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Anais do 1º Simpósio do Cone Sul sobre Manejo de Pragas e Doenças de *Pinus*

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Scolytidae in pine plantations: Overviews and situation in Brazil
Escolitídeos nas florestas de Pinus *no Brasil*

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ABSTRACT: Scolytidae are among the most destructive conifer forest pests throughout the world. The phleophagous species (bark beetles) are the predominant group in temperate regions, where they cause millions of dollars in losses in outbreak years. Xylomycetophagous ambrosia beetles predominate in the tropics, and they cause, when compared to bark beetles, less damage, and it is more difficult to quantify. In Brazil, ca. 35% of the reforested area is occupied by tropical and subtropical *Pinus* species, all of which exotic. Scolytid beetles are growing in abundance and diversity in these forests, but to date no attacks on live trees were registered. While the host selection mechanism for some bark beetles, including primary and secondary attraction, has been studied intensively, host-selection behavior for the ambrosia beetles has generally received little attention. Several ambrosia beetles are known to respond to the kairomone ethanol (primary attraction), but recent experiments showed that some species also respond to other pine host kairomones, alone or in combination with ethanol. Secondary attraction in ambrosia beetles is reported in very few species, none of them in the tribe Xyleborini, which comprises the majority of the most abundant Brazilian scolytid species. Monitoring in Brazilian forests has been traditionally conducted by the use of vane traps, baited with ethanol. However, there are clear indications that some other trap type models, combined with different lures, are more efficient in trapping certain species of scolytids.

KEYWORDS: Ethanol, Kairomone, *Pinus*, Scolytidae beetles or scolytid, Xyleborini

RESUMO: Besouros da família Scolytidae estão entre as pragas mais sérias de florestas de coníferas no mundo. As espécies fleófagas (besouros da casca) são o grupo dominante em regiões temperadas, onde causam milhões de dólares de prejuízos em anos em que atingem surtos epidêmicos. Besouros da ambrosia, xilomicetófagos, predominam nos trópicos, onde causam danos comparativamente menores, quando em comparação com os besouros da casca, além destes serem mais difíceis de se quantificar. No Brasil, cerca de 35% da área reflorestada é ocupada por espécies de *Pinus* tropicais e subtropicais, todas estas exóticas. Escolitídeos estão aumentando em abundância e diversidade nestas florestas, mas até a presente data não há registros de ataques a árvores vivas. Enquanto que o mecanismo de seleção hospedeira para alguns besouros da casca , incluindo os processos de atração primária e secundária, tem sido estudado intensivamente, o comportamento de seleção hospedeira para besouros da ambrosia tem recebido, de forma geral, pouca atenção. Vários besouros da ambrosia são conhecidos por responder ao cairomônio etanol (atração primária), mas experimentos recentes evidenciaram que algumas espécies respondem também a outros cairomônios dos pinos hospedeiros, tanto sozinhos como em combinação com etanol. Uma atração secundária em besouros da ambrosia é conhecida para muito poucas espécies, nenhuma delas na tribo Xyleborini, que engloba a maioria das espécies brasileiras mais abundantes de Scolytidae. O processo de monitoramento em florestas

brasileiras tem sido conduzido tradicionalmente pelo uso de armadilhas de impacto, iscadas com etanol. Entretanto, há claras indicações de que outros modelos de armadilhas, combinados com atrativos distintos do etanol, são mais eficientes na captura de certas espécies de Scolytidae.

The family Scolytidae is a relatively large group within the Coleoptera, with approximately 6,000 described species (Wood, 1986). Based on their feeding habits, these beetles can be generally classified into phloeophagous, xylomycetophagous, xylophagous, myelophagous, herbiphagous and spermophagous species (Atkinson and Equihua-Martinez, 1986; Browne, 1961). The most important groups economically are the phloeophagous and xylomycetophagous scolytids.

The phleophagous species, which feed primarily on phloem tissue, are also known as bark beetles. Those beetles are the predominant group in temperate regions (Noguera-Martinez and Atkinson, 1990), where they are among the most destructive conifer forest pests (Paine et al., 1997). The main bark beetle pests, which include species able to kill standing trees, are found in the genera *Dendroctonus*, *Ips* and *Scolytus* (Lie and Bakke, 1981; Arbeitsgruppe Waldschutz, 1984; Drooz, 1985), and losses often reach millions of dollars in outbreak years (Lie and Bakke, 1981; Drooz, 1985; Niemeyer, 1985; Miller et al., 1987). In southeastern USA the bark beetle guild, composed of *Dendroctonus frontalis Zimmermann*, *Dendroctonus terebrans* (Olivier), *Ips calligraphus* (Germar), *Ips grandicollis* (Eichhoff) and *Ips avulsus* (Eichhoff) (Birch et al., 1980) is considered to be the most destructive group of forest insects (Smith et al., 1993).

