https://doi.org/10.33451/florafauna.v31i1pp15-22
FLORA AND FAUNA ISSN 2456 - 9364 (Online)
2025 Vol. 31 No.1 PP 15-22 ISSN 0971 - 6920 (Print)

Exploring the genetic diversity of *Musa sikkimensis* land races in Nagaland, India

K. R. Singh, *A. Sarkar and S. Walling

Department of Horticulture,
School of Agricultural Sciences,
Medziphema Campus, Nagaland University,
NAGALAND - 797106, INDIA
*Corresponding Author
E-mail : asarkar@nagalanduniversity.ac.in

Received **:** 25.03.2025; ***Accepted*** : 28.04.2025

How to cite : Singh KR, Sarkar A, Walling S. Exploring the genetic diversity of *Musa sikkimensis* land races in Nagaland*. Flora and Fauna* 2025. 31(1) : 15-22.

ABSTRACT

Musa sikkimensis is an interesting species of *Musa* confined to the scenic state of Nagaland in northeastern India. The purpose of this research is to explore into the diversity and landraces of *Musa sikkimensis* in Nagaland hill region, revealing in light of morphological characters, ethnobotanical utilisation, long-term management, involvement of local residents and valuable conservation in Nagaland, India.The findings emphasise the necessity of maintaining and safeguarding these unique genetic resources as well as merging traditional knowledge with current conservation measures, to ensure their long-term use and survival of these valuable taxa.

Figures : 04 References : 10 Tables : 03
KEY WORDS : Conservation, Diversity, Ethnobotany, Morphology, *Musa sikkimensis*,

Introduction

Musa, a complex genus of plants, encompasses both cultivated and wild species. *Musa sikkimensis* is a fascinating and distinct member of the wild species. Native to the picturesque state of Nagaland in northeastern India, *Musa sikkimensis* possesses exceptional traits that make it an intriguing subject for research and conservation initiatives. Nagaland is renowned for its extensive genetic diversity within the Musaceae family, ranging from seeded wild species to seedless cultivars. The hypothesis that *Musa* originated in South and Southeast Asia, particularly the Indo-Myanmar region[7,10]was supported by this diversity.*Musa sikkimensis* is an indigenous species of Nagaland, a state recognised for its rich biodiversity and cultural diversity. This work aims to provide an in-depth exploration of the *Musa sikkimensis* diversity and landraces present in Nagaland, highlighting its unique characteristics, cultural value and ecological adaptations. The species has adapted to survive in the Nagaland region's unique ecological conditions, making it an important genetic resource for both scientific research and horticulture growth.The cultivation and utilization of *Musa sikkimensis* by local communities in Nagaland have been deeply rooted in their traditional knowledge and practices for generations. According to indigenous beliefs, the species has numerous medical uses and is of great economic significance because it provides food, fibre and other essential nutrients.A scientist[2] studied *M. sikkimensis* and *M. nagensium*, emphasising their close kinship due to their possession of large seeds. He proposed that future research, using new Sikkim collections, might help resolve the nomenclatural difficulties surrounding the works of scientists[1,5]. Another

ACKNOWLEDGEMENTS : The authors are thankful to Dr Rajib Gogoi, Senior Scientist, Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok, Sikkim, for assisting in virtually identifying the species. Additionally, the gratitude is extended to Ms.Phyobeni Mozhui,Agriculture Officer, Wokha and Mr Lipise Sangtam, CEO of Naga Farmers Group and Mr Dikekmongba, village Head of old Chungliyimti village, Tuensang for their assistance during the exploration.

TABLE-1 : Study on reproductive characters of *Musa sikkimensis* var. siand *M. Sikkimensis ver. simondsii*

