



RESEARCH ARTICLE

Performance of Brinjal (*Solanum melongena* L) Germplasm for Shoot and Fruit Borer Infestation and Marketable Yield

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ABSTRACT

The present field experiment was aimed to evaluate the tolerance level to shoot, fruit borer infestation, and yield traits with 174 brinjal accessions at the University orchard, Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. Among the evaluated accessions, the Acc- EC 490062, Acc - EC 144139-D and Acc - IC 344646 were identified as the best performers as they showed favorable effects for earliness to flowering and harvest, number of fruits per plant and yield. In addition, they recorded the lowest level of shoot and fruit borer infestation with a high marketable yield. The least incidence of shoot borer (13.97 %) was registered in the accession EC 144139-D, EC 490062 (14.35 %), followed by the accession IC 344646 (15.74 %). Whereas the minimum infestation of fruit borer was recorded by the accessions EC 490062 (13.18 %), EC 144139-D (13.52 %), and IC 344646 (13.67 %). The maximum marketable yield per plant (3.46 kg) was registered by the Acc - EC 490062 followed by Acc - EC 144139-D (3.80 kg) and Acc- IC 344646 (3.64 kg). The genotypes acknowledged in the current investigation can be explored as parents in future crop improvement programmes of brinjal.

Keywords: *Brinjal Accessions; Plant Traits; Earliness; Fruit Traits; Shoot and Fruit Borer Infestations; Marketable Yield*

INTRODUCTION

Vegetable cultivation plays a vital role in making the cropping system more remunerative. There are plenty of reasons, which hinder the production levels of vegetable crops. They are, non-availability of suitable cultivars/varieties, high cost of the desirable seed /planting materials, damage of pests and diseases and change of climatic conditions, etc. To overcome these problems, selecting the best genotypes from the germplasm pool that will serve as a basic material in crop improvement programmes to develop suitable high yielding varieties with resistance to biotic and abiotic stresses gains importance.

Brinjal is a common vegetable grown throughout India. Nevertheless, it has its regional specificity based on its color, size, shape, stripes on the surface, thorniness, etc. The nutritional value of brinjal per 100g according to the United States Department of Agriculture (USDA), shows that brinjal fresh weight comprises 0.3 per cent minerals, 0.3 per cent fat, 1.3 per cent fiber, 1.4 per cent protein, 4 per cent of various vitamins and carbohydrates (A and C) and 92.7 percent moisture. It is a good

source of potassium, phosphorus, calcium, iron and the vitamin B group. Besides its nutritional quality, brinjal has numerous health benefits in orthodox and traditional medicine. Although brinjal is not so popular for its high health-promoting micronutrients, it has low calories and low fat, making it valuable in diets. Remarkably, available literature suggested that brinjal is used as a medicine in different parts of the world for various illnesses (Oladosu, 2021).

The germplasm collection could be a source of desirable traits for improving existing brinjal varieties in the country. In addition, the global interest in the development of cultivars has encouraged germplasm collection and preservation. Hence, these resources are important to plant breeders as a reservoir of genetic variation. Characterization and evaluation of plant germplasm are vital for identifying desirable accessions for utilization in breeding programs (Upadhyaya *et al.*, 2008). The importance of utilization and development of varieties towards high yield and high marketable yield to supply high-value brinjal to the market is highly essential to enhance the profitability to the growers.

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Knowledge of agro-morphological genetic variation and cropping conditions on vegetative and yield-related traits plays a significant role in varietal improvement and production of brinjal (Sulaiman *et al.*, 2020). In any selection programme, the mean performance of the genotypes for individual characters serves as an essential criterion for discarding the undesirable types. This indicates that germplasm studies may act as a potential source and offer scope for the selection of high-yielding genotypes with desirable horticultural attributes. Hence the potential of germplasm act as genetic resources, "Evaluation and identification of suitable cultivars is mandatory" for maintaining plant genetic resources to identify the best types and use them in the further breeding programme. Therefore, the present investigation was undertaken to characterize brinjal accessions collected from NBPGR, New Delhi, by assessing the performance of brinjal accessions for important plant traits and shoot and fruit borer resistance, marketable yield to identify the best performing accessions.

MATERIAL AND METHODS

The present brinjal evaluation study was conducted at the University Orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. A total number of 203 (200 accessions and three check varieties) brinjal accessions were received from the National Bureau of Plant Genetic Resources (NBPGR), New Delhi. Among the 200 accessions and three check varieties sown, 170 accessions and two check varieties (Pusa Upkar and Punjab Sadabahar) were germinated. They were

evaluated along with two more check varieties of brinjal viz., CO1 and CO2 released from Tamil Nadu Agricultural University, Coimbatore. Around 174 genotypes (170 accessions and four check varieties) were utilized for the study. Seeds were sown in the nursery and the seedlings were transplanted in the main field after 30 days. The experiment was laid out in "Augmented Block Design". Required cultural operations like watering, manuring and weeding were done periodically by adopting standard cultural practices. A random of five plants were marked for recording observations in each accession. The observations were recorded on plant traits viz., plant height and no. of branches, flowering, earliness to flowering and fruit harvest, fruit and yield traits viz., single fruit weight, fruit length, fruit girth, fruit weight, no. of fruits per plant, yield per plant, shoot and fruit borer infestation and marketable yield per plant. The obtained data were subjected to statistical analysis as suggested by Panse and Sukhatme, 1985.

