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Short communication

Traslucent pheromone traps increase trapping efficiency of ambrosia beetle *Megaplatypus mutatus*

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ABSTRACT

Megaplatypus mutatus (=*Platypus mutatus*) is an ambrosia beetle native to South America. Unlike most ambrosia beetles, it attacks only living trees, penetrating the xylem of its host by boring long tunnels. These galleries cause severe stem-breakage and mortality in commercial poplar plantations.

In previous studies we showed that volatile emissions from pioneer male *M. mutatus* are composed of (+)-6-methyl-5-hepten-2-ol, 6-methyl-5-hepten-2-one and 3-pentanol. Recently, we developed reservoir type controlled release dispensers and tested the efficacy of various trap designs in the field. Results showed that black cross-vane traps (CIPEIN-CV) captured significantly more insects than other traps designs baited with the same dispensers. In the present study we modified the colour, the construction material and the size of traps with the aim of increasing trapping efficacy and reducing the final trap cost. The results showed that significantly more female and male *M. mutatus* were captured in small and large traslucent traps (CIPEIN-CVt) than in black CIPEIN-CV trap. Furthermore, traslucent CIPEIN-CVt trap costs were significantly lower than costs for CIPEIN-CV traps. Significantly improved trapping efficacy with an important decrease in final costs will allow detection of considerably lower populations of *M. mutatus* in monitoring programs.

1. Introduction

Ambrosia beetles are an economically important insect group in forest ecosystems affecting weakened or felled trees. The common name derives from the fungus carried and inoculated by the adult beetles, on which the larval stages feed.

Megaplatypus mutatus (=*Platypus mutatus*) (Chapuis) (Platypodinae, Curculionidae) is an ambrosia beetle native to South America. Unlike most ambrosia beetles, it attacks only living trees, penetrating the xylem of its host by boring long tunnels. Attacks are initiated by pioneer males that select a host tree and build short nuptial galleries, to which they attract females using a sexual pheromone. Following copulation, *M. mutatus* pairs extend their galleries to produce offspring. These galleries weaken the tree trunks and can result in severe stem-breakage and tree mortality in commercial poplar plantations (Alfaro et al., 2007; Achinelli et al., 2005). Additionally, the quality of the wood is seriously affected by the dark stained tunnels of decayed wood caused by the mycelium of the associated symbiotic fungus *Raffaelea santoroi*. In previous studies we showed that volatiles emited to attract females by pioneer male *M. mutatus* are composed of (+)-6-methyl-5-hepten-2-ol ((+)-sulcatol, or retusol), 6-methyl-5-hepten-2-one (sulcatone) (González Audino et al., 2005) and 3-pentanol (Gatti Liguori et al., 2008). Behavioural bioassays and electroantennogram recordings confirmed an attractive response, with (+)-sulcatol, sulcatone and 3-pentanol specifically attracting females. Other Platypodids (Shore and McLean, 1983; Renwick and Vite, 1977) and Scolytids (Byrne et al., 1974; Flechtmann and Berisford, 2003; Borden and McLean, 1979) also respond to sulcatol but not to sulcatone or 3-pentanol.

M. mutatus was accidentally introduced in Italy in 1998 (EPPO/OEPP, 2004, 2007; Tremblay et al., 2000) and threatens poplar plantations which are a highly important economic resource. In 2000, it was detected in *Populus canadensis* (Mönch) in the Caserta province in the Campania region. The risk of the dispersion of *M. mutatus* to other regions of Europe and its corresponding potential damage is of great concern to European regulatory authorities, who added it to the EPPO/OEPP Alert List (2004, 2007) recommended treating it as a quarantine pest (EPPO/OEPP, 2007). Dispersal is facilitated by transportation of infested logs. North American forest resources are also at risk (Alfaro et al., 2007).

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The development of traps baited with synthetic pheromones that can be used for *M. mutatus* management and detection of low level populations is an important goal for control and surveillance programs in Europe, Argentina, and in other areas, including North America, that are threatened by invasion of this species.

In a recent study (Funes et al., 2009), we developed reservoir type controlled release polyethylene dispensers and tested various trap designs baited with a range of pheromones doses in the field. Results showed that cross-vane traps baited with reservoir type dispensers captured significantly more *M. mutatus* than other trap designs baited with the same dispensers. In intercept traps, beetles attracted by the bait collide with the trap and fall into the collecting receiver cup (Niemeyer and Watzek, 1982; McLean et al., 1987).

Although baited cross-vane traps captured *M. mutatus*, the number of beetles caught were relatively low. Also, the cost of the trap can become an important issue for local forest producers. Therefore, in the present study we modified the colour, the construction material and the size of the cross-vane funnel traps with the aim of increasing trapping efficacy and at the same time reducing the final cost of the trap.

