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Research Article

CORRELATION AND PATH ANALYSIS IN F_4 GENERATION OF PUMPKINS (*Cucurbita* sp.)

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Abstract- An experiment was conducted with 60 genotypes of pumpkins to study the correlation and direct and indirect effects of different characters on fruit yield per hectare. The experiment was conducted in a randomized block design. Correlation studies indicated that fruit yield per hectare was positively and significantly correlated with fruit yield per vine (0.991, 0.980), average fruit weight (0.718, 0.686), number of fruits per vine (0.524, 0.555), fruit flesh thickness (0.500, 0.406), fruit width (0.483, 0.436) and fruit length (0.464, 0.419) at both genotypic and phenotypic levels. Genotypic path analysis shows that days to first male (1.0918) and female (-0.7358) flowering, fruit length (-0.6348), average fruit weight (0.5923), number of fruits per vine (0.4736) and fruit yield per vine (0.4645). Therefore, emphasis should be given on days to first male and female flowering, fruit length, average fruit weight, number of fruits per vine and fruit yield per vine for enhancing the yield of pumpkin.

Keywords- Pumpkin, Correlation, Path analysis, Fruit yield per hectare

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Introduction

Pumpkin is an important cucurbitaceous vegetable grown throughout India and other warmer regions of the globe. Archaeological evidences show that pumpkin was distributed in both North and South America, Mexico and Peru being the primary centres of origin. Because of its high carotene content and good keeping quality, it is considered as a vegetable of immense value. Pumpkin is placed as high value vegetable owing to its high productivity, low cost of production, high nutritive value, good storability, long period of availability, better transport qualities and excellent response to forcing and extensive cultivation both in tropical and subtropical parts of our country. Pumpkin is also known as 'kasiphal', 'sitaphal', 'lalkaddu' in Hindi. Ripened fruits are used for the preparation of delicacies called halwa, jams and other sweets. It has good nutritional value with 4.6 g of carbohydrates, 1.4 g of protein and 2180 IU of vitamin A per 100g of edible fruits [1]. Seeds (kernals) of pumpkin are highly nutritious and used in confectionary. In the recent time, pumpkin has got industrial importance with the development of pulp powder as a nutraceutical supplement to Vitamin 'A' requirement. Pumpkin is cheaper source of Vitamin A when compared to carrot which necessitates specific climatic requirement for its production and pumpkin has high productivity per unit area compared to carrot.

Materials and methods

The experiment was conducted at the field of Vegetable Science unit of Kittur Rani Channamma College of Horticulture, Arabhavi, Belagavi District (Karnataka) during the year 2014-15. The present study was carried out with 60 genotypes comprising of 58 lines developed at Kittur Rani Channamma College of Horticulture, Arabhavi and two genotypes collected from Indian Institute of Horticultural Research, Bengaluru. Experiment was laid out in randomized block design with two replications. Sowing was done in 1st week of August, on ridges with spacing of 2.0 × 0.9 m, each entry comprised eight plants and all the recommended agronomic package of practices were followed. The observation was recorded on five randomly selected plants per replication for each genotype on 22 traits. Genotypic (r_g) and phenotypic (r_p) correlation coefficients were estimated as suggested by [2]. The genotypic correlation was subjected to calculate path coefficient analysis as per the method suggested by [3,4].

Results and Discussion

Many of these yield contributing characters are interacted in desirable and undesirable direction. Hence, knowledge of association between the traits can greatly help in avoiding the inversely related compensation effects during selection. The genotypic and phenotypic correlation coefficients were presented in [Table-1].

Positive and significant association was observed in the present investigation for fruit yield per vine with average fruit weight (r_g=0.704**; r_p=0.673**), number of primary branches per vine at 45 (r_g=0.445**; r_p=0.354**) and 75 DAS(r_g=0.485**; r_p=0.422**) [5], number of fruits per vine (r_g=0.559**; r_p=0.601**), fruit flesh thickness (r_g=0.501**; r_p=0.400**), fruit length (r_g=0.470**; r_p=0.425**), fruit width (r_g=0.475**; r_p=0.424**), number of seeds per fruit (r_g=0.364**; r_p=0.334**), vine length at 45 (r_g=0.511**; r_p=0.420**) and 75 DAS (r_g=0.357**; r_p=0.303**) [6], hundred seed weight (r_g=0.181*) [7] and seed cavity length (r_g=0.355**; r_p=0.337**) at both genotypic and phenotypic levels. Fruit yield per vine was negatively and significantly associated with days to first male (r_g=-0.354**; r_p=-0.234*) and female flowering (r_g=-0.330**; r_p=-0.249**) [8]. Correlation studies revealed that yield can be improved by selecting genotypes for vines with profuse branches, more number of fruits and average fruit weight.

