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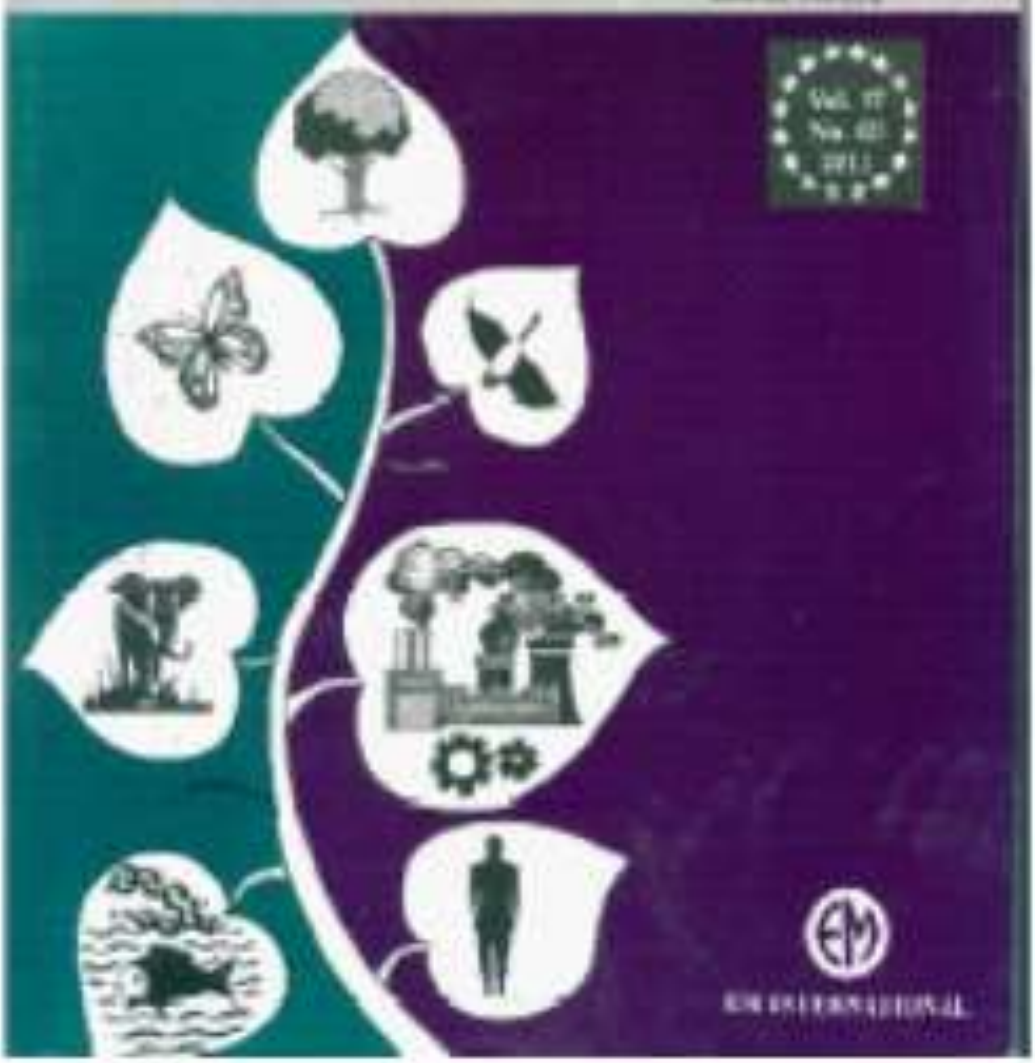

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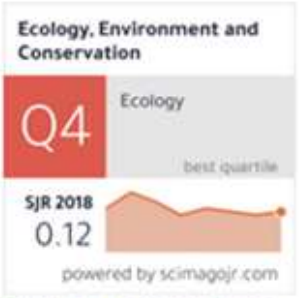


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# Analysis of mistletoe host preference at Sector C Airlangga University, Surabaya, Indonesia

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(Received 2 January, 2019; accepted 28 February, 2019)

