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Correlation and Path Coefficient Analysis of Quantitative Characters in Spine Gourd (*Momordica dioica* Roxb.)

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Abstract: Fifty genotypes of spine gourd (*Momordica dioica* Roxb.) were evaluated in a randomized block design with two replications at the Vegetable Research Station, Rajendranagar, Hyderabad, Andhra Pradesh, India during kharif, 2012. Correlation and path coefficient analysis were carried out to study the character association and contribution, respectively for twelve quantitative characters namely vine length (m), number of stems per plant, days to first female flower appearance, first female flowering node, days to first fruit harvest, days to last fruit harvest, fruiting period (days), fruit length (cm), fruit width (cm), fruit weight (g), number of fruits per plant and fruit yield per plant (kg) for identification of the potential selection indices. Correlation and path coefficient analyses revealed that fruiting period and number of fruits per plant not only had positively significant correlation with fruit yield but also had positively high direct effect on it and are regarded as the main determinants of fruit yield. Days to first fruit harvest had positively moderate direct effect on fruit yield and its association was negatively significant, days to last fruit harvest had negatively high direct effect on fruit yield and its association was significant positively, hence restricted simultaneous selection can be made for days to first fruit harvest and days to last fruit harvest. The improvement in fruit yield can be effective if selection is based on days to first fruit harvest, days to last fruit harvest, fruiting period and number of fruits per plant.

Key words: Character association, character contribution, germplasm lines, fruit yield, yield components

INTRODUCTION

Spine gourd also known as teasle gourd, agakara, adavi kakara, boda kakara and bonta kakara, is an underutilized and underexploited rhizomatous, perennial, dioecious, cucurbitaceous fruit vegetable. It is originated in Indo-Malayan region (Rashid, 1976). It has been cultivated in India, Bangladesh and neighboring countries for a long time. It has prominent position among the cucurbitaceous vegetables owing to its good nutritional and medicinal value, high keeping quality, ability to withstand long distance transportation, high market price and good export potential (Rasul, 2003). Although considered as underutilized and minor cucurbitaceous vegetable, it is widely cultivated in Odissa, Maharashtra, Bihar and West Bengal and is slowly gaining popularity as a commercial vegetable crop because of its rich taste and high nutritional value. It contains high amount of carotene (Gopalan *et al*., 1982) and is cheap source of vitamins and minerals (Bhuiya *et al*., 1977). It possesses several medicinal and curative properties like decoction of leaves reduces fever, tuberous roots help in relieving headache, sweating, stone formation, migraine, while fruit is quite helpful in controlling diabetes and blood pressure. Its commercial cultivation is meager due to non-availability of improved varieties, difficulties in propagation by seed due to dormancy, low multiplication rate of tubers, dormancy of tubers and unpredictable sex ratio in seedling progeny (Ali *et al*., 1991).

Yield is a complex character as it is under polygenic control and is more responsive to varying environmental conditions. An efficiency of selection in breeding program mainly depends on the knowledge of the role of environment and degree of association of the component characters. Correlation coefficient analysis is useful in developing an effective basis of phenotypic selection in plant population. Study of character association has considerable use in plant breeding because selection for one character may bring about simultaneous effect on other, depending on the intensity of association between

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the two traits under consideration. Larner (1958) stressed the importance of correlation of the various characters with yield. The phenotypic correlation indicates the extent of the observed relationship between characters, while genotypic correlation provides an estimate of inherent association between genes controlling any two characters. Although the correlation coefficient analysis is useful in determining the relative influence of the various characters on yield, it does not provide an exact picture of the relative importance of direct and indirect influences of each of the characters towards the yield. Path coefficient analysis developed by Wright (1921) proves helpful in partitioning the correlation coefficient into direct and indirect effects. It is basically a standardized partial regression analysis and deals with a closed system of variables that are linearly related. Such information provides realistic basis for allocation of appropriate weightage to various yield components.

