HYPSIPYLA SHOOT BORERS IN MELIACEAE

DFID
Department for International Development

CSIRO

QFRI

RIRDC
RURAL INDUSTRIES RESEARCH & DEVELOPMENT CORPORATION

AusAID

ACIAR PROCEEDINGS No. 97

Hypsipyla Shoot Borers in Meliaceae

Proceedings of an International Workshop held at Kandy, Sri Lanka 20–23 August 1996

Editors: R.B. Floyd and C. Hauxwell

Australian Centre for International Agricultural Research
Canberra, 2001

A Review of *Hypsipyla grandella* Zeller Research in Pará State, Brazil

M.M. Maués[1]

Abstract

The shoot borer *Hypsipyla grandella* Zeller is the most important pest of the forest trees of the Meliaceae family (*Swietenia macrophylla* King, *Cedrela odorata* L. and *Carapa guianensis* Aubl.) in Pará State, Brazil. Despite the economic importance of these species and interest being shown by the timber industry in establishing plantations of *S. macrophylla*, little attention has been given to attempting to solve this problem. Two approaches to diminish the occurrence of attack have been investigated: firstly, to control the insect by the use of light traps; secondly, to use line planting and planting in species mixtures. The light trap proved ineffective even in small-scale plantations. The silvicultural methods reduced the level of attack but did not completely eliminate damage from *H. grandella*. No large-scale trials have been established. Due to the importance of these timbers in the local economy and in the international market, systematic research on *H. grandella* in the Amazon region is recommended as a priority.

TIMBER products are the fourth most important source of export earnings in Pará State, Brazil. The most commercially important species of Meliaceae of the sub-family Swietenioideae are *Swietenia macrophylla* King (Mogno or 'big leaf' mahogany), *Cedrela odorata* L. (Cedro or Cedar) and *Carapa guianensis* Aubl. (Andiroba or Crabwood). These are exported in significant volumes from the state (Carvalho 1994a, b) (Figure 1) but are produced by selective logging from native forest at a rate that is considered unsustainable.

Native species of Swietenioideae have been planted by enrichment of forests, in mixed species plantations and in agroforestry. Areas planted for each species are given in Table 1, with *S. macrophylla* being the most extensively planted. The greatest limitations to planting of these species are: damage caused by *Hypsipyla grandella* Zeller, competition for light in enrichment plantings, nutrient deficiencies and poor genetic makeup of the planting stock (Lyhr 1992). In addition, *Khaya ivorensis* A. Chev. from west Africa and *Toona cilliata* Roem from Asia have been introduced on an experimental scale.

Species of the genus *Hypsipyla* are found throughout the Americas (Berti Filho 1973; Newton et al. 1993). In Pará State, *H. grandella* is the most important pest of Meliaceae, attacking growing shoots of *S. macrophylla*, *C. odorata* and *C. guianensis*. *Hypsipyla ferrealis* only attacks the fruit of *C. guianensis* (Newton et al. 1993). There is no published information about *H. grandella* attack on *T. ciliata* in Pará State, despite an experiment that is being conducted in order to evaluate the 'preference' of *H. grandella* attack in a mixed 1:1 *T. ciliata* and *S. macrophylla* plantation. In an experimental *K. ivorensis* plantation in eastern Amazon, there was no damage caused by *H. grandella*, but there was severe damage by *Trigona* sp. causing either abnormal sprouting or atrophy of the stem (Falesi and Baena 1999).

Control of *H. grandella* investigated in the Brazilian Amazon

In Brazil, despite the economic importance of the Swietenioideae and the interest shown by the timber

[1] Embrapa Eastern Amazon, Entomology Lab. Cx. P. 48, C.P. 66.095-100 Belém, Pará, Brazil. E-mail: marcia@cpatu.embrapa.br

industry in planting *S. macrophylla*, little attention has been directed at the problem of attack by *H. grandella*. Berti Filho (1973) determined methods for the laboratory production of *H. grandella* using artificial and natural diets and studied its life cycle as a first step in the search for biological or chemical control methods. The research that has been conducted on control has followed two approaches (Table 2): firstly control of the insect by the use of light traps, and secondly control through silvicultural systems that reduce insect prevalence.

Light trapping

A light trap experiment was implemented from 1993 to 1995 in a two-year old plantation of *S. macrophylla* in secondary vegetation in the State of Acre (Fazolin and Oliveira 1994). The objectives were to determine the insect population patterns associated with the *S. macrophylla* plantation and to test the effectiveness of the trap in the control of *H. grandella* by capturing adults on an adhesive-coated plastic sheet. Based on three years observations, this method was determined to be ineffective.

