Journal of Economic Entomology, 2026, **00**(00), 1–5
DOI: https://doi.org/10.1093/jee/toag323
Short Communication

ENTOMOLOGICAL SOCIETY OF AMERICA
SHARING INSECT SCIENCE GLOBALLY

OXFORD

Biological and Microbial Control

Burlap-ribbon traps are effective for detecting *Agrilus* (Coleoptera: Buprestidae) eggs and associated parasitoids

Toby R. Petrice*[,1], Jian J. Duan[2], and Jonathan M. Schmude[2]

[1]USDA Forest Service, Northern Research Station, East Lansing, MI, USA
[2]USDA ARS, Beneficial Insects Introduction Research Unit, Newark, DE, USA

*Corresponding author. USDA Forest Service, Northern Research Station, 2601 Coolidge Road, Suite 203, East Lansing, MI 48823, USA (Email: toby.petrice@usda.gov).

Subject Editor: Kevin Dodds

Agrilus species (Coleoptera: Buprestidae) often oviposit in bark cracks and crevices to protect their eggs from natural enemies and unfavorable conditions, making field detection of eggs and associated parasitism challenging. Burlap-ribbon traps, which mimic tree bark texture, have been shown to induce emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, to lay eggs on covered ash (*Fraxinus* sp.) surfaces. We evaluated these traps for detecting eggs of EAB and its congener bronze birch borer (*Agrilus anxius* Gory), as well as associated egg parasitism, using ash trees exhibiting different amounts of canopy decline and on girdled *Fraxinus pennsylvanica* and *Betula papyrifera*. Of 55 traps deployed on ash trees, 42 traps remained undisturbed, with EAB eggs recovered from 76% of those traps. Parasitized EAB eggs were detected on 21% of the undisturbed traps, with an average parasitism rate of 21%. On girdled trees, EAB eggs were recovered from traps installed on all *F. pennsylvanica* trees, and *A. anxius* eggs from traps on 3 of 5 *B. papyrifera* trees. Significantly more total eggs and parasitized eggs were recovered from *B. papyrifera* than EAB eggs from *F. pennsylvanica*, and parasitism rates were higher for *A. anxius*. These findings show that burlap-ribbon traps reliably detect *Agrilus* eggs and parasitoids across host species, canopy conditions, and girdling treatments, and could be a useful tool for biological control monitoring programs.

Keywords: biocontrol, oviposition, survey

Introduction

Several species of *Agrilus* in North America are serious pests of hardwood trees (Duan et al. 2024). Among them, the introduced emerald ash borer (EAB) [*Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae)] is the most destructive pest, having killed hundreds of millions of ash trees (*Fraxinus* spp.) in the United States and Canada (Haack et al. 2002, Poland and McCullough 2006, Chamorro et al. 2015). Many *Agrilus* species, including EAB, oviposit in bark cracks or crevices, or between layers of loose bark on tree trunks and branches to provide protection to the eggs from predation and unfavorable abiotic factors (Barter 1957, Haack and Benjamin 1982, Loerch and Cameron 1984, Reed et al. 2025). This cryptic oviposition behavior makes field detection and collection of *Agrilus* eggs extremely challenging, hindering efforts to monitor egg parasitism.

A recent field study demonstrated that burlap-ribbon traps, which consisted of burlap ribbons that were tightly wrapped around trunks or branches of trees, effectively induced EAB females to oviposit eggs on the burlap-covered bark surface of ash trees (Duan et al. 2024). The trap allowed eggs to be easily observed and collected after the burlap was removed. In that study, low levels of EAB egg parasitism (<2%) by the introduced egg parasitoid *Oobius agrili* Zhang & Huang (Hymenoptera: Encyrtidae) were detected several years after it was released at that site (Duan et al. 2024).

In addition to *O. agrili*, which was introduced for EAB biocontrol, 6 other *Oobius* spp. occur in North America (Triapitsyn et al. 2015). At least 2 species, *O. minusculus* Triapitsyn & Petrice and *O. whiteorum* Triapitsyn, attack native North American *Agrilus* species (Loerch and Cameron 1984, Petrice et al. 2025, Triapitsyn et al. 2015, Duan et al. 2024). However, these native parasitoid-host interactions have been poorly studied, in part due to the small size of parasitoids and the difficulty of observing and collecting *Agrilus* eggs in the field. To date, it is not known if burlap-ribbon traps are also effective in detecting eggs of other common *Agrilus* pests and their associated egg parasitoids.