Several researchers have studied the correlation and path coefficient analysis in spine gourd and other *Momordica* species to measure the association between yield and its components; direct and indirect effects of component characters on yield. Highly significant associations of fruit yield were observed with vine length in spine gourd (Bharathi *et al*., 2005) and bitter gourd (Bhave *et al*., 2003; Sundaram, 2010), number of stems per plant in teasle gourd (Naik and Akhtar, 2012), days to first female flower appearance in spine gourd (Bharathi *et al*., 2005; Singh *et al*., 2009), bitter gourd (Sundaram, 2010), sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011), first female flowering node in spine gourd (Bharathi *et al*., 2005), bitter gourd (Dey *et al*., 2005; Sundaram, 2010) and teasle gourd (Rahman *et al*., 2011), days to first fruit harvest in spine gourd (Singh *et al*., 2009) and bitter gourd (Dey *et al*., 2005); fruiting period in bitter gourd (Bhave *et al*., 2003), fruit length, fruit width and fruit weight in spine gourd (Bharathi *et al*., 2005; Singh *et al*., 2009), bitter gourd (Dey *et al*., 2005), sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011) and number of fruits per plant in spine gourd (Bharathi *et al*., 2005; Singh *et al*., 2009), bitter gourd (Dey *et al*., 2005), sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011; Naik and Akhtar, 2012). Fruit yield has been reported to be influenced by moderate to high direct effects of vine length in bitter gourd (Islam *et al*., 2009) and teasle gourd (Naik and Akhtar, 2012), days to first female flower appearance in spine gourd (Bharathi *et al*., 2005) and bitter gourd (Dey *et al*., 2005; Sundaram, 2010), first female flowering node in spine gourd (Bharathi *et al*., 2005) and bitter gourd (Dey *et al*., 2005; Sundaram, 2010), days to first fruit harvest in bitter gourd (Dey *et al*., 2005), fruit length in spine gourd (Bharathi *et al*., 2005), bitter gourd (Dey *et al*., 2005; Islam *et al*., 2009) and teasle gourd (Rahman *et al*., 2011), fruit width in spine gourd (Bharathi *et al*., 2005), bitter gourd (Sundaram, 2010) and sweet gourd (Sanwal *et al*., 2007); fruit weight in spine gourd (Singh *et al*., 2009), bitter gourd (Dey *et al*., 2005), sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011; Naik and Akhtar, 2012) and number of fruits per plant in spine gourd (Bharathi *et al*., 2005; Singh *et al*., 2009), bitter gourd (Dey *et al*., 2005), sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011; Naik and Akhtar, 2012). Days to first female flower appearance, fruit weight and number of fruits per plant were identified as important selection indices for the yield improvement in *Momordica* spp.

In this study, an attempt was made to study the interrelationships among important characters and their direct and indirect effects on fruit yield in spine gourd germplasm by adopting correlation and path coefficient analysis.

MATERIALS AND METHODS

A set of 50 female accessions of spine gourd (*Momordica dioica* Roxb.) collected and maintained by the Vegetable Research Station, Rajendranagar in collaboration with the National Bureau of Plant Genetic Resources (NBPGR) Regional Station, Rajendranagar, were evaluated in a randomized block design with 2 replications on trellis system during kharif, 2012. Each genotype was raised in a single-row plot of 3.0 m length and 2.5 m width. A row-to-row spacing of 2.5 m and a plant-to-plant spacing of 1.0 m was adopted. A plant population of 3 plants per row, plot and genotype was maintained. Recommended cultural practices were followed. Observations were recorded on 3 plants in each genotype and in each replication for vine length (m), number of stems per plant, days to first female flower appearance, first female flowering node, days to first fruit harvest, days to last fruit harvest, fruiting period (days), fruit length (cm), fruit width (cm), fruit weight (g), number of fruits per plant and fruit yield per plant (kg). Correlation coefficient and path coefficient analysis were computed by following the standard statistical procedure (Panse and Sukhatme, 1967; Dewey and Lu, 1959).

RESULTS

Correlation coefficient analysis: From the perusal of the estimates of phenotypic and genotypic coefficients of variation (Table 1), in general, it was observed that estimates of genotypic correlation coefficients were

Table 1: Phenotypic and genotypic correlation among twelve quantitative traits of spine gourd