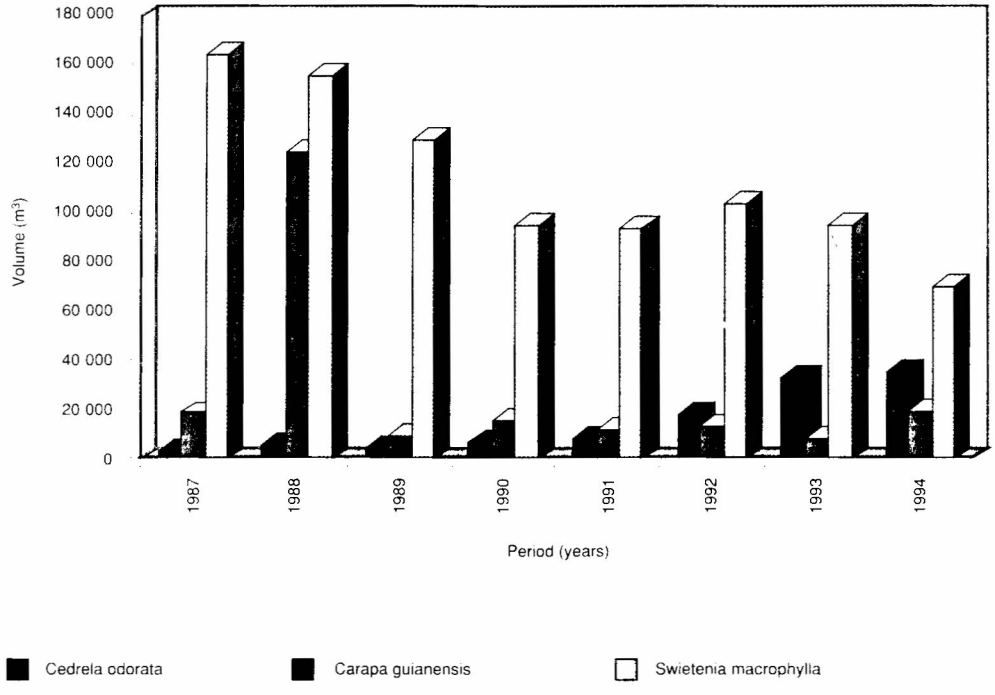

Figure 1. Volume (m^3) of sawn timber exported from Pará State, Brazil in the period of 1987 to 1994. Source: Carvalho (1994a, b).

Table 1. Native and exotic species of Meliaceae subfamily Swietenioideae planted in Pará State, Brazil.

Tree species	Origin	Present area planted (ha)	Program status[1]
Swietenia macrophylla King	Native	603	A
Cedrela odorata L.	Native	100	A
Carapa guianensis Aubl.	Native	100	A
Toona ciliata M. Roem.	Introduced	100	B
Khaya ivorensis A. Chev.	Introduced	100	B

[1] A. Ongoing but having limited or variable success, B. Preliminary or experimental only.

Table 2. Summary of current and past research effort on various aspects of Hypsipyla grandella Zeller biology and control. – none; * minor; ** major.

Area of study	Current research	Historical research
Biology		
Taxonomy	–	–
Life history	–	**
Ecology in natural stands	–	–
Ecology in plantations	–	–
Population dynamics	–	*
Natural enemies	–	–
Other		
Control		
Biological control	–	–
Chemical control	*	–
Silvicultural control	*	**
Provenance trials	–	*
Pheromone studies	–	–
Genetic engineering	–	–
Other		

Silvicultural control

Two alternative strategies of silvicultural control have been attempted; however, the results are inconclusive (Yared and Carpanezzi 1981). The first was to promote rapid establishment and early growth so that the plant quickly passes through the period when it is most susceptible to damage. This can be through site selection and soil preparation (including fertilisation), giving abundant overhead light and lateral shade to promote vertical growth, intensive plantation maintenance (e.g. weeding), and pruning of attacked plants to concentrate vertical growth on one stem. The second strategy was to screen the trees from attack through planting a low density of plants per hectare, creating a dense matrix of other vegetation and maximising forest heterogeneity, thus attempting to reproduce forest conditions.

