yield per plot (0.430), average fruit weight (0.0.284) and fruit diameter (0.046).

Fruit diameter had low positive direct effect (0.140) on yield. Positive indirect effect was observed through node to first male flowering (0.155), days to last harvest (0.167), number of fruits per plant (0.337), fruit yield per plot (0.359), average fruit weight (0.292) and fruit length (0.014).

Table 1: Genotypic path coefficient analysis among growth, earliness, yield and yield component in ridge gourd

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	-0.2239	-0.2154	-0.2163	-0.0703	-0.1262	-0.0422	-0.0903	-0.1267	-0.0511	-0.0438	-0.0252	0.0450	0.0195	-0.0078	0.0425	-0.0475
2	-0.3975	-0.4131	-0.4011	-0.1979	-0.2792	-0.0507	-0.0967	-0.3124	-0.1017	-0.0409	0.0024	0.1214	0.1228	0.0023	0.1603	-0.0635
3	0.6507	0.6537	0.6733	0.2590	0.4099	0.0718	0.1825	0.4976	0.2946	0.1047	-0.0563	-0.1363	-0.1291	-0.0175	-0.1798	0.0836
4	-0.0967	-0.1475	-0.1184	-0.3078	-0.2567	-0.0032	0.0040	-0.1622	-0.1024	0.0173	0.1319	0.0317	0.1752	0.0232	0.1589	-0.0306
5	0.2856	0.3423	0.3083	0.4223	0.5065	0.0167	-0.0017	0.2985	0.1440	-0.1339	-0.1786	-0.1400	-0.2902	-0.1316	-0.3018	0.0077
6	0.0210	0.0137	0.0119	0.0012	0.0037	0.1114	0.0862	-0.0186	0.0040	0.0608	0.0142	0.0295	0.0522	0.0470	0.0514	0.0774
7	-0.1800	-0.1045	-0.1210	0.0057	0.0015	-0.3455	-0.4463	0.0856	-0.0518	-0.3478	-0.1617	-0.1908	-0.2405	-0.2139	-0.2310	-0.3190
8	-0.1828	-0.2443	-0.2387	-0.1702	-0.1904	0.0538	0.0620	-0.3230	-0.1193	0.0082	0.0844	0.0997	0.1226	-0.0174	0.1477	-0.0155
9	-0.0821	-0.0885	-0.1574	-0.1196	-0.1023	-0.0129	-0.0418	-0.1329	-0.3597	-0.0868	0.1411	-0.1690	0.0085	-0.0033	-0.0210	0.0057
10	0.1690	0.0855	0.1341	-0.0486	-0.2282	0.4714	0.6725	-0.0220	0.2083	0.8630	0.3850	0.5898	0.5675	0.7332	0.5434	0.7148
11	-0.0431	0.0022	0.0320	0.1639	0.1349	-0.0486	-0.1386	0.0999	0.1501	-0.1707	-0.3826	-0.1745	-0.1059	-0.1909	-0.0634	-0.1281
12	-0.0240	-0.0351	-0.0242	-0.0123	-0.0330	0.0316	0.0511	-0.0368	0.0561	0.0816	0.0545	0.1194	0.0531	0.0671	0.0575	0.0497
13	-0.0588	-0.2009	-0.1295	-0.3847	-0.3873	0.3167	0.3642	-0.2566	-0.0160	0.4444	0.1870	0.3007	0.6759	0.3593	0.6756	0.3577
14	0.0051	-0.0008	-0.0038	-0.0110	-0.0379	0.0615	0.0699	0.0079	0.0013	0.1239	0.0728	0.0819	0.0775	0.1458	0.0722	0.1278
15	0.0443	0.0904	0.0622	0.1202	0.1388	-0.1074	-0.1205	0.1064	-0.0136	-0.1466	-0.0386	-0.1122	-0.2328	-0.1154	-0.2329	-0.1150
16	0.0202	0.0146	0.0118	0.0095	0.0014	0.0662	0.0680	0.0046	-0.0015	0.0788	0.0319	0.0396	0.0504	0.0834	0.0470	0.0952
17	-0.0930	-0.2476	-0.1768	-0.3406	-0.4446	0.5907	0.6245	-0.2907	0.0413	0.8124	0.2619	0.5359	0.9270	0.7635	0.9266	0.8004
Partial R^2	0.0208	0.1023	-0.1190	0.1049	-0.2252	0.0658	-0.2787	0.0939	-0.0149	0.7011	-0.1002	0.0640	0.6265	0.1113	-0.2158	0.0762

1 Days to Taken 1st Male Flowering 2. Days to Taken 1st Female Flowering 3. Days to 50% Flowering 4. Node to First Male Flower 5. Node to First Female Flower 6.Sex Ratio 7.Vine Length cm At 90 Days 8.Days to 1st harvest 9.Days to Last harvest 10.Fruit Length cm 11.Flesh Thickness cm 12.Rind Thickness mm 13.Fruit Set % 14.Fruit Diameter 15.Fruits/ Plant 16.Average Fruit Weight (g) 17.Fruit Yield/ Plant (g) 18.Fruit Yield/ Plot (kg) 19.Fruit Yield Q/ha

Table 2: Phenotypic path coefficient analysis among growth, earliness, yield and yield component in ridge gourd

