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Original Research Article

Gene Action Studies in Brinjal (*Solanum melongena* L.) for Yield and Yield Component

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Keywords

Brinjal, Gene action, Yield, Pooled

A B S T R A C T

The study on genetic component of variance revealed that additive and non-additive system operating in inheritance of yield and yield components. Gene effect with respect to the nature and magnitude for yield and its contributing traits were studied by involving 30 crosses made by using 10 lines and 3 testers. Crosses were evaluated in two subsequent year i.e. 2013-14 and 2014-15 and pooled analysis was carried out. For earliness, plant height, fruit length and fruit diameter σ^2gca (average) was reported higher than σ^2sca. σ^2gca (line) was found higher than σ^2 gca (tester) for most of the characters. Rest of the characters shows high σ^2sca than σ^2gca.For most of the characters except earliness, fruit length and fruit diameter σ^2_D was higher than σ^2_A.For total yield/plant line× tester interaction were reported57.04%, 53.76% and38.35% respectively in year 2013-14, 2014-15 and in pooled analysis.σ^2 gca/ σ^2sca ratio was less than unity for mast of the characters except earliness, fruit length and fruit diameter. In majority of characters there were preponderance of non-additive gene action; therefore these characters could be exploited through heterosis breeding.

Introduction

Brinjal (*Solanum melongena* L.), is one of the most important vegetable crops, belonging to the family Solanaceae. Internationally, it is referred as eggplant, having chromosome number 24. India is regarded as the primary centre of origin/diversity of brinjal (Bhaduri, 1951 and Vavilov, 1931). It is popular among people of all social strata and hence, it is rightly called as vegetable of masses (Patel and Sarnaik, 2003). Eggplant is well known for its medicinal properties and has also been recommended as an excellent remedy for liver complaints and diabetic patients (Tiwari *et al.*, 2009). The eggplant phytochemical that have received most research attention is the phenolics, a powerful antioxidants (Vinson *et al.*, 1998). Polyphenols have shown to be beneficial for human health due to its many biological activities like free-radical scavenging, regulation of enzymatic activity and anti-cancer activities and regulator of cell signaling pathways (Sato *et al.*, 2011). Consequently, due to the multiple health benefits of eggplant, which include anti-oxidant, anti-diabetic, hypotensive, cardio protective and hepatoprotective effects, the demand for eggplant has been on a rapid and steady rise in the recent years (Ojiewo *et al.*, 2007). In India, brinjal occupies an area of 0.71 million hectare with estimated production of 13.59 million tonnes and productivity stands at 19.1 tonnes per hectare (NHB, 2015). In Uttarakhand, it grows over an area of 2.33 thousand hectare with an annual production of27.05 thousand tonnes and productivity 11.60 tonnes per hectare (SHB, 2015).

An analysis of the above figure indicates that the productivity of Brinjal is low in India. In Uttarakhand, the productivity is still lesser than the national average. The reasons attributed are, use of low yielding cultivars grown for local preferences. It is not possible to have one common cultivar to suit different localities and local preferences. It is therefore required to improve the yield potential of available land races through hybridization, may yield good hybrids or varieties. Direct selection for quality traits is not successful due to interaction of gene with environment. The knowledge of the nature and magnitude of gene effects controlling inheritance of characters related to productivity would add in the choice of efficient breeding methods and thus accelerate the pace of its genetic improvement and also breaking the yield barriers. Considering the importance of such information, an experiment was conducted to understand the gene effects governing various yield and related traits in brinjal.

Materials and Methods

Present investigation was conducted during autumn-winter season, 2013-14 and 2014-15 at the Vegetable Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand), India. The University lies in south of the Shivalik range of Himalayas. It falls in humid sub-tropical zone locally known as *'Tarai'* situated at latitude of 29° North, longitude of 79.3^0 East and altitude of 243.84 meters above mean sea level (MSL). The experimental material comprised of F_1 population, developed by crossing 10 lines of Brinjal viz Swarn Syamli, PB71, BARI, SMB115, BB85, BRLVAR6, IBWL2001-1, PB66, LC7 and PB70 with 3 testers, namely Pant Samrat, Pant Rituraj and DBL02.Crosses were made by conventional method, hand emasculation and pollination in year 2012 in autumn winter season.30 F_1 along with their parents were evaluated in randomize block design with three replication each row consists of ten plants, planted at a distance of 75 × 60 cm. Twelve characters were observed viz: Days to 50% flowering, Number of primary branches per plant, Plant height (cm), Fruit length (cm), Fruit diameter (mm), Number of marketable fruits per plant, Weight of marketable fruits per plant (Kg), Number of unmarketable fruits per plant, Weight of unmarketable fruits per plant (Kg), Total number of fruits per plant, Total yield per plant (Kg), Yield per hectare (q) during autumn - winter season 2013-14 and 2014-15 and pooled analysis was also done. The data was analyzed as per the method recommended by Kempthorne, 1957.

