



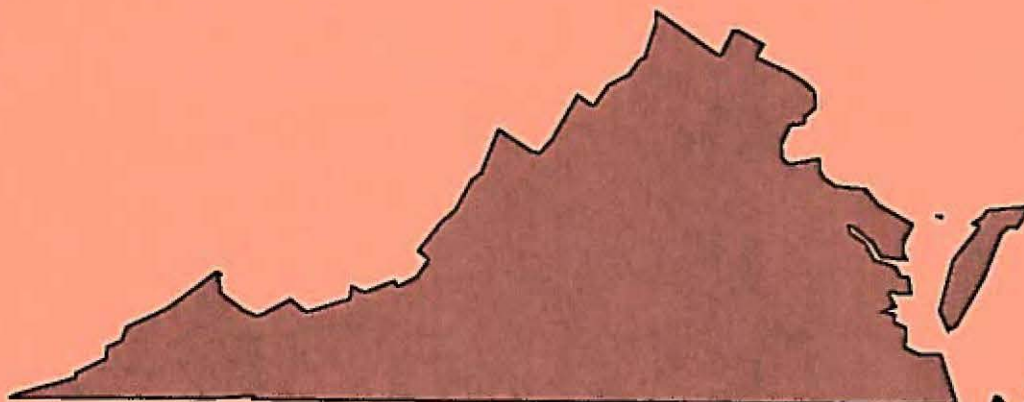
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2002



# FOREST HEALTH MONITORING REVIEW



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The  
**Forest Health Monitoring Review**

Is Prepared Semi-Annually by  
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To Help Keep Virginia's Forestry Community  
Informed of Forest Health Conditions,  
Problems and Issues



Much of the information in this report is obtained through our  
cooperative *Forest Health Protection* and *Forest Health  
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## UPDATE

**WEATHER** – Drought has dominated the weather news, and rightly so; but a late freeze



and several storms also made the headlines this year. Another extraordinary pattern was the consistently warmer-than-normal temperature, except for a generally cooler-than-normal May. April averaged from 3.1 to 5.2 degrees above normal across all six climatic divisions. Very warm! From June through September average temperatures ranged from about 1.5 to 2.5 degrees above normal all across Virginia.

Precipitation varied considerably more. In April, half the climatic divisions received above-normal rainfall and half below. For example, the Western Piedmont had only 49% of normal rainfall, whereas the Central Mountains received 153%. May saw a reversal of extremes and was closer to normal, ranging from 81% in the Central Mountains to 105% in the Western Piedmont. June was dry everywhere, ranging from 47% to 92% of normal. July was very dry in Tidewater and the Eastern Piedmont, a little drier than normal in the Northern and Western Piedmont, and slightly above normal in the Central and Southwestern Mountains. August was very dry everywhere except the Eastern Piedmont. September ranged widely, from only 58% of normal precipitation in the Eastern Piedmont to 134% in the Central Mountains. For the whole period from April through September the Northern climatic division averaged near normal, whereas all other divisions were dry with average cumulative deficits ranging from 1.33 to 5.71 inches for the period. Keep in mind that local conditions can vary greatly from the division averages. Remember too, that Virginia was already in a prolonged drought at the beginning of this period, as reported in the last issue.

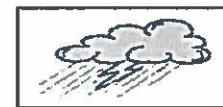
Welcome relief was delivered by several October rains. Let's hope this is just the beginning of a new trend.



As if drought weren't problem enough, an unusual late freeze affected vegetation over most of Virginia. Particularly hard hit were the southwestern counties where some locations had up to five nights in a row with freezing temperatures, including some in the low twenties. Most freeze injury was sustained during the period May 19-22. Gardens, vineyards and Christmas trees lost new growth. Forest trees were affected to varying degrees according to leaf development, elevation and location of frost pockets. Symptoms were obvious and widespread on oak, yellow-poplar and sycamore at lower elevations in the mountain counties. In the eastern counties, sassafras and pepperbush were also noticeably affected. In several cases this injury was mistaken for herbicide damage.



Every month from April through August brought damaging storms with hail, high winds or flash floods to some Virginia locality. On April 28, a probable tornado ripped through part of Campbell County south of Lynchburg causing severe losses. The same storm brought recorded damage from strong wind



or hail to at least eight other counties across a large portion of the Commonwealth. Early May delivered several storms to the southern half of Virginia causing local floods, wind damage and hail. June and July produced hail and wind damage in at least five separate, local events in the central and southern mountains. A late August storm brought some flooding to Virginia's southeastern corner and very welcome rain in most other areas.

