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Association and path correlation studies in Radish (*Raphanus sativus* L.) under valley condition of Uttarakhand

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Abstract

Twenty genotypes of radish (*Raphanus sativus* L.) were evaluated in Randomized Block Design during Rabi season 2010-11 at experimental farm of Horticultural Research Centre, Chauras Campus, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand (India) to assess the correlation coefficient and path coefficient analysis. Root yield/plant was positively correlated with plant height 40 days after sowing, number of leaves 40 days after sowing, plant height 50 days after sowing, number of leaves 50 days after sowing, plant height 60 days after sowing, number of leaves 60 days after sowing, number of leaves 70 days after sowing, total plant height after harvesting, total plant weight and leaf weight, while it showed negative correlation with plant height 70 days after sowing at phenotypic and genotypic levels. The maximum positive direct effects on root yield/plant was observed by number of leaves 70 days after sowing followed by plant height 70 days after sowing and plant height 60 days after sowing, while plant height 50 days after sowing, number of leaves 60 days after sowing, total plant height after harvesting, total plant weight and root length had negative direct effect.

Keywords: radish, correlation, path coefficient

Introduction

Radish (*Raphanus sativus* L.) is a popular vegetable which is grown from temperate to tropical regions. It is one of the important root vegetables. Radish is a good source of vitamin-C (ascorbic acid), and supplies a variety of minerals. The edible portion of radish root develops from both the primary root and the hypocotyls. It is a favorite's crop of the kitchen garden as it is easily grown and is ready for use within 3 to 6 weeks from the time of seed sowing. Selection based upon yield alone will not be very much effective unless, the emphasis is given to various yield components. The knowledge of correlation among yield and its contributing traits may be helpful to a plant breeder to determine the degree of association between them and help to improve the efficiency of selection by the use of favourable combination of characters and to minimize the retarding effect of those characters which are negatively correlated. Correlation coefficient studies measures the association between the characters without any concern to causation, to get clear cut idea about relationship path coefficient analysis is the best technique because it measures direct and indirect effect of each characters towards yield. The genotypic correlation coefficient were thus, further partitioned into direct and indirect effects to find out the cause and effect relationship of various traits of yield. Therefore, the present investigation were undertaken to study the correlation coefficient and path coefficient analysis.

Materials and Methods

The experimental materials constituted a germplasm collection of 20 varieties of radish (*Raphanus sativus* L.). The experiment was conducted in rabi season, 2010-11 at Horticultural Research Centre, Chauras Campus, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand (India) situated in the Alaknanda valley (78° 47' 30" E longitude and 30° 13' 0" N latitude and at an elevation of 550 m above msl), a semi-arid, sub-tropical climate with dry summer and rigorous winters with occasional dense fog in the morning hours from mid-December to mid-February. The experiment was laid out in Randomized Block Design with three replications. The entire experimental field was divided into three blocks of equal size and each block possessed 20 plots. Each plot measured 1.80 X 1 m² area. The varieties were sowed at ridges of 23to25cm above the soil surface and spacing of ridges to ridges is 45cm and plant to plant 6to8cm and seed are sown 1.5 to 3cm deep in the soil. All the recommended agronomic practices were followed to raise a healthy crop Choudhury (2000) [2].

Observations were recorded on five randomly selected plants for 19 quantitative and qualitative traits *viz.*, plant height after 40 days of sowing, number of leaves after 40 days of sowing, plant height after 50 days of sowing, number of leaves after 50 days of sowing, plant height after 60 days of sowing, number of leaves after 60 days of sowing, plant height after 70 days of sowing, number of leaves after 70 days of sowing, plant height after harvesting, total plant weight, leaf weight, root yield/plant, leaf length, root length, root diameter, number of leaves, TSS, vitamin C and acidity. The data obtained from selected plants under each treatment were subjected for phenotypic and genotypic correlation which was worked out by employing the formula suggested by Al-Jibouri *et al.* (1958)^[1]. The direct and indirect contribution of various characters to yield were calculated through path coefficient analysis as suggested by Wright (1921)^[9] and elaborated by Dewey and Lu (1959)^[4].

