*Indian Journal of Ecology (2025) 52(1): 26-30*
*DOI: https://doi.org/10.55362/IJE/2025/4450*

**Manuscript Number: 4450**
**NAAS Rating: 5.38**

# Assessing Population Dynamics and Seed Germination in the Endemic Tree *Micromeles cuspidata* (Bertol.) C.K. Schneid.

**Viheno Iralu**

*Centre for Biodiversity Studies, Nagaland University, Lumami-798 627, India*
*E-mail: vihenoiralu@nagalanduniversity.ac.in*

***Abstract*:** The present study assessed the population status and seed germination of the endemic tree *Micromeles cuspidata* (Bertol.) C.K. Schneid. in northeast India. A total population density of 594 individuals was recorded, consisting of 67 adults, 215 saplings, and 312 seedlings. Regeneration was generally good across sites, except for sites Law Shnong Mawkasain and Law Shnong Umladkur , where no saplings or seedlings were present. Sites Law Adong Pongtung and Syiemship forest demonstrated fair regeneration. Seed germination experiments revealed that all treatments induced germination within two weeks. The highest germination rate (96%) occurred in seeds treated with 2000 mg $L^{-1}$ gibberellic acid ($GA_3$), while the lowest rate (65.33%) was observed at 3000 mg $L^{-1}$ $GA_3$, indicating that higher concentrations had inhibitory effects. Untreated seeds also exhibited a high germination rate (90.67%), suggesting that *M. cuspidata* can be propagated effectively without chemical intervention. These results provide critical insights for ex-situ conservation strategies. The conservation of adult trees in natural habitats is essential for maintaining viable populations in the wild. Furthermore, seed collection, germination and the reintroduction of seedlings into community-conserved areas are recommended to enhance the species' long-term survival.

***Keywords*:** Conservation, Ex-situ, Gibberellins, Germination, Population density

*Micromeles cuspidata* (Bertol.) C.K. Schneid. (Synonyms- *Photinia cuspidata*, *Pyrus cuspidata*, *Sorbus verrucosa* and *Micromeles verrucosa*), is a small tree species of the family Rosaceae. The species is distributed in tropical and subtropical forests of India and parts of Southeast Asia. In India, the species has been recorded from a few hill forests in Meghalaya (Tripathi 2013, Mir 2017) and is considered endemic to the region (Upadhaya et al., 2017). However, the species' population is small and faces threats from anthropogenic activities and habitat degradation. The current trends suggest a continued decline in its population unless conservation measures are urgently implemented (Mir and Upadhaya 2021). The species is harvested locally as a good source of firewood (Mir 2017). The International Union for Conservation of Nature (IUCN) has categorized the species as 'Data Deficient' highlighting the paucity of data on the status of the species beyond Meghalaya (IUCN 2021). Furthermore, no conservation initiatives have been undertaken for this species, and it remains absent from any ex-situ collections (BGCI 2019). Thus, this study seeks to assess the population status of the tree species in Meghalaya and study seed germination potential of *M. cuspidata* to facilitate ex-situ propagation and conservation efforts of this vulnerable species.

## MATERIAL AND METHODS

**Study area:** The study was carried out in the Khasi and Jaintia Hills of Meghalaya (89°49'E to 92°50'E longitude and 25°02'N to 26°07'N latitude). The elevation ranges from 900-1500 m asl. The forest types found in this region are categorized as subtropical broad-leaved humid forests (Champion and Seth 1968). The average annual rainfall is ca. 3500 mm and temperatures vary from 26°C in summer to 5°C in winter.

**Population structure:** Extensive field surveys were conducted in the potential areas of the species occurrence based on herbarium records. The species was found in 18 sites spread across the Khasi and Jaintia Hills of Meghalaya. To understand the population density of the species in these forests, a belt transect measuring 20 m wide and 250 m long was laid in each forest. The transect was further divided into 10 $m^2$ quadrates for sampling of *M. cuspidata* and associated species where all trees measuring ≥ 5 cm diameter at breast height (dbh) were counted and measured. Individuals <5 cm dbh and> 1 m height were categorized under saplings and those <1 m height were categorized as seedlings. The regeneration was categorized as good, fair, poor, none and new following the Sukumar et al. (1992) based on the number of trees, saplings and seedlings.