RESULTS AND DISCUSSION

The recorded observations were statistically analyzed and the mean values were tabulated and presented in Table 1. The statistical analysis revealed highly significant differences among the genotypes for all the traits indicating the presence of sufficient variability in the experimental material. The selection of suitable parents is an essential criterion for the success of a crop improvement program. The research conducted by Srivastava (2020) revealed that eggplant germplasm had ample genetic variation portrayed through agro-morphological characterization.

Table 1. Mean performance of brinjal accessions

Acc No.	Plant height (cm)	No. of branches	Days to 50% Flowering	Days to first harvest	Single fruit weight (g)	Fruit length (cm)	Fruit girth (cm)	Number of fruits	Yield per plant (kg)	Shoot borer incidence (%)	Fruit borer incidence (%)	Marketable yield (kg)
EC 111317	63.47	9.87	70.53	87.73	68.57	10.32	13.84	38.43	2.63	19.57	29.86	1.85
EC 112773	86.32	7.25	77.33	97.53	107.82	10.36	15.17	30.52	3.29	18.71	22.32	2.56
EC 144139-D	87.59	12.43	56.33	66.63	78.66	11.92	13.54	55.84	4.40	13.97	13.52	3.80
EC 169079	89.32	8.54	65.73	75.87	82.54	16.43	7.35	36.74	3.03	15.62	28.43	2.17
EC 169757	55.56	9.35	60.33	82.38	52.36	6.74	6.32	37.62	1.97	18.34	22.17	1.54
EC 304072	76.47	5.55	65.63	89.76	58.84	8.70	6.22	40.15	2.36	19.75	20.54	1.88
EC 305048	65.38	6.76	67.83	91.45	56.54	8.43	6.52	36.45	2.06	21.86	18.78	1.68
EC 305056	82.47	7.43	66.33	93.53	66.86	9.37	7.24	25.83	1.73	20.43	19.21	1.40
EC 305070	106.28	6.85	68.37	83.53	72.64	8.52	9.86	32.34	2.35	16.52	18.24	1.93
EC 305163	92.17	7.84	66.43	89.37	81.43	10.48	6.39	39.42	3.21	12.14	27.36	2.34
EC 315014	80.35	9.52	65.27	87.67	65.73	12.32	5.42	48.78	3.21	17.18	15.21	2.73
EC 316226	66.61	7.37	69.33	93.45	60.44	11.42	5.86	33.54	2.03	19.73	23.87	1.55
EC 316227	77.75	7.26	72.63	98.73	59.57	10.36	8.62	40.17	2.40	20.42	26.74	1.76
EC 316230	62.34	6.87	61.77	87.54	66.68	11.24	7.53	38.25	2.55	16.78	19.58	2.06
EC 316242	58.73	6.64	61.67	86.33	48.73	7.36	6.52	42.76	2.08	21.54	30.32	1.45
EC 316244	63.64	8.51	67.66	81.43	66.29	10.74	9.67	50.32	3.34	20.87	23.54	2.56

