CAN SHOT-HOLE BORER OF TEA (*XYLEBORUS FORNICATUS* EICHH.) INFEST AND GROW IN SHADE TREES OF TEA?

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Introduction

It has been known for a long time that Shot-hole Borer of tea (*Xyleborus fornicatus* Eichh.) can be found in trees that are interplanted in tea to provide shade. It is known that the tea itself sustains a dense infestation and that shade trees are not necessary to perpetuate it. Nevertheless, since there is a good prospect of controlling the beetle in the tea itself, it is worth while examining the importance of alternative hosts for the beetle, which might now become more critical.

A distinction should be made between a host-tree that can merely be infested by the beetle—*i.e.* the beetle can make galleries in it—and a host-tree that can also sustain the growth of the beetle and thus assist in the continuation of the infestation. The presence of galleries with old female beetles in them is evidence only of the first; the presence of well-grown larvae, pupae, or young adults is evidence that the tree can act as a source of new infestation to the surrounding tea.

TABLE 1.—*Summary of literature recording (a) infestation and (b) breeding by Shot-hole Borer in certain shade trees.*

Genus	Species	Infestation	Breeding
Albizzia		Speyer, 1917	
,,	*falcata* (=*moluccana*)	Green, 1903; 1912 Speyer, 1918 Ranaweera, 1959 Judenko, 1961	Green, 1909; 1910 Rutherford, 1914 Judenko, 1961
Erythrina		Speyer, 1917 Judenko, 1961	Judenko, 1961
,,	*lithosperma*	Speyer, 1918 Light, 1927	Gadd, 1942
Grevillea		Green, 1903; 1906 Rutherford, 1914 Speyer, 1917	nil
,,	*robusta*	Speyer, 1918 Gadd, 1942 Judenko, 1961	nil
Gliricidia	*sepium*	Light, 1927 Gadd, 1942 Judenko, 1961	nil

Table 1 summarises the records of infestation of certain trees by Shot-hole Borer and also the records of breeding occuring in the same trees. It is naturally difficult, if indeed possible, to provide firm evidence that the beetle never breeds in a certain species of tree but if the number of searches made is sufficiently large and widespread over both time and space, a failure to find breeding must mean

that if it occurs at all, it is of slight importance. Thus Green (1908) stated that breeding does not occur in *Grevillea*. Gadd (1942) found young stages in various other species of trees, but only adult females in *Grevillea*. Gadd (1942) also looked for and failed to find evidence of breeding in *Gliricidia*.

It should be noted that Green (1912), found seven other species of Scolytidae, apart from *X. fornicatus*, in living, diseased, or dead stems and branches of *Albizzia*, while Green (1912) and Ranaweera (1959) found four other species of bark beetles in *Grevillea*. Careful identification of the species of beetle is essential, for these other species are of no importance to tea.

Present Observations

My observations have been made on the same four species of trees and also on *Albizzia sumatrana*. The trees were kindly identified by Mr J. E. Senaratne, Systematic Botanist, Department of Agriculture, Peradeniya; flowers and fruits of dadap were not available so the species could not be determined, though there is no reason against its being *Erythrina lithosperma*. The beetles were kindly identified by Professor K. E. Schedl, Federal Forest Research Institute of Austria.

The methods used have been partly described before (Judenko, 1960). Living branches of the trees, of diameters five-sixteenth inch to one inch (8-25 mm) were dissected and the adults were collected of all bark beetles (Scolytidae) of about the size of Shot-hole Borer. After identification of species, the sexes of *X. fornicatus* found were determined; since only the females can make galleries (Fisher *et al*, 1953), the presence of males in galleries would generally indicate that they had grown up there. The length was measured of each piece of wood examined, so that a numerical estimate of frequency could be made. The examinations were made in March, April, and July, 1959.