Effective survey methods for *Agrilus* egg parasitoids would be valuable for monitoring biological control impacts on native and invasive species. In 2025, we conducted field studies in several hardwood forests in Michigan to evaluate the efficacy

Received: 28 July 2026. **Revised:** 30 September 2026. **Accepted:** 2 October 2026
Published by Oxford University Press on behalf of Entomological Society of America 2026.
This work is written by (a) US Government employee(s) and is in the public domain in the US.

of the burlap-ribbon traps for detecting eggs of EAB and *A. anxius* Gory (bronze birch borer), a congener that is a native pest of birch trees (*Betula* spp.) (Muilenburg and Herms 2012, Haack and Petrice 2019). We installed burlap-ribbon traps according to methods described in Duan et al. (2024) on EAB-infested *Fraxinus* spp., and artificially stressed *Fraxinus pennsylvanica* (Marshall) and *Betula papyrifera* (Marshall).

Materials and Methods

During 2025, we conducted 2 separate studies to evaluate burlap-ribbon traps for monitoring *Agrilus* oviposition and egg parasitism. In the first study, we targeted EAB eggs on EAB-infested ash trees. We arbitrarily selected 5 to 10 *F. pennsylvanica* or *F. americana* L. trees at each of 6 sites in the southern Lower Peninsula of Michigan where EAB and *O. agrili* were established. Selected ash trees were living but had signs or symptoms of recent EAB attack (i.e., declining canopies, fresh woodpecker feeding holes, and/or epicormic shoots). Mean (±SE) tree diameter at breast height (DBH) was 10.7 ± 0.7 cm (range: 3.0 to 23.9 cm). We rated the canopy condition of each tree following Smith (2006), with a rating of *1* being a healthy tree with no or minimal crown decline (<20%); *2* with some crown decline (21% to 40%); *3* with very noticeable canopy decline 41% to 60%; or *4* with high canopy decline (61% to 80%). Burlap-ribbon traps were installed during 11 to 26 June 2025. Growing degree days [base 10 °C (GDD_{10})] from the nearest weather stations ranged from 339 to 537 GDD_{10} (Michigan State University Enviroweather: https://enviroweather.msu.edu/). Each burlap-ribbon trap consisted of a 3.8-cm-wide × 1-m-long burlap ribbon (Duan 2024). The burlap ribbon was wrapped tightly around the tree trunk, approximately 1 m above the ground, and secured by stapling each end directly to the bark

