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Performance of parthenocarpic lines of brinjal (*Solanum melongena* L.) in net house and open field during the rainy season

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Abstract

Brinjal carries facultative parthenocarpy that is affected by seasonal variation and the environment of cultivation. Twenty-four parthenocarpic genotypes involving three parthenocarpic hybrid checks and one non-parthenocarpic varietal check (Punjab Neelam) were included to assess their performance under net house and open-field conditions during the rainy season. The genotypes, environments, and their interactions affected the performance of all the traits under investigation. Among the genotypes, PC-104-13-3, PC-104-13-1, PC-104-12-2, PC-104-3-1, PC-133-1, PC-136-4, PC-115-1, and non-parthenocarpic check Punjab Neelam had been the best for vegetative growth, while 93213-PC-2-1 and 93213-PC-2-3 for earliness and yield-related traits. In general, all the vegetative, flowering, fruiting, and yield-related traits flourished better under net house conditions as compared to open field conditions. Interaction effects between environment and genotype indicated that 93213-PC-2-1 and 93213-PC-2-3 were earlier for days to first harvest (35.0 and 38.0 days), at the top for the number of flowers per cluster (10.67 and 11.33, respectively), the number of fruits per cluster (6.67 and 7.00, respectively) and the maximum number of marketable fruits per plant (25.51 and 28.03, respectively), when grown under net house conditions. The maximum and statistically at par average fruit weight was observed in PC-104-13-1 (298.33 g) and parthenocarpic hybrid check Nikki (291.67 g) in net house conditions. The parthenocarpic genotypes PC-123-1 (2.89 kg), PC-2016-6-2 (2.87 kg), PC-1-12-2 (2.78 kg), PC-104-13-1 (2.64 kg), PC-17-1 (2.61 kg), parthenocarpic hybrid checks Shelly (2.74 kg) and Nikki (2.73 kg), and Amaron check (2.55 kg) displayed at par marketable fruit yield per plant under net house conditions. In all, the marketable yield and its related traits during the rainy season were affected by the environment of cultivation, where the parthenocarpic genotypes performed better in net house conditions in brinjal.

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Key words: Brinjal, Parthenocarpy, Environmental effect, Genetic variation, Marketable yield

Introduction

Brinjal or aubergine or eggplant (*Solanum melongena* L.), an important vegetable crop, has been proposed as a national vegetable in India, recently. It is infested with many insect-pests and diseases during the period of its cultivation. Brinjal shoot and fruit borer (*Leucinodes orbonalis*) is the most devastating pest that causes huge losses in marketable yield (70-92%) of this crop. The climatic conditions prevailing during the rainy season especially in September are more conducive for the multiplication of this pest. In contrast, protected cultivation in a net- or poly-houses provides earliness, higher productivity and quality, and pesticides free produce that increases the returns to growers (Rai et al. 2004). Initially, two brinjal hybrids viz; BH-1 and BH-2 were recommended for net house cultivation (Dhatt et al. 2012). However, brinjal is being often-cross pollinated crop, relies on insect activity as well as wind velocity to affect higher fruit sets. In this regard, protected structures displayed poor fruit sets and demanded supplementary pollination (tapping the main stem for pollen dispersal) for increasing productivity.

Parthenocarpy provides potential prospects for improvement in fruit set under adverse conditions that hinder pollen formation, its germination, and fertilization and simultaneously improved the fruit quality (Jessica et al. 2017; Falavigna et al. 2017; Knapp et al. 2017). Initially, genetic parthenocarpy was found in the European mutant cultivar 'Talina' and the trait was found to be associated with the enhanced level of auxin and gibberellins in the flower buds. The Japanese used 'Talina' in their breeding program, confirmed single dominant gene inheritance for this trait from segregating generations, and also developed improved parthenocarpic lines (Yoshida et al. 1998; Saito et al. 2009). Agronomic evaluation of genetically engineered parthenocarpic lines highlighted their superiority for the quality of fruits and yield potential in brinjal (Donzella et al. 2000). As per the earlier reports, the synthesis of growth regulators such as auxin in the ovaries is responsible for the initiation of fruit development without the sexual processes such as pollination and fertilization. However, the synthesis of growth regulators is temperature sensitive and promotes parthenocarpy exclusively under suboptimal conditions of lower temperature. Therefore, the screening of trait-specific genotypes and their evaluation for yield-related traits in specific seasons and environments is essential. To address the problem of fruit-set under protected structures, the trait of parthenocarpy could be helpful in pollinator-dependent crops (Knapp et al. 2017). Therefore, there is a need to develop, evaluate and utilize the parthenocarpic lines with the inbuilt potential of initiating the fruit set without pollination and fertilization. In this context, the present investigation was planned to evaluate the locally developed parthenocarpic lines for their seedless trait, growth behaviour, and production potential under the net house and open field conditions in the rainy season.

