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Morphological Profiling of Spiny Brinjal (*Solanum melongena* L.) Germplasm through NBPGR Descriptors

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A B S T R A C T

The present research work entitled "Morphological Profiling of Spiny Brinjal (*Solanum melongena* L.) Germplasm through NBPGR Descriptors" was carried out during 2025 at the Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, with the objective of characterizing fifteen spiny brinjal genotypes. The experiment was conducted in a Randomized Block Design (RBD) with two replications. A total of ten qualitative morphological characters, viz., petiole colour, leaf blade lobing, corolla colour, calyx colour, number of leaf prickles, fruit pedicel prickles, fruit colour, calyx spines, fruit position and fruit length-to-breadth ratio, were recorded to assess the extent of morphological variation among the genotypes. The evaluated genotypes exhibited considerable variability for all the studied traits. Petiole colour ranged from green to greenish violet and dark brown, while leaf blade lobing varied from weak to very strong. Corolla colour ranged from white to bluish violet, and calyx colour varied from green to dark purple. The number of leaf prickles, fruit pedicel prickles and calyx spininess ranged from smooth to highly spiny, indicating wide diversity in spine expression. Fruit colour exhibited marked variation from milky white and green to different shades of purple and lilac. All the genotypes exhibited pendent fruit position, whereas the fruit length-to-breadth ratio ranged from broader-than-long to three times longer than broad. The observed morphological variability indicates the existence of substantial genetic diversity among the evaluated germplasm and provides valuable baseline information for germplasm characterization, conservation and the identification of promising genotypes for future breeding and crop improvement programmes.

Introduction

Vegetables constitute a vital component of Indian agriculture, with brinjal contributing 12.987 MT to India's total horticultural production of 362.086 MT in 2024–25 (Anon., 2025). Brinjal (*Solanum melongena* L.), belonging to family Solanaceae, is widely cultivated in tropical and subtropical regions and performs optimally at 20–30°C daytime and 15–20°C nighttime temperatures (Jat *et al.,* 2018).

Among brinjal types, spiny genotypes are valued for their superior nutritional and biochemical profile including higher ascorbic acid, protein, phenol content and elevated proline levels conferring stress tolerance and therapeutic compounds such as chlorogenic acid with anti-obesity and cardioprotective effects (Vethamoni and Rajashree, 2016; Reshmika *et al.,* 2016; Gogula, 2015; Prohens *et al.,* 2013). They also command premium market value in Tamil Nadu districts such as Vellore, Thirupathur and Tiruvannamalai. Despite this economic and nutritional importance, spiny brinjal genotypes remain poorly characterized at the morphological level. They harbour considerable diversity in growth habit, leaf and stem architecture, prickle distribution and intensity, flower characters and fruit shape, size and colour diversity that is largely undocumented and unexploited. Systematic morphological characterization using standardized descriptors is therefore essential for accurate genotype identification, germplasm cataloguing, and establishing distinctness for varietal registration. The National Bureau of Plant Genetic Resources (NBPGR) descriptors offer a validated framework for recording both qualitative and quantitative morphological traits in brinjal allowing genotypes to be distinguished reliably and their diversity assessed systematically.

Given this gap in documentation, the present study was undertaken to profile the morphological diversity of spiny brinjal genotypes using NBPGR descriptors, with the objective of characterizing the available germplasm and identifying distinct genotypes for conservation and future breeding programmes.

Materials and Methods

The present investigation was conducted during 2025 at the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA & RI), Karaikal. The crop was grown from January to July 2025. A total of 15 spiny brinjal (*Solanum melongena* L.) genotypes collected from diverse locations (Table 1) were evaluated for morphological and quality traits. The genotypes exhibited considerable variation in leaf morphology, fruit size, fruit shape, spine intensity, and quality characteristics. The experiment was laid out in a Randomized Block Design (RBD) with two replications. Each genotype was represented by 15 plants per replication and maintained at a spacing of 75 cm × 60 cm.

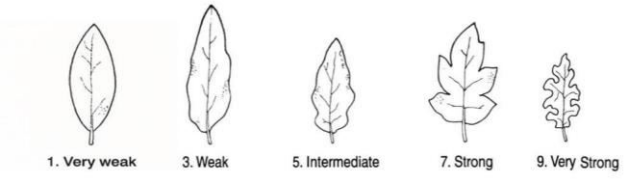
Observations on morphological characters were recorded from five randomly selected and tagged plants in each replication by visual assessment using the minimal descriptors for brinjal prescribed by the National Bureau of Plant Genetic Resources (NBPGR) (Srivastava *et al.,* 2001). The morphological traits were scored based on the descriptor codes provided by NBPGR. The descriptor codes used for the recorded morphological characters are given below.

