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Correlation and Path Coefficient Analysis in chow-chow (*Sechium edule* (Jacq.) Swartz.)

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ABSTRACT

Correlation and path analysis were carried out in twenty diverse genotypes of chow-chow collected from different North Eastern states of India. Correlation studies indicated that fruit yield per plant was positively and significantly correlated with days to first flowering, number of nodes at first fruit set, length of internodes, length of leaf, width of leaf, petiole length, number of fruits per plant, fruit length, fruit weight, fruit diameter which indicated the importance of these traits in selection for yield. Path analysis revealed that maximum positive direct effect on fruit yield per plant was imposed by fruit weight, number of fruits per plant and number of nodes at genotypic level. This indicated that these are the real independent characters and have maximum contribution towards increase in fruit yield per plant.

Key words: *Chow-chow, Correlation, Path analysis, Independent and fruit yield.*

Introduction

Chow-chow (*Sechium edule* (Jacq.) Sw.] also known as Chayote is an underutilized crop of family Cucurbitaceae, is native to Central America and humid tropical region of Mexico. In India, the crop was introduced by the Western Missionaries (Singh *et al.*, 2012) and nowadays it is widely distributed along the Himalayan states and adjoining areas of Myanmar, Bhutan and Nepal. It is basically used for human consumption. In addition to the fruits; stems, tender leaves and tuberous roots are also eaten. Besides, fruit extract also has antihypertensive effect, antibacterial, antifungal, antioxidant (Cadena-Iniguez *et al.*, 2013).

It is very popular among the tribals of NEH regions owing to its hardiness, profuse fruiting with minimum care and its multiple uses. Though, it is native of Mexico but considerable diversity is found in North East region. Mizoram is the leading state with an estimated area of 845 ha and 10985 MT production (Sanwal, 2008). North East has good genetic variability for various traits in chow-chow and not much exploration has been taken to tap the diversity till now. So there is need to develop a variety (ies) with good qualitative and yield traits, suitable for cultivation in this region.

Thus, keeping in view, the present research work has been conducted to study the correlation and path analysis in 20 genotypes of chowchow.

Materials and Methods

The present study was carried out at Horticulture Research farm, SASRD, Medziphema, Nagaland. It is situated at 25°45’43" N latitude and 93°53’04" E longitude at an elevation of 305 m above the sea level, bringing sub-tropical climate. The preparation of the field was done by tractor-drawn cultivator followed by two cross-harrowing to pulverize the soil and finally the field was leveled with planker. Field was divided in to treatments replications with randomized block design. Twenty genotypes of chow-chow from different places of North Eastern Region have been collected to conduct the experiment (Table 1). Seeds are sown in hills on raised bed along with channels or furrows. Dig pits of 45 cm x 45 cm x 45 cm at a spacing of 1m x 1m. Fully matured and sprouted fruits collected from high yielding vines were planted in pits @ 1 pit^{-1}. Five randomly selected equally competitive plants from each row in each replication were tagged for the purpose of recording the observation on 21 characters viz. vine length, days to first flowering, number of nodes at first fruit set, length of internodes, length of leaf, width of leaf, petiole length, no. of fruits/ plan, fruit weight, fruit length, fruit diameter, calcium, fat, Vit. C, TSS, moisture, carbohydrate, protein, crude fibre, yield per plant and yield per ha. The genotypic and phenotypic correlation coefficient of yield and quality contributing traits were estimated as per described method Al-Jibouri *et al.* (1958). The direct and indirect effect was estimated as per the method of Wright (1921) and elaborated by Dewey and Lu (1959) respectively.

Results and Discussion

The phenotypic and genotypic correlation coefficients among different characters were worked out in all possible combinations (Table 2). In general, it was observed that genotypic correlation coefficient (r_g) values were higher in magnitude than phenotypic correlation coefficient (r_p) values. Vine length showed positive and significant correlation (0.5439 P, 0.5462 G) with width of leaf. Days to first flowering showed positive and significant phenotypic correlation with number of nodes at first fruit set (0.4477 P, 0.4492 G) and length of internodes (0.4620 P, 0.4662 G) and length of leaf (0.4467). However, days to first flowering showed negative and significant correlation with fruit diameter (-0.4715) at genotypic level. Number of nodes at first fruit set showed positive and significant correlation with days to first flowering (0.4477 P, 0.4492 G). Length of internodes showed positive and significant correlation with days to first flowering (0.4620 P, 0.4662 G), width of leaf (0.5343 P, 0.5396 G) and fruit weight (0.4956 P, 0.5002 G). Width of leaf showed positive and significant correlation with vine length (0.5439 P, 0.5462 G), length of internodes (0.5343 P, 0.5396 G), fruit length (0.5187 P, 0.5322 G) and fruit diam-

