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PATH COEFFICIENT ANALYSIS FOR YIELD AND YIELD ATTRIBUTING CHARACTERS IN PUMPKIN (*Cucurbita moschata* DUCH. EX POIR)

Pradeep Kumar[1], G.C. Yadav[1*], Abinash Kumar Patel[2*], Vishal Singh[1] and Ramesh Kharwar[1]

[1]Department of Horticulture, School of Agricultural Sciences and Technology, Babsaheb Bhimrao Ambedkar University (A central University) Lucknow 226025 (UP), India

[2]Department of Horticulture, Post Graduate College of Agriculture, Dr. Rajendra Prasad Central Agricultural University Pusa Samastipur 848125 Bihar, India

*Corresponding author E-mail: gcy1972@gmail.com, abinashpatel56@gmail.com

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ABSTRACT

The site of experiment was Main Experimental Station of Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during *Zaid* season, 2022 and the objective was to estimate the path coefficient analysis for different traits on fruit yield in pumpkin. The phenotypic direct and indirect effects of most of the traits were similar in nature and higher in magnitude. The highest positive direct effect on fruit yield per plant was exerted by number of fruits per plant (0.964) followed by average fruit weight (0.871), flesh thickness (0.266), vine length (0.134) and days to 50% pistillate flower anthesis (0.107. The highest positive indirect effect was shown by polar circumference of fruit (0.395) followed by equatorial circumference of fruit (0.365), internodal length (0.262), fruit cavity (0.258), vine length (0.253), days to first fruit harvest (0.191), flesh thickness (0.165), number of primary branches (0.142) and days to 50% pistillate flower anthesis (0.109) via average fruit weight on fruit yield per plant. Hence, direct selection can be done by considering those traits showing direct positive effect on fruit yield for development of high yielding variety of pumpkin.

***Key words*:** Path coefficient analysis, pumpkin or *Cucurbita moschata*

Introduction

Pumpkin (*Cucurbita moschata* Duch. ex. Poir) is a member of the family cucurbitaceae and the genus *Cucurbita*. Pumpkin is a herbaceous annual, deep rooted, sexually propagated vegetable having epigeal germination system. Stem is angular, five ridged without hairs, trailing and branched. Trailing vine strikes roots at nodes. Leaves are deeply or shallowly lobed not pinnatifid. The fruit shape may be flat, round, oval, globular, oblong, elongates, cylindrical. The skin colour is usually mottled-green or dark-green in immature and brown-yellow or brown-red in mature fruits, but specific colour variations in immature fruits, such as, very dark-green, dark-green, green, light-green, pale-green, light yellow, white, almond colour etc. With mild to conspicuous mottling are also encountered, which turn into differing shades of colour at maturity. The skin may be ribbed or smooth. The flesh may be pale-yellow to deep-orange or crimson. The variation in seed size is common. Striking differences in maturity period, number of fruits per plant, yield potential, female to male ratio, vine length and resistance to diseases and insect-pests are also met (Rana *et al.*, 1986). Pumpkin is monoecious and highly cross pollinated in nature. Like other cucurbits, inbreeding depression is negligible in *Cucurbita* even after prolonged selfing (Whitaker, 1974). Fruits have diuretic and vermetic action. Seeds are non-bitter, tasty and nutritious and seed can be also used as vermicide. The flowers are large and yellow coloured with showy companulate and gamopetalous corolla. Ovary is inferior and tricarpellary. Plants are monoecious, highly cross pollinated, entomophilous with three anthers.

Path coefficient analysis are procedure that are efficiently utilized for estimating the rate of various yield components in different crops, leading to the selection of superior genotypes, to give a deeper insight into accessory feature under selection. As a result, having knowledge on the relationship between different yield components and their proportion contribution to the yield and its component is critical for a reasonable strategy to improving vegetable production. Knowledge of relationship is essential for the simultaneous improvement of yield and its components. The nature and extent of correlation values in the breeding material with which the plant breeder is working to determine the outcome of any breeding programme (Tellis *et al*.,2009; Meena *et al*., 2013)

The yield has a complicated character and improving it directly is challenging.

