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# Use of etanol in the collector recipiente of ethanolic traps as attractive bait for Scolytinae (Coleoptera: Curculionidae) in eucalyptus stands in region of Cerrado

## *Uso de trampas de etanol con y sin cebo para subfamilia Scolytinae (Coleoptera: Curculionidae) en bosques de eucalipto en la Región de Cerrado*

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**ABSTRACT**

Trap models for Scolytinae generally use attractive bait-holders and a collector with ethanol to store the insects. The aim of this paper was verify if the ethanol in the container insect collector can be used as an attractive substance, without need of an extra compartment. The study was carried out in Cuiabá, state of Mato Grosso, Brazil, between June 2009 and May 2010 in stands of *Eucalyptus camaldulensis*, *Eucalyptus urophylla* x *Eucalyptus camaldulensis*, *Eucalyptus urophylla* x *Eucalyptus grandis* and native cerrado. Eight escolitídeo-curitiba model traps were installed in each environment, four with 96% ethanol bait holders and the others without attractive. In all traps 70% ethanol was used in the insect collecting container. In the bait traps 2,246 insects and 2100 insects were collected in the no bait, totaling 4,436 insects distributed in 13 genus and 24 species. The use of traps with ethanol baits had no significant effect on insect collection during the evaluated period and regardless of the environments.

**Keywords:** Ambrosia beetles, ethanol, insect bait.

***RESUMEN***

*Los modelos de trampa para insectos, subfamilia Scolytinae, generalmente usan portadores de cebo atrayentes y un receptor de etanol para conservar los insectos. El objetivo de esta investigación fue verificar si el etanol en el contenedor de recolección de insectos es eficiente como un atractivo sin la necesidad de un compartimiento adicional. El estudio se llevó a cabo en el municipio de Cuiabá, provincia de Mato Grosso, de junio de 2009 a mayo de 2010 en* Eucalyptus camaldulensis, Eucalyptus urophylla *x* Eucalyptus camaldulensis, Eucalyptus urophylla *x* Eucalyptus grandis *en el área remanente del bioma de Cerrado. Se usaron ocho trampas de modelo escolítido-curitiba en cada ambiente, cuatro con soportes de cebo conteniendo 96% de etanol y los demás exentos de atrayente. En todas las trampas se usó etanol al 70% en el recipiente colector. Se recolectó un total de 4.346 insectos, distribuidos en 13 géneros y 24 especies, con 2.246 individuos recolectados en trampas que contenían cebo y 2.100 en trampas sin cebo. El uso de etanol en el portador de cebo no tuvo un efecto significativo en la recolección de insectos, independientemente de los ambientes.*

***Palabras claves:*** *escarabajo ambrosia; etanol; trampa para insectos.*

## Introduction

The forest cultivation such as eucalyptus is a viable alternative for the supply of raw material of forest origin. However, homogeneous forests are unstable environments and are less able to withstand biotic disturb, thus susceptible to insect outbreaks that can cause damage to forestry stands (Rocha *et al*., 2011).

Many species of ambrisua beetles belonging to the family Curculionidae, especially those of the subfamily Scolytinae, are considered eucalyptus pests and they occur in eucalyptus in Brazil abundantly (Zanuncio *et al.,* 2005, Peres Filho *et al*., 2007).

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Within the subfamily Scolytinae there are approximately 6.000 species, distributed in about 180 genus (Booth *et al.* 1980). The most important forest species are xylomycophagous (Flechtmann 1995), of which they are popularly known as ambrosia beetles, which live in open galleries inside the host wood and feed on symbiotic fungi grown on the walls of these galleries (Furniss and Carolin 1977).

Population surveys of forest Scolytinae are made using traps of different models (Ruiz-Portero *et al.* 2004). These traps may contain substances that are attractive to ambrosia bettles, such as aggregation pheromones and/or monoterpenic or alcoholic compounds (Romero *et al.* 2007), in order to increase their attractive power. In Brazil, ethanol is the most widely used substance as an attractive bait in Scolytinae surveys (Dorval *et al.* 2004, Müller and Andreiv 2004, Rocha *et al.* 2011, Peres Filho *et al.* 2012), although the use of host logs as an attractive bait has also been successfully used (Flechtmann and Gaspareto 1997, Flechtmann *et al.* 1999).