Table 1. Details of the genotypes and their source

Sl. No.	Genotypes	Place of Collection	Latitude, Longitude & Altitude
1.	G-1	Siiro village, Ziro, Arunachal Pradesh	27°31′9′′N, 93°50′23′′E, 1706 m
2.	G-2	Tuichang, Champhai Dist., Mizoram	23°15′30′′N, 92°57′35′′E, 1678 m
3.	G-3	Mao-Gate, Senapati Dist., Manipur	25°30′47′′N, 94°8′4′′E, 2452 m
4.	G-4	Hong village, Ziro, Arunachal Pradesh	27°31′18′′N, 93°50′41′′E, 1702 m
5.	G-5	Pfutsero, Phek Dist., Nagaland	25°34′4′′N, 94°18′12′′E, 2133 m
6.	G-6	Hundung Village, Ukhrul Dist., Manipur	25°4′46′′N, 94°21′7′′E, 1656 m
7.	G-7	Kohima Village, Kohima Dist., Nagaland	25°40′47′′N, 94°6′58′′E, 1449 m
8.	G-8	Mawkriah, East Khasi Hills, Meghalaya	25°30′47′′N, 91°47′16′′E, 1529 m
9.	G-9	Nongpiur, East Khasi Hills, Meghalaya	25°32′37′′N, 91°48′46′′E, 1518 m
10.	G-10	Makhel, Senapati Dist., Manipur	25°27′54′′N, 94°9′9′′E, 2118 m
11.	G-11	Kaibi, Senapati Dist., Manipur	25°28′4′′N, 94°9′47′′E, 2231 m
12.	G-12	Khoupum, Tamenglong Dist., Manipur	24°41′17′′N, 93°26′6′′E, 1160 m
13.	G-13	Punanamei, Senapati Dist., Manipur	25°31′16′′N, 94°9′13′′E, 2459 m
14.	G-14	Tuirot, Namchi, Sikkim	27°9′46′′N, 88°22′34′′E, 1335 m
15.	G-15	Tamei, Tamenglong Dist., Manipur	25°9′44′′N, 93°40′53′′E, 1330 m
16.	G-16	Silesih, Aizawl, Mizoram	23°48′29′′N, 92°44′1′′E, 1142 m
17.	G-17	Medziphema, Dimapur Dist., Nagaland	25°46′3′′N, 93°53′1′′E,368 m
18.	G-18	Tenning, Peren Dist., Nagaland	25°20′43′′N, 93°39′42′′E, 1503 m
19.	G-19	Vidima, Dimapur Dist., Nagaland	25°47′28′′N, 93°41′53′′E, 157 m
20.	G-20	Makhan, Senapati Dist., Manipur	25°26′43′′, 94°6′17′′E, 1671 m

Table.2 Phenotypic (P) and genotypic (G) correlation coefficients among yield and yield attributes in twenty two genotypes of chowchow

