Environment and Ecology 41(3): 1358—1361, July—September 2023
Article DOI: https://doi.org/10.60151/envec/BOBX3828
ISSN 0970-0420

Study on Genetic Variability, Heritability and Genetic Advance in Spinach Beet under Garhwal Region of Uttarakhand

Ganesh Raturi, Gargi Goswami, S. C. Pant

Received 28 February 2023, Accepted 10 May 2023, Published on 24 July 2023

ABSTRACT

An investigation was carried out at the Vegetable Research and Demonstration Block, College of Horticulture, Veer Chandra Singh Garhwali, Uttarakhand University of Horticulture and Forestry, Bharsar Pauri (UK) during September, 2021 to evaluate diverse germplasm of spinach beet under temperate conditions of Garhwal region of Uttarakhand. The experiment was laid out in RCBD with three replications. In this study, fifteen genotypes including one check cultivar Pusa Harit were evaluated for different horticultural traits. Eight genotypes viz., Genotype-4, Arka Anupama, All Green, Palak Haryali, Genotype-1, Genotype-10, Genotype-2 and Genotype-7 performed better yield attributing traits and recorded higher than check cultivar. These genotypes need further testing to be released as a substitute of already existing spinach beet varieties or they can be involved in further breeding program for development of superior varieties in spinach beet. Genetic analysis indicated that phenotypic coefficient of variance (PCV) was higher than genotypic coefficient of variance (GCV) in all the attributes studied. The phenotypic coefficients of variance (PCV) and the genotypic coefficients of variance (GCV) were found high in total leaves weight per plot, the least was found in dry matter content. High heritability estimates coupled with high genetic gain were found highest for the character average leaves weight per plant and lowest for dry matter content, indicated that these traits are under additive gene effects and are more reliable for effective selection.

Keywords GCV, PCV, Heritability, GAM.

INTRODUCTION

Spinach beet (*Beta vulgaris* var. bengalensis, 2n = 2x = 18) commonly known as Indian Spinach in english and Palak in hindi originated from Indo-Chinease region belongs to the genus *Beta*, species vulgaris and family Chenopodiaceae (Nath 1976). Spinach beet is also known as Silver chard, Seakale beet, Silver beet, Perpetual spinach, Indian spinach and Spinach beet, which is a close relative of other forms of *Beta vulgaris*, beetroot (Sugar beet) and Swiss chard since they all have the same Chromosome number, 2n = 18 (Purohit 1968). Spinach beet is a winter season crop and can be grown throughout the year under mild

Ganesh Raturi[1]
HNB, Srinagar Garhwal, Uttarakhand, India

Gargi Goswami[2]*, S. C. Pant[3]
[2,3]Assistant Professor
College of Horticulture VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Gharhwal, Uttarakhand 246123, India

Email: gargi.goswami1423@gmail.com
*Corresponding author

temperature conditions. It tolerates warm weather better than spinach. However, high temperature results in premature bolting and reduces number of cuttings. Spinach beet is a highly salt tolerant crop and can be grown successfully in saline sodic soil. It can be grown in slightly alkaline soil with pH 7.0 - 10.5 (Rana 2018). Genetic improvement of any crop mainly depends upon the amount of genetic variability present in the population and the germplasm serves as a valuable source of base population and provide scope for wide variability. Vegetable breeder is primarily concerned with the improvement of both qualitative and quantitative plant characters. Hence, adequate knowledge of genetics of various traits is very essential in vegetable breeding program for obtaining desired results in the generation. However, the success of vegetable breeding depends on the extent and the magnitude of variability existing in the germplasm. At the same time, improvement is possible on the basis of heritable variation. Hence, for improvement of spinach beet yield trait is necessary. For a successful crop improvement program, information on the nature and magnitude of genetic variability, degree of transmission of the traits is of immense importance. The variability available in the population can be partitioned into heritable and non-heritable component viz., phenotypic and genotypic coefficients of variance, heritability and genetic advance on which selection can be effectively carried out. Heritability denotes the proportion of phenotypic variation due to genotypes thus help the breeders to select the elite variety for a character. However, heritability indicates only the effectiveness which selection of a genotype can be based on phenotypic performance but it fails to indicate the expected genetic progress in one cycle of selection. High heritability alone is not enough to make efficient selection in segregating generations, unless information is accompanied for substantial amount of genetic advance. Genetic advance denotes the improvement in the mean genotypic values of selected families over base population and thus helps the breeder to select the progenies in the earlier generation itself.

