A comprehensive review on *Dendrophthoe falcata* (L.f.) Ettingsh. (Loranthaceae)

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**Abstract:** The plant species belong to the family Loranthaceae (mistletoe family) are hemiparasites. *Dendrophthoe falcata* is a large bushy evergreen stem hemiparasite. It can capture food from the host trees by means of penetrating roots called the haustoria. This epiphytic parasite found generally on various host plants in large amounts worldwide and causes much damage to economical cultivated plants and also grown on different host plants throughout India. As hemiparasite it is associated with tropical trees specifically the mango trees and rarely few timbers yielding trees. It has been reported to have increased its host range and found growing on varieties of trees. The species of *Dendrophthoe falcata* commonly known as *Loranthus* are common parasitic flowering plants occur all over India and cause severe damage to the field crops. However, comprehensive reports on the occurrence of this parasite, host range, effect on crop production, management practices are not available in the country. Under these circumstances the present study was undertaken to identify the species of *Loranthus* attacking a fruit yielding crop mango (*Mangifera indica*) cultivated in and around Vizianagram District, Andhra Pradesh to observe their parasitic relationship with their host plants.

**Keywords:** *Dendrophthoe falcata* - *Mangifera indica* - Hemiparasite - Bird pollination.

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**INTRODUCTION**

Phanerogamic plant parasites are destructive pests of several economically important fruit trees such as mango and of several field crops such as mustard, legumes, tobacco, berseeem, lucerne etc. Among important families containing parasitic species are Loranthaceae, Orobanchaceae, Convolulaceae, Scrophulariaceae, Lauraceae, Santalaceae and Balanophoraceae. These parasites damage the plants through exhaustion of nutrients and sometimes through restriction of growth of the plant. Some of them produce toxins also. The parasitic angiosperms produce seeds that are dispersed by wind, bird and other animals and also through soil. The parasitic flowering plants can be halo or partial parasites of stem and roots. *Cuscuta* is a halo - parasite of stem while *Orobanche* is halo-parasite of roots. *Striga* is a semi-parasite of roots while *Dendrophthoe falcata* (L.f.) Ettingsh. (Loranthaceae) is a semi-parasite of stems. The semi-parasites possess leaves and synthesize the carbohydrate portion of their food. These parasites establish relationship with host vascular elements to draw nutrients (Singh 2002). *Dendrophthoe falcata* (Loranthaceae) is a hemiparasite associated with tropical trees specifically the mango tree and rarely few timbers yielding trees. Loranthaceae is the largest family of Santalales with 73 genera and 900 species. It is also called the “Showy Mistletoes” due to the often specular bright red and yellow flowers which can be more than 20 cm long. The evergreen parasitic species of various families such as Loranthaceae, Eremolepidaceae and Viscaceae are commonly called as “Mistletoes”. Loranthaceae family is the well-known family of the parasitic plants that included genus like *Viscum* and *Dendrophthoe* (Loranthus).

**TAXONOMICAL DESCRIPTION**

The plant is a partial stem-parasite (hemiparasite). Taxonomically, it is a large bushy shrub, dichotomously
branched, perennial, partial stem parasite, glabrous with grey-smooth bark, having twiggy and woody branches. Leaves thick, sub-sessile, coriaceous, elliptic ovate to oblanceolate, mostly opposite, obtuse, sometimes acute, entire, slightly shining, variable in size and shape, midrib prominent, usually red with attenuated base; Flowers whitish-yellow, red, orange-red or yellowish red and sometimes pink, 5–15 cm. long, axillary to supra-axillary, unilateral spikes with persistent bract. Calyculus 4 mm. long, glabrous and persistent with 4–5 lobes, stamens 5, filament approximately 3–5 mm. long or even upto corolla and epipetalous, glabrous; Style 2.5–3.5 cm. long with capitate stigma; Fruit berries 7–11 mm. long, bright red, globose to ovoid-oblong; seeds minute and oblong (Cooke 1908, Shah 1978, Bole & Pathak 1988, Shetty & Singh 1991).

