Emerald Ash Borer Life Cycle in South Dakota

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Emerald ash borer is native to eastern Asia but was accidentally introduced into North America sometime during the 1990s. It was first discovered near Detroit, Mich. in 2002 after widespread ash mortality was noticed. Since then, emerald ash borer has spread throughout much of eastern North American and in isolated spots in the western United States.

The first South Dakota confirmation was in Sioux Falls in 2018. It is believed to have been in Sioux Falls for at least three years before the discovery. Since 2018, emerald ash borer has been found in other communities within the state. It is expected to spread throughout the state by 2035. The current quarantine map, which identifies counties where emerald ash borer has been confirmed, is available at: emeraldashborerinsouthdakota.sd.gov.

Green, black, and white ash, along with their many cultivars, are highly susceptible to attack by the borer. These trees usually die within three to five years of the initial attack. The only means of protecting ash trees from becoming infested is through insecticide treatments. Insecticide treatments, however, are only recommended for ash trees within quarantined counties or if an infestation is confirmed within 15 miles of the tree's location.

There are insecticides available to the public for treating emerald ash borer but these are only effective for small trees - those less than four inches in diameter. Treating larger trees requires higher concentration of insecticides and these formulations are only available to commercial applicators.

The treatment period is determined by the life cycle of the borer. The following is a general description of the emerald ash borer life cycle in South Dakota. Most of the population follows a one-year life cycle where the insect completes its development over a one year period. Occasionally some emerald ash borers will take two years to complete this cycle from egg to adult.

Lifecycle of the emerald ash borer

Adult

The adult emerald ash borer is a torpedo shaped metallic beetle about ½-inch long and ⅛-inch wide (Figure 1). The top of the beetle is a coppery green. The underside has purplish highlights. The adults may be found crawling on host trees during sunny days when the air temperatures are in the 70s or 80s°F. They quickly take flight if disturbed so most people never see the adults.

Figure 1. Emerald ash borer adult

Emerald ash borer adults begin emerging at about 550 growing degree days (GDD-base 50) - late May - about the time black locust trees begin to bloom. The adults emerge from D-shaped holes they cut through the outer layer of bark (Figure 2).

Figure 2. Adult D-shaped emergence hole

Emergence peaks at about the time lindens are in bloom, about 1,000 GDD. This is mid to late June for much of the state. Emergence continues until about 1,400 GDD, mid to late July, when panicle hydrangeas are near full bloom.

Most adults live for about three to five weeks after emerging. The majority are flying between early June and early July. A few may be found in late July. All the adults have died by late August.

Egg

The adult female feeds on ash leaves for about a week before laying eggs so the first eggs are deposited on the bark in early June. The amber-colored eggs are spherical, about 1/32-inch in diameter (Figure 3). They are deposited in the rough bark along the ridges between a branch and the trunk or beneath bark flakes so are difficult to see.

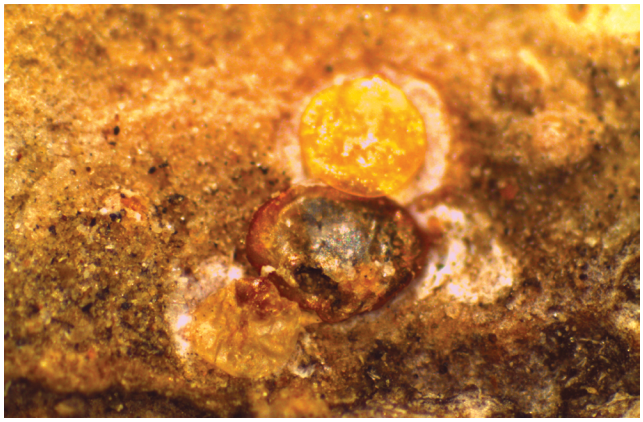

Figure 3. Eggs deposited in bark cracks

The eggs hatch in about ten days. The larvae burrow directly into the tree from the eggs. They do not move along the bark surface before tunneling into the tree.

Larva

The creamy white legless emerald ash borer larvae are flattened with ten bell-shaped segments along their long abdomen (Figure 4). The abdomen ends in two small pinchers. The head is a small brown capsule set on a larger round segment. The larvae feed in the phloem. This tissue, also known as the inner bark, is where sugars are moved through the tree.

Figure 4. Larva beneath bark

The larvae wind their galleries (tunnels) through this tissue in a serpentine pattern. This permits the larvae to avoid suffocation by the sap flowing through the phloem. As the tree declines over two to four years of repeated attacks, the sap flow slows and the galleries become more meandering.

