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Planting trees and shrubs

Reduce transplant shock and plant material losses due to improper planting and mulching.

Now that the spring is finally here, everybody is anxious to get outside and add a few trees and shrubs to their landscapes.

Most post-planting failures are the result of mistakes made in selecting, buying, planting and post-planting care. Generally, they lead to the incidence of insect and disease problems.

But before we roll up our sleeves and grab the shovels, let us review a few basic but necessary points on choosing and handling good nursery stock, and the planting and mulching procedure.

Some common mistakes are planting too deep or too shallow, and improper mulching that induces collar and root rots *(Phytophthora sp.)*.

Stressed trees are more prone to boring-insects like American plum borer, lilac borer, dogwood borer, peachtree borers, and rodent injury.

By mulching too high we are creating "condominiums" for mice and voles where they can strip away bark, which girdles the trees and shrubs causing them to die.

Specific steps that describe how to choose, care for and plant nursery plant material are presented in this issue.

In This Issue:

Selecting and handling nursery trees

Trees and shrubs for planting are offered in a few different ways: bare-root, balled-and-burlapped (B&B), potted and container grown. Good, strong and healthy nursery plants will translate into a beautiful, well established landscape.

In other words, there is no saving money when it comes to the quality of the nursery trees and shrubs. When it comes to fruit trees, this is one up-front investment that is well justified and will continue to pay dividends through the remainder of its productive life.

Figure 1. *Well-developed nursery tree: well-feathered with a strong root system. (Photo credit: M. Bulatovic-Danilovich)*

Bare-root, container grown, or potted?

This is the question that poses a dilemma for consumers. Bare-root trees and shrubs are field-grown and dug up without any soil attached to the roots. Good fruit trees should be $\frac{5}{8}$ to $\frac{7}{8}$ inches in diameter and well feathered – having several well distributed and well developed branches (Fig. 1).

Larger diameter trees are fine too, as long as they have been handled properly and did not suffer from cold injury while in the field or in storage.

Small diameter trees very likely have a high mortality rate after planting due to the lack of energy and strength to face transplant stress, particularly under the dry soil conditions encountered in the year planted.

Trees are usually dug up in fall and could be planted immediately or

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Scouting and monitoring in greenhouses and high tunnels

The primary goal of monitoring insects and diseases is to locate and identify problems over time in your facility. This is done through consistent weekly observation of random plants, and assessing the sticky traps/cards and indicator plants in the location at the same time and day each week.

Scouting notebook

Three critical items should be included in your scouting notebook: 1) a map of your location; 2) blank scouting forms, and 3) laminated photographs of common insects and diseases.

The map for your location does not need to be fancy, but it should include the layout of the location indicating entrances, equipment, benches and water hoses (Fig. 2), to help you identify where you will put sticky cards and/or indicator plants, as well as locating "hot spots" of insect or disease presence over time.

It is helpful to number on the map the location of cards and indictor plants, as well as regions for checking random plants so you can identify where your scouting team found the problems.

Create a scouting form for the weekly assessment of pests in your location (Table 1). Use a form so that you record the same data for weekly and yearly comparison. However, your form should be easy to use and not overly cumbersome.

Data can be collected in many ways – presence vs. absence, or counts of a particular pest. Either way is acceptable, but everyone should collect data in the same way and in the same locations.

Sticky cards

Sticky cards alert growers to the presence of certain insect pests. But only adult stages of flying insects are found on these cards, thus they are not a good indicator of the damage caused by immature stages of the same insects. So, weekly random plant inspection must be used in combination with sticky card monitoring.

