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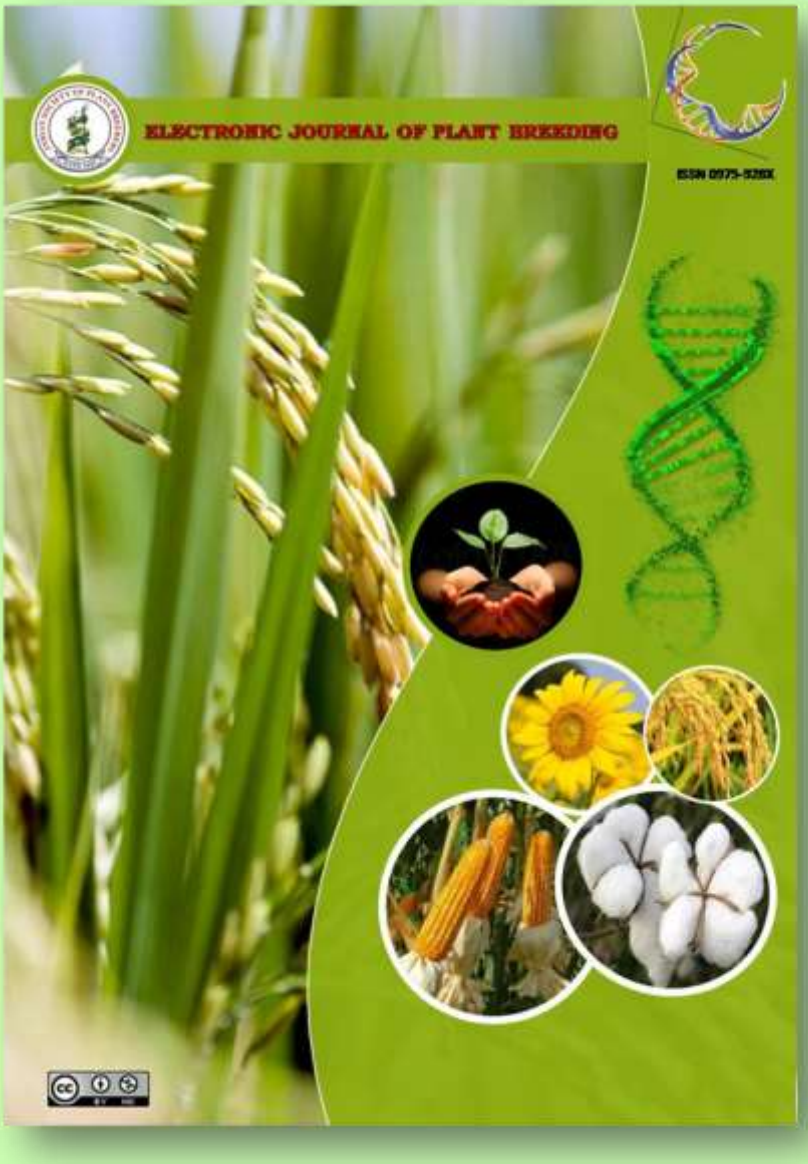

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Research Article

Correlation & path analysis in local germplasm and characters association of ivy gourd (*Coccinia grandis* L.)

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Abstract
The experiment was carried out with 30 genotypes in completely randomized block design with 3 replications to study the association among fruit weight and its components and their direct and indirect influence on total marketable fruit weight of ivy gourd at Department of Horticulture, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur during kharif season 2017-18 in completely randomized design with three replications. Correlations study revealed that phenotypic correlation coefficient was slightly higher than corresponding value of genotypic correlation for majority of the characters. Fruit weight has highest significant positive correlation with total chlorophyll and significant negative correlation with fruit volume. The correlation between phosphorus and fruit diameter was negative significant. Path analysis study revealed that average leaf length has showed highest positive direct effect on fruit weight followed by total chlorophyll content in leaves, petiole length, ascorbic acid content whereas, moisture, inter nodal length, fruit length, leaf width showed negative direct effect on the fruit weight.

