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Path Coefficient analysis for yield and yield attributing traits in spine gourd (*Momordica dioica* Roxb.)

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Abstract
Ninety genotypes of spine gourd (*Momordica dioica* Roxb.) were evaluated in a randomized block design with two replications at the Vegetable Research Field, College of Horticulture, Mandsaur, (M.P), during *kharif* season of 2013. Correlation and path coefficient analysis were carried out to study the character which were associated and contributed towards the final yield. Twelve quantitative characters *viz.*, first female flower appearance, days of anthesis to fruit maturity, fruiting period, fruit length (mm), fruit weight (g), fruit width (mm), individual fruit weight (g), fruit rind thickness (mm), number of seeds/fruit, number of fruits/plant, days to last fruit harvest and fruit yield (g) for identification of the potential selection indices. The correlation coefficient analysis revealed that fruit yield had significantly positive genotypic correlation with days to first female flower appearance, Fruiting period, fruit length, fruit weight, fruit width, individual fruit weight, fruit rind thickness, number of seeds/fruit, number of fruits/plant and had significantly negative correlation with days of anthesis to fruit maturity. Path analysis revealed that number of fruits per plant had positively high direct effect on fruit yield at genotypic (0.7898) and phenotypic level (0.8476) indicating that these traits influenced yield in spine gourd.

Keywords: spine gourd, *Momordica dioica*, path coefficient analysis.

Introduction
Spine gourd (*Momordica dioica* Roxb. Ex. Willd.) belongs to the family Cucurbitaceae. Commonly known as spiny gourd or spine gourd and also known as prickly carolaho. In telugu it is called boda kakara and on the east coast of Andhra it is called aa-kakara-kaya. Spine gourd is a native of tropical regions in Asia, Polynesia besides tropical Africa and South America. As many of the species of this genus have been found to grow wide in India, Bangladesh, Sri Lanka, Myanmar and Malay etc. (Hooker, 1879) [6] indicated that this region might be the origin of spine gourd. Kartoli mainly grown in Orissa, Bihar and West Bengal as a crop and kitchen garden plant but occurs as wild in Punjab, Uttar Pradesh, Rajasthan, Madhya Pradesh, Kerala and Maharashtra. It is used as a vegetable in all regions of India and some parts in South Asia. kakrol has a number of problems including low yield. Fruits become inedible at maturity owing to the presence of large number of hard seeds. Low rate of tuber production (10-20 tuberous pieces per year); germination of seeds is very low or impossible due to hard seed coat (Rashid 1976), non-availability of improved varieties, difficulties in propagation by seed due to dormancy, dormancy of tubers and unpredictable sex ratio in seedling progeny (Ali *et al.*, 1991) [1].

Materials and Method
The present study was carried out at the Vegetable Research Field, College of Horticulture, Mandsaur, (M.P), during kharif season of 2013. Mandsaur is situated in Malwa plateau in Western part of Madhya Pradesh. The topography of the experimental field is plain. Ninety genotypes of spine gourd collected from different regions of Madhya Pradesh and were evaluated in randomized block design during the year *kharif* 2013. Recommended dose of manures and fertilizers were applied to provide better nutrition to the crop and all the plant protection measures were taken care to maintain the healthy crop stand. The present investigation was carried out to measure the extent of path coefficient among 90 diverse genotypes of Kartoli in randomized block design with two replications. Observations were recorded on reproductive viz Days to first female flower appearance, Days from anthesis to fruit maturity, Days to First fruit harvest, Days to last fruit harvest, Fruiting period, Fruit length, Fruit weight, Individual fruit weight, Fruit rind thickness, number of seeds per fruit, Number of fruits per plant and Fruit yield per plant.

Result and Discussion

The estimates of direct and indirect effects of the eleven fruit yield related characters on fruit yield are presented in the Table 1.

At phenotypic level, days to first female flower appearance, days of anthesis to fruit maturity, Fruiting period, fruit length, fruit weight, fruit width, Individual fruit weight, fruit rind thickness, number of seeds/fruit, number of fruits/plant, had positively direct effect, while days to last fruit harvest had negatively negligible direct effect on fruit yield. At genotypic level, days to first female flower appearance, days of anthesis to fruit maturity, fruiting period, fruit weight, fruit width, Individual fruit weight, fruit rind thickness, number of seeds/fruit, number of fruits/plant, had positively direct effect, while days to first fruit harvest and fruit length had negatively negligible direct effect on fruit yield.

The direct effect of days to first female flower appearance at phenotypic (0.0581) and genotypic (0.0249) level and equal to its correlation coefficient at phenotypic (0.3942**) and genotypic (0.3810**) was a direct selection through this trait will be effective.

Path coefficient analysis revealed that 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[1] days to first female flower appearance in spine gourd [2] sweet gourd[3]and teasle gourd [4] fruit weight in spine gourd [5] and bitter gourd [6]. Fruit length, days to first female flower appearance and fruit rind thickness had low direct effect on fruit yield. Low direct effect of fruit length was also reported by [3, 7] in sweet gourd. Days to first fruit harvest showed negative direct effect on fruit yield. In contrast [7, 2]. Days to last fruit harvest had negatively high direct effect on fruit yield. Similar findings were also reported by [7]. Number of fruits per plant had positively high direct effect on fruit yield at genotypic (0.7898) and phenotypic level (0.8476) 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 [5, 2] bitter gourd [8], sweet gourd [3] and teasle gourd [4, 9]. Days of anthesis to fruit maturity showed significant negatively correlated with fruit yield and was direct positive effect. All other remaining traits were significant positively correlated with fruit yield.

