

## Emerald Ash Borer, *Agrilus planipennis* (Fairmaire)

### Introduction

Emerald ash borer (EAB; *Agrilus planipennis* Fairmaire) (Coleoptera: Buprestidae) is a serious pest of ash (*Fraxinus* spp.) due to the woodboring nature of the larvae. It is native to areas of Asia including China and the Russian Far East.

In 2002, EAB was discovered in North America in the US State of Michigan and the neighbouring Canadian province of Ontario and has since spread to 35 US States, and the district of Columbia, and to five Canadian provinces. It has caused extensive damage killing hundreds of millions of ash trees leading to serious concerns over the survival of some ash species, related biodiversity and ecosystems, as well as causing significant economic damage and costing billions of dollars to manage. Emerald ash borer was also discovered in the Moscow region of European Russia in 2003 and has since spread from here particularly southwards and westwards and is now present in Ukraine (EPPO, 2022).

### History of classical biological control against *Agrilus planipennis*

Several hymenopteran parasitoid species were found associated with EAB in its native range and some were imported into the USA leading to the selection and release of four species for the classical biological control of EAB. These are the larval parasitoids *Tetrastichus planipennisi* (Hymenoptera: Eulophidae), *Spathius agrili* and *S. galinae* (Hymenoptera: Braconidae) and the egg parasitoid *Oobius agrili* (Hymenoptera: Encyrtidae). Parasitoids have now been released in the majority of US States and Canadian provinces where EAB has invaded and post-release monitoring has confirmed establishment of released parasitoids in 22 States.

Both *T. planipennisi* and *S. galinae* have proved successful in the management of EAB in the USA. *Tetrastichus planipennisi* is widely established, spreading rapidly in areas where it has been released. It has been reported to kill 36-85% of late instar EAB larvae in saplings and to reduce EAB population growth by 50%. *Spathius galinae* is also dispersing from release sites and rates of parasitism of 35-78% are reported accounting for a 31-57% reduction in EAB population growth.

*Oobius agrili* is confirmed as established and spreading although dispersal is slow (Duan *et al.*, 2018). Its impact on EAB populations has yet to be fully determined.

Sustained establishment of *S. agrili* in the USA is yet to be confirmed despite being released in multiple States (Duan *et al.*, 2018; USDA APHIS, 2022).

All four of these parasitoids are also approved for release in Canada but only *T. planipennisi*, *O. agrili* and *S. galinae* are used as *S. agrili* does not establish that far north (CFIA, 2018).

### Most promising natural enemies for classical biological control

*Tetrastichus planipennisi* preferentially attacks late instar EAB larvae, its only known host. It has a high reproductive potential, up to four generations per year and is capable of high rates of parasitism (> 60% in its native range). This parasitoid has a short ovipositor and is therefore best suited for the protection of ash saplings and trees that are sprouting basally following attack.

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*Spathius galinae* attacks 2<sup>nd</sup> to 4<sup>th</sup> instar EAB larvae. It has at least two generations per year, and high rates of parasitism (up to 63%) are reported in its native range. This parasitoid has a longer ovipositor than *T. planipennis* and can therefore provide protection against EAB in larger trees.

*Spathius agrili* preferentially attacks late instar EAB larvae. It completes three generations per year and is capable of high rates of parasitism in its native range. Both *S. galinae* and *S. agrili* will attack other *Agrilus* species.

*Oobius agrili* is a parasitoid of EAB eggs and will attack other *Agrilus* species with eggs of similar size. In its native range it has at least two generations per year and it is capable of high rates (ca. 62%) of parasitism (Duan *et al.*, 2018).

### Other natural enemies for classical biological control

*Atanycolus nigriventris* (Hymenoptera: Braconidae) is a larval parasitoid native to the Russian Far East. However, difficulties in maintaining a viable population prevent both its rearing and host specificity testing required before approval for use of this species could be considered; rates of parasitism are in the region of 23% (Gould *et al.*, 2015).

The differing geographic distribution of the egg parasitoid *Oobius primorskensis* (native to the Russian Far East and South Korea), along with differences in its diapause behaviour compared with the related *O. agrili*, makes this species of potential interest as a classical biological control agent against EAB. Rates of parasitism of 23-44% are reported from the Russian Far East however, laboratory host testing indicated that it is capable of parasitizing eggs of several other North American species of *Agrilus* (Duan *et al.*, 2019).

*Spathius polonicus* (Hymenoptera: Braconidae) is native to the West Palearctic, although has not been recorded in some countries within this wider region (e.g. UK). It attacks EAB in its invasive range around Moscow (Russia) with high rates of parasitism recorded (> 50%; Orlova-Bienkowskaja, 2015). If EAB were to invade areas where *S. polonicus* is apparently absent, deliberate release of this parasitoid as a classical biological control agent could be considered. However, it has a broad host range which may restrict its use for classical biological control.

### References

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