Introduction

Vegetables constitute an important component of balance diet for human being. They are natural protective food rich in vitamins and minerals. Ivy Gourd (*Coccinia grandis* (L.) Voigt) is a perennial, dioecious, tropical cucurbitaceous vegetable crop having chromosome no. 2n=24. It contains water 94 %, dietary fibre 1.6 g, protein 1-2 g, fat 0.4 g, carbohydrates 3.1 g, carotene 156 µg, iron 14 mg, vitamin-A 260 IU, vitamin-C 28 mg, energy 18 kcal. It is also known as little gourd or scarlet fruit gourd. The name coccinia is derived from the latin word coccineous, meaning scarlet color in their ripe fruits (Wanger *et al.* 1999). It has been designated by various names such as kundru (Hindi), kovakka or kova (Malayalam), kovakki kovai (Tamil), thondakayi (Kannada), dondakaya (Telgu), tondle (Marathi), giloda (Gujrati), kundhti (Sanskrit) etc. A daily consumption of 100 g fruits is effective for lowering sugar content of diabetic patients. It is rich in vitamin C. It also provides vitamin B_1 and B_2. These vitamins are required by the human body, and help in strong immune system of human body. Tendrils of ivy gourd are also rich in mineral like potassium, calcium and iron, which are needed in optimum quantity for functioning of body. Various parts of *Coccinia grandis* have specific medicinal value as reported by many researchers. This crop is propagated vegetatively by tuberous roots, which provides unique advantage in improving this crop through clonal selection. The Udaipur district of Rajasthan state is known to give avenue to a degree of clonal variation in this crop. However, very little work has been done. Association analysis is an important approach in a crop improvement programme. It gives an idea about relationship between characters. The correlated characters can be used for indirect selection if main economically important characters have low variability. The major causes underlying association are either due to pleiotropic gene action or linkage or both. The phenotypic correlation includes a genotypic and environmental effect, which provides information about total association between the observable characters. Genotypic correlation provided a measure of genetic association between the characters and normally used in selection. Path coefficient measures the direct and indirect contribution of various independent characters towards dependent character and helps in determining component characters thus, useful for indirect selection.

Material and Methods

The experimental material comprising 30 genotypes (Table No. 1) of ivy gourd were collected from different forest location around the Udaipur district of Rajasthan and the quality parameters were studied at the Department of Horticulture, Rajasthan College of Agriculture,

Maharana Pratap University of Agriculture and Technology, Udaipur during July to September month of 2017. For in-situ study, fruits, leaf were collected from each selected plant from 30 different forest locations of Udaipur district of Rajasthan.

Three samples of fruits, leaf & soil were collected randomly from each location having high density of ivy gourd plants. The observations were recorded on different growth and quality characters viz., inter nodal length, petiole length, leaf length, leaf width, fruit length, fruit diameter, fruit weight, fruit volume, moisture content, ascorbic acid, protein content and total chlorophyll content in leaves. Total protein content was determined by Lowry's method (Lowrey *et al*. 1951). Correlation coefficients measure the relationship between two or more series of variables. The genotypic correlation coefficient provides a measure of genotypic association between different characters, while phenotypic correlation includes both genotypic as well as environmental influences. The correlation coefficients at phenotypic and genotypic level between all possible pairs of characters were estimated by Al-Jibouri *et al*. (1958). Path coefficient is a standardized partial regression coefficient and measures the direct and indirect influence of one variable upon another thereby permitting the separation of the correlation coefficient into the component of direct and indirect effects. The path coefficient analysis was carried-out as per the method suggested by Dewey and Lu (1959). Genotypic correlation coefficients of 11 variables with fruit weight (g) were used to estimate the path coefficients for the direct effects of various independent characters on fruit weight (g).

