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OCCURRENCE OF MISTLETOE (*LORANTHUS SPP.*) INFESTATION ON GARDEN CROTON (*CODIAEUM VARIEGATUM*) AND OTHER HOST TREES

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Abstract **- Mistletoes (*Loranthus* spp.) are one of the major groups of plant parasites, which are found in a wide range of vegetative zones in India. They cause great economic loss to our fruit and timber trees, when compared to any other member of the parasitic family of flowering plants. Some of the well known effects of plant parasites on the host trees are reduction of overall growth rate and vigour, low fruit and seed production; slow drying of branches; predisposition to other pests and diseases, and ultimately causing premature death. Studies on the incidences of mistletoe infestation, their distribution in urban environment and the possible impacts that *Loranthus* spp. could cause on a wide range of native and exotic species have been reported by several botanical researchers. The most common tree hosts reported by them include the like neem (*Azadirachta indica*), mango (*Mangifera indica*), guava (*Psidium guajava*), sugar apple (*Annona squamosa*), mahogany (*Swietenia* sp.), etc. In this article, the author reports the finding of a new host species i.e, garden croton (*Codiaeum variegatum*) of the family *Euphorbiaceae,* for the hemi-parasite *Loranthus spp.,* and also presents a report on a survey conducted in and around the campus of WIP, a large wood-based industrial complex in Valapattanam, Kannur during December, 2019-January, 2020 to determine the intensity and level of mistletoe infestation in tree species. The intensity and the total number of trees infected by the parasitic weed were determined. *Mangifera indica* hosted the highest number of mistletoe. Results revealed remarkable variation in the level of mistletoe infestation between tree species.**

Keywords- ***Loranthus*** **spp., mistletoe infestation, garden croton, host trees**

I. INTRODUCTION

Plant parasites are a group of flowering plants which grow on other living plants and rely partially or completely on host plants for nutrients and water, by attaching to the host using specialised structures known as haustoria. These parasites are classified as either root or shoot parasite based on the site of their attachment to the hosts or as hemi-parasitic or holo-parasitic based on the presence or absence of functional chloroplasts in their leaves.

Mistletoe (*Loranthus spp*.) is the predominant group of angiosperm shoot parasites, and is found in a wide range of vegetative zone [1]. It is classified in the genera of Loranthaceae, which belong to the order Santalales, widely distributed from the tropics to temperate region with 77 genera and 950 species [2]. In Kerala, the mistletoes are called '*ithikkanni*'or '*ithil kanni*'or '*pullunni*'. They cause more economic loss than any other members of the parasitic family. Some of the well known effects of plant parasites on the host trees are reduction of overall growth rate and vigour, low fruit and seed production; slow drying of branches; predisposition to other pests and diseases, and ultimately causing premature death.

In the district of Kannur, Kerala, *Loranthus spp.* grows on several native and exotic trees and shrubs, both naturally occurring and cultivated. The need to understand the impacts that these parasites could cause on native and alien species is the reason behind the origin of the studies on infestation in different urban and semi-urban environments. *Loranthus spp.* is an evergreen, shrubby, parasitic plant found over different common trees like neem (*Azadirachta indica*), mango (*Mangifera indica*), guava (*Psidium guajava*), sugar apple (*Annona squamosa*), etc. in all over India. It spreads through birds and wind dispersed seeds and causes deformity in twigs and trunks.

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It is a major parasite on the silver oaks (*Grevillea robusta* A.Cunn. ex. R.Br.) and pomegranate (*Punica granatum* L.) and 40 hosts observed in Tiruchirappalli city areas [3]. Kamble *et al* (2016) reported the occurrence of a new partial/semi-stem parasite, *Dendrophthoe* sp., on pomegranate (*Punica granatum L.*) around the Aurangabad area of Maharashtra, India [4]. Despite their devastating effects on trees and therefore conservation importance, very little is known about mistletoe distribution and its associations with trees [5]. The objective of the present study was to analyse the mistletoe abundance and the associations with trees in Valapattanam, Kannur in order to assess the severity of infection and host range of the parasite in the region for the implementing proper and timely management strategies to control the mistletoe population.

II. MATERIALS AND METHODS

The survey of *Loranthus* spp. on infected host plants was conducted at the premises of The Western India Plywoods Ltd (WIP), Railway Station and Manna areas of Valapattanam, Kannur District. This study area is located at 11^0 55' N, 75^0 20' E, and 6.0m above sea level. The locations of the WIP campus were in and around the campus including the office, factories and the R&D building. The method of simple random sampling was carried out during December, 2019-January, 2020 to study and collect the parasite–host association from the field.

