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Studies on correlation and path-coefficient analysis for yield and its contributing characters in watermelon [*Citrullus lanatus* (Thunb.) Mansf.]

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Abstract
A field experiment was conducted at College of Horticulture, University of Horticultural Sciences, Bagalkot, Karnataka, during *Rabi* 2018 to assess the nature and magnitude of association among yield and its contributing traits in watermelon. Twenty three genotypes were evaluated with two replications in Randomized Block Design. The results revealed that number of branches per vine, average fruit weight, number of fruits per vine, rind thickness, flesh thickness, pulp to seed ratio, days to first male flowering and fruit diameter had significant and positive association with fruit yield per vine, whereas, sex ratio had significant negative association with fruit yield per vine. Since, these associations are in the desirable direction, selection for these traits will improve the yield per vine. Path coefficient studies revealed that number of fruits per vine, average fruit weight and pulp to seed ratio had high direct positive effect on fruit yield per vine indicating their true positive and significant association with yield.

Keywords: Watermelon genotypes, correlation coefficient, path analysis

Introduction
Watermelon [*Citrullus lanatus* (Thunb.) Mansf.] is the well known and widely cultivated summer season crop, belongs to family cucurbitaceae. It is a trailing vine, fairly drought resistant, flourishing on fertile, sandy soils in hot, sunny and dry environments (Robinson and Walters, 1997) [13]. The fruit has cooling effect and is used as an expectorant, diuretic and stomachic. The fruit contains 92 per cent water, 0.2 per cent protein and 0.3 per cent minerals in 100 gram edible flesh. The major nutritional components of the fruits are carbohydrates (6.4 g/100 g), vitamin A (590 IU) and lycopene (4,100 µg/100 g, range 2,300-7,200 µg/100 g) which is a powerful antioxidant (Gusmini and Wehner, 2004) [5].

Yield is a complex character and is governed by polygenic system. Moreover, it is highly influenced by environmental fluctuations. Correlation study measures the natural relationship between various characters and helps in determining the component characters on which selection can be based for yield improvement. Association of characters determined by correlation coefficient will not provide an exact picture of the relative importance of direct and indirect influence of each of the characters towards yield. Path coefficient analysis developed by Wright (1921) [21] has been employed in many vegetables in order to overcome the unreliability of correlation coefficient. This technique involves effective partitioning of the correlation coefficient into measures of direct and indirect effects on yield. Therefore, the present investigation was undertaken with a view assess the nature and magnitude of association among yield and its contributing traits for selecting high yielding genotypes of watermelon.

Material and methods
The present research was conducted at the main campus of University of Horticultural Sciences, College of Horticulture, Bagalkot, Karnataka, India, during October 2018 to January 2019. Germplasm of watermelon comprising of 23 genotypes collected from different sources formed the experimental material and the seeds were sown directly in the main field in randomized block design with two replications. The spacing maintained between rows was 2.5 m and between plants was 1.0 m. Standard package practices were adopted to raise the crop. Observations were recorded from five randomly selected plants for the characters *viz*., vine length at 75 DAS, number of branches at 75 DAS, days to first male flowering, days to first female flowering, node at first female flower appeared, days to first fruit harvest, sex ratio,

fruit diameter, average fruit weight, number of fruits per vine, fruit yield per vine, rind thickness, flesh thickness, total soluble solids, lycopene content, pulp to seed ratio, number of seeds per fruit and hundred seed weight.

Genotypic and phenotypic correlation coefficients were calculated using the method given by Johnson *et al.* (1955) [9], by using analysis of variance and covariance matrix in which total variability has been split into replications, genotypes and errors. The genotypic and phenotypic correlation coefficients were used to find out their direct and indirect contributions towards yield per vine. The direct and indirect paths were obtained according to the method given by Dewey and Lu (1959) [3].