MATERIALS AND METHODS

The investigation was conducted at the Vegetable Demonstration and Research Block Department of Vegetable Science, College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar. The site is located at an altitude of 1900 meters above mean sea level at a longitude of 78.990 E and latitude of 30.0560 N (Anonymous 2012).

The climate of Bharsar has a mild summer, higher precipitation and colder to severe cold prolonged winter. The South-East monsoon commences towards the end of June while the North-East monsoon causes occasional winter showers during November to February. Winter witness frequent snow fall in this region while during summer months, the valley has hot climate prevailing for few hours in a day. The maximum temperature during May-June is recorded between 30^0C - 35°C. However, nights are considerably cooler than the daytimes. December and January are the coldest months and the minimum temperature reaches to 1^0C to 4^0C. Relative humidity is normally highest during rainy season (July-August), often recorded near to saturation point (92-97%) and it gradually decreases towards December (Bisht and Sharma 2014). The soil of studied site was comprised of medium clay to sandy loam with pH of 6 to 6.5. The analysis of variance for different characters was carried out using mean data in order to assess the genetic variability among genotypes. Both phenotypic and genotypic coefficient of variability for all the characters was estimated using formula of Burton. The broad sense heritability (h^2) was estimated for all characters as the ratio of genotypic variance to the total or phenotypic variance. The expected genetic gain or advance for each character was estimated by using the following method suggested earlier.

RESULTS AND DISCUSSION

Mean performance and other genetic parameters like phenotypic and genotypic co-efficient of variability (PCV, GCV), heritability (h), genetic advance as percent of mean (GAM) for the eleven quantitative characters are presented in Table1. Mean performance of various genotypes for the eleven characters under study indicated that wide range of variability was present among the genotypes. Significance difference was observed among all the genotypes for all the characters through analysis of variance study. This indicated the presence of sufficient variability in the

Table 1. Estimates of phenotypic and genotypic coefficient of variability, heritability, genetic advance and genetic gain for different traits.

Characters	Mean	Min	Max	Var (g)	Var (p)	Herita-bility (%)	GA	GA% in mean	GCV (%)	PCV (%)
Days to initial germination	7.60	5.67	11.33	2.23	2.60	85.71	2.85	37.46	19.64	21.22
Days for 50% germination	9.02	7.33	13.33	2.30	2.70	85.09	2.88	31.95	16.82	18.23
Dry matter content (%)	8.18	7.38	10.59	0.58	0.71	82.65	1.43	17.49	9.34	10.27
Vitamin C content (mg/100g)	37.01	26.50	48.08	40.86	41.98	97.33	12.99	35.10	17.27	17.51
Chlorophyll content (mg/g)	2.53	1.74	2.94	0.13	0.15	87.64	0.70	27.51	14.27	15.24
Total number of leaves	36.06	24.13	52.93	75.60	78.78	95.97	17.55	48.66	24.11	24.61
Average leaf length (cm)	15.77	11.82	21.35	7.55	7.79	96.95	5.57	35.36	17.43	17.70
Average leaf width (cm)	5.28	3.52	8.64	2.02	2.12	95.02	2.85	54.07	26.93	27.62
Average length of whole plant (cm)	19.84	15.72	26.15	10.48	10.84	96.65	6.56	33.04	16.31	16.60
Average leaves weight / plant (g)	16.08	6.69	40.72	84.65	84.98	99.62	18.92	117.63	57.21	57.32
Total leaves weight /plot (kg)	0.98	0.39	2.37	0.35	0.35	99.13	1.21	122.89	59.92	60.18

genetic material under study and it was good enough to carry out further analysis.

