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Resistance Profiling of Brinjal (*Solanum melongena* L.) Landraces of Tamil Nadu and Development of Resistant Hybrids against Shoot and Fruit Borer (*Leucinodes orbonalis* Guenee)

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ABSTRACT

Background: The study aimed to collect brinjal (*Solanum melongena* L.) landraces from different districts of Tamil Nadu followed by evaluation of landraces resistance to the shoot and fruit borer (*Leucinodes orbonalis* Guenee) and utilize the best-performing resistant landraces in hybrid development under resistance breeding.

Methods: Twenty landraces were screened under field conditions using a randomized block design with three replications and per cent fruit infestation was recorded across three harvests (105, 115 and 125 days after sowing).

Result: The results revealed substantial variability in pest response, with mean fruit infestation ranging from 9.68% to 41.44%. Based on resistance categories, two landraces, Karur Kathiri and Vellur Mulkathiri were identified as highly resistant, while eight showed moderate to fair resistance. Four genotypes displayed lower resistance, five were susceptible and Vellai Urutu Kathiri was classified as highly susceptible. The resistant landraces were subsequently used in hybridization with elite high-yielding cultivar to develop F_1 hybrids combining both yield advantage and pest resistance. The identified resistant landraces represent valuable genetic resources for brinjal improvement and their successful utilization in hybrid breeding demonstrates the potential for developing high-yielding, pest-resistant cultivars. The study highlights the importance of leveraging native germplasm for sustainable pest management and reducing dependence on chemical insecticides in brinjal production.

Key words: Brinjal, Hybrid breeding, Landraces, Resistance screening, Shoot and fruit borer.

INTRODUCTION

Brinjal (*Solanum melongena* L.), also known as eggplant, is one of the most important solanaceous vegetable crops cultivated in tropical and subtropical regions of the world (Praneetha and Jayakashmi, 2018). India is regarded as the center of origin and diversity for brinjal, where a vast array of landraces and traditional cultivars have evolved through centuries of farmer selection. The crop is valued not only for its nutritional composition being rich in minerals and antioxidants but also for its economic significance in smallholder and commercial farming systems (Hazra, 2023). Despite its importance, the productivity of brinjal is severely constrained by several biotic and abiotic factors, among which the shoot and fruit borer (*Leucinodes orbonalis* Guenee) is the most destructive pest. The shoot and fruit borer is responsible for yield losses ranging from 40-70%, depending on the region and season. The pest damages tender shoots and developing fruits, reducing both marketable yield and quality (Sharma *et al.,* 2017). Seasonal dynamics and economic impact of shoot and fruit borer have been reported in brinjal crops in India (Kumar and Singh, 2013). The indiscriminate insecticide use has led to resistance development in pest populations and the destruction of natural enemies. Therefore, development of pest-resistant varieties through host plant resistance breeding offers a sustainable, economical and environmentally safe alternative for managing *L. orbonalis*. Landraces, representing locally adapted farmer-maintained germplasm, serve as a rich reservoir of genetic

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variability for resistance traits. These traditional cultivars often possess adaptive mechanisms such as dense trichomes, thick pericarp, phenolic compounds, or altered volatiles that deter ovipositor and larval feeding (Susmitha *et al.,* 2023a). Exploring such genetic diversity from different agro-ecological regions provides an opportunity to identify and utilize novel resistance sources in breeding programs (Tiwari *et al.,* 2016).

Hybrid breeding is a proven approach for enhancing yield potential and combining desirable traits such as pest resistance, adaptability and fruit quality (Venkataramani, 1946). By crossing resistant landraces with high-yielding but susceptible varieties, it is possible to develop F_1 hybrids that express both heterosis and resistance. Such hybrids can play a crucial role in reducing pesticide dependence while sustaining high productivity levels under pest pressure (Shrivastav *et al.,* 2024). Significant heterosis for fruit borer resistance in brinjal hybrids has also been reported in recent breeding studies (Ramani *et al*., 2015). The present study was undertaken to evaluate brinjal landraces collected from different parts of Tamil Nadu for resistance to shoot and fruit borer, to identify promising resistant genotypes and to utilize the best-performing resistant landraces in hybridization with elite high-yielding varieties for the development of pest-resistant, high-yielding brinjal hybrids suitable for sustainable vegetable production.

