A Promising Method to Protect Mahogany Plantations from Attack by the Shoot Borer, *Hypsipyla robusta* Moore (Lepidoptera: Pyralidae)

Kazuma MATSUMOTO[a], Kusdi MULYADI[b] and Ragil S.B. IRIANTO[c]

[a] *Japan International Research Center for Agricultural Sciences (Ohwashi 1-2, Tsukuba, 305 Japan)*

[b] *Palembang Reforestation Technology Centre (Jl. Kolonel Burian, Palembang, Indonesia)*

[c] *Forest and Nature Conservation Research and Development Centre (Jl. Gunung Batu 5, Bogor, Indonesia)*

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Abstract

Mahogany shoot borer, *Hypsipyla robusta*, is a serious pest of high quality meliaceous timber trees, and no effective method of control has been developed so far. We observed that two experimental plantations of mahogany (*Swietenia macrophylla*) enclosed by acacia trees (*Acacia mangium*) were not attacked by the borer for three years in Benakat, South Sumatra, where the attack by the borer had always occurred in mahogany plantations. This protection method could be promising, though its effectiveness must be reconfirmed by further replication of the experiments.

Additional key words: Meliaceae, *Swietenia macrophylla*, *Acacia mangium*, tropical forest, pest control

Many species of meliaceous trees, such as mahogany, *Swietenia* spp., Spanish cedar, *Cedrela* spp., African mahogany, *Khaya* spp., red cedar or Asian mahogany, *Toona* spp., etc., are promising high quality timber trees in the tropics. However, extensive attack by the shoot borers, *Hypsipyla* spp. (Lepidoptera: Pyralidae), has been deterring the establishment of the plantations. *H. robusta* is an important pest species in the Indo-Australian[5, 6, 8, 11, 12, 13] and Ethiopian Regions[1, 9, 16] and *H. grandella* in the Neo-tropical Region[2, 10, 15, 17]. The larvae of these insects bore into young shoots. The attack does not cause the death of the tree, but once a leading shoot is attacked and dies, branching at the attacked point occurs subsequently, resulting in deformation of

the bole and loss of the economical value of the timber to be harvested in the future (Plate 1). Various protection methods have been attempted without success (for review, see Newton et al.[7]), except for Howard's[4] experiment in which an azadirachtin (a neem extract)-based insecticide was sprayed onto a small number of *S. mahagoni* trees.

In the Benakat Trial Plantation (located in the South Sumatra Province, Indonesia) of Palembang Reforestation Technology Centre (Agency for Forestry Research and Development, Ministry of Forestry, Indonesia), mahogany (*Swietenia macrophylla*) stands so far planted had been always attacked by *H. robusta*, and the attack usually started within two years, mostly within a year, after planting[3, 14]. Based on experiments, Sutomo[14] demonstrated that weeds left uncut around the mahogany could be a physical barrier against the attack by the shoot borer until the height of the trees exceeded that of surrounding weeds. Furthermore, one mahogany stand surrounded by a plantation of an acacia tree, *Acacia mangium*, and a fire belt with five rows of acacia (2 m spacing between rows and 2 m within a row) was not attacked until weeds and lower branches of acacia in the fire belt were cleared in the third year when most of the mahogany trees had reached a height of ca. 4 m. It is assumed that adult *H. robusta* would not fly through dense foliage and vegetation. It is also known that the attack by the shoot borer is reduced to some extent when meliaceous trees are planted in various mixture or enrichment (line) plantations, probably because the presence of other plants may hinder the location of meliaceous trees by the adult moth[7]. If we enclose a mahogany plantation with a densely planted non-host tree species with dense foliage from the lower through upper branches as in the case of *A. mangium*, this species may play a role as a physical barrier against invasion by the moth. Moreover, since *A. mangium* is not a host plant of *H. robusta*, the moth should not colonize in the acacia plantation. Therefore, the acacia plantation may act as a barrier between this mahogany plantation and other mahogany plantations or natural forests where the shoot borer may occur, reducing the possibility of invasion by the borer into the mahogany plantation.