Results and Discussion

Correlation study

The estimates of correlation coefficient (Table 1) revealed that fruit yield per vine was highly significant and positively correlated with average fruit weight (rG = 0.729), number of fruits per vine (rG = 0.426) and flesh thickness (rG = 0.410) and it was positive and significantly (only at p = 0.05) correlated with rind thickness (rG = 0.355), pulp to seed ratio (rG = 0.319), days to first male flowering (rG = 0.315), fruit diameter (rG = 0.314) and number of branches at 75 DAS (rG = 0.308). The results indicated that vines with profuse branches, yielding high number of fruits per plant with big size fruits would results in higher fruit yield per vine. These results are in agreement with the findings of Singh and Singh (1988) [17] and Sundaram *et al*. (2011) [18] in watermelon for sex ratio, Gopala krishnan *et al.* (1980) [4], Borthakur and Shadeque (1994) [1] and Kumaran *et al.* (2000) [10] in pumpkin; Singh and Ram (2003) [15] and Vishwanatha (2003) [20] in muskmelon for number of branches per plant, Choudhary *et al*. (2012) [2] and Nisha *et al*. (2018) [12] in watermelon; Whereas fruit yield per vine had significant and negative (at p = 0.05) association with sex ratio (rG = -0.364).

Vine length at 75 DAS had highly significant (P = 0.01) and positive association with number of branches per vine at 75 DAS (rG =0.707), sex ratio (rG =0.572), node at first female flower appeared (rG = 0.486) and days to first female flowering (rG =0.380). These results are in line with the findings by Bothakur and Shadeque (1994) in pumpkin and Talukder *et al*. (2018) [19] in bitter gourd. Number of branches per vine at 75 DAS had significant and positive association with days to first fruit harvest (rG = 0.333), days to first male flowering (rG = 0.318), fruit yield per vine (rG = 0.308) and sex ratio (rG = 0.298).

Days to first male flowering had significant and positive correlation with hundred seed weight (rG = 0.496), days to first female flowering (rG = 0.392), node at first female flower appeared (rG = 0.316), fruit yield per vine (rG = 0.315) and average fruit weight (rG = 0.307) as conformed by Rukam *et al*. (2008) [14] and Mehta *et al*. (2009) [11], Harshawardhan *et al.* (2011) [7] in musk melon. Days to first female flowering had highly significant and positive association with node at first female flower appeared (rG = 0.765), days to first fruit harvest (rG = 0.511) and sex ratio (rG = 0.393).

A strong positive and significant association of nodes upto first female flowering with sex ratio (rG = 0.539) and days to first fruit harvest (rG = 0.535) was observed. Days to first fruit harvest had highly significant and positive association with fruit diameter (rG = 0.377). Sex ratio (rG = 0.312) and average fruit weight (rG = 0.311) also had positive and significant association with the trait. These results are in agreement with Choudhary *et al*. (2012) [2] in watermelon and Ibrahim and Ramadan (2013) [8] in sweet melon. Sex ratio exhibited significant and negative association with total soluble solids (rG = -0.374), fruit yield per vine (rG = -0.364) and number of fruits per vine (rG = -0.360).

The fruit diameter had highly significant and positive association with flesh thickness (rG = 0.873), average fruit weight (rG = 0.610) and number of seeds per fruit (rG = 0.434). Fruit yield per vine (rG = 0.314) had significant and positive association with the trait under consideration. These results are in line with findings by Choudhary *et al*. (2012) [2], Hakimi and Madidi (2015) [6] in watermelon. Average fruit weight exhibited highly significant and positive association with fruit yield per vine (rG = 0.729), flesh thickness (rG = 0.686), pulp to seed ratio (rG = 0.439) and total soluble solids (rG = 0.379). Number of fruits per vine had significant and positive association with fruit yield per vine (rG = 0.426), rind thickness, fruit yield per vine (rG = 0.355), hundred seed weight (rG = 0.355) and lycopene content (rG = 0.303). These results are in conformity with Choudhary *et al*. (2012) [2] and Nisha *et al*. (2018) [12] in watermelon. A strong positive and significant association of flesh thickness to number of seeds per fruit (rG = 0.445) and fruit yield per vine (rG = 0.410) was observed. The trait had significant positive association with total soluble solids (rG =0.356). Total soluble solids had significant and positive association with pulp to seed ratio (rG = 0.367).

