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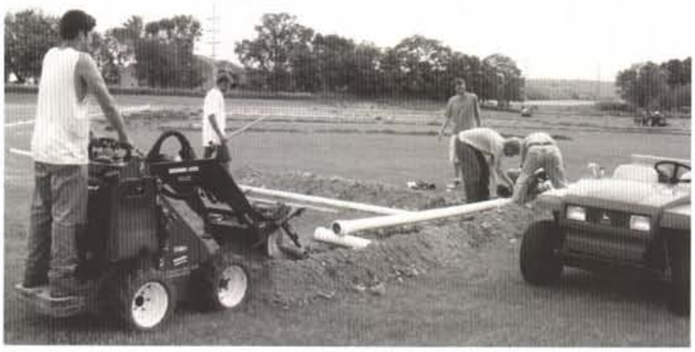
The new irrigation system would not be possible without all the donations received. The UW-Madison Turf Program is very thankful for the generosity from so many in the industry. We'd like to thank the donors noted above.

The staff makes connections while the "Toro Dingo" trenches ahead.



Plant pathology graduate students conduct their work while the irrigation system goes in around them.

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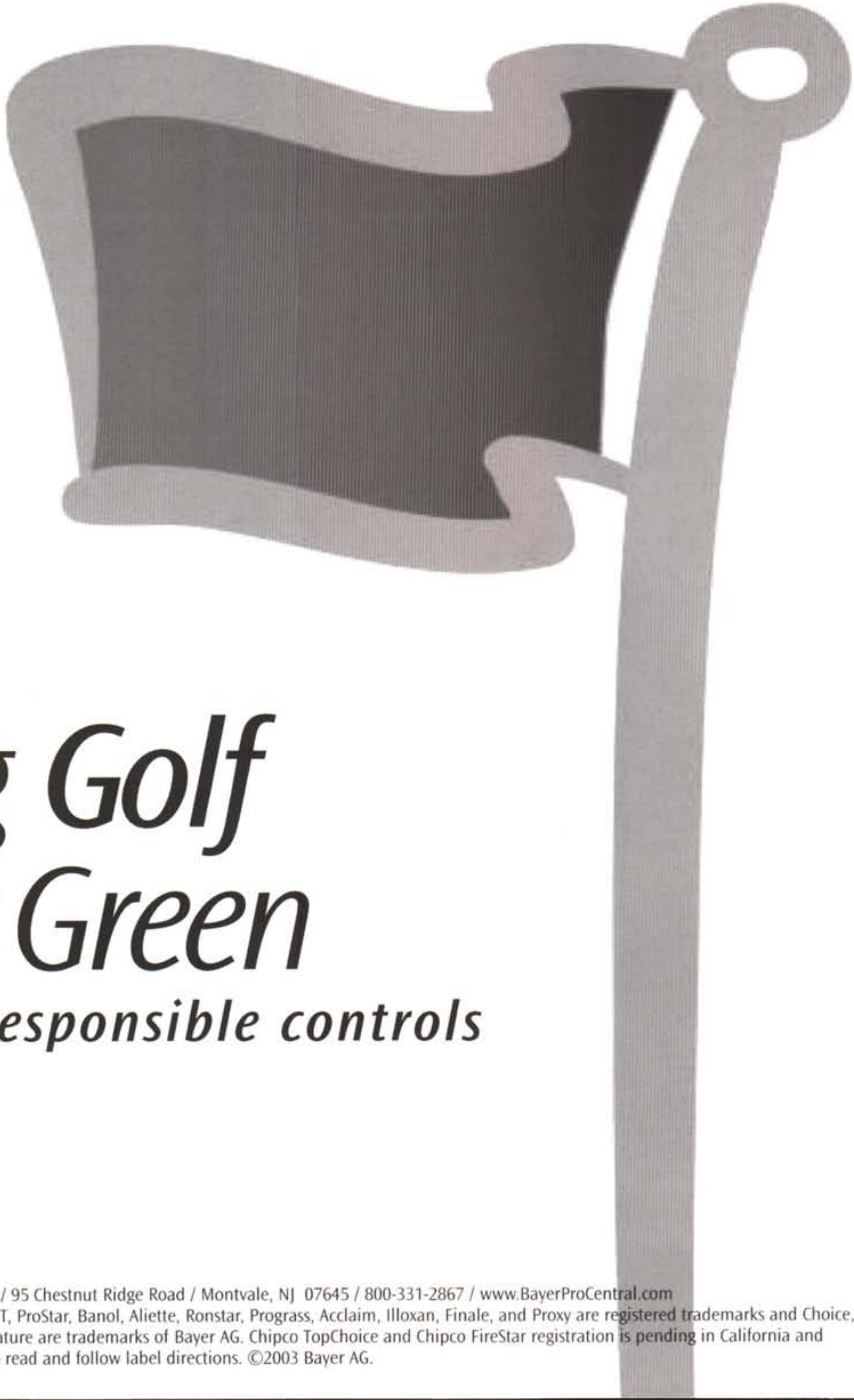

