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STUDIES ON VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN BRINJAL (*SOLANUM MELONGENA* L.)

N. Madhavi, A. C. Mishra*, J. Om Prasad and Naveen Bahuguna

Department of Vegetable Science, Uttarakhand University of Horticulture and Forestry, Ranichauri Campus, Tehri Garhwal - 249 199 (Uttarakhand), India.

Abstract

The present investigation was conducted during *Kharif*, 2013 at Vegetable Research Block, Uttarakhand University of Horticulture and Forestry, Ranichauri Campus, Tehri Garhwal (Uttarakhand), India with 21 diverse genotypes of brinjal. The experiment was laid out in randomized block design with three replications. The data was recorded for sixteen plant growth and fruit yield related characters *viz*., days to 50% flowering, plant height at 50% flowering (cm), number of branches per plant, leaf area (cm^2), flowers per cluster, fruits per cluster, fruit setting percentage (%), fruit length (cm), fruit diameter (cm), fruit volume (cm^3) number of fruits per plant, average fruit weight (g), plant height at last picking (cm), dry matter content (%), number of pickings and fruit yield per plant (kg). The cultivars *viz*., Azad T-3, JBGR-1, CH-10-45, Mukta Keshri and Punjab Nagini were found promising as they contained more than one desirable trait. High phenotypic and genotypic coefficients of variation (PCV and GCV), heritability and genetic advance were observed for number of fruits per plant, average fruit weight, fruit yield per plant, fruit volume, fruits per cluster, number of pickings, flowers per cluster, fruit diameter and dry matter content. Therefore, these characters which may be included in selection criteria for improvement in fruit yield per plant.

Key words : Brinjal (*Solanum melongena* L.), variability, heritability and genetic advance, randomized block design (RBD).

Introduction

Brinjal or egg plant or Aubergine or Guinea Squash or poor man's crop (*Solanum melongena* L.) is one of the most important vegetable crops grown in India. It belongs to the family Solanaceae and have chromosome number 2n = 24. Vavilov (1928) was of the opinion that Indo-Burma region is the primary center of origin. Many of the round varieties set fruits at slightly lower temperature, but are highly susceptible to frost. Brinjal is also considered to be the drought susceptible crop. Genotypic differences in tolerance to moisture stress have been noticed (Chen *et al*., 2002). The long fruited varieties set fruit at higher temperature and show tolerance to frost. It can be successfully grown both in rainy and summer seasons. In India, it is being cultivated approximately in 0.709 million ha area with an annual production 12.92 million tonnes of fruits and productivity of 182.2 quintals ha^{-1}. Presently, the Uttarakhand State has 2,330 ha area under brinjal cultivation. This crop has annual production of 27,120 tonnes with a productivity of 116.4 quintals ha^{-1} (Anonymous, 2013). Moreover, information on extent of genetic variability among available genetic resources, the nature and extent of association between various yield attributes and relative importance and direct and indirect influence of each of the component traits on yield could prove helpful in formulating an effective breeding strategy for augmenting the productivity of brinjal at specific region like hills of Uttarakhand, India. Therefore, the present investigation was carried out to study the variability, heritability and genetic advance for sixteen quantitative traits in brinjal.

***Author for correspondence :** E-mail : acm24680@gmail.com

Materials and Methods

The experiment was carried out during the *kharif* season of 2013 at Vegetable Research Block, Department of Vegetable Science, Uttarakhand University of Horticulture and Forestry, Ranichauri Campus (30° 18' N latitude and 78° 24' E longitude at an elevation of 2000 m), Tehri Garhwal (Uttarakhand), India. Seeds of twenty one genotypes (Arka Shirish, Utkal Madhuri, DBL-329, Uttara, JBGR-1, Azad T-3, Azad B-3, Utkal Keshri, Punjab Nagini, Swarna Avilamb, Pusa Shyamal, GOB-1, CH-10-45, NDB-3, Annamalai, Brinjal Local Long, Pant Samrat, Mukta Keshri, PR-5, Swarna Shoba and Utkal

Tarni) were sown in different rows on a raised bed nursery followed by normal nursery practices. The experiment was laid out in randomized block design with three replications at the spacing of 60 cm and 45 cm between rows and plants, respectively. All the recommended cultural practices were followed to raise a healthy crop and data were recorded for sixteen plant growth and fruit yield characters *viz*., days to 50% flowering, plant height at 50% flowering (cm), number of branches per plant, leaf area (cm^2), flowers per cluster, fruits per cluster, fruit setting percentage (%), fruit length (cm), fruit diameter (cm), fruit volume (cm^3), number of fruits per plant, average fruit weight (g), plant height at last picking (cm), dry matter content (%), number of pickings and fruit yield per plant (kg). The data thus obtained were analyzed statistically for range of performance, variance and coefficients of variation at genotypic and phenotypic levels (σg, σp, GCV and PCV), heritability in broad sense (% h^2) and genetic advance (GA).