Pulp to seed ratio had significant and positive association with fruit yield per vine (rG = 0.319). However, number of seeds per fruit and hundred seed weight (rG = -0.413) had significant and negative correlation with the trait under consideration. These results are in agreement with Rukam *et al*. (2008) [14] and Mehta *et al*. (2009) [11] in musk melon.

Path coefficient analysis

Path coefficient analysis furnishes a means of measuring the direct and indirect effects of a variable through other variables on the end product. Positive direct effect on fruit yield per vine was observed through days to fist male flowering, days to first female flowering, days to first fruit harvest, sex ratio, average fruit weight, number of fruits per vine, flesh thickness, pulp to seed ratio, number of seeds per fruit and hundred seed weight (Table 2). Whereas, negative direct effect was noticed through vine length at 75 DAS, number of branches at 75 DAS, node at first female flower appeared, fruit diameter, rind thickness, total soluble solids and lycopene content.

Among these traits, number of fruits per vine, average fruit weight and pulp to seed ratio had high positive direct effect indicating their true positive and significant association with yield. Similar results were reported by previous scientists *viz.*, Choudhari *et al*. (2012) in watermelon, Singh and Lal (2005) [16] and Rukam *et al*. (2008) [14] in musk melon. Therefore, direct selection for these traits would be rewarding for improvement of yield. Though, number of branches at 75 DAS, days to first male flowering, fruit diameter, rind thickness and flesh thickness had significant and positive correlation with fruit yield, they had low direct positive effects indicating that their association with fruit yield was not true.

Table 1: Genotypic correlation coefficients among growth, earliness, yield, quality and seed parameters in watermelon

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.000	0.707**	0.350*	0.380**	0.486**	0.307*	0.572**	0.270	0.100	-0.024	-0.305*	0.198	-0.344*	-0.305*	0.013	0.319*	-0.141	-0.106
2		1.000	0.318*	0.194	0.244	0.333*	0.298*	0.054	0.199	0.271	-0.226	-0.063	-0.451**	-0.220	0.143	0.245	-0.159	0.308*
3			1.000	0.392**	0.316*	0.227	0.155	-0.008	0.307*	0.112	0.038	0.050	-0.082	0.158	-0.205	-0.004	0.496**	0.315*
4				1.000	0.765**	0.511**	0.393**	0.197	0.038	-0.250	-0.351*	0.226	-0.178	-0.591**	0.099	0.156	-0.085	-0.075
5					1.000	0.535**	0.539**	0.052	0.094	-0.319*	-0.317*	0.133	-0.119	-0.430**	0.261	0.012	-0.111	-0.126
6						1.000	0.312*	0.377**	0.311*	-0.129	0.189	0.254	-0.131	-0.097	-0.055	0.164	0.137	0.076
7							1.000	0.025	-0.137	-0.360*	-0.097	-0.029	-0.374*	-0.182	-0.215	0.367*	-0.173	-0.364*
8								1.000	0.610**	-0.105	0.253	0.873**	0.246	-0.035	0.203	0.434**	-0.242	0.314*
9									1.000	-0.191	0.244	0.686**	0.379**	0.186	0.439**	0.127	0.163	0.729**
10										1.000	0.190	-0.080	-0.049	-0.029	-0.087	-0.061	-0.191	0.426**
11											1.000	0.248	0.042	0.303*	-0.202	0.202	0.355*	0.355*
12												1.000	0.356*	0.017	0.177	0.445**	-0.115	0.410**
13													1.000	0.082	0.367*	-0.271	-0.054	0.242
14														1.000	-0.092	-0.074	0.190	0.193
15															1.000	-0.496**	-0.413**	0.319*
16																1.000	-0.041	0.090
17																	1.000	0.112
18																		1.000

Critical r_g value at 5%= 0.2907 Critical r_g value at 1% = 0.3761 *significant at 5% **Significant at 1%

