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Research Article

Evaluation of F_2 progeny families of brinjal three-way cross hybrids for tolerance to shoot and fruit borer

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Abstract
Brinjal (*Solanum melongena* L.), an important solanaceous vegetable crop cultivated across tropical and subtropical regions, is severely constrained by the Brinjal Shoot and Fruit Borer (BSFB), *Leucinodes orbonalis*, the most destructive pest of the crop, capable of causing yield losses exceeding 70%. The current study is focused on field screening of 28 segregating F_2 progeny families derived from complex three-way cross hybrids to identify transgressive segregants with inherent tolerance to BSFB damage. Correlation analysis revealed that total fruit yield per plant exhibited a strong positive association with marketable yield, total number of fruits per plant, and average fruit weight. Marketable yield showed a highly significant negative correlation with per cent fruit infestation (PFI) (r=-0.593), highlighting the direct economic impact of BSFB injury. Extensive phenotypic variability was observed, with PFI ranging from 0 to 75 per cent. Based on PFI and percent shoot infestation values, the genotypes were classified into distinct resistance categories, and a selection index was constructed using PFI and marketable yield with equal weightage. This approach enabled the identification of 50 superior lines combining higher marketable yield with reduced pest damage. These findings demonstrate that integrating PFI with key yield components can accelerate the development of high-yielding, BSFB-resistant brinjal cultivars.

Keywords : Brinjal, Shoot and fruit borer, Three-way cross, Segregating population, Host plant resistance, Selection index

INTRODUCTION

Brinjal is the fifth most important *Solanaceous* crop, produced under an area of 1.924 million hectares globally and producing 60.827 million tonnes with an average yield of 31,615 kg/ha (FAO, 2023). Approximately 90% of global eggplant production is concentrated in Asia, predominantly in China and India (Chapman, 2019). Although brinjal is cultivated across India, its productivity remains low (17.5 t ha^{-1}), which is considerably below the global average. Despite its nutritional advantages, eggplant cultivation is confronted with several challenges, including severe vulnerability to diseases, insect pests and abiotic stresses such as high temperatures and drought conditions (Senthilvadivu *et al.,* 2023). Brinjal is reported to be affected by more than 50 insect pest species across the globe, underscoring the severity of pest-related challenges in its cultivation (Nayar *et al.,* 1976). Among these, the shoot and fruit borer, *Leucinodes orbonalis* Guenée, a member of the family Pyralidae and order Lepidoptera, is considered the most destructive, leading to yield reductions of up to 70% (Akanksha *et al.,* 2023).

The female moth of *L. orbonalis* lays eggs on young leaves and tender shoots, and the emerging larvae bore into shoots and fruits, causing wilting, flower drop and internal fruit damage (Udikeri *et al.,* 2024). The pest thrives in hot and humid conditions, contributing to its widespread occurrence in brinjal-growing regions (Khatri and Shukla, 2010). To manage such pests, chemical pesticides are widely used, but their intensive and improper application has resulted in adverse consequences, including health hazards, increased production costs, environmental degradation, and disruption of natural enemies, often leading to secondary pest outbreaks (Divekar *et al.,* 2022; Narayana *et al.,* 2022; Arya *et al.,* 2022). Consequently, integrated pest management (IPM) strategies have increasingly emphasized sustainable and long-lasting approaches, with host plant resistance (HPR) playing a central role. Therefore, identifying genotypes that can naturally withstand shoot and fruit borer infestation is essential for improving brinjal cultivation.