Results and Discussion

Highly significant differences were recorded among the varieties for all the characters suggesting that the genotypes included in the experiment were having appropriate variation for different traits and hence were suitable for further genetic analysis. The relative variability of different characters is presented in table 1.

The data presented in table 2 revealed that phenotypic variance for all the traits had higher values corresponding to their genotypic counterpart although the differences were not much high in all the cases. Genotypic and phenotypic variances were highest for fruit volume followed by average fruit weight, leaf area, fruit setting percentage, number of fruits per plant and plant height at last picking. High genotypic and phenotypic variances have also been reported by Patel *et al*. (2004), Kushwah and Bandhyopadhya (2005), Singh and Kumar (2005), Dhameliya and Dobariya (2007), Mishra *et al*. (2008), Prasad *et al*. (2010), Sabolu *et al*. (2014) and Singh *et al*. (2014) in brinjal. The phenotypic coefficients of variation (PCV) were greater than their corresponding genotypic coefficients of variation (GCV) in respect of all quantitative traits indicating that the apparent variation is not only due to genotypes, but also due to influence of environment although the difference between GCV and PCV were narrow (Arivalagan *et al*., 2013). High value of PCV and GCV were noticed for number of fruits per plant, average fruit weight, fruit yield per plant, fruit volume, flowers per cluster, fruits per cluster, number of pickings and dry matter content. The characters showing

Table 1 : Analysis of variance (ANOVA) for quantitative characters in brinjal (*Solanum melongena* L.).

Source of variation	DF	Days to 50 % flower-ing	Plant height at 50% flowering (cm)	Number of branches per plant	Leaf area (cm^2)	Flowers per cluster	Fruits per cluster	Fruit setting percen-tage (%)	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cm^3)	Number of fruits/ plant	Average fruit weight (g)	Plant height at last picking (cm)	Dry matter content (%)	Number of pick-ings	Fruit yield/ plant (kg)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Replication	2	4.33	1.25	0.02	7.87	0.04	0.05	20.38	0.99	0.02	90.39	2.54	16.89	6.73	0.16	0.05	0.04
Genotype	20	151.6**	217.1**	8.14**	2545.5**	6.22**	3.04**	402.4**	42.2**	9.73**	1221 1.6**	381.9**	8423.5 **	313.1**	27.9**	6.52**	1.26**
Error	40	8.20	5.94	0.33	10.17	0.08	0.05	7.96	0.83	0.08	51.2	1.63	9.25	4.24	0.65	0.04	0.01

** Significant at 1% level.

Table 2 : Estimates of variability, heritability and genetic advance of different characters in brinjal (*Solanum melongena* L.).

