CORRELATION COFFICIENT AND PATH ANALYSIS OF YIELD AND IT'S COMPONENTS ANALYSIS IN PUMPKIN (*Cucurbita moschata* Duch ex. Poir)

Abstract

The present experiment was carried out to find out the Correlation coefficient and path analysis of yield and its components analysis in pumpkin (*Cucurbita moschata* Duch ex. Poir) among the different genotypes with the using 35 diverse genotypes including one check for quantitative traits and qualitative traits. The experiment was sown in Randomized Block Design with three replications. The experiments were conducted at Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya during summer, 2021. The observation was recorded viz. node number at first staminate flower anthesis, node number at first pistillate flower anthesis, days to first staminate flower anthesis, days to first pistillate flower anthesis, days to first fruit harvest, fruit polar length (cm), fruit equatorial circumference (cm), flesh thickness (cm), number of fruits per plant, average fruit weight (kg) and total fruit yield/ Plant (kg). Genotypes involved in this study were Correlation coefficient and path analysis of yield and have good breeding value, which confirmed the predictions of analysis of variance. Out of 35 genotypes among four genotypes were produced significantly higher yield than best check Narendra Agrim.

Keywords: Pumpkin, Correlation coefficient, Path analysis, Genotypes and Direct and Indirect effect.

Introduction

Pumpkin (*Cucurbita moschata* Duch. ex. Poir.) is a sexually propagated monoecious climbing vegetable belonging to the genus *Cucurbita*, order Cucurbitales, family Cucurbitaceae, (Mohsin *et al*., 2017), with chromosome number 2n= 40 (Martins *et al.,* 2015). Kashiphal, Sitaphal, and Kaddu are all names for pumpkin (Rana, 2014). The principal sites of origin and domestication for cultivated Cucurbita species may be found in various parts of Central and South America (Jeffrey, 1990). Pumpkin has more energy, carbs, vitamins, and minerals than

other fruits and vegetables, and is particularly rich in carotenoid colours (Bose and Som, 1998). It is a day neutral plant.

The name "pumpkin" comes from the Greek word Pepon, which means "big melon" or "round and enormous fruit." Pumpkin is composed of *Cucurbita moschata, Cucurbita pepo, Cucurbita maxima, Cucúrbita mixta, Cucurbita facifola* and *Telfairia occidentalis* (Caili *et al.*, 2006). Carotene levels rise in mature fruits that have been stored. After three months of storage under shade discovered a 12.63 percent rise in beta-carotene content in fresh whole pumpkin (Chavasit *et al*. 2002). Pumpkin is a good source of vitamins, especially high carotenoid colors and minerals, and is quite high in energy and carbs. It has the potential to improve people's nutritional health, particularly among vulnerable groups in terms of vitamin A. Night-blindness is a severe problem in many South Asian countries. The problem can simply be rectified by encouraging the general public to consume more pumpkin.

It is grown on 99 thousand hectares in India, with yearly production and productivity of 2117 thousand MT and 22.5 thousand MT/ha (NHB, 2018-19). Uttar Pradesh produces 360.16 ton of pumpkin. It has unisexual, single, or fasciculate flowers that range in color from yellow to deep orange.

Degree of association between the various characters and direct effect of yield contributing traits on total yield is of paramount significance in formulating an appropriate breeding strategy aimed at exploiting the inherent correlation of the original population. The path coefficient analysis provides the partitioning of correlation coefficients into direct and indirect effect giving the relative importance of each causal factor.

Material and Methods

The present investigation was carried out during summer 2021 at the Main Experiment Station of Department of Vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, (Narendra Nagar), Kumarganj, Ayodhya, U.P. Geographically, Kumarganj falls under humid sub- tropical climate and is located in between 24.470 and 26.560N latitude and 82.120 and 83.980E longitude at an altitude of 113 m above the mean sea level. The soil type of experimental site was clay-loam. Kumarganj falls under semi-arid region receiving an annual

mean rainfall of about 1200 mm. Major rainfall in this area occurs from July to September. Sometimes, continuous cloudy weather with heavy rains for a longer period drastically affects the local agricultural system. Occasional showers are also very common in winter season, but this period is usually cool and dry. The hot period of summer season generally starts somewhere in middle of April and continues till the middle of June when the presence of monsoon in the sky become clearly visible. The experiment was conducted in Randomized Block Design with three replications to assess the performance of thirty five genotypes including 1 check. Each entry was sown in one rows with 3 m, length spaced 3 m with plant to plant spacing of 0.5 m in each replication. The experiment was sown on 4 March, 2021.