MATERIALS AND METHODS

Experimental material and layout

The present investigation was carried out during the 2024-2025 cropping season using twenty local landraces of brinjal (*Solanum melongena* L.) collected from 17 districts of tamilnadu (Plate 1) *viz.,* Karur Kathiri, Thoppi Kathiri, Odavai Patchai Kathiri, Patchai Muttai Kathiri, Sevanthampatti Kathiri, Velirpatchai Kathiri, Kovilpatti Vellai Kathiri, Madurai Kathiri, Pudukkottai Sellugudi, Pudukkottai Alavayal, Udumalai Samba, Negamam Varikathiri, Vellur Mulkathiri, Kannadi Kathiri, Kannimanuthu Kathiri, Otha Oorutu Kathiri, Vellai Oorutu Kathiri, Dindigul Neelam Kathiri and Gundu Kathiri (Plate 2). The field trial was laid out in a randomized block design (RBD) with three replications. Each genotype was planted in a single row of 3 m length, maintaining a spacing of 60 × 45 cm between plants. The seedlings of brinjal were raised in nursery beds and transplanted to the main field 25 days after sowing (DAS). The egg mass of FSB were artificially inoculated at 50 DAS. The first harvest was carried out at 105 days after sowing, followed by the second harvest at 115 DAS and the third harvest at 125 DAS.

Data collection

Observations were recorded at each harvest on the weight of healthy and infested fruits caused by shoot and fruit borer (*Leucinodes orbonalis* Guenee). The per cent fruit infestation was calculated using the below given formula:

Per cent of FSB infestation =

$$\frac{\text{Weight of infested fruits harvested}}{\text{Total weight of fruit harvested}} \times 100$$

Classification of reaction

Based on the mean per cent infestation, landraces were categorized according to the scale proposed by Lal *et al.* (1976) as shown in the Table 1.

Hybrid breeding and F1 evaluation

Based on the results of resistance screening, the highly resistant landrace Karur Kathiri was selected as the male parent, while Annamalai Brinjal, a high yielding but susceptible commercial variety, was chosen as the female parent for hybridization. The crossing protocol is followed as per Davidar *et al.* (2015). The reason for selecting annamalai brinjal as female parent is not only the high

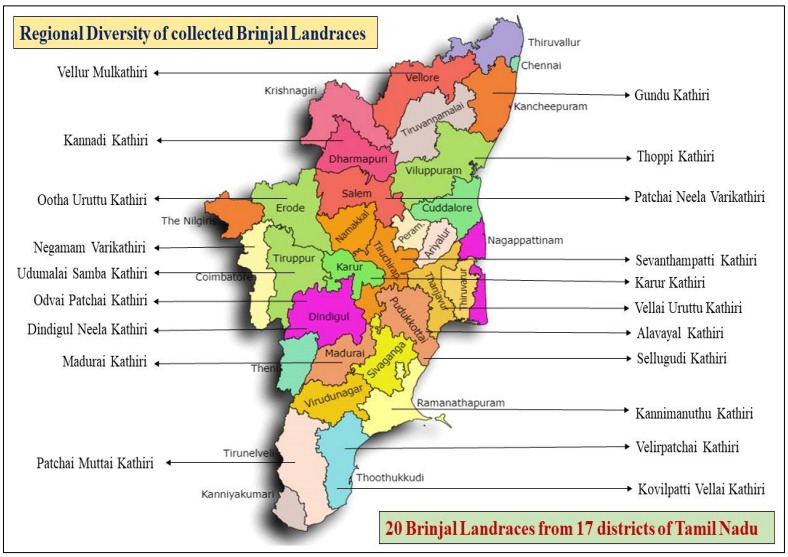


Plate 1: Landraces collected from different regions of Tamil Nadu.

