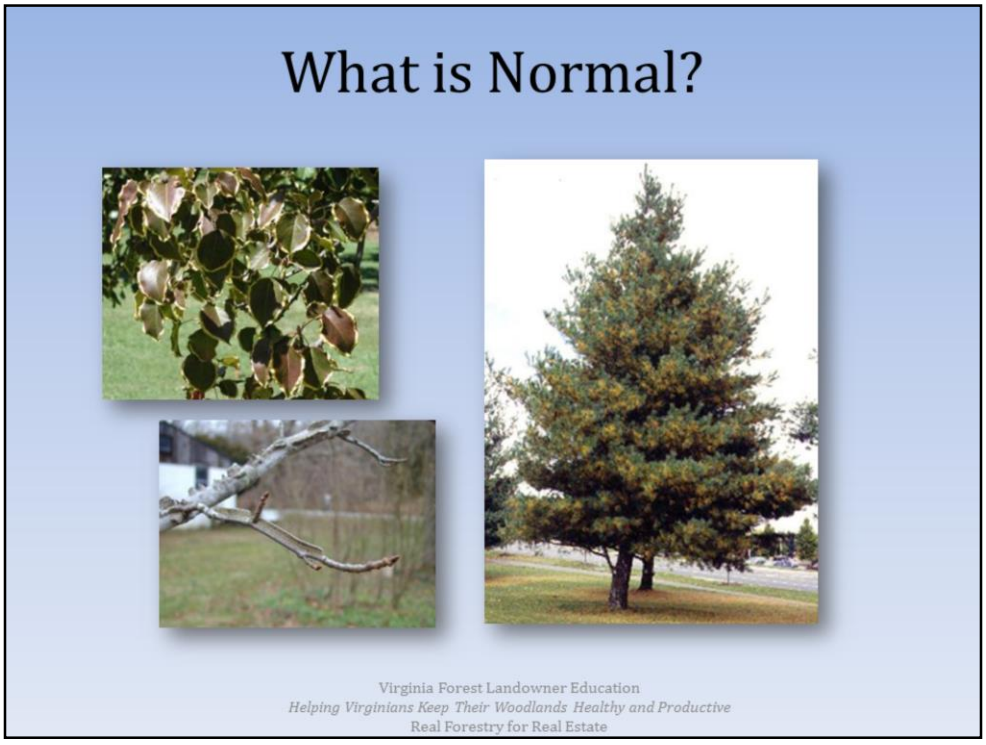
Challenges to Sustainable Forestry: Diseases & Insects

Virginia Forest Landowner Education
Helping Virginians Keep Their Woodlands Healthy and Productive
Real Forestry for Real Estate

One key component of sustainable forestry is maintaining forest health. Sometimes this is easier said than done. Over the years, there have been a number of forest health issues which have resulted in major changes in the composition and look of the Appalachian forest. And there are more in progress, which may have an even larger impact on our forests. In this presentation, we will discuss what to look for when trying to identify a forest health issue (to rule out environmental or human caused symptoms), one disease which dramatically changed the course of the Appalachian forest in the 20th century, the Chestnut Blight, and then we will discuss some diseases and insects which are currently wrecking havoc on our forests and steps forest landowners can take to minimize losses.

Much of this presentation is based on the "Forest Health Review" publications from the Virginia Department of Forestry. Most of the images are from www.bugwood.org

The image on this slide shows two different species of trees, one affected by a disease, and one by an insect. The stump in the picture is from an American chestnut, killed back by the chestnut blight; what was growing out of the stump was a hemlock, killed by the hemlock wooly adelgid. We will cover both of these problems in more detail shortly.

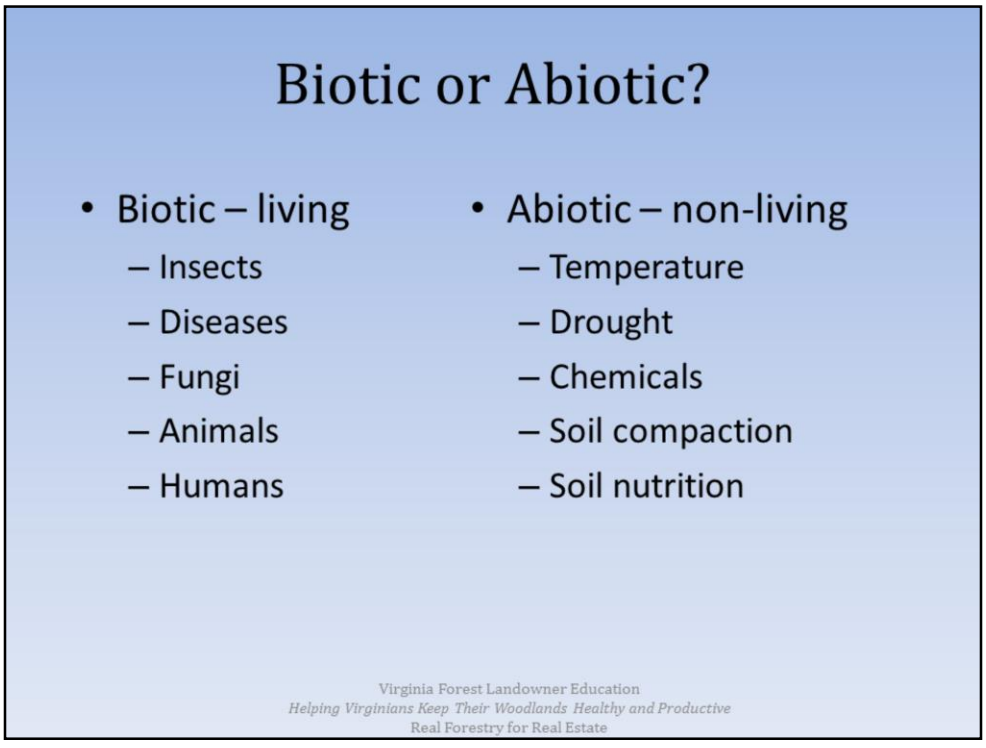


Before you can diagnose a health problem, you should be familiar with what is normal for different species. Here are some examples which, to the untrained eye, may appear to be symptoms of diseases, but which are in fact, quite typical of the species. Some plants, like this Bradford pear, may have variegated leaves (leaves with white patches); sweetgum branches and bark have funny-looking ridges; and white pine needles turn yellow/brown in the fall before they fall off, a normal, annual process. One good example of a false alarm was a landowner who called one December wanting to know what was wrong with her cypress. The leaves had all turned brown and were falling off. Even though cypress is a gymnosperm, like pine trees, it is not an evergreen – this deciduous tree sheds all its leaves every winter.