Knowledge of the yield connection with distinct component qualities is required to make progress in the intended direction. A crop breeding programme aimed at boosting plant productivity must take into account not just yield but also the components of yield that have a direct or indirect impact on yield. Path coefficient analysis determines the direct influence of one variable on another and allows the correlation coefficient to be divided into direct and indirect effects components (Ahmed *et al*., 2013). This gives a clear picture of the direct and indirect effects of the various traits on the fruit yield of the plants.

Materials and Methods

The present investigation was conducted at Main Experimental Station of Department of Vegetable Science of Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during Zaid season, 2022. The experiment was laid out in Randomized Block Design with three replications to assess the performance of thirty-five genotypes including 1 check. Each entry was sown in one row with 3 m, length spaced 3 m with plant to plant spacing of 0.5 m in each replication. Observation were recorded for seventeen different characters of pumpkin *i.e*., days to 50% staminate flower anthesis, days to 50% pistillate flower anthesis, node at first staminate flower anthesis, node at first pistillate flower anthesis, number of primary branches, vine length (m), nodes per vine, internodal length (cm), days to first fruit harvest, equatorial circumference of fruit (cm), polar circumference of fruit (cm), flesh thickness (cm), fruit diameter(cm), fruit cavity (cm), average fruit weight (kg), number of fruit per plant and fruit yield per plant (kg). Path- coefficients were estimated by solving the following simultaneous equation indicating the basic relationship between correlation and path-coefficient as by Dewey and Lu (1959). The equation used are as follows:

$$r_{iy} = P_{iy} + \sum_{j-1}^{16} riy.Pjy \text{ for ij} = 1, 2\ldots\ldots..16$$

$$r_{iy} = P_{ij} + \sum_{j-1}^{16} riy.Pjy \text{ for ij} = 1$$

The above equation can be written in the form of matrix

[A] 16 × 1= [B] 16 × 1 [C] 16 × 1

Where,

A is column vector of correlations r_{iy}

B is the correlation matrix of r_{ij}, and

C is the column vector of direct effects, P_{iy}

Residual factor was calculated as follows:

$$Pxy = \sqrt{1 - R2}$$

$$R^2 = \sum_J Piy.riy$$

The rij's *i.e.*, r1.2 to r15-16 denote correlations between all possible combination of independents characters P1y to P12y denote direct effect of various characters on character y.

r_{iy}= Correlation coefficient between i^{th} and y character.

p_{iy}= Direct effect of i^{th} character on Y.

Results and Discussion

The path coefficients analysis was carried out from phenotypic and genotypic correlation coefficient to resolve direct and indirect effect of characters on fruit yield per plant. The direct and indirect effect of different characters on fruit yield per plant at phenotypic level had presented in Table 1. The highest positive direct effect on fruit yield per plant was exerted by number of fruits per plant (0.964) followed by average fruit weight (0.871), flesh thickness (0.266), vine length (0.134), days to 50% pistillate flower anthesis (0.107), number of primary branches (0.061), node to first pistillate flower anthesis (0.035) and fruit cavity (0.001). The substantial negative direct effect on fruit yield per plant was showed by nodes per vine (-0.023), polar circumference of fruit (-0.039), days to first fruit harvest (-0.063), equatorial circumference of fruit (-0.089), node to first staminate flower anthesis (-0.100), days to 50% staminate flower anthesis (-0.104) and internodal length (-0.191).

The highest positive indirect effect was shown by polar circumference of fruit (0.395) followed by equatorial circumference of fruit (0.365), internodal length (0.262), fruit cavity (0.258), vine length (0.253), days to first fruit harvest (0.191), flesh thickness (0.165), number of primary branches (0.142) and days to 50% pistillate flower

Table 1: Direct and indirect effect of different characters on fruit yield on phenotypic level in pumpkin germplasm.