**Seed source:** Mature fruits of *M. cuspidata* were collected from Mawsynram region (25.298°N, 91.581°E) in Meghalaya in mid-January. Fruits were collected from randomly selected trees to attain a composite and representative seed lot. The fruits measured approximately 0.87 cm in diameter and typically contained 3 to 4 ovate seeds, each measuring 3.9 mm across. The seeds were manually extracted and thoroughly washed and air-dried. The seeds were stored at room temperature (24 ± 1°C). Germination experiments were conducted within one week of seed collection to avoid the loss of viability.

**Germination tests:** Seed germination rates were systematically evaluated under controlled laboratory conditions to determine the impact of $GA_3$ treatments. Seeds were subjected to a 48-hour soaking period in a range of $GA_3$ solutions with concentrations of 200 mg $L^{-1}$, 500 mg $L^{-1}$, 1000 mg $L^{-1}$, 2000 mg $L^{-1}$, and 3000 mg $L^{-1}$. The control group was maintained where seeds received no $GA_3$ treatment for comparison with $GA_3$ treated seeds. Both the control and $GA_3$-treated seeds were placed on glass Petri dishes that measured 9 cm diameter × 2 cm height lined with Whatman No. 1 filter paper. The seeds were incubated at a constant temperature of 25°C (±1°C). For each $GA_3$ concentration, three replicates, each with 25 seeds, were maintained. The filter papers were regularly moistened with distilled water at 3-day intervals to maintain moisture levels. Seed germination was carefully monitored daily until the cessation of germination. To understand seedling growth, 500 seeds were sown in plastic trays filled with a mixture of soil and sand at a ratio of 3:1. The germinated seedlings were transplanted into poly bags after 3 months and transferred to greenhouse conditions having a controlled light intensity of approximately 3 mol $m^{-2}$ $d^{-1}$, similar to understory light intensities in the field conditions. The seedlings were watered at 3-day intervals and mortality rates were documented. After one year,10 seedlings were harvested to assess the growth in shoots, roots, leaves and biomass.

**Data analysis:** The germination percentage for each treatment replication was determined.

$$G (\%) = n/N \times 100,$$

Where *n* represents the number of seeds that germinated, and *N* denotes the total number of seeds.

Mean germination time (MGT) was calculated using the following formula:

$$MGT = \Sigma (n * d)/ N,$$

where *n* is the number of seeds that germinated on a particular day, d is the number of days since the test began, and *N* is the total number of seeds that germinated by the end of the experiment (Ellis and Roberts 1981). The time required for 50% germination ($T_{50}$) was calculated as follows:

$$T_{50} = t_1 + [(N/2 - n_i)(t_j - t_i)]/n_j - n_i$$

where N is the final number of germinated seeds, $n_i$ and $n_i$ are the cumulative numbers of germinated seeds at times $t_i$ and $t_j$, respectively, when $n_i < N/2 < n_j$ (Farooq et al., 2006).

The analysis was performed with Tukey's least significant difference test ($p < 0.05$) using SPSS (Version 20).

## RESULTS AND DISCUSSION

**Population structure:** The total population density was 594 individuals comprising 67 adults, 215 saplings and 312 seedlings. The highest number of individuals were observed in Sai Mika forest (S9) with 113 individuals and the lowest population was in Law Shnong Mawkasain (S4) and Law Shnong Umladkur (S14) with only 1 adult individual in each site (Table 1, Fig. 1). The dominant associated species were *Castanopsis tribuloides* (Sm.) A. DC., *Castanopsis purpurella* (Miq.) N.P. Balakr., *Cinnamomum pauciflorum* Nees, *Elaeocarpus lancifolius* Roxb. and *Helicia nilagirica* Bedd. The regeneration of the species based on the number of adults, saplings and seedlings revealed an overall good regeneration except for sites S4 and S14 where saplings and