Results and Discussion

Knowledge of the nature of association between fruit yield and its components are of great interest in vegetable breeding. The statistics, which measures the relation and its extents, between two or more variables is known as correlation coefficients. A correlation study provides information that selection for one character will result in progress for all positively correlated characters. Many of the characters are correlated, because of natural association, positive or negative with other characters.

The most important trait, total fruit yield (kg) had exhibited highly significant and positive phenotypic correlation with number of fruit per plant (rp=0.522), average fruit weight (rp=0.394), days to first pistillate flower anthesis (rp=0.334) respectively.

Number of fruit per plant had highly significant and negative phenotypic correlation with average fruit weight (rp=-0.461).Average fruit weight had significant and positive phenotypic correlation with Fruit equatorial circumference (cm) (rp=0.352). All the maturity traits *viz.*, node to first staminate and pistillate flower anthesis, days to first staminate and pistillate flower anthesis and days to first fruit harvest were almost significantly and positively correlated among themselves. The correlation coefficients of number of fruit per plant, fruit polar circumference, fruit equatorial circumference and days to first staminate and pistillate flower anthesis with average fruits weight and flesh thickness where negative and significant.

Table 1: Estimates of phenotypic correlation coefficient between 10 characters in pumpkin.

Characters	Node number at first staminate Flower anthesis	Node number at first pistillate flower anthesis	Days to first staminate flower anthesis	Days to first pistillate flower anthesis	Fruit polar length (cm)	Fruit equatorial circumference (cm)	Flesh thickness (cm)	Days to first fruit harvest	Average fruit weight (kg)	Number of fruit per plant	Total fruit yield Per Plant(kg)
Node number at first staminate Flower anthesis	1	0.361*	0.362*	0.284	0.102	-0.214	0.184	0.194	0.115	0.023	0.131
Node number at first pistillate flower anthesis		1	0.308	0.218	0.053	-0.321	0.059	-0.171	-0.172	0.224	0.011
Days to first staminate flower anthesis			1	-0.16	0.12	0.026	0.092	0.304	-0.011	-0.05	-0.032
Days to first pistillate flower anthesis				1	0.044	-0.237	-0.031	-0.012	0.007	0.231	0.334*
Fruit polar length (cm)					1	-0.01	0.052	0.104	0.187	-0.173	0.048
Fruit equatorial circumference (cm)						1	0.143	-0.136	0.352*	-0.243	0.076
Flesh thickness (cm)							1	-0.316	0.13	-0.004	0.206
Days to first fruit harvest								1	0.012	-0.057	-0.051
Average fruit weight (kg)									1	-0.461**	0.394*
Number of fruit per plant										1	0.522**

Several Studies on genotypic and phenotypic correlation coefficients among the fruit yield and yield attributing traits including plant growth characters, maturity traits, fruit shape, size and quality of pumpkin have been reported by the scientists in India and abroad (**Amaral *et al.*, 1994**; **Kumaran *et al.*, 1998**; **Mohanty, 2001**; **Pandey *et al.*, 2002**).

The most important trait, total fruit yield (kg) had exhibited highly significant and positive genotypic correlation with number of fruit per plant (rp=0.528), days to first pistillate flower anthesis (rp=0.507) respectively. total fruit yield significant and positive correlation with average fruit weight (rp=0.395), number of fruit per plant highly was significant and negative genotypic correlation with average fruit weight (rp=-0.464) and no. of fruit per plant had significant and positive genotypic correlation with days to first pistillate flower anthesis (rp=0.364), average fruit weight was significant and positive genotypic correlation with Fruit equatorial circumference (cm) (rp=0.401).