Result and Discussion

In the present investigation, maximum inter nodal length was recorded in G-4 (147.33 mm), petiole length in G-4 (70.33 mm), leaf length in G-4 (12.27 cm), leaf width in G-5 (11.57 cm), fruit length in G-29 (8.10 cm), fruit diameter in G-2 (2.70 cm), fruit weight in G-15 (25.70 g), fruit volume in G-15 (22.7 cc), moisture content in G-13 (94.90 %), ascorbic acid in G-10 & G-26 (0.145 mg/g), chlorophyll content in leaves in G-15 (1.06 mg/g), protein in G-13 (1241.33 mg/100 g) (Table No. 2).

The results revealed that the fruit weight having a significant positive correlation with total chlorophyll content in leaves (0.40) and significant negative correlation with fruit volume (-0.45) at phenotypic level. The finding of these characters are supported by Basusumatary *et al.* (2014) in spine gourd, Kumaresan *et al*. (2006) in snake gourd and Koppad *et al.* (2015) in ridge gourd (Table No. 3).

Petiole length has significant positive correlation with inter nodal length (0.51, 0.48) at phenotypic and genotypic levels respectively. Leaf length has significant positive correlation with inter nodal length (0.67, 0.64) and Petiole length (0.49, 0.45) at phenotypic and genotypic levels respectively. Leaf width has significant positive correlation with Leaf length (0.55, 0.52) phenotypic and genotypic levels respectively. Fruit volume has significant negative correlation with Leaf width (0.67) phenotypic level. Moisture content has significant negative correlation with fruit length (-0.55), fruit volume (-0.39) and inter nodal length (-0.38) at phenotypic level. Ascorbic acid content has significant negative correlation with fruit volume (-0.69) at phenotypic level. Total chlorophyll content in leaves has significant negative correlation with Leaf length (-0.43, -0.37) at phenotypic and genotypic levels respectively. Protein content has significant positive correlation with moisture content (0.39) at phenotypic level.

The finding clearly indicated that genotypic coefficient had of higher magnitude to the corresponding phenotype ones, thereby establishing strong inherent relationship among the character studied. The low phenotypic value might be due to applicable interaction of the genotypes with the environment. Similar results were also noted by Malek *et al.* (2007) in pointed gourd. In general, the values of genotypic correlation were higher than their corresponding phenotypic correlations in the present study.

This indicated that though there was high degree of association between two variables at genotypic level, its phenotypic expression was deflated by the influence of environment. There was no correlation between soil parameters and plant characters except soil phosphorus with fruit diameter. There was no correlation between soil parameters and plant characters except soil phosphorus with fruit diameter. The correlation between phosphorus and fruit diameter was negative significant (-0.45). According to findings correlation coefficient between soil and plant characters indicating that phosphorus content influence the growth and quality parameters of ivy gourd (Table No. 4).

In present investigation, the data revealed that average leaf length has showed highest positive direct effect (0.89) on fruit weight followed by total chlorophyll content in leaves (0.50), petiole length (0.40), ascorbic acid (0.39) similar results were also noted by Sanpath *et al.* (2017) in pumpkin. whereas, moisture content (-1.07), fruit length (-0.64), leaf width (-0.27) showed negative direct effect on the fruit weight. Thereby plant having high leaf length and chlorophyll content, petiole

length, ascorbic acid content should be considered in selection criteria for increasing fruit weight. So the selection of above mentioned traits having direct and indirect effect on yield may lead to improvement in total fruit weight in ivy gourd. The present study suggested that more emphasis should be given to selecting genotype with higher fruit weight, which is confirmed to the finding of Singh *et al.* (2006) in pointed gourd who also suggested fruit weight had direct effect on yield followed by Kumaresan *et al.* (2006) in snake gourd also reported that fruit weight can increase the yield per vine directly (Table No. 5).

The association study among different characters revealed that selection should be based on average fruit weight, leaf length, total chlorophyll content in leaves, petiole length and ascorbic acid content. Path coefficient analysis of fruit yield contributing attributes revealed that average leaf length has showed highest positive direct effect on fruit weight followed by total chlorophyll content in leaves, petiole length, ascorbic acid content which indicated that these are the main contributors to the fruit weight.