Plate 1. Ten-year-old mahogany trees, *Swietenia macrophylla*, with frequent branching of the bole due to earlier attack by the shoot borer, *Hypsipyla robusta* (Benakat, South Sumatra, March 1991)

It was thus assumed that the enclosure of a mahogany plantation by acacia as a physical barrier could be applied as a protection method against the shoot borer attack. In order to test this assumption, we carried out field experiments in the Benakat Trial Plantation. The experiments were only partially conducted due to the circumstances outlined below. However, we report our results, due to the beneficial effect observed.

Materials and methods

Originally we set up six experimental plots including two control plots in March, 1992. However, since four of them were lost due to repeated fire during the earlier part of the experimental period, data for only the remaining two plots, denoted Plots 1 and 2, will be reported. The two plots were set up in plantations of *A.*

mangium (planting space 2 m × 4 m) in the rainy season between 1988 and 1989. In each plot, 325 *S. macrophylla* trees were planted in a 50 m × 50 m area (2 m × 4 m spacing). The mahogany plantations in Plot 1 and Plot 2 were enclosed by nine and four rows of additional *A. mangium* trees, respectively, planted at the same time as the mahogany trees with a row interval of 1 m and within row spacing of 1 m to ensure the effect of enclosure. Attack of the mahogany trees by *H. robusta* was monitored on December 11, 1992, August 20, 1993, May 2, 1994 and June 14, 1995. The tree height was measured up to the nearest 10 cm in the last two surveys. Weeding was performed occasionally, due to labour constraint. Line weeding, 2 m in width along the row of mahogany trees was performed in 1992, 1993 and 1995, while complete weeding was conducted in 1994, a few days prior to each survey.

Results

There were no attacks by *H. robusta* throughout the experimental period (Plate 2), although the tree mortality was high during the first year (Table 1). The seedlings were planted with a delay, at the end of the rainy season, due to administrative reasons, and a proportion of them dried up in the dry season, resulting in a high mortality. The average tree height was 1.6 ± 0.7(SD) m in Plot 1 and 1.9 ± 1.0 m in Plot 2 on May 2, 1994, and 3.2 ± 1.4 m in Plot 1 and 3.3 ± 1.5 m in Plot 2 on June 14, 1995, but the height varied among the trees (Fig. 1). Due to infrequent weeding, some of the trees were shaded by weeds and remained short, while the height of 61 (32.6%) of the surviving 187 trees exceeded 2 m in May 1994 and that of 99 (56.3%) and 53 (30.1%) of the surviving 176 trees exceeded 3 m and 4 m, respectively, in June 1995. The maximum tree height recorded was 7.0 m in 1995. The surrounding *A. mangium* trees planted together with the mahogany trees reached a height of ca. 10 m in 1995.

Plate 2. Young mahogany trees, Swietenia macrophylla, that were not attacked by the shoot borer, *Hypsipyla robusta*, in the experimental plantation enclosed by *Acacia mangium* (Benakat, South Sumatra, May, 1994)

Table 1. Changes in the survival of mahogany trees (*Swietenia macrophylla*) in Plots 1 and 2

	Number of Surviving trees				
Plot	Mar.1992	Dec.1992	Aug.1993	May 1994	June 1995
1	325	102	88	83	78
2	325	121	107	106	102

