Studies on correlation and path analysis in segregating population of Mangalore melon (*Cucucmis melo* var. *acidulus*) derived from the inter-varietal cross MS 78 x RNMS-1

Abstract

Correlation and path coefficients analysis can help to assess the mutual relationship between various plant characters and determines component characters on which selection can be based or improvement in yield. The 260 Mangalore melon vines were evaluated for yield contributing characters to observe their associations and direct and indirect effect on fruit yield per vine at College of Horticulture, Bagalkot during summer 2021-22. The study revealed that fruit yield per plant had significant positive correlation number of female flowers, fruit length, fruit width, number of fruits per vine, fruit weight, flesh thickness, seed cavity width and seed cavity length which are important characters to be accounted for gaining improvement in yield. Path analysis revealed that fruit weight exhibited highest positive direct effect on fruit yield per vine followed by flesh thickness, number of fruits per vine, seed cavity length and so on.

Keywords: F_2 generation, Correlation, Path analysis

Introduction

Mangalore melon or culinary melon (*Cucumis melo* var. *acidulus*) is one among the non-dessert melon group vegetable belongs to the family Cucurbitaceae and the genus cucumis with a diploid chromosome number of 2n= 2x = 24 (Pitrat, 2008). It is considered to be the most ancient form of melon domesticated in China (Jeffrey, 1980) and also it is known that it is originated from wild melon (var. *agrestis*) in China. It is also called by different names in different languages. In South Indian states like Karnataka, Kerala, Tamil Nadu, Telangana and Andhra Pradesh, it is known by a variety of local names such as Mangaluru cucumber, Mangaluru southekayi, sambar cucumber, sambar southe and so on.

Fruits are varying in size, colour, shape, pulp texture, with smooth tender skin, moisture rich, white flesh usually with little sweetness and odour (Gondi *et al*., 2016). The crop is gaining much importance because of its earliness, high production potential with nutritive value. It is the most unique cucurbitaceous vegetable with respect to its keeping

quality. The fruits can be stored up to 8-10 months without losing their freshness just by hanging them from the ceiling, firmly bound by thin coconut fiber ropes (Swamy, 2017).

India has been reported to be rich in melon genetic resources, as Mangalore melon is morphologically diverse, especially with regard to fruit traits because of cross pollination and monoecious nature. It can also show non-uniformity in fruit size, shape, colour, quality and fruit yield. For attaining the uniformity in these traits, a good understanding of genetic stock of Mangalore melon and selection of superior genotypes in segregating populations is very important for any crop improvement programme for the development of new varieties.

Yield being a complex quantitative character, direct selection for yield may not result in successful improvement. The correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be done for improvement of complex quantitative character like yield (Jain, 1982). Path analysis splits the correlation coefficients into direct and indirect effects of a set of dependent variables on the independent variable thereby aids in the selection of elite genotype.

Path coefficient provides an effective means of entangling direct and indirect causes of association and measures the relative importance of each causal factor. Partitioning of total correlation into direct and indirect effects would be worthwhile for an effective selection program during handling of segregating population or in the varietal development.

Material and methods

Location of experimental site

An experiment was conducted during 2021-22 at the experimental block, Department of Biotechnology and Crop Improvement, College of Horticulture, University of Horticultural Sciences, Bagalkot. Geographically Bagalkot is located in the Northern dry regions of Karnataka and categorized under the zone 3 and region II among the agro-climatic zones of Karnataka

Experimental material

The F_2 population consists of 260 individuals, which were obtained from selfing the F_1's of inter-varietal hybrids of Mangalore melon derived from the cross MS 78 x RNMS-1. These populations were subjected for correlation and path analysis.

Design and experimental layout

An experiment was conducted in augmented design. Seeds were sown in the main field at a spacing of 2.0 m x 60 cm. Total of about 260 vines were subjected to record the observations on various growth, flowering and yield parameters. The cultivation practices like drip irrigation, mulching and fertigation has been carried out for proper growth and development of crop. The regular plant protection measures were taken up against biotic factors like insect-pests and diseases to achieve healthy growth of vines.