Character		Vine length	Days to first flowering	No. of nodes at first fruit	Length of internodes	Length of Leaf	Width of leaf	Petiole length	fruits/ plant	Fruit weight	Fruit length	Fruit diameter	Calcium
Vine length	**P**	**1.0000**	0.3689	0.7873	0.8473	0.6457	0.5439*	0.5935	-0.0181	0.3929	0.2626	0.1142	0.0393
	G	**1.0000**	0.3670	0.7899	0.8552	0.6530	0.5462*	0.6468	-0.0153	0.3939	0.2704	0.1450	0.0410
Days to first flowering	**P**		**1.0000**	0.4477*	0.4620*	0.4422	0.3488	0.3174	-0.1078	0.4302	0.4000	-0.3598	0.0829
	G		**1.0000**	0.4492*	0.4662*	0.4467*	0.3500	0.3464	-0.1040	0.4322	0.4119	-0.4715*	0.0850
Number of nodes at	**P**			**1.0000**	0.8246	0.7773	0.7526	0.6863	-0.2022	0.4105	0.3554	0.0699	-0.0555
first fruit set	**G**			**1.0000**	0.8284	0.7902	0.7581	0.7448	-0.2054	0.4122	0.3662	0.0961	-0.0506
Length of internodes	**P**				**1.0000**	0.6458	0.5343*	0.7552	-0.2829	0.4956*	0.3996	-0.1912	0.0159
	G				**1.0000**	0.6616	0.5396*	0.8221	-0.2915	0.5002*	0.4150	-0.2235	0.0264
Length of leaf	**P**					**1.0000**	0.9072	0.5726	-0.3080	0.6863	0.6037	0.2442	-0.0150
	G					**1.0000**	0.9122	0.6430	-0.3073	0.6954	0.6201	0.2980	-0.0210
Width of leaf	**P**						**1.0000**	0.5813	-0.2288	0.6513	0.5187*	0.3549	-0.1037
	G						**1.0000**	0.6446	-0.2282	0.6544	0.5322*	0.4477*	-0.1081
Petiole length	**P**							**1.0000**	-0.3164	0.4735*	0.4254	-0.1497	0.0738
	G							**1.0000**	-0.3537	0.5142*	0.4646*	-0.2282	0.0595
No. of fruits/plan	**P**								**1.0000**	-0.6783	-0.6213	0.3191	-0.1199
	G								**1.0000**	-0.6850	-0.6326	0.4738*	-0.1261
Fruit weight	**P**									**1.0000**	0.8704	-0.0453	-0.0920
	G									**1.0000**	0.8804	-0.0584	-0.0919
Fruit length	**P**										**1.0000**	-0.1388	-0.0460
	G										**1.0000**	-0.1908	-0.0485
Fruit diameter	**P**											**1.0000**	-0.1203
	G											**1.0000**	-0.1658
Calcium	P												1.0000
	G												1.0000
Yield per plant	P	0.5151	0.5492	0.4309	0.4677	0.6623	0.6582	0.3694	-0.2804	0.8786	0.7580	0.1147	-0.1797
	G	0.5214	0.5575	0.4349	0.4726	0.6782	0.6667	0.3987	-0.2970	0.8831	0.7726	0.1718	-0.1814

Table 3. Phenotypic (P) and genotypic (G) path coefficients indicating direct and indirect effects of components characters on fruit yield in twenty two genotypes of chowchow

