

The bronze birch borer, *Agrilus anxius*, as a potential risk for European birch: Host naivety and early detection tools

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Bronze birch borer
(*Agrilus anxius*) causing
birch decline in North
America

- Crown thinning
- Dead trees

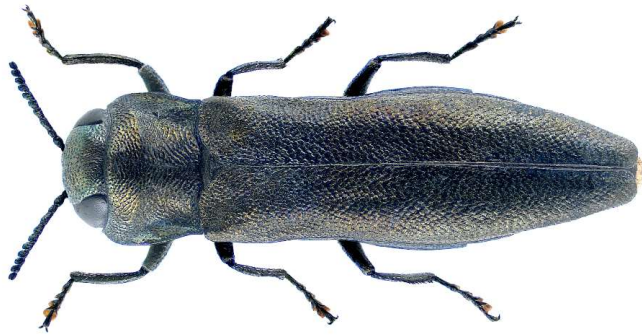


Agrilus spp.

- Under Buprestidae family
- Typically secondary pests
- Wood borers
- Over 3000 species



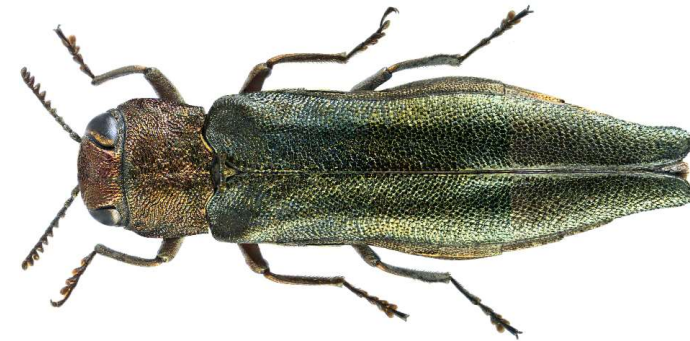
Examples of *Agrilus* species in Sweden



A. betuleti



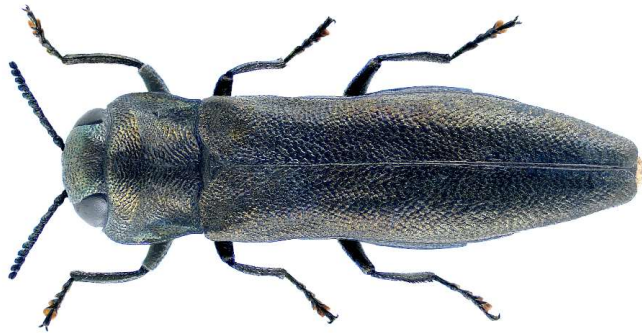
A. paludicola



A. viridis



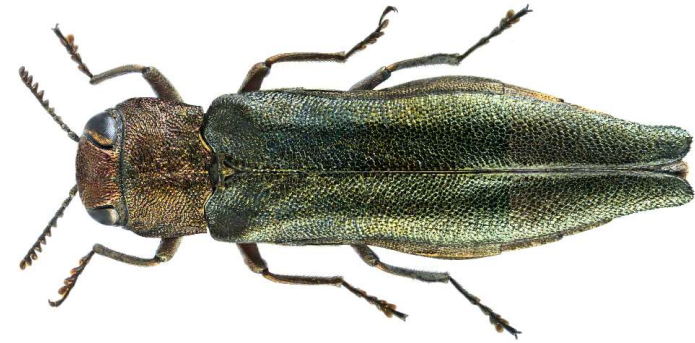
A. anxius



A. betuleti



A. paludicola



A. viridis

Native vs non-native pest/host associations



Bronze birch borer



Some stress
factor (e.g.
drought)

→ Can cause some mortality



Bronze birch borer

(No co-evolutionary
history)