Hail seems to be a really common event in Virginia, and its effects are usually so local that detailed records don't exist. I wish they did. Hail can cause severe defoliation and bark injury. If all hail events were documented for a decade their cumulative occurrence would probably be surprisingly extensive.

**DROUGHT EFFECTS** – Trees have exhibited symptoms of drought for at least the past three years, but this season produced far more severe and widespread effects. These included early leaf shed of yellow-poplar, late summer browning of red maple, an extraordinary increase in oak mortality, a late-season surge in engraver beetle infestations, local tip mortality on young loblolly pine and general browning of whole forest patches in some mountain areas. Not all trees that turned brown or shed foliage early will die, but the obvious increase in tree mortality suggests that continuation of drought or additional stress will be the last straw for many more trees.



In the case of oaks that have died, the immediate cause of death seems to be combinations of twolined chestnut borer, shoestring root rot and hypoxylon dieback. The rates of oak mortality and the very high densities of twolined chestnut borer galleries suggest that this beetle has built up to really extraordinary population levels in some places. Reports of increased oak mortality have come from many counties, east and west. The fundamental agent of course, is



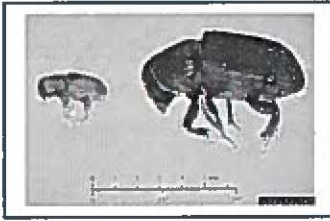
drought. I have even seen a few cases where it appears that trees had reached the permanent wilting point before being invaded by secondary agents.

Regardless of weather patterns from here on out, trees will take years to recover. Any additional stress at this point is likely to be lethal. Don't forget that root disease and dieback also increase during droughts. If this winter and next spring return to normal temperatures and precipitation we will still see above-normal incidence of tree decline and mortality in '03.

An April '98 paper in Science presented baldcypress tree-ring chronologies to support the assertion that the Lost Colony of Roanoke Island disappeared during the most extreme drought in 800 years (1587-1589) and the near abandonment of Jamestown Colony occurred during the driest 7-year period in 770 years (1606-1612).

**Never confuse motion with action. *Benjamin Franklin***

**BARK BEETLES** – All five of the common pine bark beetles can be found more easily



than usual now, sometimes in the same trees. Southern pine beetles are still most active in the southwestern mountains, from Roanoke to Marion. They have also cropped up on the Appomattox-Buckingham State Forest and the central Coastal Plain, where they are generally associated with engraver beetles. By far the most common and widespread species is

the small southern pine engraver, *Ips avulsus*, which attacks relatively thin-barked areas in pine tops, or Virginia pine or young trees. It is frequently in trees that have also been attacked by black turpentine beetles at the base. The other two engraver beetle species are encountered less consistently. Dead pines are evident in almost every county. Even eastern white pines have been killed.

So far, most infestations have involved only a few trees in each location so that liquidation of stands has generally not been necessary. Unfortunately, there have been exceptions to this generality.

Cold weather, if it comes, will at least slow up the rate of infestation. Sub-zero temperatures could end the outbreak, at least for awhile; but engraver beetles would probably rebound if the drought continues.

In special cases, insecticide application can be an appropriate treatment, especially for turpentine beetles or small numbers of felled trees. However, EPA has prompted the removal of Dursban 4E from the market and it has been the only registered insecticide that was both readily available and effective. It is still legal to use existing stocks, but obtaining Dursban 4E will be increasingly difficult. (Registered formulations of Lindane are also still legal, but have been unavailable for years.) There are two other insecticides registered for use against bark beetles, but research has shown that neither is particularly effective. A new promising alternative could possibly become available within a year or two.

**GYPSY MOTH** – From over 400,000 acres of defoliation last year to about 50,000 this spring – that's a big drop. Some of the decrease is attributable to an aggressive suppression program in northern Virginia, and certainly larval disease was an important factor. Cool, wet weather around the time of egg hatch and the late freeze in mid May could also have had major effects. Seth Miller reported seeing significant larval mortality fairly soon after egg hatch.



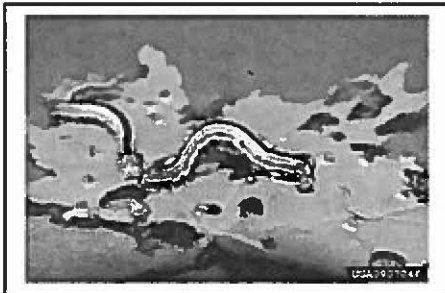
Long after defoliation information was posted on our website we learned that mapped areas south and west of Roanoke had been defoliated by other insects and not by gypsy moth. Corrected information has been forwarded to cooperators and posted on our site.