Observations recorded

The observations were recorded in each vine on eighteen quantitative and quality parameters *viz*., days to first male flower appearance, days to first female flower appearance, node at which first male flower appear, node at which first female flower appears, number of male flowers, number of female flowers, sex ratio, vine length (cm), number of branches per vine, days to first harvest, fruit length (cm), fruit width (cm), fruit weight (g), number of fruits per vine, flesh thickness (cm), seed cavity width (cm), seed cavity length (cm) and fruit yield per vine (kg). The mean data was subjected for correlation (Al-Jibouri *et al.*, 1958) and path analysis (Dewey and Lu, 1959).

Results and Discussion

Correlation analysis

Variability studies provide information on the extent of improvement in different characters, but not on the extent and nature of relationship existing between various contributory and economically important characters. The correlation coefficients were examined on all possible combinations of growth, yield and quality attributing characters in F_2 population and the data pertaining to character association studies was presented in Table 1.

Association of fruit yield per vine with its related characters

The total fruit yield per vine had positive and significant correlation with number of female flowers (0.134), fruit length (0.535), fruit width (0.378), fruit weight (0.737), number of fruits per vine (0.188), flesh thickness (0.268), seed cavity width (0.209) and seed cavity length (0.498). This indicated that there is a strong association between these traits with fruit

yield per vine. These results agree with Rani *et al.,* (2015) for inter-nodal length, fruit weight and fruit length and Koppad *et al.* (2017) for yield parameters.

Sex ratio had negative significant correlation (-0.138) with fruit yield per vine. Whereas, days to first male flower appearance (0.024), days to first female flower appearance (0.027) and node at which first male flower appears (0.011) had the positive and non-significant association with fruit yield. Node at which first female flower appears (-0.031), vine length (-0.027), number of branches per vine (-0.010) and days to first harvest (-0.113) had negative and non-significant association with fruit yield and the data presented in Table 1.

Path coefficient analysis

The relationship between yield and its component traits may be in positive or negative direction, but it is the net result of direct effect of that particular character and indirect effects via other character. Hence, it is necessary to determine the path coefficients, which partition the observed correlation into direct and indirect effects and also reveals the cause-and-effect relationship between yield and its related traits.

The phenotypic path coefficient analysis was done for fruit yield per vine which was performed with a set of 17 characters. By partitioning the correlation coefficient into direct and indirect effects of a selected trait on fruit yield per vine and its indirect effect through other characters is an important step for an effective selection. The path analysis for 18 characters computed and presented in Table 2.

Fruit weight exhibited highest positive direct effect on fruit yield per vine (0.890) followed by flesh thickness (0.689), number of fruits per vine (0.583), seed cavity length (0.696), seed cavity width (0.065), node at which first male flower appears (0.042), number of female flowers (0.038), sex ratio (0.035), node at which first female flower appears (0.019), days to first female flower appearance (0.015) and days to first harvest (0.006).

Fruit yield per vine had negative direct effect by days to first male flower appearance (-0.060), number of male flowers (-0.074), vine length (-0.020), number of branches per vine (-0.015), fruit length (-2.039) and fruit width (-0.049). Similar results were also observed by findings of Hossein *et al.* (2012), Reddy *et al.* (2017), Yadagir *et al.* (2017), kamgoud (2018), Kumar *et al*. (2020) and Kumbar *et al.* (2021).