ABSTRACT

The purpose of this research is to know the preference of mistletoe in the host plant. The study was conducted in March-April 2018. The method used for preference test is *purposive sampling*. The preference of mistletoe host based on correlation coefficient analysis is -0,276. The results of this study indicate that there are 6 species of mistletoe found in the study sites: *1) Scurum atropurpurea, 2) Scurulla parasitica, 3) Macrosolen tetragonos, 4) Dendropthoe pentandra, 5) Helixanthera sessiflora 6) Dendropthoe curvata.* There are 22 host species of mistletoe, *such as Samanea saman, Peltophorum pterucarpum, Syzygium aqueum, Delonix regia, Annona squamosal, Swietenia mahagoni, Tamarindus indica, Ricinus communis, Bauhinia purpurea, Averrhoa bilimbi, Ficus benjamina, Ficus elastic, Pterocarpus indicus, Tectona grandis , Acacia mangium, Melaleuca leucadendra, Manilkara kauki, Mangifera indica, Muntingia calabura, Albizia falcata, Lagerstroemia speciosa, Citrus aurantifolia.* Besides, there are 6 species of non host mistletoe such as *Aegle marmelos*, *Areca catechu*, *Elaeis guineensis*, *Garcinia dulcis*, *Xanthosoma sagittifolium*, and *Cerbera manghas*.

***Key words*** *: Mistletoe, Preference, Host Availability*

## Introduction

Knowledge of biodiversity richness as Indonesia's bioresource has an important role for human life. The 5th National Biodiversity Report is a report on Indonesia's national implementation of the Convention on Biological Diversity articles and work programs. An overview on Status, Trend, and Threats of Biodiversity is presented Indonesia's biodiversity condition. The documented species diversity comprised of 1,500 species of algae, 80,000 fungal species, 595 species of lichens, 2,197 fern species, and 30,000 – 40,000 of spermatophyte species, accounting for 15.5% to the world flora (KLHK, 2014).

One of the plant's riches in the world is the Loranthaceae because it is the largest and most diverse family (73 genera and ca. 990 species) distributed in the Old and New World tropics (Crespo *et al*., 2016). Moreover, The largest number of species is in West Java which is 29 species. Whereas, in East Java and Central Java each of 19 species and 15 species (Kartika *et al*., 2016). Loranthaceae or commonly called as Mistletoe, Mistletoes are a taxonomically diverse group of hemiparasitic plants from the order Santalales that access water from their host plants but are capable of photosynthesis. Mistletoes also take up nutrients such as nitrogen from their hosts, either passively from the xylem or actively from the phloem (Griffiths *et al*., 2016).

Mistletoe is considers as an unwanted plant to economically important horticultural plant. However, mistletoes are also known to be medicinal plants that can be used in traditional therapies (Rahmawati *et al*., 2014) in Indonesia and other coun-

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tries such as in treatment for cough, diabetes, hypertension, cancer, diuretic (Endharti *et al*., 2016). In Java, mistletoe is used as a medicine for *Varicella simplex, Herpes zoster*, diarrhea, hookworm, tumor, and cancer. Ethnobotany research argued that parasites of dried tea boiled water can be drunk to cure uterine cancer and other cancers. In addition, the facts on the ground showed that the water stewed of mistletoe and *Catharantus roseus* can cure cancer (Kartika *et al*., 2016).

Geographically, Sector C at Airlangga University is located in East Java, Indonesia on $7^0$16′18′′S $112^0$45′29′′E. Plants that adorn the campus gardens are trees that have a wide canopy and flowers that vary in shape and color. The existence of trees in the campus environment can make the campus become more beautify, soothing, and shade the surroundingenvironment; reduce air and sound pollution; as well as providing live specimens for teaching materials of Botany at Airlangga University. However, the existing trees are also the main attraction for the growth of mistletoe which can cause some negative impacts for the host plant, includes a decrease in tree vigour and growth increments, less leaf assimilation, less fruit and seed, drying of branches, logs quality including strength properties of wood and tree mortality (Muttaqin *et al*., 2016).

The main purpose of this research is to produce information on the parasite preference of plant's host that can be used as a baseline for future use, such as science, ecology, ethnobotany, regional economic potential, management of natural resource programs, and can be compared with other similar research. This research is intended to reveal the preference of mistletoe in its host plants at Airlangga University, Surabaya, Indonesia.

## Material and Methods

Preference observation of mistletoe at Sector C Airlangga University of Surabaya. This research was conducted on March-April 2018 by using *purposive sampling* technique with exploratory method that is by exploring campus area, and observing mistletoe using binoculars and taking specimens of mistletoe that grow in various plant species that can be found at Airlangga University of Surabaya. For the research location map, it has been done presented in Figure 1.

