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Correlation and Path Coefficient studies in Turnip (*Brassica rapa* L.) for yield and its attributing traits

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ABSTRACT

A study was conducted in Horticulture Research Centre, Chauras Campus, H. N. B. Garhwal University, Srinagar (Garhwal), Uttarakhand, India, during winter season 2017-18 by using fifteen strains of turnip replicated three times in a Randomized Block Design. Root yield/plant was positively correlated with plant height 30, 60 and 75 days after sowing, number of leaves 30, 60 and 75 days after sowing, total plant weight, leaf length, root length and root diameter at phenotypic and genotypic levels. The maximum positive direct effects on root yield/plant were observed by number of leaves 75 days after sowing followed by plant height 75 days after sowing, plant height 60 days after sowing, while total plant height after harvesting, plant height 30 days after sowing, number of leaves 60 days after sowing and total plant weight had negative direct effect

KEYWORDS

Path Coefficient, Correlation, Turnip, Growth, Yield

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Turnip (*Brassica rapa* L.) is an economically and nutritionally significant root vegetable belonging to the family *Brassicaceae*, which comprises several important horticultural crops. Widely cultivated across temperate and tropical regions, turnip is well-adapted to diverse agro-climatic conditions. It is valued for its edible swollen root, which develops from both the primary root and the hypocotyl, and is consumed either raw or cooked. Turnip is rich in essential nutrients, including vitamins (such as vitamin C), minerals, dietary fiber, and antioxidants, making it an important component of a balanced diet. Its short growing period, high yield potential, and suitability for off-season and kitchen garden cultivation further enhance its agronomic and economic importance. Despite its recognized value, the genetic improvement of turnip has lagged behind other vegetable crops, particularly in terms of targeted breeding for yield enhancement.

Yield in turnip, as in many other crops, is a complex polygenic trait influenced by a multitude of physiological, morphological, and environmental factors. Direct selection for yield is often inefficient due to the high degree of environmental interaction and low heritability of the trait. Therefore, understanding the interrelationships between yield and its contributing traits is essential for effective selection and genetic improvement. Previous studies in various crops have demonstrated the usefulness of correlation and path coefficient analyses in identifying key traits that directly or indirectly influence yield. While some work has been carried out on the agronomic evaluation of turnip, there is limited information available on the precise contribution of yield components through statistical approaches such as correlation and path analysis in this crop. This presents a significant research gap that needs to be addressed to facilitate more efficient breeding strategies.

The present study aims to fill this gap by conducting correlation and path coefficient analyses in turnip to assess the relationships between yield and its attributing traits. By identifying the traits with the most substantial direct and indirect effects on yield, this research will provide valuable insights for breeders aiming to develop high-yielding varieties through selection of appropriate trait combinations. This approach is expected to improve the precision and effectiveness of selection in turnip breeding programs.

Materials and Methods

A field experiment was carried out in winter season, 2017-18 at Horticultural Research Centre, Chauras Campus of 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) at an elevation of 550 m above mean sea level, 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 study consists of fifteen genotypes of turnip which was collected from different parts of country. The entire trial field was equally divided into three blocks of equal size and each block possessed 15 plots.

Each plot size 2 X 2 m^2 areas and the seed are sown 2 cm deep in the soil. All the recommended agronomic practices were followed to raise a healthy crop (Choudhury, 2000). The parameters were recorded for ten selected plants. The data recorded for each character on the basis of observational plants were averaged and the mean values obtained were used for statistical analysis. Correlation coefficients were worked out to determine the degree of association among the characters as well as yield. Correlations of various biometrical characters were undertaken as per the procedure suggested by (Al-Jibouri *et.al.*, 1958). Path analysis was done as per the procedure outlined by (Wright, 1921 and Dewey and Lu, 1959).

Results and Discussion

The estimates of genotypic and phenotypic correlation coefficient (table 1) showed that the phenotypic correlation was of higher magnitude than the corresponding genotypic ones for most of the characters combination. This could be interpreted on the basis that there was a strong inherent genotypic relationship between the characters studied, but their phenotypic expression was impeded by the influence of environmental factors. The results indicated that root yield per plant was significant and positively correlated with plant height 30 days after sowing (0.75), number of leaves 30 days after sowing (0.78), plant height 60 days after sowing (0.49), number of leaves 60 days after sowing (0.88), plant height 75 days after sowing (0.66), number of leaves after 75 days after sowing (0.88), number of leaves 75 days after sowing (0.98), total plant height after harvesting (0.59), total plant weight (0.76), leaf length (0.66), root length (0.99) and root diameter (0.89) while it showed negative correlation with acidity (-0.82) at phenotypic levels. This might be due to the fact that increase in root size tends to increase the sugar accumulation thereby reducing acidity. These finding are also in the agreement with those of (Murali *et al*., 1998, Danu and Lal, 1998, Singh *et al.*, 2002, Ullah *et al.*, 2002, Mukhdoomi *et al.*, 2008 and Shama *et al.*, 2009). The estimation of correlation coefficients indicates only the extent and nature of association between yield and its components, but does not show the direct and indirect effects of different yield attributes on yield per se.