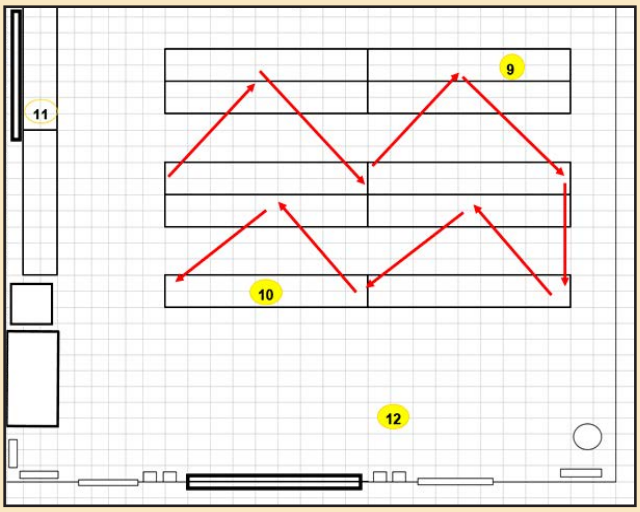

Figure 2. *Partial greenhouse map with locations of sticky cards highlighted in yellow and a pattern to scout random plants, identified by red arrows. (Photo Credit: B.E. Liedl)*

Bright yellow cards are used to attract the most species of insects. Blue cards should be used if you are interested in monitoring thrips, as they are not attracted to yellow. However, you should reduce or eliminate blue cards if you are using bumble bees for pollination, as they are attracted to the color. Besides the typical 3 by 5 inch cards, larger sized cards, as well as tapes and ribbons can be used.

Figure 3. *Yellow sticky card placed above the plant canopy to assess flying insect pests. (Photo credit: C. Postawait)*

Cards should be placed 1 to 2 inches above the plant canopy and moved as the plants grow (Fig. 3). Sticky cards should be replaced weekly if insect populations are high, or if the cards collect debris. Additional cards can be placed near doors, vents and in plants that are more insect susceptible.

However, reduce the number of cards if you are using biocontrol agents that fly, as they may be caught on the cards. Also, put cards in place before introducing new crops to monitor for overwintering pests.

Indicator plants

Susceptible varieties of certain plants can provide early detection

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Scouting and monitoring *(continued from page 2)*

of thrips by acting as an indicator plant. For example, some petunia varieties are very effective in detecting thrips, as well as Impatiens Necrotic Spot Virus (INSV).

Others include sweet peppers and fuchsias for detecting aphids, and tomatoes, gerbera daisy and poinsettia for detecting whiteflies. Indicator plants should be placed every 20 to 30 feet at bench or floor level among the crop.

Scouting plan

Designate one or two employees to scout for pests and evaluate the effectiveness of the control measures undertaken. Scouting should take place by the same people to ensure the procedures and identifications are done consistently. Pick a day and time to scout each week. You can scout more than once, but it is important to scout weekly at the same time to generate useful data.

Scout least-infested areas first, and heavily infested areas last to minimize carryover of pests into cleaner environments. Inspect the entire crop first for any dead or off color plants. Make notes of what you see and where it is located on the scouting sheet.

Next, begin to randomly inspect the plants along an established route identified on your map, using a zig-zag pattern between benches or pots (See pattern in red in Fig. 2).

You should check at least ten locations for every 1,000 sq ft of area. So in a standard 30×96 ft house, you would inspect about 28 locations within the space.

Use a piece of white paper to tap the plants and dislodge insects after inspecting the undersides of the foliage. Also inspect any hanging plants and weeds in the space. Mark these on your scouting form.

Assess the sticky cards for insects as you move through the house. As with the random inspections, data can be gathered as either presence/absence, or as counts.

You can reduce time counting the whole card by limiting the counted area to just a single 1 inch vertical column in the middle. It must be vertical, since different insects will not be evenly distributed across the card horizontally. Record the data on your scouting form and replace the old sticky cards.

It helps to date and mark the location on each card. You can track data on a spreadsheet to monitor over the season and compare it to prior years. Another alternative is to use a free online program, such as IPM Suite *ipmsuite.com*.

