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PRELIMINARY STUDIES ON SCREENING PLANT SPECIES FOR POTENTIAL DIVERSIONARY HOSTS FOR *XYLEBORUS FORNICATUS* OF TEA

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A study was conducted to find plant species that can be used as diversionary hosts for *Xyleborus fornicatus* of tea. Twenty nine plant species were assayed during this study and they were categorized into four groups in respect of the beetle behaviour. They include the followings; a) plants that never attract the beetles; b) plant species that attract the beetles and bore galleries, thereafter kill by different means; c) plant species that attract the beetles and bore galleries but neither with brood development nor killing effect; and d) plants that attract the beetles and bore galleries thereafter, further development of the brood too occur.

Tithonia diversifolia and *Solonum indicum* did not allow the beetles to bore them while *Grevillea robusta* and *Eupatorium iniulifolium* are the only two plant species found to attract beetles and kill effectively.

INTRODUCTION

Xyleborus fornicatus Eichhoff (Coleoptera: Scolytidae), a polyphagous beetle, is one of the major insect pests of tea in Sri Lanka. Owing to cryptic habitat of *X. fornicatus*, the strategies aimed to control the pest problem have not acquired the desired level.

The discovery of synthetic insecticides during 1940s was the major break through in the pest control and they were considered the panacea for the crop protection. However, the development of resistance to pesticides, resurgence of pests, secondary pest outbreaks and undesirable side effects on human health and environment have compelled to integrate the potential control strategies into this pest management system within a frame of "eco-friendly management strategy".

Altogether 99 plant species belonging to 36 families have been recorded to attack by *X. fornicatus*. Twenty one species facilitated the borer to breed inside them. Leguminosae, Verbinaceae, Moraceae and Euphobiaceae are the families having general attraction for the beetle. Among these families Leguminosae plants show

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more selectivity in attracting the beetles. There is a certain amount of selectivity as indicated by preference to and wide occurrence in tea (Theaceae), castor (Euphorbiaceae), and kesambi (Sapindaceae) (Danthanarayana, 1968). In Sri Lanka, *X. fornicatus* so far recorded to attack 49 plant species while the principal host plants are tea and castor. Other than tea and castor, they can breed successfully in *Albizzia fulcata*, *Erythrina lithosperma*, *Crotalaria* spp. and *Tephrosia candida* (Danthanarayana, 1968; Judenko, 1961).

Every major woody plant family of the orient tropics is acting as a host for *X. fornicatus* with the exception of members of Sapotaceae. In Java and Sumatra *X. fornicatus* has become a pest of kesambi plants (*Schleichera oleosa*) which provides an oil seed of some importance (Kalshoven, 1958).

Recently it has been found that cut stems of jungle plant, *Montanova bipinnatifida* (Compositae) attracted by large numbers of *X. fornicatus* beetles in India. It was shown that placing of cut stems of this plant in the infested fields attracted the beetles, which may be killed by burning the stems eventually (Selversundaram *et al*, 2000).

Some host plants are recorded to resist the *X. fornicatus* but the beetles get entrapped in the stem by exuding gum and therefore, they are not able to construct complete galleries. Such hosts are *Grevillea robusta, Hakea saligna, Poinciana regina, Alberia gardneri, Swietenia mahogani, S. macrophylla, Albizzia procera,* and *Adenthera microsperma* (Kalshoven, 1958; Danthanarayana, 1968). Some plants are recorded with exudation of sap once attacked by the beetles. For example: *Dalbergia latifolia, Tectona grandis, Vitex pubescense, Peltophorum ferrugineum, Cassia fistula, Trema orientalis* and *Cebia pentranda* (Kalshoven, 1958). The present study was aimed as a preliminary study to find plant species that can be used as diversionary hosts for *X. fornicatus* of tea in Sri Lanka.

MATERIALS AND METHODS

The *X. fornicatus* female beetles used in this study were collected from the infested tea branches brought from Nayapane estate, Pussellawa. The branches were split opened to collect the beetles. The plant species that have been used as either shade trees, green manure plants, fuel trees, hedge rows, fruit trees or those grown naturally as weeds or wild plants were collected from St. Coombs, Waltrim and Mahanilu tea estates in Talawakelle, Lindula and Upcot respectively (Table 1). *Montanova bipinnatifida* stems were collected from Haggala botanical gardens. Natural infestation of *X. fornicatus* and their brood development in plants during field collection of stems were also noted. Tea, *Camellia sinensis* (clone DT1 and TRI 2025) was used as standard.