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Table 1. Germplasm Locations

Germplasm No.	Location (Udaipur, Rajasthan)	Longitude (°)	Latitude (°)
G-1	MANVA KA KHEDA	73.74	24.55
G-2	KALDWAS	73.75	24.56
G-3	KALDWAS, POST OFFICE	73.76	24.56
G-4	DANGIYO KI PANCHAULI	73.78	24.59
G-5	MALA THALAI	73.66	24.59
G-6	BUJRA	73.63	24.57
G-7	NAYA KHERA	73.73	24.34
G-8	SISARMA	73.65	24.55
G-9	KEMRI	73. 98	24.53
G-10	UNDARI KHURD	73.62	24.50
G-11	BALEECHA	73.81	24.34
G-12	KANPUR KA KHEDA	73.76	24.55
G-13	KANPUR	73.76	24.56
G-14	BHEELON KA BEDLA	73.72	24.67
G-15	KARELON KA GURHA	73.76	24.69
G-16	BHOEYON KI PANCHOLI	73.79	24.56
G-17	CHEERWA	73.67	24.58
G-18	BAMORA	74.04	24.38
G-19	BATHEDA	73.97	24.57
G-20	KHERODA	73.99	24.58
G-21	BAMANIYA	74.12	24.56
G-22	KUNTHWAS	74.12	24.52
G-23	MEETHA NEEM	73.90	24.56
G-24	PHALET	73.91	24.50
G-25	UMARDA	73.77	24.51
G-26	BERWAS	73.75	24.58
G-27	KHARSAN	74.03	24.59
G-28	BHATEWAR	74.00	24.61
G-29	UDAISAGAR LAKE	73.80	24.56
G-30	DODAWALI	73.55	24.56

Table 2. Mean values for Inter nodal length (mm), Petiole length (mm), Leaf length (cm), Leaf width (c), Fruit length (cm) and Fruit diameter (cm)

SN	Genotype	Inter nodal length (mm)	Petiole length (mm)	Leaf length (cm)	Leaf width (cm)	Fruit length (cm)	Fruit diameter (cm)
1	G1	90.00	23.33	6.50	7.73	5.50	2.40
2	G2	72.33	25.00	10.43	9.50	4.53	2.70
3	G3	109.67	46.67	10.10	9.37	6.33	2.03
4	G4	147.33	70.33	12.27	10.27	4.53	2.00
5	G5	88.67	29.67	9.10	11.57	6.70	2.10
6	G6	72.33	23.33	5.17	7.50	5.67	1.97
7	G7	61.00	28.67	6.13	6.87	6.47	1.83
8	G8	94.33	31.33	8.93	10.70	4.73	1.57
9	G9	98.67	36.33	9.23	10.13	5.63	1.53
10	G10	52.33	30.00	5.63	7.50	4.50	1.97
11	G11	91.67	28.67	6.67	8.53	5.83	2.37
12	G12	94.00	32.67	7.87	9.97	4.87	2.43
13	G13	93.00	54.33	8.83	9.80	5.60	2.10
14	G14	55.67	35.33	5.53	7.00	5.57	2.17
15	G15	60.00	38.00	5.10	6.83	6.23	2.17
16	G16	100.33	35.00	12.20	11.30	7.37	2.67
17	G17	120.00	28.67	7.57	8.90	6.27	2.53
18	G18	66.33	25.67	6.37	5.50	5.50	2.37
19	G19	74.67	44.33	7.30	4.97	5.60	1.87
20	G20	99.00	35.67	6.90	7.27	6.43	1.60
21	G21	102.00	28.67	8.57	6.50	5.30	1.50
22	G22	94.00	26.00	8.90	6.80	5.57	1.93
23	G23	91.67	25.00	6.87	5.57	6.43	2.20
24	G24	87.67	34.00	8.83	7.13	6.47	1.87
25	G25	99.00	32.33	8.50	6.77	6.50	1.97
26	G26	105.33	35.33	9.63	8.27	6.53	2.03
27	G27	89.00	33.33	8.67	7.40	6.47	1.50
28	G28	94.33	38.00	9.93	6.47	4.63	1.67
29	G29	118.67	40.67	8.00	5.87	8.10	2.27
30	G30	119.33	38.33	8.53	6.17	8.07	2.40
	GM	91.41	34.49	8.14	7.94	5.93	2.06
	SEm	2.90	2.26	0.27	0.31	0.26	0.15
	CD 0.05	8.20	6.38	0.75	0.88	0.73	0.41
	CD 0.01	10.91	8.49	1.00	1.17	0.97	0.55
	CV	5.49	11.33	5.66	6.80	7.54	12.32