Materials and Methods

The present investigation was carried out with twenty-four parthenocarpic genotypes including one non-parthenocarpic check variety Punjab Neelam (BR-104) and three parthenocarpic check hybrids (Amaron, Nikki, and Shelly) from the private sector under both net-house and open field conditions. For the rainy season crop, the nursery was sown in the third week of June and the healthy seedlings were transplanted in July 2018. The crop was transplanted in the net house as well as open field conditions with an inter and intra row spacing of 90 x 30 cm following randomized complete block design (RCBD) in three replicates. The crop in both environments was raised as per recommended cultural practices. Five healthy growing plants of each genotype were selected in each replication for taking observations in net house and open field conditions. Data were recorded for various plant growth (plant height, inter-nodal length, leaf length, leaf width), flowering (days to 50% flowering, number of flowers per cluster), and fruit traits (fruit length, fruit width, days to first harvest, marketable number of fruits per cluster, marketable number of fruits per plant, average fruit weight, marketable fruit yield per plant), which are directly or indirectly related to yield potential in brinjal. The proportion of seedless fruits was observed visually by taking 10 fruits randomly. The fruits of each entry were cut vertically from the middle and the number of seeded and seedless fruits was observed. The number of seeds per fruit was also noted down. Types of flowers at the full-bloom stage from five plants in each genotype were observed as long, medium, short, and pseudo-short styled. The data from the net house and open field conditions was compiled replication-wise considering genotype as the first factor and environment as the second factor and then subjected to statistical analysis following Factorial RBD. The critical differences for the comparison of genotypes, environments, and their interactions for the traits under observations were calculated using the CPCS-1 software package for statistical analysis (Cheema and Singh 1990).

Results and Discussion

In rainy season cultivation of parthenocarpic brinjal under the net house and open field conditions, the results of statistical analysis for morphological traits highlighted significant mean square values for genotypes, environments as well as interactions of both the factors. It indicated that there was significant variation in the performance of the parthenocarpic genotypes, the effect of different environments, and the interaction of individual genotype with the type of environment in which it was cultivated. A similar type of study describing the effect of an environment of cultivation on various growth and yield traits was reported by Ganesan (2004).

Effect of genotypes: The average performance of parthenocarpic genotypes from two environments for vegetative, flowering, and yield traits are presented in Table 1. On an average, the genotype PC-104-13-3 (144.47 cm) had the tallest and statistically at par plants with non parthenocarpic check BR-104 (144.13cm), PC-104-12-2, PC-133-1, PC-104-3-1, PC-104-13-1, PC-136-4, PC-1-12-2, , PC-115-1, PC-11-5, PC-1-2016-3-2, 93213-PC-2-1. The shortest plants were observed in PC-67-2(118.91 cm). Parthenocarpic genotype PC-133-1 (99.66 mm) had the longest internodal length that was statistically at par with PC-104-12-2, PC-136-4, PC-11-2, PC-104-13-3, check hybrid Amaron, PC-123-1, and PC-104-13-1. The most narrowly spaced leaves were seen in PC-1-2016-3-2 (71.96 mm). In general, the genotype PC-104-12-2 (21.03cm) had the longest leaves and statistically at par leaf length with PC-115-1, PC-1-2016-6-2, PC-121-1, and parthenocarpic check Nikki. The shortest leaves were noticed in 93213-PC-2-1(16.51cm). The broadest and narrowest leaves were noticed in PC-115-1 (13.84 cm) and PC-1-2016-3-2 (10.71 cm), respectively. The earliness in flowering and the first harvest are the indicators of early bearing. In the present investigation, the genotype 93213-PC-2-1 took the least number of days for 50% flowering (25 days) and first harvest

Table 1: Effect of genotypes on vegetative, flowering, and yield traits of parthenocarpic lines during rainy season cultivation in brinjal