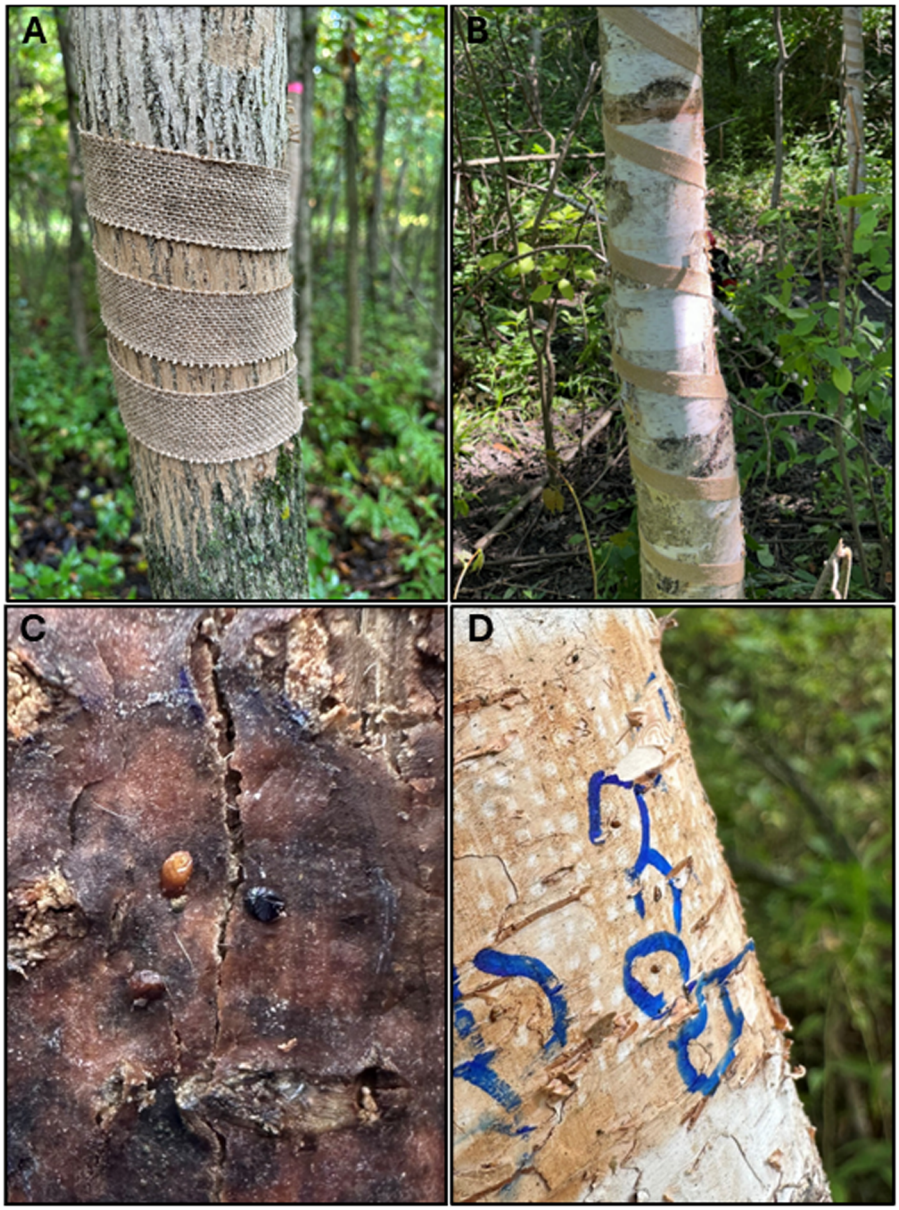


Fig. 1. Burlap-ribbon trap on *F. pennsylvanica* (A), burlap-ribbon trap on *B. papyrifera* (B), EAB eggs on *F. pennsylvanica*—light brown egg was hatched, darker eggs were parasitized (C), *A. anxius* eggs on *B. papyrifera* circled with blue marker.

Table 1. Number of undisturbed burlap-ribbon traps and percentage of traps that recovered *Agrilus* eggs and parasitized *Agrilus* eggs

Host species/condition	No. undisturbed traps	Traps (%) with *Agrilus* eggs	Traps (%) with parasitized eggs
***Fraxinus* spp./stressed by EAB**	42	76%	21%
***F. pennsylvanica*/girdled**	5	100	80
***B. papyrifera*/girdled**	5	60	60

Table 2. Estimated marginal mean (±SE) number of total and parasitized eggs, and proportion of parasitized emerald ash borer eggs recovered per burlap-ribbon trap placed on ash trees with different stages of canopy decline in the southern Lower Peninsula of Michigan in 2025. Means with the same letters (within columns) were not significantly different ($P < 0.05$)

Canopy decline rating	No. traps	Mean (±SE) total eggs	Mean (±SE) parasitized eggs	Mean proportion parasitized
1 (0–20%)	13	3.3 ± 0.5b	0.6 ± 0.2a	0.18 ± .06a
2 (21–40%)	12	4.9 ± 0.6ab	1.6 ± 0.4a	0.33 ± 0.08a
3 (41–60%)	9	5.0 ± 0.7ab	0.8 ± 0.3a	0.15 ± 0.06a
4 (61–80%)	8	6.4 ± 0.9a	1.0 ± 0.4a	0.16 ± 0.06a

(Fig. 1A and B). If trees had rough or furrowed bark, a draw knife was used to carefully smooth the surface of the corky bark layer, taking care not to damage the tree phloem (Duan 2024). This is necessary to ensure that eggs are deposited on the outer bark surface rather than being deposited in bark cracks or crevices.

In the second study, we targeted eggs of EAB and *A. anxius* at a site in the southern Lower Peninsula of Michigan where both *F. pennsylvanica* and *B. papyrifera* were present, and EAB and *O. agrili* were established. In 2025, we selected 6 trees each of *F. pennsylvanica* and *B. papyrifera* that did not have signs or symptoms of recent *Agrilus* attack. Mean DBH for *F. pennsylvanica* was 8.4 ± 0.8 cm (range: 6.7 to 11.4), and for *B. papyrifera* was 10.2 ± 1.0 (range: 7.3 to 13.4). To attract EAB and *A. anxius*, we artificially stressed each tree by girdling. Girdling was done on 13 May 2025 (GDD_{10} = 155) by removing the bark and phloem layer from a 20-cm-long section of the tree bole 20 cm above the ground using a draw knife. Burlap-ribbon traps were installed on each tree 1 m above the ground on 19 May 2025 (GDD_{10} = 214).