Resistance breeding plays a crucial role in improving crop resilience by modifying its genetic architecture to develop traits that defend against pests like BSFB. This approach effectively reduces yield losses by incorporating genes that confer high levels of resistance. Various studies have been conducted and are ongoing to incorporate resistance into cultivated genotypes, through heterosis breeding, interspecific hybridization, biochemical analysis, and biotechnological approaches (Habde *et al.,* 2017). Heterosis breeding encompasses hybridization and selection to develop cultivars with enhanced resistance to BSFB, contributing to improved yield and tolerance (Kamalakkannan *et al.,* 2007; Joshi *et al.,* 2024; Sivasankarreddy *et al*., 2024). Interspecific hybridization utilizes wild relatives of brinjal to transfer resistance genes into cultivated varieties, broadening the genetic base for pest resistance (Karmakar and Singh, 2023). They serve as important genetic resources for developing new varieties and hybrids that are having resistance to shoot and fruit borer. The wild brinjal species *viz*., *S. sisymbrifolium*, *S. xanthocarpum*, *S. nigrum*, *S. khasianum* and *S. integrifolium* (Lal *et al*., 1976), *S. incanum* and *S. khasianum* (Kale *et al.,* 1986) and *S. virginianum* (Puthiamadom *et al*., 2021 have been reported to exhibit resistance to shoot and fruit borer. The existing breeding efforts have primarily focused on simple crosses or evaluating existing open-pollinated varieties. However, complex crosses can accumulate unique allelic combinations that are essential for strengthening HPR mechanisms. The present study addresses this gap by undertaking the screening of F_2 progeny families derived from three-way cross hybrids, a genetic pool that has rarely been attempted (Sivasankarreddy, 2025) and is critically required for evaluation in the context of BSFB resistance breeding. This novel approach aims to harness genetic diversity from multiple parents to develop superior, pest-tolerant brinjal varieties by accumulating resistant alleles through an additional round of recombination. Therefore, in this context, the present study was formulated and undertaken to assess shoot and fruit borer infestation in 28 F_2 progeny families of three-way cross hybrids, along with their parental lines and standard checks. Moreover, research focusing on the genetic association between yield and its component traits, as well as the direct and indirect effects of different yield components, is always useful for improving selection efficiency (Gupta *et al.,* 2017).

MATERIALS AND METHODS

Plant Materials: The experiment was conducted from January 2024 to August 2024 at the ICAR-NBPGR Regional Station, Thrissur. The selected three-way cross hybrids, representing diverse parental combinations were advanced to develop F_2 progeny families for evaluation of yield and BSFB tolerance, as detailed in **Table 1**, and were assigned specific genotype codes for further evaluation. Twenty-eight F_2 progeny families derived from three-way cross hybrids were evaluated for resistance to brinjal shoot and fruit borer (BSFB) and for yield, along with five parental lines (Ponni, Vengeri, IC618016, IC636521, IC624240). Surya was planted as the susceptible check to ensure maximum natural infestation of the shoot and fruit borer. The varieties Haritha and Neelima were chosen as checks for yield analysis.

Field Experiment: Seed treatment was performed using 1% KNO_3 for 1 hour. The seeds were sown in protrays filled with medium composed of coirpith, vermicompost, perlite, and vermiculite in 2:1:0.5:0.5 ratio. Healthy seedlings, 35-40 days old, were transplanted to the main field in March 2024, following a spacing of 75 x 60 cm. A total of 20 seedlings per progeny family were transplanted, along with parents and checks. Crucially, as the experimental material comprised highly segregating F_2 progeny families, all recorded observations were collected on an individual plant basis. Crop management practices throughout the experimental period adhered strictly to the scientific recommendations outlined in the Package of Practices of Kerala Agricultural University (2016).

Data collection and analysis:Observations for shoot and fruit borer resistance, growth parameters, and quantitative traits were recorded for yield analysis. Recorded traits included, number of infested shoots per plant, total number of shoots per plant, number of infested fruits per plant and total number of fruits per plant. Percent shoot infestation (PSI) and percent fruit infestation (PFI) were

Table 1. List of parents, checks and selected three-way cross hybrids

Genotypes	Genotype code	Genotypes	Genotype code
Parents		**Selected three-way cross hybrids**	
Ponni	1	(Vengeri × IC636521) × Ponni	(2 × 4) × 1 = 241
Vengeri	2	(Vengeri × IC618016) × IC624240	(2 × 3) × 5 = 235
IC618016	3	(Vengeri × IC624240) × IC618016	(2 × 5) × 3 = 253
IC636521	4	(Vengeri × IC636521) × IC624240	(2 × 4) × 5 = 245
IC624240	5	(Vengeri × IC636521) × IC618016	(2 × 4) × 3 = 243
Checks		(Ponni × Vengeri) × IC618016	(1 × 2) × 3 =123
Haritha (Yield analysis)		(Ponni × Vengeri) × IC636521	(1 × 2) × 4 = 124
Neelima (Yield analysis)		(Ponni × IC618016) × IC624240	(1 × 3) × 5 = 135
Surya (BSFB susceptible check)		(IC618016 × IC636521) × Ponni	(3 × 4) × 1 = 341
		(IC618016 × IC636521) × Vengeri	(3 × 4) × 2 = 342
		(IC618016 × IC636521) × IC624240	(3 × 4) × 5 = 345