Surveys of several defoliated areas revealed that high egg mass densities remain in some locations despite the widespread occurrence of larval disease. Once again there is the potential for significant defoliation in these western counties next spring. Conditions

elsewhere in Virginia could also be of some concern. There was no general expansion of local infestations across the Piedmont, as might have occurred; but scattered infestations did increase. Next spring, local defoliation could begin to become an issue for some counties that have not had to deal with gypsy moths for quite awhile, unless natural control prevents it. Federal trapping results indicate that there is no gypsy moth threat in southern and southwestern counties.

Our largest State Forests were used again this year for a cooperative study regarding gypsy moth mating disruption with different pheromone doses and application patterns. Mating disruption was used operationally on more than 500,000 acres in 2002.

**FALL CANKERWORM** – Inquiries from Herb Reynolds and consulting forester, Paul



Haney, prompted an early aerial survey of defoliation caused by the fall cankerworm in areas east of the Blue Ridge and north of Charlottesville. Pockets of near-total defoliation were scattered across several counties, mostly on the western aspects of small mountains, plus about 1800 acres on Mason Neck reported by Troy Shaw of Fairfax County. These areas included some, but not all of the historical foci of cankerworm outbreaks and involved other locations where heavy

cankerworm defoliation had not previously been recorded. In addition, no tendency for defoliation to occur on westerly aspects has been noted before. I have no explanation. It is possible that some of this defoliation was caused by other inchworm species although the areas I checked were primarily fall cankerworm.

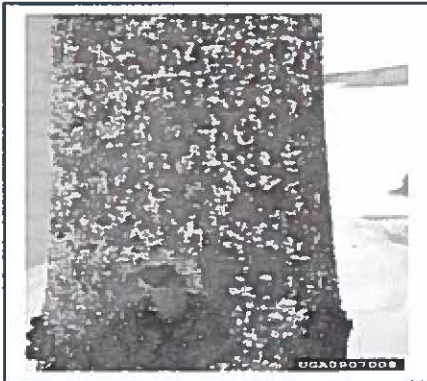
Drew Arnn reported that cankerworm defoliation also occurred in Danville. Circumstances prevented a complete survey of the southern mountains where fall cankerworm defoliation has been prevalent during previous outbreaks. Presumably, some of the defoliation erroneously attributed to gypsy moths was caused by this native insect instead. Next spring might offer an opportunity to find out.

**OTHER DEFOLIATORS** – Several other defoliating insects were at noticeable densities this spring and summer. Lawrence Tankersley reported variable levels of yellow-poplar weevil feeding in southwestern counties. Heavy leaf stippling by sycamore lace bug was scattered throughout central and western counties. Bob Boeren saw quite a bit of oak defoliation by buck moth in Botetourt County, and this insect could have contributed to some of the defoliation that was initially attributed to gypsy moth. Isolated patches of pine sawfly defoliation were observed by Clay Sawyers in Patrick County and Rich Reuse in Chesterfield. Later than usual, the locust leafminer returned to its historical prominence following a year or two of relatively reduced activity. Eastern tent caterpillar was generally light, but noticeable in a few widely scattered spots. Defoliation by sycamore anthracnose was light but widespread in western Virginia.

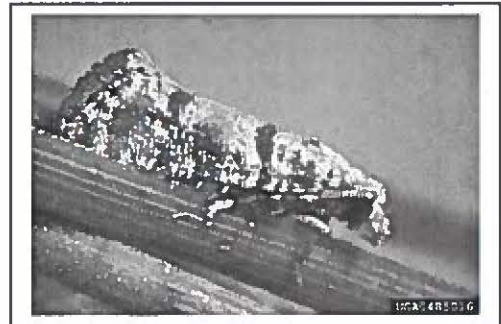
If you don't execute your ideas, they die. *Roger von Oech*

**OAK FLAGGING** – In May and June, chestnut oak branch tips in parts of Albemarle, Augusta and neighboring counties were dying as if damaged by periodical cicada. It didn't make sense for cicadas to choose just chestnut oaks and this was not supposed to be a year for periodical cicada emergence. Close inspection showed that the causal agent was *Botryosphaeria quercuum* or a related fungus. The underlying cause, of course, was drought.

**PINE BARK ADELGID** – An increase in the incidence of this insect is difficult to overlook because its cottony exudation makes white pine internodes appear snow-covered. This was reported from several widely scattered locations. It tends to look much worse than it is, and outbreaks are usually suppressed by predators in a year or two. On the other hand, Virginia has sustained a few episodes of eastern white pine mortality in which pine bark adelgids and drought appeared to play a part. On individual yard trees it is sometimes possible to rub them off with gloves. Chemical suppression is possible, but rarely practical.