Test arrangement: From the collected plant stems, three pieces each of 10 cm long and 1 cm diameter from each species were cut and kept in glass jars measuring

12 cm height and 7.5 cm diameter. Both ends of the stem pieces were sealed with wax. Twelve adult female beetles were placed in each jar containing the cut stems using a camel hairbrush. Jars were covered with muslin cloths and were placed in an incubator at 25 ° C. Each treatment was replicated ten times. Preference by *X. fornicatus* to each plant species was measured externally by the number of galleries made in each stem after seven days of introduction of the beetles. Fourteen days from the incubation, the stems were split opened and the number of damage points and actual galleries made by the females were recorded. Whenever the live beetles and eggs were encountered inside the galleries, such stems were repeated for further brood development for 21 days and the life stages were recorded.

Plant species were categorized based on the number of galleries per 10 cm long stem as a comparison to that of tea (clone TRI 2025).

Mean gallery/10cm	Category of plant
0	resistant
0-1.4	less susceptible compare to tea
1.5-1.7	susceptibility similar to tea
>1.7	more susceptible compare to tea

RESULTS AND DISCUSSION

Mean number of galleries per 10 cm long stem of each plant tested is given in table 1. It was found that following plant species are more attractive to *X. fornicatus* than tea. They are *Eupatorium iniuliforlium, Grevillea robusta, Azadirachta indica, Acacia decurrens, Calliandra calothyrusus* and *Flamingea conjesta* (Table1).

Tithonia diversifolia and *Solonum indicum* did not allow the beetles to make galleries in them. The plant species tested against the *X. fornicatus* may be of different kinds based on the observations made. They are as follows.

a) Some plant species did not allow the beetles to make galleries in them.

b) Some specific plant species have substances that are known initially to attract the pest and thereafter kill by different means. *ie*. By secreting toxic substances or forming gummy materials to stuck the beetles in it. These plants could be called as trap plants and they may help in effective control of the pest. Further, the toxic substances that are responsible for killing the pest can be isolated for possible use as "botanicals".

c) The beetles were attracted towards some plant species but there was neither brood development nor killing effect. In this situation, if attraction is higher than to tea, an adoption of external killing could be made as a trapping mechanism. However, if they are weak in attraction, they have no use.

d) Some plant species were infested by the beetles and they remained alive to produce a brood, which consisted of eggs, larvae, pupae or young adults. Such plants could serve as a source of new infestation and this category of plants cannot be used in the management of *X. fornicatus* as a diversionary host.

The objective of the present study was achieved by categorizing plants that belong to category "b" (Table 2).

The plants such as *Albizzia moluccana, Calliandra calothyrusus, Psidium guava, Cassis* sp., *Erythrina lithosperma Coffea arabica, Camellia sinensis*, and *Lamtana camera* were found to develop brood. Mean total live stages encountered per occupied gallery in each plant species are given in Table 3.

Danthanarayana, (1968) reported that resistance of *Hakea saligna* to *X. fornicatus* was by exudation of gummy matter, but it was not observed in this study. *Crotolaria* sp. did not produce brood in this study but, it was reported as producing brood (Danthanarayana, 1968).

Flemingea conjesta did not produce brood in the laboratory bioassay work during this study, but the particular field in Mahanilu estate from where the stems were collected showed gallery formation and the brood development almost similar to that of tea, Clone DT1. The reason may be that *X. fornicatus* possibly acting differently in that particular locality. However, this has to be further investigated.

Stems of *Calliandra calothyrusus* showed brood development in the laboratory but apart from the gallery formation a brood development never encountered in the field planted trees from where the stems were collected for this study. According to the observations made in the field, the infested branches of this tree tend to break from the gallery points unlike in *F. conjesta* and this may be the reason for the brood development to annihilate in the field.

Montanova bipinnatifida, a jungle plant reported to have attracting capacity for *X. fornicatus* in India and the authors have made a statement to use cut stems of this plant as a trapping mechanism (Selversundaram, 200). However, the identified plant obtained from the Haggala botanical gardens did not show such an attraction towards the beetles and the attraction was even less compared to that in tea in this study.