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0.0372	0.0348	0.0337	0.0105	0.0203	0.0067	0.0145	0.0200	0.0062	0.0073	0.0035	-0.0070	-0.0030	0.0013	-0.0066	0.0076	-0.0036	-0.0036
2	-0.1337	-0.1429	-0.1322	-0.0651	-0.0936	-0.0178	-0.0322	-0.1019	-0.0302	-0.0121	0.0033	0.0383	0.0369	0.0003	0.0520	-0.0219	0.0340	0.0336
3	0.1555	0.1588	0.1717	0.0613	0.1010	0.0178	0.0458	0.1155	0.0661	0.0236	-0.0155	-0.0336	-0.0305	-0.0054	-0.0432	0.0183	-0.0283	-0.0289
4	0.0251	0.0406	0.0319	0.0892	0.0688	0.0017	-0.0029	0.0422	0.0280	-0.0061	-0.0367	-0.0080	-0.0470	-0.0056	-0.0422	0.0082	-0.0271	-0.0273
5	-0.1049	-0.1256	-0.1128	-0.1478	-0.1919	-0.0051	-0.0019	-0.1033	-0.0452	0.0494	0.0649	0.0503	0.1029	0.0510	0.1120	-0.0047	0.0834	0.0839
6	-0.0019	-0.0013	-0.0011	-0.0002	-0.0003	-0.0104	-0.0078	0.0015	-0.0004	-0.0054	-0.0012	-0.0027	-0.0045	-0.0043	-0.0047	-0.0071	-0.0060	-0.0060
7	0.0398	0.0230	0.0272	-0.0033	0.0010	0.0764	0.1019	-0.0190	0.0090	0.0761	0.0356	0.0419	0.0529	0.0470	0.0491	0.0712	0.0614	0.0612
8	0.0428	0.0569	0.0537	0.0377	0.0430	-0.0118	-0.0149	0.0798	0.0239	-0.0013	-0.0205	-0.0238	-0.0262	0.0033	-0.0329	0.0041	-0.0215	-0.0211
9	-0.0116	-0.0146	-0.0267	-0.0217	-0.0163	-0.0028	-0.0061	-0.0208	-0.0692	-0.0146	0.0232	-0.0285	0.0000	-0.0017	-0.0042	-0.0007	-0.0035	-0.0038
10	-0.0501	-0.0214	-0.0348	0.0172	0.0653	-0.1330	-0.1894	0.0041	-0.0534	-0.2535	-0.1090	-0.1642	-0.1497	-0.2102	-0.1541	-0.2012	-0.1982	-0.1966
11	-0.0017	0.0004	0.0016	0.0074	0.0061	-0.0021	-0.0063	0.0046	0.0060	-0.0077	-0.0179	-0.0078	-0.0046	-0.0085	-0.0027	-0.0056	-0.0044	-0.0044
12	-0.0204	-0.0291	-0.0213	-0.0097	-0.0285	0.0282	0.0447	-0.0323	0.0447	0.0703	0.0474	0.1085	0.0474	0.0594	0.0498	0.0437	0.0561	0.0555
13	0.0059	0.0185	0.0127	0.0378	0.0385	-0.0311	-0.0372	0.0236	0.0000	-0.0424	-0.0183	-0.0313	-0.0717	-0.0356	-0.0663	-0.0359	-0.0615	-0.0609
14	0.0008	-0.0001	-0.0008	-0.0015	-0.0064	0.0100	0.0111	0.0010	0.0006	0.0199	0.0114	0.0131	0.0119	0.0240	0.0115	0.0204	0.0181	0.0179
15	-0.0105	-0.0217	-0.0150	-0.0282	-0.0349	0.0272	0.0288	-0.0247	0.0037	0.0363	0.0089	0.0274	0.0553	0.0286	0.0598	0.0282	0.0533	0.0526
16	0.0208	0.0156	0.0109	0.0094	0.0025	0.0696	0.0712	0.0052	0.0011	0.0810	0.0317	0.0411	0.0511	0.0866	0.0482	0.1020	0.0793	0.0784
17	-0.0655	-0.1622	-0.1126	-0.2072	-0.2961	0.3970	0.4105	-0.1836	0.0342	0.5330	0.1684	0.3525	0.5842	0.5143	0.6077	0.5296	0.6816	0.6701
18	-0.0267	-0.0654	-0.0468	-0.0852	-0.1216	0.1598	0.1671	-0.0736	0.0154	0.2156	0.0685	0.1422	0.2361	0.2072	0.2449	0.2138	0.2733	0.2780
19	-0.0990	-0.2357	-0.1607	-0.2994	-0.4431	0.5802	0.5968	-0.2618	0.0406	0.7695	0.2475	0.5085	0.8414	0.7517	0.8780	0.7701	0.9863	0.9787
Partial R^2	-0.0037	0.0337	-0.0276	-0.0267	0.0850	-0.0060	0.0608	-0.0209	-0.0028	-0.1951	-0.0044	0.0552	-0.0603	0.0180	0.0525	0.0786	0.6722	0.2721

1 Days to Taken 1st Male Flowering 2. Days to Taken 1st Female Flowering 3. Days to 50% Flowering 4. Node to First Male Flower 5. Node to First Female Flower 6.Sex Ratio 7.Vine Length cm At 90 Days 8.Days to 1st harvest 9.Days to Last harvest 10.Fruit Length cm 11.Flesh Thickness cm 12.Rind Thickness mm 13.Fruit Set % 14.Fruit Diameter 15.Fruits/ Plant 16.Average Fruit Weight (g) 17.Fruit Yield/ Plant (g) 18.Fruit Yield/ Plot (kg) 19.Fruit Yield Q/ha

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