



notched leaf margins may be apparent. After a minimum requisite feeding period of two weeks, females lay 40-70 individual, small eggs in bark cracks, crevices and under bark flakes. Egg laying typically begins at the topmost stems and branches of the canopy. Larvae hatch from the eggs within approximately two weeks and bore through the bark and into the sapwood. Larvae complete their growth and pupation in 'S' shaped galleries chewed in the phloem and cambium (Figure 5). The EAB life cycle typically takes one year, but may take as long as two years.

Figure 5: "S" shaped galleries chewed by larvae in phloem and cambium



## Symptoms

Water and nutrient transport within attacked trees is significantly disrupted due to numerous larvae leading to individual branch dieback or whole tree death when larval populations are high. Tree symptoms such as yellowing, wilting and crown dieback are early indications that this invasive pest is present. Later in an infestation, heavily attacked trees will exhibit extensive branch death, bark cracking and abundant epicormic shoot growth. It may take several years before a tree finally succumbs completely.

Birds such as downy and hairy woodpeckers are adept at finding trees with relatively low larval populations. Therefore, increased woodpecker activity in the tops of ash trees, as well as distinct bark 'blonding' caused

by the bird's bark flaking foraging behavior, is an important cue to look more closely for further evidence of an EAB infestation.

## Management

### Chemical Treatment

Early preventative treatment with insecticides is a highly effective strategy for protecting and preserving ash trees. There are multiple application methods and chemical options available depending on the level of pressure due to beetle population density. Once an ash shows greater than 40% crown decline, however, treatment efficacy is significantly impaired. Recovery, even after effective treatment may not become apparent until the second year. Trees with greater than 50% die back should be scheduled for removal as soon as practical to prevent hazardous conditions due to the brittle nature of dead ash wood.

Since it is challenging to detect trees with low larval densities, but undesirable to apply insecticides before EAB invades an area, treatments should ideally begin when EAB is found within 10-15 miles of an ash tree's location.

Research has determined that management techniques change as population levels build. Emerald ash borer population dynamics typically follow a pattern:

Early Stage (*Cusp of invasion*) - Over 3-4 years populations slowly build; losses from EAB are less than 8% of the total ash tree population. Annual preventive treatments with soil applied imidacloprid will protect ashes during this stage.

Peak Stage (*Crest of tree mortality*) - By year five of an infestation, EAB populations are very high. The majority of unprotected ash trees will be killed over the next four to five years. During this stage, stem injection with emamectin benzoate every other year has been shown to be the most effective treatment to protect ash trees from the severe pressure presented by this pest.

Late Stage (Core infestation) - By this stage, most unprotected ashes have been killed and beetle populations are declining. Annual preventative treatments with soil applied imidacloprid will again protect ash trees at this stage.

### **Sanitation**

Removal and destruction by chipping, burial, or burning is recommended for all heavily damaged ashes. Wood should not be stored as firewood through the winter months and firewood should not be transported from areas known to be infested by emerald ash borer.

### **Cultural Practices**

Maintain the health of ash trees with good cultural practices including pruning, fertilization, proper mulching and irrigation during dry periods. This will reduce stress and improve the tolerance of trees to borer attacks.



Founded in 1926, The Bartlett Tree Research Laboratories is the research wing of Bartlett Tree Experts. Scientists here develop guidelines for all of the Company's services. The Lab also houses a state-of-the-art plant diagnostic clinic and provides vital technical support to Bartlett arborists and field staff for the benefit of our clients.