

First report of *Dendrophthoe falcata* (L. F.) Ettingshon important Agroforestry species: *Populus deltoidea* and *Melia dubia*

Abstract

This study reports the first documented instance of *Dendrophthoe falcata* (L. f.) Ettingsh., a parasitic plant, infecting *Populus deltoidea* and *Melia dubia*, two economically valuable agroforestry tree species. Infected trees in both species exhibited a reduction in the size and growth of secondary branches, culminating in top drying and mortality due to crown gall formation on primary branches. The knowledge regarding the control of *Dendrophthoe* in timber species is limited with mechanical weeding by pruning affected branches on host trees being the common practice. Chemical control is ineffective and unfamiliar to farmers. Further research is essential to understand *Dendrophthoe*'s distribution, host specificity, and dispersal mechanisms to protect valuable agroforestry species like Poplar and Melia from its detrimental effects.

Keywords: Giant mistletoe, Poplar, Melia, timber, farmers.

Introduction

India is home to seven of the approximately 30 species of *Dendrophthoe*, with *Dendrophthoe falcata* (L.f.) Etting. var. *falcata* being one of them [1, 2]. A hemiparasitic plant belonging to the Loranthaceae family, *D. falcata* thrives on the shoots or stems of angiosperm plant hosts. Commonly known as "Loranth" or "Giant Mistletoe" in English and "Banda" in Hindi [3], this species has two main varieties: *D. falcata* var. *coccinea* (red flowers) and *D. falcata* var. *falcata* (greenish-white flowers). This is an evergreen, shrubby, partial parasite widespread in tropical and subtropical regions globally.

This genus is chiefly hemiparasitic shrub with opposite or subopposite and pinnately veined leaves, and axillary or terminal inflorescences with sessile spikes. The flowers are bisexual or unisexual (dioecious plants), 5- or 6-merous, actinomorphic. The inflorescence is an axillary or sometimes terminal raceme or spike. Calyx is usually persistent. The corolla, which can be greenish, yellowish, or white, has free petals that are small and shorter than 10 mm. Stamens are inserted on the petals. The ovary is 1-locular, the style lacks articulation, and the stigma is capitate. The fruit is an ovoid or subglobose berry. Each berry contains the embryo, the endosperm and a mucilaginous viscin, that consists of cellulose in a mixture of acidic and neutral polysaccharides [4-5]. The fruit is a berry, usually ovate [6]. Chromosome number has been reported as $2n=18$ [7]. The chromosome number has been reported as $2n=18$.

The plant species *D. falcata* are typically ornithophilous [2]. Seed dispersal also occurs through birds. The seeds, present in bird fecal matter, attach to branches with the help of a non-digestive gummy mucilage surrounding the seed. This mucilage aids in securing the seeds to the host branches, where they subsequently germinate in the bark.

D. falcata has been used in traditional medicine for its diverse therapeutic properties, including antimicrobial, antidiabetic, antioxidant, anticancer, antilithiatic, antihypertensive, and antiviral effects [8]. Among various species, *D. falcata* is extensively studied and utilized to treat a wide range of conditions such as skin disorders, pulmonary tuberculosis, psychic disorders, asthma, paralysis, ulcers, menstrual disorders, and wounds. It is also consumed as a health food to enhance immunity and is used as a pain reliever, aphrodisiac, narcotic, and diuretic [9-11].

As a partial parasite, *D. falcata* cannot thrive in soil without a host. Notably, this species is considered a potential pest due to the significant damage it inflicts on various economically valuable plants. By forming connections with its host, the parasite obtains water and mineral

nutrients. Specifically, *D. falcata* is a common phanerogamic plant parasite, frequently targeting fruit and forest trees. Seeds of *D. falcata* germinate primarily forming a massive haustorium. However, successful establishment is depends upon the haustorium penetrating the host tissue, determining its ultimate fate [18].