**Classification**

| Kingdom        | Plantae                                      |
|----------------|----------------------------------------------|
| Phylum         | Tracheophyta                                 |
| Class          | Magnoliopsida                                |
| Order          | Santalales                                   |
| Family         | Loranthaceae                                 |
| Genus          | Dendrophthoe                                 |
| Species        | falcata                                      |

**Botanical name**: Dendrophthoe falcata (L.f.) Etting.

**Common names**: Banda, Banda Patha (Hindi); Vrksadani, Vriksharohini, Vrikshabhak, Bandaka, Vanda (Sanskrit); Vanda, Bandgul (Marathi); Pulluri, Pulluruvi, Uchi (Tamil); Ittiikkanni (Malayalam); Maduk, Badanike (Kannada); Bemdram (Konkani); Vando (Gujarati); Raghumala (Assamese); Jiddu, Yelinga, Badanika, Bajinika, Vajinika, Velagabadanika (Telugu).

**DISTRIBUTION**

Loranthaceae as a family of Santalales comprises about 73 genera and 900 species (Russell & Nickrent 2008, APG III 2009). Once upon a time there are 450–500 species Loranthus existed; but most of the historic species have been transferred to other genera and only 10 species of Loranthus are currently available (Nickrent et al. 2010). D. falcata also known as Loranthus longiflorus Desr., is a perennial climbing woody parasitic plant. It is indigenous to tropical regions especially in India, Sri Lanka, Thailand, China, Australia, Bangladesh, Malaysia and Myanmar. Loranthus species are serious parasites of a large variety of economic plants, both angiosperms and gymnosperms. At present Loranthus spp., are destructive to economic plants in many parts of the world. D. falcata is a large bushy parasitic plant that grows on a variety of host plants in deciduous forests throughout India. The worldwide distribution of Loranthaceae was divided into seven geographical areas: Africa, South America, Asia, Malaysia east of Wallace’s line (New Guinea), Malaysia west of Wallace’s line, Australia and New Zealand (Russell & Nickrent 2007).

**Dendrophthoe falcata in India**

*Dendrophthoe falcata* is known as ‘Vanda’ in the Indian Ayurvedic System of Medicine. There are about thirty species of *Dendrophthoe* and seven species are found in India (Sampathkumar & Selvaraj 1981). It has been used in traditional medicine and found to have antimicrobial, anti-diabetic, antioxidant, anticancer, antilithiatic, hypertensive and antiviral properties (Daud et al. 2005). Among different species, *D. falcata* is largely studied and is used to control a wide variety of diseases such as skin disorder, pulmonary tuberculosis, psychic disorders, asthma, paralysis, ulcers, menstrual disorders and wounds. They are used as health food for enhancing immunity and used as a pain reliever, aphrodisiac, narcotic and diuretic (Sastry 1952, Pattanayak & Sunita 2008, Pattanayak et al. 2008). Since time immemorial, many species of *Loranthus* have been used medicinally by the Brazilians. The leaves of *Loranthus rotundifolius* Engl. cooked in milk have been used to cure chest diseases (Maout et al. 1876). A total of 20 different species of the genus *Dendrophthoe* found all over the world, among them seven species are widely spread in India. The hemiparasite *Dendrophthoe falcata* (L.f.) Etting. var. *falcate* (Loranthaceae) is one of the seven species present in India (Fig 1). Hemiparasites have the parasitic relationship with more than 300 host plants (Sampathkumar & Selvaraj 1981). They are also known as potential pests, due to the severe damage which they cause to many economically important plants.

**POLLINATION**

The plant species *D. falcata* are typically Ornithophilous (pollinated by birds). The seed dispersal is by birds,
mainly “Flowerpeckers”. The seeds in the bird faecal matter get attached to the branches with the help of non
digestive gummy mucilage around the seed. Thus it gets the attachment on the host branches and germinates in
the bark. The plant is a partial parasite and cannot be grown in soil. Mostly *D. falcata* prefers to grow only on
top of the canopy of host.

**Figure 1.** Two varieties of hemiparasite *Dendrophthoe falcata* (L.f.) Ettingsh. infecting *Mangifera indica* L.: A, *Dendrophthoe falcata* var. *falcate*; B, *Dendrophthoe falcata* var. *coccinea*.