Fruit yield per hectare had positive and significant association with fruit yield per vine (r_g=0.991; r_p=0.980), average fruit weight (r_g=0.718; r_p=0.686), number of fruits per vine (r_g=0.524; r_p=0.555), fruit flesh thickness (r_g=0.500; r_p=0.406), fruit width (r_g=483; r_p=0.436), fruit length (r_g=0.464; r_p=0.419), vine length at 45 DAS (r_g=0.483; r_p=0.399), number of primary branches per vine at 75 DAS (r_g=0.450; r_p=0.395) and 45 DAS (r_g=0.381; r_p=0.302), number of seeds per fruit (r_g=0.377; r_p=0.336), seed cavity length (r_g=0.354; r_p=0.342), vine length at 75 DAS

(r_g=0.322; r_p=0.277) and hundred seed weight (r_g=0.198; r_p=0.192) at both genotypic and phenotypic levels.

Breeding for earliness is an important approach to get higher prices in early market. Days to first male and female flowering was negatively and significantly associated with vine length at 45 and 75 DAS and number of primary branches per vine at 45 and 75 DAS at both genotypic and phenotypic levels. These results indicate the inverse relationship between earliness and growth parameters. These results are similar in line with the findings of earlier workers *viz.*, [9,10] in cucumber. Results indicate that dwarf and compact genotypes are early in nature. These traits can be considered to develop genotypes with earliness.

Table-1 *Genotypic and phenotypic correlation coefficients of different characters in pumpkins (Cucurbita sp.)*

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	r_g	1.000	0.566**	0.602**	0.641**	-0.513**	-0.478**	0.584**	0.503**	0.417**	0.072	0.475**	0.513**	0.294**	0.340**	0.278**	0.511**	0.483**
	r_P	1.000	0.519**	0.524**	0.557**	-0.371**	-0.363**	0.530**	0.441**	0.275**	0.021	0.313**	0.465**	0.241**	0.303**	0.217*	0.420**	0.399**
2	r_g		1.000	0.068	0.211*	-0.246**	-0.258**	0.493**	0.468**	0.394**	-0.017	0.176	0.373**	0.158	0.184*	0.376**	0.357**	0.322**
	r_P		1.000	0.089	0.200*	-0.224*	-0.227*	0.458**	0.425**	0.334**	-0.039	0.084	0.345**	0.130	0.165	0.304**	0.303**	0.277**
3	r_g			1.000	0.927**	-0.358**	-0.257**	0.260**	0.254**	0.132	0.343**	0.305**	0.248**	-0.065	0.162	-0.024	0.445**	0.381**
	r_P			1.000	0.777**	-0.224*	-0.177	0.224*	0.231*	0.087	0.243**	0.210*	0.223*	-0.088	0.094	-0.034	0.354**	0.302**
4	r_g				1.000	-0.301**	-0.298**	0.391**	0.350**	0.214*	0.242**	0.271**	0.310**	0.032	0.125	0.184*	0.485**	0.450**
	r_P				1.000	-0.315**	-0.263**	0.359**	0.309**	0.172	0.198*	0.195*	0.288**	0.000	0.106	0.144	0.422**	0.395**
5	r_g					1.000	0.914**	-0.339**	0.107	-0.508**	-0.206*	-0.461**	-0.145	-0.513**	-0.361**	-0.207*	-0.354**	-0.313**
	r_P					1.000	0.735**	-0.256**	0.024	-0.331**	-0.112	-0.210*	-0.132	-0.298**	-0.288**	-0.077	-0.234*	-0.197*
6	r_g						1.000	-0.378**	-0.045	-0.442**	-0.120	-0.360**	-0.264**	-0.526**	-0.333**	-0.195*	-0.330**	-0.306**
	r_P						1.000	-0.318**	-0.070	-0.325**	-0.064	-0.194*	-0.244**	-0.365**	-0.285**	-0.118	-0.249**	-0.239**
7	r_g							1.000	0.643**	0.714**	-0.169	0.524**	0.552**	0.273**	0.294**	0.484**	0.704**	0.718**
	r_P							1.000	0.605**	0.631**	-0.159	0.455**	0.540**	0.223*	0.280**	0.440**	0.673**	0.686**
8	r_g								1.000	0.094	-0.083	0.174	0.823**	-0.175	0.147	0.334**	0.470**	0.464**
	r_P								1.000	0.068	-0.073	0.112	0.765**	-0.124	0.130	0.253**	0.425**	0.419**
9	r_g									1.000	-0.102	0.565**	-0.023	0.703**	0.347**	0.445**	0.475**	0.483**
	r_P									1.000	-0.051	0.442**	-0.012	0.556**	0.289**	0.365**	0.424**	0.436**
10	r_g										1.000	0.100	-0.131	-0.039	0.184*	-0.248**	0.559**	0.524**
	r_P										1.000	0.063	-0.112	-0.028	0.167	-0.191*	0.601**	0.555**
11	r_g											1.000	0.105	0.382**	0.317**	0.300**	0.501**	0.991**
	r_P											1.000	0.094	0.232*	0.232*	0.231*	0.400**	0.980**
12	r_g												1.000	-0.165	0.137	0.280**	0.355**	0.500**
	r_P												1.000	-0.155	0.119	0.255**	0.337**	0.406**
13	r_g													1.000	0.538**	0.362**	0.142	0.354**
	r_P													1.000	0.415**	0.261**	0.113	0.342**
14	r_g														1.000	-0.002	0.364**	0.165
	r_P														1.000	-0.022	0.334**	0.128
15	r_g															1.000	0.181*	0.377**
	r_P															1.000	0.175	0.336**
16	r_g																1.000	0.198*
	r_P																1.000	0.192*
17	r_g																	1.000
	r_P																	1.000