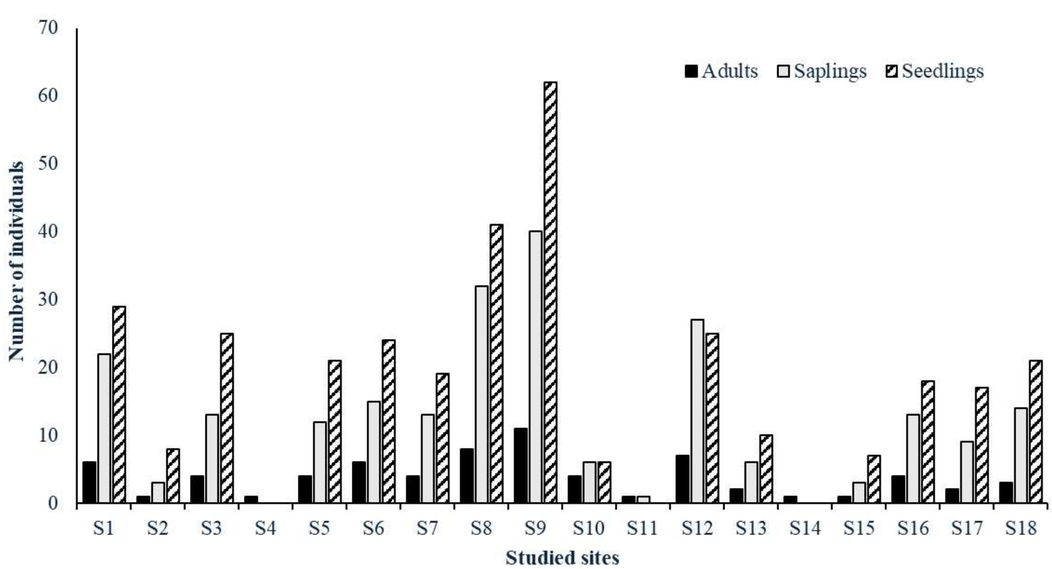


**Fig. 1.** Number of adults, saplings and seedlings of *M. cuspidata* in the studied sites

seedlings were absent. Two sites S10 and S12 showed fair regeneration (Table 1).

The variation in the population density of *M. cuspidata* in different sites may be attributed to differences in land use, topography and anthropogenic activities operating in and around the habitat of the species. The species was in both forest edges and in dense forests indicating the species' ability to withstand external disturbances. However, as the species is harvested for its valued firewood, forest patches located close to villages are at higher risk of over-exploitation. Studies have shown that disturbance poses the risk of reducing the densities of flowering species risking the proliferation of invasive species (Bisht et al., 2022). Disturbance in the form of extraction is known to reduce the density of flowering trees as observed in species such as *Magnolia rabaniana* (Mir et al., 2017). The regeneration of the species was satisfactory across most of the studied sites, as indicated by a higher number of saplings and seedlings compared to adults. The highest number of adult trees was at site S9, with 11 individuals, although the overall number of adults across all sites remained low. The positive correlation was observed between the densities of saplings, seedlings and adult trees, underscoring the importance of conserving adult populations in their natural habitats to ensure the long-term persistence of this endemic species.

**Seed germination:** Seed germination was observed within 14.5 days after the start of the experiment. The average germination percentage was 87.11 across the treatments. MGT was 13.50 days and the time to reach 50% germination ($T_{50}$) was 14.97. Seeds that were not subjected to $GA_3$ treatment showed a relatively high germination rate of 90.67%, with an MGT of 14.96 days and a $T_{50}$ of 15.67 days. The highest germination percentage of 96 was in seeds treated with 2000 mg $L^{-1}$ $GA_3$, which also had the shortest MGT of 11.85 days (Table 1). However, seeds treated with 3000 mg $L^{-1}$ $GA_3$ resulted in the lowest germination percentage (65.33) which was significantly lower than all other treatments. This treatment also had the longest MGT (15.21 days) albeit the $T_{50}$ was the shortest (13.54 days). Seeds treated with 1000 mg $L^{-1}$ $GA_3$ had the longest $T_{50}$ (16.41 days). The application of $GA_3$ expedited the time for germination in seeds with significantly shorter mean germination days achieved in seeds treated with higher concentrations of $GA_3$ as compared to untreated seeds (Table 2, Fig. 2). Seedlings transplanted into greenhouse conditions had a survival of 55% after one year. Seedlings were vulnerable to desiccation and seedling growth was slow (Table 3).