Genotypes	*Musa sikkimensis* var. *sikkimensis*	*Musa sikkimensis* var. *simondsii*
Male bud shape	Like a top	Lanceolate
Bract apex shape	Intermediate	Slightly pointed
Bract base shape	Large shoulder	Large shoulder
Colour of bracts (external)	Pink-purple	Purple-brown
Colour of bract (internal)	Orange-red	Orange-red
Free tepal shape	Oval	Oval
Free tepal colour	Translucent white	Translucent yellow
Compound tepal colour	Cream	Cream
Ovary shape	Arched	Arched
Stigma colour	Cream	Yellow

scientist[9] classed 'form'[1], variety *'hookeri,'* and King's species *M. hookerii* as subspecies of *M. sikkimensis*[5]. An investigator[9] presented a complete description based on his personal Darjeeling collection, dubbed B.E. 79, in 1957. This specimen was selected as the neotype of *M. sikkimensis* by a group of scientists in their latest investigations[3,4,9]. Despite the fact that this species grows widely in India, most botanists failed to identify it, mistaking it for other *Musa* species. It was included in the studies and specimens from 1996 to 1998 that could be found at the Edinburgh Herbarium[6].

Materials and Methods

The experiment was carried out between 2022 and 2023 to explore *Musa sikkimensis*. The study involved randomly selecting sampling in three districts of *Musa* biodiversity areas: Wokha, Peren and Tuensang. Two distinct varieties of *Musa sikkimensis* were identified during the exploration, namely *Musa sikkimensis* var. *sikkimensis* and *Musa sikkimensis* var. *simondsii*. The exploratory research incorporated the utilization of passport data obtained from the National Bureau of Plant Genetic Resources (NBPGR) in New Delhi, along with direct surveys and observational methods. To gather information about specific locations, open-ended interviews were conducted with local residents and vendors at local fruit markets. Living specimens, in the form of suckers with a minimum of three suckers per accession, were collected for *ex-situ* conservation at the School of Agricultural Sciences, Nagaland University.The study locations were carefully observed, noted, recorded, characterized and documented in terms of species diversity. Moreover, through open-ended conversations with local farmers, the indigenous names of *Musa* species in tribal languages unique to each region were obtained. The information pertaining to the study sites was meticulously recorded, aligning with the provided passport data or survey format and fruit descriptors from the National Bureau of Plant Genetic Resources (NBPGR) in New Delhi. Additionally, data on the morphological characteristics of the plants were collected and documented.

Results and Discussion

Two species of *Musa sikkimensis* were collected from three distinct locations. *Musa sikkimensis* var. *sikkimensis* was collected from old Chungliyimti village in Tuensang and old Jalukie, Sector-B in Peren. *Musa sikkimensis* var. *simondsii* was also collected from old Chungliyimti village in Tuensang and Forest Colony in Wokha, Nagaland. The specimens were collected from

TABLE-2 : Fruit morphological characters of *Musa sikkimensis* and *simondsii*

Genotypes	*Musa sikkimensis* var. *sikkimensis*	*Musa sikkimensis* var. *simondsii*
Fruit shape	Straight	Straight
Fruit apex	Blunt tipped	Blunt tipped
Immature fruit peel colour	Dark Green	Green
Mature fruit peel colour	Yellow	Bright Yellow
Pulp colour	Cream	White
Flesh texture	Soft	Firm
Presence of seed	Presence	Presence

an elevation of 1000-1400 meters above mean sea level (MSL). The latitude and longitude coordinates for the collection sites are as follows: old Chungliyimti village - 94.8331p E, 26.3457p N; old Jalukie, Sector-B - 93.4362p E, 25.3154p N and Forest Colony - 94.2655p E, 26.0830p N.The indigenous people of old Chungliyimti village called both the *Musa sikkimensis* species as Jümü homa in the Sangtam dialect, while residents of Forest Colony in Wokha refer *Musa sikkimensis* var. *simondsii* to it as Yourup in the Lotha dialect. These locations are authentic wild habitats where *Musa sikkimensis* is a common and widely spread species. The topography of these regions is steep and dissected. The species is abundantly available in this region and is predominantly rainfed. The local people mostly use suckers for vegetative propagation.The local community utilizes various parts of *Musa sikkimensis* for ethnobotanical purposes. The male inflorescence is used in culinary endeavours. The fruit serves as fodder for domestic animals and the pseudostem being hardy is