Genotypes	Plant height (cm)	Inter-nodal length (mm)	Leaf length (cm)	Leaf width (cm)	Days to 50% flowering	Flowers /cluster	Days to harvest	Fruit length (cm)	Fruit width (cm)	Fruits per cluster	Marketable fruits per plant	Average fruit weight (g)	Marketable yield/ plant (kg)
PC-11-2	120.07	88.47	19.24	10.91	37.67	1.33	52.00	12.33	8.11	1.17	8.27	225.00	1.79
PC-11-5	132.33	84.18	19.24	10.73	36.67	1.17	54.67	11.82	6.40	1.00	8.57	189.17	1.54
PC-1-12-2	134.23	83.41	18.32	12.75	36.67	2.00	51.33	11.97	7.45	1.67	8.81	226.67	2.01
PC-115-1	132.66	83.48	20.92	13.84	38.34	2.83	56.17	11.81	8.28	1.83	8.64	197.50	1.74
PC-17-1	121.45	76.77	18.62	13.21	28.50	1.83	51.50	11.84	7.10	1.67	12.10	169.17	1.93
PC-121-1	119.91	75.20	20.52	12.03	36.00	1.67	52.83	12.03	8.08	1.50	8.75	200.83	1.67
PC-123-1	125.75	86.91	19.85	11.64	35.34	1.67	52.17	11.43	7.31	1.33	8.60	224.17	2.15
PC-133-1	141.89	99.66	19.37	13.04	39.67	2.00	53.50	12.53	6.93	1.33	8.14	205.00	1.70
PC-136-4	135.57	88.48	18.22	11.41	36.67	2.17	50.33	12.08	7.29	1.50	7.91	207.50	1.96
PC-104-3-1	138.34	82.99	18.28	12.13	35.50	2.33	53.00	13.42	8.28	2.00	8.10	183.33	1.52
PC-104-12-2	142.68	90.24	21.03	12.00	37.17	2.00	54.67	12.66	8.16	1.33	8.30	205.00	1.80
PC-104-13-1	138.34	86.72	18.76	11.30	34.33	2.00	53.00	14.23	8.65	1.17	6.59	268.33	1.88
PC-104-13-3	144.47	88.09	18.99	12.08	34.50	1.83	50.00	12.38	8.27	1.67	7.25	233.33	1.69
PC-1-2016-1-1	126.83	84.54	18.57	12.18	36.50	2.83	55.33	10.25	6.05	2.50	9.57	159.17	1.56
PC-1-2016-3-2	131.10	72.59	17.53	10.71	38.17	3.33	53.17	9.68	5.67	2.17	9.50	164.17	1.73
PC-2016-6-2	129.57	75.29	20.71	12.94	36.83	2.83	52.00	9.44	5.13	2.67	8.95	209.50	2.06
PC-67-2	118.91	65.01	18.92	11.70	33.84	3.33	50.00	7.52	6.08	2.67	8.71	166.67	1.64
PC-67-6	125.76	75.83	18.59	10.79	31.50	2.83	53.50	9.78	5.32	2.00	8.37	167.50	1.55
93213-PC-2-1	129.91	77.68	16.51	11.00	25.00	8.00	40.67	8.72	5.80	5.00	19.32	71.67	1.47
93213-PC-2-3	128.68	84.55	19.48	11.07	28.00	9.00	43.67	9.50	4.54	5.67	20.87	70.00	1.53
BR-104 (NPVC)	144.13	81.89	19.60	12.18	46.67	1.33	66.83	13.83	10.95	1.17	5.24	245.83	1.29
Amaron (PHC)	127.67	87.67	19.45	12.15	33.33	1.50	55.83	14.67	7.20	1.33	7.00	247.50	1.75
Nikki (PHC)	128.49	75.36	20.52	12.20	32.67	1.33	51.17	13.32	6.61	1.17	6.91	260.83	1.84
Shelly (PHC)	123.72	75.51	18.31	11.98	33.00	1.33	49.67	13.12	6.99	1.33	7.50	252.50	1.87
CD(P=0.05)	16.58	5.28	0.98	0.71	2.02	0.76	1.77	0.80	0.49	0.66	1.13	13.84	0.25

PHC=parthenocarpic hybrid check; NPVC= non-parthenocarpic varietal check, BR-104 (Punjab Neelam)

(40.67 days). However, late flowering and fruiting (46.67 and 66.83 days) were observed in non-parthenocarpic check Punjab Neelam. The longest (14.67 cm), thickest (11.03 cm), and thinnest (4.54 cm) fruits were measured in parthenocarpic hybrid check Amaron, non-parthenocarpic check BR-104, and 93213-PC-2-3, respectively. The heaviest fruits were weighed in PC-104-13-1 (268.33 g) and parthenocarpic hybrid check Nikki (260.83 g). Among the most important yield traits, generally, the highest number of flowers and fruits per cluster as well as marketable fruits per plant were observed in 93213-PC-2-3 (9.00, 5.67, and 20.87, respectively) followed by 93213-PC-2-1 (8.00, 5.00, and 19.32, respectively). However, the least number of marketable fruits per plant was observed in non-parthenocarpic check Punjab Neelam (5.24). Overall, PC-123-1 displayed the highest (2.15 kg) marketable fruit yield per plant and remained statistically at par with PC-2016-6-2 (2.06 kg), PC-1-12-2 (2.01 kg), PC-136-4 (1.96 kg) and PC-17-1 (1.93 kg). Whereas, the lowest marketable fruit yield per plant was observed in non-parthenocarpic varietal check Punjab Neelam (1.29 kg). The genetic behaviour for producing more fruits per plant and higher fruit weight led to considerable differences in yield performance among the parthenocarpic genotypes. The genotypic differences agreed with the findings of Kumar et al. 2016 in brinjal and Abbey and Rao (2018) in different vegetable crops.