Results and Discussion

The estimates of general combining ability variances σ^2gca, (lines), σ^2gca (testers) and σ^2gca (average), specific combining ability variances (σ^2sca) and ratio σ^2gca/ σ^2sca are presented in Table-1 and Proportional contributions of lines, testers and their interaction to total variances are depicted in Table -2.

The value of table 1 depicted that σ^2gca (line) were higher than σ^2gca (tester) for all the characters except fruit diameter whereas σ^2sca were higher than the σ^2gca (average) for the characters number of primary branches per plant, number of marketable fruits per plant, weight of marketable fruits per plant, number of unmarketable fruits per plant, weight of unmarketable fruits per plant, total number of fruits per plant, total yield per plant, yield per hectare and for plant height σ^2sca were higher than the σ^2gca (average) in year 2013-14 and pooled data whereas it was recorded less than σ^2gca (average) in year2014-15.These characters were govern by non-additive gene action and can be improved through hybridization. Similar results were reported by Patil and Shinde (1989), Kumar and Ram (1987), Suneetha *et al*., (2008) and Choudhary and Didel (2014).

Table.1 Genetic components of variance

Characters	Season	σ^2 gca (lines)	σ^2 gca (testers)	σ^2 gca (average)	σ^2 sca	σ^2 gca/ σ^2 sca
Days to 50% Flowering	2013-14	22.62	14.44	16.33	6.36	2.57
	2014-15	33.36	11.52	17.02	1.86	9.15
	Pooled	19.89	12.92	14.53	2.82	5.15
Number of primary branches/plant	2013-14	0.24	0.06	0.10	0.23	0.43
	2014-15	0.25	0.07	0.11	0.23	0.48
	Pooled	0.25	0.07	0.11	0.24	0.46
Plant height (cm)	2013-14	20.58	1.37	5.81	30.55	0.19
	2014-15	24.90	19.84	21.00	13.54	1.55
	Pooled	11.38	8.82	9.41	13.20	0.71
Fruit length (cm)	2013-14	4.89	4.77	4.80	2.59	1.85
	2014-15	4.97	4.90	4.91	3.16	1.55
	Pooled	5.09	4.88	4.93	3.38	1.46
Fruit diameter (mm)	2013-14	32.85	158.35	129.38	47.75	2.71
	2014-15	28.48	181.78	146.40	44.33	3.30
	Pooled	31.51	170.28	138.26	48.39	2.86
No. of marketable fruits/plant	2013-14	20.53	16.47	17.40	32.87	0.53
	2014-15	22.73	10.30	13.16	23.43	0.56
	Pooled	20.71	13.27	14.98	23.39	0.64
No. of unmarketable fruits/plant	2013-14	2.76	0.23	0.84	1.79	0.47
	2014-15	3.16	0.55	1.15	4.39	0.26
	Pooled	2.19	0.30	0.74	2.13	0.35
Wt. of marketable fruits/plant (Kg)	2013-14	0.09	0.02	0.03	0.15	0.20
	2014-15	0.04	0.02	0.02	0.10	0.20
	Pooled	0.05	0.02	0.02	0.10	0.20
Wt. of unmarketable fruits/plant (Kg)	2013-14	0.01	0.00	0.00	0.02	0.00
	2014-15	0.02	0.01	0.01	0.04	0.25
	Pooled	0.01	0.00	0.01	0.02	0.50
Total numbers of fruits/plant	2013-14	34.55	17.80	21.67	39.00	0.56
	2014-15	36.23	15.50	20.28	35.56	0.57
	Pooled	34.71	16.71	20.86	31.96	0.65
Total yield /plant (Kg)	2013-14	0.10	0.02	0.04	0.23	0.17
	2014-15	0.10	0.05	0.06	0.23	0.26
	Pooled	0.10	0.03	0.05	0.19	0.26
Total yield/ hectare (q)	2013-14	4955.27	1124.52	2008.54	11391.51	0.18
	2014-15	4774.27	2338.81	2900.84	11290.18	0.26
	Pooled	4781.70	1663.86	2383.36	9591.90	0.25