**HOST RANGE**

**Figure 2.** Parasite interaction of *Dendrophthoe falcata* (L.f.) Ettingsh. on its host plant *Mangifera indica* L.: A&B, Development of woody, round abnormal structures on host; C, Interaction between haustorial roots and host tissue; D, Development of new branches of *Loranthus* on woodrose.

The parasitic plants *Loranthus* can grow abundantly on the branches of woody trees such as mango (Fig 2). It belongs to the family Loranthaceae (Watson & Dallwitz 1992). Its common name in English is “Loraths” or
“Giant Mistletoe”, in Hindi “Banda” (Singh 1996). Loranthus plant is hemiparasite. It is parasitic under natural conditions and is also photosynthetic. The parasite obtains water and mineral nutrients from the host plant. It is a common angiosperm parasite of fruit and forest trees (Phanerogamic plant parasite). The most common host is the mango tree, and in northern India 60–90% of the mango trees are infected by the parasite. As many as 343 hosts have been listed in India, which included all the common horticultural and forest trees (Table 1). In the central part of India the most common host is Madhuca latifolia L. The parasite can be easily spotted on the branches of host trees as a dense cluster of small twigs bearing smooth broad leaves and long, tubular, orange coloured flowers with red berries (Johri & Bhatnagar 1972, Watson & Dallwitz 1992, Mehrotra & Aggarwal 2004). There are two common varieties of D. falcata, the plant with red flowers used to be called D. falcata var. coccinea and the plant with greenish white flowers used to be called D. falcata var. falcata.

Table 1. Different host plants parasitized by Dendrophthoe falcata (L.f.) Ettingsh. in India and their economic importance.

