# Hypsipyla grandella (Lepidoptera: Pyralidae) Boring Khaya ivorensis (Meliaceae) Fruits and Seeds in Brazil: First Report

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# *Hypsipyla grandella* (Lepidoptera: Pyralidae) boring *Khaya ivorensis* (Meliaceae) fruits and seeds in Brazil: first report

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The genus *Hypsipyla* (Lepidoptera: Pyralidae) is found throughout the tropics, and its larvae, which are specialized borers of trees in the family Meliaceae, may damage twigs, branches, leaves, bark, flowers, fruits, and seeds (Taveras et al. 2004; Cunningham et al. 2005; Castro et al. 2016). The mahogany shoot borer, *Hypsipyla grandella* Zeller, is found throughout Central and South America, except in Chile (Perez et al. 2010a). Damage caused by this pest on trees of the subfamily Swietenoideae (Meliaceae), such as mahogany (*Swietenia macrophylla* G. King) and cedar (*Cedrela* spp.), is so intense and severe that they can make commercial plantations of these species unfeasible (Pérez-Salicrup & Esquivel 2008; Jesus-Barros et al. 2015; Castro et al. 2016).

The principal damage occurs when *H. grandella* larvae feed on meristematic shoot tissues, causing loss of apical dominance, bifurcations, and deformations, and resulting in reduction in the economic value of the trees (Zaché et al. 2013; Barradas-Juanz et al. 2016a). There are no effective techniques to control this pest, and integrated management has failed to reduce damage to acceptable levels (Barradas-Juanz et al. 2016b; Castro et al. 2017). The principal strategies to reduce damage by *H. grandella* larvae, with different success rates, are biological and chemical control, and plant resistance (Perez et al. 2010b; Ruiz et al. 2016; Castro et al. 2017).

Exotic Meliaceae, from similar edaphoclimatic regions to those of Brazil (Alves-Júnior et al. 2017) are less susceptible to *H. grandella* than native species (Cunningham et al. 2005; Perez et al. 2010a). African mahogany (*Khaya ivorensis* A. Chev.) (Meliaceae) plantations began in the mid-1970s in the northern region of Brazil and spread during the late 80s, with seedlings originating from seeds (Ribeiro et al. 2016). Restrictions in the market of native Meliaceae (usually endangered species), the high wood quality, and the high resistance of *K. ivorensis* to *H. grandella* encouraged expansion of mahogany plantations using this tree in Brazil (Alves-Júnior et al. 2017; Ribeiro et al. 2017, 2018). However, *H. grandella* has started damaging *K. ivorensis* shoots in Brazil (Zanetti et al. 2017).

The mahogany shoot borer damages native Meliaceae fruits and seeds in Brazil (Pinto et al. 2013; Castro et al. 2017). These reproductive structures are a good source of protein and minerals for insect nutrition (Pinto et al. 2013), and are used to culture *H. grandella* in the laboratory (Barradas-Juanz et al. 2016a; Castro et al. 2016). Damage to reproductive structures may compromise natural forest regeneration (Jesus-Barros et al. 2015), and reduce available material for seedling production (Pinto et al. 2013).

The objective of this study was to report, for the first time, damage on *K. ivorensis* fruits and seeds by *H. grandella* in Brazil. The study was carried out in a *K. ivorensis* plantation for sawn wood production, with about 73,000 trees in 175 ha, spaced 5 × 5 m, in the municipality of Corinto, Minas Gerais, Brazil (18.427500°S, 44.431389°W, 672 masl). Planting was done from Nov 2009 to Nov 2011. Seven-yr-old eucalyptus plantation, pasture, and regenerated "Cerrado" (Brazilian savannah) areas surrounded the *K. ivorensis* plantation. The predominant vegetation in the region is Cerrado, with tropical climate, dry season (Köppen-Geiger climatic classification: Aw), average annual precipitation and temperature of 1,157 mm and 22.4 °C, respectively. Clay-rich yellow latosol predominates, and the topography varies from flat to smooth wavy.

