

Genetic diversity studies in turnip (*Brassica rapa* L) under low hills of Himachal Pradesh

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ABSTRACT

The present investigations were carried out at the vegetable research farm of the Department of Vegetable Science, College of Horticulture and Forestry, Neri, Hamirpur, Himachal Pradesh during rabi 2020. Twelve genotypes were evaluated in randomized complete block design with 3 replications to know the extent of variability, heritability and genetic advance as per cent of mean for average root yield with leaves and other horticulture traits among the genotypes. Analysis of variance showed significant differences among all the genotypes for all the characters under study. Best genotype in terms of average root yield with leaves was Pusa Sweti (200.66 g) along with T-COHF-NERI-5 (185.77 g). The traits viz leaf area, root-shoot ratio, plant spread and ascorbic acid content expressed high GCV and PCV values. High heritability was exhibited by the trait duration of availability of marketable roots followed by days to first harvest and ascorbic acid content. However high genetic advance as percentage of mean was observed for the trait root-shoot ratio followed by plant spread, ascorbic acid content, duration of availability of marketable roots and average root yield with leaves.

Keywords: Turnip; genetic variability; coefficient of variance; genetic advance; heritability

INTRODUCTION

Turnip (*Brassica rapa* L) is one of the members of family Cruciferae which is a popular root vegetable grown for its large roots which are consumed in various forms such as boiled vegetable, salad or for making palatable pickles. In the plains of north India, it is planted as commercial rabi season crop which brings quick and high income to the farmers and is also suited very well in multiple cropping system. Most of the popular cultivars of turnip are either introductions or selections from the existing material. Till date, very less effort has been made for the genetic improvement of this crop in our country. The scope of improvement through selection in any character depends on the genetic variability present in the germplasm; greater the variability in the available germplasm better would be the chances of selecting superior genotypes (Vavilov 1951). Burton (1952) suggested that genetic variability along with heritability should be considered for assessing maximum and accurate effect of selection. Genetic coefficient of variation is used to measure the range

of genetic variability present in a particular character. It is important to assess the relative magnitude of components of variability in order to use such information together with other selection parameters for improvement of the plant type through adoption of effective breeding methods (Johnson et al 1955). Lush (1940) referred broad sense heritability as a ratio of genetic variance to the total variance. Estimates of heritability depend upon the amount of genetic variation existing in the population as well as the environment under which it is evaluated. Therefore heritability estimates obtained from different populations grown under different environments are neither directly comparable nor do individual estimates reflect it as a property of quantitative traits.

MATERIAL and METHODS

The present research was carried out in low hills of Himachal Pradesh during rabi season 2020 at the vegetable research farm of the Department of Vegetable Science, College of Horticulture and

Forestry, Neri, Hamirpur, Himachal Pradesh during consisting 12 genotypes of turnip. Direct sowing of turnip plants was done during October 2020 at a spacing of 30 cm × 10 cm in randomized complete block design with three replications of each genotype and thinning of plants was done for implying proper spacing so that 10 plants were retained in each row. The observations were recorded on 16 different horticultural traits including average root yield with leaves. All the parameters of variability and heritability in broad sense were calculated as per the formula given by Burton and Devane (1953) and Allard (1960). The estimates of genetic advance as per cent of mean were calculated as given by Allard (1960).

RESULTS and DISCUSSION

Coefficient of variation: Analysis of variance (ANOVA) for 12 genotypes (Tables 1, 3) depict that the mean sum of squares due to the genotypes was significant for all the characters indicating presence of considerable variability among the various turnip genotypes. High magnitude of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was recorded by the traits leaf area (PCV= 20.93), root-shoot ratio (PCV= 36.45, GCV= 33.53), plant spread (PCV= 26.92, GCV= 23.98) and

ascorbic acid content (GCV= 20.30) (Table 2). It was observed that PCV was higher than the GCV and the difference between the two coefficients was quite less in magnitude.

Heritability: Data given in Table 2 show that heritability in broad sense was recorded in a range of 38.80 to 98.36 per cent. High heritability was observed for the character duration of availability of marketable roots (98.36%) followed by days to first harvest (95.03%) and ascorbic acid content (93.22%). Whereas the moderate (80-90%) heritability was observed for the traits average root yield with leaves (86.65%), root-shoot ratio (84.61%), root length (82.55%) and average root yield without leaves (82.08%). However low (<80%) heritability value was seen for the traits viz plant spread (79.31%), leaf width (74.42%), days to 50 per cent germination (72.25%), leaf area (68.20%), root diameter (66.24%), number of leaves per plant (62.09%), plant height (59.31%) leaf length (43.89%) and TSS (38.80%). Similar results were reported by Makhdoomi (2003) and Ullah et al (2010) in radish crop.