Table.2 Proportional contributions of lines, testers and their interaction to total variances

S. No.	Characters	Cropping season	Lines (females)	Testers (males)	Lines x Testers
1.	Days to 50% flowering	2013-14	59.01	27.57	13.41
		2014-15	76.82	18.52	4.66
		Pooled	29.93	7.46	62.61
2	No. of primary branches/ plant	2013-14	53.29	10.49	36.22
		2014-15	53.01	10.16	36.83
		Pooled	10.45	35.82	53.69
3	Plant Height (cm)	2013-14	44.04	3.67	52.30
		2014-15	49.05	27.74	23.21
		Pooled	21.65	30.61	40.75
4.	Fruit length (cm)	2013-14	46.03	31.29	22.69
		2014-15	46.02	33.24	20.74
		Pooled	32.36	21.59	46.05
5.	Fruit diameter (mm)	2013-14	18.89	60.72	20.38
		2014-15	14.92	69.34	15.73
		Pooled	65.61	17.60	16.79
6.	No. of marketable fruits/ plant	2013-14	37.36	21.82	40.82
		2014-15	48.91	16.31	34.78
		Pooled	21.01	34.31	44.64
7.	No. of unmarketable fruits/plant	2013-14	66.46	4.88	28.66
		2014-15	48.61	6.23	45.16
		Pooled	5.80	37.07	57.13
8.	Wt. of marketable fruits/plant (Kg)	2013-14	42.20	6.58	51.21
		2014-15	31.76	10.03	58.23
		Pooled	8.59	50.90	40.52
9	Wt. of unmarketable fruits/plant (Kg)	2013-14	27.84	6.54	65.62
		2014-15	41.91	11.73	46.37
		Pooled	12.07	52.20	35.73
10	Total number of fruits/plant	2013-14	46.44	17.59	35.97
		2014-15	50.34	15.89	33.76
		Pooled	17.96	31.53	50.51
11	Total yield/plant (Kg)	2013-14	36.69	6.26	57.04
		2014-15	33.98	12.25	53.76
		Pooled	9.86	51.80	38.35
12.	Total yield hectare (q)	2013-14	36.69	6.26	57.05
		2014-15	33.97	12.25	53.78
		Pooled	9.85	51.81	38.34

The value of ratio between σ^2gca and σ^2sca were observed more than unity in days to 50% flowering, fruit length and fruit diameter, thus these characters were govern by additive gene action and can be improve by simple selection. The perusal value of Table 2 revealed that the proportional contribution of lines varies from18.89 (Fruit diameter) to 66.46(Number of unmarketable fruits per plant) in year 2013-14and 14.92 (Fruit diameter) to 76.82 (Day's to 50% flowering) in year 2014-15 whereas in pooled data it ranges from 5.80 (Number of unmarketable fruits per plant) to 65.61(Fruit diameter). The range of proportional contribution of tester in year 2013-14 was 3.67(Plant height) to 60.72(Fruit diameter) and in year 2014 -15 it was ranged between 6.23(Number of unmarketable fruits per plant) to 69.34(fruit diameter) while, it ranged 7.46 (Day's to 50% flowering) to 52.20(Weight of unmarketable fruit per plant) in pooled analysis. In case of line × tester proportional contribution was recorded from 13.41 (Day's to 50% flowering) to 65.62 (Weight of marketable fruit per plant) in 2013-14, 4.66(Day's to 50% flowering) to 58.23(Weight of unmarketable fruit per plant) in 2014-15 and in pooled analysis it ranged from 16.79(Fruit diameter) to 62.61 (Day's to 50% flowering).

For most of the characters sca variance was greater than gca variance this shows that there is preponderance of non-additive gene action and these characters can be improved through heterosis breeding.

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