→ Can lead to mass
mortality



Example: Common Garden Study

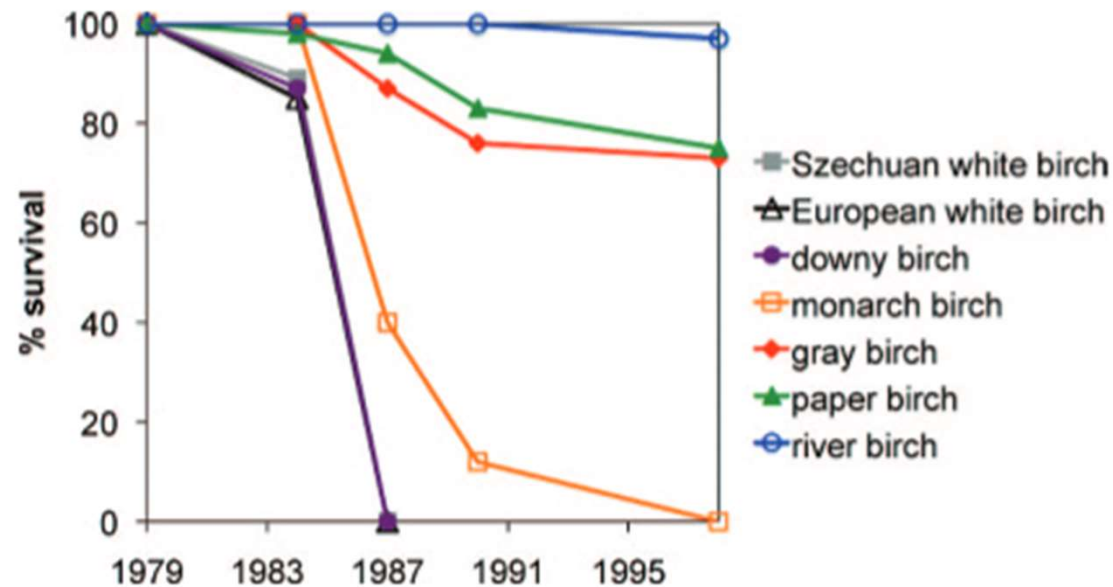


Fig. 1. Percent survival of seven birch (*Betula*) species in a common garden in Wooster, OH, USA from year of planting as two-year-old seedlings in 1979 through 1998.

“Bronze birch borer (BBB, *Agrilus anxius*) kills healthy Eurasian birch trees (*Betula* spp.).” (Nielsen et al. 2011, Muilenburg and Herms 2012)

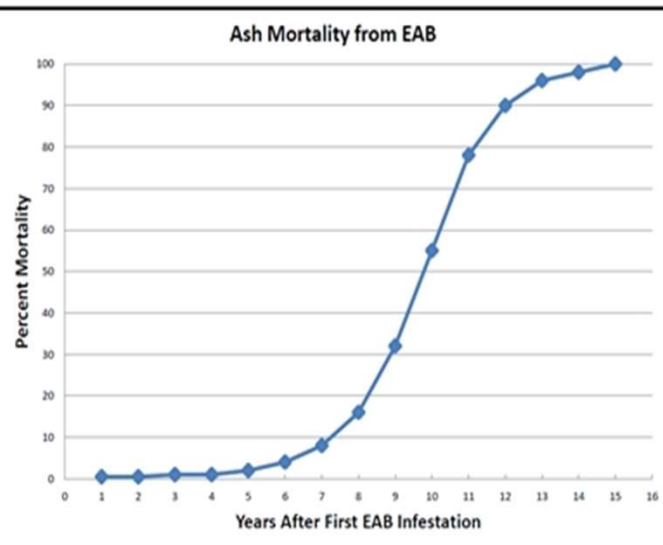
Emerald Ash Borer (*A. planipennis*)



Emerald Ash Borer (*A. planipennis*)

Before June 2006

After August 2009



Picture: Dan Herms

<https://theconservationfoundation.org/everything-you-need-to-know-about-the-emerald-ash-borer-part-1/>