Correctly identifying the most common pests on your plants and traps will help you choose the best control strategy. It helps to have a sheet with photos of commonly found insects – aphids, fungus gnats, shore flies, thrips and whiteflies.

When an insect cannot be identified, take a photograph to compare with other reference books, or share with an Agriculture Service professional for proper identification. A similar sheet with images of plants affected by common disease and virus pests should also be included in the notebook.

The summer issue of *IPM Chronicle* (Vol. 3:3) will discuss using scouting data to help you make decisions about when to spray or release biocontrol agents, and will include suggestions for changes to your production.

Scouting Sheet

Week:	Date:	House:	Staff:
General Notes:			

Sticky Card Counts

Card #	Location	Aphids	Whiteflies	Fungus Gnats	Thrips	Shoreflies	Other (specify)
Total							
Average							
Additional Comments							

Random Plant Inspections

Location	Crop	Pest(s)	Comments	Action Taken

Table 1. *Weekly scouting sheet to collect sticky card and random plant inspection information. (Image: B.E. Liedl)*

Resources

Greenhouse IPM with an Emphasis on Biocontrols. Pennsylvania Integrated Pest Management Program. *extension.psu.edu/publications/agrs-096.*

Greenhouse Scouting and Monitoring *uvm.edu/~entlab/Greenhouse%20IPM/Scouting.html#YSC*

Bacterial canker of tomato

Bacterial canker of tomato, caused by *Clavibacter michiganensis subsp. michiganensis* (Cmm), is an important disease that may cause devastating losses to growers. As the bacteria can be on or inside the seed (seedborne), disease can start very early on the seedlings and kill them before plants attain maturity.

In a seedborne situation, when the seed germinates, the bacteria move systemically through the xylem from which it invades the phloem, pith, and cortex and is considered the reason for wilting.

If only a minor portion of seeds are infected in the seed lot, disease can spread very quickly in the seedling flat or in the field planting by splashing rain, water sprinklers or human activity under favorable weather condition (high humidity and high temperature).

Figure 4. *Symptom of bacterial canker of tomato on leaf (yellow margin bordering the scorched and healthy tissues. (Photo credit: R. Pitblado, OMAFRA, ON, Canada)*

Figure 5. *Bacterial canker spots on tomato fruit (white and/or dark spots with white halos. (Photo credit: mrgoutham. blogspot.com/2011/05/tomato-diseases-pictures.html)*

Identification

Small, water-soaked lesions appear on foliage of infected seedlings that remain stunted and eventually may die due to wilting. On older leaves, symptoms appear as a marginal browning or scorching that progress toward the leaf midrib. A yellow margin usually borders the scorched and healthy tissues (Fig. 4).

Secondary infections on leaves initiate localized lesions in between the veins that may enlarge quickly and become tan and necrotic. Eventually the necrotic area advances to a more dark brown coloration.

Older plants may also show symptoms on and inside the stems. A longitudinal cut of these stems will reveal reddish-brown vascular discoloration including pith. Sometimes cavities may develop within stems that may split open into brown longitudinal cankers that justify the name of the disease.

In general, infected branches break off easily. Spots on fruit appear slightly raised and whitish at first, and gradually turn centers dark-colored with white halos measuring $\frac{1}{16}$ to $\frac{1}{8}$ inch in diameter (Fig. 5).

Management

Disease-free seeds and transplants. Seeds should be obtained only from reputable sources. Seeds kept from locally grown fruit should be tested for the presence of bacterium. Suspected seeds should either be treated with hot water by dipping seeds in 130°F water for 25 minutes or treated with diluted bleach.

Crop rotation and residue removal. Rotate away from tomatoes and other solanaceous crops for at least three years. If rotation is not an option, crop residues should be removed or deep ploughed in the soil to facilitate quick decomposition. Canker causing bacteria will not survive in the soil once infected residue is decomposed.

Proper sanitation. In greenhouse conditions, floors, wooden stakes and pots should be thoroughly sanitized by approved products in between crops.