Characters	DSFA	DPFA	NFSA	NFPA	NPB	VL	NPV	IL	DFFH	EC	PC	FT	FD	FC	AFW	NFPP	FYPP
Days to 50% staminate flower anthesis	**-0.104**	0.053	0.000	0.004	0.002	0.008	-0.002	0.000	-0.009	0.013	0.000	0.032	0.011	0.000	-0.009	0.004	0.003
Days to 50% pistillate flower anthesis	-0.052	**0.107**	0.010	0.003	0.000	0.001	-0.002	0.001	-0.021	0.001	-0.001	-0.004	0.005	0.000	0.109	-0.148	0.009
Node to first staminate flower app	0.000	-0.011	**-0.100**	-0.006	0.015	0.023	0.001	-0.030	0.007	0.000	-0.008	0.023	0.009	0.000	0.090	-0.261	-0.249*
Node to first pistillate flower anthesis	-0.012	0.009	0.016	**0.035**	-0.004	0.054	-0.008	-0.036	-0.007	-0.004	-0.007	0.035	-0.048	0.000	0.097	-0.086	0.032
Number of Primary	-0.004	0.000	-0.025	-0.003	**0.061**	0.044	-0.001	-0.072	-0.009	-0.012	-0.003	0.088	-0.047	0.000	0.142	-0.008	0.152
Vine Length branches	-0.006	0.001	-0.017	0.014	0.020	**0.134**	-0.009	-0.146	0.002	-0.008	0.000	0.084	-0.052	0.000	0.253	-0.175	0.095
Nodes per Vine	-0.009	0.011	0.003	0.012	0.003	0.054	**-0.023**	0.007	-0.009	-0.002	-0.003	0.032	-0.023	0.000	0.120	-0.053	0.118
Internodal Length	0.000	0.000	-0.016	0.007	0.023	0.103	0.001	**-0.191**	0.000	-0.008	0.004	0.072	-0.035	0.000	0.262	-0.165	0.058
Days to first fruit harvest	-0.015	0.035	0.010	0.004	0.009	-0.003	-0.003	0.001	**-0.063**	-0.004	-0.005	0.018	-0.011	0.000	0.191	-0.018	0.146
Equatorial circumference	0.015	-0.001	0.000	0.002	0.008	0.012	-0.001	-0.016	-0.003	**-0.089**	-0.023	0.058	-0.058	0.000	0.363	-0.197	0.071
Polar circumference	-0.001	0.002	-0.019	0.007	0.004	-0.001	-0.002	0.021	-0.008	-0.052	**-0.039**	0.022	-0.029	0.000	0.395	-0.272	0.029
Flesh thickness	-0.013	-0.001	-0.009	0.005	0.020	0.043	-0.003	-0.052	-0.004	-0.019	-0.003	**0.266**	-0.098	0.000	0.165	0.010	0.306**
Fruit Diameters	0.007	-0.003	0.005	0.010	0.016	0.040	-0.003	-0.038	-0.004	-0.030	-0.007	0.148	**-0.175**	0.001	0.267	-0.215	0.019
Fruit Cavity	0.017	-0.019	0.004	0.005	0.008	0.032	-0.004	-0.023	0.010	-0.020	-0.004	0.029	-0.095	**0.001**	0.258	-0.303	-0.105
Average Fruit Weight	0.001	0.013	-0.010	0.004	0.010	0.039	-0.003	-0.057	-0.014	-0.037	-0.018	0.050	-0.054	0.000	**0.871**	-0.580	0.215*
Number of Fruit per Plant	0.000	-0.016	0.027	-0.003	-0.001	-0.024	0.001	0.033	0.001	0.018	0.011	0.003	0.039	0.000	-0.525	**0.964**	0.528**

*R SQUARE = 0.7920 RESIDUAL EFFECT = 0.4561; * &** Signficant at 5% & 1% respectively; Bold values shows direct and normal values shows indirect effects.*

DSFA: Days to 50% staminate flower anthesis; DPFA: Days to 50% pistillat flower anthesis; NFSA: Node to first staminate flower anthesis; NFPA: Node to first pistillate flower anthesis; NPB: No. of Primary branches; VL: Vine length; NPV: Nodes per Vine; IL: Internodal Length; DFFH: Days to first fruit harvest; EC: Equatorial circumference; PC: Polar circumference; FT: Flesh thickness; FD: Fruit Diameters; FC: Fruit Cavity; AFW: Average Fruit Weight; NFPP: No. of Fruit per Plant; FYPP: Fruit Yield per Plant

Table 2: Direct and indirect effect of different characters on fruit yield on genotypic level in pumpkin germplasm.