Ohashi et al. (1993) recommended the first strategy, emphasising rapid growth for the first 4.5 metres and not exceeding 50% shade. Citing Dubois (1978) based on plantations at Curuá-Una Experimental Station, located in the Amazon basin, they recommend that plantations of Meliaceae in the Amazon use wide spacing, partial shading and control of competing vegetation in mixtures with non-susceptible species in groups or lines with less than 100 trees per hectare.

The absence of attack on four year-old *S. macrophylla* and *C. guianensis* in enrichment plantings (the 'ecru' method) in 25-year old secondary vegetation was attributed to the screening (Yared and Carpanezzi 1981). Furthermore, Marques et al. (1993) reported the results of fertilised mixed plantations of *S. macrophylla* with other tree species, including *Cordia goeldiana* Cham., *Dipteryx odorata* Aubl., *Vochisia maxima* Ducke, *Bagassa guianensis* (Aubl.) and *Bertholletia excelsa* (Humb. & Bompl.), and fruit species including *Theobroma grandiflorum* (Willd. ex Spreng.) Schum., *Inga* sp. and banana (*Musa* sp.) in Santarém, Pará. In these trials, *H. grandella* attack was only observed in the second year (21% attack) when the *S. macrophylla* had reached 5.7 m, whereas, at three years and height of 6.9 m, there was little attack. The authors considered that even the attacked trees would produce timber if pruned. It is believed that the lateral barrier provided by banana could explain the reduced and delayed attack.

S. macrophylla and *C. guianensis* have been grown in Taungya along with maize, manioc, and *C. goeldiana*, in Santarém. Attack on one-year-old, 0.8 m high *C. guianensis* was 4%. In the same area, 82% attack was reported on 2-year-old, 5 m high *S. macrophylla* that was planted with maize, banana, *C. goeldiana* and *Cordia alliodora* Huber (Brienza Júnior et al. 1983).

Experimental or commercial-scale plantations of native Meliaceae in Amazonia have been shown to suffer severe attack by *H. grandella* when grown in full sun, but that attack may be reduced in shade. Yared et al. (1988) found 56.8% mortality in plantations of *S. macrophylla* at 3.4 m high in full sun in Belterra, Pará, and up to 100% mortality of *C. guianensis* and *C. odorata* by 6.5 years. The high mortality rates were caused by intolerance to full sun and a severe *H. grandella* attack. Brienza Júnior et al. (1990) report *H. grandella* attack in *S. macrophylla* plantations in Capitão-Poço, Pará, being more pronounced in plantations in full sun, although there was also damage to line enrichment plantings in secondary vegetation. The authors recommended that *S. macrophylla* should not be planted in pure plantations but in conditions of partial shade or in mixed plantations with fast-growing species. Similarly, Kanashiro et al. (1983) reported severe attack by *H. grandella* on provenance trials of *C. odorata* planted in full sun in Belterra, Pará: 50% of plants were attacked at six months and subsequently all plants were attacked, while plants in secondary vegetation in partial shade were not attacked at six months. Berti Filho (1973) also observed less attack in *Cedrela* sp. planted in partial shade compared to full sun in southern Brazil.

Results of growing under shade do not provide consistent protection. Ohashi et al. (1993) conducted an experiment on enrichment planting with *C. odorata* and *C. guianensis* in different light regimes at different spacing in primary and logged humid

Amazonian forest in the Curuá-Una Experimental Station. *H. grandella* attack increased with reduced light and spacing. According to the above-mentioned authors, this happened because more than 50% shade inhibiting growth of the tree and consequently increased of *H. grandella* attack. Rate of growth of Meliaceae in enrichment plantings can be slow. At age 4 years in enrichment plantings in secondary forest, *S. macrophylla* and *C. guianensis* have been reported to have a height increment of 1.3 m per year and a diameter at breast height increment of 1.3 cm/year and 1.5 cm/year respectively (Yared and Carpanezzi 1981). Mean height increment *C. odorata* was recorded as 0.7 m/year after 6 years in enrichment planting in native forest (Ohashi et al. 1993).

Based on the studies described above, partial shade (not surpassing 50% shade), mixed planting and intensive maintenance (fertilisation, weeding and pruning) may reduce *H. grandella* attack in Meliaceae plantations.

Conclusion

Research on *H. grandella* attack on Meliaceae in the Amazon region is preliminary. However, promising results have been shown with measures to accelerate growth and plantings in situations similar to natural forest habitat with a low density of plants per hectare and high species diversity.