Trait		Vine length (ru)	No. of stems per plant	Days to first female flower appearance	First female flowering node	Days to first fruit harvest	Days to last fruit harvest	Fruiting period (days)	Fruit length (cru)	Fruit width (cru)	Fruit weight (g)	No. of fruits per plant	Fruit yield per plant (kg)
1	rp	1.000	0.481**	-0.298**	-0.097	-0.246*	0.386**	0.456**	0.295**	0.329**	0.391**	0.433**	0.454**
	rg	1.000	0.569**	-0.304**	-0.13	-0.278**	0.485**	0.559**	0.710**	0.507**	0.480**	0.501**	0.527**
2	rp		1.000	-0.255*	-0.07	-0.430**	0.401**	0.596**	0.507**	0.216*	0.497**	0.751**	0.769**
	rg		1.000	-0.262**	-0.05	-0.448**	0.464**	0.680**	0.807**	0.360**	0.577**	0.770**	0.810**
3	rp			1.000	0.086	0.445**	-0.039	-0.318**	-0.202*	-0.259**	-0.201*	-0.207*	-0.16
	rg			1.000	0.100	0.508**	-0.007	-0.326**	-0.440**	-0.319**	-0.238*	-0.214*	-0.194
4	rp				1.000	0.122	-0.117	-0.179	0.056	-0.049	0.134	-0.121	-0.061
	rg				1.000	0.136	-0.092	-0.155	0.175	-0.143	0.197*	-0.146	-0.082
5	rp					1.000	0.01	-0.622**	-0.254*	-0.186	-0.228*	-0.420**	-0.385**
	rg					1.000	0.025	-0.636**	-0.390**	-0.275**	-0.266**	-0.466**	-0.433**
6	rp						1.000	0.768**	0.435**	0.229*	0.357**	0.619**	0.576**
	rg						1.000	0.761**	0.777**	0.333**	0.407**	0.702**	0.685**
7	rp							1.000	0.502**	0.302**	0.422**	0.758**	0.702**
	rg							1.000	0.858**	0.420**	0.493**	0.847**	0.810**
8	rp								1.000	0.396**	0.642**	0.494**	0.542**
	rg								1.000	0.789**	1.158**	0.818**	0.811**
9	rp									1.000	0.444**	0.224*	0.233*
	rg									1.000	0.673**	0.338**	0.320**
10	rp										1.000	0.487**	0.546**
	rg										1.000	0.572**	0.651**
11	rp											1.000	0.969**
	rg											1.000	0.992**

r_g: Genotypic correlation coefficient, r_p: Phenotypic correlation coefficient, *, **Significant at the 0.05 and 0.01 probability levels, respectively

higher than the phenotypic correlation coefficients for most of the characters, indicating a strong inherent association of the characters under study with a probable influence of environment on the expression. Phenotypic and genotypic correlation coefficient analysis revealed that the fruit yield was positively and significantly correlated with the vine length, number of stems per plant, days to last fruit harvest, fruiting period, fruit length, fruit width, fruit weight and number of fruits per plant. Significantly negative correlation was observed between days to first fruit harvest and fruit yield per plant.

At both phenotypic and genotypic levels, vine length had significantly positive correlation with number of stems per plant, days to last fruit harvest, fruiting period, fruit length, fruit width, fruit weight and number of fruits per plant and had significantly negative correlation with days to first female flower appearance and days to first fruit harvest. Number of stems per plant had significantly positive correlation with vine length, days to last fruit harvest, fruiting period, fruit length, fruit width, fruit weight and number of fruits per plant and had significantly negative correlation with days to first female flower appearance and days to first fruit harvest at both phenotypic and genotypic levels.

Days to first female flower appearance had significantly positive correlation with days to first fruit harvest and had significantly negative correlation with vine length, number of stems per plant, fruiting period, fruit length, fruit width, fruit weight and number of fruits per plant at both phenotypic and genotypic levels. First female flowering node had positively significant correlation with fruit weight at genotypic level only.

Days to first fruit harvest had significantly positive correlation with days to first female flower appearance and had significantly negative correlation with vine length, number of stems per plant, fruiting period, fruit length, fruit width, fruit weight and number of fruits per plant at both phenotypic and genotypic levels. Days to last fruit harvest had significantly positive correlation with vine length, number of stems per plant, fruiting period, fruit length, fruit width, fruit weight and number of fruits per plant at both phenotypic and genotypic levels. Fruiting period had significantly positive correlation with vine length, number of stems per plant, days to last fruit harvest, fruit length, fruit width, fruit weight and number of fruits per plant and had significantly negative correlation with days to first female flower appearance and days to first fruit harvest at both phenotypic and genotypic levels.