The most common models of ambrosia beetle traps are basically a flight interception barrier and a collecting container, usually filled with hydrated ethanol, where insects remain until collection. Some common pitfall traps, such as ESALQ-84 (Berti Filho and Flechtmann 1986) and Escolitídeo-curitiba (Marques and Pedrosa-Macedo 1986), also have an attached device known as a bait holder, where the attractive substance is stored, usually ethanol in different concentrations.

The use of the bait holder presents some practical problems, as it increases the cost of making the traps and, because they are small in volume, requires more field maintenance to replace the attractiveness, making the process more expensive and time consuming. Since the collecting container has a larger volume of ethanol, besides immobilizing and preserving the collected individuals, the aim of this paper was to evaluate ethanol as an attractive substance only in the collecting container, avoiding the need for attracting traps.

## Material and Methods

The research was carried out in property location along the highway MT 351 km 42, municipality of Cuiabá-MT with 2.580 hectares, of which 2.000 of *Eucalyptus* spp., 64 of Permanent Preservation Area (PPA) and 516 hectares of Legal Reserve Area (LRA). The regions climate types are between Aw and Cw de Köppen. Both types of weather are characterized by dry winter between May and September and rainy summer from October to April. The average annual precipitation varies between 1.800 and 2.000 mm (Pinto and Oliveira Filho 1999). The predominant vegetation cover in the region is open arboreal savannah, with areas of seasonal forest and savannah/seasonal forest transition.

The research was carried out between June 2009 and May 2010 in the following environments: stands of *Eucalyptus camaldulensis*, *Eucalyptus urophylla* x *Eucalyptus camaldulensis*, *Eucalyptus urophylla* x *Eucalyptus grandis* and in an area of native cerrado vegetation adjacent to eucalyptus plantations, belonging to the LRA of the property. The eucalyptus stands were two years old and did not undergo any silvicultural treatment until the end of the research.

The insect collection was carried out with the Escolitídeo-curitiba ethanol trap, in which eight traps were installed in each environment, four of them with 96º GL ethanol bait holders and the others without this device. In all traps, 70% ethanol was used in the collecting container. The bait holder was 50-cm long, 0.5 cm diameter plastic hose, fixed in a "U" shape between the impact panel blades (Figure 1).

The traps were installed at 1.5 m from the ground in two rows 100 m between rows and 30 m between traps, the first with four baited traps and the second with four non-baited traps. A minimum

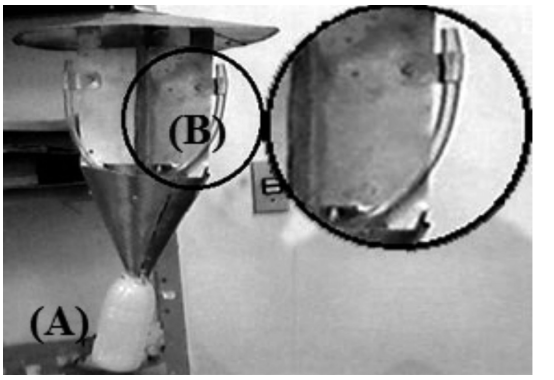


Figure 1. Ethanolic trap adapted from the model Escolitídeo-curitiba. Pickup container (A) and (B) bait holder.

distance of 50 m from the edges of the fields was kept as a border to avoid edge effect. In the cerrado area, the traps distribution was identical to that of eucalyptus stands, obeying the same spacing between traps and lines. The collections were made biweekly together with the replacement of ethanol in the containers and bait holders of the traps.