D. falcata attacks a diverse array of tree species, including medicinal, ornamental, horticultural, and economically valuable forest trees [12]. It exhibits a broad host range, with widespread distribution across various geographical locations in the country [13]. Notably, as many as 343 host species have been reported in India alone. Previous studies have documented significant host ranges in specific regions, including 98 hosts in Karnataka, India [13], 55 hosts at Jahangirnagar University campus, Savar, Bangladesh, and 50 hosts in Rajshahi city, Bangladesh [14]. In the central region of India, *D. falcata* is frequently observed on *Madhucalatifolia* L. Despite its broad host range, it exhibits a striking specificity, exclusively targeting dicotyledonous plants. Monocots are conspicuously absent from the recorded host list, while only one gymnosperm host, *Pinus longifolia* Roxb., has been reported [15].

One of the characteristic features is its non-specificity in the selection of host plants [15-18]. It readily infects a wide variety of common trees throughout India, including neem (*Azadirachta indica*), mango (*Mangifera indica*), guava (*Psidium guajava*), sugar apple (*Annona squamosa*), and others. *D. falcata* predominantly infects mango trees, with a staggering 60-90% infection rate observed in northern India. A study at Banaras Hindu University (BHU) main campus found mango trees to be the most preferred host of *D. falcata* (Singh, 2017) [19]. However, it has been reported to have increased its host range and found growing on varieties of trees [2]. It rarely associates with tropical timbers trees barring *Bombax ceiba*, *Bauhinia purpurea*, *Cassia fistula*, *Casuarina equisetifolia*, *Eucalyptus globules*

and *Pterospermum acerifolium*. Therefore, the present report of its incidence on *Populus deltoides* and *Melia dubia*, two economically valuable agroforestry tree species highlight the need for immediate attention and management.

Materials and method

An investigation on the growth and health of agroforestry demonstration plantations was conducted at Prayagraj, Uttar Pradesh, India (25°32'42.3"N, 81°53'28.3"E, elevation 86.7 m above mean sea level). The plantations featured *Populus deltoides*, *Melia dubia*, *Eucalyptus tereticornis*, *Gmelina arborea* and *Tectona grandis*. Any infestation of insects and pests in individual trees was carefully recorded through visual inspection in three plantations of all species. The age of these plantations ranged from 6-9 years. Infested samples were collected during January and May 2024 and subsequently identified.

Results and discussion

Among the plantations of the five species, *D. falcata* infestations were detected in only two instances: one plantation of *Populus deltoides* (year of establishment 2018) and one plantation of *Melia dubia* (year of establishment 2016). However, it is notable that these tree species have not been reported previously as host for *D. falcata*. Poplar and Melia trees are extensively cultivated in Punjab, Haryana, Uttar Pradesh, and several other states, particularly under agroforestry systems for their fast growth ensuring high economic returns to the farmers in a short rotation. Therefore, the present finding expands the known host range of *D. falcata*, underscoring the need for revised management strategies to mitigate potential adverse impacts on productivity of these valuable cash crops.

Although the selection of host plants is entirely at random, experimental evidence indicates that this parasite has its own spectrum of hosts controlled by some factors one of which seems to be osmotic pressure relationships between the host and the parasite. *D. falcata* predominantly grows on the top of the host canopy to conduct photosynthesis [20]. The parasite is easily spotted on the branches of host trees as a dense cluster of small twigs bearing smooth, broad leaves and long, tubular, orange-colored flowers with red berries [21-23]. *D. falcata* causes reduced vigor, growth rates, poor fruit yield, and top drying in its hosts, predisposing them to insect infestations and other diseases, ultimately resulting in the death of the host trees [12]. The parasite significantly impedes growth of the host trees [23-24] and its infestation has been shown to be lethal [25-26]. A similar pattern was observed in Poplar and Melia trees under the present study. Infected Poplar and Melia trees exhibited a reduction in size, number of leaves, and growth of secondary branches, eventually leading to top drying and the death of the tree. Unlike healthy Poplar trees, which typically shed leaves from November to February, the infected tree exhibited stunted growth compared to other Poplar and Melia trees.

