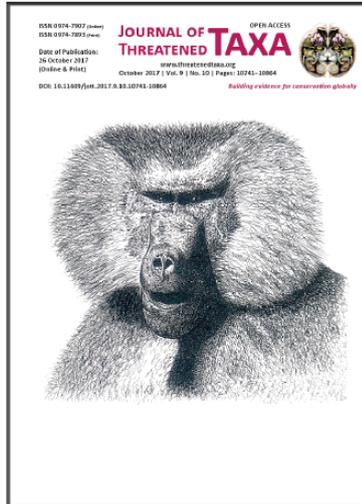


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## FEASIBILITY STUDY ON THE VEGETATIVE PROPAGATION OF FOUR ENDEMIC RARE BALSAMS (*IMPATIENS* SPP.) THROUGH STEM CUTTINGS FOR CONSERVATION AND MANAGEMENT IN IDUKKI DISTRICT, KERALA, INDIA

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**Abstract:** Ex situ conservation by vegetative propagation was successfully established in the endemic rare balsam species *Impatiens anaimudica*, *I. elegans*, *I. disotis* and *I. phoenicea* of the Western Ghats. The experiment was done in an open environmental nursery at Munnar exposed to constant temperature (7–24 °C) and relative humidity (70–100 %) throughout the study period. These favourable conditions provided a suitable platform for the establishment. We observed a significant difference in the regeneration patterns of the four species. *I. elegans* started to regenerate after the 10<sup>th</sup> day of planting with high success, while *I. disotis* showed a 30% success rate. After maturation all species were transplanted to natural ecosystems.

**Keywords:** Ex situ, *Impatiens*, regeneration pattern, vegetative propagation.

India is a rich source of plant biodiversity, but many species and their associated ecosystems are in urgent need of conservation. Conservation involves protecting natural communities, and in some cases regenerating endangered populations by raising individuals for return to source ecosystems. In some plants, asexual propagation can facilitate more rapid multiplication than sexual reproduction (Bonga 1982). In vitro propagation of *Impatiens* species has been reported (Han & Stephen 1987), but this technique is expensive and pollination

studies of *Impatiens* have revealed a low percentage of seed germination compared to other conventional techniques (Sreekala et al. 2011; Ramasubbu et al. 2011). In contrast, vegetative propagation is relatively simple and cost effective. Lopez & Runkle (2008) reported that photosynthetic day light integral (DLI) treatment during propagation influences rooting, biomass accumulation and subsequent growth and development of vegetatively propagated herbaceous ornamental cuttings, and conditions for successful vegetative propagation of *Impatiens hawkeri* using a supplemental light source have recently been reported (Currey & Lopez 2013).

The genus *Impatiens* (Balsaminaceae) is represented by ca. 1,000 species distributed in tropical and north temperate regions of India, China, Africa, America and Europe. Approximately, 210 species are known from India, mainly concentrated in two hotspots of balsam diversity, the Himalaya and Western Ghats (Pusalkar & Singh 2010). Of the 169 *Impatiens* species endemic to India (Singh et al. 2015), 106 are endemic to the Western Ghats (Bhaskar 2012) including 30 scapigerous species (Bhaskar 2006; Prabhu et al. 2014). According to the recent assessment by Bhaskar (2012), of the 106 species

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of *Impatiens* in South India and 13 varieties, nearly 90 taxa are endangered, with 37 species (including varieties) assessed as Critically Endangered, 36 as Endangered and 17 as Vulnerable. Kerala part of the Western Ghats is blessed with rich diversity of endemic balsams, so far 80 taxa have been reported from here (Prabhukumar et al. 2014; Hareesh et al. 2015). In Kerala, balsams are mainly distributed in four districts: Idukki, Palakkad, Wayanad and Thiruvananthapuram. More than 58 species are reported from Idukki District, 34 in Palakkad District and four from Alappuzha District, including three cultivated species (Prabhukumar 2015).

Four endemic balsam species were considered for vegetative propagation in this study:

**1. *Impatiens anaimudica* C.E.C. Fisch. (Image 1a)**

Habit: Herb

Habitat: Moist shady places on the shola forest margins and stream banks

Red List Status: Not Evaluated

Endemism: Southern Western Ghats of Kerala (Idukki District)

Flowering and fruiting: June to December; noted up to February during the study.