Identification data of mistletoe and other number (number of mistletoe host based on family and species) were analyzed descriptive and presented in table and graph form. Analysis host preference of mistletoe based on correlation coefficient analysis by using SPSS 21.0 program and the preference of mistletoe type use formula**:**

$$\text{Mistletoe Preference} = \frac{\text{numbers of parasite individual}}{\text{total number of parasites}}$$

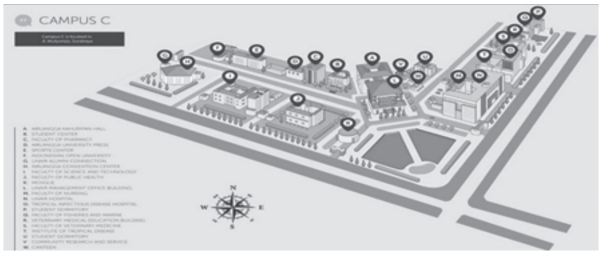


**Fig.1.** Map of Research Locations

## Result and Discussion

This research showed that there are 6 spesies of mistletoe found in the research location, such as: *1) Scurrula atropurpurea, 2) Scurulla parasitica, 3) Macrosolen tetragonos, 4) Dendropthoe pentandra, 5) Helixanthera sessiflora 6) Dendropthoe* curvata. There are 22 host species of mistletoe, such as *Samanea saman, Peltophorum pterucarpum, Syzygium aqueum, Delonix regia, Annona squamosal, Swietenia mahagoni, Tamarindus indica, Ricinus communis, Bauhinia purpurea, Averrhoa bilimbi, Ficus benjamina, Ficus elastic, Pterocarpus indicus, Tectona grandis, Acacia mangium, Melaleuca leucadendra, Manilkara kauki, Mangifera indica, Muntingia calabura, Albizia falcata, Lagerstroemia speciosa, Citrus aurantifolia.*

The host of mistletoe is a plant that is infected by mistletoe to live and breed. Based on graph 1, it can be seen that the family of plants became the host of mistletoe are 13 families and the highest is Fabaceae with 8 species of mistletoe. They are *Bauhinia*

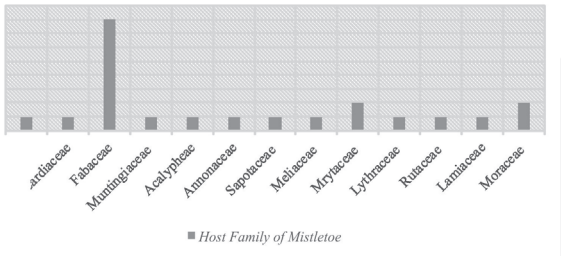


**Fig. 2.** Host Family of Mistletoe in Airlangga University, Surabaya, East Java-Indonesia

*purpurea, Samanea saman, Delonix regia, Albizia falcata, Tamarindus indica, Acacia mangium, Peltophorum pterucarpum,* and *Pterocarpus indicus*. Fabaceae (legumes family) is one of the flowering plant families, which is economically important (Irsyam and Priyanti, 2016). Fabaceae has cosmopolitan distribution, including about 650 genera and approximately 18,000 species, representing one of the largest families of Angiosperms and one of the leading economically (Nerilson *et al*., 2017)

Various species of Fabaceae were planted as ornaments and shade trees in public places, including in Airlangga University Surabaya has many functions such as ornamental plants and shade on campus because it has strong roots and stems, twigs do not appear at the base of the stem, the stature and shape of the crown is quite beautiful, small leaves so as not to endanger the user roads or parks if falling, non-toxic flowers, resistant to dry climates, resistant to air and motor pollution, and oxygen contributors (Hasanah, 2017). On the other hand, Fabaceae has seeds that are easily dispersed to other areas by ani-