Results and Discussion

The estimates of genotypic and phenotypic correlation coefficient (Table 1.) showed that the phenotypic correlation were of higher magnitude than the corresponding genotypic

for most of the characters combination. The results indicated that root yield per plant was significant and positively correlated with plant height 40 days after sowing (0.70), number of leaves 40 days after sowing (0.68), plant height 50 days after sowing (0.45), number of leaves 50 days after sowing (0.68), plant height 60 days after sowing (0.56), number of leaves after 60 days after sowing (0.96), number of leaves 70 days after sowing (0.86), total plant height after harvesting (0.92), total plant weight (0.86) and leaf weight (0.62), while it showed negative correlation with plant height 70 days after sowing (-0.94) at phenotypic levels. These finding are also in the agreement with those of Murali *et al.* (1998)^[6], Danu and Lal (1998)^[3], Singh *et al.* (2002)^[8], Ullah *et al.* (2002), Mukhdoomi *et al.* (2008)^[5] and Shama *et al.* (2009)^[7].

The maximum positive direct effects on root yield/plant (Table 2.) was observed by number of leaves 70 days after sowing (4.15) followed by plant height 70 days after sowing (1.92) and plant height 60 days after sowing (1.80), while plant height 50 days after sowing (-3.02), number of leaves 60 days after sowing (-1.59), total plant height after harvesting (-2.21) and total plant weight (-1.75) had negative direct effect.

Table 1: Genotypic and phenotypic correlation for 19 quantitative and qualitative traits in radish

character	Plant height 40 DAS(cm)	Number of leaves 40 DAS	Plant height 50 DAS (cm)	Number of leaves 50 DAS	Plant height 60 DAS (cm)	Number of leaves 60 DAS	Plant height 70 DAS (cm)	Number of leaves 70 DAS	Total Plant height after harvesting (cm)	Total plant weight (g)	Leaf weight (g)	Root yield/plant (g)	Leaf length (cm)	Root length (cm)	Root diameter (cm)	No. of leaves	T.S.S (° Brix)	Vitamin C (mg/100g)	Acidity (mg/100g)
Plant height 40 DAS(cm)	x	0.47 (0.94)**	0.65 (0.80)**	0.33 (0.77)**	0.66 (0.23)	0.33 (0.75)**	0.53 (0.75)**	0.37 (0.55)**	0.25 (0.72)**	0.01 (0.53)**	0.02 (0.24)	0.24 (0.70)**	0.25 (0.32)	0.05 (0.74)**	-0.41 (-0.75)**	0.08 (0.73)**	0.11 (-0.49)**	-0.37 (-0.44)**	0.25 (0.37)**
Number of leaves 40 DAS		x	0.55 (0.93)**	0.79 (0.83)**	0.50 (0.26)	0.76 (0.68)**	0.19 (0.65)**	0.75 (0.63)**	0.27 (0.69)**	0.45 (0.54)**	0.37 (0.34)	0.50 (0.68)**	0.03 (0.35)	0.54 (0.69)**	-0.04 (-0.66)**	0.61 (-0.69)**	0.08 (-0.65)**	0.05 (0.47)**	-0.03 (-0.42)**
Plant height 50 DAS(cm)			x	0.57 (0.65)**	0.90 (0.07)	0.54 (0.46)**	0.66 (0.46)**	0.55 (0.45)**	0.54 (0.52)**	0.30 (0.29)	0.46 (0.16)	0.37 (0.45)**	0.58 (0.13)	0.30 (0.47)**	-0.34 (-0.44)**	0.35 (0.46)**	0.15 (-0.49)**	0.04 (0.26)	-0.05 (-0.25)
Number of leaves 50 DAS				x	0.55 (0.72)**	0.86 (0.66)**	0.19 (0.56)**	0.82 (0.79)**	0.39 (0.55)**	0.60 (0.83)**	0.57 (0.74)**	0.64 (0.68)**	0.02 (0.78)**	0.66 (0.62)**	-0.056 (-0.57)**	0.62 (0.65)**	0.14 (-0.60)**	0.26 (0.79)**	-0.13 (-0.55)**
Plant height 60 DAS(cm)					x	0.45 (0.52)**	0.79 (0.38)**	0.43 (0.83)**	0.60 (0.35)	0.15 (0.89)**	0.33 (0.95)**	0.22 (0.56)**	0.68 (0.98)**	0.26 (0.44)**	-0.55 (-0.38)**	0.12 (0.50)**	0.27 (-0.55)**	-0.02 (-0.89)**	-0.04 (-0.63)**
Number of leaves 60 DAS						x	0.072 (0.97)**	0.95 (0.85)**	0.58 (0.96)**	0.75 (0.80)**	0.70 (0.55)**	0.79 (0.96)**	0.14 (0.57)**	0.83 (0.98)**	0.12 (0.98)**	0.79 (0.98)**	0.08 (-0.77)**	0.32 (0.70)**	-0.19 (-0.60)**