EC 316275	83.72	6.78	71.82	90.43	57.38	9.71	11.36	29.36	1.68	18.63	19.48	1.36
EC 316284	94.18	7.34	69.83	87.33	49.36	10.42	7.92	36.18	1.79	19.13	26.21	1.33
EC 378820	68.54	7.68	70.77	88.53	71.85	8.31	6.84	30.42	2.19	17.45	21.53	1.72
EC 379244	60.23	6.22	73.33	86.53	63.48	9.74	8.43	43.54	2.76	19.72	28.45	1.98
EC 384619	65.36	8.34	70.33	90.57	51.50	6.76	5.84	37.68	1.94	18.67	27.41	1.41
EC 393239	78.54	6.78	71.37	92.33	67.39	7.18	8.82	33.25	2.24	19.23	19.58	1.81
EC 467271	86.31	9.28	76.53	90.73	82.30	12.38	9.15	30.14	2.48	20.46	23.87	1.89
EC 490062	70.13	11.63	56.73	65.57	68.67	11.57	8.83	64.75	4.45	14.35	13.18	3.86
IC 023771	78.56	8.64	68.55	79.33	67.74	8.55	17.65	41.32	2.80	21.22	24.35	2.12
IC 023957	48.73	7.22	69.66	77.53	85.73	9.76	8.75	33.45	2.87	19.52	23.47	2.20
IC 023969	63.54	9.85	73.23	88.26	60.14	14.35	10.56	40.52	2.44	22.56	30.75	1.69
IC 023971	80.45	8.31	67.50	78.17	59.53	9.24	5.91	30.47	1.81	18.92	23.85	1.38
IC 074194	104.64	7.45	69.33	80.45	53.85	7.88	5.43	29.65	1.60	19.18	20.58	1.28
IC 074207	89.36	10.37	65.66	83.53	54.26	6.38	6.83	42.18	2.29	20.74	26.43	1.69
IC 074224-I	93.87	6.78	63.86	87.46	68.75	8.45	8.39	28.73	1.98	18.75	28.79	1.41
IC 089826	82.53	9.40	62.03	82.33	53.86	6.70	6.27	30.32	1.63	16.47	19.15	1.32
IC 089837-D	62.38	8.08	61.56	80.47	58.92	9.58	7.33	29.87	1.76	17.25	21.86	1.38
IC 089888	108.47	6.84	62.38	87.53	50.18	12.87	10.43	36.36	1.82	22.34	25.63	1.36
IC 089910-C	83.71	8.45	65.66	78.36	55.36	8.90	6.74	21.87	1.21	16.54	17.21	1.01
IC 089912	78.72	9.32	71.33	81.38	72.31	12.72	6.20	33.28	2.40	18.43	28.13	1.73
IC 089929-A	107.53	10.87	78.38	89.53	95.87	12.16	14.25	36.85	3.53	19.18	22.87	2.73
IC 08993	68.75	7.87	69.15	90.43	99.27	14.18	13.21	27.42	2.72	20.16	25.68	2.03
IC 089947	79.56	5.58	66.53	78.74	63.31	10.34	5.46	40.43	2.56	21.75	26.18	1.89
IC 089949-B	50.38	4.68	77.85	93.58	65.67	9.72	8.46	23.89	1.57	17.38	20.44	1.25
IC 090026	53.58	5.33	65.37	73.84	64.86	8.53	7.95	30.34	1.97	14.86	19.32	1.56
IC 090031	72.18	6.84	69.34	84.53	35.16	11.16	9.34	38.36	1.35	16.26	25.32	1.01
IC 090035	75.68	5.67	61.63	88.78	62.08	8.92	6.53	33.84	2.10	19.50	23.48	1.61
IC 090046	63.77	6.36	60.73	90.43	64.63	9.26	7.55	29.25	1.89	16.87	18.92	1.54
IC 090051	92.36	4.68	68.63	92.16	86.78	10.94	8.78	31.62	2.74	19.04	19.78	2.20
IC 090068	78.56	9.72	72.18	85.33	87.46	12.50	13.76	37.53	3.28	17.89	19.38	2.65
IC 090085	81.26	6.85	59.38	69.84	68.72	11.36	8.43	40.67	2.79	18.43	20.18	2.23
IC 090088	93.48	7.38	67.14	87.43	103.54	8.42	9.35	27.86	2.88	19.44	21.46	1.57
IC 090092	96.75	10.87	78.68	91.34	70.15	10.58	12.50	40.84	2.86	21.87	25.54	2.13
IC 090111	60.52	6.74	68.33	90.63	65.38	10.30	7.73	48.15	3.15	15.29	15.43	2.67
IC 090132	118.73	10.32	81.36	91.53	98.14	11.63	15.42	36.59	3.59	19.83	24.32	2.72
IC 090137	75.36	5.42	72.33	92.48	59.83	11.21	6.84	40.62	2.43	16.24	18.96	1.97
IC 090144	68.94	9.27	69.74	96.55	50.46	9.53	11.72	40.53	2.05	22.34	26.85	1.50
IC 090260	59.43	8.74	72.33	88.35	56.83	12.18	7.84	43.85	2.49	19.85	24.05	1.90
IC 090806	74.21	9.26	60.58	81.43	92.17	8.74	6.50	30.42	2.80	23.42	30.37	1.95
IC 090810	68.72	7.39	62.63	90.36	61.79	9.37	8.54	41.13	2.54	21.87	29.56	1.79
IC 090811	81.23	8.43	76.33	91.58	60.55	9.32	5.86	39.21	2.37	20.78	26.58	1.75
IC 090871	87.53	8.64	69.53	88.33	118.32	9.43	15.97	33.64	3.98	16.87	19.82	3.10
IC 090905	56.27	6.31	61.73	84.38	55.38	9.21	6.74	30.26	1.67	17.84	21.54	1.10
IC 090915	62.36	7.39	63.66	87.43	58.92	10.75	5.37	30.21	1.78	21.68	23.42	1.37
IC 090931	54.51	8.47	64.77	92.16	53.63	9.76	8.35	28.57	1.53	24.53	26.87	1.12
IC 090940	97.84	7.32	62.57	78.43	63.48	13.36	9.33	25.45	1.61	23.24	18.76	1.31
IC 090942	87.56	9.87	81.36	88.74	92.17	10.84	15.35	37.86	3.49	19.73	20.86	2.77
IC 098735	92.17	10.35	80.43	89.21	74.66	9.18	8.54	39.93	2.98	21.84	27.63	2.16
IC 099670	87.65	9.25	68.34	86.43	84.15	14.18	12.17	30.24	2.54	20.78	26.29	1.88