yielder but also has the aphid resistance. The *Vellur Mulkathiri* has thorns in its calyx so, it has not been chosen as male parent based on consumer suggestions and preference. The F_1 hybrids were developed, along with both parents, were evaluated under open-field conditions with artificial inoculation of egg mass, to study hybrid performance and resistance expression. Each parents and hybrids were planted in RBD with three replications. Observations were recorded on yield attributes and pest infestation indices (Lal *et al.,* 1976; Neelavathi, 2025).

RESULTS AND DISCUSSION

Screening for shoot and fruit borer

Significant variation was observed among the twenty brinjal (*Solanum melongena* L.) landraces with respect to mean per cent fruit damage caused by the shoot and fruit borer (*Leucinodes orbonalis* Guenee) on a fruit weight basis (Table 2). The infestation percentage across genotypes ranged from 9.68% to 41.44%, indicating a wide spectrum of resistance and susceptibility among the tested landraces (Haque *et al.,* 2024). Among the evaluated landraces, the two landraces namely, Vellur Mulkathiri (9.68%) and Karur Kathiri (9.77%) recorded the lowest mean infestation, classifying them as highly resistant according to the scale proposed by Lal *et al*. (1976). These genotypes consistently showed minimal damage across all three harvests, with infestation percentages below 11% at each stage. The uniform resistance exhibited by these lines suggests the presence of stable defensive traits such as thick fruit epidermis, dense trichome covering and possible biochemical deterrents that restrict larval feeding and ovipositor. A group of eight landraces *viz*., Sevanthampatti Kathiri (12.83%), Kovilpatti Kathiri (13.53%), Madurai Kathiri (12.68%), Pudukkottai Sellugudi Kathiri (12.97%), Pudukkottai Alavayal Kathiri (13.05%), Udumalai Samba Kathiri (15.83%), Negamam Varikathiri (20.51%) and Odavai Patchai Kathiri (18.15%) showed fairly resistant reactions, with mean infestation values ranging between 11 and 20%. These entries displayed moderate pest incidence, suggesting that although they permit larval entry, the damage progression remains limited, possibly due to inherent tolerance mechanisms. The four landraces such as Thoppi Kathiri (30.01%), Kannimanuthu Kathiri (29.29%), Otha Oorutu Kathiri (26.89%) and Gundu Kathiri (29.46%) were categorized as less resistant, exhibiting 21-30% mean fruit infestation. Infestation increased progressively with successive harvests, suggesting partial resistance that weakened with continuous pest pressure

Table 1: Resistant category based on per cent infestation.

Scale	Reaction category	Per cent of FSB infestation
1	Immune	0%
2	Highly resistant	1-10%
3	Fairly resistant	11-20%
4	Less resistant	21-30%
5	Susceptible	31-40%
6	Highly susceptible	>40%



Plate 2: Landraces used for screening for shoot and fruit borer.

and increasing fruit load. Despite noticeable fruit boring, these genotypes retained moderate yields, reflecting a degree of compensatory growth and tolerance. Four landraces, Patchai Muttai Kathiri (31.28%), Velirpatchai Kathiri (38.51%), Kannadi Kathiri (35.86%) and Dindigul Neelam Kathiri (32.55%) were classified as susceptible to shoot and fruit borer infestation, showing consistent and heavy damage across all harvests. Fruits in these lines exhibited extensive tunneling, premature drying and fruit drop, indicating poor structural defense and greater palatability to the larvae. The Vellai Oorutu Kathiri recorded the highest mean infestation (41.44%), making it the most susceptible genotype among all. This landrace showed severe fruit boring in all harvests, with up to 47.11% damage during the first harvest itself, signifying its high vulnerability to *L. orbonalis* attack (Table 3).