Effect of environments: Brinjal is a crop of a warm climate and its growth and yield potential is also affected by the environment of cultivation. In the present investigation, the results for the effect of the environment of cultivation (net house and open field) on the vegetative, flowering, and yield traits of brinjal are presented in Table 2. Overall performance of brinjal, irrespective of genotypes cultivated under the net house and open field conditions highlighted that the vegetative growth in terms of plant height (170.87 cm), internodal length (86.72 cm), leaf length (20.63 cm), and leaf width (13.25 cm) was better in the former environment as compared to the later in the Rainy season. The crop grown in the net house was earlier in flowering (26.85days) and days to harvest (43.51days) than crop grown in open conditions. The number of flowers per cluster (3.04) and fruits per cluster (2.19) as well as the marketable fruits per plant (12.22) were also higher in the net-house-grown brinjal in the Rainy season. Similarly, fruit length, width, and weight were also better in the net-house-grown crop as compared to the open field crop. The improvement in all the yield-related parameters also enhanced the marketable yield potential under net house conditions in comparison to open field

Table 2: Effect of environment on vegetative, flowering, and yield traits of parthenocarpic lines during rainy season cultivation in brinjal

Traits	Net house	Open-field	Environment CD (P=0.05)
Plant height (cm)	170.87	91.00	4.79
Inter-nodal length (mm)	86.72	77.48	1.52
Leaf length (cm)	20.63	17.67	0.28
Leaf width (cm)	13.25	10.57	0.21
Days to 50% flowering	26.85	43.36	0.58
Flowers per cluster	3.04	2.17	0.22
Days to first harvest	43.51	61.24	0.51
Fruit length (cm)	12.41	10.95	0.23
Fruit width (cm)	7.66	6.57	0.14
Fruits per cluster	2.19	1.72	0.19
Marketable fruits per plant	12.22	6.28	0.33
Average fruit weight (g)	212.70	183.15	3.99
Marketable fruit yield/ plant(kg)	2.38	1.09	0.07

cultivation. The results of the present investigation suggested that brinjal cultivated under net house conditions responded better in comparison to open-field conditions. The vegetative growth for plant height, inter-nodal length, leaf length, and leaf width was enhanced by improvement in the growing environment. Earliness was brought by triggering early initiation of flowers, pollinator-independent fruit set, and faster development of fruits as compared to the open cultivated crop. The increase in the number of flowers and set fruits per cluster, better fruit growth, availability of more marketable fruits due to check on the shoot and fruit borer infestation increased the yield potential of brinjal in net house conditions. Similar results for enhanced productivity under protected conditions were reported by Ganesan (2004), Katsoulas and Kltass (2008), and Ramesh and Arumugam (2010). Environment as an aggregate of different factors such as light, temperature, relative humidity affects plant growth and development. The increased growth and yield in the net house might have occurred due to the availability of optimum temperature and RH that efficiently regulated the developmental processes such as checking the evapotranspiration losses, enhancing uptake of nutrients from the soil, and improving photosynthetic rates as reported by Ummyiah et al. (2017).

Effect of genotypes and environments: The results of combined effects of genotypes and environments on various growth, flowering, and yield traits are presented in Table 3 and Table 4. It revealed that different genotypes, as well as growing conditions, significantly influenced the overall performance of parthenocarpic lines in brinjal. The performance of all the genotypes for vegetative, flowering, and yield traits had been better

Table 3: Effect of genotype and environment on growth and flowering traits of parthenocarpic lines during rainy season cultivation in brinjal