Silvicultural methods that avoid attack in the first two years and ensure fast growth can produce a worthwhile timber log. However, adequate protection cannot be assured. It will be necessary to initiate studies on the population dynamics of the insect and further investigate the productivity and economics of different plantation systems on different sites. The potential for genetic resistance through chemical composition or strong recovery following attack also warranted further study.

Acknowledgments

Thanks to Dr Jorge G. Yared and Dr Sílvio Brienza Jr. of the Embrapa Eastern Amazon, for reading and offering suggestions on the manuscript and providing bibliographic material, and to Dr Ian Thompson of the DFID (former ODA) /Embrapa Eastern Amazon for help with the revision of the English and comments.

References

Berti Filho, E. 1973. Observações sobre a biologia de *Hypsipyla grandella* (Zeller, 1848) (Lepidoptera: Phycitidae). Masters dissertation, Escola Superior de Agricultura 'Luis de Queiroz', Universidade de São Paulo, Piracicaba, São Paulo, 108 p.

Brienza Júnior, S., Kitamura, P.C. and Dubois, J. 1983. Considerações biológicas e econômicas sobre um sistema de produção silvo-agrícola rotativo na região do Tapajós. Belém: EMBRAPA-CPATU Boletim de Pesquisa 50, 22 p.

Brienza Júnior, S., Castro, T.C.A. and de Viana, L.M. 1990. Ensaio de espécies florestais sob duas condições ecológicas: 1. Avaliações silviculturais. Anais, 6° Congresso Florestal Brasileiro. Campos do Jordão, São Paulo, 616–624.

Carvalho, G. dos S. 1994a. Evolução dos volumes de madeiras exportados pelo Estado do Pará (período 1987 a 1993). Belém: AIMEX.

Carvalho, G. dos S. 1994b. Evolução dos volumes de madeiras exportados pelo Estado do Pará (período 1988 a 1994). Belém: AIMEX.

Dubois, J. 1980. Silvicultural research in the Amazon. Rome: FAO. Technical Report, 3.19.

Falesi, I.C. and Baena, A.R.C. 1999. Mogno-africano Khaya ivorensis A. Chev. Em sistema silvipastoril com leguminosa e revestimento natural do solo. Embrapa Amazônia Oriental, Documentos 4. 81 p.

Fazolin, M. and D'Oliveira, M.V.N. 1994. Utilização de armadilha luminosa no controle da *Hypsipyla grandella* (Zeller, 1848) em plantio homogêneo de mogno em Rio Branco (AC). In: Resumos, Simpósio Internacional de Estudos Ambientais sobre Ecossistemas Florestais 3, Porto Alegre, 41–42.

Kanashiro, M., Yared, J.A.G. and Marques, L.C.T. 1983. Ensaio de espécies/procedências de *Cedrela* spp. Belém: EMBRAPA-CPATU Pesquisa em Andamento 113, 3 p.

Lyhr, K.P. 1992. Mahogany. Silviculture and use of American mahogany (*Swietenia* spp.). Unit of Forestry. Department of Economics and Natural Resources. The Royal Veterinary and Agricultural University. Copenhagen. 89 p.

Marques, L.C.T. and Yared, J.A.G. 1993. Ferreira, C.A.P. 1993. Alternativa agroflorestal para pequenos produtores agrícolas, em áreas de terra firme do município de Santarém, Pará. Belém: EMBRAPA-CPATU. Boletim de Pesquisa 147, 18 p.

Newton, A.C., Baker, P., Ramnarine, S., Mesén, J.F. and Leakey, R.R.B. 1993. The mahogany shoot borer: prospects for control. Forest Ecology and Management, 57: 301–328.

Ohashi, S.T., Costa, L.G.S. and Pedroso, L.M. 1993. Enriquecimento de floresta tropical mecanicamente explorada com as espécies *Cedrela odorata* L. (Cedro) e *Carapa guianensis* Aubl. (Andiroba), no planalto de Curuá-Una, Pará, Brasil. Boletim da FCAP Belém, 21: 1–21.

Yared, J.A.G. and Carpanezzi, A.A. 1981. Conversão de capoeira alta da Amazônia em povoamento de produção madeireira: o método 'recrú' e espécies promissoras. Belém: EMBRAPA-CPATU Boletim de Pesquisa 25, 27 p.

Yared, J.A.G., Kanashiro, M. and Conceição, J.G.L. 1988. Espécies florestais nativas e exóticas: comportamento silvicultural no planalto do Tapajós. Belém: EMBRAPA-CPATU. Boletim de Pesquisa 49, 29 p.