IC 099676	91.32	10.16	67.58	77.53	68.76	12.78	10.32	32.35	2.22	23.84	29.78	1.56
IC 099691	88.56	7.45	68.27	74.89	62.32	11.33	6.85	36.87	2.30	20.58	25.46	1.72
IC 099712	60.38	8.41	69.66	81.73	65.27	13.82	5.31	31.12	2.03	22.63	22.84	1.57
IC 099726	55.78	7.34	67.33	83.45	58.43	10.72	7.26	26.34	1.54	18.91	18.17	1.27
IC 099731	70.16	10.32	70.33	95.37	52.68	10.84	10.38	40.57	2.14	21.54	25.67	1.60
IC 104083	92.17	7.87	63.48	90.57	67.31	9.62	7.11	37.83	2.55	19.33	17.63	2.11
IC 104089	87.68	6.92	62.17	86.32	78.54	8.74	10.86	29.68	2.33	17.86	14.85	1.99
IC 104096	69.14	5.39	59.84	88.56	59.82	6.85	8.27	33.45	2.00	21.53	15.21	1.70
IC 111010	58.42	6.76	70.63	91.48	56.27	6.22	6.64	36.21	2.04	16.28	16.22	1.71
IC 111018	78.43	8.43	71.66	93.85	52.52	7.85	6.24	30.28	1.59	25.47	20.78	1.26
IC 111037	82.35	9.78	73.36	88.93	50.34	11.82	13.30	43.28	2.18	22.53	32.16	1.48
IC 111066-2	105.57	9.53	68.36	86.43	82.32	10.50	9.85	30.54	2.51	17.32	29.42	1.78
IC 111085	75.32	7.63	69.77	81.85	62.67	8.37	7.66	27.76	1.74	17.64	14.10	1.50
IC 111387	68.72	6.53	68.33	89.43	58.44	12.63	8.74	23.85	1.39	16.82	16.87	1.16
IC 111409	55.63	5.53	71.73	92.66	60.35	9.25	6.83	29.64	1.79	19.17	17.33	1.48
IC 111431	88.65	10.20	68.66	77.34	54.42	7.84	5.56	33.21	1.80	16.21	15.78	1.52
IC 111443	92.76	8.65	73.22	92.47	66.27	9.57	6.42	36.52	2.42	25.13	20.14	1.94
IC 112315	92.94	10.53	69.33	89.48	60.45	7.82	5.36	39.85	2.41	20.73	22.63	1.87
IC 112723	69.15	10.94	76.38	92.18	50.23	8.53	12.06	44.17	2.22	20.56	27.84	1.61
IC 112728	76.82	7.88	61.33	90.56	72.37	8.33	6.20	40.73	2.95	22.85	25.70	2.20
IC 112736	70.14	10.62	60.33	71.37	60.58	7.95	14.18	58.52	3.55	16.92	14.12	3.01
IC 112738	66.72	6.34	59.75	89.38	56.50	10.56	7.40	36.54	2.06	20.75	16.87	1.72
IC 112750	74.72	9.65	67.66	71.75	75.72	6.71	5.82	30.87	2.34	18.68	17.24	1.94
IC 112779	108.36	8.92	71.73	89.53	87.51	11.26	15.83	40.58	3.55	19.36	28.53	2.54
IC 112815	74.32	10.35	69.77	83.33	57.36	8.86	7.64	31.21	1.79	21.12	19.58	1.44
IC 112848	57.53	6.25	69.66	87.37	59.91	8.36	5.84	29.35	1.76	14.87	17.67	1.45
IC 112851	64.32	10.36	69.44	78.57	75.45	10.54	6.26	33.42	2.52	15.71	18.74	2.05
IC 112905	55.84	6.28	68.76	77.67	50.53	7.23	4.72	40.53	2.05	16.34	23.48	1.57
IC 112909	92.34	10.36	70.84	92.74	97.53	8.16	14.23	38.52	3.76	18.76	19.15	3.04
IC 112934	107.46	7.86	63.33	76.73	39.72	5.82	5.66	28.67	1.14	17.42	20.67	0.91
IC 112950	86.56	6.56	63.34	90.57	66.43	9.34	6.15	32.18	2.14	21.14	22.54	1.64
IC 112993	96.74	9.67	69.16	85.33	98.47	14.16	12.38	39.56	3.90	18.57	18.42	3.19
IC 136200	84.25	9.37	60.66	76.76	48.74	12.41	8.45	30.14	1.47	20.25	27.23	1.14
IC 169782	78.34	7.34	66.27	78.73	71.65	10.67	7.13	33.28	2.38	21.22	20.78	1.74
IC 203399	93.42	10.86	70.33	94.76	63.15	8.68	13.46	43.40	2.74	20.47	26.53	2.02
IC 218975	107.35	6.53	68.77	84.33	53.88	13.62	7.67	36.59	1.97	18.92	20.78	1.57
IC 249315	94.32	5.44	64.36	83.87	55.60	14.30	6.38	40.43	2.25	17.66	16.45	1.88
IC 249319	102.46	6.33	65.76	80.54	67.43	12.77	6.51	39.66	2.00	15.73	19.17	1.58
IC 249327	86.54	6.54	67.33	79.76	55.21	7.72	6.64	31.25	1.73	21.27	23.68	1.33
IC 249343	93.42	7.28	65.33	84.53	72.47	7.88	5.23	36.68	2.66	22.43	24.45	2.01
IC 249356	103.54	8.24	73.58	88.13	51.43	7.85	7.84	40.32	2.07	21.05	28.77	1.48
IC 261771	88.43	7.18	65.77	90.16	67.83	8.93	5.47	34.87	2.37	21.87	21.73	1.86
IC 261788	45.46	3.12	69.43	84.54	50.84	6.91	5.63	35.42	1.80	26.34	29.42	1.28
IC 261792	74.53	3.24	71.76	89.47	47.86	5.30	5.12	30.66	1.47	20.45	30.26	1.03
IC 261793	50.36	3.37	73.73	92.13	62.21	12.47	7.83	41.46	2.58	21.17	29.54	1.82
IC 261803	80.53	10.58	70.53	87.37	68.46	9.08	12.67	40.58	2.79	18.46	20.15	2.23
IC 261808	64.42	5.40	69.33	90.18	65.43	10.72	6.52	44.21	2.89	19.68	22.46	2.25
IC 261831	76.84	7.86	73.53	98.95	82.16	6.17	10.38	43.54	3.58	23.16	29.78	2.52
IC 264470	108.34	8.46	61.33	93.84	66.68	13.35	10.23	39.92	2.66	17.22	27.34	1.94