III. RESULTS AND DISCUSSION

Host-parasite associations are dynamic and new host combinations with known host species are continuing to be documented. The reasons for the dynamic nature of host-mistletoe combinations include the presence of 'novel' (i.e. exotic or 'non'-indigenous) host species [6]. During the present work, *Loranthus sp.* infestation on a new host shrub species, garden croton (*Codiaeum variegatum*) of the family *Euphorbiaceae*, was recorded by the author for the first time, and observed the development of hypertrophy of the host branch at the point of infection (Fig.1). Some of the major observations on the distribution of the parasite on other host trees, in and around the campus of a large wood-based industrial complex in Valapattanam during January-February, 2020 are also presented here (Table.1).

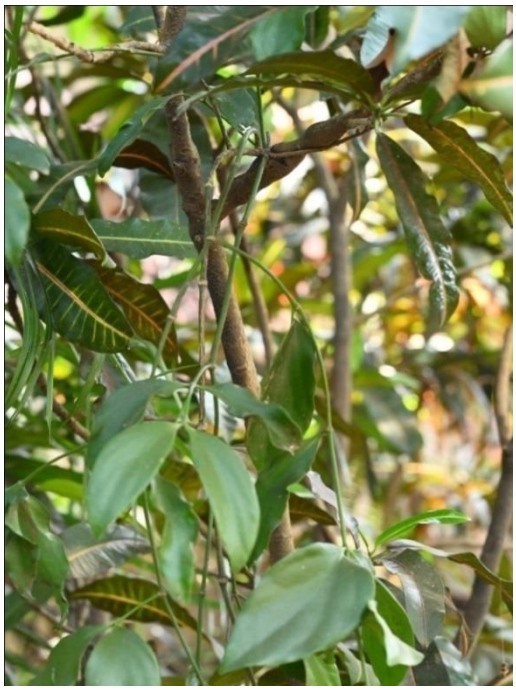

Fig.1. Parasitic growth of *Loranthus* spp. on garden croton (*Codiaeum variegatum*). Note the swelling on the branch at the point of infection by mistletoe.

The survey of the garden shrubs, fruit and timber trees in WIP Campus and nearby areas in Valapattanam has revealed that out of 25 host species, 9 species were found to be infested with mistletoe. This work also recorded the diversity of host species which can be parasitized by *Loranthus spp.* and the variation in the level of hemi-parasite infestation among shrubs and trees. The present data is expected to serve as a reference for future investigations on host-specificity as well as the host-parasite-disperser interaction.

One of the important observations during this study was the occurrence of the parasite on almost all branches of a huge mango tree (*Mangifera indica*) than the other exotic and indigenous trees of the area. This is in accordance with the finding of earlier workers that the probability of mistletoe infection increases with increasing tree size. This high level of infestation of tall trees is probably because they could attract more seed dispersal birds, and therefore receive more mistletoe seeds [7][8]. *Mangifera indica* is the abundant host species and had the highest infestation intensity (64.28%) followed by *Ficus exasperata* (33.33%) (Table.2). It is also noted that the appearance of the parasites during the early stages of the establishment on *Mangifera indica* tree was found to be slightly different from that of the well-established ones i.e., the leaves of the seedlings were dark green in colour and larger in size when compared to the light green and smaller leaves of

old ones. This could be attributed to the requirement of producing carbohydrates as a source of carbon through their well-established photosynthetic mechanism for the survival of the tiny plants from an early stage, dependent on the host only for water and minerals [9][10].

The initiation of the haustoria and the attempts to penetrate the host tree bark were clearly visible in the case of seedlings (Fig.2 & Fig.3). Jackfruit tree (*Artocarpus integrifolia*) was the other preferred host species that was infested by mistletoes and all the leaves of one of the branches of a tree in WIP campus were found to be reduced in size due to the infestation. This study also revealed that these parasites are capable of causing harm to fruit tree crops and timber trees in various ways which include growth loss and reduced yields. This finding is in support of the earlier studies on the effect of the parasitic life on the metabolism of the host trees [11]. According to Zaroug *et al* (2014) serious damage from parasites results in the death of the branches distal to the infection site in the case of poorly managed orchards and/or under drought stress conditions, often leading to the death of the host [12].

Table 1. List of the host plants of *Loranthus* spp. found in Valapattanam

No.	Host species	Common name	Family	Origin
1	*Mangifera indica*	Mango tree	Anacardiaceae	India
2	*Codiaeum variegatum*	Garden croton	Euphorbiaceae	Indonesia, Malaysia, Australia
3	*Swietenia mahagoni*	Mahagony tree	Meliaceae	South Florida(U.S)
4	*Samanea saman*	Rain tree	Fabaceae	Central and South America
5	*Ficus religiosa*	Sacred Fig or Peepal	Moraceae	Indian Subcontinent and Indochina
6	*Ficus bengalensis*	Banyan tree	Moraceae	India
7	*Ficus exasperate*	Sand paper fig	Moraceae	Africa,Arabian Peninsula and India
8	*Ficus racemose*	Cluster fig	Moraceae	Indian Subcontinent, Australia,Malaysia and Indo-China
9	*Artocarpus integrifolia*	Jackfruit tree	Moraceae	South India and Malaysia
10	*Achras sapota*	Sapodilla, Sapota	Sapotaceae	Southern Mexico, Central America and Carribean
11	*Macaranga peltata*	Chandada	Euphorbiaceae	Northern Thailand, Sri Lanka and India
12	*Dalbergia latifolia*	Indian Rosewood	Fabaceae	Southeast India
13	*Tectona grandis*	Teak	Lamiaceae	India,Myanmar and Java
14	*Psidium guajava*	Guava	Myrtaceae	Mexico, Central America, Carribean and northern S.America
15	*Acacia auriculiformis*	Earleaf Acacia	Fabaceae	Australia, Indonesia and Papua New Guinea
16	*Eucalyptus sp.*	Eucalypts	Myrtaceae	Australia
17	*Morus alba*	White Mulberry	Moraceae	China
18	*Alstonia scholaris*	Blackboard tree or devil's tree	Apocynaceae	Southern China, Tropical Asia and Australasia