Character		Vine length	Days to first flowering	Number of nodes at first fruit	Length of internodes	Length of leaf	Width of leaf	Petiole length	No. of fruits/ plant	Fruit weight	Fruit length	Fruit diameter	Calcium
Vine length	P	**-0.0277**	-0.0102	-0.0218	-0.0235	-0.0179	-0.0151	-0.0165	0.0005	-0.0109	-0.0073	-0.0032	-0.0011
	G	**-0.0904**	-0.0332	-0.0714	-0.0773	-0.0591	-0.0494	-0.0585	0.0014	-0.0356	-0.0245	-0.0131	-0.0037
Date of first flowering	P	**0.0165**	**0.0447**	0.0200	0.0206	0.0197	0.0156	0.0142	-0.0048	0.0192	0.0179	-0.0161	0.0037
	G	0.0026	**0.0070**	0.0031	0.0033	0.0031	0.0025	0.0024	-0.0007	0.0030	0.0029	-0.0033	0.0006
Number of nodes at	P	0.3534	0.2010	**0.4489**	0.3701	0.3489	0.3378	0.3081	-0.0908	0.1843	0.1595	0.0314	-0.0249
first fruit	G	0.4672	0.2657	**0.5915**	0.4900	0.4674	0.4484	0.4405	-0.1215	0.2438	0.2166	0.0568	-0.0299
Length of internodes	P	-0.1231	-0.0671	-0.1198	**-0.1452**	-0.0938	-0.0776	-0.1097	0.0411	-0.0720	-0.0580	0.0278	-0.0023
	G	-0.1352	-0.0737	-0.1309	**-0.1581**	-0.1046	-0.0853	-0.1299	0.0461	-0.0791	-0.0656	0.0353	-0.0042
Length of leaf	P	-0.1185	-0.0811	-0.1426	-0.1185	**-0.1835**	-0.1664	-0.1051	0.0565	-0.1259	-0.1108	0.0448	0.0028
	G	-0.1419	-0.0971	-0.1718	-0.1438	**-0.2174**	-0.1983	-0.1398	0.0668	-0.1512	-0.1348	-0.0648	0.0046
Width of leaf	P	-0.1445	-0.0927	-0.2000	-0.1420	-0.2410	**-0.2657**	-0.1544	0.0608	-0.1730	-0.1378	-0.0943	0.0275
	G	-0.1859	-0.1192	-0.2581	-0.1837	-0.3105	**-0.3404**	-0.2195	0.0777	-0.2228	-0.1812	-0.1524	0.0368
Petiole length	P	-0.0530	-0.0284	-0.0613	-0.0675	-0.0512	-0.0519	**-0.0893**	0.0283	-0.0423	-0.0380	0.0134	-0.0066
	G	-0.0647	-0.0346	-0.0745	-0.0822	-0.0643	-0.0644	**-0.1000**	0.0354	-0.0514	-0.0464	0.0228	-0.0059
No. of fruits/plant	P	-0.0123	-0.0730	-0.1370	-0.1916	-0.2086	-0.1550	-0.2143	**0.6773**	-0.4595	-0.4208	0.2161	-0.0812
	G	-0.0115	-0.0783	-0.1545	-0.2193	-0.2311	-0.1716	-0.2661	**0.7522**	-0.5153	-0.4759	0.3563	-0.0949
Fruit weight	P	0.6141	0.6724	0.6417	0.7746	1.0728	1.0180	0.7401	-1.0603	**1.5631**	1.3605	-0.0709	-0.1438
	G	0.6767	0.7425	0.7082	0.8592	1.1947	1.1241	0.8834	-1.1768	**1.7178**	1.5123	-0.1003	-0.1578
Fruit length	P	0.0010	0.0016	0.0014	0.0016	0.0024	0.0021	0.0017	-0.0025	0.0034	**0.0040**	-0.0005	-0.0002
	G	-0.0050	-0.0077	-0.0068	-0.0077	-0.0115	-0.0099	-0.0086	0.0118	-0.0164	**-0.0186**	0.0036	0.0009
Fruit diameter	P	-0.0071	-0.0224	0.0044	-0.0119	0.0152	0.0221	-0.0093	0.0199	-0.0028	-0.0086	**0.0623**	-0.0075
	G	0.0064	-0.0208	0.0042	-0.0098	0.0131	0.0197	-0.0101	0.0209	-0.0026	-0.0084	**0.0441**	-0.0073
Calcium	P	0.0021	0.0045	-0.0030	0.0009	-0.0008	-0.0056	0.0040	-0.0065	-0.0050	-0.0025	-0.0065	**0.0539**
	G	0.0033	0.0068	-0.0040	0.0021	-0.0017	-0.0086	0.0047	-0.0100	-0.0073	-0.0039	-0.0132	**0.0795**
Yield per plant	P	0.5151	0.5492	0.4309	0.4677	0.6623	0.6582	0.3694	0.2804	0.8786	0.7580	0.1147	-0.1797
	G	0.5214	0.5575	0.4349	0.4726	0.6782	0.6667	0.3987	-0.2970	0.8831	0.7726	0.1718	-0.1814

Phenotypic Residual effect = 0.0988; Genotypic Residual effect= 0.0496; Diagonal values indicate direct effect.

eter (0.4477 G). Petiole length showed positive and significant correlation with fruit weight (0.4735 P, 0.5142 G) and fruit length (0.4646 G).

Fruit weight showed positive correlation with length of internodes (0.4956 P, 0.5002 G) and petiole length (0.4735 P, 0.5142 G). Fruit length showed positive correlation with width of leaf (0.5187 P, 0.5322 G) and petiole length (0.4646 G). Fruit diameter showed correlation with width of leaf (0.4477 G) and number of fruits per plant (0.4738 G) and negative correlation with days to first flowering (-0.4715 G).

These findings clearly indicated that genotypic correlations were of higher magnitude to the corresponding phenotypic ones, thereby establishing strong inherent relationship among the characters studied. The low phenotypic value might be due to appreciable interaction of the genotypes with the environments. Hence, direct selection for these traits may lead to development of high yielding genotypes of chowchow. Hence, direct selection for these traits may lead to the development of high yielding genotypes of chowchow. These findings were in conformity with Sanwal *et al.* (2008) and Verma *et al.* (2017) in chow-chow.