1. Vine length at 75 DAS
2. Number of branches per vine at 75 DAS
3. Days to first male flowering
4. Days to first female flowering
5. Node at first female flower appeared
6. Days to first fruit harvest
7. Sex ratio
8. Fruit diameter
9. Average fruit weight
10. Number of fruits per vine
11. Rind thickness
12. Flesh thickness
13. Total Soluble Solids
14. Lycopene content
15. Pulp to seed ratio
16. Number of seeds per fruit
17. Hundred seed weight
18. Fruit yield per vine

Table 2: Genotypic path coefficient analysis for yield and its components in watermelon

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	rG
1	-0.422	-0.064	0.023	0.039	-0.113	0.022	0.204	-0.069	0.069	-0.020	0.071	0.030	0.038	-0.016	0.009	0.152	-0.059	-0.106
2	-0.298	-0.091	0.021	0.020	-0.057	0.024	0.107	-0.014	0.137	0.230	0.052	-0.010	0.050	-0.011	0.098	0.117	-0.066	0.308*
3	-0.148	-0.029	0.065	0.040	-0.074	0.016	0.055	0.002	0.211	0.095	-0.009	0.008	0.009	0.008	-0.140	-0.002	0.206	0.315*
4	-0.160	-0.018	0.025	0.102	-0.178	0.037	0.140	-0.050	0.026	-0.212	0.082	0.035	0.020	-0.030	0.068	0.074	-0.035	-0.075
5	-0.205	-0.022	0.021	0.078	-0.233	0.038	0.193	-0.013	0.065	-0.271	0.074	0.020	0.013	-0.022	0.179	0.006	-0.046	-0.126
6	-0.130	-0.030	0.015	0.052	-0.125	0.072	0.112	-0.096	0.214	-0.109	-0.044	0.039	0.015	-0.005	-0.038	0.078	0.057	0.076
7	-0.241	-0.027	0.010	0.040	-0.126	0.022	0.357	-0.006	-0.094	-0.305	0.022	-0.004	0.042	-0.009	-0.147	0.174	-0.072	-0.364*
8	-0.114	-0.005	-0.001	0.020	-0.012	0.027	0.009	-0.253	0.419	-0.089	-0.059	0.157	-0.027	-0.002	0.139	0.206	-0.101	0.314*
9	-0.042	-0.018	0.020	0.004	-0.022	0.022	-0.049	-0.155	0.687	-0.162	-0.057	0.105	-0.042	0.010	0.301	0.060	0.068	0.729**
10	0.010	-0.025	0.007	-0.025	0.074	-0.009	-0.129	0.027	-0.131	0.848	-0.044	-0.012	0.005	-0.002	-0.060	-0.029	-0.080	0.426**
11	0.129	0.021	0.002	-0.036	0.074	0.014	-0.035	-0.064	0.167	0.161	-0.233	0.038	-0.005	0.016	-0.138	0.096	0.148	0.355*
12	-0.083	0.006	0.003	0.023	-0.031	0.018	-0.010	-0.259	0.471	-0.068	-0.058	0.153	-0.040	0.001	0.121	0.212	-0.048	0.410**
13	0.145	0.041	-0.005	-0.018	0.028	-0.009	-0.134	-0.062	0.261	-0.041	-0.010	0.054	-0.112	0.004	0.251	-0.129	-0.023	0.242
14	0.129	0.020	0.010	-0.060	0.100	-0.007	-0.065	0.009	0.128	-0.025	-0.071	0.003	-0.009	0.051	-0.063	-0.035	0.079	0.193
15	-0.005	-0.013	-0.013	0.010	-0.061	-0.004	-0.077	-0.052	0.301	-0.074	0.047	0.027	-0.041	-0.005	0.685	-0.236	-0.172	0.319*
16	-0.135	-0.022	0.000	0.016	-0.003	0.012	0.131	-0.110	0.087	-0.052	-0.047	0.068	0.030	-0.004	-0.340	0.475	-0.017	0.090
17	0.059	0.015	0.032	-0.009	0.026	0.010	-0.062	0.061	0.112	-0.162	-0.083	-0.018	0.006	0.010	-0.283	-0.019	0.416	0.112