1. Petiole color: The Petiole color was observed in 5th leaf from top at full foliage stage

Code	Characters
1	Green
2	Greenish violet
3	Violet
4	Dark violet
5	Dark brown
99	Others

2. Leaf blade lobing: The leaf blade lobing was recorded in 5th leaf from top at full foliage stage

Code	Characters
1	Very weak
3	Weak
5	Intermediate
7	Strong
9	Very strong
99	Others



3. Corolla colour: The corolla colour was observed in flowering stage

Code	Characters
1	White
2	Greenish white
3	Pale violet
4	Light violet
5	Bluish violet
99	Others

4. Calyx color: The calyx color was observed in flowering stage

Code	Characters
1	Green
2	Light purple
3	Dark purple
99	Others

5. Number of leaf prickles: The number of leaf prickles were recorded at full foliage.

Code	Characters
0	One
3	Few (1-5)
5	Many (>5)

6. Fruit pedicel prickles: The fruit pedicel prickles were counted during marketable stage

Code	Characters
0	One
1	Few (1-5)
2	Many (>5)
99	Others

7. Fruit colour: The fruit colour was recorded at horticultural maturity fruits stage

Code	Characters
1	Milky white
2	Green
3	Deep yellow
4	Fire red
5	Scarlet red
6	Lilac red
7	Purple
8	Purple black
9	Black
10	Light purple

8. Calyx spininess: The calyx Spines was recorded at flowering stage

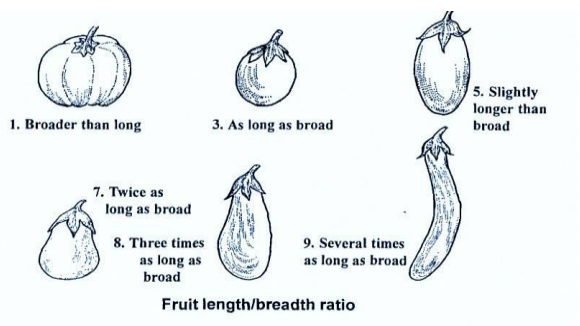
Code	Characters
3	Smooth
5	Medium thorny
7	High thorny
99	Others

9. Fruit position The position of fruit was recorded at horticultural maturity

Code	Characters
3	Pendent
5	Semi pendent
7	Erect
99	Others

10. Fruit length-breadth ratio: The fruit length-breadth was recorded as an average of 5 fruits at horticultural maturity stage

Code	Characters
1	Broader than long
2	As long as broad
3	Slightly longer than broad
4	Twice as long as broad
5	Three times as long as broad
99	Several times as long as broad



Result and Discussion

Petiole colour among the genotypes ranged from green to greenish violet, with T_3 - Purple spiny brinjal exhibiting greenish violet petiole colour and T_{15} - Thar Rachit exhibiting dark brown petiole colour, while the remaining genotypes exhibited green colour (Table 3). Leaf blade lobing exhibited wide variation with T_5 - Mattu Gulla brinjal exhibits very strong lobing, T_1 - VRM-1, T_6 - Cat head, T_7 - Striped spiny brinjal, T_8 - Small spiny brinjal, T_{12} - Rakesh and T_{13} - Golenda showing strong lobing, and T_9 - Blue spiny brinjal exhibits weak lobing (Fig. 1). Corolla colour ranged from white inT_6 - Cat head and T_{13} - Golenda to bluish violet in T_5 - Mattu Gulla brinjal, T_8 - Small spiny brinjal and T_{14} - Green spiny brinjal, with the remaining genotypes displaying light to pale violet shades (Fig. 2). Calyx colour was green across the genotypes, except for T_{15} - Thar Rachit, which exhibited dark purple calyx colour (Table 2).

The density of prickles on the upper leaf surface ranged from a smooth, prickle-free surface in T_6 - Cat head, T_{10} - Velur spiny brinjal, T_{15} - Thar Rachit to a high density exceeding five prickles in T_5 - Mattu Gulla brinjal, T_7 - Striped spiny brinjal, T_{11} - Chrompet spiny brinjal and T_{14} - Green spiny brinjal, while the remaining genotypes recorded a moderate density of one to five prickles. A comparable trend was observed for fruit pedicel prickles, ranging from completely smooth in T_6 - Cat head and T_{15} - Thar Rachit to densely prickled in T_1 - VRM-1, T_7 - Striped spiny brinjal, T_8 - Small spiny brinjal and T_{13} - Golenda (Table 2).