Ripe or almost ripe bored fruits were collected in May 2018 from the soil beneath *K. ivorensis* trees in an 8-yr-old stand. These fruits were taken to the Laboratory of Applied Forest Entomology of the Federal University of Minas Gerais in Montes Claros, Minas Gerais, Brazil, where each fruit was analyzed. The total number of damaged fruits and seeds, total number of *H. grandella* larvae, pupae, and adults per fruit, presence of other organisms, and behavioral aspects of this pest were observed. The identification of *H. grandella* was based on external morphological characteristics of all stages of this insect.

Ten *K. ivorensis* fruits bored by *H. grandella* were collected (Fig. 1-A). These fruits were internally damaged by larvae of this pest (Fig.

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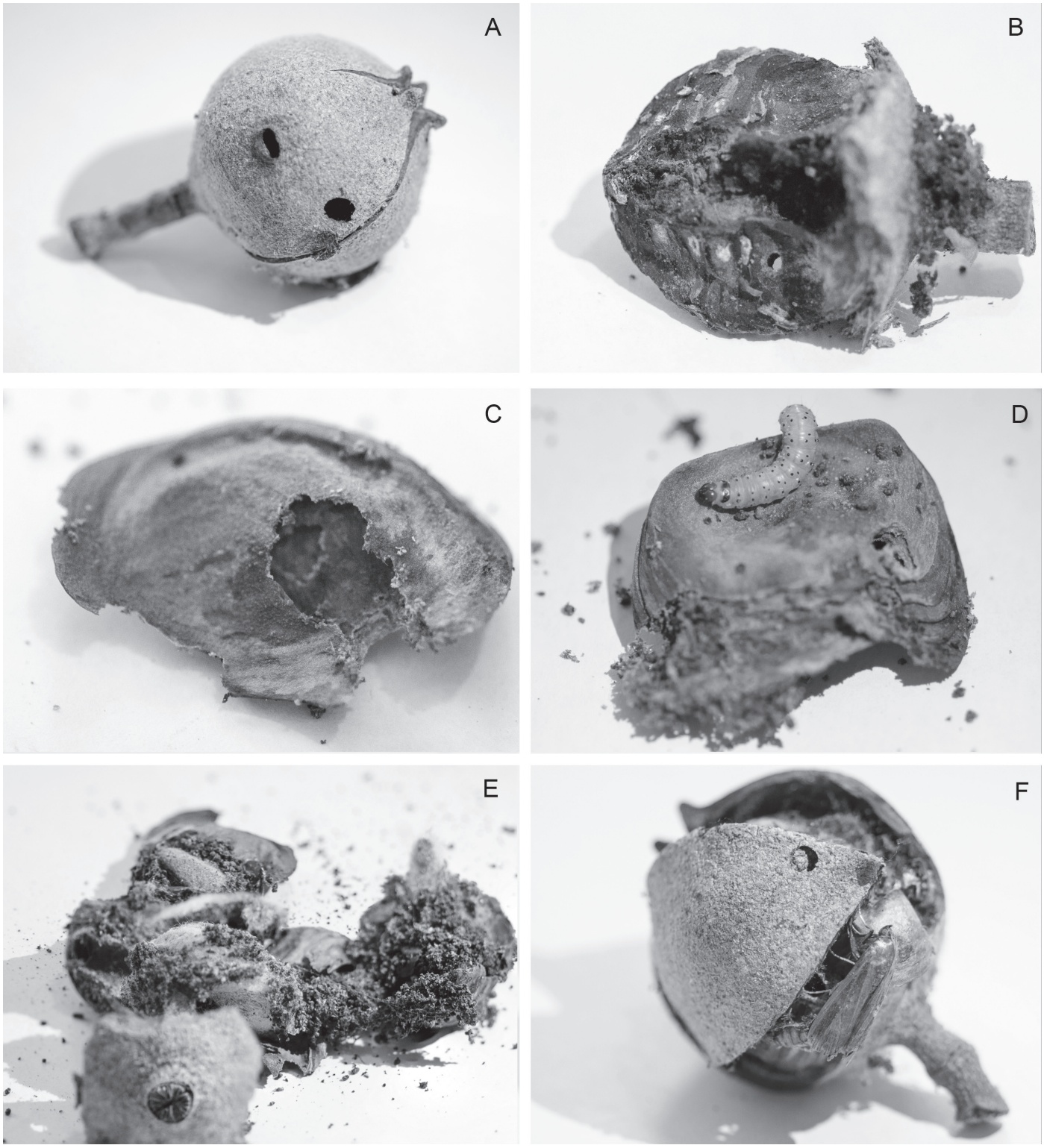