Importance of prevention and early detection

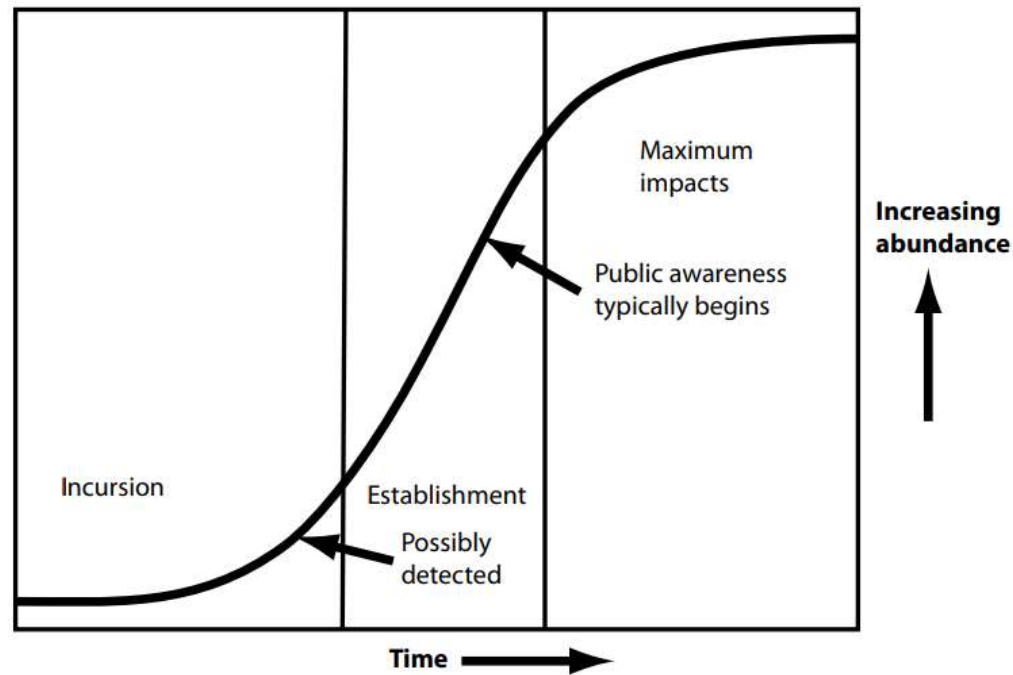
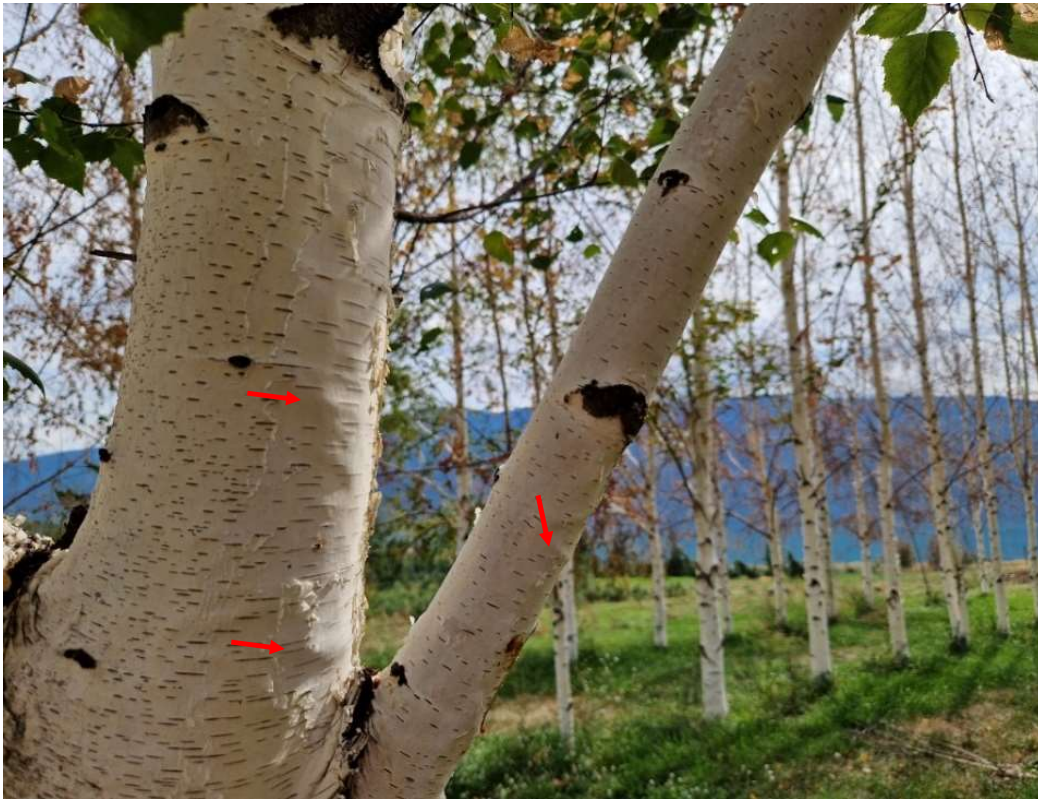