Seeds of *M. cuspidata* exhibited high percentages of germination for both treated and untreated seeds under controlled laboratory conditions. Seeds germinated within two weeks indicating the absence of dormancy at the time of seed dispersal. The $GA_3$ treatments showed variations in the germination percentage with the lowest percentage

**Table 1.** Basal area of adult *M. cuspidata* in the studied sites and regeneration status

| Sites | Site code | Density of adult trees | Basal area ($m^2$) | Regeneration status |
|---|---|---|---|---|
| Law Adong Laitsohum | S1 | 6 | 0.565 | Good |
| Law Adong Saitbakon | S2 | 1 | 0.002 | Good |
| Law Kyntang Nonglienkien | S3 | 4 | 0.040 | Good |
| Law Shnong Mawkasain | S4 | 1 | 0.001 | None |
| Twah Samparat | S5 | 4 | 0.042 | Good |
| Tyllong Um-Kyrwiang | S6 | 6 | 0.050 | Good |
| Law Adong Tyrsad | S7 | 4 | 1.010 | Good |
| Law Adong Phlangwanbroi | S8 | 8 | 0.260 | Good |
| Sai Mika | S9 | 11 | 0.116 | Good |
| Syiemship forest RK Mission | S10 | 4 | 0.233 | Fair |
| Lum Shynna | S11 | 1 | 0.045 | Poor |
| Law Adong Pongtung | S12 | 7 | 0.325 | Fair |
| Law Siarpa | S13 | 2 | 0.342 | Good |
| Law Shnong Umladkur | S14 | 1 | 0.093 | None |
| Tyrongmawlieh Mission Tynnai | S15 | 1 | 0.039 | Good |
| Law Kyntang Tyrsad | S16 | 4 | 0.505 | Good |
| Law Marai | S17 | 2 | 0.202 | Good |
| Wah Bah Pomolang | S18 | 3 | 0.150 | Good |

**Table 2.** Germination characteristics of *M. cuspidata* seeds

| Treatment (mg $L^{-1}$) | Total germinated | Germination percentage | Mean germination time (days) | $T_{50}$ (days) |
|---|---|---|---|---|
| Control | $22.67\pm0.33^{a}$ | $90.67\pm1.33^{a}$ | $14.96\pm0.04^{a}$ | $15.67\pm0.09^{a}$ |
| 200 | $22.00\pm0.00^{a}$ | $88.00\pm0.00^{a}$ | $14.07\pm0.20^{ab}$ | $14.92\pm0.08^{ab}$ |
| 500 | $23.33\pm0.33^{a}$ | $93.33\pm1.33^{a}$ | $12.17\pm0.05^{d}$ | $14.19\pm0.06^{b}$ |
| 1000 | $22.33\pm0.33^{a}$ | $89.33\pm1.33^{a}$ | $12.73\pm0.26^{d}$ | $16.41\pm0.57^{a}$ |
| 2000 | $24.00\pm0.58^{a}$ | $96.00\pm2.31^{a}$ | $11.85\pm0.39^{d}$ | $15.06\pm0.42^{a}$ |
| 3000 | $21.78\pm0.62$ | $65.33\pm1.33$ | $15.21\pm0.22^{ac}$ | $13.54\pm0.12^{b}$ |

Means followed by the same letter in each column do not differ significantly at $p< 0.05$.

