# Alternative Survey Methods for the Emerald Ash Borer

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# Alternative survey methods for the emerald ash borer

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The emerald ash borer, *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae), a highly destructive pest of ash (*Fraxinus* L.) (Oleaceae), was discovered initially in North America in 2002 near Detroit, Michigan, USA. It has subsequently been detected in 31 additional US states and in 2 Canadian provinces (Haack et al. 2002; Emerald Ash Borer Info 2017). Since its arrival in the mid-1990s (Siegert et al. 2014), it is estimated that *A. planipennis* has killed tens of millions of trees throughout this range (Emerald Ash Borer Info 2017).

Since 2008, the US Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA-APHIS-PPQ) Emerald Ash Borer Cooperative Program has conducted a multi-state emerald ash borer survey (USDA APHIS PPQ 2017). The traps currently deployed are glue-coated purple prism traps (Francese et al. 2008, 2013a) baited with [3Z]-hexenol, a green leaf volatile found to increase *A. planipennis* trap catch (Grant et al. 2010, 2011; Poland et al. 2011; Crook et al. 2012).

Multi-funnel traps (Lindgren 1983) have been shown to be a promising tool for catching emerald ash borer (Francese et al. 2011). Because these traps lack the messy adhesive-coating found on the prism traps, multi-funnel traps are a more user-friendly option that do not need to be discarded after each use. Green multi-funnel traps, based on a color attractive to emerald ash borer (Crook et al. 2009; Francese et al. 2010) caught more *A. planipennis* than the standard black multi-funnel traps, purple multi-funnel traps, and prism traps in trapping assays conducted in heavily infested areas in southeastern and south-central Michigan. Fluon®-coated intercept panel traps have been shown to increase cerambycid trap catch, and remain effective for more than 1 field season (Graham et al. 2010; Graham & Poland 2012; Allison & Redak 2017). Fluon®-coated green multi-funnel traps also caught 40× more emerald ash borer adults than traps not treated with any coating (Francese et al. 2013b). In low emerald ash borer density areas, green multi-funnel traps have been shown to be as effective in detecting populations as purple prisms (Crook et al. 2014).

Green multi-funnel traps have been available for use as a survey and detection tool for emerald ash borer since 2015, but due to their initial purchase and associated survey costs, they are not in wide programmatic use. The current survey guidelines recommend that during the course of the field season, multi-funnel traps be checked every 2 to 3 wk and prism traps only every 6 wk (USDA APHIS PPQ 2017). This additional maintenance leads to extra travel and personnel hours spent surveying, which increases program costs. Trap upkeep costs would include the additional killing agent that gets added at each trap check. Currently, the recommended killing agent in the US for the green multi-funnel traps is a propylene glycol solution (about 20–30%) in water, in the form of "recreational vehicle" antifreeze (USDA APHIS PPQ 2017). Several studies found that traps equipped with a wet cup captured more cerambycid and buprestid species than traps equipped with a dry cup; however, because there were no *Agrilus* species captured in these studies, additional investigations are needed to evaluate this trapping method for *A. planipennis* (Allison & Redak 2017).

The overall goal of the research presented here was to assess various trap modifications and survey methods that could help to both reduce the aforementioned costs associated with multi-funnel traps, and thus provide alternatives to sticky traps for survey of emerald ash borer. In particular, the main objectives were to investigate the effect of the trap checking frequency and the effect of wet vs. dry killing agents on emerald ash borer trap catch and detection. To test these objectives, 2 separate trapping studies, the trap check interval study (Study 1) and the trap cup collection method study (Study 2), were conducted using green plastic multi-funnel traps (Chemtica USA, Durant, Oklahoma, USA) previously described by Francese et al. (2011). Traps were unbaited and coated with a 50% dilution of Fluon® that previously had been shown to be as effective at catching *A. planipennis* (Francese et al. 2013b) and other woodborers (Allison et al. 2016) as a 100% dilution. For both studies, traps were hung from ropes in the lower canopy (5–8 m) of host along the edges of white (*Fraxinus americana* L.) and green (*Fraxinus pennsylvanica* Marshall) ash-dominated woodlots in Edmore, Michigan; North Andover, Massachusetts; and Bethel, Ohio, USA. No lures were used on the traps. We replicated treatments in a randomized complete block design with trap lines as blocks. Within each trap line, we put traps in adjacent trees with an average of 5 m between traps.

The trap check frequency study was conducted in both North Andover, Massachusetts (n = 7) and Bethel, Ohio (n = 7) to determine how often multi-funnel traps needed to be checked. Four trap check intervals were compared: 1-wk, 3-wk, 6-wk, and 12-wk. Trap timing intervals were chosen based on the recommended survey guidelines (3 wk), recommended lure change timing (6 wk), and the full location specific predicted *A. planipennis* flight period duration (12 wk). Because 1 of the 12 wk traps placed in Massachusetts fell during the course of the season, the trap line that was a part of that replicate was removed from the study.