Table 1: Contd.

character	Plant height 40 DAS(cm)	Number of leaves 40 DAS	Plant height 50 DAS (cm)	Number of leaves 50 DAS	Plant height after 60 DAS(cm)	Number of leaves 60 DAS	Plant height 70 DAS(cm)	Number of leaves 70 DAS	Total Plant height after harvesting (cm)	Total plant weight (g)	Leaf weight (g)	Root yield/plant (g)	Leaf length (cm)	Root length (cm)	Root diameter (cm)	No. of leaves	T.S.S (° Brix)	Vitamin C (mg/100g)	Acidity (mg/100g)
Plant height 70 DAS(cm)							x	-0.04 (-0.72)**	0.38 (0.96)**	-0.25 (-0.72)**	-0.11 (-0.40)**	-0.24 (-0.94)**	0.67 (0.46)**	-0.11 (-0.97)**	-0.73 (-0.99)**	-0.26 (-0.96)**	-0.29 (-0.68)**	-0.12 (-0.59)**	0.04 (0.55)**
Number of leaves 70 DAS								x	0.57 (0.77)**	0.84 (0.95)**	0.78 (0.86)**	0.88 (0.86)**	0.10 (0.85)**	0.85 (0.82)**	0.16 (0.75)**	0.90 (0.85)**	0.02 (0.86)**	0.29 (0.90)**	-0.08 (-0.73)**
Total Plant height after harvesting (cm)									x	0.60 (0.67)**	0.69 (0.45)**	0.56 (0.92)**	0.75 (0.42)**	0.74 (0.98)**	-0.22 (-0.96)**	0.46 (0.97)**	-0.13 (-0.80)**	0.33 (0.62)**	-0.30 (-0.49)**
Total plant weight (g)										x	0.93 (0.89)**	0.93 (0.86)**	0.15 (0.94)**	0.88 (0.76)**	0.36 (0.73)**	0.88 (0.80)**	-0.04 (-0.76)**	0.63 (0.92)**	-0.36 (-0.79)**
Leaf weight (g)											x	0.85 (0.62)**	0.37 (0.96)**	0.82 (0.50)**	0.25 (0.43)**	0.78 (0.58)**	-0.02 (-0.68)**	0.60 (0.95)**	-0.32 (-0.56)**
Root yield/plant (g)												x	0.05 (0.64)**	0.86 (0.95)**	0.35 (0.95)**	0.86 (0.96)**	0.03 (0.83)**	0.43 (0.74)**	-0.18 (-0.72)**

Table 1: Contd.

Character	Plant height 40 DAS(cm)	Number of leaves 40 DAS	Plant height 50 DAS (cm)	Number of leaves 50 DAS	Plant height 60 DAS (cm)	Number of leaves 60 DAS	Plant height 70 DAS(cm)	Number of leaves 70 DAS	Total Plant height after harvesting (cm)	Total plant weight (g)	Leaf weight (g)	Root yield/plant (g)	Leaf length (cm)	Root length (cm)	Root diameter (cm)	No. of leaves	T.S.S (° Brix)	Vitamin C (mg/100g)	Acidity (mg/100g)
Leaf length (cm)													x	0.19 (0.52)**	-0.44 (-0.46)**	-0.02 (-0.58)**	-0.21 (-0.60)**	0.24 (0.94)**	-0.18 (-0.65)**
Root length (cm)														x	0.13 (0.98)**	0.83 (0.99)**	-0.05 (-0.80)**	0.47 (0.80)**	-0.31 (-0.58)**
Root diameter (cm)															x	0.33 (0.97)**	0.15 (0.73)**	0.36 (0.60)**	-0.25 (-0.56)**
No. of leaves																x	0.08 (0.83)**	0.38 (0.73)**	-0.13 (-0.60)**
T.S.S (° Brix)																	x	-0.26 (-0.78)**	0.02 (0.62)**
Vitamin C (mg/100g)																		x	-0.42 (-0.55)**
Acidity (mg/100g)																			x

*, ** = Significant at 5 % and 1 % level of significant, respectively
(Value in paranthesis indicated phenotypic correlation coefficient)

Table 2: Direct and indirect effects on main diagonal of 19 characters in radish.