Characters	DSFA	DPFA	NFSA	NFPA	NPB	VL	NPV	IL	DFFH	EC	PC	FT	FD	FC	AFW	NFPP	FYPP
Days to 50% staminate flower anthesis	**-0.057**	0.432	0.007	0.010	-0.005	-0.010	0.090	-0.045	-0.293	0.070	-0.001	0.064	0.010	0.044	-0.136	-0.027	0.152
Days to 50% pistillate flower anthesis	-0.048	**0.509**	0.027	0.010	-0.008	0.026	0.099	0.015	-0.709	0.036	0.001	-0.028	0.011	0.035	0.362	-0.343	-0.008
Node to first staminate flower app	0.002	-0.077	**-0.179**	-0.010	0.038	-0.151	-0.014	0.091	0.146	-0.003	0.012	0.035	0.006	0.006	0.233	-0.436	-0.302**
Node to first pistillate flower anthesis	-0.009	0.078	0.028	**0.063**	-0.015	-0.396	0.130	0.137	-0.032	-0.011	0.013	0.053	-0.018	-0.015	0.175	-0.166	0.017
Number of Primary	0.002	-0.033	-0.052	-0.007	**0.129**	-0.312	0.034	0.219	-0.141	-0.022	0.003	0.129	-0.015	-0.010	0.263	-0.019	0.168
Vine Length branches	-0.001	-0.016	-0.032	0.029	0.048	**-0.845**	0.153	0.415	0.074	-0.018	-0.002	0.122	-0.017	-0.022	0.465	-0.265	0.090
Nodes per Vine	-0.014	0.141	0.007	0.023	0.012	-0.362	**0.356**	-0.005	-0.204	0.005	0.002	0.045	-0.010	-0.016	0.272	-0.129	0.123
Internodal Length	0.005	0.016	-0.035	0.018	0.061	-0.750	-0.004	**0.467**	0.047	-0.025	-0.008	0.107	-0.013	-0.009	0.420	-0.255	0.043
Days to first fruit harvest	-0.020	0.442	0.032	0.002	0.022	0.077	0.089	-0.027	**-0.815**	-0.019	0.008	0.031	-0.004	0.021	0.541	-0.189	0.192*
Equatorial circumference	0.022	-0.098	-0.003	0.004	0.016	-0.082	-0.011	0.064	-0.083	**-0.184**	0.031	0.080	-0.017	-0.021	0.648	-0.275	0.092
Polar circumference	0.001	0.008	-0.042	0.016	0.007	0.032	0.013	-0.076	-0.125	-0.115	**0.050**	0.020	-0.009	-0.009	0.697	-0.413	0.054
Flesh thickness	-0.010	-0.041	-0.018	0.010	0.048	-0.299	0.047	0.145	-0.073	-0.043	0.003	**0.345**	-0.032	-0.008	0.294	0.011	0.379**
Fruit Diameters	0.011	-0.111	0.020	0.022	0.038	-0.286	0.067	0.118	-0.059	-0.063	0.009	0.219	**-0.051**	-0.052	0.526	-0.368	0.041
Fruit Cavity	0.032	-0.225	0.015	0.012	0.017	-0.235	0.072	0.056	0.222	-0.049	0.006	0.035	-0.033	**-0.078**	0.510	-0.469	-0.115
Average Fruit Weight	0.006	0.137	-0.031	0.008	0.025	-0.293	0.072	0.146	-0.329	-0.089	0.026	0.076	-0.020	-0.030	**1.341**	-0.826	0.221*
Number of Fruit per Plant	0.001	-0.137	0.061	-0.008	-0.002	0.176	-0.036	-0.093	0.121	0.040	-0.016	0.003	0.015	0.029	-0.870	**1.274**	0.556**

R SQUARE = 1.0230 RESIDUAL EFFECT =SQRT(1- 1.0230); Bold values shows direct and normal values shows indirect effects.