**Fig. 1.** External aspect of a *Khaya ivorensis* (Meliaceae) fruit bored by *Hypsipyla grandella* (Lepidoptera: Pyralidae) (A), internal aspect of a bored fruit (B), and bored seeds (C), *H. grandella* larvae damaging *K. ivorensis* seeds (D), pupae inside the fruit (E), and an adult resting on a bored fruit (F).

1-B), and half of them had exit holes (Fig. 1-A). Each fruit had, on average, 33.6 seeds, with 99.4% of the seeds damaged (Fig. 1-C), and 4.2 *H. grandella* individuals at different development stages. Some fruits did not contain the insect, but they had characteristic *H. grandella* injuries and external exit holes. The mean number of larvae per fruit was 3.4, with up to 13 larvae in a single fruit (Fig. 1-D). Two fruits had 1 and 4 pupae (Fig. 1-E), respectively, and another fruit had 3 *H. grandella* adults (Fig. 1-F). Other insects were found in half of the fruits evaluated, including Diptera larvae in 3 fruits, and 3 Dermaptera adults in 1 fruit.

This is the first record of *H. grandella* damaging *K. ivorensis* fruits and seeds, an exotic plant in Brazil. This is important because this plant

was introduced due to the damage caused by this insect in native Meliaceae, such as *Carapa guianensis* Aubl., *Carapa procera* DC., *Cedrela fissilis* Vell., and *S. macrophylla* (Pinto et al. 2013; Castro et al. 2018). The report of damage by this pest in African mahogany shoots in 2016 (Zanetti et al. 2017), and this report on fruits and seeds, show that the resistance of *K. ivorensis* to *H. grandella* was broken by selective pressure acting over the large area cultivated with this plant in Brazil (Zanetti et al. 2017). In addition, a major concern is the fact that approximately 200 km separates the region where the damage was reported in shoots of *K. ivorensis* with damage to fruits and seeds, suggesting that this problem might be occurring in an extensive area of Brazil.

The total of 13 larvae in a single *K. ivorensis* fruit is higher than that reported for this species occurring in *C. fissilis*, where only 1 larva occurred on average, with a maximum of up to 4 per fruit (Castro et al. 2018). This may be due to the cannibalism of smaller larvae by larger and older ones in *C. fissilis* fruits with many larvae. In addition, the survival of a larger number of larvae per *K. ivorensis* fruit may indicate a better quality of this host for the larvae of this pest. Up to 4 pupae of *H. grandella* were found in a single fruit of *K. ivorensis*, but only 1 pupa was reported in *C. fissilis* fruits (Castro et al. 2018).

The *K. ivorensis* seeds were mostly damaged by *H. grandella*, with greater damage than that reported for *Carapa* spp. injured by *Hypsipyla ferrealis* Hampson (Lepidoptera: Pyralidae) and *H. grandella*, and of *C. fissilis* by *H. grandella* (Pinto et al. 2013; Castro et al. 2018). A diet based on *S. macrophylla* seeds may contain the essential nutrients for development of this insect (Castro et al. 2016). Adults of *H. grandella* from larvae feeding on seeds of *K. ivorensis* developed regularly, but *H. grandella* larvae, when reared on leaves of *Khaya senegalensis* (Desv.) A. Juss. (Meliaceae), have produced malformed adults (Perez et al. 2010a). Seeds of *K. ivorensis* may contain the essential elements for the development of this pest, and those damaged may lose germination potential (Pinto et al. 2013). Even seeds that are partially eaten may have their germination capabilities affected, and production of seedlings in nurseries may suffer, or generate less vigorous seedlings that are more susceptible to the attack by this pest in the field.

The viability of *K. ivorensis* plantations in Brazil should be reevaluated due to recent evidence of the resistance breakdown of this species by *H. grandella*. Damage to fruits and seeds impairs seedling production of *K. ivorensis* and may be a source of inoculum for healthy trees.