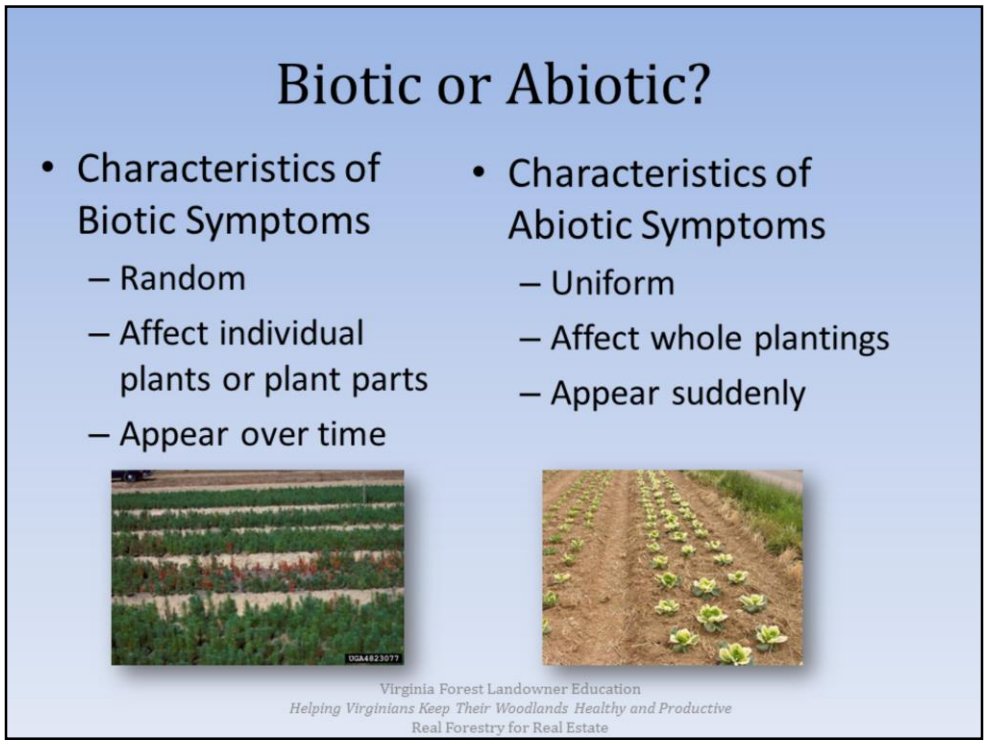
Learning what is normal might possibly be as time consuming as learning how to diagnose diseases. For your purposes, it's probably best to keep in mind that just because something looks odd, it may not necessarily be a disease. A forester could probably spend an entire career cataloguing the quirks of trees

Additionally, there are some insects and diseases out there that do cause some damage, but are not life threatening to the tree. A prime example of this is the locust leaf miner (an insect, not a disease). You may have noticed that every August our black locust start to look pretty rough. This is a result of infestation by the locust leaf miner. However, regular infestations of this insect don't appear to cause any permanent damage to the trees. It simply causes a temporary aesthetic problem (and perhaps some reduction in growth). And, since locust isn't a timber tree, and isn't usually grown for its beauty, this isn't a big deal.

So how do you go about determining what is normal or what is not normal but ok? The first thing you'll need to know is what species you are looking at. Then, you can either look up information on that species to determine if it has any funny quirks, or you can call your local Extension office and talk to an Agent. This will probably be the easiest way to go. Contact information by county is available from http://www.ext.vt.edu/ or in the Blue Pages of your phonebook.



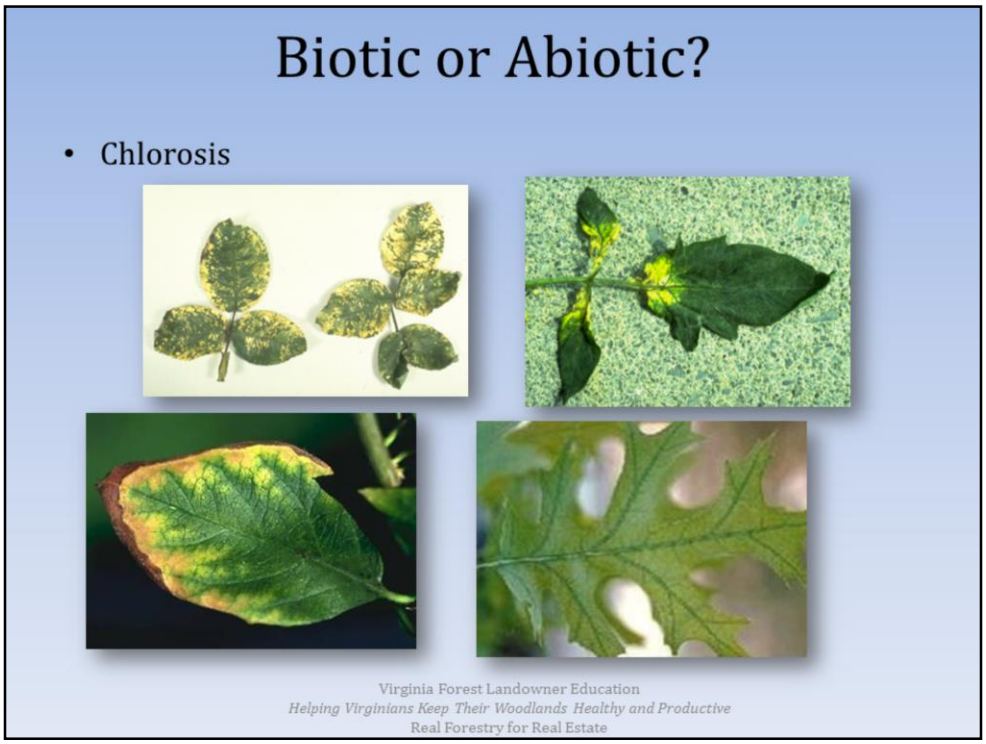
Once you've reasonably ruled out that what you're seeing isn't normal and isn't ok, then you will need to do some more detective work.
You'll want to try to figure out if the symptoms you are seeing are being caused by biotic (living) or abiotic (climatic/non-living) factors.
Since the title of this presentation is Insects & Diseases, will I be talking about biotic or abiotic factors?? Correct, biotic. This slide just shows some examples of each type of factor.



To determine if the symptoms you are seeing are caused by a biotic or an abiotic factor, you can look at a few characteristics of the symptoms. Keep in mind, when you see damage on a plant, you are not looking at the actual problem….you are looking at the symptoms of the problem. Like when you have a cold and sneeze, the sneeze isn't the disease, it is the symptom of the cold.

So, in general, symptoms caused by living or biotic factors will be randomly distributed on the plant parts; they will affect individual plants or plant parts, and they will appear slowly, over time.

If the symptoms you see are uniform, affect entire plantings, and/or appear suddenly, they are more likely being caused by an abiotic factor. Think about it this way, if an insect or disease (biotic factors) gets into a forest, there will be an small infection point. Then the problem will spread out from there. If, on the other hand, you get carried away and plant your tomatoes too early in the spring and a frost hits (an abiotic factor), the entire planting will be affected – and the symptoms will appear quickly.