Table 1. Genotypic and phenotypic correlation coefficient among yield and yield attributes in turnip

Character	Plant Height 30 DAS (cm)	Number of Leaves 30 DAS	Plant Height 60 DAS (cm)	Number of Leaves 60 DAS	Plant Height 75 DAS (cm)	Number of Leaves 75 DAS	Total Plant Height (cm)	Total Plant 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 30 DAS (cm)	x	0.49 (0.96) **	0.67 (0.82) **	0.35 (0.79) **	0.68 (0.29)	0.38 (0.77) **	0.29 (0.74) **	0.05 (0.55) **	0.32 (0.75) **	0.29 (0.34)	0.09 (0.77) **	-0.49 (-0.79) **	0.010 (0.75) **	-0.16 (-0.45) **	-0.39 (-0.48) **	0.28 (0.39) **
Number of Leaves 30 DAS		x	0.58 (0.99) **	0.86 (0.96) **	0.55 (0.28)	0.81 (0.71) **	0.30 (0.71) **	0.55 (0.60) **	0.60 (0.78) **	0.04 (0.45)	0.55 (0.79) **	-0.09 (-0.78) **	0.69 (-0.79) **	-0.18 (-0.85) **	0.15 (0.59) **	-0.23 (-0.82) **
Plant Height 60 DAS (cm)			x	0.58 (0.67) **	0.93 (0.09)	0.60 (0.50) **	0.55 (0.61) **	0.33 (0.25)	0.41 (0.49) **	0.68 (0.23)	0.36 (0.57) **	-0.45 (-0.58) **	0.40 (0.55) **	-0.25 (-0.59) **	0.10 (0.36)	-0.10 (-0.45)
Number of Leaves 60 DAS				x	0.60 (0.80) **	0.87 (0.70) **	0.41 (0.58) **	0.63 (0.88) **	0.69 (0.88) **	0.04 (0.88) **	0.86 (0.62) **	-0.069 (-0.68) **	0.69 (0.75) **	-0.24 (-0.68) **	0.16 (0.89) **	-0.23 (-0.65) **
Plant Height 75 DAS (cm)					x	0.50 (0.60) **	0.69 (0.40)	0.20 (0.92) **	0.32 (0.66) **	0.78 (0.98) **	0.30 (0.49) **	-0.60 (-0.40) **	0.26 (0.59) **	-0.20 (-0.56) **	-0.12 (-0.90) **	-0.14 (-0.73) **
Number of Leaves 75 DAS						x	0.45 (0.89) **	0.82 (0.96) **	0.88 (0.98) **	0.24 (0.47) **	0.88 (0.99) **	0.23 (0.97) **	0.89 (0.97) **	-0.10 (-0.89) **	0.42 (0.78) **	-0.20 (-0.68) **
Total Plant Height (cm)							x	0.69 (0.59) **	0.54 (0.99) **	0.65 (0.32) **	0.78 (0.88) **	-0.28 (-0.99) **	0.266 (0.897) **	-0.26 (-0.73) **	0.39 (0.52) **	-0.32 (-0.52) **
Total Plant Weight (g)								x	0.98 (0.76) **	0.47 (0.88) **	0.85 (0.66) **	0.45 (0.63) **	0.79 (0.86) **	-0.22 (-0.66) **	0.53 (0.82) **	-0.46 (-0.78) **
Root Yield/ Plant (g)									x	0.25 (0.55) **	0.79 (0.89) **	0.41 (0.89) **	0.90 (0.98) **	0.13 (0.93) **	0.63 (0.84) **	-0.29 (-0.82) **
Leaf Length (cm)										x	0.20 (0.66) **	-0.28 (-0.78) **	-0.10 (-0.89) **	-0.29 (-0.66) **	0.36 (0.99) **	-0.20 (-0.59) **
Root Length (cm)											x	0.25 (0.99) **	0.87 (0.91) **	-0.15 (-0.79) **	0.50 (0.85) **	-0.36 (-0.56) **
Root Diameter (cm)												x	0.43 (0.89) **	0.20 (0.78) **	0.45 (0.67) **	-0.25 (-0.58) **
No. of Leaves													x	0.10 (0.59) **	0.41 (0.78) **	-0.29 (-0.69) **
T.S.S (° Brix)														x	-0.29 (-0.79) **	0.05 (0.69) **
Vitamin C (Mg/100g)															x	-0.49 (-0.60) **
Acidity (Mg/100g)																x

Note: *, ** = Significant at 5 % and 1 % level of significant, respectively

Table 2. Direct and indirect effects of various yield attributes on root yield in 15 genotypes of brinjal