Days to first fruit harvest had exhibited highly significant and positive genotypic correlation with node number at first staminate flower anthesis (rp=0.467), days to first staminate flower anthesis (rp=0.638) respectively. Days to first fruit harvest had exhibit highly significant and negative genotypic correlation with Flesh thickness (cm) (rp=-0.578). Flesh thickness had showed significant and positive genotypic correlation with node number at first staminate flower anthesis (rp=0.342).Fruit equatorial circumference (cm) had showed highly significant and negative genotypic correlation with node number at first staminate flower anthesis (-0.466), node number at first pistillate flower anthesis (rp=-0.395), Days to first pistillate flower anthesis (rp=-0.466).

All the maturity traits *viz.*, node to first staminate and pistillate flower appearance, days to first staminate and pistillate flower anthesis and days to first fruit harvest were almost significantly and positively correlated among themselves. The correlation coefficients of number of fruit per plant, fruit polar circumference, fruit equatorial circumference and days to first staminate and pistillate flower anthesis with average fruits weight and flesh thickness were negative and significant. **Mohanty *et al.*, (2001)** and **Amaral *et al.*, (1994**) had also reported higher estimate of genotypic correlations than the However, genotypic correlation were longer in corresponding phenotypic correlation between fruit yield and yield components.

Table 2: Estimates of genotypic correlation coefficient between 10 characters in pumpkin

Characters	Node number at first staminate Flower anthesis	Node number at first pistillate flower anthesis	Days to first staminate flower anthesis	Days to first pistillate flower anthesis	Fruit polar length (cm)	Fruit equatorial circumference (cm)	Flesh thickness (cm)	Days to first fruit harvest	Average fruit weight (kg)	Number of fruit per plant	Total fruit yield Per Plant(kg)
Node number at first staminate Flower anthesis	1	0.702**	0.639**	0.591**	0.08	-0.466**	0.342*	0.467**	0.175	0.026	0.196
Node number at first pistillate flower anthesis		1	0.443**	0.393*	0.087	-0.395*	0.057	-0.238	-0.2	0.258	0.01
Days to first staminate flower anthesis			1	-0.279	0.15	0.072	0.094	0.638**	-0.014	-0.055	-0.036
Days to first pistillate flower anthesis				1	0.032	-0.466**	-0.025	-0.239	0.012	0.364*	0.507**
Fruit polar length (cm)					1	-0.067	0.07	0.252	0.201	-0.188	0.051
Fruit equatorial circumference (cm)						1	0.154	-0.191	0.401*	-0.279	0.093
Flesh thickness (cm)							1	-0.578**	0.149	-0.006	0.235
Days to first fruit harvest								1	0.012	-0.082	-0.064
Average fruit weight (kg)									1	-0.464**	0.395*
Number of fruit per plant										1	0.528**

*** &** Significant at 5% & 1% respectively**

Path coefficient analysis is a tool to partition the observed correlation coefficient into direct and indirect effects of yield components on fruit yield to provide clearer picture of character associations for formulating effective selection strategy.

The direct and indirect effects of different characters on fruit yield per plant at phenotypic level are presented in Table 2. The highly positive direct effect on total fruit yield per plant was exerted by number of fruit per plant (0.866) followed by average fruit weight (0.755) and days to first pistillate flower anthesis (0.180) exerted positive direct effect on total fruit yield per plant. The direct effects on total fruit yield per plant showed by rest of the traits were substantially too low such as namely days to first staminate flower anthesis (0.088). Although average fruit weight had showed highest positive direct effects on total fruit yield per plant. Days to first fruit harvest (-0.016), node number at first staminate flower anthesis (-0.039), node number at first pistillate flower anthesis (-0.117), Fruit equatorial circumference (-0.002) exerted negative direct effects on total fruit yield. Fruit equatorial circumference (0.001), flesh thickness (0.000), days to first fruit harvest (0.001) days to first pistillate flower anthesis (0.042) showed indirect positive effects *via*. Average fruit weight on total fruit yield. However, fruit polar length (-0.008) exhibited high negative and considerable indirect effect *via.* Average fruit weight on the total fruit yield. Indirect effects average fruit weight (-0.348), fruit polar length (-0.008), days to first pistillate flower anthesis (-0.026), days to first staminate flower anthesis (-0.004), and node number at first staminate flower anthesis (-0.001) were showed indirect negative effects *via.* No. of fruit per plant on total fruit yield.