TABLE-3 : Physical characters of *Musa sikkimensis* and *simondsii*

Genotypes	*Musa sikkimensis* var. *sikkimensis*	*Musa sikkimensis* var. *simondsii*
Leaf blade length (cm)	177.33 ± 7.09	223.33 ± 8.33
Leaf blade width (cm)	74.67 ± 4.04	83.67 ± 3.06
Pseudostem height (m)	4.83 ± 0.76	3.65 ± 0.30
Pseudostem girth size (cm)	41.17 ± 2.02	38.33 ± 2.08
No. of suckers	3.67 ± 0.58	2.33 ± 1.53
Leaf petiole length (cm)	53.67 ± 3.06	54.50 ± 1.80
No. of hands/bunch	5.33 ± 0.58	3.33 ± 0.58

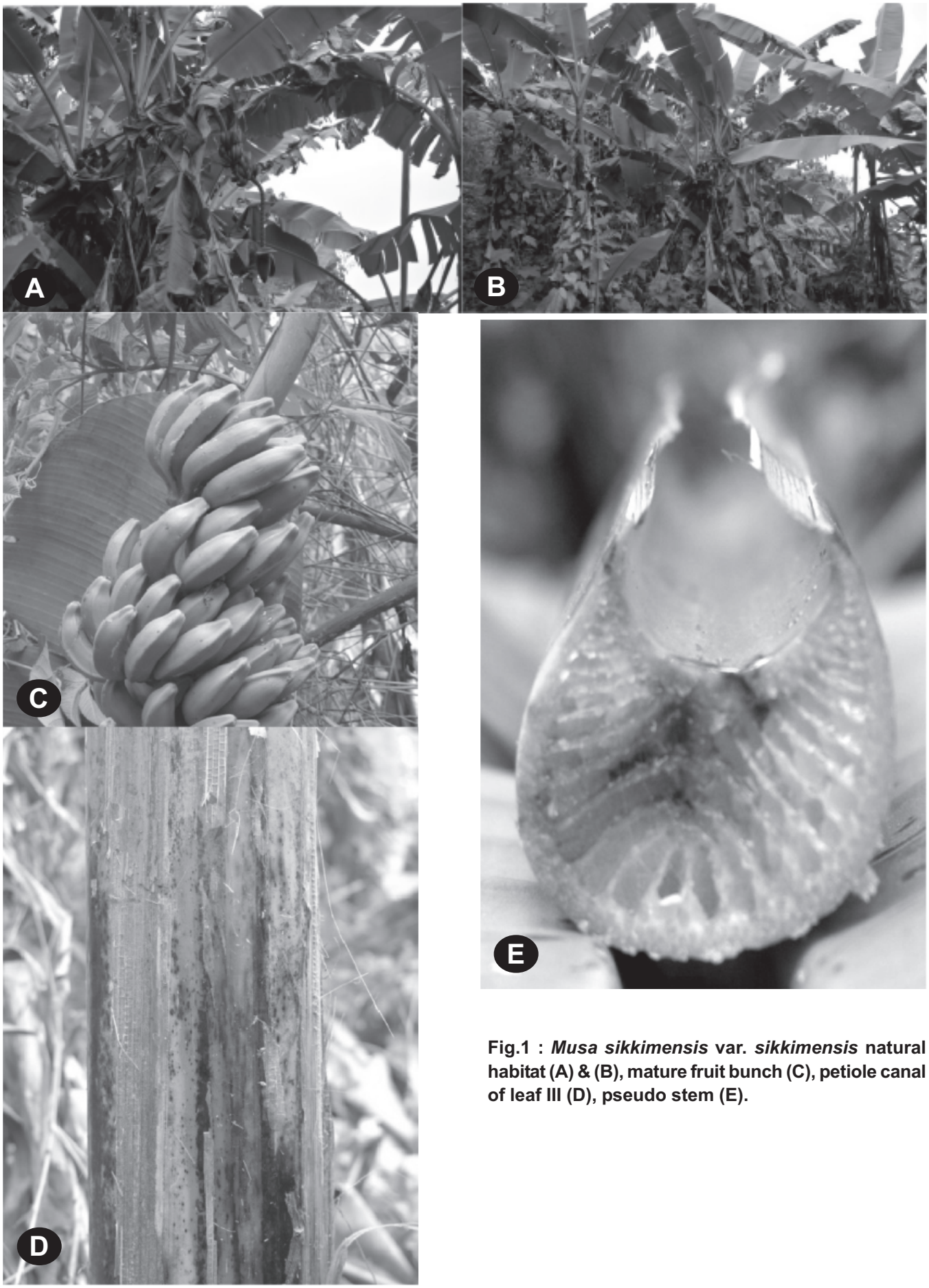

Fig.1 : *Musa sikkimensis* var. *sikkimensis* natural habitat (A) & (B), mature fruit bunch (C), petiole canal of leaf III (D), pseudo stem (E).