Scouting. Plants should be scouted on a regular basis to remove symptomatic plants as quickly as possible. However, this should not be done when plants are wet, as it may spread the organism to healthy plants.

Chemical control. Application of products such as fixed copper, resistance inducers (Regalia®, Seaweed extract) preventatively may reduce new infections, however, once bacteria get in the system, the benefit of using these products will be minimal.

European Starlings

European Starlings *(Sturnus vulgaris)* are dark-colored robin-sized birds that breed from January to June. During the breeding season, their dark feathers show purplish-green iridescence and their bills turn bright yellow.

Figure 6. *A breeding-age adult European Starling (Sturnus vulgaris).*

Outside of the breeding season, the starling's dark-colored feathers are speckled with white spots. Juveniles are pale brown to grey in color.

History and range

European Starlings are an exotic species introduced into New York in the late 1800s by someone who wanted to bring all of the birds mentioned in Shakespeare's works to the United States.

Since their introduction, starlings have spread across the United States. They are abundant across their range and are known for their aggressive behavior, often throwing hatchlings of other bird species from nesting areas they covet.

Nesting habits

Starlings will nest in holes or cavities in a variety of structures including tree cavities, artificial nest boxes, and holes in buildings or cliff faces. They often cause conflicts with humans by constructing nests in barns, buildings or behind window shutters. Starlings can be boisterous and loud, and their droppings can produce quite a mess around the nest site.

Protection

Migratory birds in the U.S. are protected under the Migratory Bird Treaty Act of 1918. Protections do not cover nonnative species whose occurrence is solely the result of intentional or unintentional human-assisted introduction. Therefore the European Starling is not protected. Local ordinances, however, may provide some level of protection to starlings, so check with your local law enforcement or state wildlife officials before beginning a control program.

Discourage roosting

Starlings can be excluded from buildings or other structures by closing all openings larger than one inch. To prevent roosting on ledges, install thin metal spikes (Nixalite® strips) or cover the ledge with metal, wood or plastic at a 45 degree angle so birds will slide off.

Figure 7. *Urban nest site. (Photo credit: www.flickr.com / creative commons)*

Discourage nesting

Frightening devices such as recorded distress calls, noise devices, bright objects or pyrotechnics (fireworks) can be used to scare starlings away from roosts.

Be sure to vary the frightening techniques so birds do not become accustomed to one device or technique. Deploy pyrotechnics in the evening when birds are coming in to roost. Be persistent, as several nights of harassment may be needed to keep the birds away.

Repellent

A soft, sticky repellent (such as Tanglefoot®) can also be applied to ledges or structural beams to discourage roosting. Check your local farm and garden store to find commercial varieties. Protecting the surface of the ledge or beam with masking tape or other material before applying the sticky repellent will increase effectiveness on porous surfaces and aid in cleanup.

Shooting

Shooting can be effective as a dispersal technique or to reduce the population size in areas with small starling populations. Be sure to practice safe gun handling and check local ordinances for restrictions on the use of air rifles or firearms before implementing a shooting program.

European Starling control is an undertaking that may require weeks of effort. If you begin at the first signs of damage, are flexible in your approach, and don't give up, you should be able to keep the birds at bay . . . at least until next year.

Selecting and handling nursery trees *(continued from page 1)*

held in storage or "heeled-in" outside until ready for planting. When heeled-in, trees need to be placed in trenches in a well-drained and wind-sheltered location, preferably at the northern exposure to prevent breaking dormancy very early in the spring. For the same reason, tree tips should be facing south. Soil should cover the graft union and extend to cover the better portion of the trunk in an attempt to minimize winter cold injury. Trees can stay in these trenches well into the spring until the time of planting at a permanent location.

The trees and shrubs sold through the local garden centers are usually potted and/or container-grown. Potted trees and shrubs are placed into the containers filled with soilless potting mix and sold the same season.