Table 1. Phenotypic correlation coefficients among yield and yield components in F_2 population derived from the cross MS 78 x RNMS-1 (N = 260)

Traits	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}
X_1	1.000	0.929**	-0.023	-0.040	-0.004	-0.128*	0.090	0.025	-0.177**	0.060	0.091	0.025	0.138*	-0.124*	0.034	0.107	0.091	0.024
X_2		1.000	-0.006	-0.064	-0.026	-0.082	0.046	0.028	-0.189**	0.052	0.104	0.066	0.116	-0.090	-0.039	0.141*	0.126*	0.027
X_3			1.000	-0.020	-0.066	-0.042	-0.031	-0.066	-0.012	-0.001	-0.039	-0.057	0.000	-0.052	0.012	-0.009	-0.047	0.011
X_4				1.000	0.031	0.006	0.017	0.060	0.102	0.020	0.011	0.012	-0.036	-0.025	0.060	-0.070	-0.008	-0.031
X_5					1.000	0.039	0.779**	0.085	0.066	-0.010	-0.034	-0.015	-0.147*	0.106	-0.020	-0.025	-0.029	-0.122*
X_6						1.000	-0.550**	0.077	0.095	-0.127*	0.004	0.003	-0.185**	0.487**	-0.034	0.036	0.014	0.134*
X_7							1.000	0.009	0.006	0.076	-0.010	0.016	-0.004	-0.148*	-0.012	-0.028	-0.006	-0.138*
X_8								1.000	0.189**	-0.069	0.029	0.042	-0.035	0.051	0.062	-0.112	0.014	-0.027
X_9									1.000	-0.129*	-0.092	-0.060	-0.036	0.083	-0.063	-0.030	-0.081	-0.010
X_{10}										1.000	0.100	0.058	-0.108	-0.057	0.030	0.052	0.098	-0.113
X_{11}											1.000	0.782**	0.591**	-0.203**	0.404**	0.267**	0.959**	0.535**
X_{12}												1.000	0.491**	-0.278**	0.680**	0.586**	0.379**	0.378**
X_{13}													1.000	-0.406**	0.378**	0.246**	0.525**	0.737**
X_{14}														1.000	-0.244**	-0.114	-0.147*	0.188**
X_{15}															1.000	-0.187**	0.129*	0.268**
X_{16}																1.000	0.351**	0.209**
X_{17}																	1.000	0.498**

*Significant at 5 per cent probability level, **Significant at 1per cent probability level

Where,

X_1- Days to first male flower appearance
X_2- Days to first female flower appearance
X_3- Node at which first male flower appear
X_4- Node at which first female flower appears
X_5- Number of male flowers
X_6- Number of female flowers
X_7- Sex ratio
X_8- Vine length (cm)
X_9- Number of branches per vine
X_{10}- Days to first harvest
X_{11}-Fruit length (cm)
X_{12}-Fruit width (cm)
X_{13}- Fruit weight (g)
X_{14} - Number of fruits per vine
X_{15}- Flesh thickness (cm)
X_{16} - Seed cavity width (cm)
X_{17}-Seed cavity length (cm)
X_{18} - Fruit yield per vine (kg)

Table 2. Path coefficients analysis among yield and yield components in F_2 population derived from the cross MS 78 x RNMS-1