IC 265246	68.71	6.27	67.87	88.76	78.42	12.64	6.47	29.98	2.35	18.52	25.96	1.74
IC 272904	88.26	5.54	60.43	82.13	86.57	9.84	5.38	26.85	2.32	19.26	27.84	1.68
IC 279555	79.36	6.86	59.94	75.07	53.84	7.83	6.45	34.14	1.84	21.42	28.43	1.32
IC 280961	78.84	6.35	65.66	81.83	40.22	6.65	4.37	30.87	1.24	23.84	20.18	1.00
IC 281112	65.23	7.28	64.33	84.50	41.26	7.28	5.25	41.26	1.70	20.15	22.37	1.32
IC 281115	62.47	10.43	71.23	86.03	54.52	9.32	6.38	44.58	2.43	21.93	29.58	1.72
IC 285125	70.84	8.24	62.74	90.17	58.94	8.52	7.46	26.63	1.57	25.45	16.74	1.31
IC 304981	90.54	9.87	73.36	95.33	86.14	14.76	15.35	40.56	3.49	22.35	25.18	2.62
IC 310884	77.56	68.94	66.53	89.46	61.84	9.85	6.43	37.68	2.33	19.66	22.92	1.80
IC 316236	98.65	9.87	71.36	87.58	70.14	11.36	12.84	43.87	3.08	20.93	27.54	2.24
IC 317472	87.74	8.67	68.92	92.37	82.73	12.92	7.34	38.14	3.16	18.67	22.43	2.46
IC 332508	92.48	5.97	66.78	89.45	64.57	10.42	7.68	33.24	2.15	19.34	20.87	1.71
IC 332516	90.87	6.84	60.53	97.62	50.92	9.63	6.32	30.42	1.55	21.65	23.42	1.19
IC 333527	82.30	5.46	69.67	92.33	66.22	10.81	6.72	29.36	1.94	23.66	20.78	1.54
IC 336472	105.72	10.34	69.33	90.53	56.3	12.63	9.55	27.68	1.56	25.87	20.54	1.24
IC 336793	107.06	8.36	71.23	89.93	53.72	7.52	5.32	30.74	1.65	24.92	22.67	1.28
IC 344646	80.57	11.38	60.67	68.57	83.92	14.84	8.56	50.32	4.22	15.74	13.67	3.64
IC 345744	82.74	8.67	64.68	77.33	43.86	8.42	5.16	34.92	1.53	17.35	25.34	1.15
IC 347750	66.53	6.45	63.73	76.84	45.58	9.27	6.84	33.84	1.54	18.62	26.18	1.14
IC 347962	92.72	7.34	70.83	88.43	68.72	8.66	7.16	30.21	2.08	16.82	21.73	1.63
IC 353212	63.84	8.63	74.45	92.67	72.34	7.43	6.32	32.84	2.38	15.93	19.76	1.91
IC 354140	50.42	5.32	73.37	89.17	53.44	8.62	6.26	39.87	2.13	19.21	29.35	1.51
IC 354511	55.37	6.48	63.23	83.43	58.52	6.72	5.74	31.24	1.83	22.23	18.36	1.50
IC 354525	86.54	10.36	80.16	103.33	80.42	14.16	8.92	40.76	3.28	16.84	28.47	2.35
IC 354539	65.72	7.76	65.33	81.25	52.24	9.38	7.82	33.46	1.75	22.67	23.45	1.34
IC 354562	53.42	6.42	68.63	83.44	54.66	8.52	6.43	25.68	1.40	20.53	17.93	1.15
IC 354578	85.87	8.761	63.66	81.38	58.81	12.32	4.82	50.62	2.98	16.78	14.03	2.57
IC 354596	68.75	7.62	72.63	86.15	42.44	14.06	8.51	32.18	1.37	15.73	14.32	1.18
IC 354597	65.37	8.34	73.33	81.42	63.51	13.61	7.22	20.77	1.32	16.92	20.87	1.05
IC 354635	69.26	5.42	73.66	88.49	60.72	13.37	6.50	21.68	1.32	18.35	18.86	1.08
IC 354637	82.37	6.34	62.66	69.78	56.81	6.92	5.65	26.43	1.50	19.46	22.63	1.17
IC 354676	85.71	7.62	68.76	89.92	53.62	12.33	6.71	33.81	1.81	22.30	23.75	1.39
IC 354694	50.42	5.43	73.33	82.51	55.75	10.42	6.23	35.36	1.97	18.96	22.14	1.54
IC 354701	67.60	6.38	68.66	90.36	53.56	9.73	6.07	30.57	1.64	17.51	24.07	1.25
IC 374535	80.72	9.56	61.33	76.85	62.46	9.67	6.26	38.43	2.40	17.86	18.38	1.96
IC 374867	74.38	8.34	63.50	76.21	58.26	8.34	5.40	33.21	1.93	19.25	21.75	1.52
IC 374904	50.54	7.16	75.33	77.54	60.48	10.40	6.42	29.78	1.80	21.48	23.47	1.38
IC 374942	85.36	5.74	61.33	84.32	58.36	12.35	6.54	26.95	1.57	22.74	30.31	1.10
IC 383106	81.17	5.26	70.37	78.84	56.61	13.45	7.82	32.26	1.83	19.27	22.43	1.42
IC 383107	80.56	10.68	80.57	89.43	85.14	13.98	15.35	40.37	3.44	21.25	24.58	2.60
IC 383392	83.64	7.86	75.33	81.67	103.51	13.96	14.37	37.13	3.84	17.57	22.84	2.97
IC 387807	62.67	6.26	64.33	90.34	64.43	12.26	8.43	33.21	2.14	18.67	18.77	1.74
IC 397299	92.64	8.35	60.23	81.78	55.73	10.53	7.74	30.84	1.72	19.25	21.45	1.36
IC 413648	80.35	8.54	63.73	86.67	51.42	9.36	5.30	33.45	1.72	20.45	22.68	1.33
IC 420406	72.68	8.17	71.85	98.54	80.54	6.33	12.47	40.72	3.28	22.38	29.76	2.31
IC 420656	33.42	4.16	73.63	78.64	61.53	11.54	5.76	36.21	2.23	17.66	25.92	1.66
IC 427007	55.43	5.21	70.63	90.33	59.684	10.20	6.57	30.48	1.81	15.48	24.61	1.37
IC 427025	82.56	6.85	73.33	81.57	50.54	14.16	11.45	40.57	2.05	21.74	27.83	1.48
IC 467247	63.15	6.35	64.50	87.43	57.58	9.72	6.75	32.68	2.86	21.63	24.64	2.16