Parthenocarpic lines	Plant height (cm)		Internodal length (mm)		Leaf length (cm)		Leaf width (cm)		Days to 50% flowering		Flowers per cluster	
	Net house	Open field	Net house	Open field	Net house	Open field	Net house	Open field	Net house	Open field	Net house	Open field
PC-11-2	161.86	78.28	97.23	79.70	23.51	14.97	13.34	8.48	28.00	47.33	1.67	1.00
PC-11-5	181.42	83.24	97.16	71.20	21.71	16.77	12.30	9.16	27.00	46.33	1.33	1.00
PC-1-12-2	170.63	97.83	84.18	82.63	21.60	15.04	16.21	9.29	28.67	44.67	2.33	1.67
PC-115-1	169.75	95.57	84.66	82.29	23.01	18.82	16.14	11.53	29.67	47.00	2.67	3.00
PC-17-1	162.45	80.44	83.88	69.66	20.35	16.89	14.44	11.97	21.00	36.00	2.33	1.33
PC-121-1	157.88	81.94	70.97	79.43	23.27	17.77	14.19	9.87	26.33	45.67	2.00	1.33
PC-123-1	162.30	89.19	89.34	84.47	22.27	17.42	13.29	9.99	29.00	41.67	2.00	1.33
PC-133-1	197.08	86.69	105.85	93.47	21.84	16.90	16.01	10.06	32.33	47.00	2.33	1.67
PC-136-4	184.64	86.50	96.25	80.71	18.27	18.16	11.62	11.20	25.67	47.67	3.00	1.33
PC-104-3-1	190.09	86.60	85.36	80.61	18.95	17.61	13.01	11.24	25.33	45.67	2.33	2.33
PC-104-12-2	188.81	96.56	94.87	85.60	22.88	19.17	12.93	11.06	26.33	48.00	2.33	1.67
PC-104-13-1	185.17	91.51	91.39	82.05	19.08	18.44	12.65	9.95	28.33	40.33	2.67	1.33
PC-104-13-3	188.71	100.23	90.40	85.77	20.45	17.52	13.40	10.76	30.67	38.33	2.33	1.33
PC-1-2016-1-1	165.18	88.47	89.20	79.87	18.37	18.77	12.63	11.73	27.00	46.00	3.00	2.67
PC-1-2016-3-2	175.48	86.73	85.46	59.71	18.07	16.98	11.77	9.64	27.33	49.00	3.33	3.33
PC-2016-6-2	160.09	99.05	85.68	64.89	22.13	19.29	13.30	12.57	28.33	45.33	2.67	3.00
PC-67-2	145.05	92.76	65.23	64.79	20.12	17.72	13.19	10.20	27.67	40.00	3.67	3.00
PC-67-6	163.16	88.36	77.58	74.07	20.35	16.83	11.64	9.93	21.33	41.67	3.33	2.33
93213-PC-2-1	160.49	99.33	84.18	71.17	18.01	15.01	11.67	10.33	19.00	31.00	10.67	5.33
93213-PC-2-3	158.72	98.63	89.08	80.01	21.03	17.93	11.59	10.55	22.67	33.33	11.33	6.67
BR-104 (NPVC)	195.67	92.60	80.38	83.40	19.90	19.29	12.81	11.55	38.00	55.33	1.33	1.33
Amaron (PHC)	157.81	97.52	86.92	88.42	19.79	19.11	14.07	10.23	26.33	40.33	1.67	1.33
Nikki (PHC)	158.12	98.85	89.38	61.33	21.41	19.62	12.54	11.85	24.33	41.00	1.33	1.33
Shelly (PHC)	160.30	87.14	76.72	74.30	18.67	17.95	13.33	10.63	24.00	42.00	1.33	1.33
CD (P= 0.05)	G×E : 23.45		G×E : 7.47		G×E : 1.38		G×E : 1.01		G×E : 2.86		G×E : 1.07	

PHC=parthenocarpic hybrid check; NPVC= non-parthenocarpic varietal check, BR-104 (Punjab Neelam), G×E = Genotype×Environment.