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## Summary

*Hypsipyla grandella* (Lepidoptera: Pyralidae) is found throughout Central and South America, except in Chile. Damage caused by this pest in native trees of the subfamily Swietenoideae (Meliaceae) is so intense and severe that it makes industrial forestry with those species unfeasible. It also may damage fruits and seeds of those trees. Damage to reproductive structures may compromise natural regeneration and impair seedling production. Management tactics for this pest include the use of resistant exotic Meliaceae, such as the Australian red cedar (*Toona ciliata* M. Roem.) and the African mahogany (*Khaya ivorensis*). The objective of this work was to report, for the first time, damage to *K. ivorensis* fruits and seeds by *H. grandella* in Brazil. The study was carried out in a plantation for sawwood production, with about 73,000 trees of *K. ivorensis* in 175 ha in Corinto, Minas Gerais, Brazil. Ripe and almost ripe bored fruits were collected from the soil beneath 8-yr-old trees in May 2018. The total number of fruits and seeds damaged, the numbers of larvae, pupae, and adults of *H. grandella* per fruit, the presence of other species, and behavior of this pest were observed. Ten fruits bored by *H. grandella* were collected. The fruits were damaged internally by larvae of this pest, and half of them had exit holes. Each fruit had, on average, 33.6 seeds, with 99.4% of the seeds damaged, plus 4.2 *H. grandella* at different development stages. Some fruits did not have the borer, but they were damaged and had the characteristic exit holes of this species. The average number of larvae per fruit was 3.4, with up to 13 larvae in a single fruit. The damage in African mahogany shoots reported in 2016, and the current damage on fruits and seeds show that resistance of *K. ivorensis* to *H. grandella* has been broken, probably due to selective pressure over the large area planted with this tree in Brazil. African mahogany plantation viability in Brazil will be affected.

Key Words: borer; cedar; mahogany; resistance

## Sumário

*Hypsipyla grandella* (Lepidoptera: Pyralidae) é encontrada em toda a América Central e do Sul, exceto no Chile. Danos por essa praga, em árvores nativas da subfamília Swietenoideae (Meliaceae), são tão intensos e severos, que inviabilizam plantios comerciais das mesmas. Esse inseto pode, também, danificar frutos e sementes dessas árvores. Danos em partes reprodutivas podem comprometer a regeneração natural e reduzir o material para produção de mudas. Técnicas de manejo de *H. grandella* incluem o uso de meliáceas exóticas resistentes como o cedro-australiano (*Toona ciliata* M. Roem.) e o mogno-africano (*Khaya ivorensis*). O objetivo desse trabalho foi relatar, pela primeira vez, danos por *H. grandella* em frutos e sementes de *K. ivorensis* no Brasil. O estudo foi realizado em plantio para produção de madeira serrada com cerca de 73,000 árvores de *K. ivorensis* em 175 ha no município de Corinto, Minas Gerais. Frutos maduros ou próximos à maturação e broqueados foram coletados no solo sob árvores com 8 anos de idade em maio de 2018. O número total de frutos e sementes atacadas, larvas, pupas e adultos de *H. grandella* por fruto, presença de outros organismos e o comportamento desta praga foram observados. Dez frutos broqueados por *H. grandella* foram coletados. Cada fruto tinha, em média, 33,6 sementes com 99,4% danificadas e 4,2 indivíduos (em algum estágio de desenvolvimento) de *H. grandella*. Esses frutos estavam danificados, internamente, por lagartas dessa praga e metade tinha orifícios e alguns não tinham essa broca, mas estavam com injúrias e orifício externo de emergência característicos da mesma. O número de lagartas por fruto foi de 3,4, com até 13 em um único fruto. O registro de danos em ponteiros de mogno-africano em 2016 e o relato atual do ataque a frutos e sementes mostram que a resistência de *K. ivorensis* à *H. grandella* foi quebrada por pressão seletiva da grande área com essa planta no Brasil. A viabilidade de plantios de *K. ivorensis* no Brasil deve ser reavaliada.

Palavras Chaves: broca; cedro; mogno; resistência

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