Container-grown trees and shrubs that are grown in soilless potting mixes remain in containers longer than one growing season and are preferred over potted nursery stock. Best performance is achieved with bare-root nursery stock.

Balled-and-burlapped trees and shrubs are dug up with the soil firmly packed around the roots. The ball is wrapped with burlap and tied with twine.

Below are some guidelines when choosing fruit trees.

Container-grown

- Select a tree that has a straight, well developed trunk and leader with nicely distributed branches.
- Make sure that the soil in the pot is moist and adheres to the roots, and does not appear to be broken up.

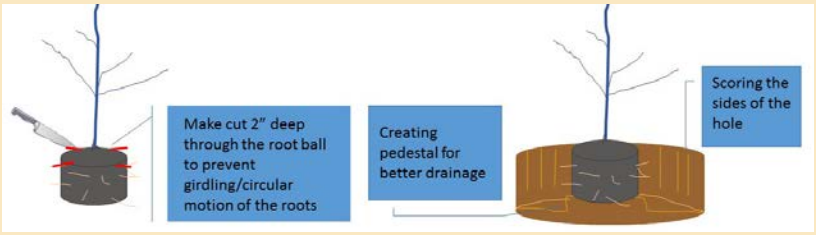

Figure 8. *Correct procedure for planting container-grown trees. (Photo credit: M. Bulatovic-Danilovich)*

- Check the root ball. It should have nicely developed healthy, cream-colored roots. Avoid roots that are brown, or the outer layer is easily pulled off – this is sure sign of a root rot.
- Avoid plants that have roots that coil around the sides or grow out of the pot at the bottom.
- Skip plants that have dry soil in the pot with moss on the top and are full of weeds. Soil needs to be moist.
- Check the graft union for possible splitting or other damage. The union should be clean and strong.

Bare-root

- Select strong and straight-growing trees. They can be single-stemmed (whips) or they can have 3 to 10 well distributed branches (feathers) with wide angles (55 to 70 degrees in reference to the main leader) that will serve as main scaffolds when designing the main tree-production frame.
- Avoid trees with weak, spindly growth. This is an indication of possible problems with the root system and/or dieback due to the winter injury, disease, or insect damage.
- Select a tree with a strong, clean graft union that shows no signs of any damage.
- Roots should be healthy and evenly distributed.

Planting trees

Assuming that you have done "first things first," here is the procedure to follow once the trees are ready for planting:

- Loosen the soil by digging a hole large enough to accommodate roots and/or a root ball for container grown trees. If the planting is done in heavy/clay soil, score the sides of the dug up hole to facilitate root penetration out of the hole and into the surrounding soil.

  Create a "pedestal" at the middle of the hole about 5 to 6 inches high to place the tree and/or root ball on to allow for better drainage and ensure that the majority of the roots are in the water pool at the bottom of the hole (Fig. 8).

  Roots should have plenty of room to be spread around without bending them so they fit into the allotted space. If the roots are coiled, they will continue to grow in the same direction, girdling and "choking" themselves out (Fig. 9).

  The rule of thumb is that the hole should be three times as wide as the roots/root ball and twice as deep, with the main

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objective of loosening the soil. For the bare-rooted trees, that means 3ft wide and 2ft deep.

- Soak the trees in water for about 12 hours prior to planting (usually overnight). This will rehydrate the roots and help them "freshen-up." They will be less likely to have transplant shock.
- Planting depth: the general rule is to plant the trees at the same depth they have been in the nursery. There are some variations to this.
- Planting dwarf apple trees may require graft union to be 3 to 6 inches above the soil line. This provision is necessary to allow for ground settling and to achieve more of a dwarfing effect. The higher the graft union, the more of a dwarfing effect.