Genetic advance: The genetic advance values for all the traits ranged from 4.77 to 63.54 per cent (Table 2). The high amount of genetic advance was observed for the horticultural traits viz root-shoot ratio (63.54%)

Table 1. Analysis of variance for different horticultural traits consisting average root yield with leaves for different genotypes of turnip (*Brassica rapa* L)

Character	Mean sum of squares		
	Replication 2 (df)	Genotype 11 (df)	Error 22 (df)
Days to 50% germination	0.19	1.18	0.13
Days to first harvest	1.03	6.93	0.12
Duration of availability of marketable roots	0.11	36.57	0.20
Number of leaves/plant	1.83	5.18	0.88
Leaf length	17.09	18.70	5.59
Leaf width	5.53	6.45	0.66
Leaf area	14,208.29	12,462.24	1,676.14
Plant height	12.34	21.21	3.95
Root-shoot ratio	0.03	0.96	0.05
Plant spread	13,095.90	1,33,621.43	10,684.62
Root length	0.13	1.25	0.08
Root diameter	0.44	0.87	0.13
TSS	0.01	0.24	0.08
Ascorbic acid content	2.08	86.04	2.04
Average root yield without leaves	98.74	583.64	39.57
Average root yield with leaves	128.76	2,075.08	101.35

df: Degrees of freedom

Table 2. Genetic parameters of variation for various horticultural traits including average root yield with leaves per plant for various genotypes in turnip (*Brassica rapa* L)

Character	Mean	Range		Coefficient of variation (%)		Heritability (%)	Genetic advance as % of mean
		Minimum	Maximum	Genotypic	Phenotypic		
Days to 50% germination	5.63	4.66	6.66	10.46	12.31	72.25	18.33
Days to first harvest	63.44	60.66	65.00	2.37	2.43	95.03	4.77
Duration of availability of marketable roots (days)	20.52	14.00	25.33	16.96	17.10	98.36	34.65
Number of leaves/plant	9.48	8.13	13.06	12.63	16.02	62.09	20.50
Leaf length (cm)	32.36	28.16	37.60	6.46	9.75	43.89	8.82
Leaf width (cm)	10.65	8.58	13.06	13.03	15.10	74.42	23.16
Leaf area (cm ²)	346.90	280.06	454.30	17.28	20.93	68.20	29.41
Plant height (cm)	33.05	29.37	38.80	7.25	9.42	59.31	11.51
Root-shoot ratio	1.64	0.79	2.59	33.53	36.45	84.61	63.54
Plant spread (cm ²)	844.04	530.66	1195.33	23.98	26.92	79.31	44.00
Root length (cm)	5.18	4.25	6.33	12.00	13.20	82.55	22.46
Root diameter (cm)	5.31	4.49	6.08	9.36	11.50	66.24	15.70
TSS (°B)	3.50	3.10	4.10	6.50	10.44	38.80	8.35
Ascorbic acid content (mg/100 g)	26.06	15.20	33.20	20.30	21.02	93.22	40.37
Average root yield without leaves (g)	92.84	65.00	109.66	14.50	16.01	82.08	27.07
Average root yield with leaves (g)	155.90	104.00	200.66	16.45	17.67	86.65	31.55

followed by plant spread (44.00%), ascorbic acid content (40.37%), duration of availability of marketable roots (34.65%) and average root yield with leaves (31.55%). However moderate level of genetic advance was recorded for the traits viz leaf area (29.41%), average root yield without leaves (27.07%), leaf width (23.16%), root length (22.46%), number of leaves per plant (20.50%), days to 50 per cent germination (18.33%), root diameter (15.70%) and plant height (11.51%). Lowest values in terms of genetic advance were found for the traits viz leaf length (8.82), TSS (8.35) and days to first harvest (4.77). Makhdoomi (2003) obtained similar genetic advance values in radish.