1. Vine length at 45 DAS (m) 2. Vine length at 75 DAS (m) 3. No. of primary branches/vine at 45 DAS 4. Number of primary branches/vine at 75 DAS 5. Days to first male flowering 6. Days to first female flowering 7. Average fruit weight (kg) 8. Fruit length (cm) 9. Fruit width (cm) 10. Number of fruits per vine 11. Fruit flesh thickness (cm) 12. Seed cavity length (cm) 13. Seed cavity width (cm) 14. Number of seeds per fruit 15. Hundred seed weight (g) 16. Fruit yield per vine (kg) 17. Fruit yield per hectare (tonnes)

Quality of the vegetable is very important to fetch higher prices and which can also give nutritional security. Therefore breeding for better quality is important. Fruit flesh thickness was positively and significantly associated with fruit width, average fruit weight, fruit yield per vine, fruit yield per hectare, vine length at 45 DAS, number of primary branches per vine at 45 and 75 DAS and days to first harvest at both the genotypic and phenotypic level and sex ratio at the genotypic level only. It also had negative and significant association with days to first male and female flowering. Hence, selection for fruit with more flesh thickness would bring improvement in both these yield and quality parameters. Similar results were reported by [11] in pumpkin. Total soluble solids (TSS) had positive and significant correlation with days to first harvest and fruit flesh thickness suggesting that, more number of days to fruit picking more TSS. It indicates late genotypes had better quality. β-carotene content of fruit was positively and significantly associated with days to first female flowering and nodes upto first female flowering. It indicates late genotypes have high β-carotene content.

Seed cavity size will add to bulkiness of the fruit which occupy more space with less mass per unit volume of space in storage and transportation. Seed cavity length was positively and significantly associated with fruit length, average fruit weight, fruit yield per vine, fruit yield per hectare, vine length at 45 and 75 DAS, number of primary branches per vine at 45 and 75 DAS. Seed cavity length was negatively and significantly associated with days to first female flowering and sex ratio. Correlation study revealed that seed cavity length was positively associated with yield parameters and inversely associated with earliness parameters. Seed cavity width was positively and significantly associated with fruit width, average fruit weight and vine length at 45 DAS. It also had negative and significant association with days to first male and female flowering. It indicates early genotypes had less seed cavity space. Plant breeder needs to give emphasis for optimizing seed cavity size.

There is preference for small sized fruit from retail consumers and can avoid purchase of cut pieces. Therefore breeding for small sized fruits is important for retail consumption and big sized fruits for wholesale or bulk consumption. Average fruit weight had positive and significant association with vine length at 45 and 75

DAS and number of primary branches per vine at 45 and 75 DAS at both phenotypic and genotypic levels and it also had negative association with days to first male and female flowering and sex ratio suggesting the possibility of simultaneous improvement of these traits. Similar results were obtained by [12] in spine gourd.