During 23 to 25 September 2025, we inspected burlap-ribbon traps on all trees at each site. Burlap ribbon was carefully removed, and the number of *Agrilus* eggs found attached to the tree surface was counted. Then the burlap ribbon was carefully inspected for eggs that were attached to the burlap fibers. For each trap, we totaled *Agrilus* eggs found on the bark and attached to the burlap. We collected all eggs that were suspected of being parasitized (i.e., eggs that were dark brown or black). These eggs were examined in the laboratory under a stereo microscope to confirm if they had parasitoid exit holes or contained immature parasitoids.

To compare total and parasitized EAB eggs recovered per trap among trees with different stages of canopy decline, we used a generalized linear model (GLM) with a Poisson distribution (SAS Institute 2012). The proportion of EAB eggs parasitized was compared using a GLM with a binomial distribution. We compared total and parasitized *Agrilus* eggs found under burlap-ribbon traps on girdled trees between *B. papyrifera* and *F. pennsylvanica* using a GLM with a Poisson distribution. A GLM with a binomial distribution was used to compare the proportion of parasitized eggs between species. Estimated marginal means that were significantly different ($P < 0.05$) were compared using the Tukey–Kramer means comparison procedure. Burlap-ribbon traps that were removed or damaged, presumably by squirrels, were excluded from analyses.

Results

We placed a total of 55 burlap-ribbon traps on ash trees with different stages of canopy decline, of which 42 (76%) were undisturbed (Table 1). Of the undisturbed burlap-ribbon traps, we recovered 198 total EAB eggs from 32 of 42 (76%) trees (Table 1). Parasitized EAB eggs were found on 21% of the undisturbed traps and overall parasitism was 21% (Table 1; Fig. 1C). Trees that had a canopy decline rating of *4* had a significantly higher mean number of EAB eggs than canopy decline *1* trees, and mean number of EAB eggs were intermediate for canopy decline *2* and *3* trees ($F = 3.39$; df = 3, 38; $P = 0.0277$; Table 2). EAB eggs parasitized by *O. agrili* were collected with burlap-ribbon traps on trees for all canopy decline stages and means were not significantly different for number ($F = 2.04$; df = 3, 38; $P = 0.1249$; Table 2) and proportion ($F = 1.67$; df = 3, 28; $P = 0.1956$; Table 2) of parasitized eggs among canopy decline stages.

Of the burlap-ribbon traps placed on each of 6 *F. pennsylvanica* and *B. papyrifera* girdled trees, 5 traps were not disturbed on each species. Of these, we recovered *Agrilus* eggs from all (100%) girdled *F. pennsylvanica* trees and 3 (60%) of the *B. papyrifera* trees (Table 1). Parasitized eggs were recovered from 4 (80%) of the girdled *F. pennsylvanica* trees and 3 (60%) of the *B. papyrifera* trees (Table 1). The number of total and parasitized eggs, and the proportion of eggs parasitized per burlap-ribbon traps varied significantly between species. Significantly more *A. anxius* eggs were recovered from traps on *B. papyrifera*, compared to EAB eggs on *F. pennsylvanica* ($F = 43.33$; df = 1, 8; $P = 0.0002$; Table 3). The mean number of parasitized *A. anxius* eggs was significantly higher compared to parasitized EAB eggs ($F = 62.96$; df = 1, 8; $P = 0.0001$; Table 3). The proportion of parasitized eggs was also significantly higher for *A. anxius* compared to EAB ($F = 38.47$; df = 1, 6; $P = 0.0008$; Table 3).