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Interaction of Nitrogen, Plant Growth Regulators and Fungicides on the Control of Anthracnose

By Dr. Geunhwa Jung, *Department of Plant Pathology, University of Wisconsin-Madison*

Can the control of anthracnose basal rot and foliar blight, caused by *Colletotrichum graminicola*, be improved by mixing fungicides with nitrogen and/or plant growth regulators? In order to develop realistic and effective management strategies for turf management professionals, this is an important question to be addressed. We already talked about the effect of contact and systemic fungicides and the timing of initial application for the control of anthracnose in last issues of the *Grass Roots* (Jung, 2004). In summary, as preventive applications, Daconil Ultrex® (contact fungicide) performed very well as did Banner MAXX® and Endorse®. The effect of the initial application on the anthracnose control was not detected due to the fact of delayed occurrence of the disease by one month in 2003 compared to 2002. Basically, the application of treatments started too early before initial disease occurrence. Experiments were run on creeping bentgrass fairways at the Blackhawk Country Club (BCC) in Madison and annual bluegrass at the Plum Lake Golf Course (PLGC) in Sayner, WI but no disease developed at the PLGC. This project was funded by WTA and NGLGCSA. Three original objectives at both sites were 1) to reaffirm research results of what we found in the 2002 experiments, 2) to determine if timing of initial fungicide applications has an effect on disease control, and 3) to evaluate interactions between fungicides, plant growth regulators, and fertilizers for the disease control. In this article, the final objective #3 will be discussed which is based on one year's data. This summer the same experiments will be repeated at both locations.

Materials and Methods

Fungicides, fertilizers, and PGRs tested for this study are listed in Tables 2 and 3 (page 37). The experimental plot at Blackhawk Country Club in Madison, WI was set up on an annual bluegrass/creeping bentgrass fairway where more than 60% of the turfgrass population was estimated to be *Poa annua* species. Over the years, high disease pressure has been consistently observed at this location. The experiment was arranged in a split block, randomized complete block design with the fungicides being the main plot and plant growth regulators/urea treatments as the sub-plot (3 ft x 3 ft). Preventive chemical applications (14 day interval) from the initial application were continued on June 16, June 30, July 14, and July 28, and August 11 at the BCC, 2003. Liquid treatments were applied with a CO_2-powered boom sprayer using XR Teejet 8005 VS nozzles at 30 psi in water equivalent to 2 gal per M. The site is maintained at 0.5" mowing height, and the plot did not receive additional fertility or plant protection treatments during the studies.

Disease ratings (percentage of plot area with symptoms) of the plots were visually recorded on September 2nd and 13th, 2003 at the BCC. The first disease symptoms at the BCC were noticed around the first week of August which was almost one month later than the previous year. In addition, the total percentage of *P. annua* populations per plot was visually estimated on June 6, 2003. Since the anthracnose occurred only on *P. annua* species, the percentage of the diseased areas of *Poa* was recalculated by estimating the percentage of the entire plot that was diseased and then dividing that amount by the proportion of *P. annua* present in the plot. The final data analysis using the recalculated damage percentage was carried out and presented in Tables 1, 2, and 3.