Collected specimens were individualized and sent to the Forest Protection Laboratory of the Forest Engineering School, Federal University of Mato Grosso (LAPROFLOR, FENF/UFMT), where they were dried in an oven at 60 ºC for 72h stored in labeled containers. The specimens were taxonomically identified by comparison at the LAPROFLOR/FENF/UFMT collection. Copies of the subfamily Scolytinae were also sent to the Forest Protection Laboratory of the Federal University of Paraná for identification. The identified beetles s were separated by environment, trap type, month of collection and repetitions.

The experimental design was completely randomized in a factorial scheme, with the environmental factor in four levels (cerrado, *E. camaldulensis*, *E. urophylla* x *E. camaldulensis*, *E. urophylla* x *E. grandis*) and the attractive bait factor in two levels (with and without bait), with four replications (traps). The variable response was the number of individuals collected per trap: total and by gender. The data were transformed (X + 0.5) as recommended by Banzatto and Kronka (2006) as it delas with insect counting data. Upon rejecting H0, the means were compared by the Scott and Knott test at 5% significance level to detect possible differences between trap type and the environment.

## Results and Discussion

The total number of individuals collected in all the environments was 4,346 of which 2,246 individuals (51.7%) in bait traps and 2,100 (48.3%) in the ones without bait, distributed in 13 genus and 24 species with an average of 136 beetles per trap/year (Table 1). According to Nakano and Leite (2000), the use of alcohol is recommended for attractiveness of ambrosia beetles, due to the fact that the attacked plants undergo alcoholic fermentation, as a result of the plant decomposition caused by fungi that penetrate in the galleries of the attacked branches.

The results indicate that 80% of the species were common to the two types of traps, except for *Corthylus antenarius*, *Xyleborus compactus* and *Hylurgus* sp., collected only in baited traps and *Xyleborus linearicolis* and *Monarthrum* sp. in the ones without bait traps. These species, however, participated with few individuals, and probably these results have random causes. The species *Hypothenemus eruditus*, *Hypothenemus obscurus*, *Premnobius cavipennis* and the genus *Cryptocarenus* spp. stood out among the species with the most expressive amounts of individuals in the four environments. Dorval *et al.* (2004) show that species of ambrisua betttles with high occurrence in homogeneous forests have high adaptability and also low specificity in the hosts selection.

Cerrado had the largest number of individuals collected, representing 34.23% of the total. This fact can be explained by the fact that this environment has a larger amount of decomposing plant material, which increases the attractiveness of ambrosia beetles. Garcia and Cunha (1994) studying the occurrence of Cerambycidae bettles in *Citrus* spp. using traps containing as attractive substance 20% sugarcane molasses, found that the conserved orchard (with cultural treatments) had smaller number of individuals than in the non-conservation orchard, because in this environment they presented larger amounts of decomposing plant.

The use of additional ethanol in the trap bait holder had no significant effect on the total number of Scolytinae collected during the survey, regardless of the environments, proving that only 70% alcohol in the collection bottle is already sufficient for the insects attractiveness. Bastos *et al.* (2018) analyzed the ethanol concentration effect (0, 25, 50, 70, 75 and 96%) on the occurrence of Scolytinae and concluded that the concentration of 70 and 75% was efficient in the insects capture. When compared to other concentrations, these traps accounted for more than 54% of the individuals collected. The authors also report that alcohol traps with 96% were the ones that obtained the smallest number of captured individuals among the tested ethanol concentrations.

In the comparison of environments within each type of bait, cerrado and *Eucalyptus urophylla* x *Eucalyptus grandis* stands had the highest averages of individuals in the traps with attractive substance, it was verified that cerrado was superior to the three eucalyptus stands in traps without bait (Table 2). The cerrado environment can be considered the

Table 1. Number of individuals per species of the subfamily Scolytinae collected in traps with and without bait in the four environments.

