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Review

Black wattle insect pests currently in Brazil

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This review treats the main insect pests associated with black wattle in Brazil, as an attempt to generate information useful for pest-management programs in plantations of *Acacia mearnsii*. This is the first compilation of insect species associated with black wattle in Brazil. Essential data about biology, behaviour, and evidence of infestation are also presented to improve the detection of pests and prevent invasions of new areas. Occurrences of pests in black wattle are described, and the damage caused by these insects to the plantations is also discussed. The main black wattle insect pest in Brazil is *Oncideres impluviata* (Coleoptera, Cerambycidae), which has been recorded annually in plantations in the state of Rio Grande do Sul.

Keywords: *Acacia mearnsii* pests, black wattle pest status

INTRODUCTION

Acacia mearnsii De Wild (black wattle) is a small tree or a large shrub native to south-eastern Australia (Nair 2007). The black wattle has high adaptive ability, as evidenced by its presence in several regions of the world (Endress 1994; Yazaki 1997; Seigler 2002). Besides Australia, the black wattle also occurs in South Africa; North, Central and South America; many countries of Asia, particularly in India, Indonesia, and China; and several countries of Europe. It is widely grown by companies and small farmers for commercial purposes (Nair 2007; Searle 1997; Stein and Tonietto 1997; http//www.cabi.org/isc/datasheet/2326).

The trees are grown on a large scale because the bark is a good source of tannin, which is essential for leather tanning (Sherry 1971; Schneider 1999; Boland 2006; Nair 2007). Tannin can also be used as anti-corrosive agent and in water treatment procedures (Mangrich *et al*. 2014). Black wattle is also a source of gum, usually employed in the pharmaceutical and food industries (Searle 1997); and is used as an ornamental plant, to control erosion, as a nitrogen-fixer for soil replenishment, and as raw material for paper (Sherry 1971; Kannegiesser 1990; Lorenzi *et al.* 2003; Caldeira *et al.* 2004).

A. mearnsii can also be used to produce charcoal (Oliveira 1968; Caldeira *et al.* 2003; Riegel *et al.* 2008), and due to its low lignin content, it has been used to produce cellulose (Freddo *et al.* 1999). Mixing *A. mearnsii* with *Pinus elliottii* Engelm and *Eucalyptus grandis* (Hill, 1862) can improve the structure of particleboard (Hillig *et al.* 2002). The plant has also been used in erosion control and reforestation projects (Schneider *et al.* 2005). In Brazil, *A. mearnsii* is economically and socially important in the southern Brazilian state of Rio Grande do Sul, because large numbers of small growers cultivate the tree under contract with companies (Stein and Tonietto 1997).

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Among the most common phytosanitation problems for black wattle are: root rot, a disease caused by the fungus *Phytophthora* (Santos *et al.* 2001); and the insect species *Adeloneivaia subangulata* (Herrich-Schäffer, 1855) (Lepidoptera: Saturniidae); *Platypus sulcatus* (Chapuis,1865) (Coleoptera: Platypodidae); and especially *Oncideres impluviata* (Germar, 1824) (Coleoptera: Cerambycidae), the longhorn beetle (Amante *et al*. 1976; Bressan and Santos 1985; Santana and Santos 2001). In Brazil, *O. impluviata* is currently the main pest of *A. mearnsii* (Amante *et al.* 1976; Baucke 1958; Stein and Tonietto 1997). In this review we present the first compilation of the main black wattle insect pests, and also potential pests of this plant occurring in Brazil.

Acacia spp. in the world and in Brazil

The genus *Acacia* contains about 1300 species (Seigler 2002; Endress 1994), of which more than 800 are endemic to Australia (Yazaki 1997), predominantly in tropical and subtropical areas (Dillon and Dillon 1945; Rice 1986). *A. mearnsii* is the third most cultivated forest species in Brazil along with rubber, teak and araucaria trees, behind *Eucalyptus* spp. and *Pinus* spp. (Abraf 2013). The first seeds were brought from South Africa in 1928 to Rio Grande do Sul (Oliveira 1968; Fleig 1993; Stein and Tonietto 1997) and since 1930 acacia growing has become an important agricultural activity, allowing the country to reach self-sufficiency in tannin production (Schneider and Tonini 2003).Black wattle plantations in Brazil are currently estimated to cover 140,000 to 200,000 hectares (Higa and Resende 1994; Stein and Tonietto 1997; Ildes 2002, 2007; Nair 2007; Attias *et al.* 2013). Many small farmers currently cultivate *A. mearnsii* in Brazil (Attias *et al.* 2013), comprising 60% of the black wattle plantations in the country (Tonietto and Stein 1997). The raw wood produced is exported as wood chips to Japan for the manufacture of cellulose (Lisboa 2009).