under net house conditions as compared to open cultivation. The parthenocarpic genotype PC-133-1 performed best for plant height (197.08 cm) and internodal length (105.85 mm) and was statistically at par for plant height with BR-104 (195.67 cm), PC-104-3-1 (190.09 cm), PC-104-12-2 (188.81 cm), PC-104-13-3 (188.71 cm), PC-104-13-1 (185.17 cm), PC-136-4 (184.64 cm), PC-11-5 (181.42 cm) and PC-1-2016-3-2 (175.48 cm) under net house conditions. The longest (23.51 cm) and the broadest (16.21 cm) leaves were observed in PC-11-2 and PC-1-12-2, respectively. Three parthenocarpic genotypes viz; 93213-PC-2-1, PC-17-1, and PC-67-6 were scored better for days to 50% flowering (19, 21.0, and 21.33 days, respectively). While 93213-PC-2-3 and 93213-PC-2-3 were earlier for days to first harvest (35.0 and 38.0days), at the top for the number of flowers per cluster (10.67 and 11.33, respectively), the number of fruits per cluster (6.67 and 7.00, respectively) and the maximum number of marketable fruits per plant (25.51 and 28.03, respectively) under net house conditions. Among various genotypes, the parthenocarpic check hybrid 'Amaron' had the longest fruits (17.18), while the non-parthenocarpic check 'Punjab Neelam' had the broadest fruits (11.33 cm). The maximum average fruit weight was observed in PC-104-13-1 (298.33 g), which was statistically at par with parthenocarpic hybrid check Nikki (291.67 g) and significantly higher than all other interactions. The highest fruit yield per plant was observed in parthenocarpic genotype, PC-123-1 (2.89 kg) that was at par with PC-2016-6-2 (2.87 kg), PC-1-12-2 (2.78 kg), parthenocarpic hybrid checks Shelly (2.74 kg), and Nikki (2.73 kg), PC-104-13-1 (2.64 kg), PC-17-1 (2.61 kg), and parthenocarpic hybrid check Amaron (2.55 kg) under net house conditions and significantly higher from all other interactions. In the present investigation, the variation in growth, flowering, and yield traits among the genotypes in a particular environment was genetically inherited. The genotypic differences among various traits during net house cultivation have also been observed (Parkash et al. 2015; Kumar et al. 2016; Abbey and Rao 2018) in different plant species. The higher yield of crop grown in the net house might be due to higher vegetative growth, more number of flowers per cluster, fruit per cluster and plant, increased average fruit weight, and more number of marketable fruits. These results were substantiated with the findings of Kumar et al. (2016) and Ngullie and Biswas (2016). The availability of an optimum range of temperature, relative humidity, and comparatively higher concentrations of CO_2 in the net house conditions might have created such a microclimate around the plants that

Table 4: Effect of genotype and environment on fruit and yield traits of parthenocarpic lines during rainy season cultivation in brinjal

Genotypes	Days to first harvest		Fruit length (cm)		Fruit width (cm)		Fruits per cluster		Marketable fruits per plant		Average fruit weight (g)		Marketable fruit yield per plant (kg)	
	Net house	Open field	Net house	Open field	Net house	Open field	Net house	Open field	Net house	Open field	Net house	Open field	Net house	Open field
PC-11-2	42.67	61.33	13.02	11.63	9.24	6.97	1.33	1.00	9.96	6.58	248.33	201.67	2.47	1.10
PC-11-5	46.33	63.00	12.10	11.54	7.09	5.71	1.00	1.00	10.59	6.56	205.00	173.33	2.17	0.91
PC-1-12-2	42.00	60.67	13.02	10.92	8.43	6.47	2.00	1.33	12.18	5.45	228.33	225.00	2.78	1.23
PC-115-1	46.67	65.67	12.33	11.29	8.80	7.77	2.33	1.33	10.75	6.54	211.67	183.33	2.28	1.2
PC-17-1	48.00	55.00	12.81	10.87	6.77	7.43	2.00	1.33	16.17	8.04	161.67	176.67	2.61	1.24
PC-121-1	44.33	61.33	12.47	11.58	8.64	7.51	1.67	1.33	10.71	6.78	206.67	195.00	2.21	1.12
PC-123-1	45.33	59.00	12.11	10.74	8.79	5.83	1.33	1.33	11.86	5.33	243.33	205.00	2.89	1.4
PC-133-1	46.67	60.33	12.80	12.26	8.25	5.60	1.33	1.33	10.67	5.61	220.00	190.00	2.35	1.05
PC-136-4	38.00	62.67	12.21	11.94	7.92	6.67	1.67	1.33	10.37	5.45	223.33	191.67	2.32	1.59
PC-104-3-1	41.33	64.67	14.23	12.61	8.42	8.13	2.00	2.00	11.03	5.18	181.67	185.00	2.01	1.03
PC-104-12-2	43.67	65.67	13.23	12.08	8.29	8.03	1.33	1.33	11.54	5.06	218.33	191.67	2.51	1.08
PC-104-13-1	43.33	62.67	14.39	14.07	9.00	8.30	1.33	1.00	9.08	4.11	298.33	238.33	2.64	1.12
PC-104-13-3	42.33	57.67	13.57	11.19	8.57	7.98	1.67	1.67	9.62	4.88	240.00	226.67	2.31	1.07
PC-1-2016-1-1	44.33	66.33	11.43	9.06	6.90	5.20	2.67	2.33	12.23	6.91	173.33	145.00	2.12	1.00
PC-1-2016-3-2	40.67	65.67	11.18	8.18	6.53	4.80	2.33	2.00	13.00	6.01	186.67	141.67	2.42	1.03
PC-2016-6-2	42.67	61.33	10.73	8.15	5.76	4.50	2.67	2.67	12.21	5.69	235.00	184.00	2.87	1.24
PC-67-2	41.00	59.00	8.47	6.56	6.37	5.80	2.67	2.67	11.59	5.83	190.00	143.33	2.21	1.06
PC-67-6	46.67	60.33	10.04	9.51	5.70	4.93	2.33	1.67	11.58	5.17	183.33	151.67	2.12	0.98
93213-PC-2-1	35.00	46.33	9.01	8.42	6.10	5.50	6.67	3.33	25.51	13.13	83.33	60.00	2.1	0.83
93213-PC-2-3	38.00	49.33	9.89	9.11	4.95	4.13	7.00	4.33	28.03	13.71	76.67	63.33	2.15	0.91
BR-104(NPVC)	57.67	76.00	14.64	13.01	11.33	10.57	1.00	1.33	5.64	4.83	265.00	226.67	1.48	1.09
Amaron (PHC)	44.00	67.67	17.18	12.16	7.50	6.90	1.00	1.33	9.66	4.33	263.33	231.67	2.55	0.95
Nikki (PHC)	41.67	60.67	13.60	13.03	6.91	6.30	1.33	1.00	9.16	4.67	291.67	230.00	2.73	0.94
Shelly (PHC)	42.00	57.33	13.42	12.82	7.44	6.53	1.33	1.33	10.11	4.89	270.00	235.00	2.74	0.99
CD (P= 0.05)	G×E : 2.51		G×E : 1.14		G×E : 0.69		G×E : 0.93		G×E : 1.61		G×E : 19.57		G×E : 0.35	