19	*Polyalthia longifolia*	Mast tree	Annonaceae	India
20	*Phyllanthus emblica*	Indian Gooseberry or Amla	Phyllanthaceae	Southeast Asia
21	*Moringa oleifera*	Drumstick tree, Moringa	Moringaceae	South Asia
22	*Prunus dulcis*	Almond	Rosaceae	Iran
23	*Syzygium cumini*	Malabar Plum or Java Plum	Myrtaceae	Indian Subcontinent
24	*Morinda citrifolia*	Noni	Rubiaceae	SouthernAsia
25	*Azadirachta indica*	Neem tree	Meliaceae	Indian Subcontinent

Table 2. Growth of *Loranthus spp.* on various host species recorded in Valapattanam

No.	**Host species**	**Total No.of hosts**	**No. of infested hosts**	**Per-centage**	**Survey area**
1	*Mangifera indica*	28	18	64.28	WIP Campus
2	*Codiaeum variegatum*	8	2	25	WIP Campus
3	*Swietenia mahagoni*	16	4	25	WIP Campus
4	*Samania saman*	64	5	7.81	Near Railway Station
5	*Ficus religiosa*	4	1	25	WIP Campus& Near Railway Station
6	*Ficus bengalensis*	2	0	0	Near Railway Station
7	*Ficus exasperate*	7	2	33.33	WIP Campus, Near Main gate of WIP & Near Railway Station
8	*Ficus racemosa*	6	0	0	Near Railway Station
9	*Artocarpus integrifolia*	10	3	30	WIP Campus; Manna area
10	*Achras sapota*	8	2	25	Near Railway Station, Manna area
11	*Macaranga peltata*	18	2	11.11	WIP Campus; Near Railway Station
12	*Dalbergia latifolia*	2	0	0	Near Railway Station
13	*Tectona grandis*	14	0	0	WIP Campus, Outside WIP Campus(W)
14	*Psidium guajava*	2	0	0	WIP Campus
15	*Acacia auriculiformis*	14	0	0	WIP Campus
16	*Eucalyptus sp.*	11	0	0	WIP Campus
17	*Morus alba*	1	0	0	WIP Campus
18	*Alstonia scholaris*	3	0	0	WIP Campus
19	*Polyalthia longifolia*	18	0	0	WIP Campus
20	*Phyllanthus emblica*	1	0	0	WIP Campus
21	*Moringa oleifera*	1	0	0	WIP Campus
22	*Prunus dulcis*	4	0	0	WIP Campus
23	*Syzygium cumini*	9	0	0	WIP Campus; Near Railway Station
24	*Morinda citrifolia*	4	0	0	WIP Campus; Outside WIP Campus(E)
25	*Azadirachta indica*	2	0	0	WIP Campus

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IV. CONCLUSION

In order to appropriately manage the damage caused by mistletoe, it is necessary to have knowledge of the biology of the parasite, its distribution mechanism, and relationships and interactions with host species [13]. The frequency of infection and density of mistletoe in each host results from inter-specific differences in growth habit and abundance. The infestation of a host depends on the visit by birds and subsequent mistletoe seed deposition and the seedling growth [14].

The present survey identified a new host species i.e, garden croton (*Codiaeum variegatum*) of the family *Euphorbiaceae*, for the hemi-parasite, *Loranthus spp* and recorded that native tree species are preferred hosts of mistletoe and carry higher level of infestation compared to exotic species. This work showed that the damage caused by mistletoe have become an increasingly serious problem in mango trees in the study area. This study also attempted to highlight the significant aspects of the interaction between mistletoe and its hosts in a semi-urban area. Further explorations are recommended to collect and prepare a detailed reference data showing the link between the parasite attack and the size of all the host species. This data will be very useful to the concerned authorities in decision-making on when or whether to remove the parasite or to destroy the infested trees and also to explore the other options to successfully control the infestation of the trees in the region.

Fig. 2. Mistletoe on *Mangifera indica* tree at WIP campus: Early and late stages of its establishment.

Fig. 3. Mistletoe on *Ficus exasperata* tree near the main gate of WIP campus.

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