Trunk injection treatments are commonly used to protect trees from emerald ash borer (EAB). This publication discusses important features and guidelines of the trunk injection treatments most commonly used.

All of the treatments described here have been shown to be effective against EAB. Actual treatment success can vary depending on initial tree condition and timing of the treatments. Trees with vascular tissue already damaged by EAB often do not respond well to treatment. Late spring to early summer treatments are more effective than those applied in late summer. Treatments generally should be considered only when EAB is known to be within 15 miles of your location.

All trunk injections cause damage to trees. Larger hole sizes and larger amounts of product cause greater internal damage.

**Trunk injection treatments for emerald ash borer control**

<table>
<thead>
<tr>
<th>Product†</th>
<th>ArborMectin</th>
<th>Boxer</th>
<th>Imicide</th>
<th>TREE-äge G4</th>
<th>TreeAzin</th>
<th>Xytecl 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active ingredient</td>
<td>Emamectin benzoate</td>
<td>Emamectin benzoate</td>
<td>Imidacloprid</td>
<td>Emamectin benzoate</td>
<td>Azadirachtin</td>
<td>Imidacloprid</td>
</tr>
<tr>
<td>Registered in NE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Not as of July 2016</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Product information**

- **Years effective**: 2 years, 2 years, 1 year, 2 years, 2 years, 1 year
- **Application timing according to the label**:
  - For optimal control, apply at least 30 days before historical egg hatch or adult flight and to trees whose vascular tissue is not damaged.
  - For optimal control, apply at least 30 days before historical egg hatch or adult flight and to trees without vascular tissue damage.
  - Injections may be made anytime translocation is occurring. Translocation typically ends within 6 weeks of the first frost.
  - No guidelines about timing were found on the label. No guidelines about timing may lead to applying treatments at times when the product would not be effective.
  - For best results, apply at least 30 days before historical egg hatch or adult flight and trees whose vascular tissue is not damaged.
  - No guidelines about timing were found on the label. The lack of timing guidelines may lead to applying treatments at times when the product would not be effective.
  - No guidelines about timing were found on the label. The lack of timing guidelines may lead to applying treatments at times when the product would not be effective.

- **Recommended timing based on average Nebraska conditions**: Mid-May through early June for good control. The label suggests applications at least 30 days before egg hatch or adult flight for optimal control. Egg hatch (later than adult flight) begins in Nebraska about mid-June; therefore the latest application for optimal control would be in mid-May. Effectiveness drops when treatments are applied later.

**Notes**:
- Other similar products may be available. No endorsement or discrimination is implied.
- The products described are the latest ones produced by the companies for EAB control.
- Quotes are from the label or supplemental publications from the company.
- Mid-May through early June for good control is the recommendation of the Nebraska Emerald Ash Borer Working Group.
Trunk injection treatments for emerald ash borer control (cont.)

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<tr>
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<tr>
<td>Precautions related to tree health</td>
<td>Applications to drought or heat stressed trees may result in injury to tree tissue, poor treatment and subsequent control. Avoid treating trees that are moisture stressed or suffering from herbicide damage.</td>
<td>“Do not inject trees that are drought stressed. Applications to drought or heat-stressed trees may result in injury to tree tissue, poor treatment and subsequently poor control. Avoid treating trees that are moisture stressed or suffering from herbicide damage.”</td>
<td>“Trees in advanced stages of insect infestation may not respond to treatment.”</td>
<td>“Applications to drought- or heat-stressed trees may result in injury to tree tissue, poor treatment and subsequent control. Avoid treating trees that are moisture stressed or suffering from herbicide damage.”</td>
<td>Treatment is not recommended if the tree is known to be infested by EAB and canopy thinning and/or dieback is greater than or equal to 30%.</td>
<td>“Trees in advanced stages of insect infestation may not respond to treatment.”</td>
</tr>
</tbody>
</table>

| Equipment for application | Tree injection devices that meet the label and dose requirements. No specific devices are mentioned. | Wedge Direct-Inject Tree Injection System and other devices that meet the label and dose requirements. | Maurget micro-infusion capsules. | QUIK-jet, QUIK-jet Air, Tree I.V., VIPER Hydraulic Device and other devices that meet the label and dosage requirements. | EcoCollect System or other devices that meet the label and dosage requirements. | Q-Gun, Q-Connect, QI Tree Infuser and other devices that meet the label and dose requirements. |
| Method of application | Depending on the device, the product is likely pressure injected into holes drilled through the bark and into the xylem. | Product is pressure injected with a needle-like device through the bark to the outer ring of the xylem. | Product is pressure injected into holes drilled through the bark and into the xylem. | Product is pressure injected into holes drilled through the bark and into the xylem. | Product is pressure injected into holes drilled through the bark and into the xylem. | Product is pressure injected into holes drilled through the bark and into the xylem. |
| Label rate | 2.5 to 16.5 ml per inch of trunk diameter | 1.2 ml per 4 in. of trunk circumference within 12 inches of the ground | 1 capsule (2 to 4 ml) per 2 inches of trunk diameter | 2.9 to 15 ml per inch of trunk diameter | 5 to 12.5 ml per inch of trunk diameter | 2 to 6 ml per inch of trunk diameter |
| Amount for high rate for 25-in. diameter tree | 390 ml | 40 ml | 48 ml | 270 ml | 312 ml | 150 ml |

<table>
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<tr>
<th>Damage to trees caused by the injections</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum injection hole diameter and depth recommended on the label or in supplemental publications</strong></td>
</tr>
<tr>
<td>Blue shading indicates the 3 rings in ash that move sap—the targeted location for injections. About 90% of sap moves in the outer annual ring and nearly 100% in the outer 3 rings.</td>
</tr>
<tr>
<td><strong>Number of injection sites for a 25-inch diameter tree</strong></td>
</tr>
<tr>
<td><strong>Relative degree of damage to the tree based on the volume of holes and product needed for a 25-inch diameter tree</strong></td>
</tr>
</tbody>
</table>

Trunk injection effectiveness and damage

- **Sap in the xylem of ash trees** moves almost entirely in the outer three annual rings. As xylem rings become older, they become less able to transport sap. Chemicals injected into the outer three rings move more completely from the injection sites and up through the trunk and branches compared to chemicals injected more deeply; therefore less chemical is needed for the treatment to be effective.

- **Deep injection holes and large amounts of product** are more likely to cause significant internal damage and contribute more to a decline in the health of the tree compared to shallow holes and small amounts of product. The damage caused by large holes and large amounts of product include (1) the loss of the ability to move water and other materials through the tree, (2) the loss of stored carbohydrate reserves (the tree’s energy reserves), and (3) the loss of the ability to store carbohydrates for future use.

- **Trees that have been well taken care of**, such as those given additional water during dry periods and/or mulched with wood chips, generally have wider annual rings and are likely to respond better to injection treatments.

- **When repeating treatments**, previous injection holes should be examined. Any holes that have not closed are signs the tree is not healthy, and a repeated treatment could seriously weaken or kill it.

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* ArborMectin hole depth is specified on the label, but not the diameter, so the largest diameter needed for an injection device likely to be used with this product was used (Arborjet QUIK-jet Air).

† Approximate hole size. Hole is made to the outer edge of the xylem with a needle-like device. No hole measurements are indicated on the label.

‡ Damage is generally greater as hole size and amount of product increase.

Photo credits: Greenindustrypros.com (QUIK-jet Air), ArborSystems (Wedgie Direct-Inject); Ronald F. Billings, Texas A&M Forest Service, Bugwood.org (Mauget Tree Injector)