Results and Discussion

No significant interactions ($P > 0.993$ and $P > 0.875$, on ratings of Sept. 2 and 13, respectively) between fungicides and urea and/or PGRs on the control of anthracnose were detected in our first year's experiment (Table 1). In other words, the control efficacy of fungicides was not significantly influenced by either nitrogen and PGRs or both. These results were a surprising outcome because at least nitrogen is expected to have a positive effect on the control of anthracnose. On the other hand, highly significant treatment differences in the control efficacy among fungicides and nitrogen/PGRs, respectively were detected (Table 1).

Daconil Ultrex® (contact fungicide) performed very well as observed in previous experiments. In addition, Banner MAXX®, Chipco Signature®, Medallion®, and Lynx® controlled the anthracnose as well as Daconil Ultrex® (Table 2). However, in a statistical point of view, these fungicides differ in efficacy from Compass®, Eagle®, and Cleary's 3336® on both Sept. ratings and additionally Bayleton® on Sept. 13 rating, but not from the other fungicides despite a difference in the mean percentage of the diseased area (Table 2). The huge variation was probably caused by visual estimations of disease damage as well as the fact that the field experiment was uninoculated. In addition, anthracnose severity is highly correlated with factors such as drought, traffic, and other stresses, so the unequal level of stresses may have also contributed to the variation. The overall trend of fungicide efficacy for controlling the disease was observed this year as in the 2002 study.

The nitrogen treatments performed better than the PGRs for anthracnose control on August 11 rating, but the trend was reversed by September ratings (Table 3). Primo Maxx did seem to decrease susceptibility more than urea and Proxy treatments which could not be biologically deciphered at this moment. Since the results were based on one year's data, at least another year's experiment is required before making any conclusion.

Conclusion

Despite of the huge variation in the disease severity which was contributed by environmental variation and other factors such as the mixed growth of two grass species in the same area, natural inoculation, and other abiotic stresses, significant and consistent treatment effect of fungicides were observed in studies of WI and other states. I still have a big question on how much of the pathogen's virulence or *Poa annua* physiological condition or both play a role of causing the actual symptoms. I can't resist stating once more how intriguing the whole question of anthracnose really is. Hopefully, a more in-depth experiment will be designed to understand the biology of the disease step by step in coming years.

Literature Cited

Jung G. Effect of first application timing on the control of anthracnose. 2004. The *Grass Roots* XXXIII No.2 pages 47-49.

Table 1. Analysis of variance of two disease ratings on September 2 and 13, 2003 for interactions of fungicides and nitrogen/plant growth regulators (PGRs) for the control of anthracnose.

		September 2, 03		September 13, 2003	
Source	DF	F ratio	Prob > F	F ratio	Prob > F
Replication	3	2.3581	0.0718	1.4502	0.2284
Chemical	13	9.8472	<.0001	6.8971	<.0001
PGRs/Nitrogen	6	5.0267	<.0001	4.3632	0.0003
Chemical x PGRs/Nitrogen	78	0.6240	0.9930	0.8036	0.8750

Table 2. Systemic and contact fungicides evaluated for the control of anthracnose disease of *Poa annua* and creeping bentgrass fairway at 14 days spray schedule at the Blackhawk Country Club in Madison, WI.

	Rate	Mean (%) of diseased area[a]	
Treatment	(oz a.i./M sq ft)	Sept. 2, 2004	Sept. 13, 2004
Eagle (Myclobutanil: 40WP)	0.6	29.5 a	29.1 a
Compass (Trifloxystrobin: 50WG)	0.15	32.0 a	27.5 a
Cleary's 3336 (Thiophanate-methyl: 4F)	4 FL	29.2 a	26.9 a
Check		26.4 ab	23.3 ab
Bayleton (Triadimefon: 50WDG)	0.5	24.1 ab	21.2 ab
Chipco 26GT (Iprodione: 2SC)	3 FL	18.8 abcd	18.3 abc
Heritage (Azoxystrobin: 50WDG)	0.2	19.2 abc	16.5 abc
Insignia (Pyraclostrobin: 20WG)	0.5	14.0 abcde	14.0 abc
Endorse (Polyoxin D: 2.5WP)	4	9.2 bcde	10.2 abc
Banner Maxx (Propiconazole: 1.24MC)	1 FL	5.4 cde	7.7 bc
Chipco Signature (Fosetyl-al: 80WG)	4 FL	1.0 de	2.9 c
Medallion (Fludioxonil: 50WG)	0.25	1.2 cde	2.8 c
Lynx (Tebuconazole: 45WP)	0.6	1.4 cde	2.7 c
Daconil Ultrex (Chlorothalonil: 82.5WDG)	2.75	0.4 e	2.3 c