**STUDIES** – This was the final season of attempts to suppress post-planting pine tip moth damage with nursery application of currently registered systemic insecticides. Early attempts with Imidacloprid showed some slight, short-lived effect of no practical value. A later test suggested that Acephate might possibly do better. So, a 15% granular formulation was applied by hand to a small section of loblolly pine nursery bed at the rate of 4.9 lb. ai per acre at three monthly intervals beginning on 8/21/01. Treated and untreated seedlings from the same bed were out-planted in mid-March on four separate tracts in 10 alternating rows of 20 seedlings each. Assessments of tip moth infestation were conducted on several dates throughout the season. Although there was more early evidence of unsuccessful attack (i.e., limited tissue damage, dead larvae) in treated than untreated seedlings, there was no difference in total damage. In fact, the treated trees sustained an insignificant but slightly higher level of damage than the untreated ones. Thanks to Jay Bassett, Denis Gaston, Matt Coleman of DOF and Mike Rowland of Resource Management Services for locating excellent study sites.



Another study to evaluate the impact of heavy aphid infestation on loblolly seedlings was terminated after a late freeze eliminated the problem.

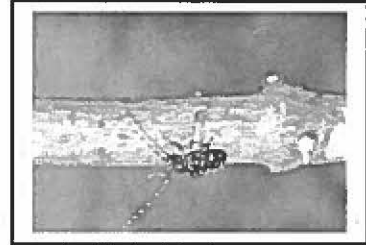
Protection of eastern redcedar seedlings against *Phomopsis* infection at the Augusta Forestry Center was evaluated again by Jack Kauffman, forest health forester with Mike Foreman's large watershed project. His second-year results indicate that acceptable efficacy can be obtained at 2/3, but not at



1/3, the recommended rate of 1 tablespoon Thiophanate-methyl (Cleary 3336 F) per gallon of water plus X-77 sticker at roughly 10-day intervals.

**EXOTIC BRIEF** – Problems of known or presumed exotic origin keep threatening our forests. This is an old problem, of course, and the forests of today are different from those of the past, in part as a result of such invaders. Previously, I have given little space to forest pests not yet established in Virginia because we have plenty to deal with from those already here. We aren't ignoring these threats, however. Here is a brief update on three such conditions to let you know we're trying to stay informed and ready.

After 4 years, authorities are still battling the Asian Longhorned Beetle in New York City, Chicago and now Jersey City. Thousands of trees have been destroyed. A lot has been learned about its biology and how to find new infestations, but it is proving very difficult to eradicate. Many states, including Virginia keep looking for this beetle and will react quickly and strongly if it is discovered.



Sudden Oak Death is a fungus disease first reported from coastal California in 1995. It infects some kinds of plants apparently without serious effects, but is lethal to certain others, including some oaks and tanoak. It continues to spread and is being found on more and more host plants. There is great concern that it will move east on nursery stock and quarantines have been enacted to prevent this. DOF will be cooperating with the federal Forest Service and others in conducting a survey to look for this disease in Virginia next spring.



A small Asian beetle called the Emerald Ash Borer was discovered feeding in the bark and sapwood of ash trees in southeastern Michigan and nearby Canada this summer. It has apparently been established for several years. Many ash species are susceptible and apparently healthy trees can be infested and eventually killed. I examined a number of declining ash trees this summer and found small branches being killed by beetles, but not this species.

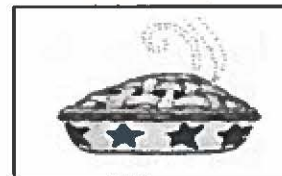


**ETC** – Wayne Bowman found the following site that explains herbicide modes of action; check it out: [www.agcom.purdue.edu/AgCom/Pubs/WS/WS-23.html](http://www.agcom.purdue.edu/AgCom/Pubs/WS/WS-23.html). \*\*\* A recent paper in the Journal of Medical Entomology confirmed the benefit of removing ticks promptly to prevent Lyme disease. Protection decreased steadily with time, but continued up to about 2 ½ days. No protection was provided if ticks were removed after 66 hours. Method of removal made essentially no difference. \*\*\* A component of catnip is repellent to cockroaches. \*\*\* A new international standard for heat treatment of wood packaging material is a core temperature of 56° C (133° F) for 30 minutes. \*\*\* A supercolony of Argentine ants that extends over thousands of miles has become established in Southern Europe. Apparently, food was so abundant and natural enemies

so few following introduction in 1920 that the ants have no need to compete and have lost their ability to recognize individuals from other nests as enemies. \*\*\* My wife is afflicted by oniomania (compulsive shopping), yet I'm the one who suffers. \*\*\* Don't confuse your pollex (thumb) with your hallux (big toe). \*\*\* Certain moth larvae that infest Yucca plants transformed into moths after 30 years in a resting state. \*\*\* The active ingredient in Oust herbicide can move off-site on dust particles. \*\*\* Reflective mulches repel certain crop pests.