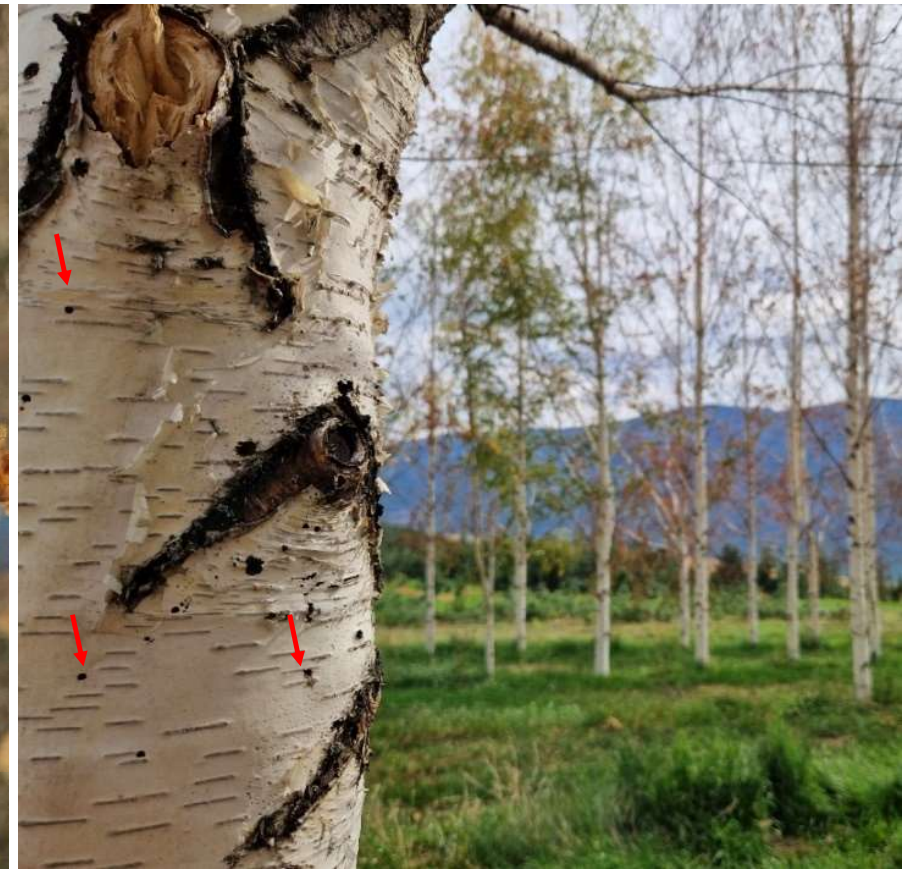
Figure 1. A typical ‘Invasion Curve’ with the phases of an organism’s Incursion (Entry), Establishment (Dispersal) and Maximum impacts.