PHC=parthenocarpic hybrid check; NPVC= non-parthenocarpic varietal check, BR-104 (Punjab Neelam), G×E = Genotype×Environment favoured the plant growth by increasing the photorespiration and photosynthetic activity as reported by Ummyiah et al. (2017). Increased levels of relative humidity within the net house checked evapotranspiration losses and also led to better utilization of water and nutrients in the plant. It might have increased hormonal metabolism and availability of photosynthates for the growth and development of the plants. Similar findings were discussed by Kumar et al. (2016).

Proportion of seedless fruits: The parthenocarpy in brinjal is a facultative type as the seed set is observed when it is pollinated through selfing or by the visits of the insect pollinators. The expression of parthenocarpy also depends upon the season of cultivation, type of cultivation (net house or open), the type of style length in the flowers of a particular genotype. The data on the proportion of seedless fruits (out of ten fruits) was presented in Fig 1. During the Rainy season, PC-11-2, PC-11-5, PC-121-1, PC-123-1, PC-104-12-2, PC-104-13-1, PC-1-2016-3-2, PC-1-2016-6-2, PC-67-6, parthenocarpic hybrid checks Amaron, Nikki, and Shelly were observed completely seedless in net house conditions, whereas other genotypes showed a proportion of seeded fruits with very less number of seeds (5-15 seeds). In open-field conditions, completely seedless fruits were observed in PC-104-13-1, PC-1-2016-6-2, PC-67-6, and parthenocarpic hybrid checks Nikki and Shelly, but PC-11-2, PC-115-1, PC-133-1, PC-136-4, PC-1-2016-3-2, PC-67-2, 93213-PC-2-3, and parthenocarpic hybrid check Amaron showed a variable number of seeds (few to many), while rest of the genotypes showed seeded fruits. The genotypes PC-104-13-1, PC-1-2016-6-2, PC-67-6, hybrid check Nikki, hybrid check Shelly bore seedless fruits in open field conditions also. Fully seeded fruits were observed in non-parthenocarpic check BR-104 irrespective of the net house or open-field conditions. The performance of parthenocarpic genotypes for seedlessness was better in net house cultivation. This approved that brinjal carries facultative parthenocarpy and needs a pollinator-free environment for getting quality seedless fruits. However, a few genotypes were parthenocarpic even in open cultivation. A high level of growth regulator in a particular genotype might have initiated the advanced growth of ovaries that led to complete parthenocarpy in open too. As per the earlier reports, the synthesis of growth regulators such as auxin in the ovaries was responsible for the initiation of fruit development without pollination and fertilization (Jong et al. 2009).