Fruit colour showed considerable diversity, ranging from milky white in T_6 - Cat head and green in T_5 - Mattu Gulla brinjal and T_{14} - Green spiny brinjal, purple in T_1 - VRM-1 and T_9 - Blue spiny brinjal,purple black in T_3 - Purple spiny brinjal, T_{11} - Chrompet spiny brinjal and T_{13} - Golenda, lilac red in T_4 - Puna local, T_7 - Striped spiny brinjal and T_8 - Small spiny brinjal, and light purple in T_2 - Illavambadi local and T_{10} - Velur spiny brinjal (Table 4) (Fig. 3).

Calyx spininess ranged from a smooth to a highly spiny condition in T_3 - Purple spiny brinjal, T_4 - Puna local, T_5 - Mattu Gulla brinjal, T_8 - Small spiny brinjal, T_{11} - Chrompet spiny brinjal, T_{12} - Rakesh, T_{13} - Golenda and T_{14} - Green spiny brinjal, while the remaining genotypes exhibited a medium spiny character. Fruit position remained uniformly pendent across all genotypes, indicating the absence of variation for this trait. Fruit length-breadth ratio varied from fruits broader than long in T_{13} - Golenda, to fruits nearly as long as broad in the majority of genotypes, fruits slightly longer than broad in T_3 - Purple spiny brinjal, T_7 - Striped spiny brinjal and T_{12} - Rakesh, fruits approximately twice as long as broad in T_4 - Puna local, and fruits nearly three times as long as broad in T_{14} - Green spiny brinjal (Table 4).

The morphological evaluation of the genotypes revealed considerable variability in several key traits, reflecting the genetic diversity present in the germplasm and its relevance to crop improvement targeting market preferences and stress adaptation.

Petiole colour varied, with T_3 - Purple spiny brinjal showing greenish violet and T_{15} - Thar Rachit showing dark brown, while the rest were green; these differences are useful for varietal identification, consistent with Kaur *et al.,* (2018) and Oguntolu *et al.,* (2022). Leaf blade lobing ranged from very strong in T_5 - Mattu Gulla brinjal to weak in T_9 - Blue spiny brinjal, a diversity that may influence light interception and photosynthetic efficiency, as also reported by Jayavalli *et al.,* (2024), Jahan *et al.,* (2023), Das *et al.,* (2017) and Sunseri *et al.,* (2010).

Corolla colour ranged from bluish violet (T_5, T_8, T_{14}) to white (T_6, T_{13}), with the rest showing violet shades, in line with Shinde *et al.,* (2012), Dash *et al.,* (2019) and Sakthivel *et al.,* (2024). Calyx colour was green in all genotypes except the dark purple T_{15} - Thar Rachit, likely reflecting anthocyanin accumulation and a stable trait for genotype distinction, similar to Patidar (2015) and Jayavalli *et al.,* (2024).

Prickle density on the upper leaf surface was high in T_5, T_7, T_{11} and T_{14} and absent in T_6, T_{10} and T_{15}. Sonali Deole (2008) reported that smooth-leaved cultivars were more susceptible to jassids than leathery or spiny-leaved ones, while Nimbalkar and More (1980) attributed spine presence/absence to a single gene with pleiotropic effects; Rajatha *et al.,* (2020) and Uddin *et al.,* (2021) similarly reported significant variation in prickle distribution with implications for pest resistance. Fruit pedicel prickles were numerous in T_1, T_7, T_8 and T_{13}, and absent in T_6 and T_{15} with implications for ease of harvest and market acceptability, consistent with Das *et al.,* (2017) and Kaur *et al.,* (2018).