Bronze Birch Borer (BBB)– *Agrilus anxius*

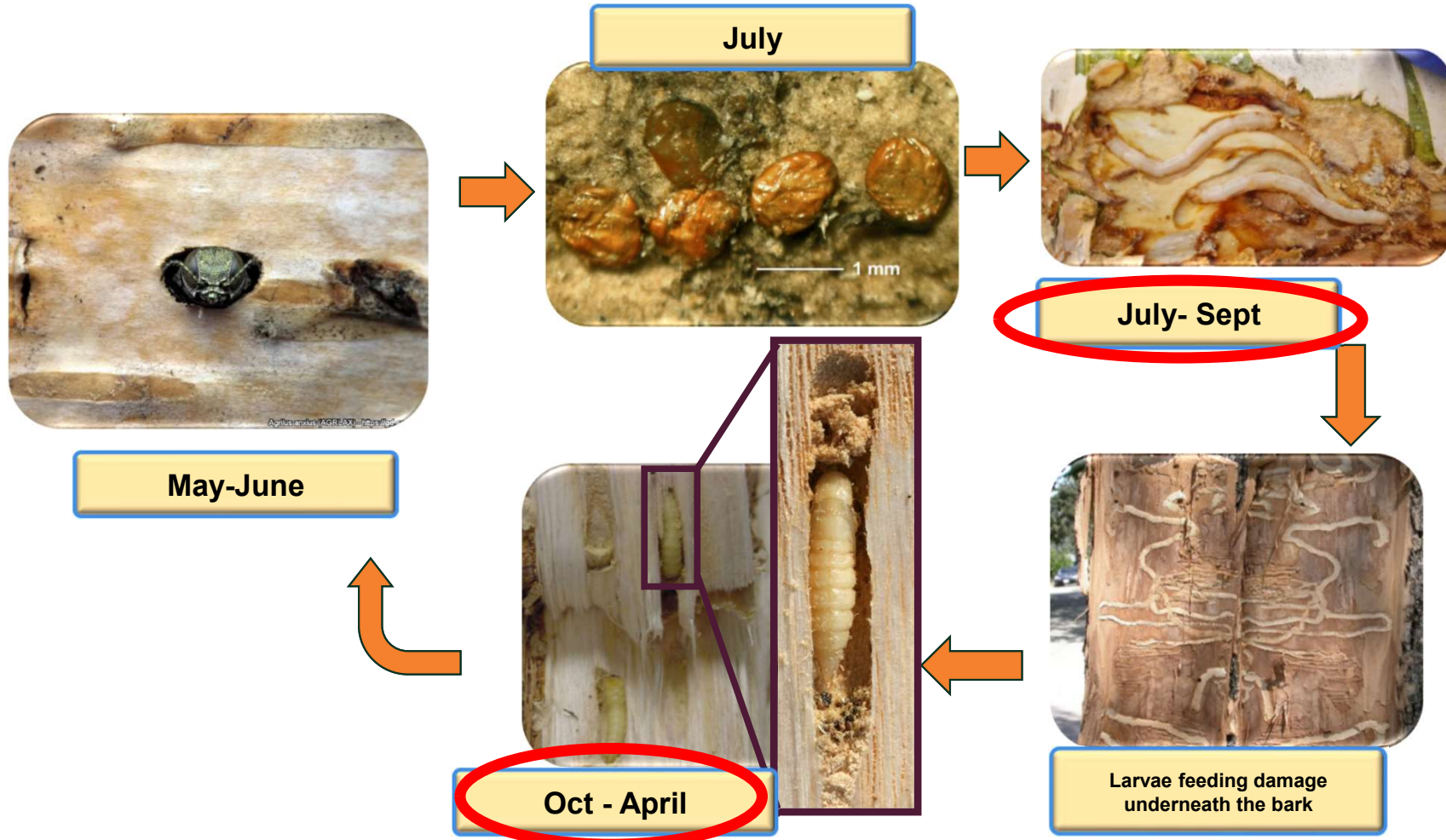


Bronze Birch Borer (BBB)– *Agrilus anxius*





BBB life cycle, cryptic

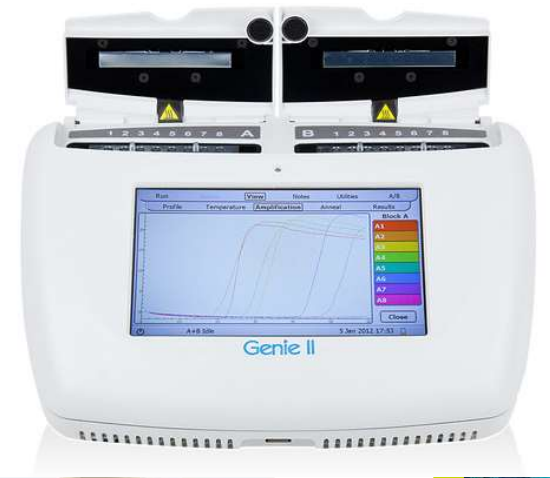


Molecular Methods for Species Identification

- Loop-mediated isothermal amplification (LAMP)
 - Rapid results in ~30 minutes
 - Bringing lab to the field
- Genie II or III
 - Portable units that can amplify DNA in the field

The assay needs to fulfill 3 criteria:

- Specific
- Sensitive
- Field validation



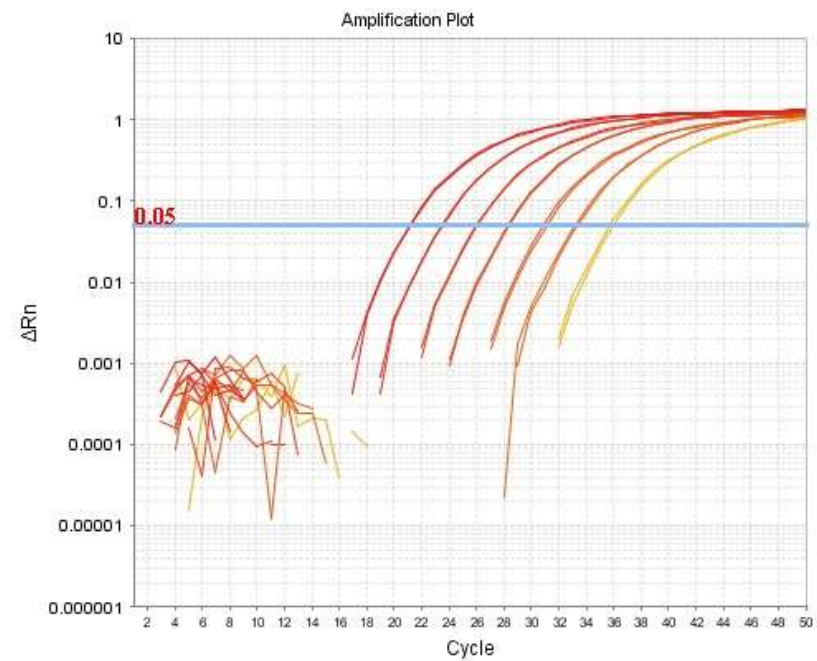
LAMP Assay

- Specific primers designed
- Species specific
 - 25 species tested
 - 13 European *Agrilus*
 - Four other Buprestids
 - Two Ambrosia beetles
 - Five Cerambycids
- Sensitivity:
 - 3.2 pg/μL

Insect Species	BBB LAMP