**Table 1.** Host Record of Mistletoe in Airlangga University, Surabaya, East Java-Indonesia

| No | Names and Host plants types | Types of Parasite | | | | | | Total number of parasites | Infected Host by Mistletotoe |
|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | | |
| | Oxalidaceae | | | | | | | | |
| 1 | *Averrhoa bilimbi* | | | | 1 | | | 1 | 1 |
| | Anacardiaceae | | | | | | | | |
| 2 | *Mangifera indica* | | | 4 | 7 | | 3 | 14 | 9 |
| | Fabaceae | | | | | | | | |
| 3 | *Bauhinia purpurea* | 3 | | | | | | 3 | 3 |
| 4 | *Samanea saman* | | | | 131 | | | 131 | 111 |
| 5 | *Delonix regia* | | | | 6 | | | 6 | 6 |
| 6 | *Albizia falcata* | 1 | | | | | | 1 | 1 |
| 7 | *Tamarindus indica* | | | | 1 | | | 1j | 1 |
| 8 | *Acacia mangium* | 2 | | | | | | 2 | 2 |
| 9 | *Peltophorum pterucarpum* | | 4 | | | | | 4 | 1 |
| 10 | *Pterocarpus indicus* | | | | 6 | | | 6 | 6 |
| | Muntingiaceae | | | | | | | | |
| 11 | *Muntingia calabura* | 1 | | | | | | 1 | 1 |
| | Acalypheae | | | | | | | | |
| 12 | *Ricinus communis* | | | | | | 4 | 4 | 2 |
| | Annonaceae | | | | | | | | |
| 13 | *Annona squamosa* | | | 1 | | | | 1 | 1 |
| | Sapotaceae | | | | | | | | |
| 14 | *Manilkara kauki* | | | 2 | 5 | | | 7 | 5 |
| | Meliaceae | | | | | | | | |
| 15 | *Swietenia mahagoni* | | | | | 1 | | 1 | 1 |
| | Mrytaceae | | | | | | | | |
| 16 | *Syzygium aqueum* | | | 2 | | 1 | | 3 | 1 |
| 17 | *Melaleuca leucadendra* | | | | | 1 | | 1 | 1 |
| | Lythraceae | | | | | | | | |
| 18 | *Lagerstroemia speciosa* | | 5 | | | | | 5 | 5 |
| | Rutaceae | | | | | | | | |
| 19 | *Citrus aurantifolia* | | 1 | | | | | 1 | 1 |
| | Lamiaceae | | | | | | | | |
| 20 | *Tectona grandis* | | | 1 | | 2 | 1 | 4 | 2 |
| | Moraceae | | | | | | | | |
| 21 | *Ficus elastica* | | 3 | 1 | | 1 | 3 | 8 | 5 |
| 22 | *Ficus benjamina* | | 3 | 1 | | 1 | | 5 | 3 |

Information: I= *Scurrula atropurpurea , II = Scurulla parasitica, III = Macrosolen tetragonos*, IV = *Dendropthoe pentandra*, V = *Helixanthera sessiflora*, VI = *Dendropthoe curvata*

mals such as birds or carried away due to human activities. Seeds carried to a region where conditions are favorable will then germinate. Grains that fall on the surface of the soil will be easy to grow, especially if exposed to sunlight (Nikmah *et al*., 2016).

Preference types of mistletoe that exist in the Airlangga University in Surabaya is *Scrulla atropurpurea* 3.33%, *Scurulla parasitica* 7.62%, *Macrosolen tetragonos* 5.72%, *Dendropthoe pentandra* 77.62%, *Helixanthera sessiflora* 1.91%, and *Dendropthoe curvata* 3 , 33% which means from this explanation, it can be argued that the highest preference on *Dentropthoe pentandra* is 77.62%. The reason is *Dentropthoe pentandra* can grow as a parasite in some host plants species, both in the form of shrubs and trees for several years. Specifically, *Dendropthoe pentandra* can be found in rain forest areas or in open forests, in plantations, in city parks, around residential areas, as well as in lowlands (height less than 200 mdpl) to areas with an altitude of 2300 mdpl. Spread occurs through birds that feed on seeds. The preference of mistletoe is directly related to bird preference as the parasite distribution vector, usually the seedlings found on the branches that initially occupy the part of the tree canopy which is found in many bird droppings containing parasitic seeds (Endharti *et al*., 2016).

The process of growth and development of mistletoe begins when the seeds of parasites are dispersed by the bird's main vector in the host, the seeds germinate and form a haustorium that enters the *xylem tapping* to absorb water, minerals and certain circumstances in the form of sugars and amino acids (Griffiths *et al*., 2016). The physiological attack of mistletoe plants through a root-modified organ called as *haustoria*. Growth of haustoria along the cambium forms a layer called *intercaler meristem*. The definition of an *intercalary meristem* is meristematic tissue derived from an apical meristem and becomes separated from the apex in its developmental process in the presence of a less advanced tissue region. Furthermore, the haustoria layer in the *xylem* tissue plays a role for the flow of the nutrient solution, while the cortical fibers grow in the *phloem* layer. The entire structure of fibers inside the *phloem* and *xylem* is called the *endophytic* system. Establishment of *endophytic* systems in some parasitic plants just behind the *apical* meristem. The endophytic system may develop and reside in new branches and the entire interconnected endophytic system is called systemic infection (Muttaqin *et al*., 2017).