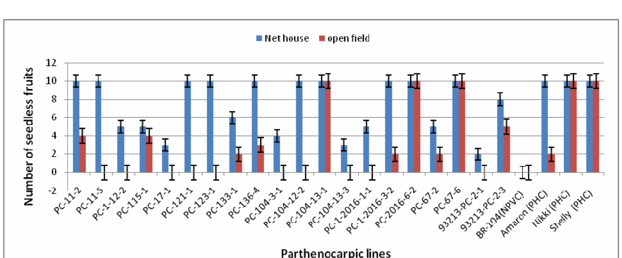

Fig. 1: Number of seedless fruits of parthenocarpic lines under the net house and open field conditions during rainy season cultivation in brinjal

It is concluded that brinjal carries facultative parthenocarpy that necessitates its cultivation in pollinator-free enclosed structures for getting quality seedless fruits. The genotypic differences for vegetative, flowering, fruit, and yield traits are highlighted and simultaneously displayed the parthenocarpic potential in two different environments. Overall, the marketable yield, its related traits, and parthenocarpic potential of genotypes were observed better in net house conditions during the Rainy season in brinjal. It helped in the selection of improved parthenocarpic genotypes with agronomically important yield traits. In the future, there is a need to explore the association between parthenocarpy and the level of growth regulators in the specific environment of cultivation in brinjal.

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बैंगन में ऐच्छिक पार्थेनोकार्पी होती है जो मौसमी भिन्नता और खेती के वातावरण से प्रभावित होती है। कुल 24 पार्थेनोकार्पिक प्रभेदों में तीन पार्थेनोकार्पिक संकर नियंत्रक और एक नॉन–पार्थेनोकार्पी किस्म नियंत्रक (पंजाब नीलम) सम्मिलित थे, जिन्हें वर्षाकाल में जालीघर (नेट हाउस) और मुक्त प्रक्षेत्र (ओपन–फील्ड) परिस्थितियों में उनके प्रदर्शन का आंकलन करने के लिए परीक्षण किया गया। प्रभेद वातावरण और आपसी क्रियात्मक पहलू के जांच तहत सभी लक्षणों के प्रदर्शन को प्रभावित किया। प्रभेद पीसी–104–13–3, पीसी–104–13–1, पीसी–104–12–2, पीसी–104–13–1, पीसी–133–1, पीसी–136–4, पीसी–115–1 और गैर–पार्थेनोकार्पिक नियंत्रक पंजाब नीलम वानस्पतिक विकास के लिए सबसे अच्छा था जबकि 93213–पीसी–2–1 और 93213–पीसी–2–3 शीघ्र और उपज संबंधी लक्षणों के लिए उत्तम पाया गया। सामान्यतौर पर सभी वानस्पतिक, फल और उपज से संबंधित लक्षण मुक्त प्रक्षेत्र की स्थितियों की तुलना में शुद्ध जालीघर की परिस्थितियों में बेहतर ढंग से विकसित हुये। पर्यावरण और प्रभेद (जीनोटाइप) के बीच पारस्परिक प्रभाव ने संकेत दिया कि 93213–पीसी–2–1 और 93213–पीसी–2–3 पहले शीर्ष कटाई के दिनों के लिए (35 और 38 दिन), प्रति गुच्छ फलों की संख्या के लिए फल पर (10.67 और 11.33 क्रमशः), प्रति गुच्छ फलों की संख्या (क्रमशः 6.67 और 7.0) और प्रति पौध विपणन योग्य फलों की अधिकतम संख्या (क्रमशः 25.51 और 28.03), जब शुद्ध घरेलू परिस्थितियों में उगाए जाते हैं। पीसी–104–13–1 (298.33 ग्राम) और पार्थेनोकापिक संकर नियंत्रक निक्की (291.67 ग्राम) में शुद्ध घर की स्थिति में अधिकतम और सांख्यिकीय रूप से बराबर औसत फल वजन देखा गया। पार्थेनोकार्पिक प्रभेद पीसी–123–1 (2.89 किग्रा.),

पीसी–2016–2 (2.87 किग्रा.), पीसी–1–12–2 (2.78 किग्रा.), पीसी–104.13.1 (2.64 किगा.), पीसी–17–1 (2.61 किग्रा.), पार्थेनोकार्पिक संकर नियंत्रक शैली (2.74 किग्रा.) और निक्की (2.73 किग्रा.) और अमरोन नियंत्रक (2.55 किग्रा.) को शुद्ध घरेलू परिस्थितियों में प्रति पौध विपणन योग्य फल उपज पर प्रदर्शित किया गया। कुल मिलाकर वर्षा ऋतु के दौरान विपणन योग्य उपज और उससे संबंधित लक्षण खेती के वातावरण से प्रभावित थे, जहां पार्थेनोकार्पिक प्रभेद ने बैंगन में शुद्ध घर की परिस्थितियों से बेहतर प्रदर्शन किया।

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