Fruit length had significantly positive correlation with vine length, number of stems per plant, days to last fruit harvest, fruiting period, fruit width, fruit weight and number of fruits per plant and had significantly negative correlation with days to first female flower appearance and days to first fruit harvest at both phenotypic and genotypic levels. At both phenotypic and genotypic levels, fruit width had significantly positive correlation with vine length, number of stems per plant, days to last fruit harvest, fruiting period, fruit length, fruit weight and number of fruits per plant and had significantly negative correlation with days to first female flower appearance, while at genotypic level, it had significantly negative correlation with days to first fruit harvest. Fruit weight had significantly positive correlation with vine length, number of stems per plant, days to last fruit harvest, fruiting period, fruit length, fruit width and number of fruits per plant and had significantly negative correlation with days to first female flower appearance and days to first fruit harvest at both phenotypic and genotypic levels. At genotypic level, fruit weight had significantly positive correlation with first female flowering node. Number of fruits per plant had significantly positive correlation with vine length, number of stems per plant, days to last fruit harvest, fruiting period, fruit length, fruit width, fruit weight and had significantly negative correlation with days to first female flower appearance and days to first fruit harvest at both phenotypic and genotypic levels.

Path coefficient analysis: The estimates of direct and indirect effects of the eleven fruit yield related characters on fruit yield are presented in the Table 2.

Direct effects: At phenotypic level, vine length, number of stems per plant, days to first female flower appearance, first female flowering node, days to last fruit harvest, fruit length and fruit weight had positively negligible direct effect, while days to first fruit harvest and fruit width had negatively negligible direct effect on fruit yield. Fruiting period had negatively low direct effect on fruit yield. Number of fruits per plant had positively high direct effect on fruit yield.

At genotypic level, vine length, number of stems per plant, days to first female flower appearance, fruit weight had positively negligible direct effect, while first female flowering node had negatively negligible direct effect on fruit yield. Fruit length and fruit width had positively low and negatively low direct effect on fruit yield, respectively. Days to first fruit harvest had positively moderate direct effect on fruit yield. Fruiting period and number of fruits per plant had positively high direct effect on fruit yield. Days to last fruit harvest had negatively high direct effect on fruit yield.

Table 2: Direct (diagonal) and indirect (off diagonal) effects of quantitative traits on fmit yield of spine gourd

Trait		Vine length (m)	No. of stems per plant	Days to first female flower appearance	First female flowering node	Days to first fruit harvest	Days to last fruit harvest	Fruiting period (days)	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	No. of fruits per plant	r with fruit yield per plant
1	P	0.048	0.023	-0.014	-0.004	-0.012	0.018	0.022	0.014	0.016	0.019	0.021	0.454**
	G	0.047	0.027	-0.014	-0.006	-0.013	0.023	0.026	0.033	0.024	0.023	0.024	0.527**
2	P	0.025	0.053	-0.013	-0.003	-0.022	0.021	0.031	0.027	0.011	0.026	0.040	0.769**
	G	0.017	0.031	-0.008	-0.006	-0.015	0.014	0.021	0.025	0.011	0.017	0.024	0.810**
3	P	-0.017	-0.014	0.057	0.005	0.025	-0.002	-0.018	-0.011	-0.015	-0.011	-0.012	-0.160
	G	-0.010	-0.009	0.034	0.003	0.017	0.000	-0.011	-0.015	-0.011	-0.008	-0.007	-0.194
4	P	-0.002	-0.002	0.002	0.028	0.003	-0.030	-0.005	0.001	-0.001	0.003	-0.003	-0.061
	G	0.000	0.000	0.000	-0.006	0.000	0.000	0.001	-0.001	0.000	-0.001	0.001	-0.082
5	P	0.009	0.015	-0.016	-0.004	-0.036	0.000	0.022	0.009	0.006	0.008	0.015	-0.385**
	G	-0.082	-0.144	0.150	0.040	0.295	0.007	-0.187	-0.115	-0.081	-0.078	-0.137	-0.433**
6	P	0.004	0.005	0.000	0.001	0.000	0.012	0.009	0.005	0.002	0.004	0.007	0.576**
	G	-0.192	-0.184	0.002	0.036	-0.010	-0.397	-0.302	-0.308	-0.132	-0.161	-0.279	0.685**
7	P	-0.057	-0.075	0.043	0.022	0.078	-0.097	-0.126	-0.063	-0.038	-0.053	-0.096	0.702**
	G	0.184	0.224	-0.107	-0.051	-0.210	0.251	0.330	0.283	0.138	0.162	0.279	0.810**
8	P	0.018	0.032	-0.013	0.003	-0.016	0.027	0.032	0.064	0.025	0.041	0.031	0.542**
	G	0.104	0.119	-0.065	0.026	-0.057	0.114	0.126	0.147	0.116	0.171	0.120	0.811**
9	P	-0.003	-0.002	0.002	0.000	0.001	-0.002	-0.003	-0.004	-0.010	-0.004	-0.002	0.233*
	G	-0.051	-0.036	0.032	0.014	0.027	-0.033	-0.042	-0.079	-0.101	-0.068	-0.034	0.320**
10	P	0.021	0.027	-0.010	0.007	-0.012	0.019	0.022	0.034	0.024	0.054	0.026	0.546**
	G	0.014	0.017	-0.007	0.006	-0.008	0.012	0.015	0.035	0.020	0.030	0.017	0.651**
11	P	0.407	0.706	-0.194	-0.114	-0.395	0.582	0.713	0.465	0.211	0.458	0.941	0.969**
	G	0.493	0.764	-0.210	-0.144	-0.458	0.691	0.833	0.805	0.333	0.563	0.983	0.992**