Table.1 Description and source of spiny brinjal genotypes

SI. No.	Treatment	Common name/ Local name	Location and district	State	Bearing habit, fruit color and fruit shape	Presence of spines
1.	**T_1**	VRM-1	KVK Virinjipuram, Vellore district	Tamil Nadu	Cluster bearing with oval shaped fruits that are glossy pink in colour with a green tinge at the distal end.	Stem, leaves, calyx
2.	**T_2**	Illavambadi local	Illavambadi village, Vellore district	Tamil Nadu	Cluster bearing with oval shaped fruits that are pale pink in colour with a green tinge at the distal end	Stem, leaves, calyx
3.	**T_3**	Purple spiny brinjal	Hooga seed, Erode district	Tamil Nadu	Solitary bearing with slightly slender shaped fruits having smooth and glossy deep purple skin.	Stem, leaves, calyx
4.	**T_4**	Puna local	Hosur, Krishnagiri district	Tamil Nadu	Cluster bearing with slightly slender shaped fruits that are purple with white stripes in colour.	Stem, leaves, calyx
5.	**T_5**	Mattu gulla brinjal	Hooga seeds, Erode district	Tamil Nadu	Solitary bearing with spherical shaped fruits, green in colour	Stem, leaves, calyx
6.	**T_6**	Cat head	Periyakulam, Theni district	Tamil Nadu	Solitary bearing with slightly oval shaped fruits, white in colour	Calyx
7.	**T_7**	Striped spiny brinjal	R K Pattarai, Chrompet, Chennai	Tamil Nadu	Solitary bearing with slightly slender shaped fruits, purple with white stripes in colour	Stem, leaves, calyx
8.	**T_8**	Small spiny brinjal	Hooga seed, Erode district	Tamil Nadu	Cluster bearing with flat round shaped fruits, purple in colour	Stem, leaves, calyx
9.	**T_9**	Blue spiny brinjal	Ulavar Anand, Namakkal district	Tamil Nadu	Cluster bearing with round shaped fruits, purple at the bottom and green at the calyx end.	Stem, leaves, calyx
10.	**T10**	Velur local	Ulavar Anand, Namakkal district	Tamil Nadu	Cluster bearing with round shaped fruits, purple with a green tinge.	Stem, leaves, calyx
11	**T11**	Chrompet Spiny brinjal	R K Pattarai, Chrompet, Chennai	Tamil Nadu	Solitary bearing with flat round shaped fruits, purple in colour	Stem, leaves, calyx
12.	**T12**	Rakesh	Ankur seeds, Nagpur district	Maharashtra	Cluster bearing with round shaped fruits, purple with green stripes	Stem, leaves, calyx
13.	**T13**	Golenda	Gavyakrishi Kodagu district	Karnataka	Solitary bearing with round oblong shaped fruits, purple in colour	Stem, leaves, calyx
14.	**T14**	Green spiny brinjal	Shreesha seeds Warangal district	Telangana	Cluster bearing with oblong shaped fruits, green in colour with a white bottom and intermittent white stripes toward the calyx end	Stem, leaves, calyx
15.	**T15**	Thar Rachit	CIAH, Bikaner district	Rajasthan	Cluster bearing with round shaped fruits, dark glossy purple in colour	Calyx

Table.2 Morphological character for variability in calyx colour, number for prickles in upper surfaces of the leaf, fruit pedicel prickles and fruit colour in spiny brinjal genotypes

SI. No	Treatments	Calyx color (Code number)	Number of prickles in upper surface of leaf (Code number)	Fruit pedicel prickles (Code number)	Fruit colour (Code number)
1.	T_1-VRM-1	1-Green	**3-Few**	2-Many	7-Purple
2.	T_2-Illavambadi local	1-Green	3-Few	1-Few	10-Light purple
3.	T_3-Purple spiny brinjal	1-Green	3-Few	1-Few	8-Purple black
4.	T_4-Puna local	1-Green	3-Few	1-Few	6-Lilac red
5.	T_5-Mattu gulla brinjal	1-Green	5-Many	1-Few	2-Green
6.	T_6-Cat head	1-Green	0-None	0-None	1-Milky white
7.	T_7-Striped spiny brinjal	1-Green	5-Many	2-Many	6-Lilac red
8.	T_8-Small spiny brinjal	1-Green	3-Few	2-Many	6-Lilac red
9.	T_9-Blue spiny brinjal	1-Green	3-Few	1-Few	7-Purple
10.	T_{10}-Velur spiny brinjal	1-Green	0-None	1-Few	10-Light purple
11.	T_{11}-Chrompet spiny brinjal	1-Green	5-Many	1-Few	8-Purple black
12.	T_{12}-Rakesh	1-Green	3-Few	1-Few	2-Green
13.	T_{13}-Golenda	1-Green	3-Few	2-Many	8-Purple black
14.	T_{14}-Green spiny brinjal	1-Green	5-Many	1-Few	2-Green
15.	T_{15}-Thar Rachit	3-Dark purple	0-None	0-None	8-Purple black