estimated as per Mannan *et al.* (2015). The quantitative traits recorded were average fruit weight (g), plant height (cm), fruit length (cm), fruit breadth (cm), yield per plant (g) and marketable yield (g). The plants were classified into distinct resistance categories according to their mean PSI and PFI values, utilizing the established criteria proposed by Mishra *et al.* (1988). Observations on the seasonal incidence of shoot and fruit borer were recorded from individual plants. All shoots and fruits of the plants were examined individually, and the number of plants showing borer damage was noted. The extent of shoot and fruit infestation was expressed as the proportion of damaged shoots and fruits relative to the total number observed, and the values were presented as percentages (Mannan *et al.,* 2015). The PFI and marketable yield per plant were used as component characters to construct selection index by giving equal weightage. These component characters were merged into a score, or index according to Arunachalam and Bandyopadhyay (1984), in such a way that the selection of the best genotypes was possible. Initially, the PFI and marketable yield data of parents and checks were first used to estimate the variance and critical difference which served as the threshold for assigning the scores to separate the plants into distinct categories for each trait. The scores obtained for the two traits were then summed and averaged to derive a cumulative average score and the plants with the lowest cumulative average score were considered superior and assigned the highest final rank. Final data organization, ranking, and grouping of the selected genotypes were performed using MS Excel. Correlation analysis was performed using the grapesAgri1 web application (Gopinath *et al.,* 2021).

RESULTS AND DISCUSSION

*Correlation studies:*The correlation coefficients between shoot and fruit infestation and various yield attributing traits are presented in **Table 2**. The study demonstrated that BSFB infestation parameters exhibited significant negative correlations with fruit yield per plant. Specifically, negative correlations were observed between yield and the number of infested shoots per plant (−0.229), per cent shoot infestation (−0.393), and per cent fruit infestation (−0.438). This strongly suggests that increased damage from BSFB infestation is directly associated with a substantial reduction in fruit yield in brinjal, a result consistent with the findings of Gangadhara *et al.* (2023), who also reported significant negative correlations between fruit yield per plant and both BSFB shoot and fruit infestation.

Analysis of correlation in the studied F_2 progeny families revealed that fruit yield per plant was significantly and positively correlated with total fruits per plant (0.899), fruit weight (0.658), total number of shoots per plant (0.357), plant height (0.332), fruit length (0.26), and fruit breadth (0.054). A positive correlation with infested fruits per plant (0.101) was also noted. Characters positively correlated with the targeted trait (yield) are of considerable importance to plant breeders for selection purposes, as they enable effective indirect selection. These findings align with prior research by Gangadhara *et al.* (2023) and Rameshkumar *et al.* (2022), who similarly reported significant positive associations of fruit yield per plant with the number of fruits per plant, fruit weight, weight of infested fruit, fruit girth, plant height, number of primary branches per plant and fruit length in brinjal.

Analysis of marketable yield per plant revealed parallel associations. Marketable yield per plant exhibited a significant positive correlation with fruit yield per plant (0.977), along with other traits: total fruits (0.881), fruit weight (0.61), total shoots (0.377), plant height (0.315), and fruit length (0.262). The marketable yield displayed significant negative correlations with BSFB damage, specifically shoot infestation (−0.411) and fruit infestation (−0.593). These correlation patterns are consistent with findings of Vidhya and Kumar (2015), who reported similar positive correlations with growth and marketable yield traits and negative correlations with shoot and fruit

Table 2. Correlation matrix among shoot and fruit infestation and yield attributing traits of brinjal