**Table 3.** Growth characteristics of one-year-old *M. cuspidata* seedlings (n=10)

| Light intensity | No. of leaves | Mean leaf area ($cm^2$) | Shoot height (cm) | Root length (cm) | Dry weight (g) |
|---|---|---|---|---|---|
| $3 \pm 0.35$ mol $m^{-2}$ $d^{-1}$ | 8±1 | 6.90±0.36 | 11.45±0.76 | 12.53±1.03 | 0.22±0.04 |

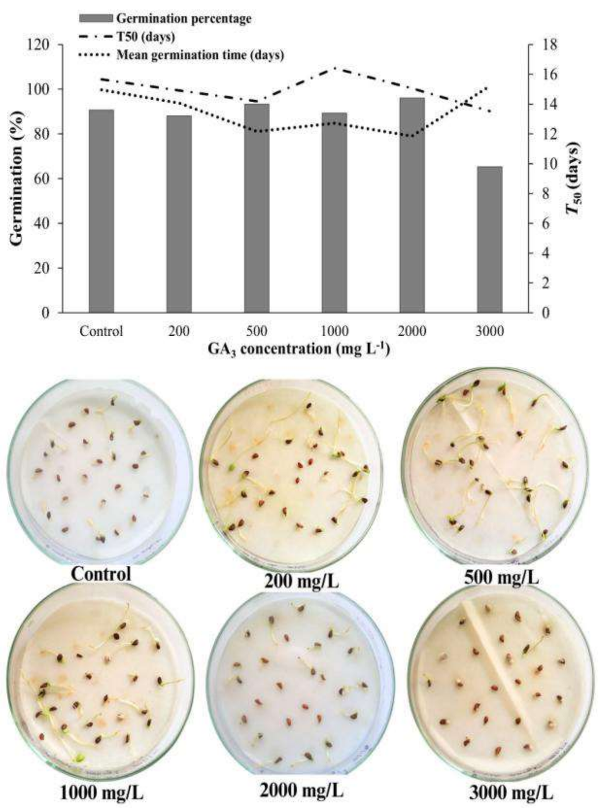


**Fig. 2.** Mean germination percentage (G%), MGT and $T_{50}$ under $GA_3$ treatments at 25°C and seeds germinating under the various $GA_3$ concentrations

observed in the highest concentration of 3000 mg $L^{-1}$. This observation suggests the inhibitory effect of $GA_3$ at high concentrations. Similar observation was observed in other species like *Saraca asoca* and *Melientha suavis* (Rout et al., 2021, Tuan et al., 2023). High $GA_3$ concentrations above species threshold limits can lead to disruptions in hormonal signaling and seed metabolism (Attia et al., 2022). The application of $GA_3$ expedited the germination process, with 2000 mg $L^{-1}$ observed as the most effective concentration for achieving rapid and high germination. Similar results have also been reported in species such as *Magnolia punduana* and *Tinospora cordifolia* (Iralu and Upadhaya 2016, Bhadra et al., 2024). Untreated seeds also achieved high germination percentages suggesting that the species can be propagated without external treatments. For conservation purposes, it is recommended that adult trees be given conservation priority. In addition, ex-situ conservation through mass germination and the introduction of seedlings in botanical gardens, national parks and community-conserved areas will go a long way in ensuring the conservation of the species.

## CONCLUSION

*Micromeles cuspidata* showed good regeneration in most sites, with significant numbers of saplings and seedlings, highlighting the potential for recovery if habitat degradation is controlled. The low density of adult individuals, especially in areas heavily impacted by anthropogenic activities, emphasizes the need for urgent conservation actions. High germination rates achieved in both untreated and $GA_3$-treated seeds suggest that the species can be effectively propagated through seed-based approaches. Despite challenges in seedling establishment under greenhouse conditions, the successful germination and propagation of *M. cuspidata* offers a viable path for ex-situ conservation efforts. Priority should be given to protecting adult populations and implementing conservation strategies, including introducing seedlings into botanical gardens and forest areas, to ensure the long-term survival of this endemic species.