| Species | Environments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | E. camaldulensis | | Cerrado | | *E. urophylla* x *E. camaldulensis* | | *E. urophylla* x *E. grandis* | |
| | B | W | B | W | B | W | B | W |
| *Cnesinus sp.* | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Coccotrypes sp.* | 3 | 2 | 3 | 2 | 1 | 0 | 5 | 3 |
| *Corthylus antenarius* | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 0 |
| *Cryptocarenus spp.* | 79 | 68 | 75 | 127 | 46 | 25 | 158 | 163 |
| *Hylocurus spp.* | 0 | 0 | 2 | 0 | 2 | 0 | 1 | 2 |
| *Hylurgus sp.* | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| *Hypothenemus bolivianus* | 11 | 10 | 11 | 8 | 5 | 4 | 14 | 8 |
| *Hypothenemus eruditus* | 152 | 160 | 121 | 116 | 180 | 124 | 161 | 135 |
| *Hypothenemus obscurus* | 62 | 70 | 71 | 109 | 39 | 65 | 118 | 100 |
| *Monarthrum glabriculum* | 2 | 4 | 11 | 14 | 2 | 0 | 8 | 7 |
| *Monarthrum sp.* | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| *Pityophtorus mandibularis* | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 3 |
| *Premnobius cavipennis* | 85 | 47 | 186 | 213 | 56 | 15 | 55 | 50 |
| *Sampsonius dampfii* | 9 | 5 | 21 | 6 | 2 | 3 | 9 | 3 |
| *Tricolus sp.* | 0 | 0 | 7 | 21 | 0 | 2 | 1 | 0 |
| *Xyleborus compactus* | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| *Xyleborus ferrugineus* | 34 | 34 | 85 | 114 | 22 | 19 | 31 | 23 |
| *Xyleborus hagedornii* | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| *Xyleborus linearicolis* | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| *Xyleborus retusus* | 10 | 5 | 55 | 39 | 6 | 7 | 32 | 3 |
| *Xyleborus spinulosus* | 67 | 50 | 29 | 35 | 41 | 37 | 44 | 35 |
| Total | 520 | 458 | 682 | 806 | 404 | 301 | 640 | 535 |
| | 978 | | 1.488 | | 705 | | 1.175 | |

(B) = with bait; (W) = without bait.

Table 2. Average of Scolytinae individuals collected in the traps with and without bait in the four sampled environments.

| Environments | Trap Type | |
|---|---|---|
| | With bait[1] | Without bait[1] |
| E. camaldulensis | 129 ± 11,37 Ba | 110 ± 10,51 Ba |
| *E. urophylla* x *E.* camaldulensis | 100 ± 10,02 Ba | 75 ± 8,63 Ca |
| *E. urophylla* x *E. grandis* | 160 ± 12,62 Aa | 133 ± 11,51 Ba |
| Cerrado | 170 ± 13,01 Aa | 200 ± 14,12 Aa |
| $F_{Environment}$ | 14,86 | |
| CV(%) | 11,47 | |

[1] Data transformed into X + 0.5.
Averages followed by the same horizontal upper case letter and the same vertical lower case letter do not differ significantly from each other by the Scott and Knott test at 5% probability.

most balanced environment diversity, since it has several types of plants, which provide greater amount of food to the insects present in there.

The average of insects was 56% higher in the cerrado than in the three eucalyptus stands. The larger collection in the cerrado environment may be explained by the young age of the eucalyptus stands studied, since insect populations need some time and conditions to settle in a forest ecosystem (Marques and Pedrosa-Macedo

1986). In addition, the cerrado area of the study is fragmented and surrounded by a modified environment and, as a result of this isolation, subject to an increase in species richness by invasion of others associated with the modified adjacent habitat (Thomazini and Thomazini 2000), and by changes in interactions between phytophagous insects and their natural enemies (Roland 1993, Kruess and Tscharntke 1994).

The genus *Coccotrypes*, *Cryptocarenus*, *Hypothenemus*, *Monarthrum, Premnobius*, *Sampsonius* and *Xyleborus* had at least one individual collected from all the environments, from which possible differences in the environment by trap type interaction were verified. The trap type factor (with and without bait) did not show a significant effect in either genus. Regarding the environment factor, only in the genus *Cryptocarenus* and *Xyleborus* the effect was significant by the F test ($\alpha > 0.05$), with more individuals in *Eucalyptus urophylla* x *Eucalyptus camaldulensis* stands and cerrado (Table 3). The genus *Hypothenemus* had the largest amount of collected individuals, but without significant difference in any of the analyzed factors, by the F test ($\alpha > 0.05$).