A declining trend in infestation percentage was generally observed from the first to the third harvest in most landraces. For instance, Karur Kathiri and Vellur Mulkathiri showed reductions from 11.23% and 10.47% (first harvest) to 7.70% and 8.89% (third harvest), respectively. Similar reductions were seen in Sevanthampatti Kathiri and Madurai Kathiri. However, some susceptible genotypes, such as Patchai Muttai Kathiri and Velirpatchai Kathiri, maintained persistently high infestation levels across all pickings, indicating that pest incidence and damage remained high despite harvesting intervals. The differences in infestation patterns among harvests reflect the combined influence of environmental factors, pest population dynamics and physiological stage of the crop. Similar screening results for FSB were in accordance with Yousafi *et al.* (2016); Khan and Singh (2014) and Shaukat *et al.* (2018).

Table 2: Mean per cent damage on fruit weight basis on brinjal landraces by shoot and fruit borer (*Leucinodes orbonalis*).

Genotypes	Name of landraces	I-harvest	II-harvest	III-harvest	Mean (%)
G1	Karur kathiri	11.23	10.38	7.70	9.77
G2	Thoppi kathiri	31.26	30.46	28.31	30.01
G3	Odavai patchai kathiri	25.00	18.36	11.09	18.15
G4	Patchai muttai kathiri	29.09	32.31	32.43	31.28
G5	Sevanthampatti kathiri	15.00	13.64	9.86	12.83
G6	Velirpatchai kathiri	43.75	39.73	32.05	38.51
G7	Kovilpatti vellai kathiri	15.76	13.61	11.23	13.53
G8	Madurai kathiri	14.00	14.95	9.09	12.68
G9	Pudukkottai sellugudi kathiri	16.82	12.75	9.35	12.97
G10	Pudukkottai alavayal kathiri	17.01	13.21	8.93	13.05
G11	Udumalai samba kathiri	18.18	12.68	16.62	15.83
G12	Negamam varikathiri	25.30	18.13	18.10	20.51
G13	Vellur mulkathiri	10.47	9.68	8.89	9.68
G14	Patchai neela varikathiri	36.21	29.11	30.37	31.89
G15	Kannadi kathiri	46.43	36.02	25.12	35.86
G16	Kannimanuthu kathiri	25.00	27.84	35.04	29.29
G17	Ootha oorutu kathiri	35.21	24.19	21.28	26.89
G18	Vellai oorutu kathiri	47.11	46.88	30.32	41.44
G19	Dindigul neelam kathiri	46.49	36.04	15.12	32.55
G20	Gundu kathiri	42.94	27.12	18.32	29.46

Table 3: Resistance categorization of brinjal landraces based on mean per cent infestation.

Scale	Reaction category	Per cent infestation range (%)	No. of landraces	Brinjal landraces
1	Immune	0	0	Nil
2	Highly resistant	1-10	2	Karur Kathiri, Vellur Mulkathiri
3	Fairly resistant	11-20	8	Sevanthampatti Kathiri, Kovilpatti Vellai Kathiri, Madurai Kathiri, Pudukkottai Sellugudi, Pudukkottai Alavayal, Udumalai Samba, Negamam Varikathiri, Odavai Patchai Kathiri
4	Less resistant	21-30	4	Thoppi Kathiri, Kannimanuthu Kathiri, Ootha Oorutu Kathiri, Gundu Kathiri
5	Susceptible	31-40	5	Patchai Muttai Kathiri, Velirpatchai Kathiri, Kannadi Kathiri, Dindigul Neelam Kathiri, Patchai Neela Varikathiri
6	Highly susceptible	>40	1	Vellai Oorutu Kathiri

Table 4: Comparison between patents and F_1 hybrid for pest resistance and yield traits.