Table.3 Morphological character for variability in petiole colour, leaf blade lobing and corolla colour in spiny brinjal genotypes

SI. No	Treatments	Petiole colour (Code number)	Leaf blade lobing (Code number)	Corolla colour (Code number)
1.	**T_1-VRM-1**	1-Green	7-Strong	3-Pale violet
2.	**T_2-Illavambadi local**	1-Green	5-Intermediate	2-light violet
3.	**T_3-Purple spiny brinjal**	2-Greenish violet	5-Intermediate	3-Pale violet
4.	**T_4-Puna local**	1-Green	5-Intermediate	3-Pale violet
5.	**T_5-Mattu gulla brinjal**	1-Green	9-Very strong	5-Bluish violet
6.	**T_6-Cat head**	1-Green	7-Strong	1-White
7.	**T_7-Striped spiny brinjal**	1-Green	7-Strong	2-light violet
8.	**T_8-Small spiny brinjal**	1-Green	7-Strong	5-Bluish violet
9.	**T_9-Blue spiny brinjal**	1-Green	3-Weak	3-Pale violet
10.	**T_{10}-Velur spiny brinjal**	1-Green	5-Intermediate	2-light violet
11.	**T_{11}-Chrompet spiny brinjal**	1-Green	5-Intermediate	3-Pale violet
12.	**T_{12}-Rakesh**	1-Green	7-Strong	3-Pale violet
13.	**T_{13}-Golenda**	1-Green	7-Strong	1-white
14.	**T_{14}-Green spiny brinjal**	1-Green	5-Intermediate	5-Bluish violet
15.	**T_{15}-Thar Rachit**	5-Dark brown	5-Intermediate	3-Pale violet

Table.4 Morphological character for variability in calyx spininess, fruit position and fruit length-breadth ratio in spiny brinjal genotypes

SI. No	Treatments	Calyx spininess (Code number)	Fruit position (Code number)	Fruit length-breadth ratio (Code number)
1.	**T_1-VRM-1**	5-Medium spiny	3-Pendent	2.As long as broad
2.	**T_2-Illavambadi local**	5-Medium spiny	3-Pendent	2. As long as broad
3.	**T_3-Purple spiny brinjal**	7-High spiny	3-Pendent	5.Slighly longer than broad
4.	**T_4-Puna local**	7-High spiny	3-Pendent	4.Twice as long as broad
5.	**T_5-Mattu gulla brinjal**	7-High spiny	3-Pendent	2.As long as broad
6.	**T_6-Cat head**	5-Medium spiny	3-Pendent	2.As long as broad
7.	**T_7-Striped spiny brinjal**	5-Medium spiny	3-Pendent	3.Slightly longer than broad
8.	**T_8-Small spiny brinjal**	7-High spiny	3-Pendent	2.As long as broad
9.	**T_9-Blue spiny brinjal**	5-Medium spiny	3-Pendent	2.As long as a broad
10.	**T_{10}-Velur spiny brinjal**	5-Medium spiny	3-Pendent	2.As long as a broad
11.	**T_{11}-Chrompet spiny brinjal**	7-High spiny	3-Pendent	2.As long as a broad
12.	**T_{12}-Rakesh**	7-High spiny	3-Pendent	5.Slightly longer than broad
13.	**T_{13}-Golenda**	7-High spiny	3-Pendent	1.Broader than long
14.	**T_{14}-Green spiny brinjal**	7-High spiny	3-Pendent	5.Three times as long as broad
15.	**T_{15}-Thar Rachit**	5-Medium spiny	3-Pendent	2.As long as broad

Fig 1. Morphological variation in leaves of different spiny brinjal genotypes.