Table 1: Mean number of galleries made by the female *Xylebrous fornicatus* in 10 cm stem # Standard error

Plant species	Family	Use/common name	Mean galleries/ 10 cm±SE
Solanum indicum	Solanaceae	Wild plant	0.0
Tithonia diversifolia	Solanaceae	Wild sunflower	0.0
Datura metal	Solanaceae	Wild plant	0.0±0.1
Grevillea pteridifolia	Proteaceae	Shade/fuel	0.2±0.1
Eucatyptus alba	Myrtaceae	Fuel tree	0.2±0.1
Psidium guava	Myrtaceae	Fruit	0.2±0.1
Coffea arabica	Rubiaceae	Beverage	0.3±0.3
Acacia auriculiformis	Leguminosae	Ornamental	0.5±0.3
Gliricidia sepium	Leguminosae	Medium shade	0.6±0.3
Lantana camera	Verbanaceae	Parasite	0.8±0.7
Erythrina lithosperma	Leguminosae	Medium shade	0.9±0.2
Persia gratissima	Lauraceae	Fruit	0.9±0.8
Montanova bipinnatifida	Compositae	Wild plant	1.0±0.0
Crotolaria sp.	Leguminosae	Green manure	1.0±0.0
Eucalyptus sp.	Myrtaceae	Fuel	1.0±0.6
Cassia spectabilis	Leguminosae	Ornamental/shade	1.0±0.3
Tecoma stans	Bignoniaceae	Timber	1.1±0.3
Morus alba	Moraceae	Silkworm host	1.1±0.1
Hakea saligna	Proteaceae	Shelter/shade	1.2±0.6
Albizzia moluccana	Leguminosae	High shade	1.3±0.2
Camellia sinensis (TRI 2025)	Theaceae	Beverage	1.4±0.6
Jakeranda mimosifolia	Leguminosae	Shade	1.5±0.5
Camellia sinensis (DT1)	Theaceae	Beverage	1.6±0.4
Eupatorium iniulifolium	Compositae	Wild plant	1.7±0.1
Grevillea robusta	Proteaceae	High shade	1.8±0.4
Azadirahcta indica	Meliaceae	Neem/timber	2.0±0.8
Cassia sp.	Legumionosae	Shade/ornamental	2.0±0.1
Acacia decurrens	Leguminosae	Medium shade	2.0±0.0
Calliandra calothyrusus	Leguminosae	Medium shade	2.1±0.2
Flemingea conjesta	Leguminosae	Green manure	2.3±0.5

Table 2: Categorization of plant species according to X.fornicatus behaviour.

Category	Plant species
a) beetles never attempted to make galleries	*Tithonia diversifolia* *Solonum indicum*
b) beetles made galleries and dead inside	*Grevillea robusta* *Acacia decurrens* *Cassia spectabilis* *Flemingea conjesta* *Gliricidia sepium* *Jakeranda mimosifolia* *Tecoma stans* *Morus alba* *Eucalyptus* sp. *Hakea saligna* *Eupatorium iniulifolium*
c) beetles live inside galleries	*Montanova bipinnatifida* *Datura metel* *Crotolaria* sp. *Persia gratissima* *Acacia auriculiformis* *Eucalyptus alba* *Grevillea pteridifolia*
d) beetles developed brood	*Azadirachta indica* *Calliandra calothyrusus* *Coffea arabica* *Lantana camera* Psidium guava *Cassia* sp. *Erythrina lithosperma* *Albizzia moluccana* *Camellia sinensis*

Table 3: The mean total number of immature stages found in one occupied gallery

Plant species	Eggs	Larvae	Pupae
Azadirachta indica	3.5	2	1.5
Calliandra calothyrusus	6.8	2.2	0.2
Coffea arabica	0	3	0
Lantana camera	3	1	0
Psidium guava	0	3	0
Cassia sp.	7	3	0
*Erythrina lithosperma**	7	5	0
*Albizzia moluccana**			
*Camellia sinensis**			

* Represents the species in which already brood development was reported.

CONCLUSIONS

Among 29 plant species tested *Lantana camera, Coffea arabica, Azadirachta indica, Erythrina lithosperma, Cassia* sp., *Calliandra calothyrusus, Albizzia moluccana* were found to develop brood and they are not suitable to consider as diversionary hosts for *X. fornicatus*.

Tithonia diversifolia and *Solanum indicum* did not allow the beetle to bore them. Species having more attraction than tea are *Jakeranda mimosifolia, Eupatorium iniulifolium, Azadirachta indica, Grevillea robusta, Acacia decurrens, Calliandra calothyrusus* and *Flemingea conjesta*. In addition, *Grobusta* and *E. iniulifolium* are the only two plant species found to kill beetles effectively.

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