Character	Plant Height 30 DAS (cm)	Number of Leaves 30 DAS	Plant Height 60 DAS (cm)	Number of Leaves 60 DAS	Plant Height 75 DAS (cm)	Number of Leaves 75 DAS	Total Plant Height (cm)	Total Plant Weight (g)	Leaves Length (cm	Root Length (cm)	Root Diameter (cm)	No. of Leaves	T.S.S.	Vitamin C	Root Weight (g)
Plant Height 30 DAS (cm)	-2.82	-0.32	1.78	-0.99	1.39	1.96	-1.47	-0.69	0.43	-0.09	-0.04	0.36	0.09	-0.05	0.78
Number of Leaves 30 DAS	-1.63	-0.52	0.88	-1.48	0.44	2.44	-0.90	-1.28	0.02	-0.16	-0.03	0.89	0.03	-0.18	0.85
Plant Height 60 DAS (cm)	-1.24	-0.41	1.48	-0.89	1.69	1.22	-1.69	-0.36	0.65	-0.14	-0.17	0.10	0.05	0.06	0.36
Number of Leaves 60 DAS	-1.75	-0.52	0.90	-1.68	0.26	2.47	-1.45	-1.60	0.19	-0.23	0.05	0.72	0.04	-0.19	0.97
Plant Height 75 DAS (cm)	-1.89	-0.11	1.12	-0.22	1.48	-0.28	-0.95	0.50	0.48	0.11	-0.19	-0.36	0.08	0.08	-0.39
Number of Leaves 75 DAS	-1.47	-0.52	0.89	-1.22	-0.10	3.28	-1.39	-1.74	0.10	-0.23	0.06	0.78	-0.09	-0.19	1.26
Total Plant Height (cm)	-1.74	-0.48	1.20	-0.89	0.77	2.41	-3.59	-1.15	0.58	-0.20	-0.18	0.49	0.01	-0.36	0.78
Total Plant Weight (g)	-0.82	-0.29	0.41	-1.55	-0.557	3.69	-1.59	-1.89	0.36	-0.24	0.28	0.85	0.02	-0.48	1.36
Leaves Length (cm)	-1.66	-0.05	1.36	-0.53	1.41	0.47	-1.72	-0.36	0.90	-0.30	-0.05	-0.03	0.06	-0.25	0.07
Root Length (cm)	-0.89	-0.39	0.55	-1.48	-0.20	3.48	-1.89	-1.78	0.59	-0.19	0.08	0.77	0.07	-0.36	1.19
Root Diameter (cm)	1.11	0.04	-0.99	-0.28	-1.48	0.59	0.56	-0.59	-0.45	-0.08	0.20	0.55	-0.05	-0.48	0.55
No. of Leaves	-1.19	-0.36	0.25	-1.39	-0.57	3.48	-1.18	-1.57	-0.11	-0.29	0.09	0.78	-0.10	-0.51	1.22
T.S.S.	0.48	0.07	-0.54	0.18	-0.62	0.04	0.36	0.09	-0.36	0.58	0.06	0.06	-0.18	0.25	0.09
Vitamin C	-0.29	-0.26	-0.08	-0.48	-0.29	1.59	-0.76	-1.69	0.20	-0.09	0.02	0.45	0.09	-0.45	0.48

Root yield is dependent on several characters which are mutually associated; these will in turn impair the true association existing between a component and root yield. A change in any one component is likely to disturb the whole network of cause and effect. Thus, each component has two paths of action viz., the direct influence on yield, indirect effect through components which are not revealed from the correlation studies. Each component has two path actions viz., direct effect on yield and indirect effect through components which are not revealed by correlation studies are known by path analysis. Path coefficient analysis showed that the maximum positive direct effects on root yield/plant (table 2) was observed by number of leaves 75 days after sowing (3.28) followed by plant height 60 days after sowing (1.48) and plant height 75 days after sowing (1.48) and leaf length (0.90) while total plant height after harvest (-3.59), plant height 30 days after sowing (-2.82), total plant weight (-1.89), number of leaves 60 days after sowing (-1.68), root length (-0.19) and TSS (-0.19) had negative direct effect.

In case of positive indirect effect on root yield/plant, the maximum was observed in total plant weight (1.36) followed by number of leaves 75 days after sowing (1.26), root length (1.19), number of leaves 60 days after sowing (0.97), number of leaves 30 days after sowing (0.85), plant height 30 days after sowing (0.78) and plant height 60 days after sowing (0.36). It clearly indicates that direct selection based on the characters having positive direct and indirect effect would be effective for an increase in yield. The similar results were obtained by previous studies by (Singh *et al.*, 2002, Ullah *et al.*, 2002, Mukhdoomi *et al.*, 2008 and Shama *et al.*, 2009). From the foregoing discussion, it can be concluded that studies on association and path correlation indicated that maximum emphasis should be given to characters like plant height, number of leaves, total plant weight, root weight, root length, root diameter and root yield/ plant at the time of selection since they exhibited positive correlation and direct positive effect. These are identified as superior yield components. Hence, the genotypes which exhibited better performance for these characters can be used in further improvement of turnip.

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