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Interspecific grafting success in *Hopea erosa:* A critically endangered tree of the Western Ghats

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Abstract
Hopea erosa (Bedd.) Slooten (Dipterocarpaceae), a critically endangered tree endemic to the southern Western Ghats of India, was successfully propagated through interspecific grafting onto *Hopea indica* and *H. ponga* rootstocks. The high graft success achieved demonstrates the effectiveness of this technique for clonal propagation and its value in the *ex situ* conservation, population recovery, and ecological restoration of the species.

Keywords: Endemic tree, threatened species, Western Ghats, *ex-situ* conservation

Introduction

Hopea erosa (Bedd.) Slooten (Dipterocarpaceae) is an evergreen tree species endemic to southern Western Ghats of India. It occurs in moist deciduous and wet evergreen forests of Kerala, Tamil Nadu, and Karnataka at elevations ranging from 70 to 800 m above sea level. Mature trees attain heights of up to 25 m and girths of approximately 1.5 m. The leaves are oblong to oblong-lanceolate, measuring 10–17 × 3–6 cm, with rounded to subcordate bases and obtuse to emarginate apices. The inflorescences are axillary, few-flowered panicles borne on short pedicels. The flowers are small, greyish-yellow to pinkish-white in colour. The fruits are ovoid to oblong, approximately 2.5 × 1.5 cm, and are characterized by persistent, enlarged calyx lobes. Flowering and fruiting occur from October to January. The species is locally known as “Eeyakam” or “Karapongu”. Its wood is hard, durable, and highly valued for its strength and longevity.

Hopea erosa is currently classified as Critically Endangered [CR C2a(i)] under the IUCN Red List Categories and Criteria (Version 3.1) (IUCN, 2021) [1]. Its global population is estimated to comprise fewer than 250 mature individuals distributed across 17 locations in the southern Western Ghats of India with fewer than 50 mature individuals per subpopulation, spanning the states of Kerala, Tamil Nadu, and Karnataka. The population is undergoing a continuing decline because of habitat degradation and a reduction in its area of occupancy. Furthermore, poor natural regeneration and low recruitment rates pose additional threats to the long-term survival of the species in its natural habitats.

A one-year-old seedling of *Hopea erosa*, collected in 2015 from Shenduruney Wildlife Sanctuary, Kollam District, Kerala, was established and maintained in the Threatened Species Park of Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI), as a part of its *ex situ* conservation programme. To facilitate its multiplication and strengthen conservation efforts, approach grafting was performed during 2023–2024 using seedlings of *Hopea indica* (RAF.) R.Kr. Singh and *H. ponga* (Dennst.) Mabb. as rootstocks**.** These closely related dipterocarp species, both endemic to the Western Ghats, were selected for evaluate the feasibility of interspecific grafting as a propagation technique for producing clonal planting material of *H. erosa.*

Materials and Methods

Interspecific approach grafting experiments on *Hopea erosa* were conducted at Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) during June–September 2023 and January–April 2024. Seedlings of *Hopea indica* and *H. ponga*, of 8–10 months, with a height of 50–70 cm and a stem diameter of 0.4–0.6 cm. were used as rootstocks. The rootstocks were raised in polybags containing a potting mixture of soil, sand and farmyard manure in a 1:1:1 ratio and maintained under nursery conditions until grafting.

For approach grafting, healthy branches approximately 8–10 months old were selected from the single *H. erosa* plant maintained in the Threatened Species Park, JNTBGRI. The polybag grown rootstock plants were firmly secured to the selected branches to facilitate the grafting process. A longitudinal cut, 5–6 cm long and 0.5–0.8 cm wide, was made on one side of each branch, 25–70 cm below the shoot apex, to expose the cambium layer. A corresponding longitudinal incision of equal size was made on the rootstock stem, approximately 8–10 cm above the soil level, ensuring maximum contact between cambium layers of both the scion and rootstock. The cuts surfaces were carefully aligned and tightly secured with a strip of plastic (approximately 30 cm x 1–1.5 cm) (Fig. 1). Owing to the limited number of branches suitable for grafting in the donor plant, only 10 seedlings of each rootstock species were used in the experiment during the first year. This experiment was repeated in the following year using the same procedure and same number of root stock species. The grafted seedlings were watered daily except on rainy days.