## ACKNOWLEDGEMENTS

The financial support received from the University Grants Commission (UGC) in the form of RGNF fellowship (Grant No.: F1-17.1/2013-14/RGNF-2013-14-ST-NAG-43868/(SA-III/website) is acknowledged. I am also thankful to the village heads of the Khasi Hills for permitting me to work and collect samples in their village forests.

## REFERENCES

Attia HK, Alamer B, Algethami W, Zorrig K, Hessini K, Gupta K and Gupta B 2022. Gibberellic acid interacts with salt stress on germination, growth and polyamine gene expression in fennel (*Foeniculum vulgare* Mill.) seedlings. *Physiology and Molecular Biology of Plants* **28**(3): 607-622.

BGCI 2019. *Plant Search online database*. Richmond, UK. www.bgci.org/plant_search.php.

Bhadra M, Mondal S, Das A and Bandyopadhyay A 2024. Gibberellic acid treatment improves seed germination and seedling establishment in *Tinospora cordifolia* (Willd.) Hook. F. and Thoms. *Journal of Applied Biology and Biotechnology* **12**(4): 128-135.

Bisht M, Chandra Sekar K, Mukherjee S, Thapliyal N, Bahukhandi A, Singh D, Bhojak P, Mehta P, Upadhyay S and Dey D 2022. Influence of Anthropogenic Pressure on the Plant Species Richness and Diversity Along the Elevation Gradients of Indian Himalayan High-Altitude Protected Areas. *Frontiers in Ecology and Evolution* **10**: 751989.

Ellis RA and Roberts EH 1981. The quantification of ageing and survival in orthodox seeds. *Seed Science Technology* **9**: 373-409.

Farooq M, Basra SMA, Afzal I and Khaliq A 2006. Optimization of hydropriming techniques for rice seed invigoration. *Seed Science Technology* **34**: 507-512.

Iralu V and Upadhaya K 2016. Dormancy, Storability and Germination of Seeds in *Magnolia punduana* (Magnoliaceae). *Botany* **94**: 967-973.

IUCN 2021. The IUCN Red List of Threatened Species. Version 2021-2. www.iucnredlist.org.Khasi Hills, Meghalaya. North-Eastern Hill University.

Mir AH and Upadhaya K 2021. *Micromeles cuspidata*. The IUCN Red List of Threatened Species 2021: e.T149018405 A149029827.

Mir AH, Upadhaya K, Odyuo N and Tiwari BK 2017. Rediscovery of *Magnolia rabaniana* (Magnoliaceae): A threatened tree species of Meghalaya, northeast India. *Journal of Asia-Pacific Biodiversity* **10**(1): 127-131.

Mir AH 2017. *Plant diversity assessment in community forests for priority conservation in Khasi Hills Meghalaya*. Ph.D. Dissertation, North-Eastern Hill University, Shillong, India.

Rout S, Beura S, Khar N and Prusty AK 2021. Role of Different Concentrations Gibberellic Acid ($GA_3$) on Seed Germination and Seedling Quality of *Saraca asoca* (Roxb.) De Wilde. *Frontiers in Crop Improvement* **9**: 2495-2500.

Sukumar R, Dattaraja HS, Suresh HS, Radhakrishnan J, Vasudeva R and Nirmala S 1992. Long-term monitoring of vegetation in a tropical deciduous forest in Mudumalai, southern India. *Current Science* **62**: 608-616.

Tuan NM, Cuong ND and Nga DT 2023. Effect of $GA_3$ on seed germination and seedling growth of threatened *Melientha Suavis* Pierre species in Thai Nguyen province, Vietnam. *European Chemical Bulletin* **12**(6): 989-998.

Tripathi AK 2013. *Quantitative assessment of floristic diversity and species populations in hill forests of Meghalaya*. Ph.D. Dissertation, North-Eastern Hill University, Shillong, India.

Upadhaya K, Mir AH and Iralu V 2017. Reproductive Phenology and Germination behavior of some important tree Species of Northeast India. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences.* DOI. 10.1007/s40011-017-0841-4.

*Received 11 October, 2024; Accepted 24 January, 2025*