Planting and Care of Fine Hardwood Seedlings

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Environmental and Management Injury in Hardwood Tree Plantations

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The injuries described in this publication sometimes mimic those caused by animals, insects, and diseases. Some environmental and management-related injuries can be treated, but it is best to prevent their occurrence.

Herbicide Injury

Herbicides applied for weed control can damage and even kill hardwood trees. Young trees are especially vulnerable the first few years after planting. This is a result of many factors, the most important of which is their low tolerance to herbicides that can affect them as much as the weeds. Non-lethal herbicide damage usually occurs when herbicide sprays drift onto hardwood seedlings or when herbicides are applied to young trees at improper rates. Above normal rainfall, soil pH, and the amount of soil organic matter also can affect how young trees respond to herbicides. Symptoms of herbicide damage include yellowed or malformed leaves, blackened stems, and dieback (Fig. 1a). At the first sign of injury, herbicide damage often appears to be a nutrient or pest problem. However, nutrient and pest problems are usually sporadic and irregular throughout a plantation. Herbicide damage usually occurs with a regular pattern such as throughout whole rows, on a number of adjacent trees in sections of rows, or in association with certain soil types. In mixed hardwood plantings, some species may be affected while other species look fine. If trees with herbicide damage survive the season, they usually will be symptom-free the next year.

Many landowners notice injury when herbicides drift from nearby agricultural fields. Trees planted in an open landscape are especially susceptible. Tree seedlings are most sensitive to drift injury after bud break; even low levels of growth regulator herbicides (2,4-D©, Banvel©, and Crossbow©) used on row crops will cause injury. Glyphosate injury to hardwood seedlings is becoming more common as this product becomes more widely used in the agricultural industry. Trees injured by herbicide drift appear withered and yellow as described above, and symptoms may persist through the entire growing season. Affected seedlings usually lose their new growth and grow slowly, but in severe cases, the injury causes dieback or death.

Recent research strongly suggests that herbicide injury causes the phenomenon called white oak tatters (Fig. 1b - *see page 2*), (Samtani, Masiunas and Appleby 2005). Drift of chloroacetamide herbicides at 1/10 and 1/100 of standard field-use rates resulted in malformed white oak leaves. The white oak tatters effect was most commonly seen on seedlings exposed to the herbicides as the leaves began to unfold. No injury was noted at the swollen bud or expanded leaf stages.

Figure 1a. *Typical symptoms of herbicide injury on young hardwoods. Oust injury on ash (left) and simazine injury on black walnut (center) and black cherry (right).*

Figure 1b. *Symptoms of white oak tatters.*

To prevent herbicide injury, become familiar with the proper use of herbicides and follow all label instructions, paying particular attention to application rate and timing. Herbicides that can be safely applied to young, dormant trees can cause injury after the trees leaf out. Select an herbicide that will be effective against the types of weeds that need to be controlled (e.g. annual, perennial, broadleaved, etc.). Soil type and soil moisture will affect the effectiveness of some herbicides and the likelihood of injury to trees. Obtain the right equipment and insure that it is functioning properly. Dry, flowable herbicides require continual agitation or settling will occur, causing the rate of application to change over time. Check spray nozzles, spray pattern, and hoses so that the herbicide will be applied to the weeds or onto the ground and not onto young trees.

Recovery of Loss from Herbicide Injury–Legal and Valuation Issues

Tree plantations established adjacent to or near row crops are subject to spray drift. Applicators are required by law to consider wind conditions and must not apply herbicides when off-site drift could possibly occur. When drift does occur, the applicator is responsible for any resulting damage. In most cases, claims for damage are referred to the applicator's insurance adjuster. Thus, a claim for damage to or death of trees as a result of herbicide drift involves negotiation with an insurance company. The willingness of an insurance company to pay a claim depends on many factors, but the larger the monetary amount of a claim the less likely they will settle quickly. The trouble and cost of making a claim sometimes exceeds the potential gain. Claimants will be asked to prove that the damage to or death of the trees was because of a particular herbicide, and that the source of the drift was the insured applicator. Unless there are eyewitnesses, it can be difficult to establish the date and time the drift occurred.