Chlorosis, or yellowing of leaf tissue, is a common symptom seen on plants. Chlorosis almost always indicates some nutrition deficiency in the soil, and shows up as yellow outer-leaf margins, or as pronounced green and light-green coloration along the mid-rib.

If you see chlorotic leaves, you may want to have the soil tested to see if there are nutrient deficiencies; you probably don't have a disease.

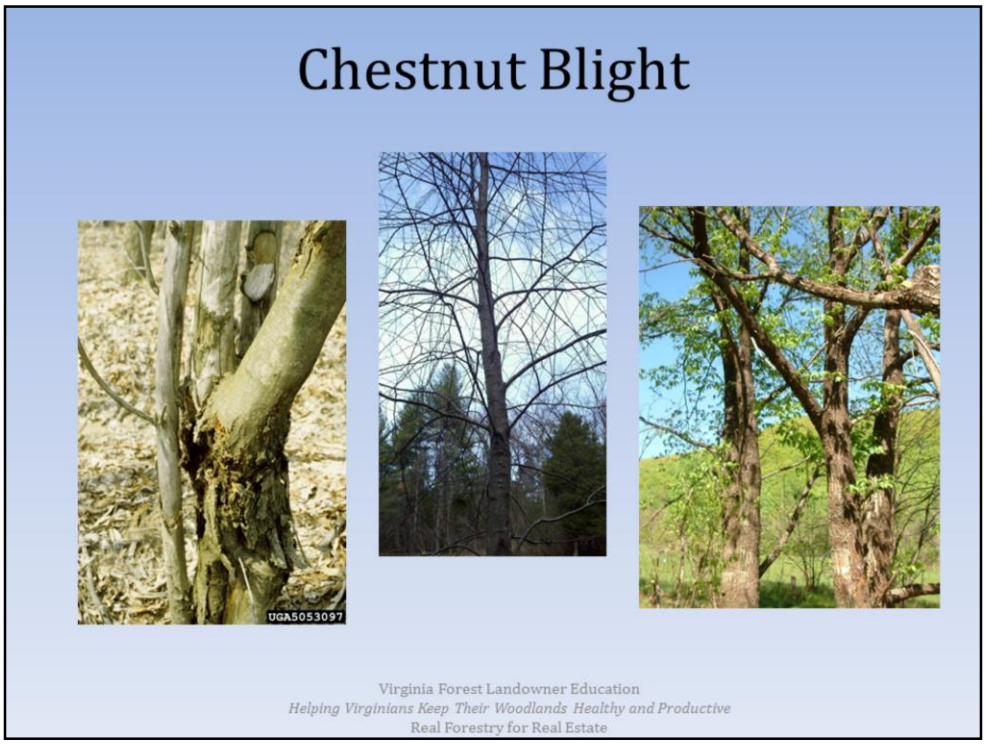
So, is chlorosis caused by biotic or abiotic factors?

Ok, now let's get into some of the common disease and insect problems forest landowners in Virginia may face. First up is the biggie – the one I alluded to at the start of this presentation, the disease which very much altered how the Appalachian forests look. Anyone care to guess what disease that is? The Chestnut Blight.

The American chestnut tree was an essential component of the entire eastern US ecosystem. A late-flowering, reliable, and productive tree, unaffected by seasonal frosts, it was the single most important food source for a wide variety of wildlife from bears to birds. Rural communities depended upon the annual nut harvest as a cash crop to feed livestock. The chestnut lumber industry was a major sector of rural economies. Chestnut wood is straight-grained and easily worked, lightweight and highly rot-resistant, making it ideal for fence posts, railroad ties, barn beams and home construction, as well as for fine furniture and musical instruments.

The blight, imported to the US on Asian chestnut trees (which are resistant to the disease), is a fungus dispersed via spores in the air, raindrops or animals. It is a wound pathogen, entering through a fresh injury in the tree's bark. It spreads into the bark and underlying vascular cambium and wood, killing these tissues as it advances. The flow of nutrients is eventually choked off to and from sections of the tree above the infection, killing them.

The photos on this slide show American chestnut trees, leaves and burrs (which contain the chestnuts). It is important to note that even though the blight killed off most of the large chestnut trees, the American chestnut can still be found in our forests.



Stumps from the dead chestnut trees still, after almost 100 years, continue to produce sprouts. Typically we see the sprouts get to the size/age when they produce chestnuts, then the blight gets into them (as they age, the bark begins to get deep furrows/splits, which allows the disease to enter the tree), and eventually they die back. Also, occasionally, trees with some natural resistance are found in the forest, large and producing chestnuts, but probably with signs of the blight. A lot of work is being done by the American Chestnut Foundation and the Virginia Department of Forestry to create hybrid chestnuts (a mix of Chinese chestnut and American chestnut) that can be planted. You probably see (and in the spring smell) Chinese chestnuts everywhere – they are widely planted. But, unlike their American counterparts, Chinese chestnut trees do not have good lumber properties, and the nuts aren't as large or as tasty. The hybrid program's goals is to create a tree with resistance to the blight, but all the other desirable characteristics of the American chestnut. Seedlings are being test planted now and will hopefully be available for commercial sale in the next 5-10 years.

In the photos above, on the left, is a canker on the main stem of a young American chestnut – once a canker like this gets started, the tree is going to die. In the center we have a photo of a large American chestnut, which, although has some stem cankers, they aren't fatal yet. This tree may have some natural resistance. On the right we have a photo of some hybrid chestnuts which the VDOF is working with on the Lesane State Forest in Augusta County.

Now, just to mention how the loss of this species altered the Appalachian forests….when chestnut was dominant, oaks were only a minor component of the forest. As the chestnuts died back, oaks came in to fill not only their physical space in the forest, but also their ecological space – acorns are a hard mast for wildlife, and a suitable substitute for chestnuts. Mature oaks are now a major component of Appalachian forests. This probably would not be the case without the chestnut blight.

This is something you could very well see on a piece of property you show. Dogwoods are the state tree, and are very commonly planted in residential areas. *Discula destructiva* is a fungus which causes dogwood anthracnose and affects flowering dogwood.