<i>Agrilus angustulus</i>	-
<i>Agrilus anxius (BBB)</i>	+
<i>Agrilus ater</i>	-
<i>Agrilus convexicollis</i>	-
<i>Agrilus curtulus</i>	-
<i>Agrilus graminis</i>	-
<i>Agrilus hastulifer</i>	-
<i>Agrilus laticornis</i>	-
<i>Agrilus obscuricollis</i>	-
<i>Agrilus olivicolor</i>	-
<i>Agrilus planipennis (EAB)</i>	-
<i>Agrilus roscidus</i>	-
<i>Agrilus sulcicollis</i>	-
<i>Agrilus viridis</i>	-
<i>Anthaxia nitidula</i>	-
<i>Chrysobothris affinis</i>	-
<i>Coraeus undatus</i>	-
<i>Lamprodila mirifica</i>	-
<i>Meliboeus fulgidicollis</i>	-
Curculionidae: Scolytinae	
<i>Anisandrus dispar</i>	-
<i>Xyleborinus saxesenii</i>	-
Cerambycidae	
<i>Aegomorphus clavipes</i>	-
<i>Exocentrus punctipennis</i>	-
<i>Leiopus nebulosus</i>	-
<i>Saperda punctata</i>	-
<i>Trichoferus pallidus</i>	-