Traits	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	'r' with yield
X_1	**-0.060**	0.014	-0.001	-0.001	0.000	-0.005	0.003	-0.001	0.003	0.000	-0.185	-0.005	0.123	-0.072	0.024	0.007	0.180	0.024
X_2	-0.056	**0.015**	0.000	-0.001	0.002	-0.003	0.002	-0.001	0.003	0.000	-0.213	-0.004	0.104	-0.052	-0.027	0.009	0.249	0.027
X_3	0.001	0.000	**0.042**	0.000	0.005	-0.002	-0.001	0.001	0.000	0.000	0.080	0.000	0.000	-0.030	0.008	-0.001	-0.094	0.011
X_4	0.002	-0.001	-0.001	**0.019**	-0.002	0.000	0.001	-0.001	-0.002	0.000	-0.022	0.000	-0.032	-0.014	0.042	-0.005	-0.015	-0.031
X_5	0.000	0.000	-0.003	0.001	**-0.074**	0.001	0.027	-0.002	-0.001	0.000	0.069	0.002	-0.131	0.062	-0.014	-0.002	-0.058	-0.122
X_6	0.008	-0.001	-0.002	0.000	-0.003	**0.038**	-0.019	-0.002	-0.001	-0.001	-0.009	0.000	-0.165	0.284	-0.023	0.002	0.028	0.134
X_7	-0.005	0.001	-0.001	0.000	-0.058	-0.021	**0.035**	0.000	0.000	0.000	0.020	0.002	-0.003	-0.086	-0.008	-0.002	-0.011	-0.138
X_8	-0.001	0.000	-0.003	0.001	-0.006	0.003	0.000	**-0.020**	-0.003	0.000	-0.060	0.002	-0.032	0.030	0.043	-0.007	0.027	-0.027
X_9	0.011	-0.003	-0.001	0.002	-0.005	0.004	0.000	-0.004	**-0.015**	-0.001	0.188	0.004	-0.032	0.048	-0.043	-0.002	-0.161	-0.010
X_{10}	-0.004	0.001	0.000	0.000	0.001	-0.005	0.003	0.001	0.002	**0.006**	-0.204	-0.003	-0.096	-0.033	0.020	0.003	0.194	-0.113
X_{11}	-0.005	0.002	-0.002	0.000	0.003	0.000	0.000	-0.001	0.001	0.001	**-2.039**	-0.026	0.527	-0.118	0.278	0.017	1.898	0.535
X_{12}	-0.007	0.001	0.000	0.000	0.003	0.000	-0.001	0.001	0.001	0.000	-1.102	**-0.049**	0.437	-0.162	0.468	0.038	0.749	0.378
X_{13}	-0.008	0.002	0.000	-0.001	0.011	-0.007	0.000	0.001	0.001	-0.001	-1.206	-0.024	**0.890**	-0.237	0.260	0.016	1.040	0.737
X_{14}	0.007	-0.001	-0.002	0.000	-0.008	0.019	-0.005	-0.001	-0.001	0.000	0.414	0.014	-0.362	**0.583**	-0.168	-0.007	-0.292	0.188
X_{15}	-0.002	-0.001	0.001	0.001	0.002	-0.001	0.000	-0.001	0.001	0.000	-0.824	-0.033	0.336	-0.142	**0.689**	-0.012	0.256	0.268
X_{16}	-0.006	0.002	0.000	-0.001	0.002	0.001	-0.001	0.002	0.000	0.000	-0.545	-0.029	0.219	-0.067	-0.129	**0.065**	0.696	0.209
X_{17}	-0.006	0.002	0.000	-0.001	0.002	0.001	-0.001	0.002	0.000	0.000	-0.545	-0.029	0.219	-0.067	-0.129	0.065	**0.696**	0.498

Residual effect = 0.15

Where,

X_1- Days to first male flower appearance
X_2- Days to first female flower appearance
X_3- Node at which first male flower appears
X_4- Node at which first female flower appears
X_5- Number of male flowers
X_6- Number of female flowers
X_7- Sex ratio
X_8- Vine length (cm)
X_9- Number of branches per vine
X_{10}- Days to first harvest
X_{11}- Fruit length (cm)
X_{12}-Fruit width (cm)
X_{13}- Fruit weight (g)
X_{14} - Number of fruits per vine
X_{15}- Flesh thickness (cm)
X_{16} - Seed cavity width (cm)
X_{17}- Seed cavity length (cm)

Conclusion

Correlation studies revealed that total fruit yield per vine had significant positive correlation with number of female flowers, fruit length, fruit width, number of fruits per vine, fruit weight, flesh thickness, seed cavity width and seed cavity length. Hence utmost importance needs to be given for these traits during selection for the yield improvement. Path analysis revealed that fruit weight exhibited highest positive direct effect on fruit yield per vine followed by flesh thickness, number of fruits per vine, seed cavity length, seed cavity width, node at which first male flower appears, number of female flowers, sex ratio, node at which first female flower appears, days to first female flower appearance and days to first harvest. Indirect selection of these traits will reward in yield improvement.

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