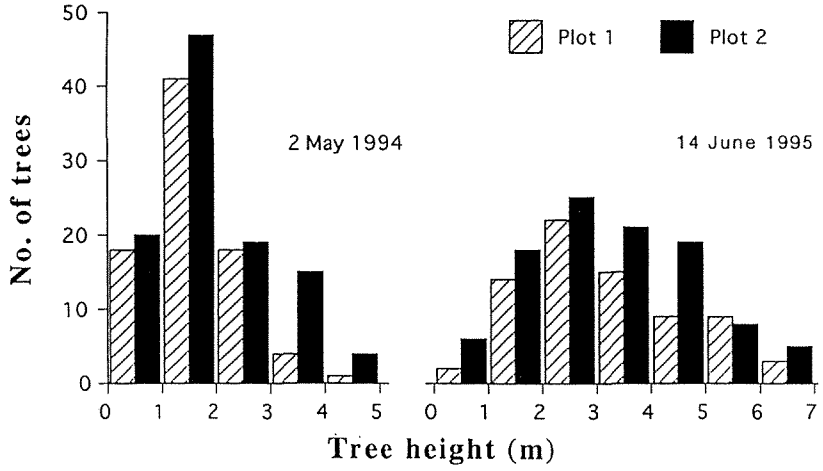

Fig. 1. Frequency distribution of the height of mahogany trees, *Swietenia macrophylla*, in Plots 1 and 2 on May 2, 1994 and June 14, 1995

Discussion

In our experiment, the height of about one third of the planted mahogany trees exceeded 2 m in 1994, above which usually the attack by *H. robusta* frequently occurs. Many trees became taller and in one-third of them the height exceeded 4 m in 1995. The borers did not attack the two plots, indicating the effectiveness of the protection by the enclosure. Planting of mahogany in an enclosure by *A. mangium* trees thus seems to be a promising method to avoid attack by *H. robusta*. The height of *A. mangium*, a well-known fast-growing species, can surpass that of mahogany trees of the same age. Also *A. mangium* has a dense foliage from the lower to upper part of the tree. Therefore, this species is suitable as a physical barrier for the protection of mahogany.

In the earlier part of the experiment, although the growth of some trees was depressed by shading, the presence of weeds may have contributed to some extent to the prevention of attacks by the borer as reported by Sutomo[14]. When the trees are shorter than the surrounding weeds, it is preferable to leave a proportion of weeds uncut as another physical barrier, i.e., circle weeding or line weeding inside the enclosure is recommended.

Presently, however, since the data were obtained from only two plots in Benakat, repeated experiments are necessary to confirm the effectiveness of this protection method. In addition, it remains to be determined whether mahogany plantations larger in size than those in the present study can be protected in the same way. Once a founder female of *H. robusta* invaded a plantation, the offsprings multiply rapidly in the plantation and damage all the mahogany trees. The larger the plantation area, the more likely the invasion by a female. Also, although our experimental plots were set up between plantations of *A. mangium*, we do not know whether a thinner barrier with only some rows of acacia trees in more risk-prone environments, such as near logged-over forests, can protect mahogany trees planted inside. Further experiments should be carried out to address these problems.

Recently, *A. mangium* has been planted extensively for land rehabilitation and/or pulp and timber industries in Southeast Asia. *H. robusta* may not occur in the inner parts of these large scale pure *A. mangium* plantations, and the moth may not fly into the plantation due to the dense foliage as suggested above. Therefore it is suggested that the foresters should consider the use of mahogany trees for a second rotation among

some of the present *A. mangium* plantation areas.

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マホガニーマダラメイガ（*Hypsipyla robusta*）の有望な被害防除法

松本和馬[a)]，クスディー　ムリヤディ[b)]，ラギル　S.B.　イリアント[c)]

[a)]国際農林水産業研究センター
（〒305　つくば市大わし１－２）

[b)]パレンバン造林技術センター
(Jl. Kolonel Burian, Palembang, Indonesia)

[c)]森林自然保護研究センター
(Jl. Gunung Batu 5, Bogor, Indonesia)

摘　要

マホガニーなど多くのセンダン科高級材生産樹種は，新梢穿孔性害虫のマホガニーマダラメイガ（*Hypsipyla robusta*）による被害が大きいため造林が阻まれており，これまで有効な防除法は確立されていない。被害が多発している南スマトラ州ブナカットにおいて，マホガニー（*Swietenia macrophylla*）林分をアカシア（*Acacia mangium*）で囲んだ筆者らの試験区２箇所では，３年間にわたって被害を免れた。今後追試験によって確証を得る必要があるが，この方法は防除手段として有望であろう。

キーワード：センダン科，マホガニ，アカシア，熱帯林，害虫防除