S. no.	Characters	Range	Mean ±SE	C.V.	C.D. at 5 %	Variance			Coefficient of variance (%)			Herit-ability	Genetic advance
						Genotypic (??^{2}g)	Phenotypic (??^{2}p)	Environment(??^{2}e)	Genotypic (GCV)	Phenotypic (PCV)	Environment (ECV)	h^2 (%)	(GA)
1.	Days to 50 % flowering	52.00-75.33	64.05±1.65	4.47	4.72	47.80	56.03	8.20	10.79	11.68	4.47	85.4	13.15
2.	Plant height at 50% flowering (cm)	34.50-68.33	46.07±1.41	5.29	4.02	70.38	76.33	5.94	18.21	18.96	5.29	92.2	16.59
3.	Number of branches per plant	8.26-13.63	10.81±0.34	5.37	0.96	2.60	2.94	0.33	14.92	15.85	5.37	88.0	3.12
4.	Leaf area (cm^2)	124.21-223.13	176.22±1.84	1.81	5.26	845.11	855.28	10.17	16.49	16.59	1.81	98.0	59.52
5.	Flowers per cluster	2.20-6.86	4.17±0.17	7.12	0.49	2.04	2.13	0.08	34.32	35.05	7.12	95.0	2.88
6.	Fruits per cluster	1.38-5.56	2.68±0.13	8.61	0.38	0.99	1.05	0.05	37.18	38.16	8.62	94.0	2.00
7.	Fruit setting percentage percentage (%)	44.55-85.69	64.87±1.63	4.35	4.65	131.50	139.46	7.96	17.67	18.20	4.35	94.0	22.93
8.	Fruit length (cm)	12.13-24.76	17.04±0.53	5.37	1.51	13.78	14.62	0.83	21.78	22.44	5.37	94.3	7.42
9.	Fruit diameter (cm)	3.20-9.20	5.78±0.17	5.08	0.48	3.21	3.301	0.08	31.02	31.43	5.08	97.4	3.64
10.	Fruit volume (cm^3)	32.66-242.66	123.78±4.13	5.78	11.8	4053.48	4104.72	51.24	51.43	51.76	5.78	98.0	130.33
11.	Number of fruits/ plant	2.60-42.13	17.27±0.74	7.39	2.11	126.78	128.41	1.63	65.21	65.62	7.39	98.0	23.04
12.	Average fruit weight (g)	24.66-192.66	89.27±1.76	3.40	5.02	2804.76	2814.02	9.25	59.32	59.42	3.40	99.8	108.91
13.	Plant height at last picking (cm)	66.23-108.96	77.07±1.19	2.67	3.40	102.98	107.23	4.24	13.16	13.43	2.67	96.0	20.48
14.	Dry matter content (%)	4.56-15.09	9.77±0.47	8.28	1.33	9.08	9.74	0.65	30.84	31.93	8.28	93.3	5.99
15.	Number of pickings	1.16-6.86	4.24±0.10	4.79	0.30	2.16	2.20	0.04	34.64	34.97	4.79	98.0	2.99
16.	Fruit yield per plant (kg)	0.39-2.67	1.17±0.06	9.07	0.18	0.42	0.43	0.01	55.36	56.10	9.07	97.4	1.31

high degree of variations have more scope for their further improvement. These results are in agreement with the findings of Mohanty and Prusti (2002), Kushwah and Bandhyopadhya (2005), Dhameliya and Dobariya (2007), Senapati *et al*. (2009), Muniappan *et al*. (2010), Dhaka and Soni (2012), Kumar *et al*. (2013) and Lokesh *et al*. (2013) in brinjal. The ECV is a unit less value and can be used to measure relative variation existed among characters. ECV values among characters were found less than 10%. This indicated low environmental effect on expression of characters. However, Ushakumari *et al*. (1991), Kushwah and Bandhyopadhya (2005), Lokesh *et al*. (2013) and Nayak and Nagre (2013) have reported higher ECV values for fruit yield per plant in their findings in brinjal.

Effectiveness of a particular breeding procedure for different traits is mainly influenced by heritability, which is useful in determining the expression of phenotype related to the genotypic contribution of the trait. Johnson *et al.* (1955) stated that heritability values together with the genetic advance aided in predicting the expected progress through selection. The estimates made with regards to heritability (broad sense) and genetic advance are presented in table 2. All the sixteen characters studied in this investigation exhibited high level of heritability (85.4% to 99.8%). High heritability for different traits indicated that large proportion of phenotypic variance was attributed to genotypic variance and therefore, reliable selection could be made for these traits on the basis of phenotypic expression. Similar results have also been reported by Prabhu and Natarajan (2007), Senapati *et al*. (2009) and Shekar *et al*. (2012) in brinjal. Almost all the traits exhibited higher genetic advance. Maximum genetic advance was observed for fruit volume followed by average fruit weight, leaf area and number of fruits per plant. A higher value of genetic advance accompanied with high heritability estimates for different traits was obtained due to additive gene effect (Panse, 1957). Genetic advance was worked out to assess the responses to selection likely to occur in selection breeding programme (Sharma *et al*., 2000 and Das *et al*., 2010).

From a collection of twenty one diverse genotypes of brinjal (*Solanum melongena* L.), it was observed that the cultivars Azad T-3, JBGR-1, CH-10-45, Mukta Keshri and Punjab Nagini could be the promising parents for future breeding programmes, as they had more than one desirable traits. On the basis of variability, heritability and genetic advance. Studies, it was concluded that the selection of genotypes to improve fruit yield per plant under mid hill condition of Uttarakhand, India.

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