Table 3. Estimated marginal mean (±SE) number of total and parasitized eggs, and proportion of parasitized *Agrilus* eggs recovered per burlap-ribbon trap placed on girdled trees of *Fraxinus pennsylvanica* and *Betula papyrifera* in Michigan in 2025. Estimated marginal means with the same letters (within columns) were not significantly different ($P < 0.05$)

Tree species	No. traps	*Agrilus* species	Mean (+SE) total eggs	Mean (+SE) parasitized eggs	Mean proportion parasitized
F. pennsylvanica	5	EAB	32.4 ± 2.5b	5.0 ± 1.0b	0.15 ± 0.03b
B. papyrifera	5	*A. anxius*	61.4 ± 3.5a	28.0 ± 2.4a	0.46 ± 0.03a

Discussion

Effective tools are needed for monitoring egg parasitism of *Agrilus* spp. In 2025, we field-tested burlap ribbon traps developed by Duan (2024) for recovering EAB and *A. anxius* eggs to monitor their egg parasitoids. We recovered EAB eggs, including parasitized eggs, from EAB-infested ash trees representing a range of declining canopies, observing more eggs on highly declined trees. This aligns with EAB's known preference for stressed trees and the progression of infestation, which leads to increased oviposition near ground level on highly declined trees. We also collected EAB on *F. pennsylvanica* and *A. anxius* eggs on *B. papyrifera* trees that were artificially stressed by girdling using burlap-ribbon traps. Our results confirm that burlap-ribbon traps can be an effective tool for recovering *Agrilus* eggs to monitor egg parasitism on stressed trees.

It is not surprising that more EAB eggs were recovered on ash trees with significant canopy decline compared to those showing little or no decline. Jennings et al. (2014) found higher numbers of ovipositing EAB females and eggs on living ash trees with high levels of canopy decline compared to trees showing little or no decline. Also, trees with significant decline will produce higher numbers of adult beetles, many of which likely oviposit on the same tree they emerged from. Furthermore, EAB infestation of trees usually begins in the canopy and progresses downward over multiple years of infestation (Chamorro et al. 2015, Duan et al. 2024). As a result, trees with higher canopy decline from *Agrilus* attacks usually have more oviposition occurring near the ground level of the tree stem where we deployed burlap-ribbon traps (Haack and Benjamin 1982, Haack et al. 1983).

This study also demonstrated that burlap-ribbon traps can be used to monitor *Agrilus* egg parasitism on trees that are artificially stressed by girdling. In addition to EAB eggs on girdled *F. pennsylvanica*, we recovered *A. anxius* eggs on girdled paper birch. In fact, the highest numbers of eggs were recovered from *B. papyrifera*. *Agrilus anxius* prefers to lay eggs in areas with rough bark or bark crevices (Anderson 1944, Loerch and Cameron 1984). In general, *B. papyrifera* has much smoother bark compared to *F. pennsylvanica*, and it is possible that burlap-ribbon traps were more effective on *B. papyrifera* because preferred oviposition sites were more limited. Species-specific oviposition behavior may also explain differences in egg recoveries between species. For instance, Green and Duan (2025) found that EAB oviposition was highest when the gap between the burlap and tree bark was 0.5 mm. It is possible that the gap size used in this study was more optimal for *A. anxius* oviposition compared to EAB. It is also possible that the differences in egg recoveries were a function of adult *Agrilus* densities at our study site. However, at our study site, EAB adults were much more abundant than *A. anxius*, given the high mortality of ash trees compared to little or no observed mortality of paper birch.

Artificially stressing trees by girdling the main stem is a proven method for attracting *Agrilus* beetles (Anderson 1944, Haack and Benjamin 1982, Petrice and Haack 2014, McCullough et al. 2016). The ability to recover *Agrilus* eggs with burlap-ribbon traps on girdled trees has unique advantages when monitoring egg parasitism. For example, suitable monitoring trees (i.e., trees showing evidence of *Agrilus* attack) may be limited or not present at survey locations. By girdling trees, *Agrilus* oviposition can be directed to trees at specific locations and the desired number of sample trees needed for effective surveys. This could be especially advantageous when monitoring areas over multiple years as long as healthy trees are available at the sampling location. Girdling also allows surveyors to select trees with smoother bark, which are easier to locate *Agrilus* eggs on, compared to trees with coarse bark.

Most parasitoids had emerged from *Agrilus* eggs before we inspected traps, but parasitized eggs without exit holes were confirmed to contain live or dead immature parasitoids. We assumed that all parasitized EAB eggs were attacked by *O. agrili*, given that no other egg parasitoids have been previously recovered from EAB in the United States (Duan et al. 2012, Abell et al. 2014, Petrice et al. 2021). Parasitized *A. anxius* eggs were likely attacked by *O. whiteorum* (Triapitsyn et al. 2015) or another native *Oobius* species.