  Trees will "sink" into the ground so that the graft union settles below the soil line allowing the sine (grafted variety) to root itself, thus losing the benefit of the rootstock. For example, if we have Gala apple on dwarf rootstock and all trees are at about 12 feet except one or two that are closer to 20 feet tall. Those taller trees are so called, "sine-rooted" expressing a very vigorous genetic trait of Gala apple.
- Trees on seedling rootstock should be planted with the graft union close to the ground level.
- Once we have the open hole, hold the tree so that the graft union is at the desired level. Start covering the roots with the soil. After a few shovels of soil over the roots, step on the soil to firm it up and make sure that there are no air pockets around the roots.

  Roots that are not in a firm contact with the soil will dry out, leading to distress.

Figure 9. *Girdling root system can cause restriction of water supply. (Photo credit: M. Bulatovic-Danilovich)*

At this time, make sure that the graft union is still at the desired level. If not, the tree can still be pulled up to where it should be. After necessary adjustment, continue covering the roots and filling the hole.

- Once the hole is completely filled up, tamp the soil firmly with your feet to straighten the tree, firm up the soil and remove any air pockets.
- Water generously. At this time, starter fertilizer dissolved in water can be applied. **Do not apply additional fertilizer in the year of planting!** Begin a fertilization program the following spring.
- Mulch around the tree, ensuring that the mulch is pulled away from the bark at the base of the tree. Failure to do so may keep that area too wet and can lead to collar (base of the tree) rot (Fig. 10), winter injury due to frequent freezing and thawing, root rot, and insect or rodent damage.
- Protect tree trunks by placing mouse or tree guards made from steel mesh or plastic coil. They come in several lengths: 24, 30, 40 inches. They can be obtained from Peach Ridge Orchard Supply, Inc. *peachridge.com/pest/rodent.htm.*
- Depending on the rootstock and growth system, proceed with the support installation (posts or trellis).
- **Do not forget to water!** Apply 2 to 3 gallons of water per tree every 7 to 14 days, or more frequently if the weather and soil conditions demand. Before

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Figure 10. *Improper mulching: placed too high – more than 12 inches – leads to collar and root rot and possible asphyxiation due to hypoxia (lack of oxygen). (Photo credit: M. Bulatovic-Danilovich)*

Star-of-Bethlehem – A spring weed

Star-of-Bethlehem *(Ornithogalum umbellatum)* is a perennial weed belonging to the lily (Liliaceae) family that can be mistaken for wild garlic or on occasions, a nutsedge. It does not possess the characteristic odor of wild garlic, but it can be identified by its slender (3 to 8 mm wide), succulent hollow dark green leaves, with a round cross section and a prominent whitish midrib. They may grow to a height of 15 to 20 cm with underground bulbs that are 2 to 3 cm long. The plant and bulbs are toxic due to the presence of certain alkaloids.

As a weed, Star-of-Bethlehem can be a problem in lawns and pastures in early spring as they start to grow actively when the forsythias are in bloom. It typically blooms in April and completes its life cycle by May/June after producing seeds and underground bulbs. Star-of-Bethlehem is occasionally grown as an ornamental because of its attractive white flowers.

In lawns, mechanical and cultural control methods are most effective if they grow in isolated spots. All bulblets must be physically removed to obtain total control. Alternately, they can be cut back repeatedly to prevent the production of bulbs and flowers, and can be over-seeded successively (twice each during spring and fall months, respectively) with an appropriate grass seed worked into the soil. This process may have to be repeated the following year or until all the propagules are depleted from the soil.

Figure 11. *Star-of-Bethlehem (Ornithogalum umbellatum) leaves with prominent white midribs; right picture showing bulbs and bulblets. (Photo credit: R. Chandran)*

Selective herbicides to manage Star-of-Bethlehem in cool-season turf grasses are partially effective and may require repeat applications. Quicksilver™ (carfentrazone) and Q-4® (sulfentrazone+quinchlora+2,4-D+dicamba) are two such products.