Traits	Annamalai brinjal (Female parent)	Karur kathiri (Male parent)	F1 hybrid
FSB resistant	Highly susceptible	Highly resistant	Highly resistant
Mean (%)	42.73	9.11	9.35
Yield	2.32 kg/plant	1. 53 kg/plant	2.87 kg/plant**
Shape	Large oblong	Small round	Large oblong
Peel color	Dark violet	Shiny purple	Dark violet
Plant height	45 cm	60 cm	52 cm
Aphid resistance	Highly resistance	Slightly resistant	Highly resistant
Based on count (Nos)	9 aphids/plant	22 aphids/plant	8 aphids/plant

CD value (1%) is 0.32 kg/plant and (5%) is 0.21 kg/plant for yield.

Hybrid breeding for pest resistance and yield

Among the tested materials, Karur Kathiri consistently recorded the lowest infestation levels across all harvests (mean 9.77%), indicating stable resistance. This genotype was thus selected as the male donor parent for hybridization with the high-yielding Annamalai Brinjal variety. The hybridization aimed to combine pest resistance from the landrace and yield attributes from the commercial cultivar. The resulting F_1 hybrid exhibited heterosis for both yield and pest resistance (Table 4). Field evaluation revealed that the hybrid plants produced larger fruit size, increased number of fruits per plant and higher total yield compared to both parents. At the same time, the hybrid showed a marked reduction in shoot and fruit borer incidence, indicating the successful transfer and expression of resistance traits from the male parent. The expression of resistance in the F_1 generation suggests dominant gene action or additive gene effects influencing pest tolerance. The combination of pest resistance and yield improvement validates the effectiveness of hybrid breeding in pyramiding desirable traits from genetically diverse parents. Similar findings have been reported by Susmitha *et al.* (2023) and Gill *et al.* (2023) who observed that hybrids derived from elite cultivars displayed superior yield and pest resistance. The hybrid also exhibited better plant vigor, increased leaf area and thicker stem, contributing to greater resilience under pest pressure. Overall, the development of this hybrid demonstrates the potential of native genetic resources with high-performing cultivars to achieve sustainable pest management (Biswas *et al.,* 2013). The successful F_1 hybrid, combining high yield and shoot and fruit borer resistance, represents a promising advancement for future brinjal hybrid breeding programs aimed at minimizing pesticide reliance and promoting eco-friendly crop improvement (Kumar *et al.,* 2020).

CONCLUSION

The present investigation successfully identified valuable genetic sources of resistance to the shoot and fruit borer (*Leucinodes orbonalis* Guenee) among twenty brinjal landraces collected from different agro-climatic regions of Tamil Nadu. The study revealed considerable genetic variability for pest resistance, ranging from 9.68% to 41.44% mean fruit infestation. Among the evaluated genotypes, Karur Kathiri and Vellur Mulkathiri were found to be highly resistant, while Vellai Oorutu Kathiri was highly susceptible. The resistant landrace Karur Kathiri was successfully utilized as a male parent in hybridization with the high-yielding variety Annamalai Brinjal as the female parent. The resulting F_1 hybrid exhibited heterosis for yield traits and a significant reduction in shoot and fruit borer infestation, indicating effective transfer of resistance genes from the landrace. This confirms the potential of hybrid breeding as a practical approach to integrate yield enhancement and pest resistance, thereby reducing dependence on chemical insecticides and promoting eco-friendly pest management.

The identified resistant landraces such as *Karur Kathiri* and *Vellur Mulkathiri* can be further utilized as donor parents in advanced breeding programs aimed at developing high-yielding, pest-tolerant varieties and hybrids. Detailed genetic and molecular characterization of these landraces is needed to identify resistance-associated genes or QTLs, facilitating marker-assisted selection (MAS) for brinjal improvement. Multilocation and seasonal evaluations of the developed hybrids can confirm the stability and durability of resistance under different environmental conditions. Integrating these resistant hybrids into Integrated Pest Management (IPM) programs will help reduce pesticide usage, enhance farmer profitability and ensure sustainable brinjal cultivation. Future breeding efforts can also focus on combining pest resistance with other desirable traits such as nutritional quality, fruit firmness and market acceptability.

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Disclaimers

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Conflict of interest

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