Path coefficient analysis at phenotypic and genotypic level was worked out to study the effect of various traits on yield per plant. The results have been presented in Table 4.3. A perusal of phenotypic path coefficient analysis showed that maximum direct positive effect on yield per plant was imposed by fruit weight (1.563 P, 1.717 G) followed by number of fruits per plant (0.677 P, 0.752 G), number of nodes at first fruit set (0.448 P, 0.591 G), fruit diameter (0.062 P), calcium (0.053 P), days to first flowering (0.044 P) and fruit length (0.004 P). While maximum negative direct effects on yield per plant were recorded for width of leaf (-0.265 P, -0.340 G), length of leaf (-0.183 P, (-0.217 G), length of internodes (-0.145 P, -0.158 G) and vine length (-0.027 P).

The maximum positive indirect effect on yield per plant was imposed by fruit length through fruit weight (1.360 P, 1.152 G), length of internodes through number of nodes (0.370 P, 0.490 G), length of leaf through number of nodes at first fruit set (0.348 P, 0.467 G), width of leaf through number of nodes at first fruit set (0.337 P, 0.448 G), petiole length through number of nodes at first fruit set (0.308 P) and fruit diameter through number if fruits per plant (0.216 P). Maximum negative indirect effect on yield per plant was imposed by characters like fruit weight through number of fruits per plant (-0.459 P, -0.515 G), fruit length through number of fruits per plant (-0.420 P, -0.475), width of leaf through length of leaf (-0.166 P), petiole length through width of leaf (-0.154 P) and fruit weight through width of leaf (-0.222 G). Residual effect at phenotypic level was observed to be 0.0988 and genotypic level at 0.0496.

The present study suggest that more emphasis should be given to selecting genotypes having fruit weight, number of fruits per plant, number of nodes at first fruit set, fruit diameter fruit weight, number of fruits per plant, number of nodes at first fruit set and fruit diameter. Directly or indirectly all characters showed positive effect on fruit yield per plant, which is in confirmation to the findings of Ahmed *et al.* (2005) in bottle gourd, Sanwal *et al.* (2008) in chow-chow, Muralidharan *et al.* (2013) and Oliveira and Oliveira (2021). Hence these traits can be used

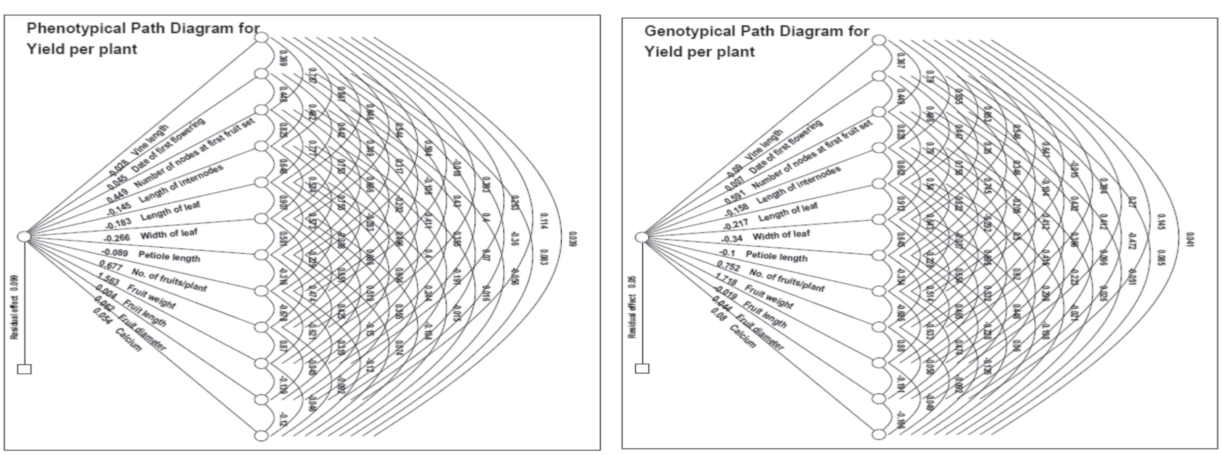

Fig. 1. Direct and indirect effect of component characters on fruit yield in chowchow.

for selection in chowchow to bring about improvement in yield.

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