| Scientific name | Common name | Family | Economic value |
|-----------------|-------------|--------|----------------|
| Acacia auriculiformis | Northern Black Wattle | Fabaceae | Ornamental plant |
| Acacia chundra (Willd.) | Red kutch | Fabaceae | Medicinal plant |
| Acacia concinna (Willd.) DC. | Shikakai, Soap-pod | Fabaceae | Medicinal plant |
| Aegle marmelos (L.) Correa | Bale tree, Indian bael, stone apple | Rutaceae | Fruit tree |
| Ailanthus excelsa Roxb. | Indian Tree of Heaven | Simaroubaceae | Medicinal plant |
| Albizia lebbeck (L.) | Krishna Siris, Oil cake tree | Fabaceae | Medicinal plant |
| Albizia procera | White siris | Fabaceae | Medicinal plant |
| Anogeissus latifolia (DC.) Wallace ex Guill. & Perr. | Axele wood | Combretaceae | Tanning and firewood. |
| Artocarpus integrifolia L.f. | Jack fruit | Moraceae | Fruit tree |
| Azadirachta indica A.Juss. | Neem, Indian lilac | Meliaceae | Medicinal plant |
| Bauhinia purpurea | Butterfly tree, Pink butterfly tree | Fabaceae | Ornamental plant |
| Bauhinia recemosa Lam. | Bidi leaf tree, The Sonpatta Tree | Fabaceae | Medicinal plant |
| Bauhinia variegata L. | Kachnar, Orchid tree | Fabaceae | Medicinal plant |
| Bombax ceiba L. | Silk Cotton Tree, Kapok Tree | Bombaceae | fodder, fuel, fiber and medicine |
| Bridelia scandens (Roxb.) Wildl. | Climbing bridelia | Phyllanthaceae | Medicinal plant |
| Canthium dicoccum (Gaerth.) Merr. | Ceylon boxwood | Rubiaceae | Medicinal plant |
| Careya arborea L. | Wild Guava, Ceylon Oak, Patina Oak | Lecythidaceae | Medicinal plant |
| Cassia fistula L. | Golden Shower, Indian Laburnum | Fabaceae | Medicinal plant |
| Cassia montana Heyne ex Roth. | Mountain cassia | Fabaceae | Medicinal plant |
| Cassia siamea Lam. | Kassod tree | Fabaceae | Ornamental and wood |
| Casuarina equisetifolia L. | Australian pine tree | Casuarinaceae | Ornamental and wood |
| Catunaregam spinosa (Thunb.) Tirveng. | Emetic nut | Rubiaceae | Fruit tree |
| Cedrela toona Roxb.ex Rottl. & Willd. | Indian mahogany, Red cedar | Meliaceae | Soft wood |
| Ceiba pentandra (L.) Gaertn. | Kapok, ceiba, white silk-cotton tree | Malvaceae | Fibre and Medicine |
| Citrus medica L. | Citron | Rutaceae | Fruit tree |
| Cordia dichotoma G.Forst. | Indian cherry, clammy cherry | Boraginaceae | Fruit tree |
| Dalbergia latifolia Roxb. | Black Rosewood, Indian rosewood | Fabaceae | Wood |
| Dalbergia paniculata Roxb. | Takoli | Fabaceae | Ornamental and medicinal |
| Dalbergia sissoo Roxb. | North Indian rosewood | Fabaceae | Timber/Wood |
| Delonix regia (Boj. ex Hook.) Raf. | Flame of the forest | Fabaceae | Ornamental and medicinal |
| Derris indica (Lam.) Benn. | Indian beech | Fabaceae | Ornamental and |
| Scientific Name                        | Common Name                   | Family           | Description                      |
|----------------------------------------|-------------------------------|------------------|----------------------------------|
| *Elaeodendron glaucum* (Rottb.) Pers.  | Ceylon Tea                    | Celastraceae     | Medicinal plant                  |
| *Enteroxylon sama* (Jacq.) Prain       | Rain tree, coco tamarind      | Fabaceae         | Ornamental and wood              |
| *Ervatamia coronaria* (Jacq.) Stapff   | Pinwheel flower               | Apocynaceae      | Ornamental plant                 |
| *Eucalyptus globules* Labill.          | Southern Blue Gum             | Myrtaceae        | Oil and timber                   |
| *Eucalyptus globules* Labill.          | Black Plum, Jamun             | Myrtaceae        | Fruit tree                       |
| *Eugenia jambolana* Lam.               | Fig Tree                      | Moraceae         | Fruit and ornamental             |
| *Ficus carica* L.                     | Hairy Fig, Devil Fig          | Moraceae         | Medicinal Plant                  |
| *Ficus microcarpa* L.f.                | Chinese Banyan, Malayan       | Moraceae         | Medicinal Plant                  |
| *Ficus religiosa* L.                   | Sacred Fig, Bodhi Tree, Peepul Tree | Moraceae     | Medicinal Plant                  |
| *Gravillea robusta* A.Cunn. ex R.Br.   | Southern Silky Oak, Australian Silver Oak | Proteaceae     | Ornamental plant                 |
| *Hardwickia binata* Roxb.              | Anjan                         | Fabaceae         | Medicinal Plant                  |
| *Holoptelea integrifolia* (Roxb.) Planch | Indian Elm               | Ulmaceae         | Medicinal Plant                  |
| *Jacaranda mimosifolia* D.Don          | Jacaranda, Blue Jacaranda     | Bignoniaceae     | Ornamental plant                 |
| *Kigelia pinnata* (Lam.) Benth.        | Sausage tree                  | Bignoniaceae     | Medicinal Plant                  |
| *Kydia calycina* Roxb.                 | Kydia                         | Malvaceae        | Ornamental plant                 |
| *Lagerstroemia speciosa* (L.) Pers.    | Pride of India, Queen, Crape Myrtle | Lythraceae     | Ornamental plant                 |
| *Lagestroemia indica* (L.) Pers.       | Crape Myrtle, Crepe Myrtle   | Lythraceae       | Ornamental plant                 |
| *Lagerstroemia lanceolata* Wall.       | Nandi Tree                    | Lythraceae       | Timber                           |
| *Mangifer indica* L.                   | Cuckoo's Joy, Mango           | Anacardiaceae    | Fruit and Timber                 |
| *Manilkara zapota* (L.) P.Royen       | Chiku, Sapodilla,             | Sapotaceae       | Fruit tree                       |
| *Manilkara hexandra* (Roxb.) Dubard    | Ceylon Iron Wood, Milk tree   | Sapotaceae       | Fruit tree                       |
| *Melia azedarach* L.                   | Chinaberry tree, Persian lilac | Meliaceae        | Medicinal Plant                  |
| *Millingtonia hortensis* L.f.          | Tree Jasmine, Indian Cork Tree | Bignoniaceae     | Ornamental and medicinal plant    |
| *Mitragyna parviflora* (Roxb.) Korth   | Kaim, True Kadamb             | Rubiaceae        | Medicinal Plant                  |
| *Moringa oleifera* Lam.               | Drumstick Tree                | Moringaceae      | Medicine and Food                |
| *Muntingia calabura* L.                | Jamaica Cherry                | Muntingiaceae    | Medicinal Plant                  |
| *Nerium odorum* L.                     | Rosebay                       | Apocynaceae      | Medicinal Plant                  |
| *Nyctanthes arboristis* L.             | Night jasmine                 | Oleaceae         | Medicinal Plant                  |
| *Peltiphorum pterocarpum* (DC.) K.Heyne | copperpod, yellow-flame      | Fabaceae         | Ornamental and medicinal plant    |
| *Phyllanthus acidus* (L.) Skeels       | Malay gooseberry, star gooseberry | Euphorbiaceae   | Medicinal Plant                  |
| *Pithecolobium duice* (Roxb.) Benth.   | Monkeypod                     | Fabaceae         | Food and medicinal plant          |
| *Prosopis cineraria* (L.) Druce        | Jammi, Khejri Tree            | Fabaceae         | Timber                           |
| *Psidium guajava* L.                   | yellow guava, or lemon guava  | Myrtaceae        | Fruit tree                       |
| *Pterospermum acerifolium* (L.) Wild.  | Maple-leaved Bayur tree       | Sterculiaceae    | Ornamental and timber             |
| *Punica granatum* L.                   | Pomegranate                   | Lythraceae       | Fruit and medicine               |
| *Salix tetrasperma* (Roxb.)           | Indian willow                 | Salicaceae       | Medicinal Plant                  |
| *Samanea saman* F.Muell.               | Rain Tree and Monkeypod       | Fabaceae         | Ornamental and timber             |
| *Stereospermum suaveolens* (Roxb.) DC. | Rose Flower Fragrant          | Bignoniaceae     | Medicinal Plant                  |
| *Stereospermum suaveolens* (Roxb.) DC. | Rose Flower Fragrant          | Bignoniaceae     | Medicinal Plant                  |
| *Tecoma stans* (L.) Juss. ex Kunth     | Yellow bells                  | Bignoniaceae     | Ornamental plant                 |
| *Tamarindus indica* L.                 | Indian date, Tamarind tree    | Bignoniaceae     | Timber and fruit                 |
| *Tecoma argentea* Bureau & K.Schum     | Yellow Tabebuia, Golden       | Bignoniaceae     | Ornamental plant                 |