[a]Values followed by the same letter do not significantly differ ($\alpha = 0.05$).

Table 3. Plant growth regulators and nitrogen evaluated for the control of anthracnose disease of *Poa annua* and creeping bentgrass fairway at the Blackhawk Country Club in Madison, WI.

	Rate	Mean (%) of diseased area[a]		
Treatment: spray schedule	(oz a.i./M sq ft)	Aug. 11, 2004	Sept. 2, 2004	Sept. 13, 2004
Primo Maxx (1ME): 28 days Urea 46-0-0 (46WG): 14 days	0.25 FL 2	2.2 abc	7.4 b	7.4 b
Primo Maxx (1ME): 28 days	0.25 FL	3.1 a	10.3 b	8.7 b
Proxy (2EW): 28 days Urea 46-0-0 (46WG): 14 days	5 FL 2	2.4 ab	11.9 ab	11.7 ab
Proxy (2EW): 28 days	5 FL	1.2 bc	13.0 ab	11.7 ab
Urea 46-0-0 (46WG): 14 days	4	0.6 c	18.1 ab	17.8 ab
Urea 46-0-0 (46WG): 14 days	2	1.6 abc	22.2 a	21.7 a
Control		2.4 abc	23.0 a	21.2 a

[a]Values followed by the same letter do not significantly differ ($\alpha = 0.05$).

The Next Dutch Elm Disease?

By Dan Egan, *Milwaukee Journal Sentinel*

A Michigan doughnut shop will become ground zero this week in that state's desperate campaign to halt a rapid invasion of an ash-killing beetle that already has claimed millions of trees in the Detroit area and is threatening to spread to other states.

The Michigan Department of Agriculture has 155 full-time employees in a fight that, if lost, federal officials say could cause as much as $60 billion in damage to U.S. forests and neighborhoods that turned to ash trees to patch the damage wreaked by Dutch elm disease in the 1960s and '70s.

The emerald ash borer has not been found in Wisconsin, but a monitoring campaign will be conducted this summer in state forests and parks.