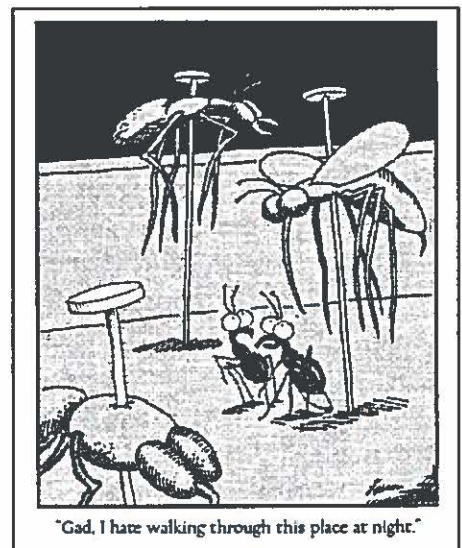
**PAGE PIE** – From *Virginia Folk Legends* comes this tale recounted by Harry Strickler to Susan R. Morton in White House, Page County, April 17, 1942.

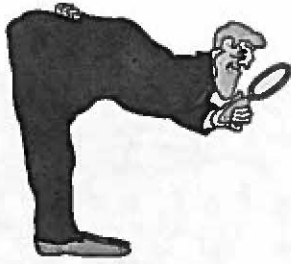
“There is a place in the road not far from the White House Bridge ... near the site of the old German settlement where for years travelers who happened to be passing late at night would suddenly find their horse restless. Sometimes it would even refuse to go, and the foot traveler would notice some uncanny presence before reaching a certain spot where a giant chestnut tree spread its branches over the road. It was all thickly grown about there, but tradition said it was the site of one of the early cabins and that one day when the menfolk were out hunting that the women ... were killed by the Indians. However, an old woman approaches the traveler, a shawl tightly drawn about her head and offers him – a pie! If the gesture of accepting it is made, she disappears with a peculiar sound that resembles a sigh.”



Perhaps this explains some of Steve Moyer's appetite for pie.

**TULIPTREE TREATMENTS** – *Native American Ethnobotany* notes that the Cherokee used infusions of yellow-poplar bark to treat pinworms, cholera infantum, dysentery, rheumatism and coughs, and infusions of root bark for fever. Bark decoctions were blown onto wounds and boils and fractured limbs and used as a wash for snakebite. More imaginative was its use for “women with hysterics and weakness.” The Rappahannock used a poultice of bruised leaves bound to the head for neuralgic pain. This might look good with our uniform. They also chewed green bark as a stimulant and aphrodisiac – probably not a good thing while in uniform.





**HEALTH WATCH**



CONDITION	EVIDENCE	REMARKS
Rodents	Girdling of pines under snow or sod	Control grass in open field plantings
Needle fall from white pine	Inner needles turning yellow	It's that time of year
Dogwood Anthracnose	Dead leaves retained on twigs	Remove stem sprouts in early fall
Weak yard trees	Early leaf fall, twig die back	Winter fertilization
Gypsy Moth	Egg masses	Report unexpected incidence
Bagworm	Bags	Destroy
Tent Caterpillar	Egg masses	Destroy
Boxelder Bugs, Elm Leaf Beetles, Lady Bugs	Aggregations in/on buildings	Ignore or vacuum up
Hemlock Woolly Adelgid	White fluff under needles	Spray ornamentals
Infested Firewood	Chewing noise, adult insects, spiders	Wear gloves, don't worry
Blister Rust Risk	<i>Ribes</i> plants in hazard areas	Inspect planting sites
Pine Bark Beetles	Fading crowns	Confirm, report spots
Winter injury	Foliage browning	Mulch sensitive plants
Overwintering pest organisms	Dead, diseased material	Remove fallen leaves and branches
Twig pruners and girdlers	Fallen limbs with pruned/girdled ends	Pick up branches and destroy

.....  
 If you want others to be happy, practice compassion. If you want  
 to be happy, practice compassion. *Dalai Lama*  
 .....