*Dendropthoe pentandra* can be found in India and Bangladesh such as Myanmar (Tenaserrin), Thailand, Philippines (rare, Luzon and Palwan), Singapore, Vietnam, Malaysia (Peninsular), and Indonesia (Sumatra, Borneo and Java) (Yuliandari, 2017).

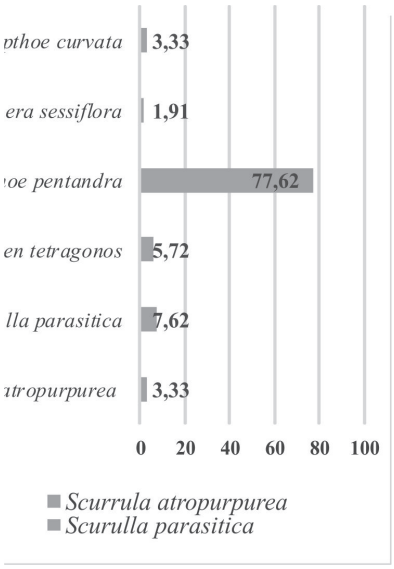


**Fig. 3.** Preference of Mistletoe in Airlangga University, Surabaya, East Java-Indonesia

Preference of Host mistletoe based on correlation coefficient analysis using SPSS version 21.0 is -0,276 which means the diversity of host species is high then the mistletoe host has a low specific, but high preference host. In contrast, mistletoe have a high specific host and low host preference in open forests with a low diversity of host species.

Mistletoes have been shown to have low host specificity in heterogeneous tropical rainforests, where there tends to be greater species richness but a lower relative abundance of any one potential host species. Host community composition can fundamentally influence the establishment and prevalence of mistletoes, and many investigations have illustrated that mistletoe distribution is correlated with the abundance (number of individuals) of host species in the plant community (LUo *et al*., 2015).

Host selection can be influenced by local conditions, such as the type and number of host species available for colonization, host structure and characteristics like height, twig size, and bark type. The dynamics of the community can also influence the mistletoe host relationship, by having more mistletoe occurrence on susceptible host individuals and in-

creasing mistletoe densities, which in turn, increase the fruit production attracting more dispersers reinforcing the contagious distribution (Acosta *et al*., 2016).

The preference of disease vectors for infected hosts is often associated with a mutualistic parasite-vector interaction. In an area with one or very few mistletoe infections, limited pollination may restrict seed production, if pollinators have difficulty locat- ing isolated mistletoes. The preferences of disease vectors for particular hosts often reflect the vectors' responses to visual or chemical indicators of host quality (Aukema, 2016).

Mistletoes are unique plants, although mistletoe can live in the woody plants dicotyledonous class, but not all plants are struck by mistletoe. Based on graph 3 it can be argued that there are 5 plants family that cannot become the mistletoe host. They are *Rutaceae* with species namely *Aegle marmelos*, *Arecaceae* with species namely *Areca catechu* and *Elaeis guineensis*, *Clussiacea*e with species namely *Garcinia dulcis*, *Araceae* with species namely *Xanthosoma sagittifolium*, and *Apocynacecae* with species namely *Cerbera manghas*. Thus, the highest percentage of *Arecaceae* family is 33%, because Arecaceae have slender stems with long and high segments, unbranched stems, and saxophone stem systems produced by seedlings of certain Arecaceae show peculiar growth patterns and distinctive morphologies. In addition to the ecological and economic importance of Arecaceae, they are of great botanical interest because of their diverse developmental patterns and adaptive strategies (Souza *et al*., 2017).