Flesh thickness (0.015) and fruit polar length (0.008) showed indirect positive effects *via*. Average fruit yield on the total fruit yield. Rest of the traits on fruit yield was very low.

The direct and indirect effects of different traits on fruit yield at genotypic level are presented in Table 3. Substantial positive and direct effect on total fruit yield were exerted by no. of fruit per plant (0.914) followed by node number at first staminate flower anthesis(0.780), fruit equatorial circumference(0.687),days to first fruit harvest (0.478), average fruit weight (0.380) ,node number at first pistallate flower appearance(0.211),flesh thickness (0.155) and fruit polar length (0.141).while high order negative direct effect on total fruit yield was exerted by days to first staminate flower anthesis (-1.026)) and days to first pistallate flower anthesis (-0.226). Node number at first staminate flower anthesis(0.020), node number at first pistallate flower appearance(0.054) and days to first staminate flower anthesis(0.057) showed highly positive

indirect effect viz. No. of fruit per plant. Remaing character showed negative indirect effect viz. no. of fruit per plant. Node number at first staminate flower anthesis (0.136), Days to first staminate flower anthesis (0.015), Fruit polar length (0.028), Fruit equatorial circumference (0.276), Flesh thickness (0.023) and Days to first fruit harvest (0.006) showed highly positive indirect effect viz. Average fruit weight. Remaing node number at first pistillate flower anthesis (-0.042), Days to first pistillate flower anthesis (-0.003), and Number of fruit per plant (-0.024) exhibited negative indirect effect viz. average fruit weight. Node number at first staminate flower anthesis (0.365), Days to first pistillate flower anthesis (0.054)), fruit polar length (0.036) and average fruit weight (0.005) showed highly positive indirect effect viz. Days to first fruit harvest and other side node number at first pistallate flower appearance (-0.050), days to first staminate flower anthesis (-0.655) and Fruit equatorial circumference (-0.131) showed highly negative indirect effect viz. days to first fruit harvest. Days to first staminate flower anthesis (-0.097) and days to first fruit harvest (-0.276) exhibited negative indirect effect on Fruit equatorial circumference. **Kumaran *et al.* (1998)** had also reported high positive direct effect of number of fruits per plant and fruit weight on fruit yield.

Table 3: Direct and indirect effect of 10 characters on fruit yield on phenotypic level in pumpkin germplasm

Characters	Node number at first staminate Flower anthesis	Node number at first pistillate flower anthesis	Days to first staminate flower anthesis	Days to first pistillate flower anthesis	Fruit polar length (cm)	Fruit equatorial circumference (cm)	Flesh thickness (cm)	Days to first fruit harvest	Average fruit weight (kg)	Number of fruit per plant	Total fruit yield Per Plant(kg)
Node number at first staminate Flower anthesis	**-0.039**	-0.014	-0.014	-0.011	-0.004	0.008	-0.007	-0.008	-0.005	-0.001	0.131
Node number at first pistillate flower anthesis	-0.042	**-0.117**	-0.036	-0.026	-0.006	0.038	-0.007	0.020	0.020	-0.026	0.011
Days to first staminate flower anthesis	0.032	0.027	**0.088**	-0.014	0.011	0.002	0.008	0.027	-0.001	-0.004	-0.032
Days to first pistillate flower anthesis	0.051	0.039	-0.029	**0.180**	0.008	-0.043	-0.006	-0.002	0.001	0.042	0.334*
Fruit polar length (cm)	0.005	0.002	0.005	0.002	**0.044**	-0.001	0.002	0.005	0.008	-0.008	0.048
Fruit equatorial circumference (cm)	0.001	0.001	0.000	0.001	0.000	**-0.002**	0.000	0.000	-0.001	0.001	0.076
Flesh thickness (cm)	0.021	0.007	0.011	-0.004	0.006	0.016	**0.115**	-0.036	0.015	0.000	0.206
Days to first fruit harvest	-0.003	0.003	-0.005	0.000	-0.002	0.002	0.005	**-0.016**	0.000	0.001	-0.051
Average fruit weight (kg)	0.087	-0.130	-0.008	0.005	0.141	0.266	0.099	0.009	**0.755**	-0.348	0.394*
Number of fruit per plant	0.020	0.194	-0.043	0.200	-0.150	-0.211	-0.003	-0.049	-0.399	**0.866**	0.522**