# Healthword Puzzle

1		2	3	4	5			6	7	8	9	
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	18							19				
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		33								34		
35	36							37	38			
39			40				41				42	
43						44						

Across	Down
2. Quality	1. Inheritance key
6. Gypsy moth targets	3. Leather type
10. Negative	4. Scatter
12. Southwestern Indian	5. Boot measure
13. Strident	6. Should
15. Alnus member	7. Hurts
17. Branch	8. Final blow
18. Ranch visitors	9. Almost a species
19. Alternates	11. Classic
20. Tendon	13. Arboreal anchor
21. Young 'ns	14. Vehicles
22. 3.1415926	16. Invasive species hideout
24. Layer	20. Nepalese porters
25. Fish or singer	23. Perfect conditions
27. Mid-wk.	25. Unsorted seedlings
28. Winglessness	26. Exist
31. Location	27. Rabbit hangout
33. Saw fences, e.g.	29. Roundwood product
34. Solo piece	30. Row
35. Veneer log	32. Sci. work area
37. Tambourine	36. Flightless bird
39. Morning	38. Nest-egg option
40. Delimiting insect	41. Cardinal dir.
42. Ogee shape	
43. Photosynthesis driver	
44. Itinerant	



"Something's wrong here, Harriet. This is starting to look less and less like Interstate 95."

## HEALTH PRIMER

### Rooting Patterns

Tree root systems are highly variable. Those of some species are under rather rigid genetic control and show only slight variation among sites. Others are quite plastic and their growth pattern varies according to the soil conditions in which they develop. Despite these differences, useful generalizations are still possible.

Most root systems conform to one of three general patterns. *Tap-rooted* species have a strong, central root that may be somewhat branched and descends to only a meter or so in some cases to many meters in others. The shallow lateral roots often have sinkers descending vertically at some distance from the main stem. Representative trees would include hickory, oak, walnut, pine and fir. *Heart-rooted* trees have several strong roots radiating diagonally downward and lack a central taproot. Birch and basswood are examples. *Flat-rooted* systems characteristic of ash and the true poplars have strong laterals with sinkers, and they lack large, deep roots.

These patterns sometimes change with age or soil conditions. Beech, for example, is tap-rooted as a seedling and gradually becomes heart-rooted. In one study of three- to eight-year-old loblolly pines grown from seed, 79% had a single tap root. Red maple rooting is highly adaptable and can exhibit almost any pattern depending on soil conditions. Longleaf pine, on the other hand, exhibits little variability and this is probably one reason it thrives only within a narrow range of site conditions.

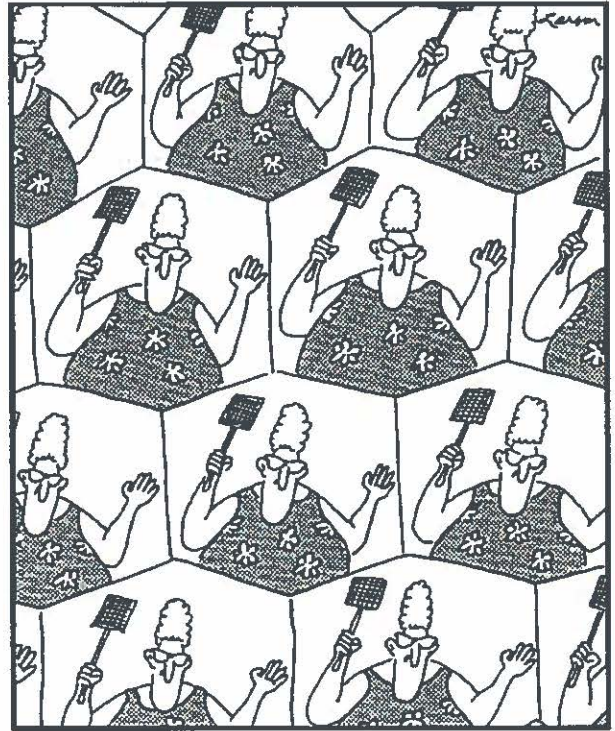
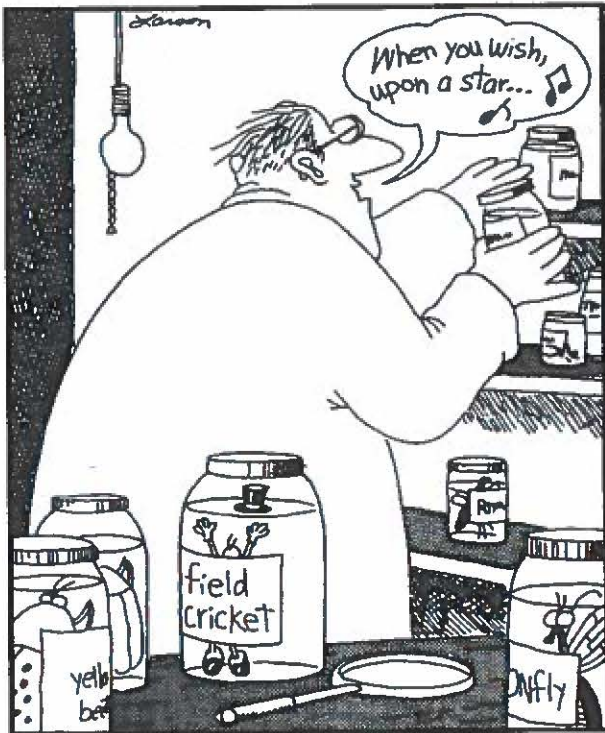
Regardless of pattern, the bulk of most tree root systems is within a meter of the surface. Fine roots tend to be even shallower and are usually more concentrated near the main stem. Lateral roots sometimes extend out as far as the tree is tall. Fine feeder roots are relatively short-lived and root development continues much longer than above-ground growth. Loblolly roots, for example continue elongation in the fall until average weekly air temperature falls below about 28° F. Root system maintenance requires a significant portion of a tree's total energy production.