G: Genotypic, P: Phenotypic, r: Correlation coefficient, *, **Significant at the 0.05 and 0.01 probability levels, respectively

Indirect effects: At phenotypic level, vine length, number of stems per plant, days to first female flower appearance, first female flowering node, days to first fruit harvest, days to last fruit harvest, fruiting period, fruit length, fruit width, fruit weight had negligible indirect effects through other component characters on fruit yield. Number of fruits per plant had negatively low indirect effect through days to first female flower appearance, first female flowering node, positively moderate indirect effect through fruit width, positively high indirect effect through vine length, number of stems per plant, days to last fruit harvest, fruiting period, fruit length and fruit weight, while negatively high indirect effect through days to first fruit harvest.

At genotypic level, vine length, number of stems per plant, days to first female flower appearance, first female flowering node had negligible indirect effects through other component characters on fruit yield. Days to first fruit harvest had positively low indirect effect on yield through days to first female flower appearance and negatively low indirect effect through number of stems per plant, fruiting period, fruit length and number of fruits per plant. Days to last fruit harvest had negatively low indirect effect through vine length, number of stems per plant, fruit width and fruit weight and had negatively moderate indirect effect through number of fruits per plant, high negative indirect effect through fruiting period and fruit length. Fruiting period had positively low indirect effect through vine length, fruit width and fruit weight, negatively low indirect effect on fruit yield through days to first female flower appearance and positively moderate indirect effect through number of stems per plant, days to last fruit harvest, fruit length, number of fruits per plant while it had negatively moderate indirect effect through days to first fruit harvest. Fruit length had positively low indirect effect on fruit yield through vine length, number of stems, days to last fruit harvest, fruiting period, fruit width, fruit weight and number of fruits per plant. Number of fruits per plant had negatively low indirect effect on fruit yield through first female flowering node, negatively moderate indirect effect through days to first female flower appearance and positively high indirect effect through vine length, number of stems per plant, days to last fruit harvest, fruiting period, fruit length, fruit width and fruit weight while it had negatively high indirect effect through days to first fruit harvest.

The magnitude and direction of direct effect of number of fruits per plant is almost equivalent to the correlation coefficient with fruit yield at both phenotypic and genotypic levels. Fruiting period had high positive direct effect on fruit yield and was significantly and positively correlated with it. The direct effect of vine length, number of stems per plant, fruit length, fruit width and fruit weight on fruit yield was negative or negligible but their correlation with fruit yield was significantly positive. The direct effect of days to first fruit harvest with fruit yield per plant was positive and high but its correlation coefficient was significantly negative. The direct effect of days to last fruit harvest was negatively high but its correlation with fruit yield was significantly positive.

Residual effects: The residual factor determines how best the casual factors account for the variability of the dependent factor, the fruit yield per plant in this case. The residual effects were 0.2028 and 0.0669, which were of moderate and negligible magnitude at phenotypic and genotypic levels, respectively.