2. Methods

Sulcatone (6-methyl-5-hepten-2-one) and 3-pentanol (both analytical grade) were obtained from Aldrich Co. (Saint Louis, MO, USA); (+)-sulcatol (+)-6-methyl-5-hepten-2-ol, 99% purity was purchased from Con-Tech Enterprises, (Delta, Canada) as commercial bubble cups.

The black cross-vane trap (CIPEIN-CV) is made in our laboratory (Fig. 1A) and consists of two black acrylic panels (2 mm thick × 17 cm wide × 26 cm high) in a crossed arrangement above a PVC funnel (20 cm diam.). The funnel is connected to a 250 cm^3 collecting reservoir cup, fitted at the bottom. The reservoir cup does not contain any killing agent. The top of the trap is made from a white plastic circular lid (30 cm in diameter). The effective interception area is 1050 cm^2. The total height (lid, cross-vanes, funnel and reservoir) of the trap is 70 cm and the weight is 800 g.

The traslucent cross-vane funnel trap (CIPEIN-CVt) is also handmade at the laboratory and (Fig. 1B and C) consists of two traslucent corrugated polycarbonate panels (4 mm thick) crossed over a polyethylene 200-μm thick bag also fully traslucent film that forms a flexible square funnel and leads to a 200 cm^3 traslucent cup (Fig. 1B and C). The top of the trap was made from a square traslucent PVC sheet (2 mm thick). We built two different sizes: larger traps had an effective interception area made of polycarbonate panels (26 cm × 52 cm) of 2550 cm^2, weighed 350 g and small traps had an effective interception area made of polycarbonate panels (17 cm × 26 cm) of 1225 cm^2, and weighed 150 g.

Pheromone release devices were polymeric reservoir systems. In these systems the pheromone is stored separately from the release rate controlling polymeric membrane. The devices used for sulcatol and 3-pentanol were rectangular bags of semi-permeable surface (low density polyethylene 40 μm thick) and for sulcatone we used glass vials with a plastic semi permeable cap of polyethylene (Alfatech, 40 μm) with an effective release area of 0.2 cm^2 (Funes et al., 2009). The release rates for the different baits were quantified in the laboratory at 28 °C using a wind tunnel with a linear air velocity of 0.5 m/s as described by Funes et al., (2009) and determined to be 10 ± 1 mg, 7 ± 1 mg and 40 ± 2 mg per day for (+)-sulcatol, sulcatone and 3-pentanol respectively.

The experiment was conducted from 8 April to 28 May 2009 during the second flight season of *M. mutatus*, in a 17.5 ha stand of 10-year-old *P. canadensis* “Conti 12” located at Alberti, Buenos Aires Province, Argentina (35°10′ S, 60°17′ W, 68 m.a.s.l.). Mean stand density was 1014 trees per ha, average DBH 23.1 ± 0.3 cm. Traps (5 traps per ha) were placed in a regular evenly spaced trapping grid resulting in an intertrap distance of at least 35 m. The experiment was setup as a completely randomized design with 7 replicates for each treatment, except for unbaited treatments of which two replicates were deployed. Treatments were: baited black cross-vane traps; unbaited traslucent cross-vane traps, baited traslucent cross-vane small traps and baited traslucent cross-vane large traps. The traps were hung from trees with the upper edge at a height of 1.90 m. Each week captured beetles were collected, and beetles were sexed and traps were re-randomized within the site to minimize possible location or neighbour-trap-treatment effects.

The number of *M. mutatus* adults (male/female) captured per trap per number of days during each intersampling period (Insect/Trap/Day) was recorded. Beetle capture was recorded once a week for seven weeks. Because seasonal effects and climatic conditions during the experiment caused variation in the number of beetles captured among replicates raw catch data were converted to the proportion (p) of total beetles within each week. The proportion data were arcsin square root transformed and tested for homocedasticity by Levenne’s test along with Shapiro-Wilks test for normality. ANOVA with Tukeys *post hoc* comparisons (Infostat 2008) was performed to test for significant differences between all treatments. Differences at the 0.05 level of confidence were considered significant.