Root systems change over time as well as space. Competition tends to reduce root growth, and root-to-shoot ratios decline with stand development as the soil becomes more or less fully occupied following crown closure. In one teenage loblolly pine stand, for example, root system weight was 21% of the combined biomass of stems, live branches and foliage. In two-year-old loblolly, root weight might be 80% or more of above-ground weight. Root growth is also related to crown position. Dominant trees develop more roots than trees with intermediate crowns, which have more root growth than suppressed trees of the same age. If you see a suppressed tree in apparently good condition it is probably connected through root grafts to a nearby stem with superior crown position. Aeration is important too. Roots generally do not persist in saturated soil so when water tables fluctuate fine roots will die and regenerate accordingly.

High root density is an advantage for extraction of water and nutrients, particularly ones like phosphate that are relatively immobile. A root density of 1 to 2 cm/cm<sup>3</sup> of soil is generally considered adequate for good growth. In one study of forest soils in the North Carolina Piedmont, root densities ranged from 0.5 to 2.0 cm/cm<sup>3</sup> of soil.

You can discover more about a person in an hour of play  
than in a year of discussion.

*Plato*

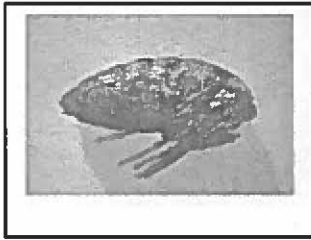


The last thing a fly ever sees

Real knowledge is to know the extent of one's ignorance. *Confucius*

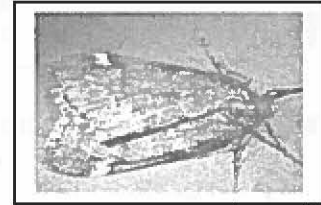
## Aptery and Gynogenesis Too! Oddities of the Fall Cankerworm

Among Virginia's native forest defoliators, the fall cankerworm has probably had the greatest overall impact. Our records indicate that moderate to heavy defoliation by this inchworm has affected one or more locations in the Commonwealth for at least 36 of the past 58 years. Other defoliators have occurred with greater frequency (e.g., locust leafminer) or extended over larger areas in any one year (e.g., yellow-poplar weevil), but no other has caused such heavy defoliation of so many species so many times. One reason for the cankerworm's relative success is its extraordinary biology.



Female cankerworms are wingless (apterous). In Virginia, they usually emerge from the soil in November, although I have seen them as early as late October and as late as early January. As they ascend saplings and larger stems they release a chemical to attract the winged males, and mate before reaching the small twigs where they lay their eggs. The adults do not feed. Larvae hatch in early spring and feed for 4 to 5

weeks on a great variety of tree species often causing total defoliation over large areas. Young larvae sometimes drop on silk threads and can disperse short distances with the wind. Mature larvae descend to the ground on silk threads and burrow into the surface soil where they form oval cocoons from silk and soil particles.



Here's the really extraordinary part: although mating occurs, the male genome is seldom incorporated into the zygote, and reproduction is primarily parthenogenetic with females producing all-female offspring (gynogenesis). This results in a variety of distinguishable genotypes that differ in frequency among localities over short distances. These types also vary somewhat in times of adult emergence and egg hatch.