qPCR

- Designed a BBB qPCR assay
 - Primer Express® Software 3.0
 - Very sensitive and specific
 - 0.005 pg/ul- more sensitive then LAMP assay



Field Validation of LAMP Assay

- Larvae and frass (eDNA) tested in BBB infested sites in Alberta and British Columbia

Paper birch (*B. papyrifera*)



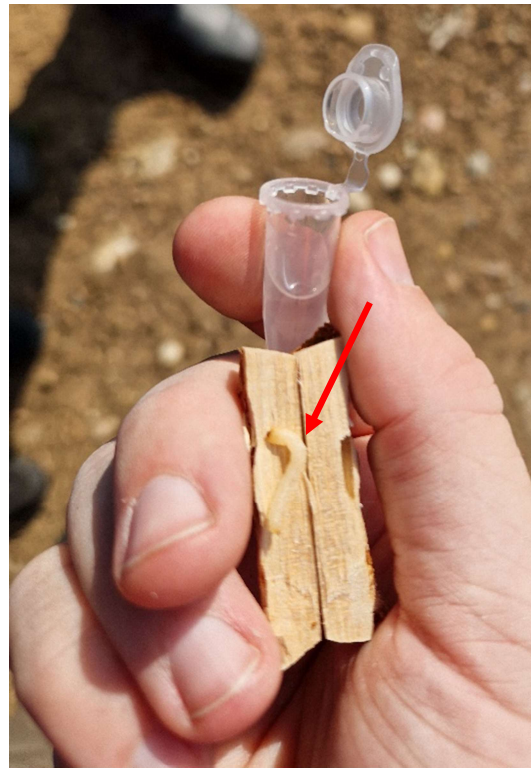
Silver birch



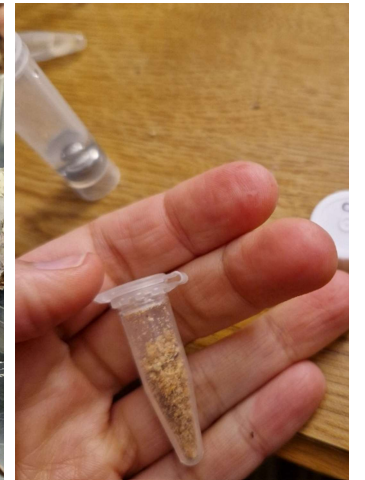
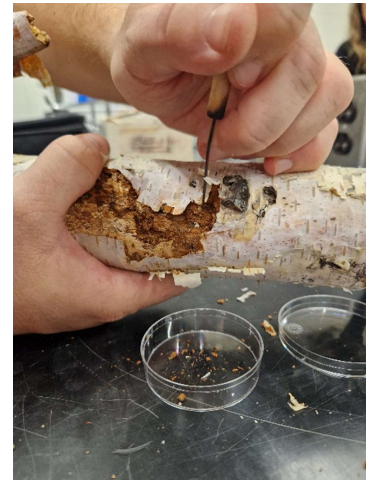
Found Larvae and Frass!