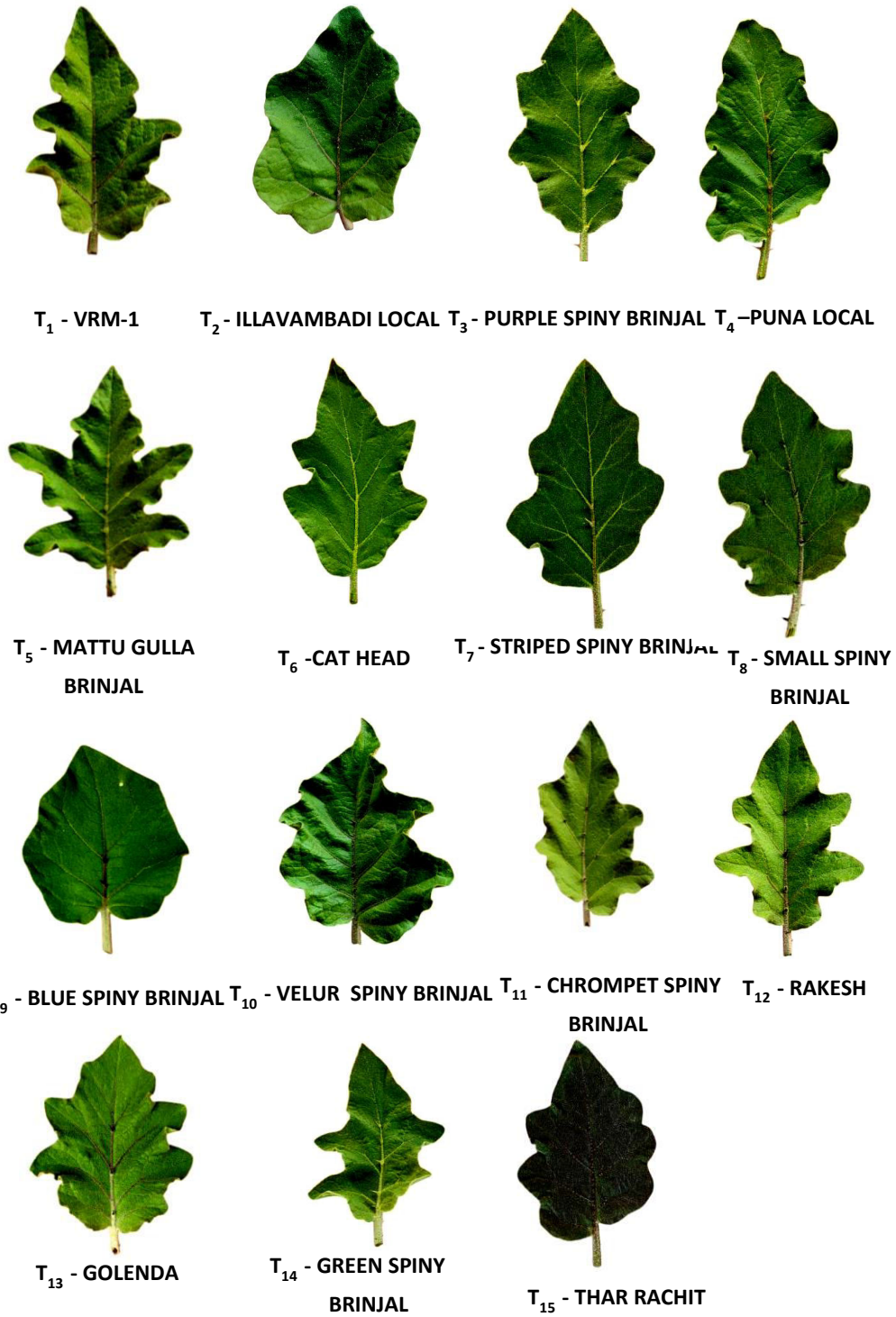


Fig 2. Morphological variation in flowers of different spiny brinjal genotypes.