DSFA: Days to 50% staminate flower anthesis; DPFA: Days to 50% pistillat flower anthesis; NFSA: Node to first staminate flower anthesis; NFPA: Node to first pistillate flower anthesis; NPB: No. of Primary branches; VL: Vine length; NPV: Nodes per Vine; IL: Internodal Length; DFFH: Days to first fruit harvest; EC: Equatorial circumference; PC: Polar circumference; FT: Flesh thickness; FD: Fruit Diameters; FC: Fruit Cavity; AFW: Average Fruit Weight; NFPP: No. of Fruit per Plant; FYPP: Fruit Yield per Plant

anthesis (0.109) via average fruit weight on fruit yield per plant. The negative indirect effect by average fruit weight (-0.580) via number of fruits per plant and number of fruit per plant (-0.525) via average fruit on fruit yield per plant.

The direct and indirect effect of different characters on fruit yield per plant at genotypic level had presented in Table 2. The highest positive direct effect on fruit yield per plant was exerted by average fruit weight (1.341) followed by number of fruits per plant (1.274), days to 50% pistillate flower anthesis (0.509), internodal length (0.467), nodes per vine (0.356), flesh thickness (0.345), number of primary branches (0.129), node to first pistillate flower anthesis (0.063) and polar circumference of fruit (0.050). The substantial negative direct effect on fruit yield per plant was showed by days to 50% staminate flower anthesis (-0.057), fruit cavity (-0.078)), node to first staminate flower anthesis (-0.179), equatorial circumference of fruit (-0.184), days to first fruit harvest (-0.815) and vine length (-0.845).

The highest positive indirect effect was shown by polar circumference of fruit (0.697) followed by equatorial circumference of fruit (0.648), days to first fruit harvest (0.541), fruit cavity (0.510), vine length (0.465), internodal length (0.420), days to 50% pistillate flower anthesis (0.362), flesh thickness (0.294), nodes per vine (0.272) and number of primary branches (0.263) via average fruit weight on fruit yield per plant. The negative indirect effect by number of fruits per plant (-0.870) and days to 50% staminate flower anthesis (-0.136) via average fruit on fruit yield per plant similarly average fruit weight (-0.826) showed negative indirect effect via number of fruits per plant on fruit yield per plant. Similar result were also reported by Yadav *et al*., (2006), Anusa *et al*., (2020) and Tiwari *et al.*, (2021).

Conclusion

It can be concluded that number of fruit per plant, average fruit weight, flesh thickness were the major contributing characters towards the fruit yield per plant while maximum positive indirect effects were exerted by polar circumference of fruit followed by equatorial circumference of fruit, fruit diameter, fruit cavity via average fruit weight. Thus, these traits should taken into consideration during selection for higher fruit yield in pumpkin.

References

Anusa, P., Kandasamy R. and Arivazhagan E. (2020). Correlation and path coefficient analysis among the landraces of pumpkin (*Cucurbita moschata* Duch ex. Poir). Annals of Plant and Soil Research, **22(1)**, 86-91

Dewey, D.R. and Lu K.H. (1959). A correlation and path co-efficient analysis of component of crusted wheat grass seed production. *Agron. J.* **51**, 515-518.

Meena, S.S., Bahadur D., Prakash O. and Mandal R.K. (2013). Magnetic and electric properties of nanoparticles of Ni-substituted ferrites synthesized using a microwave refluxing process. *Int. J. Mate. Res*., **104(7)**, 680-685.

Tellis, G.J., Prabhu J.C. and Chandy R.K. (2009). Radical innovation across nation: The preeminence of corporate culture. *J. Mark*., **73(1)**, 3-23.

Rana, T.K., Vashistha R.N. and Pandita M.L. (1986). Genetic variability and heritability studies in pumpkin (*Cucurbita moschata* Poir.). *Haryana J. Hort Sci.*, **15**, 71-75.

Tiwari, D. and Yadav G.C. (2021). Character association among the horticultural, yield traits and quality traits in pumpkin.

Whitaker, T.W. (1974). *Cucurbita.* In *Handbook of Genetics*, R.C. King (eds), 135-144.

Yadav, R.K., Sanwal S.K., Yadav D.S. and Sarma P. (2006). Correlation and path analysis in pumpkin. *Haryana Journal of Horticultural Sciences*, **35(3/4)**, 338-33