A trap cup collection method study was conducted on private land in Edmore, Michigan (n = 5), North Andover, Massachusetts (n = 5), and at East Fork State Park in Bethel, Ohio (n = 8) to compare alternate methods for killing and collecting captured *A. planipennis* adults. Four treatments were compared: (1) standard wet collection cup filled

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with 150 to 200 mL of propylene glycol (Camco Easygoing -50, Camco, Greensboro, North Carolina, USA); (2) dry collection cup with an internal funnel (cone 7.0 cm long, 13.7 cm diam.; stem 6.7 cm long, 3.9 cm diam.) placed in the bottom trap funnel to reduce the chances of escape; (3) dry collection cup containing an insecticidal strip (Vaportape II; 2,2-dichlorovinyl dimethyl phosphate (10%) Hercon Environmental, Emingsville, Pennsylvania, USA); and (4) dry collection cup containing an internal funnel and an insecticidal strip. Internal funnels were coated with Fluon® (50% solution) to prevent beetles from climbing out of the collection cup.

During trap checks, the contents of each trap cup were strained using a paper paint filter. Paint filters were then placed in individual, labeled Whirl-Pak sampling bags (Nasco, Fort Atkinson, Wisconsin, USA), ethanol was added for preservation, and samples were stored in a freezer until sorting and identification could be conducted. In both assays, collected beetles were summed for each trap over the entire field season. Summed catch was log-transformed (y + 0.5) prior to statistical analysis to normalize the data, which was confirmed by testing residuals after ANOVA. Separate analyses of variance (ANOVA) were performed on the transformed total number of *A. planipennis* adults captured per trap for each study, to compare treatment effects (cup collection method or trap check interval depending on the study) (JMP 10) (SAS Institute 2012). Confidence intervals (95%) were calculated from the standard error of the transformed trap catch. Means and confidence intervals were then back-transformed for presentation in the text and tables that follow.

In the trap check frequency study, the interval between checks ($F$ = 0.66; df = 3, 52; $P$ = 0.58) did not significantly affect trap catch (Table 1). Because there was greater decomposition and the 6- and 12-wk interval, samples had to be sorted and identified in a fume hood to reduce the smell; however, identification characteristics were not affected. These results suggest that from the program perspective, multi-funnel traps could be checked less frequently than currently recommended, which would greatly reduce costs. However, it also should be noted that leaving the traps in the field for 12 wk without checking them could lead to loss of data as was the case with the 12-wk trap that fell during the course of the study.

In the trap collection method study, collection method did not ($F$ = 0.03; df = 3, 68; $P$ = 0.99) play a significant role in trap catch (Table 2). Based on these results, dry cup methods could be used as an alternative to the propylene glycol wet cups. These results are encouraging, especially for emerald ash borer trapping in more remote areas where transporting or disposing of used propylene glycol is not practical. As expected, the dry cup without a killing agent was still effective, but would not be recommended in most situations because live beetles were found in the traps during the check period. However, this method does show promise for live-trapping other woodborer species attracted to these traps.

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**Table 1.** Back-transformed mean (± 95% confidence intervals) *Agrilus planipennis* trap catch in green multi-funnel traps checked at 1 of 4 intervals (n = 14). Trap catch had been summed for each trap for the entire season.

| Collection cup method | Trap catch |
|---|---|
| Weekly | 8.03 (4.55 – 14.15) |
| Every 3 wk | 22.31 (13.45 – 37.00) |
| Twice during the field season (at 6 and 12 wk) | 22.72 (12.23 – 42.22) |
| Once at the end of the field season (at 12 wk) | 18.52 (9.14 – 37.54) |

**Table 2.** Back-transformed mean (± 95% confidence intervals) *Agrilus planipennis* trap catch in green multi-funnel traps using 1 of 4 different collection methods (n = 18). Trap catch had been summed for each trap for the entire season.

| Collection cup method | Trap catch |
|---|---|
| Standard wet cup (propylene glycol) | 8.95 (4.89 – 16.37) |
| Dry cup with internal funnel, no pesticide strip | 9.31 (5.31 – 16.31) |
| Dry cup without funnel, with pesticide strip | 9.31 (6.18 – 18.37) |
| Dry cup with funnel, with pesticide strip | 8.29 (4.65 – 14.78) |

## Summary

As part of an ongoing project to improve survey and detection for the emerald ash borer, *Agrilus planipennis*, several field assays were conducted to (1) determine how often traps need to be checked during a given field season, and (2) compare the effectiveness of traps with “dry” (with insecticidal strips or internal funnel) vs. “wet” (with propylene glycol surfactant) collection cups. There were no significant differences among any of the trap check intervals or the trap methods tested. This will provide new tools to surveyors, and allow them more flexibility as they survey for this invasive pest.

Key Words: *Agrilus planipennis*; green multi-funnel traps; wet cup; dry cup; trap check interval

## Sumario

Se realizaron varios ensayos de campo como parte de un proyecto en marcha para mejorar el sondeo y la detección del barrenador esmeralda del fresno, *Agrilus planipennis* para (1) determinar con qué frecuencia se deben revisar las trampas durante una temporada de campo determinada, y (2) comparar la efectividad de trampas “secas” (con tiras de insecticida o embudo interno) vs. “húmedas” (con surfactante de propilenglicol). No hubo diferencias significativas entre ninguno de los intervalos de control de trampa o los métodos de trampa probados. Estos resultados proporcionan nuevas herramientas a los topógrafos y les permitirá una mayor flexibilidad a medida que realizan el sondeo para la detección de esta plaga invasiva.

Palabras Clave: *Agrilus planipennis*; trampas verdes multi-embudo; taza mojada; taza seca intervalo de revisar trampas

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