	TS	IS	TF	IF	PSI	PFI	PH	FW	FL	FB	MY	FY
TS	1	0.227**	0.288**	-0.076	-0.446**	-0.204**	0.21**	0.272**	0.285**	-0.046	0.377**	0.357**
IS		1	-0.183**	0.108*	0.708**	0.185**	-0.123**	-0.161**	-0.093*	-0.003	-0.248**	-0.229**
TF			1	0.216**	-0.335**	-0.441**	0.227**	0.302**	0.272**	0.013	0.881**	0.899**
IF				1	0.082	0.706**	0.03	-0.032	0.007	-0.005	-0.094*	0.101*
PSI					1	0.258**	-0.273**	-0.292**	-0.3**	0.039	-0.411**	-0.393**
PFI						1	-0.053	-0.161**	-0.171**	0.001	-0.593**	-0.438**
PH							1	0.385**	0.148**	-0.103*	0.315**	0.332**
FW								1	0.169**	0.097*	0.61**	0.658**
FL									1	-0.329**	0.262**	0.26**
FB										1	0.052	0.054
MY											1	0.977**
FY												1

** Correlation is significant at 0.05 level; TS-Total shoots, IS-Infested shoots, TF-total fruits, IF-infested fruits, PSI-percent shoot infestation, PFI-percent fruit infestation, PH-Plant height, FW- Fruit weight, FL-Fruit length, FB-Fruit breadth, MY-Marketable yield, FY-Fruit yield per plant

borer infestation in brinjal. The comprehensive data, including the specific correlations between shoot and fruit infestation with various quantitative traits (as presented in **Table 2**), highlight the importance of this study. Therefore, understanding these correlation patterns is crucial for facilitating indirect selection in F_2 progeny families, which ultimately results in the development of high-yielding and pest-tolerant brinjal varieties.

Scoring for brinjal shoot and fruit borer resistance: The field screening of the three-way cross F_2 progeny families confirmed the infestation and susceptibility of brinjal to the BSFB. Substantial variation was observed among genotypes, with PFI ranging from 0 to 66.66%, indicating differing levels of susceptibility to fruit borer infestation (**Table 3**). Marketable yield also varied widely, from 51.40 to 1498.90 g, with mean yields spanning 113.65 to 726.13 g. The lowest fruit infestation was recorded in nine lines, 241-8-1, 123-3-14, 123-3-16, 123-3-7, 123- 3-11, 123-3-19, 123-3-17, 123-3-12, 243-14-10 with no fruit infestation followed by 241-4-15 [(Vengeri × IC636521) × IC618016] and 254-11-6 [(Vengeri × IC624240) × IC636521], both exhibiting percent fruit infestation of 7.14 %. Among the 560 segregating plants of 28 F_2 progeny families evaluated, none were entirely free from shoot infestation by *Leucinodes orbonalis*. The plants within each family exhibited variation, reflecting the expected genetic segregation, and thus the calculation of selection scores, were performed using individual plant data to capture the full range of genetic variance and facilitate effective selection to forward the superior plants. The screening revealed a wide range of susceptibility within the population, with PSI ranging from 4.5 per cent to a maximum of 60 per cent and per cent fruit infestation varied between 0 per cent to 75 per cent (data not presented in the manuscript). Out of 560 plants evaluated, 9 plants were immune to fruit infestation from *Leucinoides orbonalis*.

In comparison to our findings, Malik and Pal Rishi, (2013) observed shoot infestation ranging from 0 to 20 per cent, whereas fruit infestation was relatively higher, varying between 14.18 per cent and 53.19 per cent across forty brinjal germplasm lines. Kavishetti and Rani (2018) also reported that the infestation percentages of brinjal shoot and fruit borer varied significantly across hybrids and seasons, with shoot infestation ranging from 15.97 per cent to 40.53 per cent, and fruit infestation ranging from 17.25 per cent to 42.50 per cent among the tested hybrids. They inferred that the observed variability in brinjal shoot and fruit infestation was primarily influenced by the genetic makeup of the brinjal hybrid, which determined its resistance or tolerance levels, as well as by seasonal environmental conditions that affected pest pressure (Kavishetti and Rani, 2018). In the present study, fruit infestation was found to be notably higher (0 to 75%) and more economically damaging than shoot infestation (4.5 to 60%) (data not presented in the manuscript). Fruit infestation started 40 days after transplanting, with the highest incidence recorded after three months of transplanting. In contrast, shoot infestation was maximum during the peak vegetative phase and declined as the plants shifted to the reproductive phase. This temporal pattern of infestation is consistent with the findings of Mannan *et al.* (2015), who demonstrated that the infestation level of brinjal shoot and fruit borer was related to the various developmental stages of the plant. Kumar and Singh, (2013) similarly observed that shoot

