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Genetic variability in radish (*Raphanus sativus* L.)

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Abstract

In the present investigation, highly significant differences were observed among all the thirty diverse genotypes of radish for all the characters. The highest genotypic co-efficient of variation as well as phenotypic co-efficient of variation was observed for root to leaf ratio among yield attributing traits, calcium content among biochemical parameters. Almost all the traits exhibited high heritability ranging from 73.85-99.96%. Highest genetic advance as percent of mean was also observed for all the characters ranging from 15.13-238.10%.

Keywords: Radish, variability, heritability, genetic advance

Introduction

Radish (*Raphanus sativus* L.) is ancient and popular root vegetable crop which is eaten as raw or in cooked form. It is grown for fleshy roots and leaves in both tropical and temperate climate. The edible portion of radish is swollen root that develops from primary root and hypocotyl. It is a rich source of Vit-C (ascorbic acid), calcium and minerals. However, selection indices for the production breeding of this crop is no yet perfected and the available information is meager and inadequate (Mapari *et al.* 2009) [7]. The genetic variability is an important factor for selecting best genotypes to make rapid improvement in yield and other related characters as well as to select the potential parent for hybridization programmes because most plant characters are polygenic in nature and are influenced by environment. Genotypic and phenotypic coefficients of variability help to access the divergence of the characters. Heritability is an index for calculating the relative influence of environment on expression of character among the genotypes. It becomes very difficult to estimate the level of variability which is heritable and which is non- heritable. Therefore, the present investigation was conducted to study the genetic variability for quantitative characters in radish.

Materials and Methods

The experiment was conducted at Kittur Rani Channamma College of Horticulture, Arabhavi during *kharif* and *Rabi* seasons of 2017-2018 with thirty genotypes of radish which are listed in the Table 1. The experiment was laid out in a Randomized Block Design with two replications. The seeds were sown at a distance of 30 cm between row to row and 15 cm between plants. All the recommended cultural operations were followed and observations were recorded in five randomly selected plants per replication for each genotype for all the eighteen quantitative characters.

The analysis of variance was carried out for pooled data of both the seasons as suggested by Gomez and Gomez (1983) [5]. The genotypic and phenotypic co-efficients of variation were obtained by the method given by Burton and De Vane (1953) [2]. The heritability (broad sense) and genetic advance as percent of mean were estimated by using the formula described by Robinson *et al.* (1949) [10] and Johnson *et al.* (1955) [6] respectively.

Results and Discussion

The extent of variability present in the radish genotypes was measured in terms of range, mean, genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV), heritability (broad sense) and genetic advance as percent of mean (Table 2).

All the genotypes differed significantly with respect to all the characters under study. A wide range of variation was observed in all the characters. A range of variation was observed in number of leaves 8.80 (HRESB-32) to VRRAD-205 (13.80), leaf area from 220.36 cm²

(VRRAD-30) to 1800.52 cm² (HRESB-30), root diameter 20.62 mm (White Icicle) to 36.71 mm (VRRAD-205), root length varied from 16.82 cm (White Icicle) to 30.46 cm (HRESB-17), root to leaf ratio ranged from 0.21 (White Icicle) to 1.90 (HRESB-10), root weight varied from 22.73 g (White Icicle) to 171.35 g (HRESB-8), root yield per plot ranged from 2.18 kg (White Icicle) to 16.45 kg (HRESB-8), root yield per hectare 5.08 t (White Icicle) to 38.26 t (HRESB-8), days to harvest varied from 27.50 days (White Icicle) to 43.75 days (HRESB-6 and HRESB-32). A wide range of variation was observed for all the biochemical parameters, ascorbic acid ranged from 7.23 mg/100 g (White Icicle) to 34.23 mg/100 g (HRESB-8), calcium content varied from 4.00 mg/100 g (HRESB-11) to 350.00 mg/100 g (VRRAD-202), fibre content 0.20% (White Icicle) to 1.40% (Pusa Himani), isothiocyanate ranged from 212.48 µg/100 g (HRESB-8) to 332.51 µg/100 g (White Icicle), potassium from 117.45 mg/100 g (White Icicle) to 207.50 mg/100 g (HRESB-24), protein content among all the genotypes ranged from 0.28% (VRRAD-202) to 0.67% (HRESB-7), sodium content varied from 18.75 mg/100 g (White Icicle) to 30.10 mg/100 g (DPR-1), total phenols from 10.38 mg/100 g (HRESB-9) to 60.56 mg/100 g (DPR-1) and total sugars varied from 0.26% (HRESB-22) to 1.50% (HRESB-8). Similar trend of results are obtained by Thorat *et al.* (2013) [14], Naseeruddin *et al.* (2014) [9], Datta *et al.* (2015) [3], Ayyub *et al.* (2016) [1], Dongarwar *et al.* (2017) [4].

A perusal data in Table 2 showed a range of GCV for yield characters varied from 8.44% (number of leaves) to 54.19% (root to leaf ratio) and for biochemical traits it was varied from 10.90% (isothiocyanate) to 115.60% (calcium content). High GCV was observed for leaf area, root to leaf ratio, root weight, root yield/plot, root yield/ha, ascorbic acid, calcium

content, fibre content, protein, total phenols and total sugars. The trend was similar for PCV also. The characters like root to leaf ratio among yield attributing parameters and calcium content among biochemical parameters showed a high GCV. The characters having high genotypic co-efficient of variation have better scope for improvement through selection. The magnitude of genotypic co-efficient of variation was closer to phenotypic co-efficient of variation this indicates that the greater role was played by genotypic rather than environment among almost all the character under study. The findings are in close agreement with the results obtained by Sivathanu *et al.* (2014) [13], Santhi *et al.* (2015) [11] and Nagar *et al.* (2016) [8].