Our research indicated that the addition of methylated seed oil (MSO) at the rate of 0.5 oz/gal water enhanced the control. Directed or spot application of glyphosate (at the high rate allowed on the label) when applied along with MSO also provided satisfactory control.

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watering, check the soil for moisture.

Use the "screw driver method." Stick the screw driver into the ground and pull it out. Wet soil will leave a mark on the metal and the screw driver will come out dirty. If the soil is dry, the screw driver will come out clean. Soil should be moist at least 4 inches into the profile. Anything less requires irrigation.

Figure 12. *Failure to remove staking wire causes severe stress and possible mortality above the wire. (Photo credit: M. Bulatovic-Danilovich)*

- After planting, trees should be pruned to correct any imperfections and to ensure good balance between the "above-the-ground" portion and available root system, proper lateral branch distribution and uniform height.
- Remove all tags to prevent girdling and consequent die-back of the branches, limbs and/or trunk (Fig.12).

Protect your ash trees from emerald ash borer

West Virginia land owners should be aware of the potential impact of emerald ash borer *(Agrilus planipennis)* on their woodlands. This invasive insect from Asia is responsible for the destruction of tens of millions of ash trees throughout the eastern United States. First identified in West Virginia in 2007, this insect can now be found infesting ash trees throughout much of the state.

Damage

Emerald ash borer attacks all North American species of ash (*Fraxinus* spp.) and the white fringe tree *(Chionanthus virginicus)*. The larvae feed under the bark on the vascular tissue of trees. Their feeding disrupts the movement of water and nutrients within the tree, killing healthy ash trees in as little as 2 to 4 years. Early infestation is often difficult to detect and generally not noticed until trees are already in decline.

Common symptoms of infestation include canopy dieback (e.g. thin tree crowns, dead branches, yellow foliage), vertical bark splitting on infested branches or trunks, and formation of epicormic shoots (i.e. water sprouts). Infested trees may also show injury from woodpeckers and other animals attempting to feed on the larvae within.

To confirm that tree injury is caused by emerald ash borer, look for S-shaped larval feeding tunnels under the bark of trees (Fig. 13) and/or small, D-shaped exit holes (~1/8 inch) produced by emerging beetles (Fig. 14).

Figure 13. *S-shaped feeding tunnels caused by emerald ash borer (Agrilus planipennis) larvae. (Photo credit: D. Frank)*

Figure 14. *D-shaped exit hole produced by emerging emerald ash borer (Agrilus planipennis) beetles. (Photo credit: D. Frank)*

Figure 15. *Adult emerald ash borer, (Agrilus planipennis), and its larva. (Photo credit: D. Frank)*

Description

Adult emerald ash borer beetles are metallic green and approximately one-half inch long, with flat backs and a gradually tapering abdomen. The larvae can reach a length of about one inch, are white to cream-colored, and have flattened, segmented bodies (Fig. 15).

Life history

The emerald ash borer has one generation per year. Beetles emerge from trees in mid-May with adult activity continuing into July. Females deposit eggs on the bark surface or into bark crevices on the trunks and branches of trees. Each female can lay approximately 75 eggs during her lifetime.

After egg hatch, the young larvae bore through the bark and feed on the sapwood until cold weather arrives. Larvae overwinter within trees and enter the pupal stage the following spring. The pupae transform into adults, which emerge from trees to continue the next generation.

Control measures

Currently, the only effective control for emerald ash borer are insecticides, which must be used as a preventative while ash trees are still healthy. Once a tree loses 40 percent or more of its canopy from emerald ash borer, it is generally too late to save the tree. Depending on the treatment, you must treat trees every year or two, for the total life of the tree.

Insecticides containing imidacloprid can be applied annually as a soil injection or drench during mid- to late-spring and/or mid-fall when the soil is moist, but not saturated or excessively dry. Emamectin benzoate must be used as a trunk injection. Emamectin benzoate is the only insecticide tested to date that controls emerald ash borer for up to two years with a single application.

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