NEBRASKA FOREST SERVICE

Emerald Ash Borer
Trunk Injection Treatment Options
for Professionals

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Mark Harrell, Ph.D., Forest Health Program Leader

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.

Arborjet QUIK-jet Air

Mauget Micro-infusion Capsule

ArborSystems Wedge Direct-Inject Injection Unit

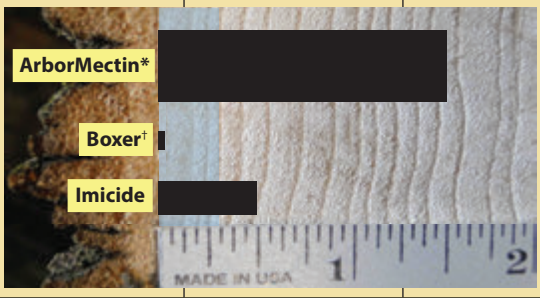
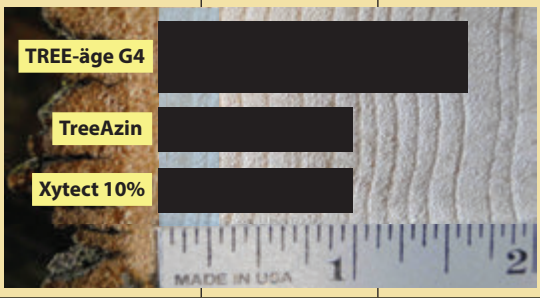
Three of many injection methods available for emerald ash borer control

Trunk injection treatments for emerald ash borer control*

Product†	ArborMectin	Boxer	Imicide	TREE-äge G4	TreeAzin	Xytect 10%
Company	Rotam North America	ArborSystems, Inc.	J.J. Mauget Co.	Arborjet, Inc.	BioForest Technologies, Inc.	Rainbow Treecare Scientific Advancements
Active ingredient	Emamectin benzoate	Emamectin benzoate	Imidacloprid	Emamectin benzoate	Azadirachtin	Imidacloprid
Registered in NE	Yes	Yes	Yes	Yes	Not as of July 2016	Yes
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. The lack of timing guidelines 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 to 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.	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.	Mid-May through early June for good control. Effectivness drops when treatments are applied later.	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.	Mid-May through early June for good control. Effectiveness drops when treatments are applied later.	Mid-May through early June for good control. Effectiveness drops when treatments are applied later.

* 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.)

Product	ArborMectin	Boxer	Imicide	TREE-äge G4	TreeAzin	Xytect 10%
Precautions related to tree health	"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." "If vascular tissue is damaged... uniform treatment and control may not be achieved."	"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." "If vascular tissue is damaged... uniform treatment and control may not be achieved."	"Trees in advanced stages of insect infestation may not respond to treatment."	"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." "If vascular tissue is damaged... uniform treatment and control may not be achieved."	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%.	"Trees in advanced stages of insect infestation may not respond to treatment."
Equipment for application	Tree injection devices that meet the label and dose requirements. No specific devices are mentioned.	Wedgle Direct-Inject Tree Injection System and other devices that meet the label and dose requirements.	Mauget micro-infusion capsules.	QUIK-jet, QUIK-jet Air, Tree I.V., VIPER Hydraulic Device and other devices that meet the label and dose requirements.	EcoJect System or other devices that meet the label and dosage requirements.	Q-Gun, Q-Connect, iQ 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
Damage to trees caused by the injections						
Maximum injection hole diameter and depth recommended on the label or in supplemental publications 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.						
Number of injection sites for a 25-inch diameter tree	13	20	12	13	16	13
Relative degree of damage to the tree based on the volume of holes and product needed for a 25-inch diameter tree ‡	**High** Holes: 2.3 cu. in. Product: 23.8 cu. in. (390 ml) **Total: 26.1 cu. in.**	**Low** Holes: 0.004 cu. in. Product: 2.4 cu. in. (40 ml) **Total: 2.4 cu. in.**	**Low** Holes: 0.1 cu. in. Product: 2.9 cu. in. (48 ml) **Total: 3.0 cu. in.**	**High** Holes: 2.3 cu. in. Product: 16.5 cu. in. (270 ml) **Total: 18.8 cu. in.**	**High** Holes: 0.7 cu. in. Product: 19.0 cu. in. (312 ml) **Total: 19.7 cu. in.**	**Moderate** Holes: 0.6 cu. in. Product: 9.2 cu. in. (150 ml) **Total: 9.8 cu. in.**

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.

* 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 (Wedgle Direct-Inject); Ronald F. Billings, Texas A&M Forest Service, Bugwood.org (Mauget Tree Injector)