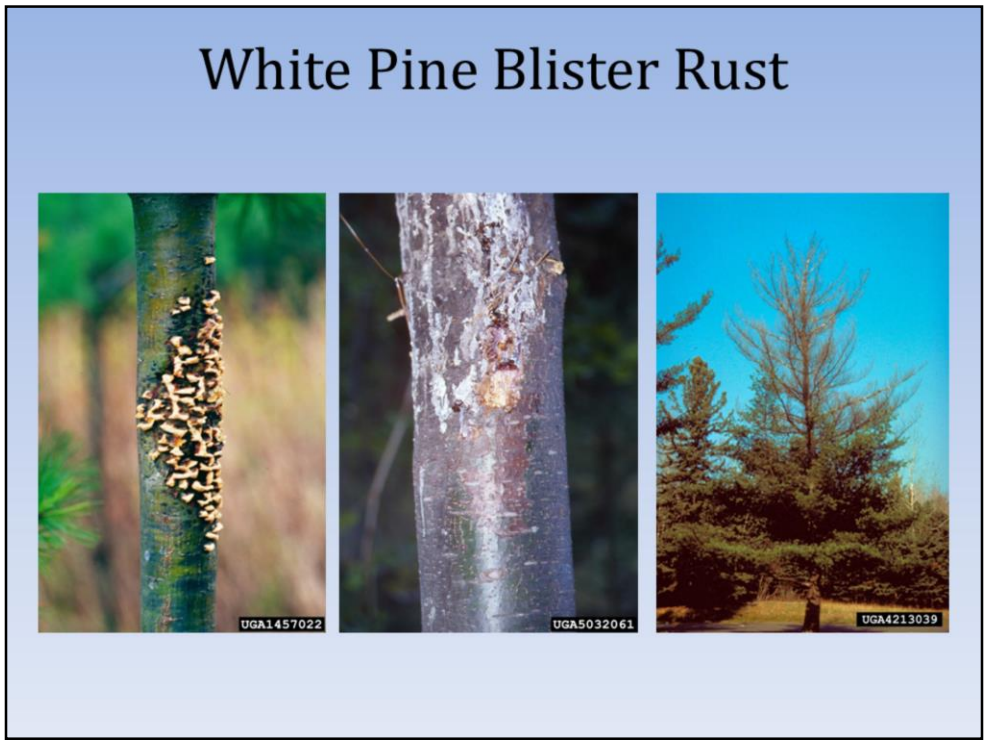
In the spring, shortly after the dogwood have leafed out, spots and blotches of varying shape and size appear on infected trees. These spots have a tan center with a purple or reddish ring around them. The flower "petals" or bracts are also susceptible and show reddish or brownish blotches. Eventually, the leaves will die. Once leaves are infected, the bacteria will spread to other parts of the tree – branches, then main stem, where cankers (lesions) form. Cankers are generally tan. Larger infected trees can die within 1-3 years; saplings may die in the same year they are infected.

This fungus tends to infect dogwoods which care growing in cool, wet shady areas – the leaves of trees growing in these areas remain wet, creating a good breeding ground for fungi.

Prevention is the best medicine. Dogwoods should be planted in areas with full sun; The trees should be kept stress–free and kept well-watered.

If trees do get infected, they can be treated using fungicides. But treatments will need to be repeated annually.

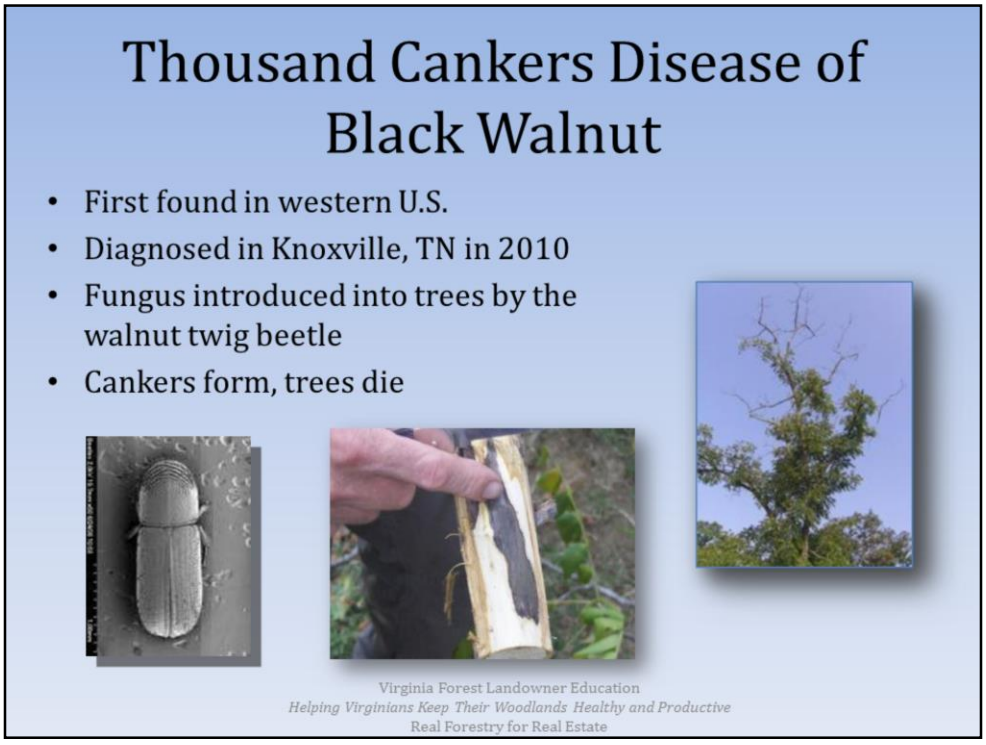
Another option is to plant trees which are resistant. A variety of the flowering dogwood, Appalachian spring is resistant; kousa dogwood is a different species which is resistant (Anthracnose was actually brought to the US on imported kousa dogwoods).



Now let's talk about a disease which affects a conifer…the white pine blister rust. This disease is native to Asia and was introduced in the early 1900's. This disease requires two hosts to complete its lifecycle. Obviously, the Eastern white pine, but also, most commonly, a currant or gooseberry.

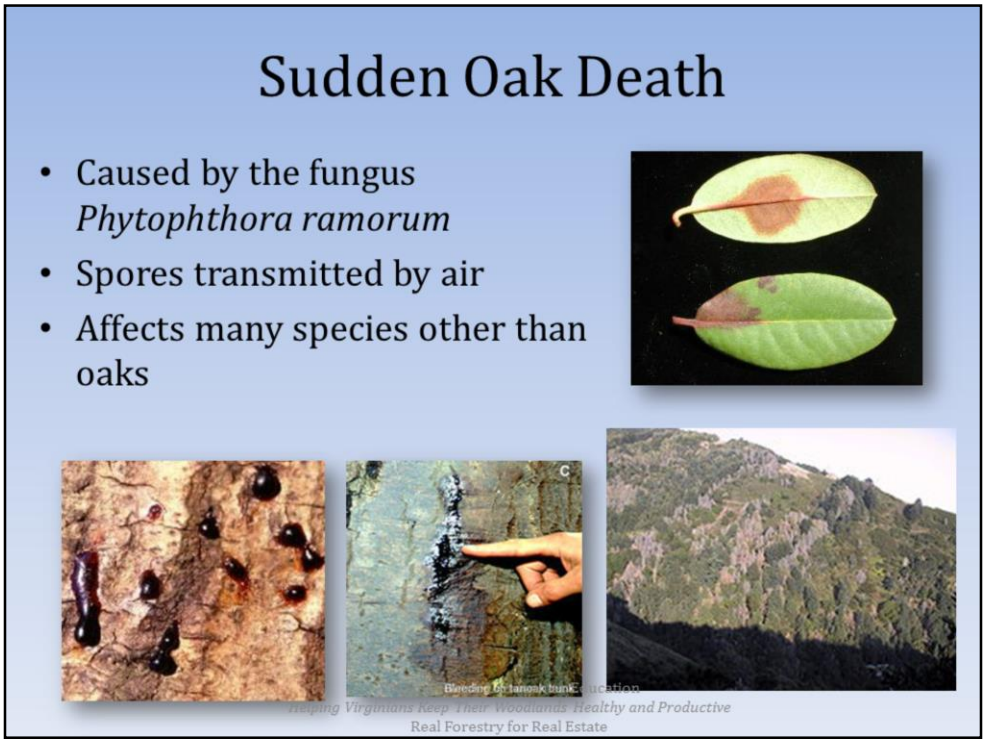
White pine is susceptible to the rust at all ages, but seedlings and young trees are often more easily infected and succumb quickly. The spores of the rust (left photo) grow into the tree small pores in the needles or through wounds. Once inside the needle, the fungus grows and expands into the branches and eventually the main stem (center photo). A main stem infection is fatal to the tree. Death is slow and can take years. Symptoms usually include top dieback (right photo), reduction in seed and cone production, and vigor.