Larvae Collection



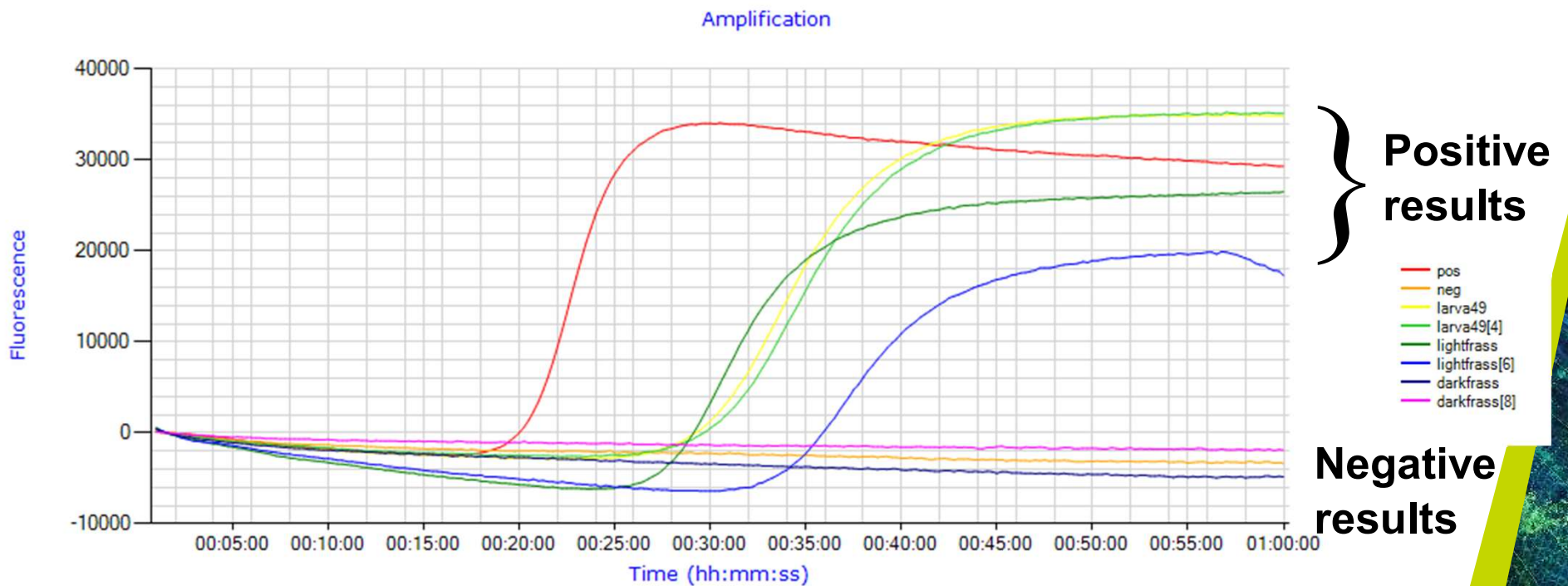
Frass Collection



Genie in the field



Results of the field study



Comparison of Paper Birch and Silver Birch

- Est. 1997 with 18 paper birch sources and 11 silver birch families from the Finnish birch breeding program.
- In 2006, mean survival for paper birch was 74% and for silver birch was 89%.

Paper birch (*Betula papyrifera*)



Healthy*	46
Missing trees	24
TOTAL (N):	70

*many 'healthy' trees exhibited previous damage to main stems and showed signs of healing

Silver birch (*Betula pendula*)



Healthy	61
Symptomatic of BBB (crown thinning)	8
Symptomatic of BBB (substantial crown dieback)	18
Dead from BBB	39
Missing trees	24
TOTAL (N):	150

Avoiding the threat of
BBB
-Proactive approach





Collaborators

Canada

Natural Resources Canada
Canadian Forest Service

Tod Ramsfield



Michelle Cleary
Sezer Olivia Kaya



Alvin Yanchuk
Trevor Doerkse
Nick Ukrainetz



National Research
Council of Italy

Alberto Santini
Nicola Luchi
Francesco Pecori
Duccio Migliorini



Aurélien Sallé



CAES

The Connecticut Agricultural Experiment Station

Claire Rutledge

Tack!

Received: 18 April 2023

Revised: 17 November 2023

Accepted: 29 November 2023

DOI: 10.1002/edn3.503

METHOD



WILEY

Development of novel LAMP and qPCR assays for rapid and specific identification of Bronze birch borer (*Agrilus anxius*)

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