IC 545256	85.92	7.73	72.33	90.67	67.85	8.63	8.81	33.21	3.01	23.66	23.83	2.30
IC 545844	63.32	4.16	72.63	92.18	54.33	9.82	8.07	34.92	3.22	20.92	20.92	2.55
IC 545854	59.34	5.72	70.33	85.78	52.42	8.65	7.83	40.28	2.11	18.32	26.58	1.55
IC 545884	89.45	8.36	63.50	88.32	40.79	7.52	6.53	35.20	1.44	17.50	19.24	1.17
IC 545928	75.84	10.85	75.33	89.27	60.57	8.92	9.53	41.85	2.53	21.35	28.52	1.81
IC 545970	51.48	4.36	73.33	91.72	41.47	6.43	6.21	42.18	1.75	18.63	21.34	1.39
NIC 023959	87.58	6.87	68.37	88.24	52.51	9.32	6.82	38.42	2.02	20.34	26.78	1.48
Punjab Sadabahar	73.45	9.636	70.13	81.36	63.17	13.63	10.72	39.34	2.50	15.12	19.34	2.22
Pusa Upkar	87.46	9.62	72.15	82.46	75.43	14.67	10.27	46.43	3.51	16.32	17.63	2.89
CO 1	87.31	9.24	73.43	82.33	67.43	11.65	10.72	48.45	3.27	15.45	16.25	2.74
CO 2	78.65	8.67	70.15	85.65	72.15	12.27	12.35	48.54	3.50	22.46	29.74	2.46
	77.76	8.15	68.34	86.02	64.69	10.13	8.30	35.80	2.33	19.55	22.73	1.80
	5.36	2.07	5.68	5.74	8.92	3.68	1.46	7.26	0.83	0.34	1.53	0.25

Plant height is one of the important traits, that contributed to yield increase. Out of the 170 accessions and four check varieties evaluated, the measured plant height was ranged from 118.73 cm to 33.42 cm. The minimum plant height of 33.42 cm was recorded by the accession IC 420656. Totally 94 accessions recorded more plant height than the grand mean (77.76 cm). The maximum plant height of 118.73 cm was recorded in the Acc -IC090132, followed by Acc - IC089888 and Acc - IC 112779. Previous workers also stated the variation in plant height among different genotypes in brinjal Dahatonde *et al.*, (2010), Kumar *et al.*, (2011), Nirmala (2012), Praneetha (2016) and Srivastava *et al.*, (2019). The number of branches is another criterion that contributes to more yield. It was found that as low as 3.12 (Acc- IC 261788) branches to as high as 12.43 branches per plant (Acc- EC 144139-D) were recorded among the evaluated germplasm. The mean for this trait was 8.15. Among the evaluated germplasm, 77 accessions recorded more branches above the grand mean value. The next best values for more number of branches recorded was in Acc- EC 144139-D followed by Acc -EC 490062(11.63) and Acc- IC344646 (11.38). Variation in the number of branches in brinjal was also observed in the evaluated brinjal entries by Kamalakkannan *et al.*, (2007) , Voddoria *et al.*, (2007), Satesh Kumar *et al.*, (2011) , Nirmala (2012), Praneetha (2016) and Srivastava *et al.*, (2019).

Earliness for flowering and fruiting is a highly desirable character, which facilitates for more number of harvests from a plant in its entire duration. The range for days to 50 per cent flowering varied from 56.33 days (Acc - EC 144139-D) to 81.36 days (Acc- IC 090132 and Acc- IC 090132). On an average 68.34 days was recorded as a grand mean for this trait. A total number of 78 accessions took a lesser number of days for 50 per cent of flowering in the population and the accession IC 099670 recorded

68.34 days for 50 per cent flowering, which was on par with the grand mean. The Acc - EC 144139-D was the earliest one, which took 56.33 days for 50 per cent flowering and the Acc -EC 490062 was the second earliest to register 50% of flowering.