CONCLUSION

On the basis of investigations carried out during the present study, it can be concluded that the genotype Pusa Sweti (200.66 g) was the best genotype in terms of average root yield with leaves followed by the genotypes T-COHF-NERI-5 (185.77 g) and T-COHF-NERI-3 (177.26 g). These genotypes were found significantly superior to other genotypes for the traits such as average root yield with leaves and few other traits like leaf length, plant height and ascorbic acid content and thus these

superior genotypes can be recommended after multi-location testing for direct cultivation and can be used in further breeding programmes. High variability coupled with high heritability and genetic advance was observed for the horticultural traits viz average root yield with leaves, leaf area, root-shoot ratio, plant spread, duration of availability of marketable roots, days to first harvest and ascorbic acid content and thus making selection effective for these traits.

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Table 3. Mean performance of various quantitative horticultural traits in different turnip (*Brassica rapa* L.) genotypes

Genotype	Parameter							
	Days to 50% germination	Days to first harvest	Duration of availability of marketable roots (days)	Number of leaves/plant	Leaf length (cm)	Leaf width (cm)	Leaf area (cm ²)	Plant height (cm)
T-COHF-NERI-1	6.33	64.66	23.00	9.46	34.40	13.06	449.17	31.26
T-COHF-NERI-2	6.00	64.33	20.33	9.13	30.23	10.30	311.46	31.33
T-COHF-NERI-3	6.66	63.33	18.00	13.06	37.60	11.93	454.30	38.80
T-COHF-NERI-4	6.00	63.00	14.66	9.50	32.33	8.87	288.72	35.49
T-COHF-NERI-5	5.00	62.00	21.00	8.73	30.86	10.33	320.20	32.91
T-COHF-NERI-6	5.00	64.66	22.00	10.60	32.54	8.58	280.06	33.37
T-COHF-NERI-7	6.00	65.00	25.33	8.49	33.86	12.73	429.76	34.68
Pusa Chandrima	5.33	63.33	22.66	8.13	29.90	10.80	323.00	31.56
Pusa Swarnima	5.66	65.00	19.33	9.26	31.33	11.29	353.74	29.37
Pusa Sweti	4.66	61.00	14.00	9.40	33.20	8.73	290.44	34.58
L-1	6.00	60.66	23.66	8.33	33.93	10.84	367.72	33.60
Purple Top White	5.00	64.33	22.33	9.72	28.16	10.44	294.23	29.66
Globe (check)								
Mean	5.63	63.44	20.52	9.48	32.36	10.65	346.90	33.05
SEm	0.21	0.19	0.25	0.54	1.36	0.47	23.63	1.14
CD	0.62	0.58	0.76	1.59	4.02	1.38	69.77	3.38
CV ^{0.05} (%)	6.48	0.54	2.19	9.86	7.30	7.63	11.80	6.01

Table 3. contd.

Genotype	Parameter							
	Plant spread (cm ²)	Average root yield without leaves (g)	Average root yield with leaves (g)	Root-shoot ratio	Root length (cm)	Root diameter (cm)	TSS (p B)	Ascorbic acid content (mg/100 g)
T-COHF-NERI-1	1064.08	97.38	162.33	1.50	4.66	4.49	3.10	24.80
T-COHF-NERI-2	687.91	66.60	140.40	0.92	5.13	5.32	3.83	30.80
T-COHF-NERI-3	833.11	95.66	177.26	1.47	5.83	5.35	3.23	22.00
T-COHF-NERI-4	530.66	65.00	104.00	1.67	4.83	4.83	3.46	33.20
T-COHF-NERI-5	628.77	100.44	185.77	1.17	5.61	5.98	3.63	23.60
T-COHF-NERI-6	551.66	97.33	149.00	1.88	5.87	5.55	3.26	15.20
T-COHF-NERI-7	905.55	88.22	131.33	2.04	4.25	5.91	3.33	24.40
Pusa Chandrima	915.66	97.33	140.25	2.31	5.46	4.87	4.10	21.20
Pusa Swarnima	1061.14	103.66	152.00	2.14	4.93	5.33	3.53	28.40
Pusa Sweti	825.66	89.22	200.66	0.79	4.33	4.54	3.30	32.80
L-1	1195.33	109.66	153.00	2.59	5.00	6.08	3.60	30.80
Purple Top White	928.99	103.55	174.88	1.47	6.33	5.49	3.63	25.60
Globe (check)								
Mean	844.04	92.84	155.90	1.64	5.18	5.31	3.50	26.06
SEm	59.67	3.63	5.81	0.13	0.16	0.20	0.16	0.82
CD _{0.05}	176.16	10.72	17.15	0.40	0.48	0.60	0.48	2.43
CV (%)	12.24	6.77	6.45	14.29	5.51	6.68	8.17	5.47

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