The character days taken to initial germination ranged from 5.67 to 11.33 days with a grand mean value of 7.60 cm. The grand mean of days taken to 50% germination is 9.02 days ranging from 7.33 to 13.33 days. Dry matter content (%) ranged from 7.38 to 10.59 with a mean value of 8.18. Vitamin C content ranged from 1.74 to 2.94 with a grand mean value of 37.01. Chlorophyll content (mg/g) ranged from 1.74 to 2.94 with a grand mean value of 2.53. Total number of leaves ranged from 24.13 to 52.93 with a grand mean value of 36.06. Average leaf length ranged from 11.82 to 21.35 with a grand mean value of 15.77. Average leaf width ranged from 3.52 to 8.64 with a grand mean value of 5.28. Average length of whole plant ranged from 15.72 to 26.15 with a grand mean value of 19.84. Average leaves weight/ plant ranged from 6.69 to 40.72 with a grand mean value of 16.08 and Total leaves weight/ plot ranged from 6.69 to 40.72 with a grand mean value of 0.98.

In general, higher phenotypic coefficient of variance value indicates the influence of environment on traits. But smaller differences between PCV and GCV values are observed for all the characters under study, as they are less influenced by the environment indicating reliability of selection based on these traits. The character total leaves weight/ plot exhibits higher GCV and PCV (59.92, 60.18) values indicating that a greater amount of genetic variability is present for this characters which provide greater scope for selection. Traits like average leaves weight/plant (57.32%, 57.21), average leaf width (27.62%, 26.93), total number of leaves (24.61%, 24.11%), days taken to initial germination (21.22%, 19.64%). Average leaf length (17.70%, 17.43%), vitamin C content (17.51%, 17.27%), days taken to 50 % germination (18.32%, 16.82%), average length of whole plant (16.60%, 16.31%), chlorophyll content (15.24%, 14.27%) exhibit moderate PCV, GCV values indicating that a moderate level of genetic variability is present in these characters. Dry matter content has low PCV and GCV (10.27%, 9.34%) values indicating limited scope for improvement through this trial.

All the characters exhibited high broad sense heritability values viz., average leaves weight per plant (99.62%), total leaves weight per plot (99.13%), vitamin C content (97.33%), average leaf length (96.95%), average length of whole plant (96.65%), total number of leaves (95.97%), average leaf width (95.02%), chlorophyll content (87.64%), days taken to initial germination (85.71%), days taken for 50% germination (85.09%) and dry matter content (82.65%) suggested that the selection based on phenotypic performance of these traits would be more effective.

High genetic advance as per cent of mean (GAM) is observed for the characters average leaves weight per plot (122.89%), average leaves weight plant (117.63%) and average leaf width (54.07%) while moderate for total number of leaves (48.66%), days taken to initial germination (37.46%), average leaf

length (35.36%), vitamin C content (35.10%), average length of whole plant (33.04%), days taken for 50% germination (31.95%) and lowest for chlorophyll content (27.51%) and dry matter content (17.49%). High heritability coupled with high genetic advance as per cent of mean is observed for the characters like observed for average leaves weight per plant, and total leaves weight per plot. Estimate of GCV was also high for these traits indicating presence of additive gene effects suggesting more scope of selection for these traits total leaves weight per plot, average leaves weight per plant and average leaf width showed higher heritability along with moderate genetic advance as per cent of mean, which indicate that these characters are under the control of additive genes and are more reliable for effective selection.

CONCLUSION

The phenotypic coefficient of variance (PCV) and genotypic coefficient of variance (GCV) were found high for total leaves weight per plot whereas moderate phenotypic coefficient of variance (PCV) was recorded for total leaves weight per plot whereas moderate phenotypic coefficient of variance (PCV) were recorded for average leaf width, total number of leaves, days taken to initial germination, average leaf length. It indicated that there was a great variation present in the experimental material used. High heritability estimates coupled with high genetic gain were observed for average leaves weight per plant whereas low heritability was recorded for dry matter content. Therefore, these traits also show some opportunity for improvement through selection.

REFERENCES

Anonymous (2012) Indian Meterological Department. Meterological Data Base, pp 10.

Bisht AS, Sharma KD (2014) Plant utilization by the communities of Bharsar and adjoining area of the Pauri Garhwal, District, Uttarakhand, India. *Biodiversities* 15(1): 94-100.

Nath P (1976) Vegetable for the Tropical Region. ICAR, New Delhi, pp 304-308.

Purohit SP (1968) Studies of Floral biology, pollen morphology, physiology, and pollination in Spinach beat. MSc (Agric) thesis. Submitted to University of Udaipur.

Rana MK (2018) Scientific cultivation of vegetables, Kalyani Publishers, New Delhi.