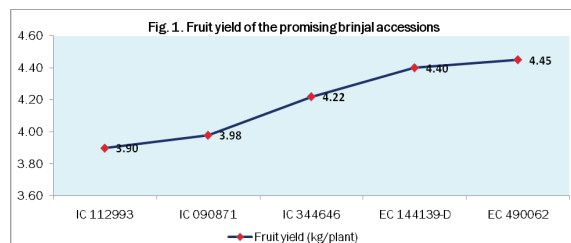
Earliness was also measured based on the number of days taken for the first harvest. Early harvest also facilitates for more number of harvests. Days taken for the first harvest ranged from 65.57 days (Punjab Sadabahar) to 103.33 days (Acc- IC 354525) with a grand mean value of 86.02 days. A total number of 72 accessions recorded a lesser number of days taken for the first harvest than the grand mean. The Acc -EC 490062 was the first which took the least number of days to first harvest (65.57 days). The next best accession was Acc - EC 144139-D, which took 66.63 days for the first harvest. Early flowering and early harvest were reported by Chowdhury *et al.*, (2010) and Nirmala (2012). Similar findings for early harvest in brinjal were registered by Omkar singh and Kumar (2005), Suneetha *et al.*, (2006), Vaddoria *et al.*, (2007), Chowdhury *et al.*, (2010), Nirmala (2012), Praneetha (2016) and Srivastava *et al.*, (2019).

The fruit weight ranged from 35.16 to 118.32 g. The maximum single fruit weight of 118.32 g was recorded by the Acc - IC 090871 followed by Acc -IC EC 112773 (107.82 g) and Acc - IC 090088 (103.54 g). A similar pattern for different ranges of fruit weight in brinjal was reported by Shafeeq *et al.*, (2007), Kumar *et al.*, (2011), Nirmala (2012), Praneetha (2016) and Srivastava *et al.*, (2019).

Fruit length also contributes to the yield increase and variation was observed among the evaluated accessions for this character. The grand mean for the length of the fruit measured among the evaluated brinjal germplasm was 10.13 cm. A total number of 81 accessions exceeded the mean value for fruit length and 93 accessions recorded a lesser value for the trait.

The maximum fruit length of 16.43 cm was recorded in the Acc - EC 169079, followed by the Acc - IC 344646 (14.84 cm) and Acc - IC 023969 (14.35 cm). The minimum fruit length of 5.3 cm was recorded in the ACC IC 261792. A wide range of fruit length in brinjal was reported by Paikra *et al.*, (2003), Deep *et al.*, (2006), Chowdhury *et al.*, (2010) Kumar *et al.*, (2011), Nirmala (2012) Praneetha (2016), and Srivastava *et al.*,(2019).

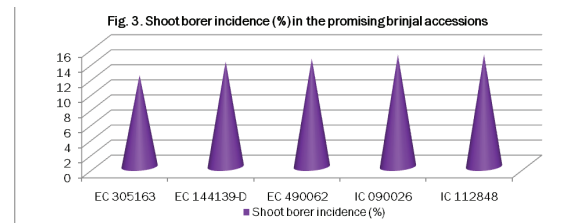
Fruit girth is another significant yield contributing character. As low as 4.37 cm to as high 17.65 cm was measured as fruit girth. The grand mean was 8.30 cm. Totally 67 accessions recorded high fruit girth than the grand mean. The maximum fruit girth was measured by the Acc. IC 023771. The next best values for the fruit girth were 15.97cm (Acc- IC 090871), 15.42cm (Acc-IC 090132) and 15.17 cm (Acc- EC112773). These findings of varied fruit girth in brinjal are in accordance with Kumar *et al.*(2011), Nirmala (2012), Praneetha (2016) and Srivastava *et al.*, (2019).



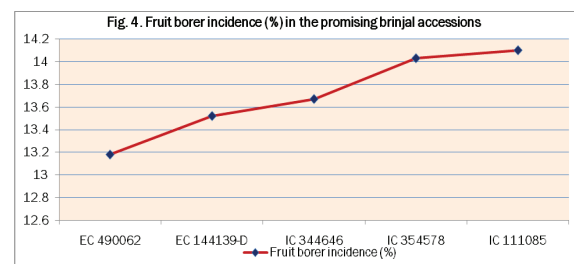
The number of fruit is the main trait, that directly decides the yield level. It was observed that a minimum of 20.77 fruits to the maximum of 64.75 fruits per plant were registered in different accessions. The Acc - EC 490062 recorded the maximum number of fruits per plant (64.75) followed by Acc- EC 144139-D (55.84) and Acc- IC 344646 (52.47). The minimum number of fruit per plant was recorded in the Acc- IC 354597. The same trend of results for variation in the number of fruits per plant were registered by Chowdhury *et al.*, (2010), Kumar *et al.*, (2011), Nirmala (2012), Praneetha (2016) and Srivastava *et al.*, (2019). The yield per plant decides the economic returns to the growers. The per plant yield ranged from 1.14 kg per plant in the Acc - IC 112934 to 4.45 kg per plant in the Acc- EC 490062. On an average, the evaluated accessions recorded 2.33 kg of yield per plant. The fruit yield of promising accessions are depicted in the figure 1. Various levels of yield in brinjal were registered by Kumar *et al.*, (2011), Nirmala (2012), Praneetha (2016) and Srivastava *et al.*, (2019) in the evaluated germplasm.