In the tropics, the xylomycetophagous species predominate (Chandra, 1981; Atkinson and Equihua-Martinez, 1986; Flechtmann et al., 1995). Those beetles are also known as ambrosia beetles, and they feed primarily on ambrosia fungi which they introduce into their hosts and also cultivate (Batra, 1967). When compared to bark beetles, ambrosia beetles cause less damage, and it is more difficult to quantify (Samaniego and Gara, 1970). Ambrosia beetles are able to attack and kill healthy trees only sporadically (Beaver, 1988). The most serious losses caused by these beetles is through degrade of lumber (Graham and Boyes, 1950; Dobie, 1978) and export barriers (Hosking, 1969; Borden and McLean, 1980). In the neotropics these beetles are frequently characterized as a constant nuisance (Fisher et al., 1953); however, in certain temperate regions such as British Columbia sawmills, ambrosia beetle damage can amount to millions of dollars per year in decked logs (Lindgren and Fraser, 1994).

In Brazil, more than 95% of the plantations consists of just two genera of trees, *Pinus* and *Eucalyptus*, both of which are exotic. Pine forests, mainly tropical (*Pinus oocarpa* and *Pinus caribaea*) and sub-tropical pines (*Pinus taeda*) cover about 35% of the total planted area. Reforestation in Brazil is relatively new, as establishment for most of these plantations began in the mid 60's. For years pine plantations remained surprisingly free of pests, and to this date few insects constitute any regular, economically important pests (Schönherr and Pedrosa-Macedo, 1979; Flechtmann et al., 1995). This may occur because there are only three narrowly distributed native conifer species in Brazil (Marchiori, 1996), none in the genus *Pinus*, leaving predominantly hardwood native insects to adapt to the introduced pines. In this country, xylomycetophagous species are the most important group of scolytids (Flechtmann et al., 1995).

In Brazil, records of ambrosia beetle damage in pines are becoming more common. So far, damage has been restricted to newly felled trees, stumps and lumber banned from export (Flechtmann et al., 1995). Attacks on live pines have not been recorded.

Once newly emerged scolytids leave their breeding hosts, they need to find new suitable hosts. There are two main hypothesis for how bark beetles are able to locate and select their hosts; attraction to host volatiles of susceptible trees or pioneer beetles randomly landing on hosts and non-hosts alike and selection of susceptible trees (Payne, 1986; Byers, 1989; Gara et al., 1993). Apparently aggressive bark beetles (species able to attack healthy standing trees) are usually not attracted by host kairomones (Byers, 1989; Byers, 1995). Secondary bark beetles however, those that colonize dying or decaying trees, are considered to be strongly attracted to either host volatiles, ethanol or a combination of both (Phillips et al., 1988; Führer et al., 1991; Byers, 1992; Werner, 1995).

While the host selection mechanism for some bark beetles has been studied intensively, host-selection behavior for the ambrosia beetles has generally received little attention (Phillips et al., 1989; Kelsey and Joseph, 1997). Ambrosia beetles colonize mainly dead or dying trees, and they must be able to detect and locate a suitable breeding material, which is usually scarce and ephemeral (Lindelöw et al., 1992).

Xylomycetophagous ambrosia beetles are polyphagous, with generally low host specificity (Beaver, 1979). Little is known about the importance and relationship of tree host kairomones and ambrosia beetle host preference (Kelsey and Joseph, 1997). Some ambrosia beetles respond to primary pine host attractants, using them as cues in host location (Bauer and Vité, 1975; Hines and Heikkenen, 1977; Fatzinger, 1985).

Ethanol however, produced in stressed trees (MacDonald and Kimmerer, 1991; Kelsey, 1994) and mainly in fallen trees or cut logs (Lindelöw et al., 1992; Kelsey, 1994), seems to represent the crucial mechanism in host location for many ambrosia beetles (Samaniego e Gara, 1970; Klimetzek et al., 1986; Phillips et al., 1988; Byers, 1992; Flechtmann et al., 1995), often acting also as a synergist to monoterpenes (Bauer and Vité, 1975; Liu and McLean, 1989).