Most claims involve young plantations containing trees that have no market value for timber. It is very difficult to place a fair market value on pre-merchantable trees. Ideally, fair market value would be based on comparable sales of young plantations. This data frequently does not exist because plantations are not usually sold separately, but as part of a farm or other large acreage. This leaves two basic valuation approaches to consider. Many plantation owners prefer to estimate a value based on the net present value of the fair market value of the plantation at maturity less costs. This approach to valuation requires projecting growth rates, timber quality, fair market values for timber years in advance, and other factors. The amount of speculation involved in this process makes estimates very difficult to defend.

An alternative is to compound all the historical costs forward to the date of valuation. This allows a landowner to use receipts and other records of out-of-pocket expenditures to prove actual costs. The appropriate interest rate to use may be debated, but this should be relatively easy to settle. If there are adequate records, a reasonable value for the time spent working on the plantation may be included in the valuation. The resulting cost-based value is more likely to be accepted by an insurance adjustor than the speculative net present value of future income.

Soil Compaction

Trees do not grow well in compacted soil. Compaction can be a localized problem or it can affect entire fields, but it may not be apparent until trees are several years old. Compacted soil drains poorly, has poor root penetration, and can cause susceptibility to disease. Compaction can be the result of previous agricultural practices, logging, the movement of other heavy equipment, or the congregation of livestock. Compaction can be ameliorated by ripping through the compacted layer or plow-pan with a deep chisel-plow before the plantation is established.

Frost Damage

Frost injury is often the first damage a grower encounters in a young hardwood plantation. Damage is most common in low-lying areas and at the base of sloping fields or hills where cold air

drains. Frost damage most often appears as dried or blackened new leaves or shoots. The extent of the injury depends on how cold the air becomes, the duration of low temperatures, and the species. Black cherry, yellow poplar, and ash are more tolerant of frost than are the oaks and walnut. In extreme cases, late frosts can kill small branches as well as their leaves and buds. Trees usually recover quickly from frost injury; secondary buds will break along the stem and new shoots will begin to grow within a few days after the frost. Usually no permanent damage is caused except for the growth of multiple stems that may require pruning. Walnuts are particularly susceptible to frost injury because they often grow in low areas where cold air drains from surrounding hillsides.

Frost Cracks

Frost cracks appear as large, suture-like wounds. They often start from just above the ground on the south side of the tree to a height of four to eight feet (Fig 2). The term "frost crack" can be misleading because the seam or crack is not always initiated by cold, but may be caused by an injury or an improperly pruned branch stub. Cold weather does contribute to the problem. A sudden, sharp drop in winter temperature causes the outer and inner layers of wood to contract at different rates, causing a vertical crack to form at weak points in the trunk. Although cracks may heal over with fresh wood, they remain weaker than the surrounding tissues, and the injury often occurs repeatedly in the same location. The cycle of cracking and wound recovery causes a buildup of tissues and the formation of frost ribs, bulges, or seams. In some cases the margins of the injury may grow inward, preventing complete closure of a wound. Frost cracks provide an opportunity for infection by wood-rotting diseases and insects, and greatly reduce the value of a log.

Figure 2. *Frost crack injury on cherrybark oak.*

Figure 3. *Dieback of red oak.*

To prevent frost cracks, avoid wounds to the trunk and properly prune branches to prevent injuries that can initiate the formation of frost cracks. Plant tree species and use seed sources that are adapted to the winter conditions for your area. Cherrybark oak and swampchestnut oak are two southern species that are susceptible to frost cracking in more northern climates. In one plantation in southern Illinois, frost cracks were found to be more common in trees that received weed control treatments in the 6th and 7th year after planting (Bohanek and Groninger 2003). It was postulated that trees lacking insulating ground vegetation around the base of the tree may be susceptible to lower winter temperatures and late spring frosts, and thus more susceptible to frost cracks.

Dieback

Dieback from the tip of newly established seedlings (Fig. 3) can be the result of both cultural and physiological processes. If seedlings

do not have adequate internal moisture or if the root-to-shoot ratio is out of balance, the seedling will reallocate resources to support survival and future growth. In severe cases, dieback can extend all the way to the root collar with complete loss of the shoot. Dieback can be caused by drought, extreme cold, drying winds, or very cold temperatures that occur suddenly in the fall after a warm period. Pests and diseases can also cause the terminals of young trees to show symptoms of dieback in the spring. Young trees that were growing vigorously late in the growing season appear to be particularly susceptible, perhaps because they were not fully dormant when cold weather arrived. Newly planted seedlings are much more prone to dieback than trees that are two years or older.