When there is no or less shoot and fruit borer damage, naturally increase in yield will be ascertained. The minimum percentage of shoot borer (12.14%) was recorded by Acc-EC 305163

followed by Acc - EC 144139-D (13.97%). The shoot borer infestation was maximum in the ACC IC 261788 (26.34%). The mean shoot borer infestation was 19.55% and 91 accessions recorded lesser shoot borer infestation than the grand mean. The shoot borer infestation is presented in figure 3.

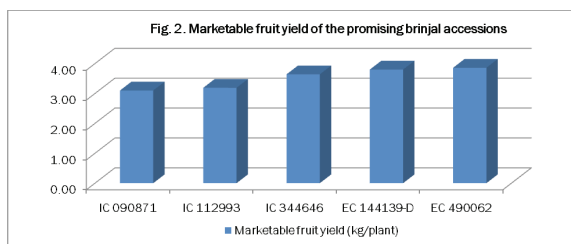


Fruit borer infestation decides the marketable fruit yield per plant. The minimum percentage of fruit borer (13.18 %) damage was recorded in the Acc - EC 490062 and Acc - EC 144139-D (13.52%). The highest fruit borer infestation of 32.16% was recorded in the ACC IC 111037. The mean for this trait was 22.73 and 90 accessions recorded lower fruit borer infestation than the grand mean. The wide range of shoot and fruit borer infestation in brinjal was also reported by Kamalakkannan *et al.* (2007), Dehatonde *et al.* (2010), Nirmala (2012), Praneetha (2016), Suresh *et al.* (2017) and Srivastava *et al.* (2019). The fruit borer infestation is presented in the figure 4.



Marketable fruit yield contributes to direct profit for the growers, which are obtained after deducting the fruit borer-infested fruits. The marketable yield ranged from 0.91 kg (Acc- IC 112934) to 3.86 kg and the mean marketable fruit yield per plant was 1.80kg per plant. The Acc IC 310884 registered on par marketable yield of 1.80 kg with the grand mean value.

The maximum marketable yield per plant (3.46 kg) was recorded by the Acc - EC 490062 followed by Acc - EC 144139-D (3.80 kg) and Acc- IC 344646 (3.64 kg). The same trend of results for various levels of marketable fruit yield in brinjal was also reported by Praneetha (2002), Thangamani (2003), Prabhu (2004), Nirmala(2012), Praneetha (2016) and Srivastava *et al.*, (2019). The marketable yield per plant is presented in figure 2.



The performance of brinjal germplasm from the present study showed that the Acc -IC090132 recorded the maximum plant height and the accessions Acc- EC 144139-D and Acc -EC 490062 registered the maximum number of branches per plant. The Acc - EC 144139-D was the earliest for 50% of flowering followed by Acc -EC 490062. The Acc -EC 490062 was the first one to register early harvest among the accessions evaluated.

The maximum single fruit weight was recorded in the Acc - IC 090871, the maximum fruit length was recorded in the Acc - EC 169079, the maximum fruit girth was measured in the Acc - IC 023771. Maximum number of fruits per plant was recorded in the Acc - EC 490062 followed by Acc- EC 144139-D and Acc- IC 344646. The highest yield per plant was recorded by the Acc- EC 490062 and Acc - EC 144139-D. The accessions Acc-EC 305163 and EC 144139-D recorded the minimum percentage of shoot borer and fruit borer damage. The Acc - EC 490062 followed by Acc - EC 144139-D and Acc- IC 344646 recorded maximum marketable yield per plant. The best accessions identified in the present study can be well utilized for varietal release and to use as parents in breeding programmes for further improvement of the desirable traits.

CONCLUSION

The germplasm evaluation study showed that the Acc- EC 490062, Acc - EC 144139-D, and Acc - IC 344646 were identified as best performers as they recorded desirable characters for earliness to flowering and fruit harvest, to record more number of fruits per plant and yield per plant. Also, they recorded the lowest level of shoot and fruit borer infestation and high marketable yield. Knowledge of morphological genetic variation on vegetative and yield-related traits plays a significant role in varietal improvement and production of brinjal (*Solanum melongena* L.). Therefore these accessions can be used in brinjal breeding programme to develop superior varieties/hybrids with high yield and low shoot and fruit borer infestation.

Funding and Acknowledgment

The authors are highly thankful to NBPGR, New Delhi for financial support offered and Tamil Nadu Agricultural University for the technical support provided to conduct this study at the University Orchard, TNAU, Coimbatore.

Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Originality and plagiarism

We assure that we have written and submitted only entirely original works.

Consent for publication

All the authors are agreed to publish this research article.

Competing interests

There were no conflict of interest in the publication of this content

Data availability

All the data of this manuscript are included in the MS. No separate external data source is required. If anything is required from the MS, certainly, this will be extended by communicating with the corresponding author through corresponding official mail; prejan27@gmail.com

Author contributions

Research grant- NBPGR, New Delhi: Idea conceptualization - SP: Experiments - SP, VS, PH: Guidance - SP: Writing - original draft - SP, VS, PH: Writing- reviewing & editing - SP, VS, PH

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