In Virginia, this disease is almost exclusively west of Blue Ridge; significant problem only in high hazard areas; so a landowner should find out if their site is high risk before planting white pine; also removal of alternate host species can help. A forester can help a landowner determine if they have a high-hazard site.



When I originally put this presentation together, less than a year ago, this disease was one in the category of could be a problem, but isn't here yet. Well, it is here in Virginia now. This one was first found on black walnut planted outside of their native range – in the western US. The thinking was that it wouldn't be a problem for black walnuts in their native range (the east coast). That is until it was found in Knoxville in 2010. And in the fall of 2011, it was found near Richmond. Currently, Richmond City, Henrico, Hanover, Goochland, Powhattan and Chesterfield Counties are under quarantine. Under the quarantine, no parts of black walnut trees (green lumber, firewood, stumps, mulch) can be moved outside the quarantine area. Nuts, dried lumber and finished wood products can be moved.

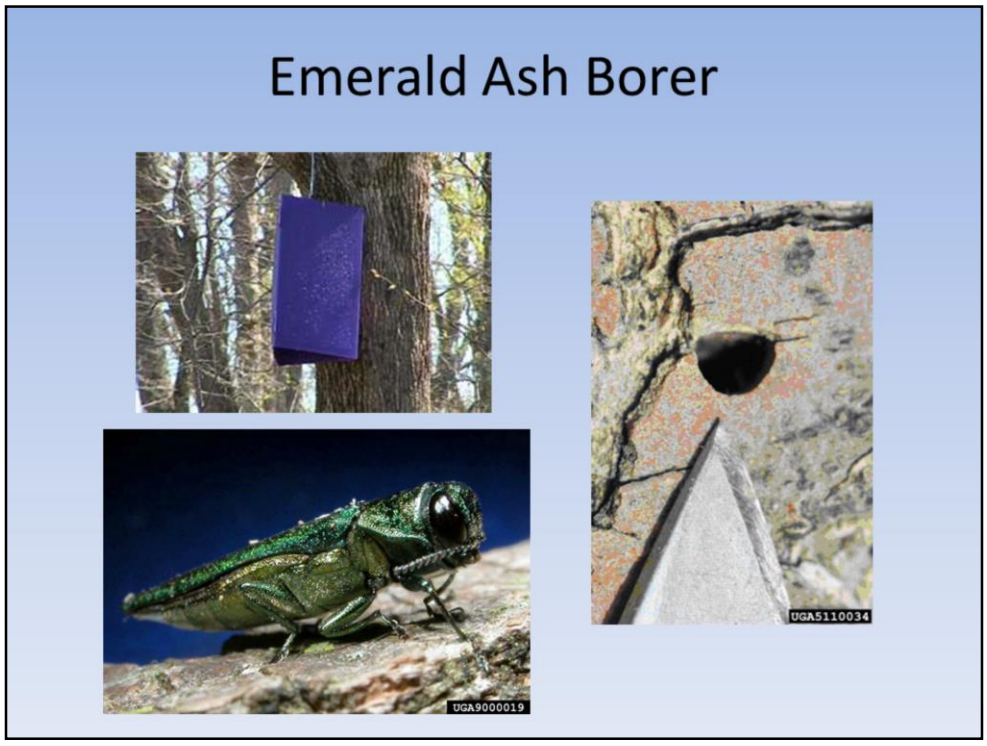
Essentially TCD is a bacterial disease introduced to trees by the walnut twig beetle (left). Evidence of infection isn't apparent until the beetles exit the trees, resulting in tiny holds in the bark. At that point, it is too late. This disease is fatal to black walnut and other than the quarantine, there are no know controls. This is a BAD one! What can landowners do? Not move firewood, and keep an eye on their walnuts. Although there isn't anything that can be done for an individual tree once infected, that tree can be removed, hopefully preventing further spread of the disease.



So, that was a small sampling of some of the diseases which are currently here in Virginia. Now let's talk about one that, thankfully, still falls into the category of "not here yet".

This disease is sudden oak death. Right now it is known to occur only in Oregon and California. But with the way we move nursery stock and wood around, it can easily be moved. Northern red oak and pin oak, two common Virginia species, are very susceptible to this disease.

Sudden oak death causes bleeding cankers, with a black or reddish ooze, on tree stems, which leads to crown dieback. Not much can be done to prevent this one – aside from not moving firewood and not purchasing nursery stock from areas with this disease.