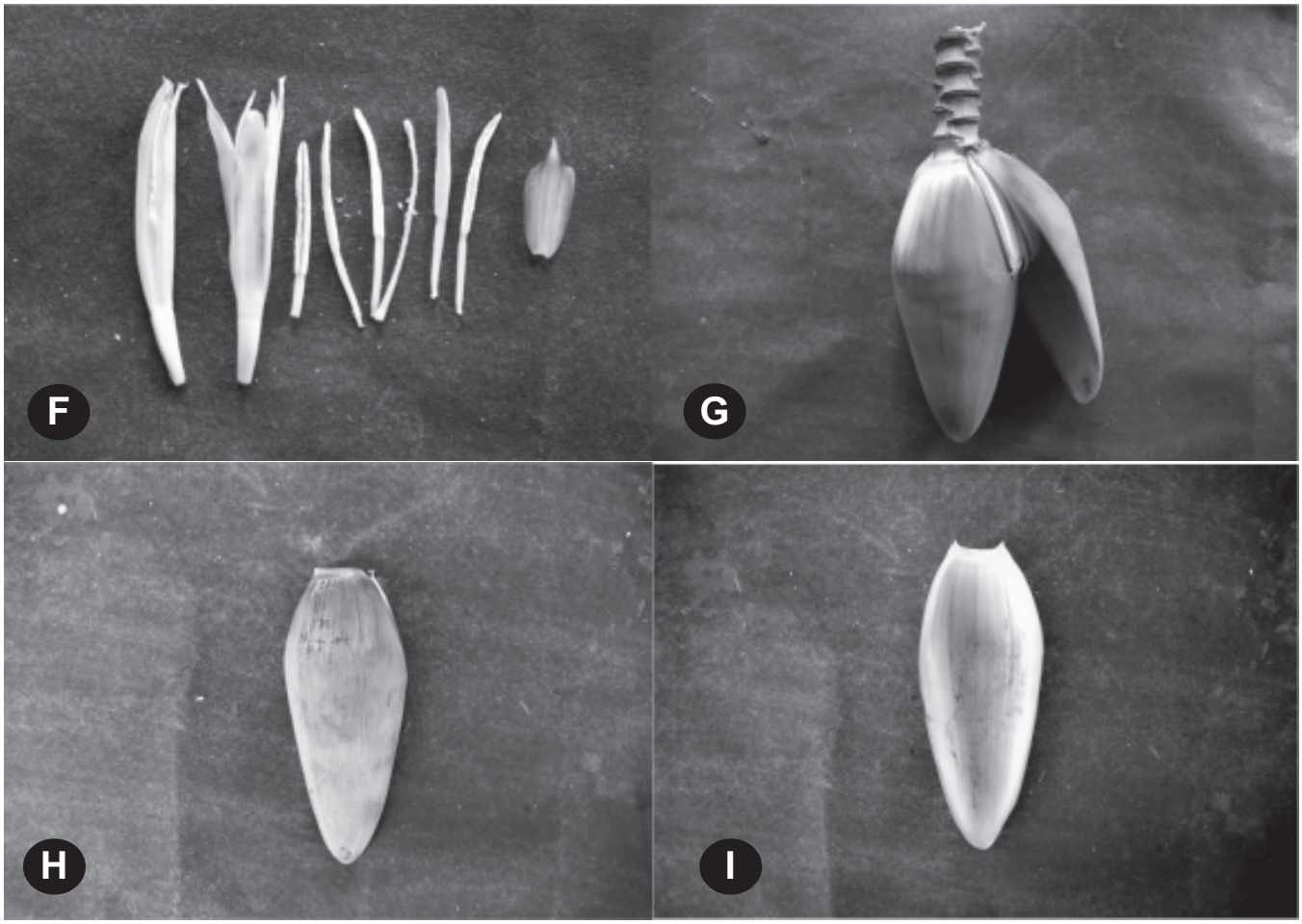

Fig.2 : *Musa sikkimensis* var. *sikkimensis* male flower parts (F),(F), male bud (G), bract of external and internal face(H) & (I).

suitable for fiber extraction.