The main insect pests of _Acacia_ spp. outside Brazil

Nair (2007) provided a valuable overview of pests of *A. mearnsii* occurring in Australia, South Africa, Kenya, China, India, and included two citations for Brazil. Previous surveys in South Africa also indicated the existence of a significant diversity of phytophagous insects associated with *Acacia* spp. (Hepburn 1966; Swain and Prinsloo 1986), belonging to the orders Coleoptera (46.1%), Lepidoptera (35.7%), Hemiptera (11.8%), Isoptera (3.6%), Psocoptera (1.4%), Orthoptera (0.9%) and Thysanoptera (0.5%). Govender (2007) recorded 14 groups of pests responsible for 60% of the mortality of *A. mearnsii* seedlings; members of the order Coleoptera, including the family Scarabaeidae and the subfamilies Rutelinae and Melolonthinae, were the dominant taxonomic group.

The main insect pests of _A. mearnsii_ in Brazil

In Brazil, although cultivation of *A. mearnsii* has increased (Abraf 2013), knowledge of the insect fauna associated with the different phenological stages of the plant is still sparse. Comparing the study by Menschoy and Baucke (1966) of insects associated with *Acacia* spp., with the findings of Govender (2007) and the records documented in Brazil (Amante *et al.* 1976; Bressan and Santos 1985; Pedrosa-Macedo *et al.* 1993; Tarragó and Costa 1990; Oliveira *et al.* 2006) suggests that the diversity at the order level present in Brazil is similar to other countries, including the predominance of coleopterans.

Insects are certainly among the main phytosanitation problems in black wattle plantations in Brazil. Their role as pests is directly related to their population density and the size of the cultivated area (Stein and Tonietto 1997). Insects attack the entire plant, ingesting both the bark and leaf tissues, sucking the sap, or attacking the wood, seeds and roots (Searle 1997).

The insects that are most frequently associated with black wattle belong to the orders Coleoptera, Lepidoptera, Hymenoptera and Hemiptera. In Brazil particularly, it is very common to find branches that have been severed by beetles (Amante *et al.* 1976), which significantly alter the tree architecture and can cause significant economic damage (Calderón-Cortés *et al.* 2011). The leaves are generally destroyed by defoliating caterpillars (Lepidoptera) or beetles (Bressan and Santos 1985; Pedrosa-Macedo *et al.* 1993; Tarragó and Costa 1990; Oliveira *et al.* 2006). Ants are important consumers of leaves and seeds (Costa and Link 2014).

Order Coleoptera

Coleopterans are economically important because many species are associated with forests (BertiFilho 1981), seriously damaging the trees in a variety of ways (Pedrosa-Macedo *et al.*1993; Oliveira *et al.* 2006; Oliveira and Costa 2009). This is the most important order of black wattle insect pests. Below we present records of the presence and damage caused to black wattle by beetles, including comments about the type of injury caused by the insects and also some evidence of their presence in the trees.

Stator limbatus (Horn 1873) is a species of the family Chrysomelidae, which has been associated with black wattle seed predation (Oliveira and Costa 2009). These beetles lay eggs in seeds, their larvae feed on them, and hatching adults make round holes, damaging the seeds. The wood borer *Platypus sulcatus* (Platypodidae) has been

documented in black wattle as building transverse and longitudinal galleries in the trees and consequently weakening the plant support, as well as facilitating the entry of pathogenic microorganisms that cause several diseases (Pedrosa-Macedo *et al*. 1993). Some typical signs of this infestation are the presence of gum and sawdust (Santana and Santos 2001). The occurrence of gummosis caused by the fungus *Phytophthora* sp. is associated with weakening of the tree, as a consequence of attacks by *P. sulcatus* (Santana and Santos 2001).

Two beetle species of the family Scarabaeidae, *Macrodactylus suturalis* (Mannerheim, 1829) (Melolonthinae) and *Rutela lineola* (Linnaeus, 1767) (Rutelinae), have also been observed attacking leaves and inflorescences of *A. mearnsii*. On the other hand, *M. suturalis* has also been observed as a black wattle pollen disperser (Gomes Costa 1943; Oliveira *et al.* 2006; Alves and Marins-Corder 2009).

The beetle *Phaops thunbergi* (Dalman, 1823) (Curculionidae) has been recorded defoliating the *A. mearnsii* follicular system in commercial plantations (Oliveira *et al.* 2006). The species feeds preferentially on young leaves, significantly reducing the leaf area with serious consequences for the photosynthetic activity as well as the development of the plant. Severe attacks on seedlings will kill the plants (Oliveira *et al.* 2006).

The occurrence of members of Scolytinae (Curculionidae) in Brazilian *A. mearnsii* plantations has been recorded by using ethanol-baited flight intercept traps. Machado *et al.* (2014) recorded 25 species of Scolytinae, of which the most abundant were *Hypothenemus eruditus* (Westwood 1836), *Xyleborinus saxeseni* (Ratzeburg 1837), *Hypothenemus* sp., *Microcorthylus quadridens* (Wood 2007) and *Corthylus pharax* (Schedl 1976). A previous study conducted by Murrai (2005) found 37 species, and the main genera were *Ambrosiodmus, Hypothenemus, Monarthrum, Xyleborinus, Xyleborus* and *Xylosandrus.* However, these records were obtained using only traps.