Table 3. Range and mean values of per cent fruit infestation and marketable yield per plant of F_2 progeny families of brinjal three-way cross hybrids

Genotype code/ F_2 progeny line number	Per cent fruit infestation range (%)	Per cent fruit infestation mean (%)	Marketable yield range (g)	Marketable yield mean (g)
R3-241-8	0-33.33	19.34	352.00-805.50	571.403
R3-235-5	10.00-40.00	21.05	232.20-670.50	428.21
R2-124-8	8.33-33.33	20.19	261.20-953.70	429.11
R3-253-12	11.11-40.00	23.23	153.60-611.20	304.30
R3-254-11	7.14-40.00	18.02	262.50-1358.50	726.13
R3-143-2	10.00-42.85	21.82	199.20-597.60	378.49
R1-123-1	8.33-28.57	18.13	301.50-941.60	548.83
R1-341-7	9.09-40.00	22.32	217.80-923.40	422.57
R1-123-3	8.33-50.00	28.05	165.20-805.20	358.30
R3-124-13	10.00-42.85	25.33	223.80-798.30	389.63
R3-341-3	12.50-40.00	26.01	224.40-569.80	335.55
R3-341-5	14.28-50.00	32.52	140.80-392.00	258.13
R3-124-5	8.33-33.33	18.53	290.00-1051.60	516.04
R2-135-12	9.09-40.00	24.55	211.20-824.00	371.78
R3-342-13	11.11-40.00	25.42	192.90-546.40	276.42
R3-254-10	7.69-40.00	23.73	146.70-835.00	310.24
R3-123-3	0-66.66	23.66	51.40-165.90	113.65
R1-245-2	16.66-50.00	26.64	140.80-422.40	295.65
R2-154-4	11.11-40.00	21.09	186.90-703.00	440.41
R2-243-4	12.50-40.00	26.79	144.80-576.80	315.86
R1-124-4	16.66-66.66	32.41	52.50-310.50	178.31
R1-123-2	8.33-28.57	17.44	411.50-912.30	631.97
R3-123-2	16.66-66.66	31.13	136.80-466.90	335.98
R1-124-1	7.14-30.00	16.64	361.50-1149.60	629.13
R3-345-2	11.11-50.00	26.00	172.20-562.40	299.5
R1-241-4	7.14-40.00	18.46	360.00-1498.90	723.50
R1-243-14	0-40.00	19.51	235.20-1312.80	644.59
R1-124-7	7.69-40.00	20.87	181.50-1000.80	421.07

infestation was more prevalent during the vegetative phase but declined with the initiation of fruiting, and eventually disappeared during the fruiting stage. This shift in pest preference from shoots to fruits causes greater economic loss during the reproductive phase.

The plants within each progeny family were subsequently classified into distinct resistance categories based on the percent fruit infestation, following the scale proposed by Mishra *et al.* (1988) and presented in **Table 4.** Based on the per cent fruit infestation values, 9 plants were classified as immune, 53 plants were classified as highly resistant, 215 as moderately resistant, 148 as tolerant, 117 as susceptible, and 18 as highly susceptible to the fruit borer infestation**.** Among the parental lines and checks, IC624240, IC636521, IC618016, and Vengeri were classified as moderately resistant, Neelima and Haritha were found to be tolerant, while Ponni and Surya were identified as susceptible, similar to the findings of Puthiamadom and Joseph (2024). Although four parental lines were moderately resistant, several individual lines within the progeny exhibited high resistance, even when compared to the checks. This clearly indicates the accumulation of resistance alleles through complex three-

Table 4. Classification of brinjal genotypes for shoot and fruit infestation based on PFI and PSI