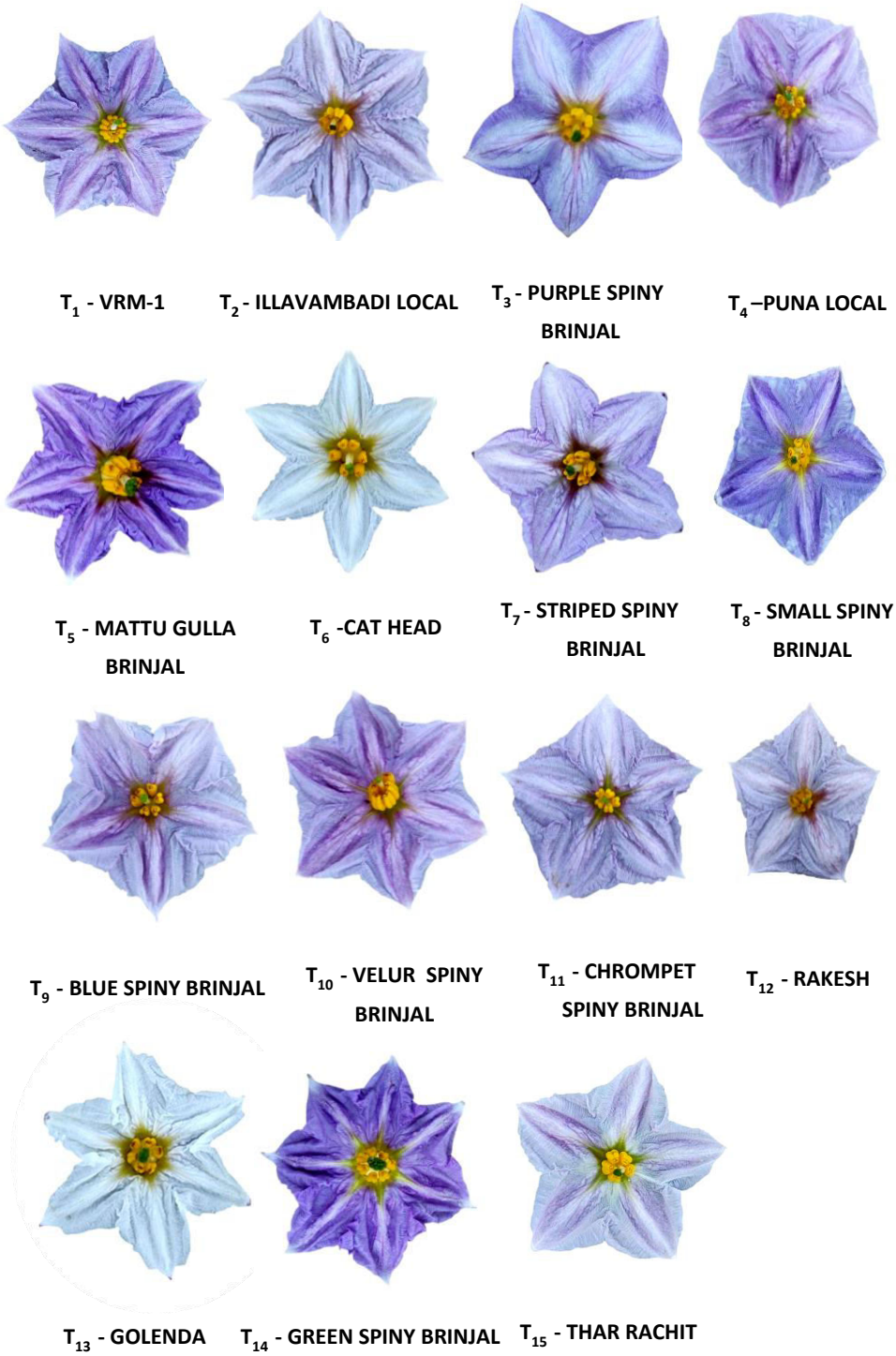
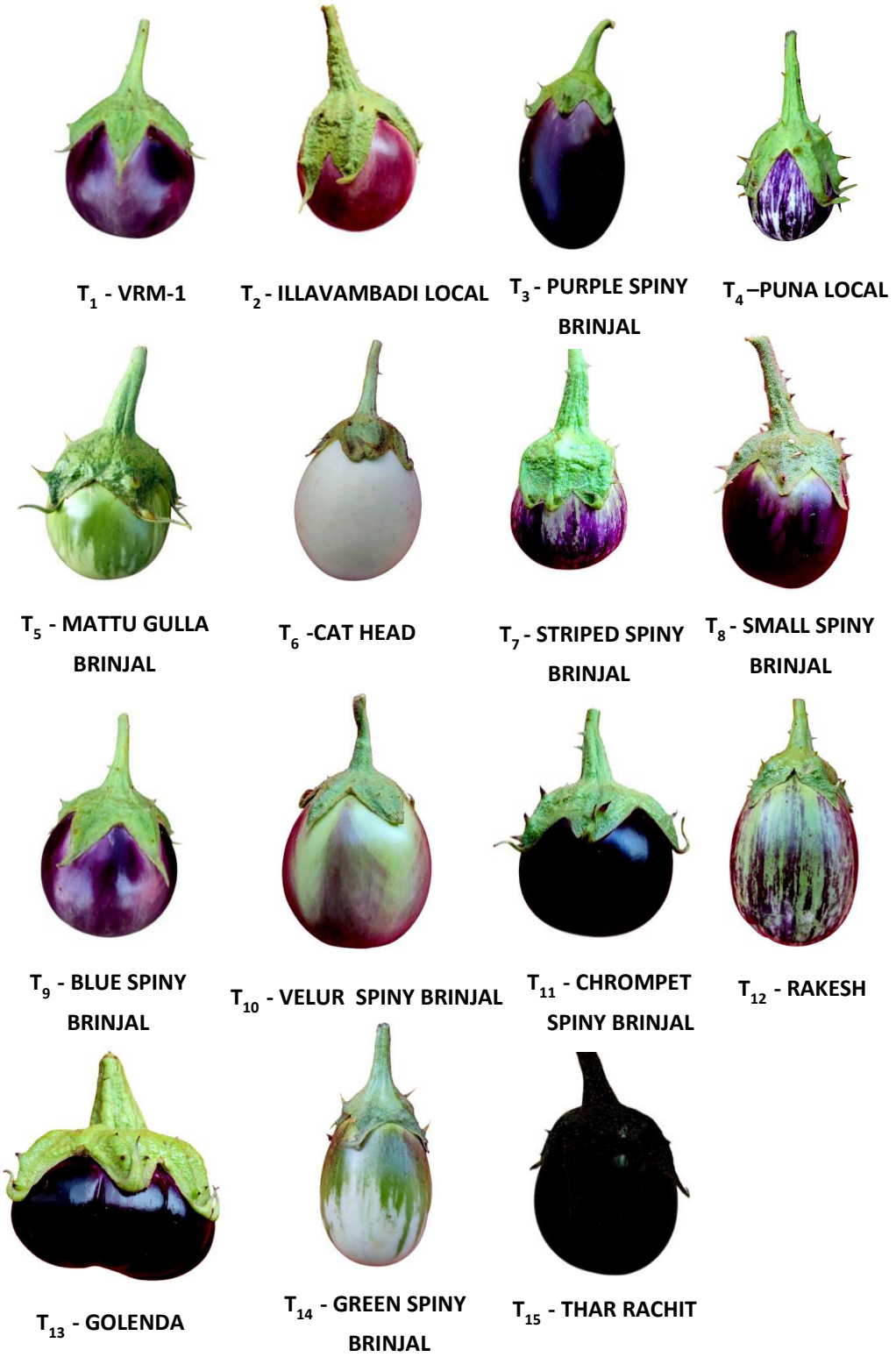