Though correlation analysis indicates the association pattern of components traits with yield, they simply represent the overall influence of a particular trait on yield rather than providing cause and effect relationship. The technique of path coefficient analysis facilitates the partitioning of correlation coefficients into direct and indirect contributions of various characters on yield. Such information would be of great value in enabling the breeder to specifically identify the important component traits of yield and utilize the genetic stock for improvement in a planned way.

Table-2 *Genotypic path coefficient analysis for fruit yield per hectare in pumpkins (Cucurbitasp.)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	r_g
1	**0.2767**	-0.0352	0.1829	-0.2533	-0.5605	0.3520	0.3461	-0.3191	0.0647	0.0343	0.0130	0.1047	-0.0833	0.0573	0.0654	0.2376	0.4833**
2	0.1567	**-0.0621**	0.0208	-0.0833	-0.2685	0.1896	0.2918	-0.2973	0.0611	-0.0079	0.0048	0.0761	-0.0448	0.0310	0.0884	0.1660	0.3225**
3	0.1665	-0.0043	**0.3038**	-0.3662	-0.3905	0.1893	0.1542	-0.1611	0.0204	0.1626	0.0083	0.0507	0.0185	0.0272	-0.0056	0.2065	0.3805**
4	0.1774	-0.0131	0.2817	**-0.3950**	-0.3285	0.2193	0.2318	-0.2222	0.0332	0.1144	0.0074	0.0632	-0.0090	0.0210	0.0434	0.2251	0.4500**
5	-0.1421	0.0153	-0.1087	0.1189	**1.0918**	-0.6724	-0.2010	-0.0682	-0.0788	-0.0975	-0.0126	-0.0295	0.1453	-0.0607	-0.0488	-0.1642	-0.3131**
6	-0.1324	0.0160	-0.0782	0.1177	0.9976	**-0.7358**	-0.2240	0.0287	-0.0686	-0.0569	-0.0098	-0.0538	0.1491	-0.0561	-0.0459	-0.1535	-0.3058**
7	0.1617	-0.0306	0.0791	-0.1546	-0.3704	0.2782	**0.5923**	-0.4081	0.1108	-0.0800	0.0143	0.1125	-0.0773	0.0495	0.1139	0.3269	0.7182**
8	0.1391	-0.0291	0.0771	-0.1383	0.1173	0.0332	0.3808	**-0.6348**	0.0146	-0.0395	0.0047	0.1679	0.0497	0.0247	0.0786	0.2185	0.4643**
9	0.1155	-0.0245	0.0400	-0.0846	-0.5545	0.3254	0.4230	-0.0596	**0.1551**	-0.0485	0.0154	-0.0047	-0.1992	0.0583	0.1046	0.2206	0.4826**
10	0.0201	0.0010	0.1043	-0.0954	-0.2247	0.0885	-0.1000	0.0530	-0.0159	**0.4736**	0.0027	-0.0266	0.0110	0.0310	-0.0584	0.2598	0.5238**
11	0.1314	-0.0110	0.0926	-0.1070	-0.5029	0.2646	0.3103	-0.1103	0.0877	0.0475	**0.0273**	0.0214	-0.1081	0.0533	0.0707	0.2325	0.5000**
12	0.1420	-0.0232	0.0755	-0.1223	-0.1579	0.1940	0.3268	-0.5226	-0.0036	-0.0619	0.0029	**0.2040**	0.0467	0.0231	0.0659	0.1647	0.3540**
13	0.0813	-0.0098	-0.0199	-0.0125	-0.5603	0.3874	0.1617	0.1113	0.1091	-0.0183	0.0104	-0.0337	**-0.2832**	0.0905	0.0851	0.0660	0.1651
14	0.0942	-0.0114	0.0491	-0.0493	-0.3940	0.2453	0.1743	-0.0931	0.0538	0.0872	0.0086	0.0280	-0.1523	**0.1682**	-0.0006	0.1690	0.3771**
15	0.0769	-0.0233	-0.0072	-0.0728	-0.2265	0.1435	0.2866	-0.2121	0.0690	-0.1176	0.0082	0.0571	-0.1024	-0.0004	**0.2353**	0.0842	0.1985*
16	0.1415	-0.0222	0.1351	-0.1915	-0.3861	0.2431	0.4169	-0.2986	0.0737	0.2649	0.0137	0.0723	-0.0403	0.0612	0.0426	**0.4645**	0.9910**