TABLE 2.—*Occurrence of adult beetles of Xyleborus fornicatus in shade trees*

Tree	Estate	Elevation in feet above sea level	Total lengths examined yards	Numbers of the beetles found inside branches			Average *Xyleborus fornicatus* per 100 yards
				females	males	total	
Albizzia falcata (L.) Back. (*moluccana* Miq.)	Pelmadulla	700	21	16	0	16	76
	Hantane	2100	150	286	13	299	199
	Oodewella	2600	100	40	3	43	43
	Queenstown	3000	17	2	0	2	12
Erythrina sp. (dadap)	Oodewella	2600	100	8	0	8	8
	Queenstown	3000	146	50	2	52	37
	Delta	3200	75	8	0	8	11
Gliricidia sepium (Jack) Steud. (*maculata* HBK)	Pelmadulla	700	27	5	0	5	19
	Hantane	2100	150	1	0	1	0.7
	Dartry	2400	150	2	0	2	1.3
	Oodewella	2600	100	3	0	3	3
Albizzia sumatrana V. steenis.	Delta	3200	75	2	0	2	3
Grevillea robusta A. Gunn	Hantane	2100	150	0	0	0	0
	Dartry	2400	150	0	0	0	0
	Oodewella	2600	100	0	0	0	0
	Queenstown	3000	164	3	0	3	2
	Delta	3200	75	2	0	2	3

In Table 2 it will be seen that some Shot-hole Borers were found in each species of tree but that in all cases the males found were a small number compared with the females. In *Grevillea robusta*, in over 600 yards of branch, only five females were found and no males. The absence of males in this tree and also in *Gliricidia sepium* confirms Gadd (1942) in regarding these trees as not concerned in breeding. *Albizzia sumatrana* was not searched so extensively, but gave a similar picture.

At the other extreme, *Albizzia falcata* (*moluccana*) was infested 150 times as much as *Grevillea* and, though males were not common (under 5% of the females), they were commoner than both sexes together in *Gliricidia* and *Grevillea*. Dadap was less heavily infested than *A. falcata* and males were present, though as only 3% of the females.

It will be seen from Table 2 that the weighted average number of beetles per 100 yard of *Albizzia falcata* is 125. For comparison with this, in Table 10 of an earlier paper (Judenko, 1958a), the number in tea per 100 yard was 1070 beetles. In Table 9 of the same publication, the average number was 63.

Innoculation Experiments

There is some degree of uncertainty in conclusions from these observation's partly because male beetles might simply have crawled into the galleries made by the females. There is a more serious difficulty in that in some species of insects there are two or more strains which cannot be separated by examination, though they have different habits. Accordingly King (1941) inoculated certain shade trees with *X. fornicatus* taken from tea and others with beetles taken from castor. He found breeding by the beetles from castor in *Albizzia falcata*, but none by the beetles from tea in this tree, nor in dadap or *Grevillea*. Gadd (1942) thought that the failure to breed might be seasonal, in relation to the condition of the wood.

Since *Albizzia falcata* is seen in Table 2 to be the only species infested much, my experiments have been confined to this tree. Four mature tea bushes, at the same age from planting and from pruning, were dug up and planted in barrels on the verandah of the laboratory at Millawitiya Estate. They were carefully examined and found to have no open beetle galleries. In May 1960, one bush was artificially infested (Judenko, 1958) with 1,000 adults of *X. fornicatus* from *Albizzia falcata*, two bushes with 1,000 of the beetles from tea, and one bush was left as control. In July 1960, the bushes were dissected, with the results shown in Table 3.

TABLE 3.—*Results of artificially infesting tea in tubs with X. fornicatus from tea and from Albizzia falcata.*

Plants from which beetles were taken	GALLERIES			LIVE INMATES					
	Open	healed	totals	eggs	larvae	pupae	yellow adults	black adults	totals
Nil	0	2	2	0	0	0	0	0	0
Tea	44	32	76	0	3	0	1	7	11
Albizzia falcata	101	9	110	8	38	2	8	49	105

Only two healed galleries were found in the tea bush that had not been deliberately infested. The tea bush that had had beetles from *Albizzia* put on it was actually more heavily infested with all stages of the beetles and had more galleries in it than the two tea bushes that had had beetles from tea put on them. Whatever the causes of this may be, it leaves no doubt that *X. fornicatus* taken from *Albizzia falcata* can infest tea.

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Summary

1. Shot-hole Borer of tea (*Xyleborus fornicatus* Eichh.) has previously been found in galleries in the shade trees *Albizzia falcata* (*moluccana*), *Erythrina lithosperma*, *Grevillea robusta*, and *Gliricidia sepium*. These findings have been corroborated and also extended to *Albizzia sumatrana*, but the degree of infestation was trivial except in *Albizzia falcata* and, to a lesser extent, *Erythrina*.

2. Male adults of the beetles were found only in *Albizzia falcata* and *Erythrina*, indicating that only in those species of trees could breeding have occurred.

3. An inoculation experiment showed that *X. fornicatus* collected from *Albizzia falcata* were able to breed in tea.

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