References

1. Borthakur U, Shadeque A. Character association in pumpkin (*Cucurbita moschata* Dutch. Ex. Poir.). South Indian Hort. 1994; 42(1):15-17.
2. Choudhary BR, Pandey S, Singh PK. Morphological diversity analysis among watermelon (*Citrullus lanatus* (Thunb) Mansf.) genotypes. Prog. Hort. 2012; 44(2):321-326.
3. Dewey DP, Lu KH. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J. 1959; 51:515-518.
4. Gopalakrishnan TR, Gopalakrishnan KG, Peter KV. Variability, heritability and correlation among some polygenic characters in pumpkin. Indian J Agric. Sci. 1980; 50(12):925-930.
5. Gusmini G, Wehner TC. Heterosis for yield in a watermelon hybrid. Cucurbit Genetics Cooperative Report. 2004; 27:43-44.
6. Hakimi F, Madidi SE. Variability of agro-morphological traits in some Moroccan watermelon landraces (*Citrullus lanatus* Thunb. Matsum. And Nakai). Int. J Curr. Sci. 2015; 17:90-96.
7. Harshawardhan C, Ram HH, Singh DK. Genetic variability studies in musk melon. Prog. Hort. 2011; 43(2):231-233.
8. Ibrahim EA, Ramadan EY. Correlation and path coefficient analyses in sweet melon (*Cucumis melo* var. *aegyptiacus*) under irrigated and drought conditions. Pakistan J Bio. Sci. 2013; 16(13):610-616.
9. Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental variability in soybean. Agron. J. 1955; 47:314-318.
10. Kumaran SS, Natarajan S, Thamburaj S. Correlation and path analysis studies in pumpkin (*Cucurbita moschata* Duch. Ex. Poir.). South Indian Hort. 2000; 46(4):138-142.

11. Mehta R, Singh D, Bhalala MK. Correlation and path analysis in muskmelon. Indian J Hort. 2009; 66(3):396-399.
12. Nisha SK, Sreelathakumary, Celine VA. Variability, interrelationship and path coefficient studies in watermelon. Indian J Hort. 2018; 75(4):619-624.
13. Robinson RW, Walters DS. Cucurbits. CAB International, Wallingford, 1997, 84-89.
14. Rukam S, Tomar GU, Kulkarni, Kakade DK. Genetic analysis in muskmelon. J. Hort. Sci. 2008; 3(2):112-118.
15. Singh DK, Ram HH. Correlation among fruit characters in the indigenous germplasm lines of muskmelon. Prog. Hort. 2003; 35(1):69-72.
16. Singh G, Lal T. Correlation and path analysis of fruit yield and its component traits in muskmelon (*Cucumis melo* L.). Crop Improve. 2005; 32(1):102-107.
17. Singh NK, Singh RK. Correlation and path coefficient analysis in watermelon (*Citrullus lanatus* (Thunb) Mansf.). Veg. Sci. 1988; 15(1):95-100.
18. Sundaram MS, Kanthaswamy V, Kumar GA. Studies on variability, heritability, genetic advance and character association in watermelon [*Citrullus lanatus* (Thunb.) Matsam and Nakai]. Prog. Hort. 2011; 43(1):20-24.
19. Talukder ZH. Khan MMH, Das AK, Uddin MS. Assessment of genetic variability, heritability and genetic advance in bitter gourd (*Momordica charantia* L) for yield and yield contributing traits in Bangladesh. Sch. J Appl. Sci. Res. 2018; 1(6):1-10.
20. Vishwanatha PD. Genetic variability and heterosis studies in musk melon (*Cucumis melo* L.). M.Sc. (Hort.) Thesis, Univ. Agric. Sci., Dharwad. 2003.
21. Wright S. Correlation and causation. J Agric. Res. 1921; 20:557-585.