Residual effect =0.0469 Bold diagonal values indicate direct effects r_g = Genotypic correlation coefficient with fruit yield per hectare,

* and** indicate significant at 5 and 1 per cent probability level, respectively, 1. Vine length at 45 DAS (m) 2. Vine length at 75 DAS (m) 3. No. of primary branches/vine at 45 DAS 4. No. of primary branches/vine at 75 DAS 5. Days to first male flowering 6. Days to first female flowering 7. Average fruit weight (kg) 8. Fruit length (cm) 9. Fruit width (cm) 10. Number of fruits per vine 11. Fruit flesh thickness (cm) 12. Seed cavity length (cm) 13. Seed cavity width (cm) 14. Number of seeds per fruit 15. Hundred seed weight (g) 16. Fruit yield per vine (kg)

Path coefficient analysis at genotypic level was worked out to study effect of various traits on fruit yield per hectare. The results obtained are described in [Table-2]. A perusal of genotypic path coefficient analysis showed that days to first male flowering had the maximum direct effect (1.0918) on fruit yield per hectare followed by days to first female flowering (-0.7358), fruit length (-0.6348), average fruit weight (0.5923), number of fruits per vine (0.4736), fruit yield per vine (0.4645), number of primary branches per vine at 45 (0.3038) and 75 DAS (-0.3950),seed cavity width (-0.2832) and vine length at 45 DAS (0.2767).These results are in conformity with those of [6;7:8] in pumpkin. In breeder's point of view, selection for yield can be achieved by employing the traits which had high direct effects like, average fruit weight, number of fruits per vine, fruit yield per vine, fruit length, days to first male and female flowering and number of primary branches per vine.

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Author Contributions:

Mahaveer Shrikant Muttur- Design of the experiment, data collection, data analysis and interpretation, drafting the article, Critical revision of the article and final approval of the version to be published.

Ravindra Mulge -Design of the experiment, given valuable suggestions and facilities to conduct the experiment, Critical revision of the article, final approval of the version to be published.

V. D. Gasti- Given valuable suggestions and support to conduct the experiment and Correction of the manuscript.

Nagesh G. C. – Interpretation, Critical correction of the article, acted as a corresponding author and final approval of the version to be published.

Santhosha G. R. – Interpretation and critical correction of the article.

Abbreviations: DAS- Days after sowing; TSS-Total Soluble Solids; r_g- Genotypic Correlation Coefficients; r_p-Pheotypic Correlation Coefficients.

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared

References

[1] Gopalan C., Ramasastri B.V. and Balasubramanian S.C. (1982) Nutritive value of Indian foods. Indian Council of medical research, National institute of nutrition, Hyderabad.

[2] Al-Jibourie H.A., Miller P.A. and Robinson H.F. (1958) *Agron. J.,* 50, 633-637.

[3] Wright S. (1921) *J. Agric. Res.,* 20, 557-587.

[4] Dewey D. R. and Lu K. H. (1957) *Agron. J.,* 51, 515-518.

[5] Akter S., Rasul M.G., Aminul Islam A.K.M. and Hossain M.M. (2013) *Bangladesh J. Pl. Breed. Genet.,* 26(1), 25-33.

[6] Kumar J., Singh D.K. and Ram H.H. (2005) *Indian J. Hort.,* 62(4), 346-349.

[7] Kumaran S., Natarajan S. and Thamburaj S. (2000) *South Indian Hort.,* 46 (3&4), 138-142.

[8] Arunkumar H., Patil M. G., Hanchinamani C. N., Shanker Goud I. and Hiremath S. V. (2011) *Karnataka J. Agric. Sci.,* 24(4), 497-500.

[9] Rao E. S., Monshi A. D. and Verma V. K. (2004) *Indian J. Hort.,* 61(4), 315-318.

[10] Muralidhara (2009) Genetic variability studies in pumpkin (*Cucurbita moschata* Duch ex. Poir). M. Sc. (Hort.) Thesis, Univ. Agric. Sci., Bengaluru.

[11] Basumatary P., Bora G. C., Kalita U. C., Saikia L. and Deka N. C. (2014) *Direct Res. J. Agric. Food Sci.,* 2(7), 77-81.