Morphological and biochemical description of *Musa sikkimensis* var. *sikkimensis*

Musa sikkimensis var. *sikkimensis* demonstrates a number of distinctive traits. It has an erect leaf habit, with green-colored upper surfaces. The dwarfism of this plant is considered normal. The pseudostem, or false stem, displays a light red coloration. Suckers are observed to grow close to the parent plant in a vertical manner. The leaf blade base shape is pointed on both sides. The petiole canal of leaf-III is open, with the margin spreading. The length of the leaf blade measures 177.33±7.09 cm, while its width spans is74.67±4.04 cm. The pseudostem reaches a height of 4.83±0.76 m and its girth size measures 41.17±2.02 cm. Virtually mother rhizome produces suckers (3.67±0.58) around the parent plant. The petiole or leaf stalk has a length of 53.67±3.06 cm.

Musa sikkimensis var. *sikkimensis* has male buds that resemble a top shape. The bract apex shape is intermediate, while the bract base shape displays large shoulders. The external color of the bracts is a vibrant pink-purple, while the internal colour is orange-red. The free tepals have an oval shape and are translucent white in colour. The compound tepals, on the other hand, display a cream colour. The ovary of this plant is arched in shape and the stigma is cream-coloured in Table 2.*Musa sikkimensis* var. *sikkimensis*displays straight fruit shape with a blunt-tipped apex. The immature fruit peel color is dark green, while the mature fruit peel color turns yellow. The pulp color is cream and the flesh texture is soft. The fruit contains seeds. The length of the fruit measures 8.23±0.21 cm, while the width spans 3.27±0.15 cm. The fruit peel has a thickness of 1.90±0.10 mm. The bunch weight is recorded as 4.60±0.58 kg, with 5.33±0.58 hands per bunch. Each hand consists of 12.33±0.58 fingers. The average fruit weight is 70.96±2.37 g and the pulp weight is 52.33±2.89 g. Fruits contain various biochemical compounds like TSS (13.89±0.10 ^{0}B), total sugar (3.87±0.06%) and titratable acidity (0.34±0.08%) that contribute to their taste, texture and nutritional value. The storage life of *sikkimensis* fruits