Bold values shows direct and normal values shows indirect effects, R SQUARE = 0.8267 RESIDUAL EFFECT = 0.4163

Table 4: Direct and indirect effect of 10 characters on fruit yield on genotypic level in pumpkin germplasm

Characters	Node number at first staminate Flower anthesis	Node number at first pistillate flower anthesis	Days to first staminate flower anthesis	Days to first pistillate flower anthesis	Fruit polar length (cm)	Fruit equatorial circumference (cm)	Flesh thickness (cm)	Days to first fruit harvest	Average fruit weight (kg)	Number of fruit per plant	Total fruit yield Per Plant(kg)
Node number at first staminate Flower anthesis	**0.780**	0.547	0.499	0.461	0.062	-0.364	0.267	0.365	0.136	0.020	0.196
Node number at first pistillate flower anthesis	0.148	**0.211**	0.093	0.083	0.018	-0.083	0.012	-0.050	-0.042	0.054	0.01
Days to first staminate flower anthesis	-0.656	-0.455	**-1.026**	0.286	-0.154	-0.074	-0.097	-0.655	0.015	0.057	-0.036
Days to first pistillate flower anthesis	-0.133	-0.089	0.063	**-0.226**	-0.007	0.105	0.006	0.054	-0.003	-0.082	0.507**
Fruit polar length (cm)	0.011	0.012	0.021	0.005	**0.141**	-0.010	0.010	0.036	0.028	-0.027	0.051
Fruit equatorial circumference (cm)	-0.320	-0.272	0.050	-0.320	-0.046	**0.687**	0.106	-0.131	0.276	-0.192	0.093
Flesh thickness (cm)	0.053	0.009	0.015	-0.004	0.011	0.024	**0.155**	-0.090	0.023	-0.001	0.235
Days to first fruit harvest	0.223	-0.114	0.305	-0.114	0.120	-0.091	-0.276	**0.478**	0.006	-0.039	-0.064
Average fruit weight (kg)	0.066	-0.076	-0.005	0.005	0.076	0.153	0.057	0.005	**0.380**	-0.176	0.395*
Number of fruit per plant	0.023	0.235	-0.050	0.332	-0.172	-0.255	-0.005	-0.075	-0.424	**0.914**	0.528**

Conclusion

The most important trait, total fruit yield (kg) had exhibited highly significant and positive correlation with number of fruit per plant and days to first pistillate flower anthesis respectively. Total fruit yield per plant significant and positive correlation with average fruit weight. Number of fruit per plant highly was significant and negative correlation with average fruit weight. Number of fruit per plant had significant and positive correlation with days to first pistillate flower.

All the maturity characters *viz.*, node to first staminate and pistillate flower appearance, days to first staminate and pistillate flower anthesis and days to first fruit harvest were almost significantly and positively correlated among themselves. The correlation coefficients of number of fruit per plant, fruit polar circumference, fruit equatorial circumference and days to first staminate and pistillate flower anthesis with average fruits weight and flesh thickness were negative and significant.

The highly positive direct effect on total fruit yield per plant was exerted by number of fruit per plant followed by average fruit weight and days to first pistillate flower anthesis exerted positive direct effect on total fruit yield per plant. The direct effects on total fruit yield per plant showed by rest of the characters were substantially too low such as namely days to first staminate flower anthesis. However, fruit polar length exhibited high negative and considerable indirect effect *via.* Average fruit weight on the total fruit yield per plant. This suggests that selection for higher number of fruits per plant will lead earliness and lower fruit weight.

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