**2. *Impatiens elegans* Bedd. (Image 1b)**

Habit: Herb

Habitat: Shola forests

Red List Status: Not Evaluated

Endemism: Southern Western Ghats of Kerala and Tamil Nadu

Flowering and fruiting: Throughout the year during the study

**3. *Impatiens disotis* Hook.f. (Image 1c)**

Habit: Herb

Habitat: Grassland

Red List Status: Not Evaluated

Endemism: Southern Western Ghats of Kerala and Tamil Nadu

Flowering and fruiting: August to October.

**4. *Impatiens phoenicea* Bedd. (Image 1d)**

Habit: Herb

Habitat: Shola forests

Red List Status: Not Evaluated

Endemic: India; Western Ghats of Kerala and Tamil Nadu

Flowering and fruiting: September to October, noted up to November during study.

Exploration of the habitat in the study area and surroundings was done with the help of tea estate management, local tribes and forest labourers, since

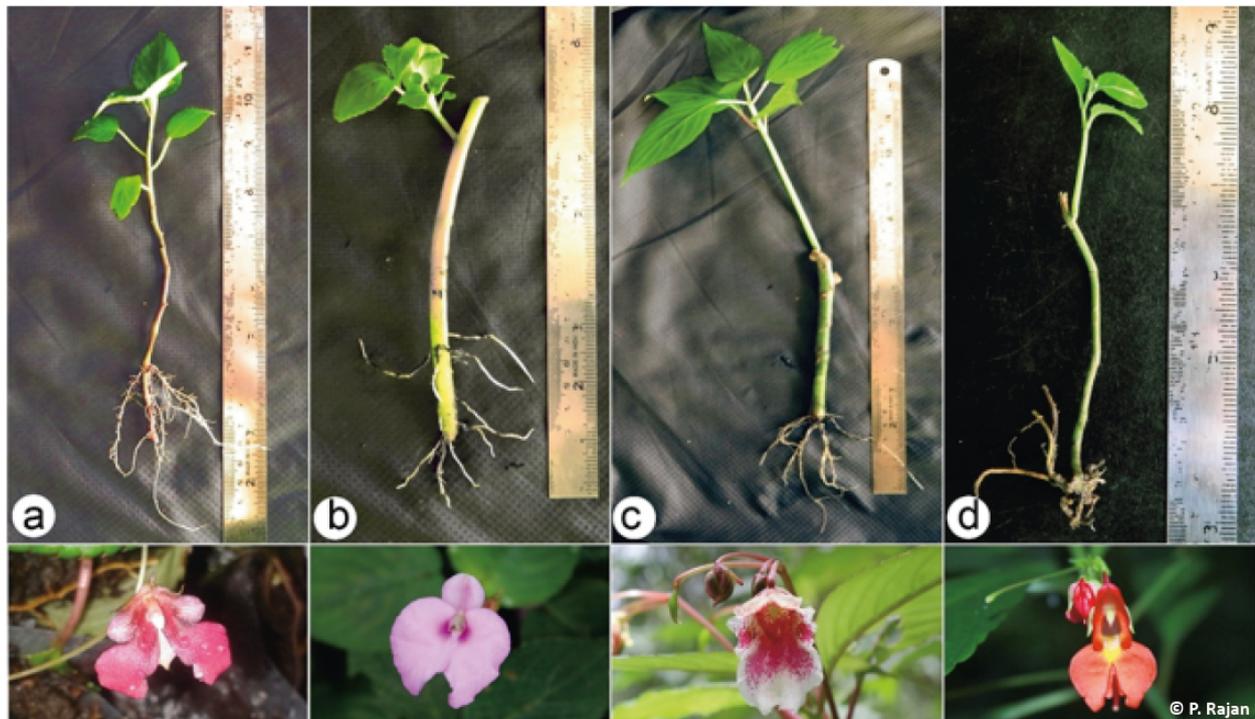


Image 1. Root and leaf formation in the selected four Balsams: a - *I. anaimudica*; b - *I. elegans*; c - *I. disotis*; d - *I. phoenicea*