DISCUSSION

In general, genotypic correlation coefficients were higher than the phenotypic correlation coefficients for most of the characters under study. Similar results were also reported in spine gourd (Bharathi *et al*., 2005; Singh *et al*., 2009) and teasle gourd (Rahman *et al*., 2011). This indicates a strong inherent association of the characters under study with a probable influence of environment on the expression. Vine length had positively significant correlation with the fruit yield. Higher the vine length higher will be the number of nodes per vine resulting in high yield since fruits are borne on nodes. The positive association of fruit yield with vine length was also reported in bitter gourd (Bhave *et al*., 2003; Sundaram, 2010). Number of stems per plant had positive association with yield as it increases the fruit bearing area per plant. Days to first fruit harvest had negatively significant association with fruit yield suggesting that early harvest is an indication of higher yield; similar result was also reported in bitter gourd (Dey *et al*., 2005). Days to last fruit harvest had positively significant correlation with fruit yield as it increases the fruiting period which in turn increases the fruit yield. Fruiting period had positive association with fruit yield indicating that extended period of harvest increases the yield. This finding is in consonance with Bhave *et al*. (2003) in bitter gourd. Fruit length and fruit width had positively significant association with the fruit yield. Similar finding were also reported in spine gourd (Bharathi *et al*., 2005; Singh *et al*., 2009), bitter gourd (Bhave *et al*., 2003; Dey *et al*., 2005), sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011). Increase in fruit length and fruit width resulted in increase in fruit weight which ultimately

increased the fruit yield. Fruit weight and number of fruits per plant also had positively significant association with fruit yield. Similar results were reported in spine gourd (Bharathi *et al*., 2005; Singh *et al*., 2009), bitter gourd (Bhave *et al*., 2003; Dey *et al*., 2005, sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011; Naik and Akhtar, 2012).

Path coefficient analysis revealed that vine length, number of stems per plant, days to first female flower appearance, first female flowering node and fruit weight had negligible direct effect on fruit yield. Similar effect of vine length on fruit yield was reported in bitter gourd (Bhave *et al*., 2003), days to first female flower appearance in spine gourd (Singh *et al*., 2009), bitter gourd (Bhave *et al*., 2003), sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011), fruit weight in spine gourd (Bharathi *et al*., 2005) and bitter gourd (Sundaram, 2010). Fruit length and fruit width had low direct effect on fruit yield. Low direct effect of fruit length was also reported by Sanwal *et al*. (2007) in sweet gourd. Days to first fruit harvest had positively moderate direct effect on fruit yield, similar to the reports of Singh *et al*. (2009) in spine gourd. Days to last fruit harvest had negatively high direct effect on fruit yield. Fruiting period and number of fruits per plant had positively high direct effect on fruit yield indicating that these traits influenced yield in spine gourd. Positively high direct effect of number of fruits per plant was also reported in spine gourd (Bharathi *et al*., 2005; Singh *et al*., 2009) bitter gourd (Dey *et al*., 2005), sweet gourd (Sanwal *et al*., 2007) and teasle gourd (Rahman *et al*., 2011; Naik and Akhtar, 2012).

The direct effect of number of fruits per plant at phenotypic (0.941) and genotypic (0.983) level was almost equal to its correlation coefficient at phenotypic (0.969^{**}) and genotypic (0.992^{**}) level suggesting that correlation coefficient explains the true relationship and a direct selection through this trait will be effective. Correlation between fruiting period and fruit yield was significantly positive and the direct effect was positively high. Hence, fruiting period can be considered as an effective trait for direct selection. The characters vine length, number of stems per plant, fruit length, fruit width and fruit weight had negative or negligible direct effect but had significantly positive correlation with fruit yield per plant, the indirect effects seem to be the cause of correlation. In such situations, the indirect causal factors are to be considered simultaneously.

The direct effect of days to first fruit harvest with fruit yield per plant is positive and high but its correlation coefficient is significantly negative. The days to last fruit harvest had high negative direct effect on fruit yield but its correlation was significantly positive. Under these circumstances, a restricted simultaneous selection model is to be followed, i.e. restrictions are to be imposed to nullify the undesirable indirect effects. The residual factor determines how best the casual factors account for the variability of the dependent factor, the fruit yield per plant in this case. The variables studied explain about 79.72 and 93.31% of the variability at phenotypic and genotypic levels, respectively in the fruit yield per plant. It indicates that some characters which have not been studied here need to be included in this analysis to account fully for the variation in fruit yield per plant.

CONCLUSION

In conclusion, the correlation coefficient analysis revealed that fruit yield had significantly positive genotypic correlation with vine length, number of stems per plant, days to last fruit harvest, fruiting period, fruit length, fruit width, fruit weight and number of fruits per plant and had significantly negative correlation with days to first fruit harvest. Path analysis revealed that days to first fruit harvest, days to last fruit harvest, fruiting period and number of fruits per plant had strong influence on fruit yield and are main determiners of fruit yield per plant. Therefore improvement in yield can be achieved by selecting the genotypes which fruit early with extended period of harvest, producing more number of fruits per plant.

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