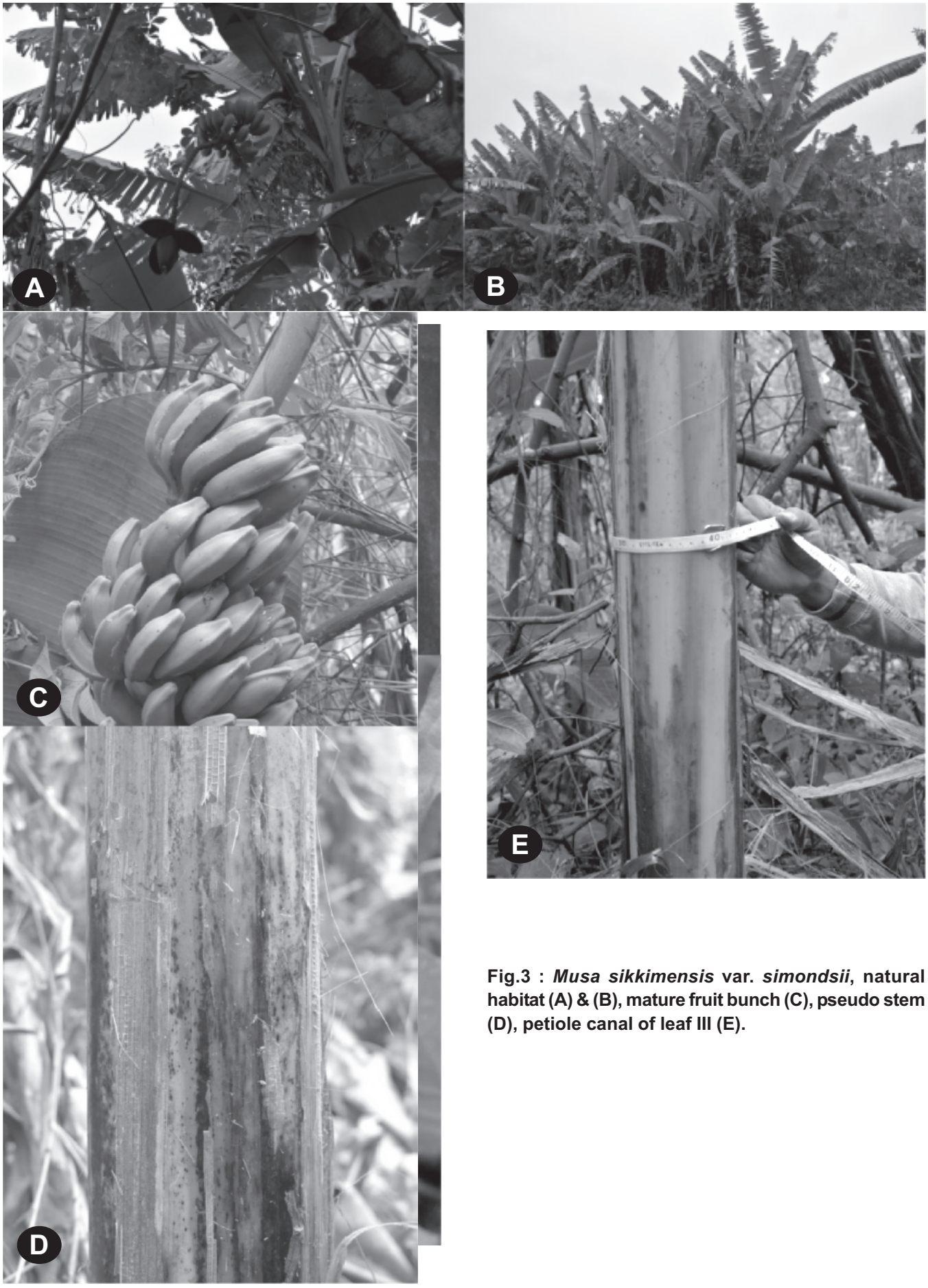

Fig.3 : *Musa sikkimensis* var. *simondsii*, natural habitat (A) & (B), mature fruit bunch (C), pseudo stem (D), petiole canal of leaf III (E).