One study has reported specimens of Scolytinae collected from branches and trunks, although the species has not yet been identified (Lemes *et al.* 2013). The direct association between beetles and branches is essential for studies emphasizing phytosanitation aspects in *A. mearnsii*, since members of Scolytinae may transmit pathogens, as documented for the fungus *Ceratocystis fimbriata* Ell. & Halst, the agent of mango wilt, which is disseminated by the species *Hypocryphalus mangiferae* Stebbing1914 (Batista 2010; Ferreira *et al*. 2010). This has particular relevance because *C. fimbriata* has been identified as the fungus causing the similar disease in black wattle in Brazil (Ribeiro *et al.* 1988; Santos 2004).

The family Cerambycidae is the most important taxonomic group for black wattle in Brazil. This family has more than 25,000 species described in the Neotropical region, with 1,550 genera, and nine of them, which are twig-girdlers, have been recorded in Brazil (Costa Lima 1955; Baucke 1958; Dillon and Dillon 1946; Amante *et al*. 1976; Monné 2005; Galileo and Martins 2006). Members of the genus *Oncideres* are the most frequent and abundant in *A. mearnsii* (Monné 2002), occurring throughout Brazil (Link *et al.* 1994; Witeck Neto and Link 1997; Coutinho *et al.* 1998). Usually, adult females cut branches and lay eggs inside them, changing the entire plant architecture and causing serious economic damage (Amante *et al*. 1976; Calderón-Cortés 1997).

Several twig-girdler species are considered to be potential pests of blackwattle in Brazil (Galileo and Martins 2006). Link *et al.* (1984) listed about 35 plant species capable of hosting *Oncideres saga* (Dalman, 1823), including black wattle (Magistrali *et al.* 2008). Three other twig-girdler species, *O.dejeani* (Thomson,1868), *O. ocularis* (Thomson, 1868) and *O. impluviata*, have been recorded as injuring black wattle and reaching other Brazilian regions; they have been recorded mainly in Rio Grande do Sul (Baucke 1958; Amante *et al.* 1976; Galileo and Martins 2006;Seffrin*et al.* 2006), probably because this state has the largest area planted to black wattle in the country, with a high concentration of monocultures.

O. impluviata is native to South America, and its host species include members of Mimosaceae, Caesalpiniaceae and Aquifoliaceae (Galileo and Martins 2006). This is the most important pest of black wattle currently in Brazil, and the available records of damage indicate its negative effect on the plants, causing heavy damage to the plantations (Cabi 2005). This species attacks black wattles of all ages, but prefers older plants, which have thicker branches (Costa and Marques 1988; Link and Costa 1993). Attack by *O. impluviata* may kill trees that are less than four years old. Older trees may survive but their branches tend to bifurcate, signaling the presence of *O. impluviata* (Amante *et al.* 1976).

O. impluviata females ring the branches of black wattle, cutting them before laying their eggs. This behavior interrupts the sap flow, damaging the tree (Amante *et al.* 1976). The larvae feed on the dry wood, boring into it and building galleries inside the branch (Amante *et al.* 1976). The insect spends about a year in this stage, and in Brazil the adults generally emerge between November and January, when they then infest new trees (Baucke 1958; Amante *et al.* 1976). Control of *O. impluviata* involves manually collecting and burning the branches (Amante *et al.* 1976; Kirch 1983).

Order Lepidoptera

Two species of this order have been cited as the main black wattle pests, *Adeloneivaia subangulata* (Lepidoptera:

Saturniidae) and *Thyrinteina arnobia* (Stoll, 1782) (Lepidoptera, Geometridae). Newly hatched caterpillars of *A. subangulata* scrape the leaf blade, and from the third instar start to eat leaves and apical buds. *T. arnobia* has been recorded as completely defoliating tree tops (Tarragó and Costa 1990). This species is also considered to be the main defoliator of *Eucalyptus* spp., and has been cited as the cause of frequent outbreaks in these plantations (Zanuncio *et al.* 2000).

Other orders

Little information is available concerning other orders of insects with species that damage *A. mearnsii* in Brazil. This section summarizes the information on different orders, which is scattered through the literature. In Hymenoptera, leaf-cutting ants are the most important taxonomic group affecting black wattle plantations. Leaf-cutting ants are currently considered to be the main Brazilian forestry pest, because of their habit of totally eating the leaf blade, causing heavy damage to trees (Della Lucia 2011). In *A. mearnsii* plantations, the leaf-cutting ant most frequently recorded is *Acromyrmex* spp. (Costa *et al.* 2011). Although leafhoppers are often observed on black wattle, mainly on nursery plants, the only record in South America is of *Aethalion reticulatum* (Linnaeus, 1767*)* (Hemiptera: Aethalionidae) on *Acacia* spp. (Arce de Hamity. 2003).

REMARKS

Based on the benefits that *A. mearnsii* provides to Brazil, especially the southern region, more extensive studies of the insect diversity in black wattles are needed in order to determine the best way to deal with the insect diversity, not only pests, but also natural enemies and beneficial species. This review describes the current status of black wattle insect pests and their significant impacts on the plantations. We hope that new information about insect diversity associated with *A. mearnsii* will soon be available to help in the implementation of alternative pest-management programs, especially the use of natural enemies, to attenuate the negative impacts of pests and make the Brazilian forestry sector sustainable.

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