Fig 1: Approach grafting of Hopea erosa onto H. ponga root stock

Approximately one month after grafting, shallow V-shaped cuts were made below the graft union on the scion and above the graft union on the rootstock at monthly intervals to gradually weaken their physiological connection with each other. After 90 days of grafting, the upper portion of the rootstock above the graft union was completely removed. In every trial, the scion was completely detached from the donor plant within 110 days after grafting process by severing the rootstock above the graft union and the scion below the graft union. These plants were then kept in shade for a few weeks following their detachment. Any shoots emerging from the base of the rootstocks were removed periodically throughout the study period.

Results and Discussion

Interspecific approach grafting of *Hopea erosa* onto *H. indica* (Fig. 2 & 3) and *H. ponga* (Fig. 4) was highly successful, achieving a 100% graft success rate, thus demonstrating the effectiveness of this method for clonal propagation. Both rootstocks proved equally well in performance and therefore found suitable for the propagation of *H. erosa* as part of *ex situ* conservation and ecological restoration initiatives. All 40 grafted plants survived and successfully produced new shoots during the subsequent flushing period (June – August), indicating the successful formation of functional graft union between the plant species. The results further indicate that *H. indica* and *H. ponga* can be considered as an appropriate rootstock for *H. erosa* grafting and 110-days are sufficient for both grafting and detaching.

Fig 2: Successful graft of Hopea erosa onto H. indica root stock

Fig 3: Successful graft of Hopea erosa showing new outgrowth from the root stock of Hopea indica

Fig 4: Successful graft of Hopea erosa onto H. ponga root stock

Approach grafting involves joining two independently rooted plants by bringing their stems into close contact until a functional vascular connection is formed. Once the graft union is established successfully, the scion is severed from its original root system and continues to grow on the newly established rootstock. The success of grafting depends on several factors, the most important being the compatibility between the scion and rootstock. Although grafting is generally more successful between closely related species, not all members of the same genus are mutually compatible. The interspecific grafting of *Hopea erosa* onto *H. indica* and *H. ponga* demonstrated a high degree of compatibility among the three species, resulting in successful graft union formation, stable vascular connections, and long-term survival of the grafts. These findings are consistent with previous reports of successful interspecific grafting in threatened and economically important tree species. Similar grafting compatibility has been reported in *Garcinia indica*

grafted onto *G. tinctoria*, *G. hombroniana*, and *G. cowa* (Mathew *et al*., 2004) [2], and in *G. mangostana* grafted onto *G. hombroniana* (John *et al.*, 2008) [3]. Successful interspecific grafting has also been documented in other genera, including *Manilkara zapota* grafted onto *M. hexandra* and *M. kauki* (Sulladmath & Reddy, 1985) [4], and *Coffea arabica* onto *C. canephora* (Koutouleas *et al*., 2004) [5]. Conservation-oriented grafting studies have proved successful establishment of *Garcinia wightii* onto *G. hombroniana* (Shareef, 2012) [6] and *Ixora polyantha* onto *I. finlaysoniana* (Shareef & Mathew, 2011) [7]. Likewise, successful grafting of the endangered *Sophora toromiro* (Phil.) Skottsb. onto *S. cassioides* (Phil.) Sparre has been reported by Espejo *et al*. (2013) [8]. More recent studies have documented successful interspecific grafting in *Pinus*, including *P. rzedowskii* onto *P. pinceana* (Solorio-Barragán *et al*., 2021) [9] and *P. patula* onto *P. teocote* (González-Jiménez *et al*., 2024) [10]. Similarly, Shareef *et al.* (2025) [11] reported the successful grafting of *Madhuca diplostemon*, a Critically Endangered species endemic to Kerala, onto *M. neriifolia*. Collectively, these studies demonstrate the broad applicability of interspecific grafting as an effective strategy for the clonal propagation, *ex situ* conservation, and recovery of threatened and difficult-to-propagate plant species.

Conclusion

This study demonstrates that interspecific approach grafting is an effective propagation technique for Critically Endangered *Hopea erosa*. The 100% graft achieved using both *H. indica* and *H. ponga* indicates their graft compatibility and successful establishment of graft unions. This method provides a practical approach for the rapid multiplication of genetically uniform planting material, thereby supporting the *ex situ* conservation, population recovery, and ecological restoration of *H. erosa*. Although both rootstock species were equally effective, *H. indica* is the preferred rootstock owing to its wider distribution and greater availability, whereas *H. ponga* is itself a threatened species with a more restricted geographic range.

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