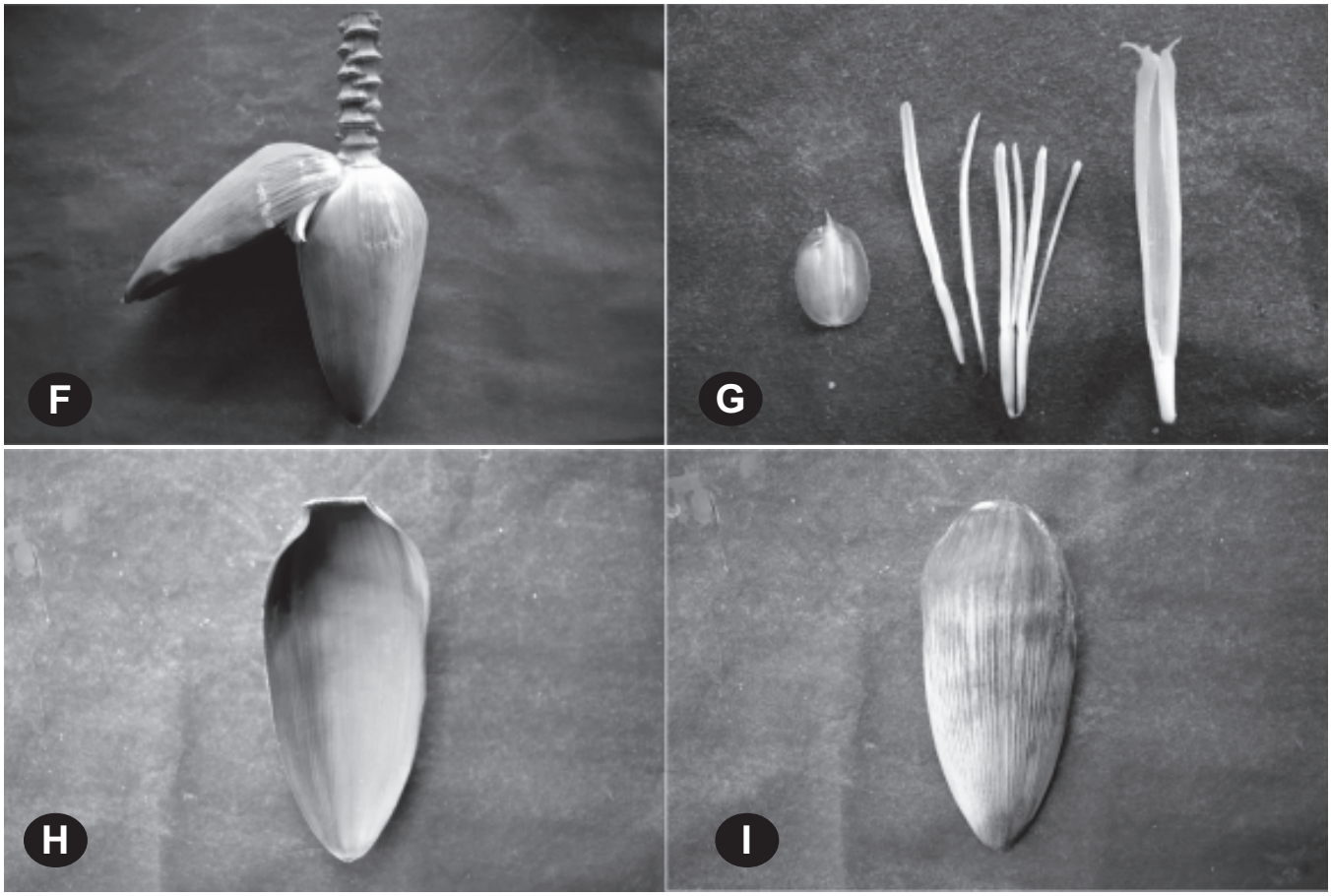

Fig.4 : *Musa sikkimensis* var. *simondsii*, male flower parts (F), male bud (G), bract of external and internal face(H) & (I)

is 9.91±1.27 days in Table-3.

Morphological and biochemical description of *Musa sikkimensis* var. *simondsii*

Musa sikkimensis var. *simondsii* displays an erect leaf habit, with a dark green coloration on the upper surface of the leaves. It exhibits a dwarfism trait, characterized by its compact size. The pseudostem, or false stem, shows a combination of green and red hues. Suckers are observed to grow at a distance from the parent plant. The leaf blade base shape is asymmetrical, with one side rounded and the other pointed. The petiole canal of leaf III is wide, with an erect margin. The length of the leaf blade measures 223.33±8.33 cm, while its width spans 83.67±3.06cm. The pseudostem reaches a height of 3.65±0.30 m, with a girth size of 38.33±2.08 cm. There are typically 2.33±1.53 suckers present. The petiole, or leaf stalk, has a length of 54.50±1.80 cm in Table 3.

Musa sikkimensis var. *simondsii*displays a male bud shape is described as lanceolate. The bract apex shape is slightly pointed and intermediate in nature. The bract base shape displays large shoulders. The external colour of the bracts is purple-brown, while the internal color is orange-red. The free tepals have an oval shape and are tinted with yellow. The compound tepals, on the other hand, display a cream color. The ovary of this plant is arched in shape and the stigma is yellow.*Musa sikkimensis* var. *simondsii*reveals straight fruit shape with a blunt-tipped apex. The immature fruit peel colour is green, while the mature fruit peel colour is a bright yellow. The pulp colour is white and the flesh texture is firm. The fruit contains seeds. The length of the fruit measures 8.47±0.21 cm, while the width spans 4.10±0.20 cm. The fruit peel has a thickness of 2.20±0.10 mm. The bunch weight is recorded as 2.89±0.35 kg, with 3.33±0.583 hands per bunch. Each hand consists of 7.67±0.588 fingers. The average fruit weight is 40.00±7.00 g and the pulp weight is21.33±4.62 g.The biochemical composition of fruits like TSS (15.86±0.59 ^{0}B), total sugar (2.83±0.12%) and titratable acidity (0.47±0.05%) also play a significant role as a genome character. The shelf life of *simondsii* is 7.21±0.58 days in Table 3.