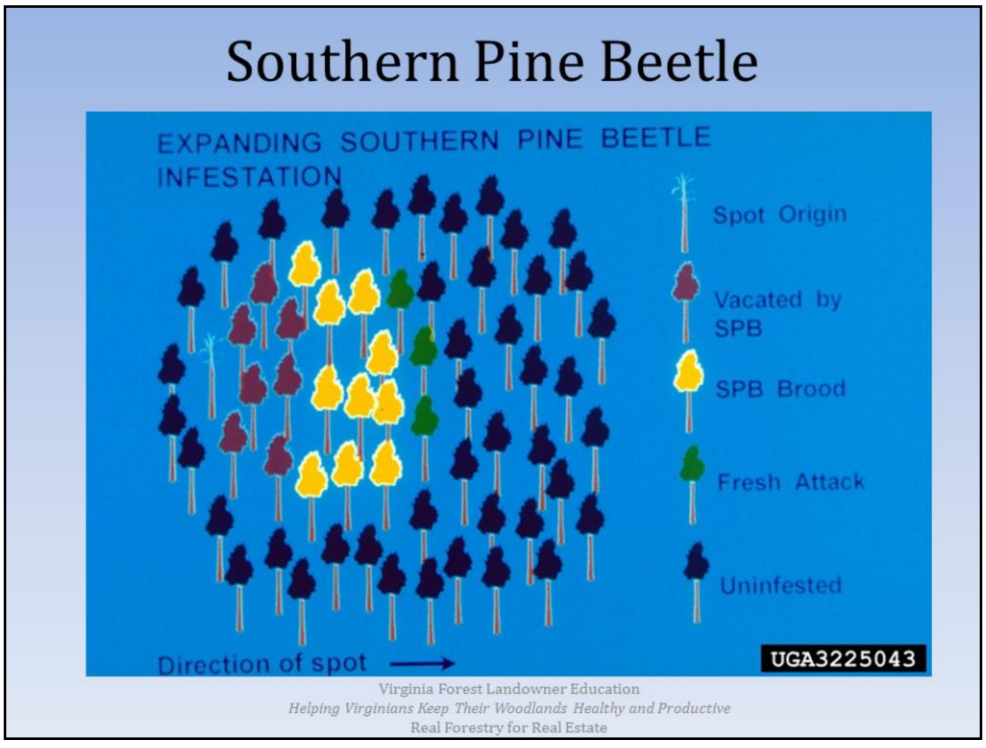


Now, in addition to diseases, our forests are also threatened by insects.

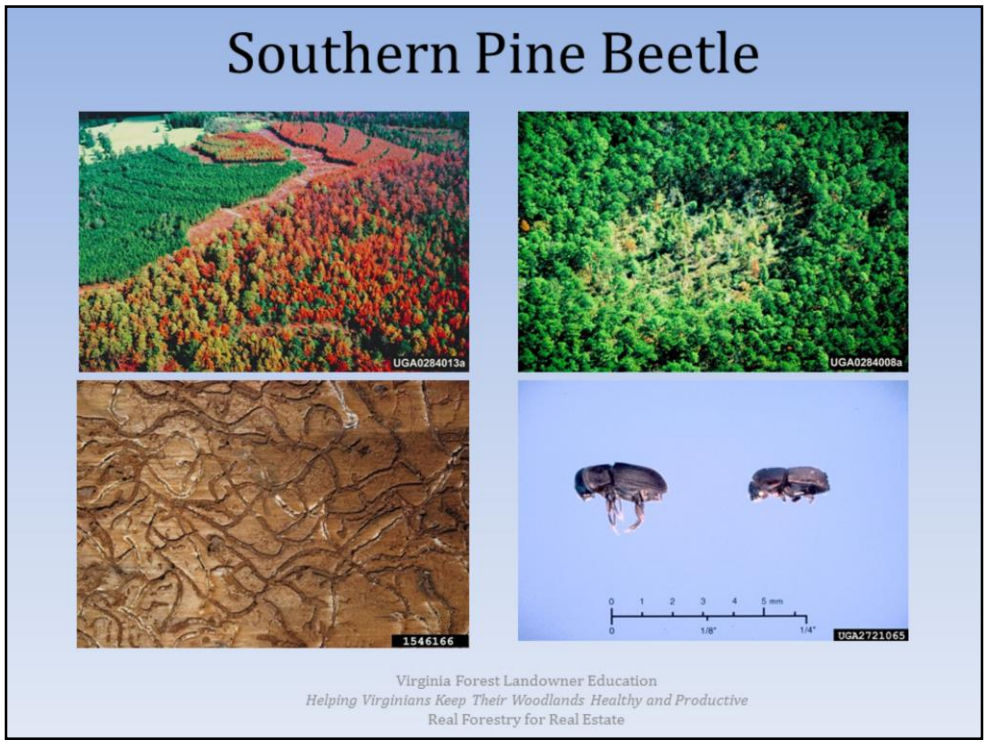
Has anyone heard about the emerald ash borer?? (EAB). This is a relatively new arrival in Virginia and it is not widespread here, yet.

However, is it a deadly insect and has just about eliminated ash from the Midwestern states. Again, like the thousands canker disease of black walnut, evidence of infestation doesn't occur until the insect exits the trees, leaving a D-shaped exit wound. By that time, the insect has already eaten the living tissue under the bark, and the tree is on its way to dead.

Who has seen these purple traps handing on trees? These traps have been placed throughout Virginia on a 2 x 2 mile grid and are being used to monitor for the presence of EAB. So far, EAB has only been found in Prince William, Loudoun, Frederick and Fairfax Counties. However, is adjoining states the spread has been rapid. It may be spreading slower here in VA due to a lower volume of ash trees in our forests and quarantines. However, EAB has been found in Tennessee, right next door to Lee county VA. So, forest health experts anticipate the next new sightings to be in SW VA. If you've ever seen the Don't Move Firewood signs, this is the bug they are trying to prevent from spreading. So, don't move your firewood!



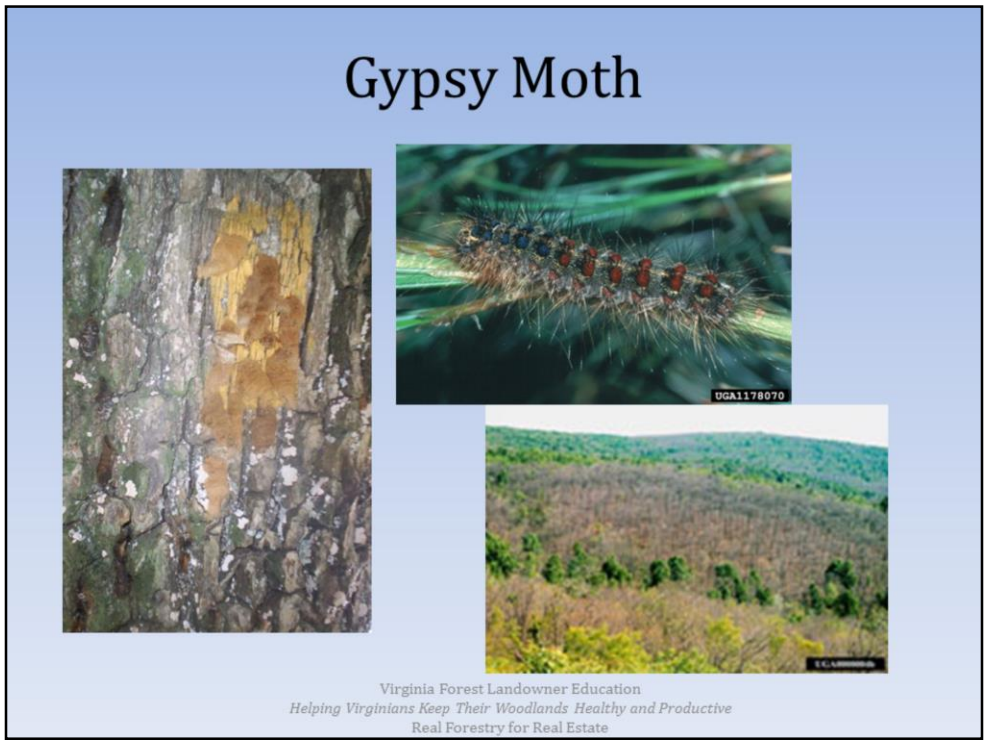
The Southern pine beetle, a native insect, historically has been a major problem in pine plantations throughout the Southeast. It has caused major economic problems. When trees are stressed (growing in forests where there are too many trees, poor soil nutrition, or droughty conditions), they emit a chemical signal. SPB's are attracted to that signal and will move in. Once they kill the stressed tree(s) they move on to adjacent trees, creating an SPB spot. The cartoon on this slide depicts the movement of a SPB spot. The most effective way to control this insect once it invades it to harvest the dead trees and a wide swatch of trees ahead of the infestation. This results in the loss of many acres of trees.