In summary, we found burlap-ribbon traps to be an effective tool for recovering EAB and *A. anxius* eggs to monitor egg parasitism. Future research should also examine the utility of oviposition traps for monitoring eggs of other native and invasive *Agrilus* species, especially larger species that attack tree stems and larger branches. If oviposition traps are utilized for recovering adult egg parasitoids, parasitized *Agrilus* eggs should be collected from traps and reared in the laboratory throughout the *Agrilus* oviposition period before adult parasitoids emerge from host eggs.

Acknowledgements

We would like to thank Louise Labbate and Julia Zick (USDA Forest Service), and Emma Charney and Eric Richard (Michigan State University, Entomology) for field and laboratory assistance; Michigan Department of Natural Resources for permits to conduct research on state-owned land; and Robert Haack and anonymous reviewers who provided useful comments on an earlier version of this manuscript. This project was supported by USDA Forest Service, Northern Research Station; USDA Agricultural Research Service, Beneficial Insects Introduction Research Unit; USDA APHIS PPA7721 program (IRA3 60-8010-5-005), and Michigan State University, AgBioResearch. Artificial intelligence (Microsoft 365 Copilot) was used to shorten and improve the Abstract and Discussion of an earlier draft of this manuscript.

Author Contributions

Toby Petrice (Conceptualization [equal], Data curation [equal], Formal analysis [equal], Investigation [equal], Methodology [equal], Project administration [equal], Resources [equal], Visualization [equal], Writing—original draft [equal], Writing—review & editing [equal]), Jian J. Duan (Conceptualization [equal], Data curation [equal], Funding acquisition [equal], Investigation [equal], Methodology [equal], Project administration [equal], Resources [equal], Supervision [equal], Visualization [equal], Writing—review & editing [equal]), and Jonathan M. Schmude (Data curation [equal], Investigation [equal], Methodology [equal], Writing—review & editing [equal])

Funding

This project was supported by USDA Forest Service, Northern Research Station; USDA Agricultural Research Service, Beneficial Insects Introduction Research Unit; USDA APHIS PPA7721 program (IRA3 60-8010-5-005), and Michigan State University, AgBioResearch.

Conflicts of Interest

None.

References

Abell KJ, Bauer LS, Duan JJ, et al. 2014. Long-term monitoring of the introduced emerald ash borer (Coleoptera: Buprestidae) egg parasitoid, *Oobius agrili* (Hymenoptera: Encyrtidae), in Michigan, USA and evaluation of a newly developed monitoring technique. *Biol. Control.* 79:36–42. https://doi.org/10.1016/j.biocontrol.2014.08.002

Anderson RF. 1944. The relationship between host condition and attack by the bronzed birch borer. *J. Econ. Entomol.* 37:588–596. https://doi.org/10.1093/jee/37.5.588

Barter G W. 1957. Studies of the bronze birch borer, *Agrilus anxius* Gory, in New Brunswick. *Can. Entomol.* 89:12–36. https://doi.org/10.4039/Ent8912-1

Chamorro ML, Jendek E, Haack RA, et al. 2015. Illustrated guide to the emerald ash borer *Agrilus planipennis* Fairmaire and related species (Coleoptera: Buprestidae). Pensoft Publishers, Sofia, Bulgaria.

Duan JJ, Bauer LS, Hansen JA, et al. 2012. An improved method for monitoring parasitism and establishment of *Oobius agrili* (Hymenoptera: Encyrtidae), an egg parasitoid introduced for biological control of the emerald ash borer (Coleoptera: Buprestidae) in North America. *Biol. Control.* 60:255–261. https://doi.org/10.1016/j.biocontrol.2011.11.007

Duan JJ. 2024. A novel oviposition trap for studying the egg-laying behavior of emerald ash borer. *J. Pest Sci.* 97:1087–1091. https://doi.org/10.1007/s10340-024-01770-5

Duan JJ, Johnson TD, O'Dea JK, et al. 2024. The ecology, economics, and management of *Agrilus* beetles. *Curr. For. Rep.* 10:487–509. https://doi.org/10.1007/s40725-024-00230-8

Green MA, Duan JJ. 2025. Effect of pore size and gap width of artificial oviposition substrates on the egg-laying behavior in *Agrilus planipennis*: implications for larval host selection. *J. Insect Behav.* 38:1–9. https://doi.org/10.1007/s10905-025-09883-0

Haack RA, Benjamin DM. 1982. The biology and ecology of the two-lined chestnut borer, *Agrilus bilineatus* (Coleoptera: Buprestidae), on oaks, *Quercus* spp., in Wisconsin. *Can. Entomol.* 114:385–396. https://doi.org/10.4039/Ent114385-5

Haack RA, Benjamin DM, Haack KD. 1983. Buprestidae, Cerambycidae, and Scolytidae associated with successive stages of *Agrilus bilineatus* (Coleoptera: Buprestidae) infestations of oaks in Wisconsin. *Great Lakes Entomol.* 16:47–55.