Ethanol attracts a wide variety of ambrosia beetles, and acts as a synergist for host kairomones or pheromones for both ambrosia and bark beetles (Bauer and Vité, 1975; Chénier and Philogène, 1989; Byers, 1995; Werner, 1995). In Brazil, ethanol (used as baits in traps) is a good attractant for many Brazilian ambrosia beetles (Marques, 1984; Carrano-Moreira, 1985; Flechtmann et al., 1995). While several Brazilian ambrosia beetles respond to ethanol-baited traps, very little is known about the relative attractiveness of host volatiles.

The only experiment reported in the literature in Brazil to study the attractiveness of logs of tropical pines relative to ethanol-baited traps was conducted in the southern part of the country (Flechtmann et al., 1999). Results, based on the response of ambrosia beetles to pine log volatiles and ethanol, indicated that these beetles could be divided into 3 groups: (1) species attracted to ethanol and that do not respond to pine terpenes (*Ambrosiodmus hagedorni*, *Ambrosiodmus retusus*, *Xyleborus spinulosus*, *Corthylus schaufussi*, *Cryptocarenus heveae* and *Hypothenemus obscurus*), (2) species attracted to ethanol but still responding to pine terpenes (*Xyleborinus gracilis*, *Xyleborus affinis*, *Hypothenemus eruditus*, *Premnobius cavipennis*) and (3) species attracted to pine terpenes and that do not respond to ethanol (*Ambrosiodmus obliquus*, *Xyleborus ferrugineus*, *Xyleborus catulus*). Moreover, scolytid beetles showed a preference over one or another tropical pine species; *Pinus caribaea* var. *bahamensis* was the least attractive of the pine species studied, while *Pinus oocarpa* was the most attractive (Flechtmann et al., 1999).

The existence of xylomycetophagous ambrosia beetles that prefer pine volatiles over ethanol is a clear indication that native scolytid species are adapting to the exotic pine species. It is hard to predict with certainty though if and when these beetles will evolve to the next logical step, i.e. attacks on live, stressed trees, as they already do with hardwoods.

Secondary attraction occurs in many bark beetle species (Borden, 1982), but in scolytid ambrosia beetles, it is recognized in just a few Corthylini (*Gnathotrichus*) and Xyloterini (*Trypodendron*) (Byrne et al., 1974; Macconnel et al., 1977; Borden e McLean, 1979). In Xyleborini, it appears that pheromone production is lacking (Beaver, 1977; Klimetzek et al., 1986), even though no specific experiments proving this are found in the literature. Preliminary experiments conducted on 3 Xyleborini species failed to find any indication that they might produce any kind of sex or aggregation pheromone (Flechtmann et al., unpub.), therefore corroborating in part literature indications.

In most insect pest management programs, a suitable monitoring system is vital for determining when insects are active, and can help to determine if any control measures are warranted (Milligan et al., 1988). Traps baited with primary, secondary or often a combination of both attractants are one of the most widely used and practical methods for detection and survey of insect populations, including scolytids (Chénier and Philogène, 1989; Turchin and Odendaal, 1996). Moreover, traps can be a key component in scolytid pest control (Bakke et al., 1983; Abgrall, 1986; Egger, 1987; Lindgren and Fraser, 1994).

In Brazil, survey and detection of Scolytidae is normally conducted with a ”pane type” trap (Flechtmann et al., 1995). None of the traps traditionally used in North America and Europe had been tested in Brazil except for one case. Flechtmann et al., unpub. compared the efficacy of the most widely used trap type in Brazil, the ESALQ-84 (Berti Filho and Flechtmann, 1986), with the traps most commonly employed in North America and Europe: the Canadian multiple funnel trap (Lindgren, 1983), the German slot trap (Niemeyer et al., 1983) and the Scandinavian drainpipe trap (Bakke et al., 1983). Results indicated that the efficiency varied according to the scolytid species; the slot trap performed very well in trapping the most economically important scolytid species in eucalypt plantations in Brazil, which are *P. cavipennis*, *X. affinis* and *X. ferrugineus*.

Overall, it appears that scolytids might grow in economic importance in plantations in Brazil. Basic research on beetle biology, primary and secondary attraction, plus an efficient monitoring program, are urgently needed.

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