The photo on the left shows an infestation (all the red trees are dead trees…pines don't have fall color!), and on the right, the result of an SPB control effort. Like the other beetles we've talked about, SPB's are very small….but as these photos show, and infestation can cause a whole lot of damage. The insects get under the bark and tunnel through the living tissues of the tree….creating galleries as shown on the photo on the bottom left. These galleries disrupt the flow of water and nutrients through the tree, eventually killing it.

In this case, prevention is possible and the best way to deal with SPB's. How does a landowner prevent SPB's? By keeping their trees stress-free. This can be done through thinning, which reduces the number of trees growing in an area, planting trees on sites with good soils, and planting species which are less susceptible to SPB (longleaf pine). The Virginia DOF has a cost-share program in place which helps landowners pay for the costs of such activities.

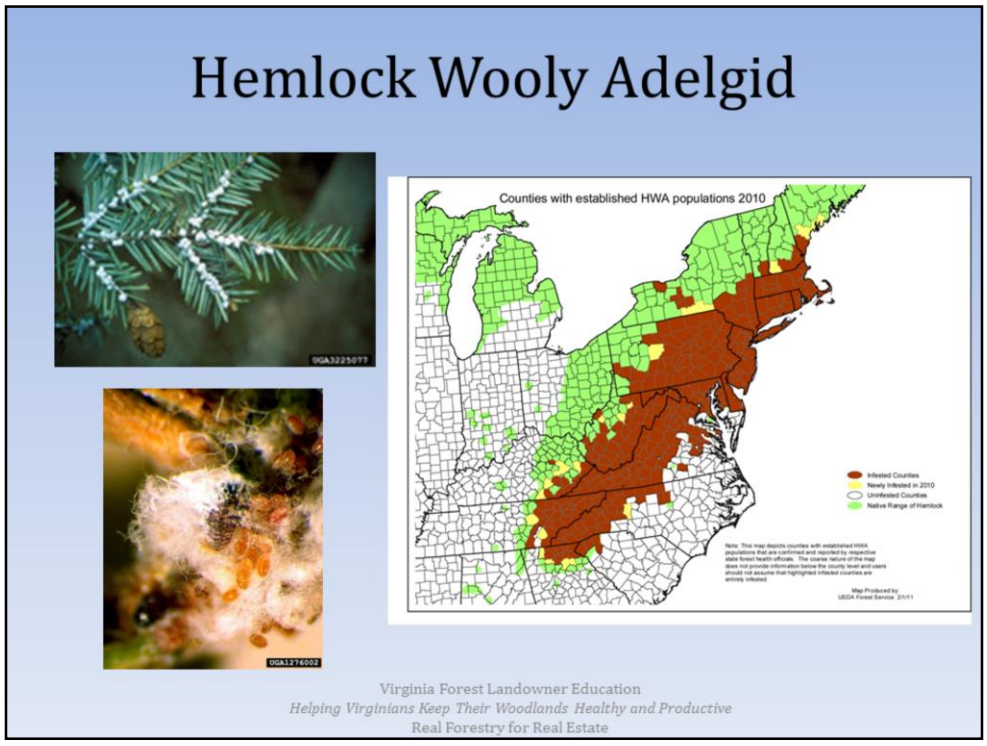
For many years now, SPB has not been a problem in Virginia, most likely due to these management strategies.



The gypsy moth caterpillar is another insect which has been a major problem in the past, but we've had a few good years lately. This is an exotic invasive species which was intentionally brought to the US to be bred with the silk worm, in hopes of increasing silk production. That didn't work, but the caterpillar lives on! They started in Boston in the early 1900's and are now found all the way down into Virginia. The females only move a few feet in their lifetime, so humans are the main means of dispersal (unintentionally). These are not the same as tent caterpillars. They lay their eggs on the sides of trees (left). You can identify the gypsy moth caterpillar by the four rows of blue dots followed by 6 rows of red dots on their backs. Fell free to squish them (top right)!

Gypsy moth caterpillars are defoliators, preferring the leaves of oaks. But when populations get really high, they will even eat grass. During an outbreak year, you will see scenes such as the one on the bottom right – large patches of leafless trees in the summer. Now, defoliation doesn't necessarily kill the trees. Several years of defoliation in succession might, or defoliation on conjunction with another stressor, like a drought year.

As far as control is concerned, nature helps some. In fact, there is a naturally occurring fungus which prevents the moths from reaching maturity, and there for from reproducing. This fungus increases during rainy spring periods. So a rainy spring = fewer caterpillars the next year. There is also a phermone spray which can be used to confuse the males, preventing them from finding females, preveting reproduction.