(Cont…)

Table 2. Mean values for fruit weight, fruit volume, moisture content, ascorbic acid content, protein content in fruit and total chlorophyll content in leaves

SN	Genotype	Fruit weight (g)	Fruit volume (cc)	Moisture (%)	Ascorbic acid (mg/g)	Total chlorophyll content in leaves (mg/g)	Protein (mg/100 g) edible portion)
1	G-1	21.20	19.7	92.13	0.125	0.94	1185.67
2	G-2	17.80	15.6	94.17	0.136	0.92	1109.00
3	G-3	18.30	16.3	93.30	0.144	0.87	1117.33
4	G-4	17.10	14.7	93.77	0.134	0.77	1116.00
5	G-5	21.40	19.4	92.40	0.142	0.93	1095.33
6	G-6	22.30	20.5	93.80	0.129	0.92	1210.33
7	G-7	16.80	14.8	93.27	0.139	0.86	1226.00
8	G-8	12.83	11.2	93.87	0.123	0.77	1110.00
9	G-9	18.10	16.6	92.00	0.135	0.93	1207.00
10	G-10	19.70	17.6	93.80	0.145	0.94	1098.00
11	G-11	18.10	16.7	92.30	0.138	0.77	1109.67
12	G-12	15.50	13.6	93.03	0.130	0.81	1236.00
13	G-13	15.73	13.7	94.90	0.123	0.90	1241.33
14	G-14	13.75	11.8	92.73	0.143	0.84	1167.33
15	G-15	25.70	22.7	94.17	0.144	1.06	1204.33
16	G-16	20.60	19.6	93.43	0.139	0.76	1196.67
17	G-17	11.50	10.1	92.67	0.127	0.93	1157.00
18	G-18	12.30	10.7	93.87	0.126	0.92	1139.00
19	G-19	14.37	12.8	93.00	0.122	0.88	1128.00
20	G-20	16.20	10.7	93.97	0.144	0.81	1190.33
21	G-21	18.30	16.6	93.07	0.136	0.92	1192.33
22	G-22	21.30	19.3	92.80	0.129	0.92	1125.00
23	G-23	17.90	15.0	92.50	0.129	0.82	1126.00
24	G-24	13.30	11.9	93.33	0.125	0.79	1151.67
25	G-25	14.80	12.5	92.57	0.143	0.92	1100.33
26	G-26	16.07	14.0	92.90	0.145	0.86	1162.67
27	G-27	15.30	13.6	93.17	0.140	0.89	1145.67
28	G-28	21.40	19.5	93.03	0.131	0.80	1109.33
29	G-29	17.60	14.6	92.03	0.135	0.90	1142.33
30	G-30	19.57	17.6	92.43	0.129	0.94	1139.00
	GM	17.49	15.4	93.15	0.134	0.88	1154.62
	SEm	0.85	0.02	0.46	0.01	0.02	27.29
	CD at 0.05	2.40	0.05	1.30	0.04	0.06	77.21
	CD at 0.01	3.20	0.07	1.73	0.05	0.08	102.71
	CV	8.42	2.89	0.86	1.85	3.99	4.09

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Table 3. Correlation coefficient between fruit weight and its attributing characters