In conclusion, the correlation coefficient analysis revealed that fruit yield had significantly positive genotypic correlation with days to first female flower appearance, Fruiting period, fruit length, fruit weight, fruit width, Individual fruit weight, fruit rind thickness, number of seeds/fruit, number of fruits/plant and had significantly negative correlation with days of anthesis to fruit maturity. Path analysis revealed that number of fruits per plant had positively high direct effect on fruit yield at genotypic (0.7898) and phenotypic level (0.8476) indicating that these traits influenced yield in spine gourd.

Table 1: Direct (diagonal) and indirect (off diagonal) effects of quantitative traits on fruit yield/plant of spine gourd

Traits		Dfffa	Dafm	Dffh	Dlfh	Fp	Fl (mm)	Fw (mm)	Ifw (g)	Frt (mm)	No.spf	No.fpp	Correlated with fypp (g)
Dfffa	G	0.0249	-0.0014	0.0143	0.0156	0.0111	0.0055	0.0076	0.0019	0.0170	0.0062	0.0087	0.3942**
Dfffa	P	0.0581	-0.0040	0.0303	0.0351	0.0254	0.0119	0.0141	0.0045	0.0058	0.0131	0.0187	0.3810**
Dafm	G	-0.0038	0.0671	-0.0134	-0.0112	-0.0064	-0.0061	-0.0083	0.0098	-0.0253	-0.0021	-0.0293	-0.3201**
Dafm	P	-0.0036	0.0529	-0.0084	-0.0082	-0.0048	-0.0031	-0.0047	0.0084	-0.0035	-0.0017	-0.0198	-0.2776**
Dffh	G	0.1080	-0.0376	0.1886	0.1326	0.0400	0.0382	0.0349	-0.0233	0.1375	0.0155	0.0388	0.2175**
Dffh	P	0.0001	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2064**
Dlfh	G	-0.1912	0.0509	-0.2145	-0.3051	-0.2670	-0.0971	-0.1380	0.0270	-0.0222	-0.0622	-0.1633	0.5388**
Dlfh	P	-0.0005	0.0001	-0.0005	-0.0008	-0.0007	-0.0002	-0.0003	0.0001	-0.0001	-0.0002	-0.0004	0.5279**
Fp	G	0.1596	-0.0342	0.0757	0.3129	0.3575	0.0990	0.1505	-0.0177	-0.0390	0.0797	0.2016	0.5544**
Fp	P	0.0042	-0.0009	0.0017	0.0084	0.0097	0.0024	0.0034	-0.0005	0.0004	0.0021	0.0053	0.5476**
Fl (mm)	G	-0.0138	0.0056	-0.0126	-0.0198	-0.0172	-0.0622	-0.0536	-0.0036	-0.0646	-0.0296	-0.0225	0.4584**
Fl (mm)	P	0.0126	-0.0036	0.0123	0.0176	0.0153	0.0618	0.0464	0.0030	0.0066	0.0261	0.0197	0.4238**
Fw (mm)	G	0.0408	-0.0165	0.0247	0.0605	0.0563	0.1151	0.1336	0.0048	0.0418	0.0500	0.0576	0.4856**
Fw (mm)	P	0.0111	-0.0041	0.0095	0.0158	0.0161	0.0342	0.0456	0.0003	0.0064	0.0138	0.0137	0.4034**
Ifw(g)	G	0.0059	0.0114	-0.0096	-0.0069	-0.0039	0.0045	0.0028	0.0780	0.0108	0.0174	0.0075	0.1735*
Ifw(g)	P	0.0044	0.0089	-0.0050	-0.0052	-0.0029	0.0027	0.0004	0.0564	0.0015	0.0106	0.0052	0.1685*
Frt (mm)	G	0.0219	-0.0121	0.0235	0.0023	-0.0035	0.0334	0.0101	0.0044	0.0322	0.0119	0.0251	0.7181**
Frt (mm)	P	0.0014	-0.0009	0.0004	0.0012	0.0006	0.0015	0.0020	0.0004	0.0141	0.0016	0.0015	0.1396*
No.spf	G	0.0314	-0.0039	0.0103	0.0256	0.0280	0.0598	0.0470	0.0280	0.0464	0.1257	0.0468	0.4541**

No.spf	P	0.0135	-0.0019	0.0034	0.0123	0.0131	0.0252	0.0180	0.0112	0.0066	0.0597	0.0209	0.4296**
No.f pp	G	0.2752	-0.3446	0.1626	0.4228	0.4454	0.2862	0.3406	0.0757	0.6160	0.2939	0.7898	0.9647**
No.f pp	P	0.2727	-0.3170	0.1519	0.4364	0.4593	0.2702	0.2550	0.0788	0.0877	0.2961	0.8476	0.9345**

Residual Effect = 0.2962 (Phenotypic) 0.2293(genotypic)

Legend

DFFA (Days to first female flower appearance), DAFM (Days from anthesis to fruit maturity), DFFH (Days to First fruit harvest),), DLFH (Days to last fruit harvest), FP (Fruiting period), FL (Fruit length), FW (Fruit weight), IFW (Individual fruit weight), FRT (Fruit rind thickness), No. SPF (number of seeds per fruit), No. F PP (Number of fruits per plant) and FYPP (Fruit yield per plant).

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