Grade	Infestation %	Number of three-way F_2 progeny plants along with parents and check	Three-way F_2 progeny lines resistant to fruit borer	Lines resistant to shoot borer
Immune	0	9 plants	241-8-1, 123-3-14, 123-3-16, 123-3-7, 123- 3-11, 123-3-19, 123-3-17, 123-3-12, 243-14-10	
Highly resistant	1-10	53 plants	241-4-15, 254-11-6, 241-4-18, 254-11-16, 124-1-4, 243-14-1, 241-4-10, 124-5-16, 254-11-17, 124-1-3, 254-11-11, 124-7-2, 124-1-11, 241-4-8, 241-4-12, 243-14-2, 124-8-9, 243-14-17, 123-1-20, 124-7-18, 341-7-18, 123-2-20, 254-11-9, 124-5-5, 124-1-8, 254-11-1, 123-2-16, 254-11-3, 254-10-9, 241-8-6, 243-14-8, 123-3-8, 241-8-1	241-4-15, 254-11-6, 243-14-4, 241-4-18, 254-11-16, 124-1-4, 241-4-10, 124-5-16, 254-11-17, 124-1-3, 241-4-20, 124-4-20, 124-7-2, 124-1-11, 241-8-1, 241-4-8, 241-4-12, 243-14-2, 124-8-9, 243-14-17, 123-1-20, 341-7-18, 123-2-20, 123-2-20, 254-11-9, 124-5-5, 124-1-8, 254-11-1, 254-11-3, 254-10-9, 241-8-6, 243-14-8, 123-3-8, 124-1-17, 124-1-16, 124-5-20, IC624240, 124-7-19, 123-1-5, 124-7-9, 135-12-7, Neelima, Vengeri
Moderately resistant	11-20	215 plants 4 parents	243-14-4, 243-14-3, 241-4-20, 123-1-11, 243-14-20, 124-7-19, 254-11-13, 124-7-9, 135-12-7, 124-8-6 Parent- Vengeri, IC618016, IC624240, IC636521,	243-14-3, 243-14-1, 254-11-11, 124-7-18, 123-1-11, 123-2-16, 243-14-20, IC636521, 254-11-13, IC618016, 124-8-6, 254-11-19, Ponni, Haritha
Tolerant	21-30	148 plants, 2 checks	254-11-19, 123-1-1, 254-11-8, 124-5-8, Neelima, Haritha	241-8-3, 241-8-11, 241-8-15, 235-5-2, 124-8-1, Surya
Susceptible	31-40	117 Lines, 1 parent, 1 check	243-14-6, 254-11-18, 123-3-12, 241-8-9, 124-10-9, 253-12-6, 123-3-2, 123-3-19, 123-10-7, 254-11-4, 124-13-15, 123-10-13, 124-13-12, Ponni, Surya	241-8-17, 124-8-5, 143-2-5, 123-10-5, 123-10-10, 123-10-13, 123-10-14, 124-5-11, 123-3-3, 123-3-8, 123-3-10. 123-3-16, 123-3-17, 123-3-20, 154-4-13, 154-4-15, 124-4-10, 123-2-15, 345-2-8
Highly susceptible	>40	18 plants	124-13-19, 243-14-15, 243-14-14, 123-3-3, 143-2-11, 341-5-9, 143-2-13, 124-10-3, 345-2-18, 341-5-7, 243-14-18, 123-3-10, 124-7-6, 341-5-20, 245-2-5, 123-3-15, 124-4-5, 124-10-15	123-3-9, 253-12-18, 123-3-18

way crosses (Sivasankarreddy, 2025). The identification of these promising three-way cross derivatives, with their relatively low BSFB incidence, provides immediate material for stabilization and advancement in resistance breeding programs.

The final selection phase involved assigning individual scores for PFI and marketable yield by using as component traits to calculate a cumulative average score for each plant across the three-way cross F_2 progeny family lines, parents and checks. Based on the cumulative average scores obtained, all plants were ranked, and the 54 top-performing genotypes are presented in **Table 5**. Among the 560 plants of 28 F_2 progeny families, 40 individual lines that were superior to the parents (identified as transgressive segregants), seven lines superior to the commercial F_1 hybrid Neelima, and three lines were on par with it. These highly promising individuals can now be selected and advanced to the next generation for further evaluation and stabilization (**Fig.1**). This study conclusively established that indirect selection based on a highly correlated yield component (marketable yield per plant) and the critical pest resistance trait (PFI) is an effective and powerful strategy for brinjal improvement, successfully leading to the identification of these valuable transgressive segregants, as suggested by Sivasankarreddy (2025).