SN	Character	P/G	Inter nodal length	Petiole length	Leaf length	Leaf width	Fruit length	Fruit diameter	Fruit volume	Moisture content	Ascorbic acid content	Total chlorophyll content in leaves	Protein content	Fruit weight
1	Inter nodal length	P	**1.000**	**0.51****	**0.67****	**0.29**	**0.28**	**0.02**	**-0.06**	**-0.38***	**-0.15**	**-0.31**	**-0.16**	**-0.11**
	(mm)	G	**1.000**	0.48**	0.64**	0.27	0.24	0.01	0.02	-0.2	-0.1	-0.27	-0.11	-0.11
2	Petiole length (mm)	P			**0.49****	**0.23**	**-0.01**	**-0.13**	**-0.36**	**0.35**	**0.02**	**-0.27**	**0.05**	**-0.09**
		G			0.45*	0.19	-0.06	-0.14	-0.1	0.19	0.04	-0.15	-0.04	-0.08
3	Leaf length (cm)	P				**0.55****	**0.01**	**0.02**	**-0.30**	**0.05**	**-0.00**	**-0.43***	**-0.30**	**-0.04**
		G				0.52**	0.01	0.01	-0.14	0.01	0.01	-0.37*	-0.18	-0.04
4	Leaf width (cm)	P					**-0.20**	**0.17**	**-0.67****	**0.19**	**0.12**	**-0.28**	**0.11**	**0.04**
		G					-0.16	0.14	-0.23	0.15	0.1	-0.25	0.05	0.04
5	Fruit length	P						**0.21**	**-0.02**	**-0.55****	**0.21**	**0.14**	**0.12**	**0.07**
		G						0.17	0.03	-0.25	0.17	0.09	0.08	0.06
	Fruit diameter	P							**0.22**	**-0.09**	**-0.11**	**0.13**	**-0.02**	**0.04**
		G							0.04	-0.04	-0.04	0.02	0	0.1
7	Fruit volume	P								**-0.39***	**-0.69****	**-0.06**	**0.18**	**-0.45***
		G								-0.04	-0.15	-0.02		-0.16
8	Moisture content	P									**-0.02**	**0.04**	**0.39***	**-0.04**
		G									-0.05	-0.07	0.09	-0.04
9	Ascorbic acid	P										**0.11**	**-0.15**	**0.29**
	content	G										0.11	-0.02	0.25
	Total chlorophyll	P											**0.20**	**0.40***
10	content in leaves	G											**0.03**	0.32
11	Protein content	P												**0.08**
		G												0.07

*& ** Significant at 1% & 5% level of significance respectively.

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Table 4. Correlation coefficient between soil parameters and fruit weight and its attributing characters.

Characters	Nitrogen content	Phosphorus content	Potassium content	Organic Carbon content	pH	EC
Inter nodal length (mm)	-.097	-.117	.243	-.072	.044	.189
Petiole length (mm)	-.042	.153	.153	.152	.066	.170
Leaf length (cm)	-.287	.200	.007	-.079	.121	.075
Leaf width (cm)	.009	.127	-.263	.204	.131	.135
Fruit length (cm)	-.087	.065	.020	-.085	-.113	.264
Fruit diameter (cm)	-.166	-.407*	-.126	-.054	-.330	.082
Weight per fruit (g)	-.043	.004	.102	-.056	-.202	-.055
Fruit volume (cc)	-.236	.007	.108	-.334	.187	-.259
Moisture (%)	-.210	.196	-.259	.005	.153	-.006
Ascorbic acid (mg/g)	.117	.091	-.088	-.033	.122	-.210
Total chlorophyll content in leaves (mg/g)	.239	-.048	-.069	.178	.033	.013
Protein (mg/100 g edible portion)	-.041	-.061	.080	.131	.046	.188