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| Genus                          | Common Name   | Family            | Economic Use                                      |
|-------------------------------|---------------|-------------------|--------------------------------------------------|
| *Tectona grandis* L.f.        | Teak          | Lamiaceae         | Timber and medicinal plant                        |
| *Terminalia arjuna* ( Roxb.) Wight & Arn. | Arjun tree    | Combertaceae      | Timber and medicinal plant                        |
| *Terminalia catappa*          | Indian almond, Malabar almond | Combertaceae, Lamiaceae | Ornamental, Food and medicinal plant              |
| *Vitex altisima* L.f.         | Peacock chaste tree | Lamiaceae.         | Wood                                             |
| *Ziziphus jujuba* Mill.       | Chinese date  | Rhamnaceae.       | Fruit and timber                                  |

**HEMIPARASITE**

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. Calyx is usually persistent. Corolla is greenish, yellowish, or white, petals free, small, shorter than 10 mm. Stamens only are inserted on the petals. Berry is ovoid or subglobose. Each berry contains the embryo, the endosperm and a mucilaginous viscin, which consists of cellulose in a mixture of acidic and neutral polysaccharides (Sallé 1983, Gedalovich *et al.* 1988). *Dendrophthoe falcata* robust shrubby epiphytic-parasite, usually on trees; Leaves often sub-opposite; Inflorescence an axillary or sometimes terminal raceme or spike; Calyx tubular or flask-shaped; Corolla 5; tube more less dilated; Stamens 5; Anthers basifixed; Ovary 1-locular; Style without articulation; Stigma capitates; Fruit a berry, usually ovate (Alam 1986). Chromosome number 2n=18 (Fedorov 1969).