Fig 3. Morphological variation in fruits of different spiny brinjal genotypes.



Fruit colour ranged from milky white (T_6) and green (T_5, T_{14}) to various shades of purple and lilac in the remaining genotypes, in agreement with Bidaramali *et al.,* (2020), Singh *et al.,* (2023), Ramesh and Patil (2004) and Shinde *et al.,* (2012). Calyx spininess ranged from high in T_3, T_5 and T_{11} supporting the observations of Jayavalli *et al.,* (2024) and Singh *et al.,* (2023). All genotypes exhibited a pendent fruit position, indicating trait stability, whereas Das *et al.,* (2017) reported variation from pendent to semi-pendent in other collections. Fruit length-breadth ratio was nearly equal in most genotypes, slightly longer than broad in T_3, T_7 and T_{12}, broader than long in T_{13}, twice as long as broad in T_4, and three times as long as broad in T_{14}, consistent with Das *et al.,* (2017) and Jahan *et al.,* (2023).

In conclusion, the present investigation revealed considerable morphological diversity among the spiny brinjal genotypes, with wide variation observed in petiole colour, leaf blade lobing, corolla colour, calyx colour, prickle density, fruit colour, calyx spininess and fruit length-breadth ratio, while fruit position remained uniform. This diversity highlights the genetic variability present within the germplasm and its value for varietal identification and future breeding programmes. The morphological profiling using NBPGR descriptors provides a reliable framework for systematic documentation and conservation, and the distinct genotypes identified may serve as valuable parental material for improving yield, quality and pest resistance in spiny brinjal.

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Conflict of Interest

The authors declare no conflicts of interest relevant to this article.

Author Contributions

N. Bavya: Investigation, formal analysis, writing—original draft. V. Kanthaswamy: Validation, methodology, writing—reviewing. M. S. Marichamy:—Formal analysis, writing—review and editing. V. Krishnan: Investigation, writing—reviewing. S. Priyanga: Resources, investigation writing—reviewing. B. Bavithra: Validation, formal analysis, writing—reviewing. R. Praveen: Conceptualization, methodology, data curation, supervision, writing—reviewing the final version of the manuscript.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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