The explanation for these results is possibly the use of 70% ethanol in the trap collection vessels, which probably had the desired attractive effect on its own, without the need to use ethyl alcohol (96%) in the bait holder. The attractive potential of ethanol has already been confirmed in the capture of several species of the Scolytinae subfamily (Moeck 1970, Moeck 1971, Montgomery and Wargo 1983, Gil *et al.* 1985). Miller and Rabaglia (2009) demonstrated the attractiveness of ethanol for several species of scolites, including *Cryptocarenus heveae* and *Xyleboru ferrugineus*, in whose traps polyethylene glycol solution (PGS) was used in the trap collection bottle instead of the alcohol solution. More detailed studies are suggested to verify the attractiveness of Scolytinae by ethanolic traps, using ethanol at different concentrations in the collection vessels.

## Conclusion

The use of traps with ethanol baits had no significant effect on the ambrosia beetles collection during the period evaluated and regardless of the environments.

Table 3. Average of individuals of genus *Cryptocarenus* and *Xyleborus* collected in the four environments.

| Environments | Genus | |
|---|---|---|
| | *Cryptocarenus*[1] | *Xyleborus*[1] |
| *E. urophylla* x *E. grandis* | 40 ± 6.37 a | 21 ± 4.64 b |
| Cerrado | 25 ± 5.07 b | 45 ± 6.73 a |
| E. camaldulensis | 18 ± 4.34 c | 25 ± 5.07 b |
| *E. urophylla* x *E. camaldulensis* | 9 ± 3.06 c | 17 ± 4.13 b |
| $F_{Environment}$ | 26.01 | 14.41 |
| CV(%) | 16.68 | 1.66 |

[1] Data transformed into X + 0.5.
Averages followed by the same horizontal upper case letter and the same vertical lower case letter do not differ significantly from each other by the Scott and Knott test at 5% probability.

## Literature Cited


Banzatto, D.A.; Kronka, S.N.
2006. Experimentação Agrícola. 4 a Ed. Jaboticabal, SP. Funep, 237 p.

Bastos, E.S.A.; Dorval, A.; Peres-Filho, O.; Souza, M.D.; Marques, E.N.; Junior, J.G.S.
2018. Influence of ethanol concentration on Scolytinae (Coleoptera: Curculionidae) in a native forest in the municipality of Campo Verde - MT. *Idesia*, Chile, 36 (4): 51-59.

Berti Filho, E.; Flechtmann, C.A.H.
1999. A model of ethanol trap to collect Scolytidae and Platypodidae (Insecta, Coleoptera). *IPEF.* Piracicaba, 34: 53-56.

Booth, R.G.; Coxy, M.L.; Madge, R.B.
1980. Guides to insect of importance to man. Coleoptera (3). CAB International. London, UK. 484 p.

Flechtmann, C.A.H.; Gaspareto, C.L.
1997. A new trap for capturing Scolytidae (Coleoptera), based on primary attraction. *Journal of Applied Entomology*, Berlin, 121 (6): 357-359.

Flechtmann, C.A.H.; Ottati, A.L.T.; Berisford, C.W.
1999. Attraction of ambrosia beetles (Coleoptera: Scolytidae) to different tropical pine species. *Environmental Entomology*, Lanham, 28(4): 649-658.

Flechtman, C.A.H.
1995. Manual de pragas em florestas. Scolytidae em reflorestamento com pinheiros tropicais. PCMIP/IPEF. Piracicaba, Brazil. 201 p.

Furniss, R.L.; Carolin, V.M.
1977. Western forest insects. USDA. Washington, US. 654 pp.

Garcia, A.H.; Cunha, M.G.
1994. Comportamento da população de Compsocerus violaceus (White, 1853) (Coleoptera, Cerambycidae) em relação a fauna de cerambicídeos coletados em pomares de citros. *Pesquisa agropecuária tropical*, Goiania, 24 (1): 163-17.