This has important consequences. Research in the 1970s showed that young cankerworm larvae need to feed on expanding foliage because they cannot survive on mature leaves, which are chemically and physically different. Also, newly emerged larvae can survive only up to 3 days without food. This means that egg hatch must coincide with bud break for optimum larval success. The same research showed that bud break on individual trees tends to vary considerably and consistently among individuals and species in a stand. Thus, through aptery and gynogenesis, individual fall cankerworm types are able to become associated with individual trees. Adult females tend to lay eggs on the same trees that they fed on as larvae the previous spring, and this leads to synchrony between bud break and egg hatch. How cool is that?!

## Girdlers and Pruners

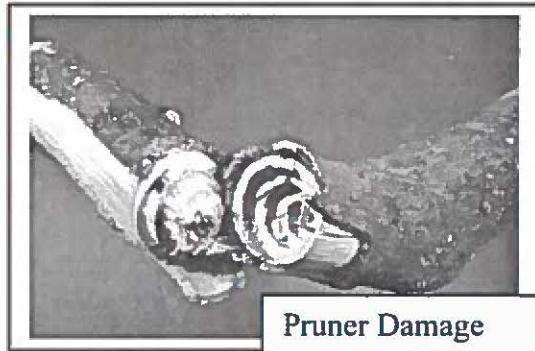
Reports from several of you indicate that this has been a relatively good year for twig pruners and girdlers. Jim Solomon's excellent *Guide to Insect Borers in North American Broadleaf Trees and Shrubs* (a copy of which was sent to each Regional Office in 1995) lists five species of beetles that prune or girdle hickories and other trees in Virginia. Your stock advice to

landowners – pick up and destroy infested twigs as soon as they fall – is sufficient, but for those who want more, here are a few details that might be of use or interest.

Pruners are species in which the larvae cut branches from the inside out. Girdling is accomplished by adult beetles that ring branches from the outside in. Those species that infest hickories are all roundheaded borers, which become longhorned beetles. They also attack other kinds of trees, in some cases more than 20 species in addition to hickory. There are other pruners or girdlers that do not attack hickories.



Girdling Damage



Pruner Damage

Natural controls, including parasitic wasps, birds, squirrels and desiccation are usually effective in preventing prolonged infestations. The reason for removing fallen twigs right away is that parasites sometimes attack the beetle larvae after twigs have fallen, and you don't want to destroy parasites along with the pests.

Life cycles vary, but generally eggs are deposited near branch tips and larvae mine either under bark or into the wood and toward the base. Sometimes, side twigs are also mined. Branch size infested and gallery dimensions vary considerably among species. Galleries mostly end up in the center of the branch except in one species where they usually stop just below the bark. Winter is spent as larvae or pupae. Life cycles can take one or two years. In cases where it takes two years, branches fall and adults emerge every other year.

### Healthword Puzzle Answers

<sup>1</sup> D		<sup>2</sup> A	<sup>3</sup> S	<sup>4</sup> S	<sup>5</sup> E	T			<sup>6</sup> O	<sup>7</sup> A	<sup>8</sup> K	<sup>9</sup> S	
<sup>10</sup> N	<sup>11</sup> O		<sup>12</sup> U	T	E		<sup>13</sup> R	<sup>14</sup> A	U	C	O	U	S
<sup>15</sup> A	L	<sup>16</sup> D	E	R		<sup>17</sup> B	O	U	G	H		B	
	<sup>18</sup> D	U	D	E	S		<sup>19</sup> O	T	H	E	R	S	
<sup>20</sup> S	I	N	E	W			<sup>21</sup> T	O	T	S		<sup>22</sup> P	<sup>23</sup> I
<sup>24</sup> H	E	N			<sup>25</sup> B	<sup>26</sup> A	S	S			<sup>27</sup> W	E	D
E		<sup>28</sup> A	<sup>29</sup> P	<sup>30</sup> T	E	R	Y		<sup>31</sup> P	<sup>32</sup> L	A	C	E
R		<sup>33</sup> G	U	I	D	E	S			<sup>34</sup> A	R	I	A
<sup>35</sup> P	<sup>36</sup> E	E	L	E	R		<sup>37</sup> T	<sup>38</sup> I	M	B	R	E	L
<sup>39</sup> A	M		<sup>40</sup> P	R	U	<sup>41</sup> N	E	R			<sup>42</sup> E	S	S
<sup>43</sup> S	U	N			<sup>44</sup> N	O	M	A	D				

An honest man can feel no pleasure in the exercise of power over his fellow citizens.

*Thomas Jefferson*