The first larvae begin hatching about 650 GDD, mid-June, when northern catalpas begin to bloom. These 1st instar larvae become about ¼-inch long (Figure 5). They thread through the phloem for about two weeks before molting to the 2nd instar. The 2nd instars are a little longer, about 2/5-inch (Figure 6). They feed for another two weeks, until about 1,500 GDD before molting into the 3rd instar.

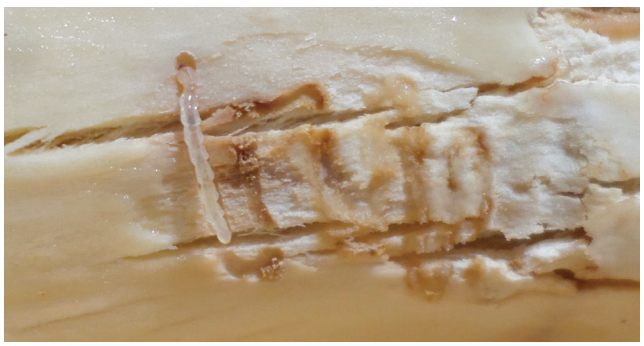

Figure 5. 1st instar larva

Figure 6. 2nd instar larva

The 3rd instar larvae becomes about ¾-inch long (Figure 7). These larvae are large enough that they not only feed in the phloem but etch the outer layer of sapwood where water is moved though the tree. These wide galleries cause extensive damage to the tree as these larvae are severing the movement of sugars from the leaves to the roots through the phloem and water from the roots to the leaves through the sapwood.

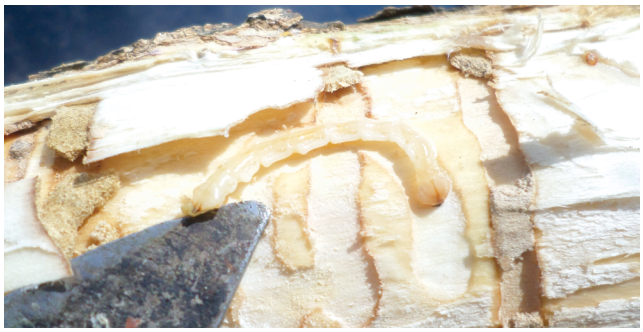

Figure 7. 3rd instar larva

The 4th instar molt is about 2,400 GDD, late August. These are the largest instar, becoming about 1 ¼-inch long (Figure 8). The tunneling by these larvae causes extensive damage to the tree. The 4th instar feed for a short time in September and October, then, by about 3,200 GDD, move deeper into the sapwood to overwinter in a chamber they construct. They curl into what is called a J-shaped larvae, where they remain until the following April (Figure 9).

Figure 8. 4th instar larva

Figure 9. J-shaped overwintering larva

Pupa

As the spring temperatures warm, the larvae unfold and shrink to form a prepupa in the chamber. This occurs during April at about 100 GDD, when forsythias begin to bloom. The prepupa is broad, almost round, and short, only ⅝-inch long (Figure 10). These transition into pupa about two or three weeks later, usually by early May. The pupae remain in their chamber for their entire development. They are first white, about ½-inch long and have little detail. Over about three weeks, the pupae gradually darken and develop the form of the adult (Figure 11).

Figure 10. Prepupa in cell

Figure 11. Pupa

Once they become adults, they crawl out of their chambers and follow a tunnel up to the bark that was carved by the larvae the previous fall. They begin emerging as an adult in late May (Figure 12) with some waiting until June or July to complete this transition.

Figure 12. Emerging adult

Treatments

The preferred method of protecting ash trees from becoming infested is through trunk injection of an insecticide by a commercial applicator. Trunk injections prevent insecticide exposure to surrounding environment.

The ideal time to perform injections is in the spring after the leaves begin to unfold, usually early May until early June. Injecting during this one-month period provides maximum benefit. Ash trees form their annual sapwood layer just before the leaves appear. This is the layer responsible for carrying the insecticide injected into the tree throughout the trunk and canopy.

Insecticides injected during this period will be carried through the newly formed sapwood into the foliage. This will kill the adult female emerald ash borer before she lays eggs. This will reduce the borer population that is flying that year. The insecticide will also quickly kill any newly hatched larvae before they are able to do any damage.

Injections performed later in the season will kill larvae but these larvae have already caused some damage through their tunneling. The tunneling can also disrupt the flow of the insecticide through the tree allowing some larvae to survive.

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