character	Plant height 40 DAS (cm)	Number of leaves 40 DAS	Plant height 50 DAS (cm)	Number of leaves 50 DAS	Plant height 60 DAS (cm)	Number of leaves 60 DAS	Plant height 70 DAS (cm)	Number of leaves 70 DAS	Total Plant height after harvesting (cm)	Total plant weight (g)	Leaves weight (g)	Leaves length (cm)	Root length (cm)	Root diameter (cm)	No. of leaves	T.S.S	Vitamin C	Root weight (g)
Plant height 40 DAS (cm)	<u>-0.62</u>	-0.35	-1.95	-0.15	1.19	-0.50	1.01	1.50	-0.53	-0.01	0.01	0.20	-0.01	-0.07	0.05	0.01	0.17	0.29
Number of leaves 40 DAS	-0.29	<u>-0.76</u>	-1.66	-0.38	0.91	-1.22	0.37	3.12	-0.59	-0.77	0.24	0.18	-0.08	-0.01	0.48	0.01	-0.02	0.62
Plant height 50 DAS (cm)	-0.40	-0.41	<u>-3.02</u>	-0.27	1.63	-0.85	1.28	2.29	-1.17	-0.53	0.30	0.48	-0.04	-0.06	0.27	0.01	-0.01	0.62
Number of leaves 50 DAS	-0.20	-0.60	-1.73	<u>-0.48</u>	0.97	-1.38	0.37	3.40	-0.86	-1.05	0.38	0.01	-0.10	-0.01	0.49	0.01	-0.12	0.78
Plant height 60 DAS (cm)	-0.41	-0.38	-2.74	-0.26	<u>1.80</u>	-0.73	1.53	1.71	-1.33	-0.24	0.21	0.56	-0.04	-0.10	0.09	0.02	0.01	0.25
Number of leaves 60 DAS	-0.20	-0.58	-1.61	-0.42	0.82	<u>-1.59</u>	0.13	3.93	-1.30	-1.32	0.47	0.10	-0.13	0.02	0.64	0.01	-0.14	0.98
Plant height 70 DAS (cm)	-0.32	-0.14	-2.01	-0.09	1.43	-0.11	<u>1.92</u>	-0.16	-0.84	0.43	-0.06	0.55	0.01	-0.13	-0.21	0.03	0.05	-0.28
Number of leaves 70 DAS	-0.22	-0.57	-1.67	-0.39	0.74	-1.50	-0.07	<u>4.15</u>	-1.26	-1.46	0.52	0.08	-0.13	0.02	0.72	-0.06	-0.13	1.10

Table 2: Contd.

character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Total Plant height after harvesting (cm)	-0.15	-0.2	-1.6	-0.18	1.08	-0.93	0.73	2.37	-2.21	-1.05	0.46	0.62	-0.11	-0.03	0.37	0.01	-0.14	0.68
Total plant weight (g)	-0.01	-0.33	-0.92	-0.29	0.25	-1.2	-0.47	3.47	-1.33	-1.75	0.61	0.12	-0.14	0	0.7	0.01	-0.28	1.14
Leaves weight (g)	-0.01	-0.28	-1.39	-0.27	0.58	-1.12	-0.19	3.27	-1.54	-1.61	0.66	0.31	-0.13	0.04	0.62	0.07	-0.27	1.04
Leaves length (cm)	-0.15	-0.01	-1.76	-0.06	1.23	-0.21	1.29	0.44	-1.67	-0.25	0.25	0.82	-0.03	-0.07	-0.01	0.02	-0.1	0.05
Root length (cm)	-0.03	-0.4	-0.92	-0.32	0.48	-1.32	-0.19	3.49	-1.62	-1.54	0.54	0.16	-0.16	0.02	0.66	0.04	-0.21	1.07
Root diameter (cm)	0.25	0.02	1.02	0.02	-0.98	-0.19	-1.39	0.65	0.47	-0.64	0.16	-0.35	-0.02	0.18	0.27	-0.01	-0.16	0.43
No. of leaves	-0.04	-0.45	-1.03	-0.29	0.2	-1.27	-0.51	3.74	-1.03	-1.54	0.52	-0.01	-0.13	0.06	0.8	-0.08	-0.17	1.07
T.S.S	0.06	0.06	0.42	0.06	-0.5	0.11	-0.57	0.02	0.28	0.06	-0.04	-0.16	0.07	0.02	0.06	-0.1	0.12	0.02
Vitamin C	0.23	-0.04	-0.1	-0.12	-0.04	-0.5	-0.21	1.21	-0.71	-1.08	0.4	0.18	-0.07	0.06	0.3	0.02	-0.46	0.52

Conclusion

The present findings clearly indicated that emphasis should be given to characters like, total plant weight, Vitamin C, root yield/plant, total soluble solid, leaf weight and number of leaves at the time of selection.

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