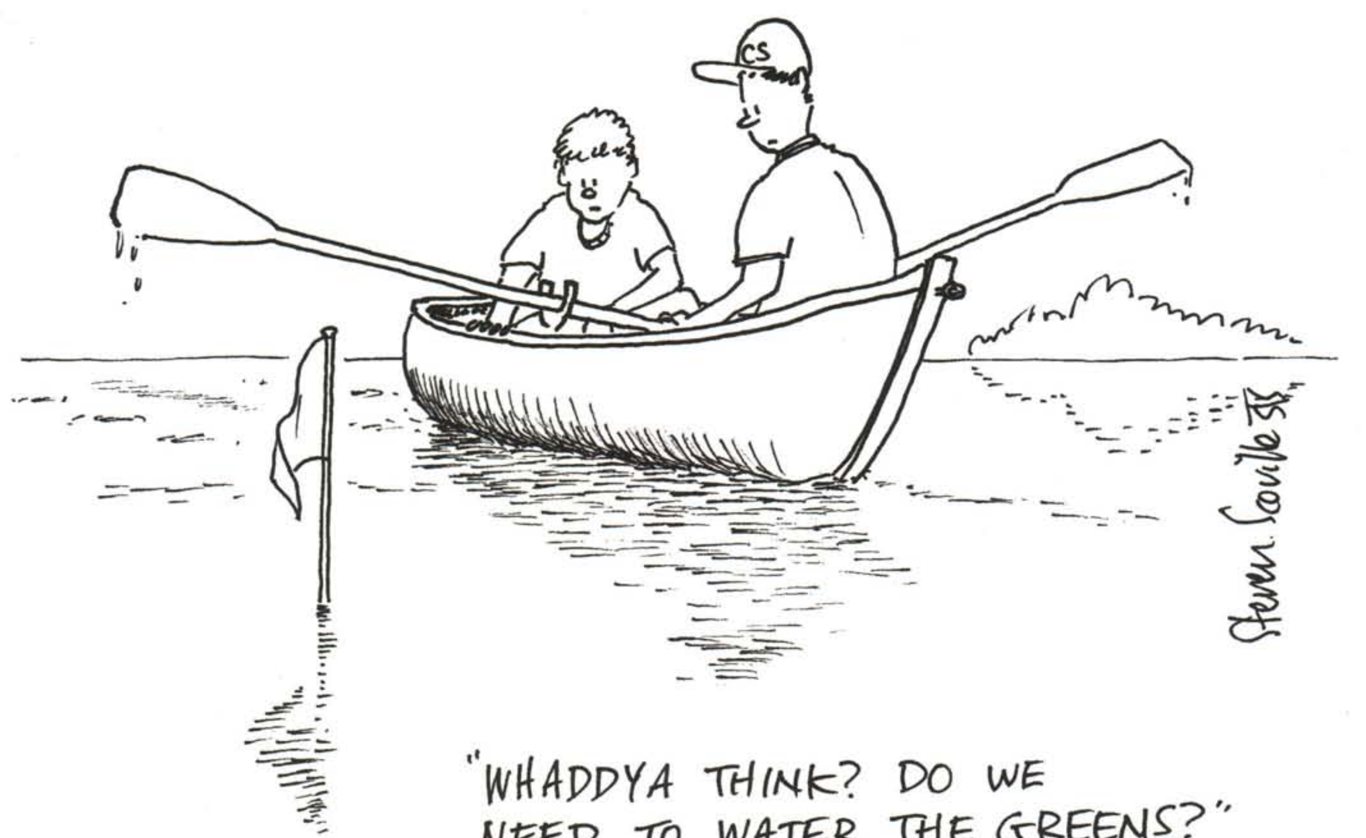
The beetle was first discovered in the United States when Michigan officials found it just two years ago. It is believed to have hitched a ride from Asia in wood packing material or in wood used to stabilize loads in cargo ships.

There are about 700 million ash trees in Michigan and more than 600 million in Wisconsin, not counting those trees planted in urban areas. Ash are among the most popular street trees because of their durability, said John Kyhl, plant pest and disease specialist with the Wisconsin DNR.

"It's hard to impress upon people the impact of this insect," said JoAnn Cruse, Wisconsin director for plant protection and quarantine for the federal Animal and Plant Health Inspection Service. "It was even hard for us to comprehend until we saw it over there, when we saw how many trees had died."

The first target in the push to eradicate the bug - and its potential host trees - is a half-mile radius around a doughnut and coffee shop in Saginaw County in northeast Michigan. Some trees from an infested nursery in the Detroit area were planted at the site in July 2002.

Every ash tree inside that circle around the doughnut shop will be chopped down. Crews expect to take down about 20,000 trees at a cost of about



"WHADDYA THINK? DO WE NEED TO WATER THE GREENS?"

$500,000. The job will take a few weeks, and then crews will move on to about a dozen other sites in the state as part of a federally funded control effort that could cost $43 million this year alone.

"It's analogous to mad cow disease," said Therese Poland, a research entomologist with the U.S. Forest Service. "If you find an infected cow, you destroy the whole herd."

The tainted wood will be chipped and hauled to an electricity-generating incinerator.

CLANDESTINE KILLER

A 13-county region in southeastern Michigan in the Detroit area has already been put under quarantine, where no ash, dead or alive, can be transported out. Officials are now figuring how and where to build a "firebreak" that will level all the ash trees in a wide swath around the perimeter of the region's core infested area.

But, as was the case with the doughnut shop in Saginaw County, some infested nursery trees and firewood made it out before the quarantine took effect.

