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Correlation analysis of musk melon, *Cucumis melo* genotypes grown under different water regimes in greenhouse

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ABSTRACT

Drought is most important abiotic stress factor responsible for greater yield loss than any other single stress condition in India. Water greatly influences the yield and quality of vegetables and thereby drastically reduces productivity including muskmelon. So, correlation study among 40 genotypes of muskmelon was done under different water regimes. The genotypes were sown in polythene bags in four replications for study root and shoot traits. Stress was imposed after germination of seeds by different levels of irrigation per day (50 ml, 25 ml and 0 ml) till 35 days old seedlings. The traits like root fresh weight with root dry weight (0.868** and 0.824**, 0.907** and 0.790** 0.896** and 0.837**), root shoot ratio by weight (0.719** and 0.643**, 0.659** and 0.602**, 0.577** and 0.468**) and root length (0.937** and 0.863**, 0.870** and 0.759**, 0.798** and 0.678**) ; root dry weight with root shoot ratio by weight (0.907** and 0.869**, 0.869** and 0.846**, 0.755** and 0.664**) and root length (0.844** and 0.792**, 0.903** and 0.741**, 0.760** and 0.640**); root shoot ratio by weight with root length (0.671** and 0.585**, 0.745** and 0.607**, 0.500** and 0.343**) were positive and significantly correlated with each other at both genotypic and phenotypic level under normal and water stress conditions. Hence selection of anyone of these traits enhances the performances of other traits.

KEY WORDS: MUSKMELON, GENOTYPES, GERMINATION, CORRELATION

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INTRODUCTION

Unpredictable drought is the single most important factor affecting world food security and the catalyst of the great famines of the past (Gale M., 2003). More than 80 percent of farmers in India are small and marginal (< 1 ha of land) thus having less capacity to cope with climate change impacts on agriculture, particularly who are mainly dependent on high return crops like vegetables (FAO, 2010). Due to succulent nature, water stress affects productivity and quality of vegetables including melons which will aggravate in changing climate scenario (AVRDC, 1990). Although, yield under drought stress is the primary trait for selection in breeding programmes. But, more emphasis has been diverted in recent days to improve several physiological traits through selection which confer drought tolerance without much compromising with yield reduction. Plant growth is one of the most drought-sensitive physiological processes due to the reduction in turgor pressure (Taiz and Zeiger, 2006). Root length of plants under imposed water stress registered high significant increases in root length above those of plants normal irrigated (Keshavagi *et al.,* 2006; Abdalla and El-Khoshiban, 2007; Songsri *et al.,* 2008) and be deeper under drought conditions than irrigated environment (Basal *et al*., 2003; Kamara *et al*., 2003; Rizza *et al.,* 2004 and Hufstetler *et al.,* 2007). Increasing the severity and duration of drought caused decline in shoot length (Cabello *et al*., 2009; Mirabad *et al*., 2013 and Pandey *et al.,* 2016).

The root/shoot length ratio is adaptive mechanism in response to water deficit; it is considered an important indicator for the ability of a genotype to tolerate drought stress. Root/shoot ratio increased under water stress condition to facilitate water absorption (Lambers *et al.,* 1998). An idea on the extent of association between traits conferring drought resistance will be much helpful to decide upon the traits to be given importance in selection for drought tolerance. A positive association between traits warrants the simultaneous improvement of both the traits while restricting selection to any one of the associated traits. By understanding the correlation between morphological traits such as root length, shoot length, root/shoot ratio), we can reach more efficiently for indirect selection of plants in relation to drought at early seedling stage (Riaz *et al*. 2013).

Hence, the present study was carried out to find association between traits like root length, shoot length, root shoot ratio by length, root shoot ratio by weight both in water stress and non-stress situations.

MATERIALS AND METHODS

Forty genotypes of musk melon (*Cucumis melo*), procured from National Agriculture Innovation Project ICAR, were used for the present investigation. The genotypes were evaluated under three moisture regimes in a randomized complete block design with four replications in Greenhouse at Bio-technology centre, SKRAU, Bikaner (Table 1). All the accessions were sown in perforated polythene bags of 110 cm length x 20 cm diameter dimension in four replications at 30^{0}C temperature for studying root and shoot traits. At initial stage, no stress was imposed till germination of seeds. Stress was created by different levels of irrigation per day (50 ml, 25 ml and 0 ml) in different sets after germination of seeds and imposed till 35 days old seedlings. After 35 days, the bottoms of polythene bags were cut opened and the sandy soil present in the polythene bags were washed without disturbing the root system. Then observations were recorded for root length (cm), shoot length (cm), root fresh weight (gm), shoot fresh weight (gm), root dry weight (gm) and shoot dry weight (gm). Root length was measured from root collar to the tip of main root. For measurement of root dry weight, roots of plants sampled at maturity were cut from the stem, dried moisture free in a hot air oven at 80^{0}C for 48 hours (till attaining constant weight). Shoot dry weight was measured after drying in oven at 80^{0}c for 48 hours. The Root shoot ratio by weight was worked out as follows: Root shoot Ratio = Root dry weight (in gm)/Shoot dry weight (in gm). Root shoot ratio by length was worked out as follows:

Table 1. List of muskmelon genotypes used for present investigation

S. N.	Genotype	S. N.	Genotype
1	ArkaJeeth	21	IIHR-RM-652
2	DurgapuraMadhu	22	IIHR-RM-653
3	EC-564755	23	IIHR-RM-655
4	IIHR-GPW-12	24	IIHR-RM-659
5	IIHR-GPW-15	25	IIHR-RM-660
6	GYNO	26	IIHR-RM-662
7	Hara Madhu	27	IIHR-RM-663
8	MM-06-662	28	IIHR-RM-671
9	MG-5	29	IIHR-RM-673
10	MS-1	30	IIHR-RM-675
11	Punjab-Sunehri	31	IIHR-RM-680
12	PusaMadhuras	32	IIHR-RM-681
13	IIHR-RM-43	33	IIHR-RM-699
14	IIHR-RM-190	34	IIHR-RM-708
15	IIHR-RM-352	35	IIHR-RM-712
16	IIHR-RM-387	36	IIHR-RM-716
17	IIHR-RM-604	37	IIHR-RM-718
18	IIHR-RM-616-1	38	IIHR-RM-719
19	IIHR-RM-619	39	IIHR-RM-720
20	IIHR-RM-624	40	EC-564754

Root shoot ratio by length = Root length (in gm)/Shoot length (in gm).

Statistical analysis: Analysis of variance and the expectations of mean squares were estimated according to Gomez and Gomez (1984). Differences between means were tested using the least significant difference (L.S.D.) test according Waller and Duncan (1969) at the 1 % and 5% level of probability. Correlation coefficients between any two characters were analysed as described by Al-Jibouri *et al.* (1958).

RESULTS AND DISCUSSION

A correlation study provides information to the breeder about importance of any trait. The estimates of genotypic correlation coefficient, in general, were higher in magnitude than phenotypic correlation coefficient for most of the characters under normal and water stress conditions. This indicates that there was high genetic relationship between the traits under study and environment has not much influencing in regarding their actual association. Similar finding have been reported by Singh and Chaudhary, (2007).

The traits like root fresh weight with root dry weight (0.868** and 0.824**, 0.907** and 0.790** 0.896** and 0.837**), root shoot ratio by weight (0.719** and 0.643**, 0.659** and 0.602**, 0.577** and 0.468**) and root length (0.937** and 0.863**, 0.870** and 0.759**, 0.798** and 0.678**) ; root dry weight with root shoot ratio by weight (0.907** and 0.869**, 0.869** and 0.846**, 0.755** and 0.664**) and root length (0.844** and 0.792**, 0.903** and 0.741**, 0.760** and 0.640**); root shoot ratio by weight with root length (0.671** and 0.585**, 0.745** and 0.607**, 0.500** and 0.343**) were positive and significantly correlated with each other at both genotypic and phenotypic level under normal and water stress conditions (Table 2, 3, 4).

Table 2. Genotypic and phenotypic correlation coefficients among eight characters in muskmelons genotypes under 50 ml (non-stress or 100% water) condition

S. No.	Characters	Levels	Root Fresh Weight (gm)	Shoot Fresh Weight (gm)	Root Dry Weight (gm)	Shoot Dry Weight (gm)	RDW/ SDW	Root Length (cm)	Shoot Length (cm)	Root Length/ Shoot length
1	Root fresh weight (gm)	G	1.000	0.230	0.868**	0.458**	0.719**	0.937**	0.366*	0.0009
		P	1.000	0.248	0.824**	0.382*	0.643**	0.863**	0.356*	-0.003
2	Shoot fresh weight (gm)	G		1.000	0.272	-0.106	0.304	0.315	0.261	-0.136
		P		1.000	0.240	-0.017	0.228	0.272	0.256	-0.142
3	Root dry weight (gm)	G			1.000	0.340*	0.907**	0.844**	0.375*	-0.054
		P			1.000	0.274	0.869**	0.792**	0.330*	-0.020
4	Shoot dry weight (gm)	G				1.000	-0.072	0.476**	-0.099	0.230
		P				1.000	-0.214	0.392*	-0.056	0.169
5	RDW/SDW	G					1.000	0.671**	0.457**	-0.176
		P					1.000	0.585**	0.364*	-0.113
6	Root length (cm)	G						1.000	0.268	0.111
		P						1.000	0.247	0.156
7	Shoot length (cm)	G							1.000	-0.900**
		P							1.000	-0.886**
8	Root length/ shoot length	G								1.000
		P								1.000