*Loranthus* does not have a root system of its own but develops root-like absorbing organs called haustoria, which penetrate deep into the tissues of the host. Morphologically the haustorium is of root origin which acts as a primary root to infect host plant. Through these organs, water and minerals flow from the conducting system of the host to the parasite. There is a continuous drain of nourishment from the host to the parasite and in course of time the attached branch withers as a result of the interference in the flow of the sap to its leaves, beyond the point of attack. In many cases the branches of the host are killed by the parasite, owing to the tapping of most of the vascular bundles (Singh 1996, Mehrotra & Aggarwal 2004). The green leaves of the parasite manufacture sugar and starch and thus it is not completely dependent on the host plant. Sometimes a parasite produces a creeping branch that grows closely along the host stem and forms haustoria at intervals.

Species of *Loranthus* are very destructive to tea plantations, citrus groves and park trees in Africa; many broad-leaved trees in the Indian Subcontinent; rubber and kapok plantations in Indonesia; *Citrus, Castanea, Camphora, Diospyros, Liquidambar, Psidium* and *Pyrus* in China and Philippines; *Lansium domesticum* Jack and *Bombycidendron vidalianum* Merril & Rolff plantations in the Philippines; *Citrus* in Mexico and South America; fruit, forage, ornamental trees, and commercial timber, especially *Eucalyptus* species in Australia (Gill & Hawksworth 1961); rubber in Malaysia; and limes in the West Indies (Baloch & Mohyuddin 1969). However, as the family Loranthaceae originated in the tropics and the subfamily Loranthoideae is native to Africa and Indo-Malaysia (Gill & Hawksworth 1961), and as at present *Loranthus* spp. are destructive to economic plants in many parts of the world.

**BIRD POLLINATION AND SEED DISPERSAL**

The parasite is disseminated mainly through its seeds, carried by birds. The birds are attracted by the brilliant colour of the berries, the pulp is sticky and viscous and so birds easily carry the seeds. The parasite causes damage due to preventing the growth of the host (Singh 1996, Mehrotra & Aggarwal 2004). Dissemination of the parasite occurs due to dispersal of its seeds mostly through birds and in some cases by other animals. The fruit is comparatively succulent, brilliantly coloured and is attractive to birds. The pulps of the seeds are sticky and thus seeds are easily carried by the birds. Although the birds eat way the pulp of fruits and get rid of the seeds by wiping or striking their beaks against branches or other objects, occasionally some of them are swallowed. Out of these few pass unharmed through the gut and germinate quite well while others are destroyed by the digestive juices in the gut (Mehrotra & Aggarwal 2004).

**WEED CONTROL**

There is a lack of knowledge in control of a weed or phanerogamic stem parasite *Loranthus*, commonly found in several areas of Andhra Pradesh and also other fruit cultivated states in India. Only mechanical weeding by cutting (pruning) of Loranthus branches on host trees is a common practice in mango cultivation. Chemical weeding by Ethephon (20 ml L⁻¹), Metribuzin (1%) and 2, 4-D powder is not effective and familiar among farmers. The biological control was not reported successfully perhaps it is in the infant stage in India.
Therefore, the study can enlightens the awareness of farmers, agronomists and researchers concerning to phanerogamic plant parasites, particularly *Dendrophthoe falcata*, in the areas of morphology, pollination biology and seed dispersal, and host-parasite interaction, to take further effective control methods in mango cultivation. Finally, Authors recommended some agricultural practices in mango orchards to control bird pollination, pollen development and seed dispersal of *Dendrophthoe falcata*. They are: 1). Cultivation of some alternative crops/ fencing crops to attract birds 2). The use of some concentrations of chemicals or plant growth regulators to cause male sterility of Loranthus, and 3). The degradation of viscin tissue (bird glue) to control seed adhesion and seed dispersal of *Loranthus*.

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