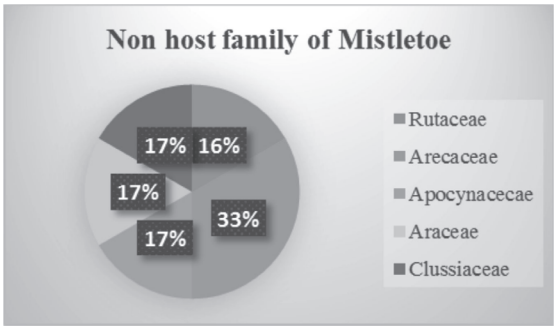


**Fig. 4.** Non Host Family of Mistletoe in Airlangga University, Surabaya, East Java-Indonesia

Besides mistletoe need stems that have sufficient moisture content and also the availability of nutrients that can be utilized by mistletoe from host plants. In habitats with low water availability, however, the mistletoes transpire less than their host and under some circumstances they can even have a total daily transpiration less than one-seventh of their hosts (Yang *et al*., 2017). The process of host infection is similar for all mistletoe species: the mistletoe attaches to a branch, forming a haustorium, and taps into the xylem of the host tree. When mistletoes are well established they can significantly modify the functional processes of the host tree; the links between the carbon, nutrient, water and energy cycles. With climate change, ecophysiological stress is increasing, potentially making trees more susceptible to mistletoe infection (Griebel *et al*., 2017).

Mistletoes also show close interactions with their pollinators and seed vectors, associations that could be considered as a true mutualism. Therefore, mistletoes can act as hemiparasites (for plant hosts) and mutualists (for dispersers and pollinators) simultaneously in natural communities (Acosta *et al*., 2016). The existence of mistletoe is also closely related to birds as an agent of pollination and distribution of parasites. Birds move the pericarp and then swallow and leave the seeds through its dirt or vomiting with viscin layers attached around the seed ensuring adhesion to the branch. This pattern of bird behavior encourages greater opportunities for recurrent infections and infections resulting from the disposal of defecate or regurgitate of viable parasite seeds adhere to the branches surfaces (Mutaqqin *et al*., 2016).

## Conclusion

There are 6 types of mistletoe found in the study sites: *1) Scurrula atropurpurea, 2) Scurulla parasitica, 3)*

**Table 2.** Correlation coefficient test results of host preference of parasite

| | | | Parasites type | Host types |
|---|---|---|---|---|
| Kendall's tau_b | Parasites type | Correlation Coefficient | 1,000 | -,276** |
| | | Sig. (2-tailed) | . | ,000 |
| | | N | 210 | 210 |
| | Host types | Correlation Coefficient | -,276** | 1,000 |
| | | Sig. (2-tailed) | ,000 | . |
| | | N | 210 | 210 |

*Macrosolen tetragonos, 4) Dendropthoe pentandra, 5) Helixanthera sessiflora 6) Dendropthoe curvata.* There are 22 host species of mistletoe, *such as Samanea saman*, *Peltophorum pterucarpum*, *Syzygium aqueum*, *Delonix regia*, *Annona squamosal*, *Swietenia mahagoni*, *Tamarindus indica*, *Ricinus communis*, *Bauhinia purpurea*, *Averrhoa bilimbi*, *Ficus benjamina*, *Ficus elastic*, *Pterocarpus indicus*, *Tectona grandis*, *Acacia mangium*, *Melaleuca leucadendra*, *Manilkara kauki*, *Mangifera indica*, *Muntingia calabura*, *Albizia falcata*, *Lagerstroemia speciosa*, *Citrus aurantifolia.* Mistletoe host preference is -0.276 which means that diversity of the host species is high, but the parasite has a low specific host, and the host preference is high. Besides, There are 6 species of non host mistletoe such as *Aegle marmelos*, *Areca catechu*, *Elaeis guineensis*, *Garcinia dulcis*, *Xanthosoma sagittifolium*, and *Cerbera manghas*.

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# Ecology, Environment and Conservation

**Country** India - SJR Ranking of India

**Subject Area and Category** Agricultural and Biological Sciences
Ecology, Evolution, Behavior and Systematics

Environmental Science
Ecology
Nature and Landscape Conservation

**Publisher** EM International

**Publication type** Journals

**ISSN** 0971765X

**Coverage** 1997-ongoing

**Scope** Published Quarterly Since 1995. Ecology, Environment and Conservation is published in March, June, September and December every year. ECOLOGY, ENVIRONMENT AND CONSERVATION is one of the leading International environmental journal. It is widely subscribed in India and abroad by institutions and individuals in education and research as well as by industries, Govt. Departments and Research Institutes.

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