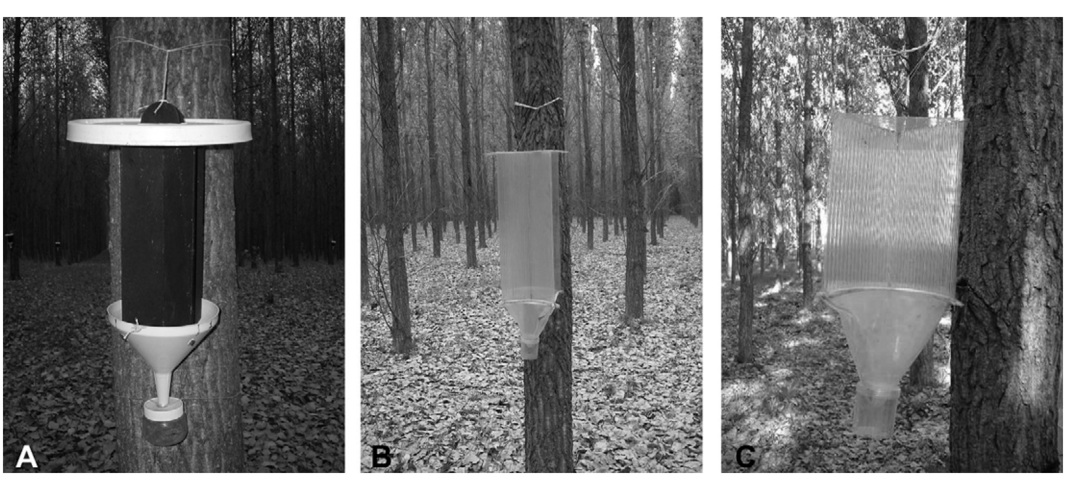

Fig. 1. Different traps colours and sizes used for trapping *M. mutatus*. (A) CIPEIN-CV cross-vane trap (black). Acrylic panels are 2 mm × 17 cm wide × 26 cm high. (B) CIPEIN-CVt traslucent cross-vane trap. Large version (panels 4 mm × 26 cm × 52 C) CIPEIN-CVt cross-vane trap. Small version (panels 4 mm × 17 cm × 26 cm).

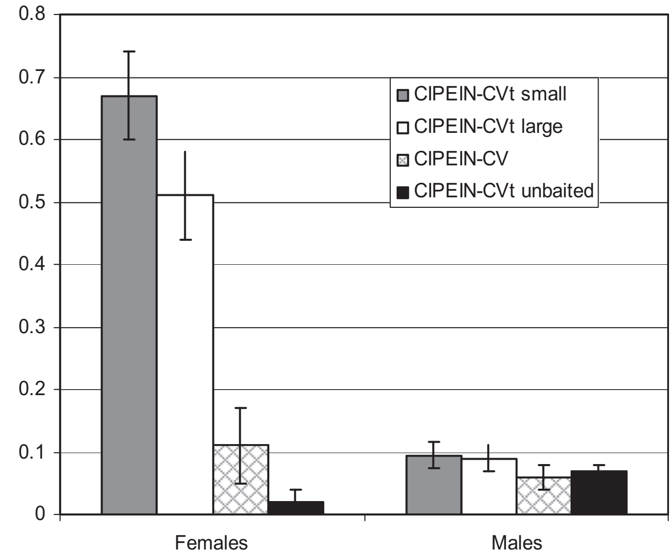

Fig. 2. Proportion of total *Megaplatypus mutatus* caught in plantations with different traps. Traps are CIPEIN-CV and CIPEIN-CVt small and large traps baited with pheromones. Control traps are unbaited. Bars represent means of the proportion of total captured beetles within each replicate. A total of 1503 insects were caught between April 8 and May 28.

3. Results and discussion

A total of 1503 insects were captured during the 7 weeks experiment. The large CIPEIN-CVt traps captured 3.4 and 5.1 (CI 95%) times more females and males, respectively, compared to CIPEIN-CV traps with the same interception area (Fig. 2). Even the small traslucent CIPEIN-CVt traps, with half of the interception surface area, also captured significantly more than the black CIPEIN-CV trap.

ANOVA detected significant differences ($P < 0.001$ for females; and $P < 0.0001$ for males) (Fig. 2), indicating an effect of the trap colour. Traslucent traps with the same shape and surface are significantly more attractive than black traps. No studies on colour preferences are available for other Platypodids. For other beetles, a drainpipe trap with wings of traslucent Fiberglas plastic which protrude outward from the pipe wall was used in Norway (Bakke, 1979) and traps painted white captured more Japanese beetles than the standard yellow traps (Ladd and Kleuin 1986).

Concerning the shape of the trap, in a previous study we found that multiple funnel traps that have shapes similar to trees silhouettes are less attractive for *M. mutatus* than cross-vane traps consisting of two acrylic panels in a cross arrangement above a funnel (Funes et al., 2009), but there is no information available about visual preferences of other Platypodid ambrosia beetles related to trap geometry.

For a number of other ambrosia beetles, in particular bark beetles (Scolytids), vertically oriented traps or traps similar to trees silhouettes elicit stronger responses than non tree shaped traps (Lindgren, 1983). However, Flechtmann et al. (2000) found in a comparative study of four types of trap geometries, that significantly more Scolytids were captured by intercept traps (called ESALQ) than multiple funnel-tree shaped traps.

Furthermore, CIPEIN-CVt trap costs are significantly lower than CIPEIN-CV ones (approximately 1/4) owing to their construction material. A significantly improved trapping efficacy with an important decrease in final costs will allow detecting considerable lower level populations in monitoring programs with less investment.

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