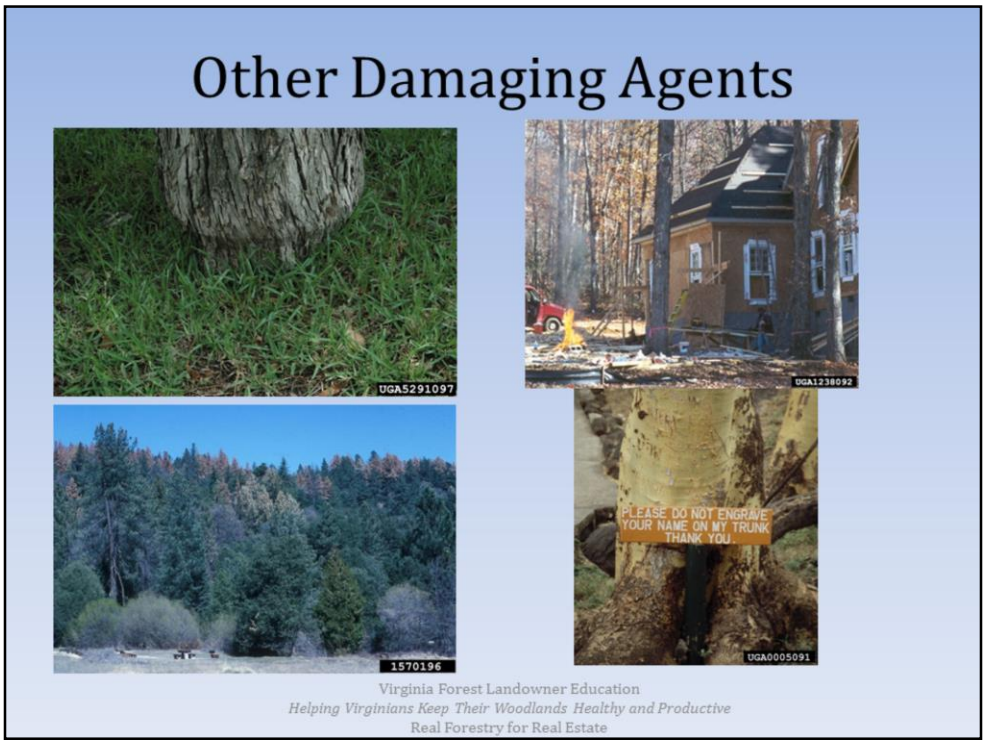


And, finally, the last insect we'll talk about…the hemlock wooly adelgid. Yet another exotic invasive species. This native of Japan was accidentally brought to the U.S. and initially found near Richmond in the 1950's. Now the HWA is found in 18 of the 24 states in which hemlock grows. You can identify infected trees simply by looking for white woolly sacs at the base of the needles (the actual insects are inside these sacs). The adelgids damage hemlock by sucking the sap from new needles, first causing a grayish hue, then premature needle fall. They may also inject a salivary toxin into the needles. The stress of premature needle fall eventually leads to death – in as little as four years, although some infected trees can survive up to 10 years or longer.

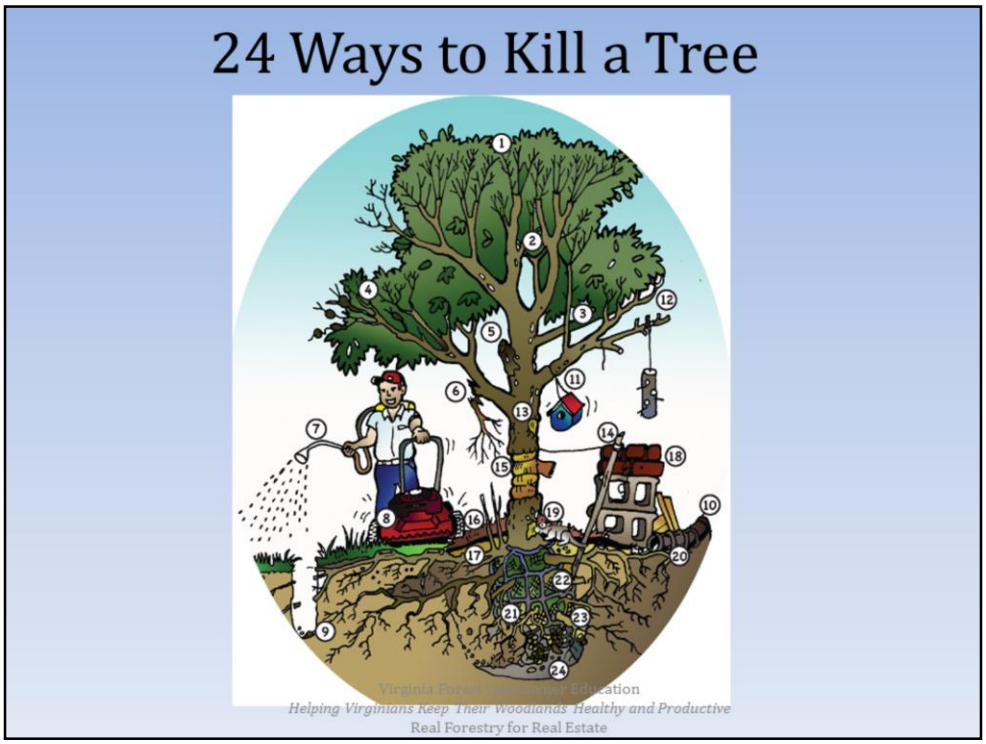
Individual trees can be protected by spraying them with the pesticide Imidocloprid (the same active ingredient we find in Advantage/Frontline for killing fleas and ticks). Know, those of you with pets know how expensive this chemical can be! Just imagine buying enough to spray on a whole forest! In some high priority areas, such as the Great Smokey Mountains National Park, the Park Service is spraying individual trees. But it just isn't feasible on a large scale.

Some biological control methods are being worked on – introducing adelgid predators from their native Japan to feed on them here. Right now, there are problems getting the native predators to reproduce and spread in the wild…and they are difficult to reproduce in the insectory (lab hatchery).

One company, Camcore, is collecting seeds from native hemlocks across their entire range….and planting them in South America. The idea is to wait until all our hemlocks here are dead and the adelgids all die off, then reintroduce hemlock. Hopefully, we'll come up with some type of treatment before we lose all the hemlock.



So, that was a brief introduction to some common insect and disease problems in Virginia. However, not all problems are caused by insects and diseases. The pictures on this slide show damage from not an insect or a disease, but from…..humans. On the top left, is damage caused by repeatedly hitting the base of the tree with a lawnmower; top right shows soil compaction and root damage during construction, bottom left shows damage from air pollution and bottom right, well, just plain vandalism. Tree in back field story…



In most cases, keeping trees free of stresses, such as wounds, drought, and nutrient deficiencies, is the best way to prevent disease. This is practical for many yard and landscape trees. This diagram depicts many avoidable practices which can cause stress to trees.

The same theory applies to forest trees as well. Keeping a healthy well-managed forest can help prevent many health problems.

1. "Top" tree to encourage watersprouts that weaken tree and encourage pests.
2. Leave co-dominant leaders to encourage "V" growth and splitting during winds and storms.
3. Leave crossing branches to rub protective bark and create wounds.
4. Ignore insect or disease damage.
5. Coat pruning cuts with paint or sealer to slow healing and promote pest problems.
6. Leave broken branches unpruned to encourage pests.
7. Spray unapproved herbicides over tree root area to weaken tree.
8. Damage roots and trunk with lawn equipment.
9. Rip through roots when digging trenches.
10. Plant close to house or obstacle to reduce adequate tree and root growing space.
11. Attach items to tree to damage bark and girdle branches with wire and rope.
12. Prune randomly to leave branch "stubs."
13. Prune flush cuts to reduce wound closure.
14. Leave tree staked until guy wire girdles trunk.
15. Leave wrap on to constrict trunk growth and rot bark.
16. Pile up excessive mulch to encourage rodent damage and bark rot.
17. Put non-porous black plastic under mulch.
18. Stack items atop roots to cause soil compaction.
19. Leave ball roping on to girdle trunk.
20. Plant near downspout to assure excessive water or water lightly to encourage shallow root growth.
21. Leave top of wire basket in place to girdle roots.
22. Leave treated or synthetic burlap on to prevent root growth.
23. Dig hole too narrow and over amend backfill to discourage proper root spread.
24. Dig hole too deep or fill with gravel to collect water and drown roots.