The present study successfully evaluated a segregating population of brinjal derived from three-way cross hybrids of brinjal for resistance to the shoot and fruit borer (SFB) and identified promising lines with improved resistance. The correlation analysis revealed significant associations between yield and its contributing traits, indicating that these traits influence the yield in the segregating population. Yield-related traits like total fruits per plant (up to 0.899) and fruit weight (up to 0.658) were confirmed as major positive drivers of yield, while Per cent Fruit

Table 5. Evaluation and ranking of lines using per cent fruit infestation and marketable yield

S. No.	Genotype code	Per cent fruit infestation	Marketable yield (g)	Cumulative average score	Rank
1	241-4-15	7.14	1498.90	1.5	I
2	254-11-6	7.14	1358.50	1.5	I
3	243-14-4	14.29	1312.80	2.5	II
4	243-14-3	13.33	1221.13	2.5	II
5	241-4-18	9.09	1205.00	2.5	II
6	254-11-16	7.69	1170.00	2.5	II
7	124-1-4	7.69	1149.60	2.5	II
8	243-14-1	7.69	1050.00	2.5	II
9	241-4-10	9.09	1052.00	3	III
10	124-5-16	8.33	1051.60	3	III
11	254-11-17	8.33	1039.50	3	III
12	124-1-3	8.33	1039.50	3	III
13	254-11-11	8.33	1027.40	3	III
14	241-4-20	11.11	1027.20	3	III
15	124-7-2	7.69	1000.80	3	III
16	124-1-11	7.14	926.90	3	III
17	241-8-1	0.00	738.40	3	III
18	241-4-8	9.09	1004.00	3.5	IV
19	241-4-12	10.00	991.80	3.5	IV
20	243-14-2	8.33	972.40	3.5	IV
21	124-8-9	8.33	953.70	3.5	IV
22	243-14-17	10.00	948.60	3.5	IV
23	123-1-20	8.33	941.60	3.5	IV
24	124-7-18	8.33	939.40	3.5	IV
25	341-7-18	10.00	923.40	3.5	IV
26	123-2-20	9.09	912.30	3.5	IV
27	254-11-9	10.00	910.80	3.5	IV
28	124-5-5	9.09	894.00	3.5	IV
29	124-1-8	9.09	884.00	3.5	IV
30	254-11-1	10.00	877.50	3.5	IV
31	123-1-11	14.29	868.80	3.5	IV
32	123-2-16	10.00	860.40	4	V
33	254-11-3	9.09	856.40	4	V
34	254-10-9	9.09	835.00	4	V
35	241-8-6	10.00	805.50	4	V
36	243-14-8	10.00	805.50	4	V
37	123-3-8	8.33	805.20	4	V
38	124-1-17	9.09	794.00	4	V
39	124-1-16	10.00	787.50	4	V
40	124-5-20	10.00	770.40	4	V
41	IC624240 (parent)	14.71	754.38	4	V
42	243-14-20	12.50	753.90	4	V
43	124-7-19	11.11	747.20	4	V
44	IC636521 (parent)	14.35	739.20	4	V
45	135-12-18	9.09	733.00	4	V
46	254-11-13	11.11	729.60	4	V
47	123-1-17	10.00	725.04	4	V
48	123-1-5	9.09	725.00	4	V
49	IC618016 (parent)	11.64	724.46	4	V
50	124-7-9	11.11	711.20	4	V
51	135-12-7	16.67	824.00	4.5	VI
52	Neelima	23.04	783.58	4.5	VI
53	124-8-6	18.75	782.60	4.5	VI
54	254-11-19	21.43	776.60	4.5	VI