**Significant at 1% (P= 0.01) level of significance, *Significant at 5% (P=0.05) level of significance

Table 3. Genotypic and phenotypic correlation coefficients among eight characters in muskmelons genotypes under 25 ml (50% water or S1) stress condition

S. No.	Characters	Levels	Root Fresh Weight (gm)	Shoot Fresh Weight (gm)	Root Dry Weight (gm)	Shoot Dry Weight (gm)	RDW/ SDW	Root Length (cm)	Shoot Length (cm)	Root Length/ Shoot length
1	Root fresh weight (gm)	G	1.000	0.363*	0.907**	0.207	0.659**	0.870**	0.582**	0.368*
		P	1.000	0.212	0.790**	0.138	0.602**	0.759**	0.470**	-0.250
2	Shoot fresh weight (gm)	G		1.000	0.188	0.406*	-0.039	0.296	0.269	-0.218
		P		1.000	0.181	0.339*	-0.028	0.187	0.242	-0.208
3	Root dry weight (gm)	G			1.000	-0.013	0.869**	0.903**	0.501**	-0.218
		P			1.000	0.004	0.846**	0.741**	0.490**	-0.262
4	Shoot dry weight (gm)	G				1.000	-0.474**	0.111	-0.086	0.143
		P				1.000	-0.487**	0.111	-0.053	0.112
5	RDW/SDW	G					1.000	0.745**	0.449**	-0.269
		P					1.000	0.607**	0.422**	-0.253
6	Root length (cm)	G						1.000	0.339*	-0.056
		P						1.000	0.258	0.053
7	Shoot length (cm)	G							1.000	-0.937**
		P							1.000	-0.924**
8	Root length/ shoot length	G								1.000
		P								1.000

** Significant at 1% (P= 0.01) level of significance, * Significant at 5% (P=0.05) level of significance

Hence selection of anyone of these traits enhances the performances of other traits. Thus, indicating the need for scope of selection (Sandu and Kang, 1998). Natarajan, (1992) also reported that yield was positively and significantly correlated with root length and root dry weight in tomato. Similar results were also reported by Viera *et al.* (1995); Dias *et al.* (2002); Ahsan *et al.* (2010) and Riaz *et al.* (2013). Whereas characters namely root fresh weight, root dry weight and root shoot ratio by weight were significant and positive correlated with shoot length under non-stress (50 ml water per day) and 50% water stress condition (25 ml water per day) respectively. Riaz *et al.* (2013) also reported similar observations. Subburamu *et al.* (1998) also concluded that yield was significantly and positively correlated with shoot length. Root fresh weight was significantly and positively correlated with shoot fresh weight in 50% water stress condition. Ahsan *et al.* (2010) also reported significant and positive correlation between root fresh weight and shoot fresh weight under water stress conditions. Different response of traits under different environments for correlation may be due to different response of genotypes under different environments.

CONCLUSION

The characters like root fresh weight with root dry weight, root shoot ratio by weight and root length ; root dry weight with root shoot ratio by weight and root length; root dry weight with root length were positive and significantly correlated with each other in all the water regime conditions. Hence selection of anyone of these traits enhances the performance of other traits.

Table 4. Genotypic and phenotypic correlation coefficients among eight characters in muskmelons genotypes under 0 ml (0% water or S2) stress condition

S. No.	Characters	Levels	Root Fresh Weight (gm)	Shoot Fresh Weight (gm)	Root Dry Weight (gm)	Shoot Dry Weight (gm)	RDW/ SDW	Root Length (cm)	Shoot Length (cm)	Root Length/ Shoot length
1	Root fresh weight (gm)	G	1.000	-0.293	0.896**	-0.021	0.577**	0.798**	0.220	0.066
		P	1.000	-0.268	0.837**	-0.003	0.468**	0.678**	0.187	0.066
2	Shoot fresh weight (gm)	G		1.000	-0.337*	0.227	-0.370*	-0.086	-0.062	0.029
		P		1.000	-0.313	0.206	-0.334*	-0.059	-0.045	0.023
3	Root dry weight (gm)	G			1.000	-0.099	0.755**	0.760**	0.208	0.0004
		P			1.000	-0.062	0.664**	0.640**	0.194	0.009
4	Shoot dry weight (gm)	G				1.000	-0.683**	0.035	-0.058	0.140
		P				1.000	-0.702**	0.060	-0.006	0.074
5	RDW/SDW	G					1.000	0.500**	0.215	-0.119
		P					1.000	0.343**	0.155	-0.078
6	Root length (cm)	G						1.000	0.299	0.036
		P						1.000	0.220	0.162
7	Shoot length (cm)	G							1.000	-0.897**
		P							1.000	-0.864**
8	Root length/ shoot length	G								1.000
		P								1.000

**Significant at 1% (P= 0.01) level of significance, *Significant at 5% (P=0.05) level of significance

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