To avoid dieback, plant only trees adapted to local winter weather conditions, store seedlings properly, and protect seedlings from exposure to wind and sun during planting. Avoid conditions that will cause trees to put out a flush of growth late in the season; in particular, avoid late season fertilization. If possible, provide young trees with additional water in late autumn. Although the leaves may have fallen from a young tree, the roots may still be active until the ground freezes. If you use mulch, be sure to pull it away from the stem; mulch should never be piled up against the base of a tree.

Sunscald

Sunscald is a type of winter injury (Fig 4). It is most commonly seen on the south and southwest sides of smooth-barked trees and is most often worsened by drought and poor snow cover. When the sun is bright in the winter, the part of the tree that receives the most exposure can be warmed enough to cause it to break dormancy even as the shaded portions of the stem remain cold. When the sun sets, tissues in the warm part of the stem are exposed to rapid chilling and can even die. This local injury can then be expanded by frost cracking (see below). Yellow poplar and other thin-barked trees tend to be particularly vulnerable, especially when planted in low density.

Prevention is the best way to reduce the impact of sunscald. Tree shelters can protect young trees from this type of injury, although the decision to invest in tree shelters (see FNR-216) should not be based on the possibility of occasional sunscald injury. Non-competing groundcovers or other vegetation may provide enough shade to help prevent sunscald and other types of winter injury. Wrapping the lower stem of trees with reflective or light-colored material can prevent sunscald and subsequent bark cracking. If tree wraps are used, remove them in the spring as temperatures rise because water that accumulates under the wrapping may provide an environment for fungal infection.

Figure 4. *Sunscald injury on the south side of a maple.*

Ice

Storms that result in the build-up of heavy ice layers on limbs can be devastating to a stand of trees. Trees exposed to heavy loads of ice should be inspected for limb breakage and splitting. Affected branches should be properly pruned to avoid entry of opportunistic diseases. Hail rarely causes long term damage to tress unless the trees are very small.

Salt

Trees planted near a highway or heavily traveled road can be affected by road deicing salts, either as spray or as runoff. Symptoms of this type of injury include a salty crust on the soil, and foliage

that is small and yellow. Trees with salt burn often appear to have symptoms of potassium or phosphorus deficiency. In areas where salt is likely to accumulate, an application of gypsum (calcium sulfate, 50 pounds per 100 square feet incorporated in the upper 6 inches) may be helpful before trees are planted.

Flood

Many hardwoods grow well on bottomland terraces near streams, but these sites pose the risk of spring flooding. Floods can kill or harm trees in several ways. Roots that are under water for more than a few days can suffocate, especially once the roots have begun active growth. Trees that have suffered damage from flooding may appear stunted, new leaves may be smaller than normal, and shoots may appear wilted and drought-stressed. Trees affected by flooding may die suddenly, or if they survive, may be more susceptible to root diseases. Dormant trees are less susceptible to flood damage, and some species, e.g., swamp white oak, burr oak, pin oak, cherrybark oak, and overcup oak, are more tolerant of flooding. Cooler temperatures and flowing flood water lessen the risk of damage. Flooding can kill young walnut trees during the growing season, especially if the trees are submerged for more than two days. The physical force of rushing flood waters injures trees by causing them to lean or be uprooted. Large objects carried downstream in a flood can damage trees by skinning the bark or breaking branches. Young trees often recover rapidly from such flooding injury, but older trees may sustain permanent damage.

Figure 5. *Symptoms of a lightning strike.*

Figure 6. *Windthrow damage.*

Lightning

Lightning strikes do not always kill a tree, but almost always damage it to the point where the tree should be removed. Trees struck by lightning can have deep gashes running the length of the bole, burn marks, or patches where the bark has exploded away from the trunk (Fig 5).

Wind

Violent downdrafts or microbursts and straight-line winds can damage trees by uprooting, bending, and tearing limbs (Fig. 6). The fastest growing trees in a plantation, e.g., walnut, black cherry, and yellow poplar, are usually the most prone to wind damage. Proper site selection and planting of windbreaks or borders can help avoid these problems. Damaged limbs should be promptly and properly removed (see pruning). Young trees that are bent can be straightened by tying them upright to stakes or neighboring trees. Remove or suppress limbs by pruning on the downwind side of a bent tree to encourage growth on the upwind side; that will restore balance to the tree. For more information on how to suppress or subordinate a limb, refer to FNR-215.