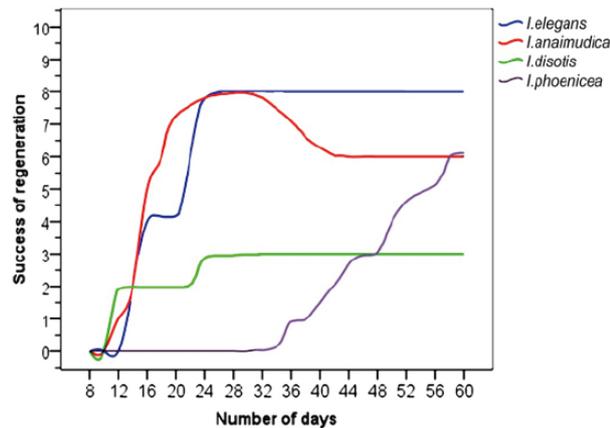


Figure 1. Regeneration pattern of the four *Impatiens* species in the ex situ condition



Image 2. Restoration efforts after successful propagation of *Impatiens* in ex situ condition

one aim of the study was to involve local people in the conservation effort. Field surveys and collection of specimens for ex situ vegetative propagation were done systematically. Prevailing weather parameters were also recorded. Herbaceous stem cuttings are softwood cuttings/semi hard wood cuttings made from non-woody plants (Tara 2009), and in this study vegetative propagation of balsams was done using soft wood stem cuttings of about 15cm harvested from the study area. 10 replicate cuttings from each species were collected into polythene bags. Locally available forest soil was used as cultivation medium, and each shoot explant was considered to be a single replicate. Shoots were kept under open environmental conditions in the nursery, with natural shaded daylight cycle and temperature, and they were mist irrigated with water as required. Diseases, pests and weeds were managed with proper weeding and culling practices to support plant growth. Weather parameters were also recorded. Under favourable conditions plants produced new buds and roots, and the regeneration success of each species was monitored for up to 60 days. Appropriate statistical tests were used to establish regeneration patterns.

## RESULTS

Monitoring of daily weather parameters during the 60 day study period showed that temperature ranged from a minimum of 7°C (during October) to a maximum of 24°C, with an average of 18°C. While relative humidity showed daily fluctuations the average remained high throughout the study, ranging from 65–100%. Thus the weather parameters of the ex situ environment were similar to those of the Shola forests where these species grow in the wild.

The species showed different regeneration patterns

(Fig. 1). All but *I. phoenicea* showed budding within 10 days of planting, and *I. elegans* was the most successful regenerator, with *I. anaimudica* and *I. phoenicea* reaching 60% success by the end of the study. *I. disotis* showed the lowest success rate at 30%, and this does not appear to have been linked to a slow budding rate as was observed for *I. phoenicea*.

## DISCUSSION

Vegetative propagation is an important tool in the conservation of rare and threatened plant species, which has been used to successfully propagate and restore over 80 species of endangered plants (Sugii & Lamoureux 1998). The four species studied here from the sholas of Munnar are endemic to the Western Ghats, and some are found only in narrow strips of protected forest. They require site-specific conservation and their habitat needs must be declared accordingly. Three species are threatened based on relevant literature (Bhaskar 2012; Sasidharan 2013), although they are not assessed as per the IUCN Red List of Threatened Species. *Impatiens elegans* is widely distributed in the outskirts of Eravikulam National Park and inside Pampadum Shola National Park, Mathikettan Shola National Park and Anamudi Shola National Park. Its status needs to be ascertained critically, keeping in mind conservation status.

Samanth et al. (2007) reported that vegetative propagation in artificial conditions is useful in ensuring long term germ-plasm conservation/ex situ conservation. In this study ex situ weather conditions were a significant factor in the successful regeneration of all four endemic balsams, and all propagated plants were successfully replanted in natural ecosystems (Image 2). These observations are informative for future conservation

efforts by the High Range Environment and Wildlife Protection Association (HREWPA), local NGOs and the forest department. Since the techniques involved are simple and planting media is locally available, tea plantation workers, eco development committee members, forest watchers and others can participate in conserving these species in their local habitat.

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