Gil, J.; Pajares, J.; Viedma, M.G.
1985. Estudios acerca de la atracción primaria em Scolytidae (Coleoptera) parasitos de coniferas. *Boletin de la Estacion Central de Ecologia*, Madrid. 14: 107-125.

Kruess, A.; Tscharntke, T.
1994. Habitat fragmentation, species loss, and biological control. *Science*, New York. 264: 1581-1584.

Marques, E.N.; Pedrosa-Macedo, J.H.
1986. Scolytidae e Platypodidae em Pinus taeda. Levantamento das espécies. *Revista Centro de Ciências Rurais*, Santa Maria, 16 (1): 61-70.

Miller, D.R.; Rabaglia, R.J.
2009. Ethanol and (–)-α-pinene: attractant kairomones for bark and ambrosia beetles in the southeastern US. *Journal of Chemical Ecology*, New York. 35 (4): 435-448.

Moeck, H.A.
1970. Ethanol as the primary attractant for the ambrosia beetle Typodendron lineatum (Coleoptera: Scolytidae). *Canadian Entomologist*, Canada. 102: 985-994.

Montgomery, M.E.; Wargo, P.M.
1993. Ethanol and other host-derived volatiles as attractants for beetles that bore into hardwoods. *Journal of Chemical Ecology*, New York. 9 (2): 181-190.

Nakano, O.; Leite, C.A.
2000. Armadilhas para insetos: pragas agrícolas e domésticas. FEALQ, 7ed., Piracicaba, Brazil. 76 p.

Peres Filho, O.; Dorval, A.; Noquelli. M.J.M.S.
2007. Coleópteros em plantios de Eucalyptus camaldulensis no estado de Mato Grosso. *Floresta e Ambiente*, Seropédica, 14 (1): 45-51.

Peres Filho, O. Barbosa, J.I.; Souza, M.D.; Dorval, A.
2012. Altura de voo de bostriquídeos (Coleoptera: Bostrichidae) coletados em Floresta Tropical Semidecídua, Mato Grosso. *Pesquisa Florestal Brasileira*, Colombo, 32 (69): 101-107.

Pinto, J.R.R.; Oliveira Filho, A.T.
1999. Perfil florístico e estrutura da comunidade arbórea de uma floresta de vale no Parque Nacional da Chapada dos Guimarães, Mato Grosso, Brasil. R*evista Brasileira de Botânica*, São Paulo, 22 (1): 53-67.

Rocha, J.R.M.; Dorval, A.; Peres Filho, O.; Souza, M.D.; Costa, R.B.
2011. Análise da Ocorrência de Coleópteros em Plantios de Eucalyptus camaldulensis Dehn. em Cuiabá, MT. *Floresta e Ambiente*, Seropédica. 18 (4): 343-352.

Roland, J.
1993. Large-scale forest fragmentation increases the duration of tent caterpillar outbreak. *Oecologia*, Berlin. 93: 25-30.

Romero, S.L.; Ochoa, P.R.; Bilbao, J.C.I.; Lafuente, A.G.
2007. Los escolítidos de las coníferas del País Vasco. Guía práctica para su identificación y control. Servicio Central de Publicaciones del Gobierno Vasco. España. 195 p.

Ruiz-Portero, C.; Barranco, P.; Cabello, T.
2004. Escolítidos de pinos en la Sierra de los Filabres, Almería (España) (Coleoptera, Scolytidae). *Boletín de la S.E.A.* 34: 119-122.

Thomazini, M.J.; Thomazini, A.P.B.W.
2000. A fragmentação florestal e a diversidade de insetos nas florestas tropicais úmidas. Embrapa Acre. Brasil. 21 p.

Zanuncio, J. C.; Sossai, M.F.; Flechtmann, C.A.H.; Zanuncio, T.V.; Guimarães, E.M.; Espindula, M.C.
2005. Plants of an Eucalyptus clone damaged by Scolytidae and Platypodidae (Coleoptera). *Pesquisa agropecuária brasileira*, Brasília, 40 (5): 513-515.