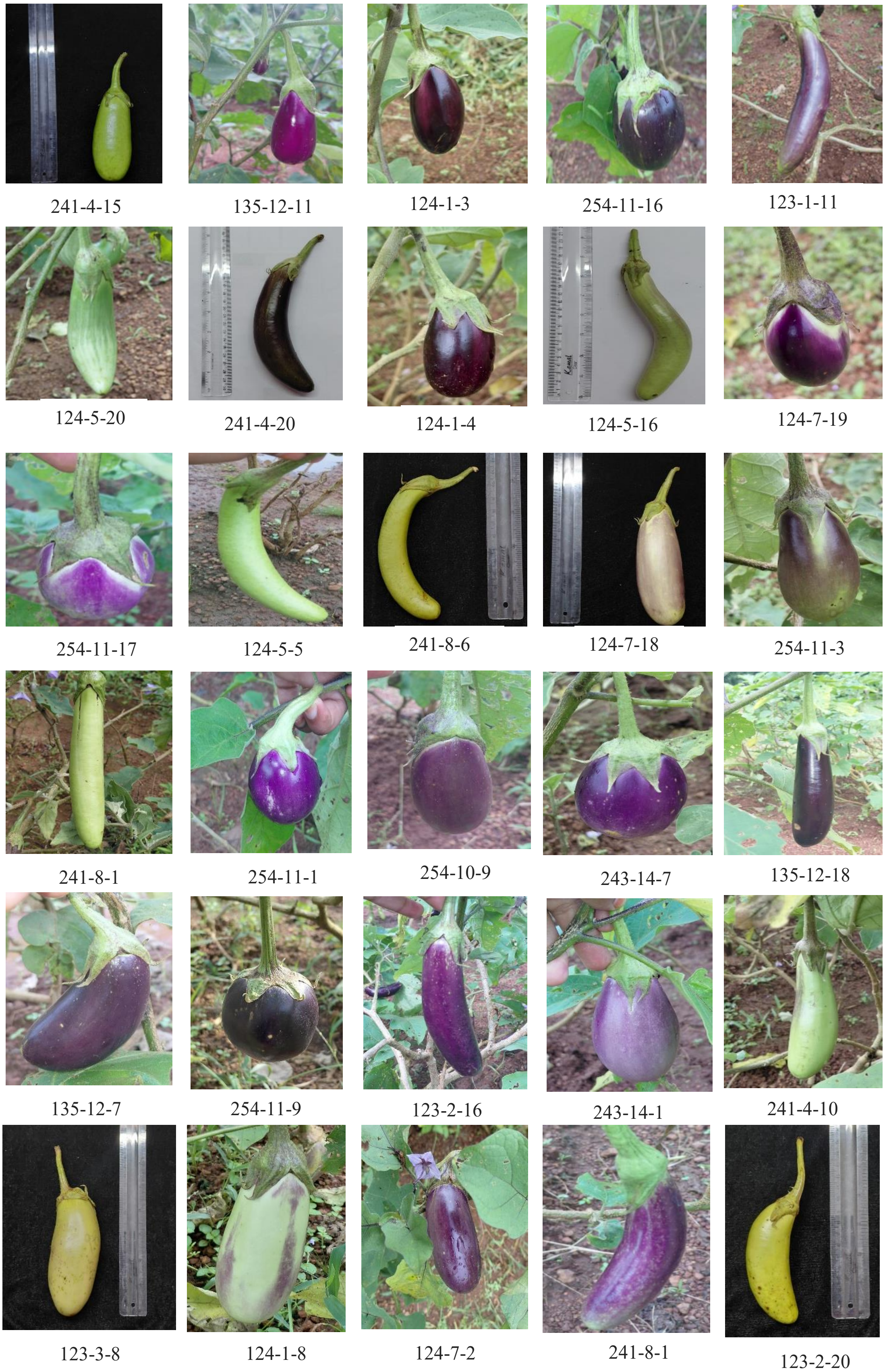

Fig.1. Morphological variation in fruits among selected F_2 plants

Infestation (PFI) showed a critical negative correlation (up to −0.593) with marketable yield. Further, among the segregating lines, 50 superior lines were selected and suggested to be forwarded based on per cent fruit infestation (PFI) and marketable yield. The line R1-241-4 [derived from (Vengeri x IC636521) x Ponni] exhibited excellent performance, coupling low PFI (7.14%) with the highest marketable yield (1498.9 g). Based on a cumulative average score combining high marketable yield and low PFI, the selected lines, along with the resistant parents, can serve as valuable genetic resources for future breeding programs aimed at developing high-yielding, shoot and fruit borer-tolerant brinjal varieties.

Conflict of interest

The authors declare no conflict of interest.

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