Strong winds can also cause wind shake, an often hidden form of injury that robs a tree of its value for timber. Wind shake is a separation or crack in the wood of a tree caused by high winds; it can be thought of as a stress fracture of the wood. Wind shake can be deep in a tree and hidden until it is revealed at harvest. Sometimes windshake symptoms are present as paired seams on opposite sides of a stem. Trees with wind shake should be removed during thinning. Wind shake can be reduced by avoiding exposed areas during site selection and by retaining edge or border trees to slow the wind.

Figure 7. *Mechanical injury at the base of a walnut tree. The injury has been closed, but the wood beneath will be darkly stained. For comparison, the white pen is about six inches long.*

Pruning Injury

Improper pruning can lead to several types of injury that ultimately lead to a tree being worthless for timber. Stripped bark, exposed stubs, or flush cuts can easily lead to the introduction of organisms that stain and cause wood rot. Avoid heavy pruning during the period of most active growth in the spring and early summer, because the bark is particularly tender and sensitive to injury at this time. For instructions on proper pruning techniques, consult FNR-215 or other tree pruning publications.

Tractor Blight

This is a common name for any type of mechanical injury that removes or punctures the bark of a tree. Injury of this type is often seen on the buttress of trees and is typically the result of careless operation of heavy machinery such as mowers, tractors, and the equipment associated with logging (Fig. 7). Young trees with thin bark are also susceptible, although young trees can recover completely if the injury is not repeated and no pests or diseases are introduced.

Tree-fall Injury

Nearby trees can be injured when trees or large limbs fall, either as a result of natural processes or human activities such as logging, thinning, and timber stand improvement. The immediate symptoms of this type of injury include stripped bark, broken limbs, and forking. Over the long-term, injury of this type often results in the introduction of pests and diseases such as heart rots that rob a tree of its value for timber. Prevention is the key to avoiding this type of loss. Special care should be taken to minimize the impact of management activities on the health of trees that are “innocent bystanders.”

Drought

Drought during the growing season, even for a few weeks, can set back the growth of young trees. Older, established trees are usually not permanently damaged by brief dry spells, but prolonged rain deficit (over many months or years) will reduce growth and endanger the health of the trees. Soil water-holding capacity, drainage, weed competition, leaf area, wind speed, humidity, and temperature will all interact to affect the severity of a drought. Leaves of trees stressed by drought may appear wilted, small, and yellowed or burned at the margins (Fig. 8). The shoots of young drought-stressed trees may grow only a few inches the entire summer. On the other hand, roots may grow significantly during droughts if the trees were planted early enough and soil moisture has not been significantly depleted. Drought-stressed trees are more susceptible to insects, disease, and further injury. If drought occurs late in the summer and persists through the fall, the potential for winter injury of young trees will increase.

Figure 8. *Typical symptoms of drought injury.*

The most obvious but often the least practical method to avoid drought stress is to water young trees. In the absence of an irrigation system, young trees can be watered by hand from a pickup truck or tractor equipped with a large water tank and hose. This type of watering is effective, but several gallons of water per tree must be applied to fully saturate the root zone. Sloped fields and a crusted soil surface make watering of trees difficult. Drought-stressed trees often take weeks to recover after watering. Other cultural methods that can minimize drought stress include planting trees as early as possible to establish new roots prior to drought, early season weed control, and mulching.

Unexplained Seedling Injury

In any given year, environmental conditions may produce seedling injury that currently can not be explained. The event may take place for a number of consecutive years and then not occur again for some time. White ash exhibits developmental problems that might be mistaken for herbicide injury, even though no herbicide has been applied and non-target drift was not an issue. In situations such as these, trees usually recover the following year.

Literature Cited

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Samtani, J. B., Masiunas, J. B., and Appleby, J. E. 2005. Abnormal leaf development on white oaks linked to drift of chloroacetamide herbicides. Online. Plant Health Progress doi:10.1094/PHP-2005-0221-01-HN.

For additional information, consult the following web sites:

http://www.extension.uiuc.edu/mg/oaktatters.htm

http://www.na.fs.fed.us/spfo/pubs/howtos/ht_non/non_all.htm

http://www1.br.cc.va.us/murray/Arboriculture/trunk_disorders.htm

http://www.extension.umn.edu/projects/yardandgarden/ygbriefs/P466winterinjury.html

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