Haack RA, Petrice T. 2019. Historical population increases and related inciting factors of *Agrilus anxius*, *Agrilus bilineatus*, and *Agrilus granulatus liragus* (Coleoptera: Buprestidae) in the Lake States (Michigan, Minnesota, and Wisconsin). *Great Lakes Entomol.* 52:21–33. https://doi.org/10.22543/0090-0222.2337

Haack RA, Jendek E, Lui HP, et al. 2002. The emerald ash borer: a new exotic pest in North America. *Newsl. Mich. Entomol. Soc.* 47:1–5.

Jennings DE, Taylor PB, Duan JJ. 2014. The mating and oviposition behavior of the invasive emerald ash borer (*Agrilus planipennis*), with reference to the influence of host tree condition. *J. Pest Sci.* 87:71–78. https://doi.org/10.1007/s10340-013-0539-1

Loerch CR, Cameron EA. 1984. Within-tree distributions and seasonality of immature stages of the bronze birch borer, *Agrilus anxius* (Coleoptera: Buprestidae). *Can. Entomol.* 116:147–152. https://doi.org/10.4039/Ent116147-2

McCullough DG, Poland TM, Lewis PA. 2016. Lethal trap trees: a potential option for emerald ash borer (*Agrilus planipennis* Fairmaire) management. *Pest Manag. Sci.* 72:1023–1030. https://doi.org/10.1002/ps.4083

Muilenburg VL, Herms DA. 2012. A review of bronze birch borer (Coleoptera: Buprestidae) life history, ecology, and management. *Environ. Entomol.* 41:1372–1385. https://doi.org/10.1603/EN12238.S

Petrice TR, Haack RA. 2014. Biology of the European oak borer in Michigan, United States of America, with comparisons to the native twolined chestnut borer. *Can. Entomol.* 146:36–51. https://doi.org/10.4039/tce.2013.58

Petrice TR, Haack RA, Strazanac JS, et al. 2025. Biology and larval morphology of *Agrilus subcintus* (Coleoptera: Buprestidae), with comparisons to the emerald ash borer, *Agrilus planipennis*. *Great Lakes Entomol.* 42:173–184. https://doi.org/10.22543/0090-0222.2560

Petrice TR, Bauer LS, Miller DL, et al. 2021. Monitoring field establishment of the emerald ash borer biocontrol agent *Oobius agrili* Zhang and Huang (Hymenoptera: Encyrtidae): sampling methods, sample size, and phenology. *Biol. Control.* 156:104535–104513. https://doi.org/10.1016/j.biocontrol.2021.104535

Poland TM, McCullough DG. 2006. Emerald ash borer: invasion of the urban forest and the threat to North America's ash resource. *J. For.* 104:118–124. https://doi.org/10.1093/jof/104.3.118

Reed K, Cole F, Audsley N, et al. 2025. Susceptibility of European Agrilus beetle species to the biocontrol agents of Emerald Ash Borer in the laboratory. *Biol. Control.* 200:105678. https://doi.org/10.1016/j.biocontrol.2024.105678

SAS Institute. 2012. OC User's Manual. Version 9.4. SAS Institute.

Smith A. 2006. Effects of community structure on forest susceptibility and response to the emerald ash borer invasion of the Huron river watershed in southeast Michigan. Ohio State University. https://books.google.com/books?id=-oUstwAACAAJ

Triapitsyn SV, Petrice TR, Gates MW, et al. 2015. Two new species of *Oobius* Trjapitzin (Hymenoptera, Encyrtidae) egg parasitoids of *Agrilus* spp. (Coleoptera, Buprestidae) from the USA, including a key and taxonomic notes on other congeneric Nearctic taxa. *Zookeys.* 498:29–50. https://doi.org/10.3897/zookeys.498.9357

Published by Oxford University Press on behalf of Entomological Society of America 2026.
This work is written by (a) US Government employee(s) and is in the public domain in the US. Journal of Economic Entomology 2026 00(00) 1–5
https://doi.org/10.1093/jee/toag323
Short Communication Biological and Microbial Control