These parasites establish a harmful relationship with the host's vascular system siphoning essential nutrients, minerals and water. By encroaching on the host, they also block sunlight, further compromising tree health. Poplar propagation is typically carried out by stem planting, but if the stem is infected, its cultivation will be affected. Consequently, *D. falcata* emergence poses a severe threat to Poplar cultivars.

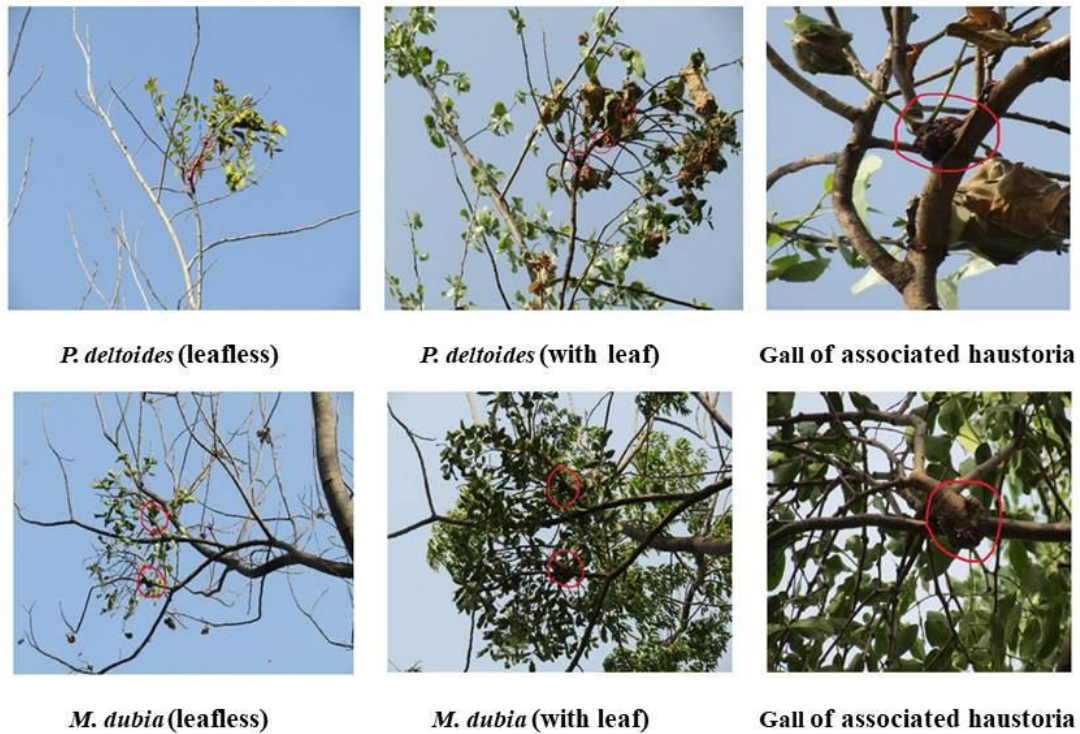


Fig 1: Infected poplar and meli trees

This semi-parasitic plant has not garnered much attention from botanists or the general public because it primarily infects woody plants, which do not hold the same economic significance as cereal and pulse-yielding plants [13]. Certain agricultural practices in mango orchards have been recommended to control bird pollination, pollen development, and seed dispersal of *D. falcata* [2]. However, there is a lack of knowledge regarding the control of *Dendrophthoe* in timber species. The common practice is mechanical weeding, which involves cutting or pruning the affected branches on host trees. Chemical weeding is neither effective nor widely known among farmers. Therefore, to protect timber trees from infection, we can rely on cutting or pruning, which controls *D. falcata* infestation. Further research is essential

to understand *Dendrophthoe*'s distribution, host specificity, and dispersal mechanisms to protect valuable agroforestry species like Poplar and Melia from its detrimental effects.

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