Musa sikkimensis was initially mentioned in a synoptic key[5]) with a brief description stating that the spathes are dull-purple, exhibiting some degree of pruinose texture on the outside. The seeds are

depressed, irregularly angular, tubercled and have a diameter of 4–5 lines. A scientist[1] categorized *M. sikkimensis* as a subspecies or variety of *Musa sapientum*, despite being fully aware of the differentiation and relied on condensed characteristics from scientist's[5]work.Musaceae are most diverse and widely distributed in India's northeastern states, where there are 30 taxa total, 19 of which are endemic to the area. This accounts for around 81% of India's total diversity of wild Musaceae. Distribution and habitat *Musa* sps has a wide distribution in an area bounded in the Northwest by Tibet's southern slope of the Himalayas, by Northern Arunachal Pradesh in the Northeast, extending as far South as Northern Assam, and East to Putao in Northern Myanmar. These wild species grow mostly in higher altitudes at elevations between 300 and 1200 m in moist ravines of evergreen forests and along riversides. This additionally reinforces the hypothesis that this region is one of the main centres of origin for the family Musaceae and shows that the area bordering Bangladesh, China and Myanmar is a zone rich in biodiversity for Musaceae.Nagaland, renowned for its rich biodiversity and favourable climatic conditions, is home to a wide variety of *Musa* species. These species hold an immense potential for ethnobotanical and economic applications. To fully unlock their potential for scientific exploration, further research is essential.Thorough investigation into these *Musa* species provided valuable insights into their genetic traits, ecological adaptations, economic value and potential uses. Such studies can contribute to the advancement of horticulture, aid conservation efforts and benefit various sectors. Additionally, by delving deeper into their unique qualities and cultural significance, we can honour and preserve Nagaland's rich cultural heritage.The local communities have long recognized the importance of safeguarding the *Musa* species. They value their culinary uses and engage in the practice of fiber extraction. In particular, indigenous people often extract fiber for weaving baskets and other products that posses a positive economic impact on the region.

Conclusion

These aspects highlight the significance of preserving and studying the diverse *Musa* species in Nagaland. Consequently, the local communities have inherited and continue to pass down the practice of conservation from one generation to the next, honouring the knowledge and traditions of their forefathers. Conservation initiatives was prosecuted by Department of Horticulture, Nagaland University to fully harness the potential of these Musa species, fostering both scientific knowledge and the preservation of Nagaland's cultural heritage.

References

1. Baker JG. A synopsis of the genera and species of Museae. *Annals Bot.*1893; **7**:204–222.
2. Cheesman EE Classification of the Bananas: Critical Notes on Species: *Musa nagensium*.*Kew Bull*.1948; **3**:325–328.
3. Hore DK, Sharma BD, Pandey G.Status of banana in North-East India. *J. Eco. Tax. Bot.*1992; **16**(2): 447–455.
4. Karthikeyan S, Jain SK, Nayar MP, Sanjappa M. Musaceae. In. *Florae Indicae Enumeratio Monocotledonae.* Calcutta, India, Botanical Survey of India.1989; pp. 103-105.
5. Kurz S. The Banana: a pomological contribution by S. Kurz. *J. Agril. Horti. Soc. India*.1878; **5**:112–168.
6. Noltie H. Musaceae. In. *Flora of Bhutan.Including a record of plants from Sikkim and Darjeeling*. Royal Botanic Garden, Edinburgh.1994; **3**:178–182.
7. Prasad K, Joe A, BheemalingappaM, Rao BRP. *Musa sabuana* (Musaceae): a new species from Andaman and Nicobar Islands. *Indian J. Forestry*.2013; **36** (1): 151–153.
8. SchumannK. Das Pflanzenreich IV.45 (1. Heft) Musaceae. Verlag von Wilhelm Engelmann Leipzig (in German). 1900.
9. Simmonds NW. Botanical results of the banana collection expedition, 1954–55. *Kew Bull*.1957; **11**:478–479.
10. Singh HP, UmaS, Sathiamoorthy S. A tentative key for identification and classification of Indian bananas. National Research Centre for Banana (ICAR). 2001.