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Correlation Studies of Carrot (*Daucus carota* L.) germplasms from Garo Hills of Meghalaya, India

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ABSTRACT

Fifteen germplasm lines of carrot collected from different parts of Meghalaya, India were evaluated on the basis of 15 horticultural traits in a randomized block design with three replications at Krishi Vigyan Kendra, ICAR NEH, Sangsangiri, Tura, Meghalaya, India during winter season from October (2014) to January (2015). Correlation analysis was carried out to study the character association and contribution for ten quantitative characters, namely leaf length (cm), leaf width (cm), petiole length (cm) length(cm), root diameter (cm), days to root harvest, root weight (g) and yield (t/ha) for the identification of appropriate selection indices. Phenotypic and Genotypic correlation coefficient analysis revealed that root weight, days to root harvest, root length, leaf width, petiole length, leaf length and root diameter had significant positive correlation with marketable yield.

Keywords: Carrot germplasm lines, character association, character contribution, correlation analysis, yield components

Carrot (*Daucus carota* L., 2n= 2x= 18) is a popular root crop grown all over the world. Carrot belongs to the family Umbelliferae. Carrot is a cool season crop. It is grown all over the world in spring, summer and autumn in temperate countries and during winter in tropical and subtropical climate. It is native of Europe and South Western Asia. Fleshy edible roots of carrot are used as human food and animal feed. Carrot juice is rich in carotene. Besides being food, carrot has therapeutic importance as it enhances resistance against blood and eye diseases.

Correlation coefficient analyses are prerequisites for improvement of any crop including carrot for selection of superior genotypes and improvement of any trait. In plant breeding, correlation analysis provides information about yield components and thus helps in selection of superior genotypes from diverse genetic populations. The correlation studies simply measure the associations between yield and other traits. Such information provides a realistic basis for allocation of appropriate weightage to various yield components.

In carrot, correlation coefficient analyses have been used by several researchers to measure the associations between yield and other traits and to clarify interrelationships between yield and other traits, respectively. In this study, an attempt was made to study the interrelationship among different characters and the direct and indirect effects of some important yield components on root yield by adopting correlation coefficient analysis.

MATERIALS AND METHODS

Field experiments for germplasm evaluation for various horticultural traits in carrot germplasms was conducted in randomized block design with 3 replication during winter season, 2014-15 at Krishi Vigyan Kendre (KVK), ICAR, NEH, Sangsangiri, Tura, Meghalaya, India (25°31' N latitude and 90° 13'E longitude and 527 m above MSL). Fifteen germplasm accessions of carrot were obtained from different parts of Meghalaya, India (Table 1). The soil was well drained sandy loam having pH 5.82, organic carbon 0.93% and available N, P and K were 212.21 kg/ha, 20.34 kg/ha and 118.42 kg/ha respectively. The spacing between the rows was kept 20 cm while, within the row it was 10cm. Initially the seed were sown in the row in line by broadcasting and later 5 plants per germplasm were maintained. Similar recommended cultural practices were followed throughout the crop period. Data were recorded for seven qualitative and eight quantitative traits. Qualitative characters were recorded for both plant and root basis for leaf colour, leaf size, root forking, root colour, root shape, root tail and root cracking.

Table 1: Sources of different germplasm lines of Radish

Sl. No.	Name of the varieties	Sources
1	Tura Selection-4	Sangsanggiri, Meghalaya
2	Tura Selection-8	Garobadha, Meghalaya
3	Shillong-3	Garobadha, Meghalaya
4	Shillong-1	Shillong, Meghalaya
5	Tura selection-1	Sangsanggiri, Meghalaya
6	Tura Selection-2	Rongram Meghalaya
7	Tura Selection-5	Tura, Meghalaya
8	Tura Selection-6	Garobadha, Meghalaya
9	Tura Selection-3	Cherangri, Meghalaya
10	Tura Selection-7	Garobadha, Meghalaya
11	Shillong 2	Tura, Meghalaya
12	Tura Selection-9	Rongram, Meghalaya
13	Tura Selection-10	Garobadha, Meghalaya
14	Tura Selection-11	Tura, Meghalaya
15	Tura Selection-12	Tura, Meghalaya

Quantitative characters like leaf length (cm), leaf width (cm), petiole length (cm), root length (cm), root diameter (cm), root weight (g), days to root harvest and yield (t/ha) were also recorded. Trait selection and measurement techniques were based on NBPGR descriptors by taking average measurement of five plants. Root growth measurements were taken at the time of harvest (marketable root stage). The mean for each trait over three replications was computed for each genotype and analyzed statistically as per randomized block design or RBD described by Panse and Sukhatme (1969) using SPSS version 16 statistical package.

RESULTS AND DISCUSSION

Fifteen carrot germplasm lines were evaluated on the basis of fifteen qualitative and quantitative traits. Analysis of variance for eight quantitative characters namely leaf length, leaf width, petiole length, root length, root diameter, days to root harvest, root weight and yield revealed highly significant differences among the carrot genotypes studied.

Complex characteristics such as yield must be related to many individually distinguishable characteristics. It is noticeable that yield is a complex character that depends up on many independent yield contributing characters, which are regarded as yield components. All changes in the components need not however, be expressed by changes in yield. This is due to varying degree of positive and negative associations between yield and its components and among components themselves. Therefore, selection should be based on these component characters after assessing their association with yield. The phenotypic and genotypic correlation coefficients are presented in Table 2 and 3.