To determine the amount of heritable variation, estimation of GCV alone is not sufficient. Heritable variation can be found with greater degree of accuracy when it is studied along with genetic advance as percent of mean. The estimate of heritability was high for all the characters ranging from 73.85% (days to harvest) to 99.96% (calcium content). High heritability accompanied with genetic advance as percent of mean was observed for leaf area, root diameter, root length, root to leaf ratio, root weight, root yield/plot, root yield/ha, ascorbic acid, calcium content, fibre content, isothiocyanate, potassium, protein, sodium, total phenols and total sugars indicating less influence of environment over these characters. These findings corroborate the earlier results obtained by Santhi *et al.* (2015) [11], Nagar *et al.* (2016) [8] and Singh *et al.* (2017) [12].

Higher heritability along with high genetic advance as percent of mean in characters suggests that inheritance of such characters is governed by additive gene effects. Therefore, selection based on phenotypic performance was useful.

Table 1: List of radish genotypes used in the experiment.

S. No.	Genotype	Source
1	HRESB-6	HRES, Hidkal Dam
2	HRESB-7	HRES, Hidkal Dam
3	HRESB-8	HRES, Hidkal Dam
4	HRESB-9	HRES, Hidkal Dam
5	HRESB-10	HRES, Hidkal Dam
6	HRESB-11	HRES, Hidkal Dam
7	HRESB-15	HRES, Hidkal Dam
8	HRESB-16	HRES, Hidkal Dam
9	HRESB-17	HRES, Hidkal Dam
10	HRESB-18	HRES, Hidkal Dam
11	HRESB-19	HRES, Hidkal Dam
12	HRESB-22	HRES, Hidkal Dam
13	HRESB-24	HRES, Hidkal Dam
14	HRESB-29	HRES, Hidkal Dam
15	HRESB-30	HRES, Hidkal Dam
16	HRESB-32	HRES, Hidkal Dam
17	HUB-1	L C from Karnataka (Kolar)
18	HUB-2	L C from Karnataka (Koppal)
19	White Icicle	YSPHF, Solan (Himachal Pradesh)
20	VRRAD-26	IIVR, Varanasi
21	VRRAD-30	IIVR, Varanasi
22	VRRAD-150	IIVR, Varanasi
23	VRRAD-202	IIVR, Varanasi
24	VRRAD-205	IIVR, Varanasi
25	HUB-3	LC from Punjab(Ludhiana)
26	Japanese White	YSPHF, Solan (Himachal Pradesh)
27	DPR-1	IIVR, Varanasi
28	Palam Hriday	IIVR, Varanasi
29	Pusa Himani	YSPHF, Solan (Himachal Pradesh)
30	Arka Nishant	IIHR, Bangalore

Table 2: Estimates of mean, range, components of variance, heritability and genetic advance over percent of mean for growth, root and biochemical parameters in radish for pooled average of both the seasons.

S. No	Character	Range	Mean	GCV (%)	PCV (%)	h ² (%)	GAM (%)
A. Growth parameters							
1.	Number of leaves	8.80-13.80	11.28	8.44	9.69	75.76	15.13
2.	Leaf area (cm ²)	220.36- 1800.52	719.76	43.23	44.29	95.23	86.89
B. Root parameters							
3.	Root diameter (mm)	20.62- 36.71	29.78	12.62	13.26	90.61	24.75
4.	Root length (cm)	16.82- 30.46	23.94	12.91	13.58	90.40	25.29
5.	Root to leaf ratio	0.21- 1.90	0.863	54.19	55.25	96.23	109.51
6.	Root weight (g)	22.73- 171.35	75.76	49.86	50.27	98.39	101.89
7.	Root yield/plot (Kg)	2.18- 16.45	7.27	49.86	50.27	98.39	101.89
8.	Root yield/ha (t)	5.08- 38.26	16.91	49.86	50.27	98.39	101.89
9.	Days to harvest	27.50- 43.75	38.02	9.33	10.86	73.85	16.51
C. Biochemical parameters							
10.	Ascorbic acid (mg/100 g)	7.23- 34.23	19.64	40.47	40.48	99.93	83.33
11.	Calcium content (mg/100 g)	4.00- 350.00	57.63	115.60	115.63	99.96	238.10
12.	Fibre content (%)	0.20- 1.40	0.93	40.33	40.37	99.79	82.99
13.	Isothiocyanate (mg/100 g)	212.48- 332.51	245.42	10.90	10.92	99.75	22.43
14.	Potassium (mg/100 g)	117.45- 207.50	171.89	13.91	14.03	98.31	28.41
15.	Protein (%)	0.28- 0.67	0.43	23.89	23.99	99.21	49.01
16.	Sodium (mg/100 g)	18.75- 30.10	25.67	12.47	12.48	99.79	25.66
17.	Total phenols (mg/100 g)	10.38- 60.56	23.02	49.25	49.27	99.93	101.43
18.	Total sugars (%)	0.26- 1.5	1.03	30.19	30.25	99.61	62.06

GCV = Genotypic coefficient of variation	h ² = Heritability (broad sense)
PCV =Phenotypic coefficient of variation	GAM = Genetic advance (percent mean)

Conclusion

In present study the characters with high Genotypic coefficient of variation, heritability accompanied with high genetic advance as percent of mean can be further improved through recurrent selection.

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