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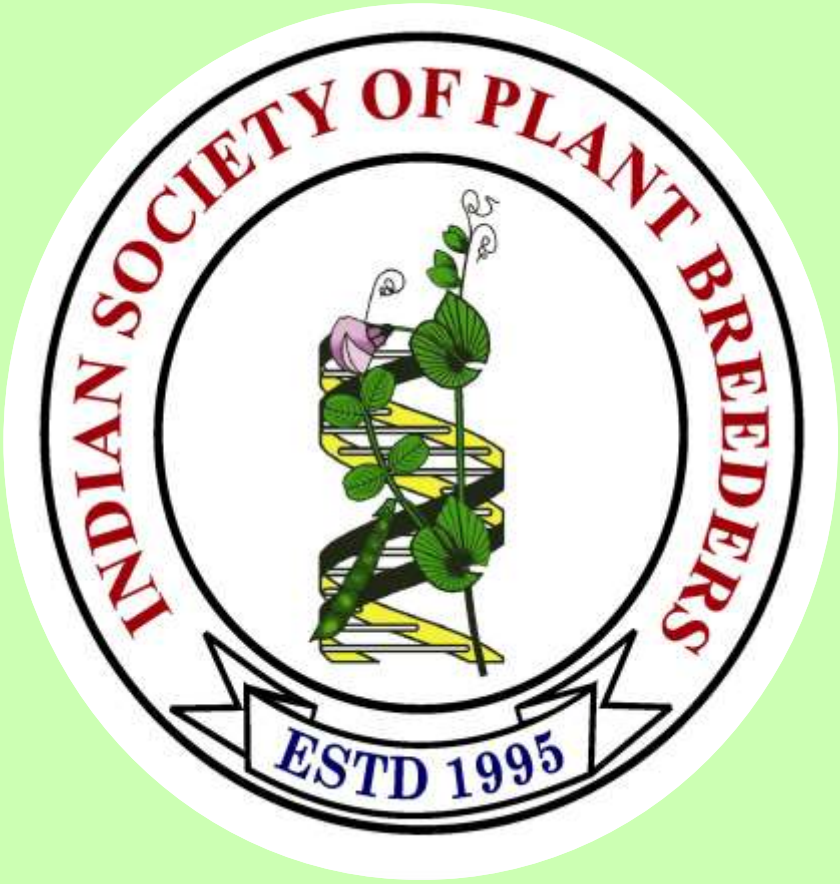
Table 5. Direct and indirect effect of yield attributing characters on fruit weight.

S.N.	Character	Inter nodal length (mm)	Petiole length (mm)	Leaf length (cm)	Leaf width (cm)	Fruit length (cm)	Fruit diameter (cm)	Moisture content (%)	Ascorbic acid content (mg/g)	Total chlorophyll content in leaves (mg/g)	Protein content (mg/100 g edible portion)	Fruit weight
1	Inter nodal length (mm)	-0.73	0.21	0.59	-0.08	-0.18	0.00	0.40	-0.06	-0.16	-0.11	-0.11
2	Petiole length (mm)	-0.38	0.40	0.43	-0.06	0.01	-0.02	-0.37	0.01	-0.13	0.03	-0.09
3	Leaf length (cm)	-0.49	0.20	0.89	-0.15	-0.00	0.00	-0.06	-0.00	-0.22	-0.21	-0.04
4	Leaf width (cm)	-0.21	0.09	0.49	-0.27	0.13	0.03	-0.20	0.05	-0.14	0.08	0.04
5	Fruit length (cm)	-0.21	-0.00	0.01	0.05	-0.64	0.04	0.59	0.08	0.07	0.08	0.07
6	Fruit diameter (cm)	-0.02	-0.05	0.02	-0.05	-0.14	0.17	0.10	-0.04	0.07	-0.01	0.04
7	Moisture content (%)	0.28	0.14	0.05	-0.05	0.35	-0.02	-1.07	-0.01	0.02	0.27	-0.04
8	Ascorbic acid content (mg/g)	0.11	0.01	-0.00	-0.03	-0.13	-0.02	0.02	0.39	0.06	-0.11	0.29
9	Total chlorophyll content in leaves (mg/g)	0.23	-0.11	-0.38	0.08	-0.09	0.02	-0.04	0.04	0.50	0.14	0.40*
10	Protein content (mg/100 g edible portion)	0.12	0.02	-0.27	-0.03	-0.08	-0.00	-0.42	-0.06	0.10	0.69	0.08

Residual effect = 0.7956



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