Those are the areas agriculture officials are most worried about now. Most are within Michigan, although some have been located in the southeast part of the country, as well as in Ohio.

Emerald ash borer can be more of a problem than the tree-munching gypsy moth and the Asian longhorn beetle, largely because it does its work so clandestinely.

The beetle lays its eggs in the bark of a tree, where they are almost impossible to spot. The bugs then hatch and bore into the tree, where they devour a layer just underneath the bark. That cuts off the delivery of nutrients between the leaves and roots.

The adult bug then bores its way out the next year when, iridescent green, it is easy to spot. But by then it is too late to save the tree; the damage has been done. Even healthy trees can succumb to the bug within two or three years.

"You can't see any symptoms on these trees until it's too late," Poland said.

NOT IN WISCONSIN

The most likely way the beetle would make the jump from Michigan to Wisconsin would be through imports prior to the Detroit-area quarantine.

Wisconsin officials stress that a dead or dying ash tree doesn't mean the beetles have landed here.

"There is a lot of ash out there declining from other causes, and we don't want to give people the impression that if you have an ash tree with dead branches that it is because of the emerald ash borer," said Jane Cummings-Carlson, forest health coordinator for the Wisconsin Department of Natural Resources.

Still, she said the state needs to be vigilant in looking for it and isolating pockets of infestation if they do pop up. Michigan is now paying the price for not identifying the sources of the problem in its early states.

"It really did sneak up on them, and when they realized what they were looking at... the extent of it is just amazing," Kyhl said.

Ash trees in the Detroit area had been dying for several years, but it wasn't until 2002 that researchers identified the source of the problem. But even when they found the culprit, they weren't sure what they had.

"Nobody in Michigan could identify what this insect was. The Smithsonian couldn't even identify it. Then it was sent to other scientists across the globe, and it was actually a Slovakian entomologist who was able to identify it as a beetle. Because the bug is kept in check in its native lands through tree resistance and natural predators, very little research has been done on it. Linsmeier-Wurfel said Michigan researchers could find less than two pages on it in Chinese literature.

Linsmeier-Wurfel said there are no firm plans yet on how and where to build the firebreak around the 2,500-square-mile core infested region near Detroit, though one federal official privately said it likely would have to be at least three miles wide.

State law allows Michigan to order the destruction of infested trees, and Linsmeier-Wurfel said most in Michigan are resigned to the sacrifice they must make to keep the pest from spreading.

"Nobody likes to see the trees go, but for the most part there is support because there is an understanding that if something isn't done now, it will just get that much worse," she said.

Researchers are working on insecticides to combat the bug, but early data shows that some are effective in wiping out about 85% of a population. That isn't good enough to eradicate the beetle. But it may offer hope for some homeowners in the core infested area around Detroit, where officials believe the tally of dead trees could soon reach 12 million.

It is already an ugly scene.

"It's like the old Dutch elm disease days, with rows and rows of dead ash in the urban areas," said Cummings-Carlson of the WDNR.

IDENTIFICATION, APPEARANCE AND SYMPTOMS

The emerald ash borer belongs to a group of insects known as metallic wood-boring beetles. Adults are dark metallic green in color, one-half inch in length and one-sixteenth inch wide and are present only from mid-May until late July. Larvae are creamy white in color and are found under the bark.

The borer's host range is limited to species of ash trees (identified by their distinctive leaves, which are located directly across from each other on the leaf stem and bark). In Michigan, most ash trees are white, black or green. Emerald ash borer does not attack mountain ash, which is not related to white, black or green ash trees.

Usually the borers' presence goes undetected until the trees show symptoms of infestations - typically the upper third of a tree will die back first, followed by the rest the next year. This is often followed by a large number of shoots or sprouts arising below the dead portions of the trunk.

The adult beetles typically make a D-shaped exit hole when they emerge. Tissue produced by the tree in response to larval feeding may also cause vertical splits to occur in the bark. Distinct S-shaped tunnels may also be apparent under the bark.

Editor's note: For more information, see www.emeraldashborer.info. This article was reprinted with permission from the February 22, 2004 edition of the Milwaukee Journal Sentinel.