Table 2: Phenotypic correlation coefficients among different characters of carrot

Characters	Leaf length (cm)	Leaf width (cm)	Petiole length (cm)	Root length (cm)	Root diameter (cm)	Root weight (g)	Days to root harvest	Yield (T/ha)
Leaf length (cm)	1	0.51**	0.01	0.38**	0.30*	0.35*	0.34*	0.35*
Leaf width (cm)		1	0.24	0.43**	0.39**	0.34*	0.34*	0.34*
Petiole length(cm)			1	0.16	0.43**	0.19	0.18	0.19
Root length(cm)				1	0.58**	0.64**	0.59**	0.64**
Root diameter(cm)					1	0.45**	0.46**	0.45**

Root weight (g)						1	0.79**	0.98**
Days to root harvest							1	0.99**
Yield (T/ha)								1

Table 3: Genotypic correlation coefficients among different characters of carrot

Characters	Leaf length (cm)	Leaf width (cm)	Petiole length (cm)	Root length (cm)	Root diameter (cm)	Root weight (g)	Days to root harvest	Yield (T/ha)
Leaf length(cm)	1	0.79**	-0.09	0.57**	0.48**	0.46**	0.45**	0.46**
Leaf width (cm)		1	0.26	0.74**	0.84**	0.55**	0.55**	0.55**
Petiole length(cm)			1	0.50**	0.99**	0.36*	0.37*	0.36*
Root length(cm)				1	0.96**	0.74**	0.78**	0.74**
Root diameter(cm)					1	0.79**	0.79**	0.79**
Root weight (g)						1	0.78**	0.99**
Days to root harvest							1	0.98**
Yield (T/ha)								1

From the study it was found that, root weight and root length largely determine the yield and thus are considered as growth attributes. In the present study, the characters showing the highest phenotypic correlation with yield were days to root harvest (0.99**) followed by root weight (0.98**), root length (0.64**), root diameter (0.45**), leaf length (0.35*) and leaf width (0.34*). All these correlation coefficients were positive and highly significant (P= 1%) (days to root harvest, root weight, root length and root diameter) and significant (P= 5%) (leaf length and leaf weight). Days to root harvest showed positive and significant correlation co-efficient with root weight (0.79**), root length (0.59**), root diameter (0.46**), leaf length (0.34*) and leaf width (0.34*). Root weight showed positive and significant correlation co-efficient with root length (0.64**), root diameter (0.45**), leaf length (0.35*) and leaf width (0.34*). Root diameter showed positive and significant correlation co-efficient with root length (0.58**), petiole length (0.43**), leaf width (0.39**) and leaf length (0.30*). Root length showed positive and significant correlation co-efficient with leaf width (0.43**) and leaf length (0.38**). Petiole length showed positive correlation co-efficient with leaf width (0.24) and leaf length (0.01). Leaf width showed positive and highly significant with leaf length (0.51**) and these results are in accordance with the findings of Muthukrishnan and Arumugam (1997).

At genotypic level highly significant and positive correlation were obtained for association with yield were root weight (0.99**), days to root harvest (0.98**), root diameter (0.79**), root length (0.74**), leaf width (0.55**), leaf length (0.46**) and petiole length (0.36*). Days to root harvest showed positive and significant correlation co-efficient with root diameter (0.79**), root weight (0.78**), root length (0.78**), leaf width (0.55**), leaf length (0.45**) and petiole length (0.37*). Root weight showed positive and significant correlation co-efficient with root diameter (0.79**), root length (0.74**), leaf width (0.55**), leaf length (0.46**) and petiole length (0.36*). Root diameter showed positive and significant correlation co-efficient with petiole length (0.99**), root length (0.96**), leaf width (0.84**) and leaf length (0.48**). Root length showed positive and significant correlation co-efficient with leaf width (0.74**), leaf length (0.57**) and petiole length (0.50**). Petiole length showed positive correlation co-efficient with leaf width (0.26). Leaf width showed positive and highly significant with leaf length (0.79**).

With respect to yield comparatively large difference between the genotypic correlation coefficient and phenotypic correlation coefficient was recorded with average root diameter (r_g= -0.00, r_p=0.06), leaf width (r_g=0.52, r_p=0.48) and leaf length (r_g=0.31, r_p=0.41). while, rest other characters have shown little difference between the genotypic correlation coefficient and phenotypic correlation coefficient and was recoeded with yield (r_g=0.98, r_p=0.94), root weight (r_g=0.16, r_p=0.11), root length (r_g=0.37, r_p= 0.32), crown head diameter (r_g=-0.45, r_p=-0.44) and petiole length (r_g=-0.34, r_p=-0.32).

Generally, positive and significant association of pairs of characters justified the possibility of correlated response to select. The negative and significant correlation prohibits the simultaneous improvement of those traits. The non significant coefficient of correlation indicates that selection for these different traits could be done separately and independently (Aynewa *et al.,* 2013). From the perusal of the estimates of phenotypic and genotypic correlation coefficient (Table 3 and 4), in general, it was observed that estimates of genotypic correlation coefficients were in most cases higher than their corresponding phenotypic correlation coefficients. More significant genotypic association was observed between the different pairs of characters than the phenotypic correlation which means genetically, there is strong association between those characters, but the phenotypic value is lessened by the significant interaction of environment. The present findings are in consonance with the earlier findings of Muthukrishnan and Arumugam (1997).

CONCLUSION

Yield is considered to be a complex, polygenic and highly variable character determined by cumulative effects of its component characters. Therefore, direct selection for yield may not be very effective and precise. Thus, it becomes necessary to find out the direction and degree of association between two characters at phenotypic and genotypic levels. In general, it was observed that estimates of genotypic correlation coefficients were in most cases higher than their corresponding phenotypic correlation coefficients. At both phenotypic and genotypic levels, the total yield showed highly significant and positive correlation with root weight, days to root harvest, root length, leaf width and root diameter. Thus the analysis of association of different characters with yield will help to select the yield contributing characters in breeding process.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests for the work.

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