



LAKE STATES WOODLANDS

Plantation Establishment Series: Maintenance



Leigh Klein, Jane Cummings-Carlson and A.J. Martin

This is the final bulletin in a three-part series on plantation establishment covering planning, planting and maintenance. Although these three topics are in separate bulletins, they are not separate concerns in plantation management. Before you order your first seedling, evaluate your planning, planting and maintenance needs.

This publication addresses common problems in young plantations and suggests ways of managing them. These problems are vegetative competition, animal damage, insects, diseases, fire, and weather and environmental injury. Weather and environmental damage, such as frost pockets, differ from the others because they cannot be controlled. Consequently, it is especially vital to consider these risks in the planning stages. We include them in this fact sheet because being able to distinguish between weather injury and other types of injury will help you decide when to use control measures and when not to.

This bulletin is also designed to help you 1) develop skills to assess plantation survival, 2) identify types of damage you may see in your plantation and 3) identify control options.

Because each plantation is unique, no publication can cover every situation. Your local forester is always available to answer your questions. Also, your county extension agent, co-op representative and local herbicide or pesticide dealers will have expertise in many areas of maintenance.

Evaluating Survival

The primary reason for evaluating seedling survival is to assess whether you will need to replant seedlings to ensure that you meet your management goals. The evaluation process enables you to observe signs of animal, insect or disease problems needing management. It will also help you evaluate the need for additional control of competing grass, brush and unwanted tree growth. If seedling survival is low or uneven, your observations will help identify possible reasons and they will help you estimate the number of replacement seedlings you need.

There are two simple methods for estimating seedling survival percentage: the "circular plot" and the "row" method. Both consist of taking a series of samples throughout your stand and basing your estimates on the proportion of live trees found compared to the total number of trees planted. For both methods, sample at least 10 different plots and average the survival percentages of each plot or row to make an estimate for the whole plantation. Survival counts are usually done 4-5 months after planting, and again after the third year. Your local forester will be able to tell you whether or not your survival rate leaves a tree density that will meet your original planting objectives.

Circular Plot

The best size for a circular plot is 1/100 of an acre. This is not only a manageable size, but it makes it easy to calculate the total number of trees in your plantation. (For example, if you have 8 trees in your 1/100 acre plot, then you have 8 x 100, or 800 trees/acre in your plantation.) To estimate survival using this technique, you need a stake and an 11' 10" rope. This measurement is the radius of a 1/100 acre circle. Choose your first plot randomly, plant the stake, stretch out the rope and walk in a complete circle around the stake (Figure 1). Count the live and dead trees that fall into this circle. If more than one tree falls on the border of the circle, count every other border tree. To calculate the survival percentage, divide the number of live trees by the total number that fell into the circle. Sample throughout your plantation, or at least every 100 feet, and average the survival from each circle to get the survival of the whole plantation. To calculate the average, add survival percentages from each plot and divide by the number of samples taken.

$$\text{Survival Percentage} = (\text{Live Trees} \div \text{Total Trees}) \times 100$$

Another way to estimate survival is to count only the number of live trees that fall in your circle. Calculate the average number of live trees per acre and compare it to the number originally planted per acre to get your survival percentage. This is a useful alternative when dead trees are missing or difficult to find.

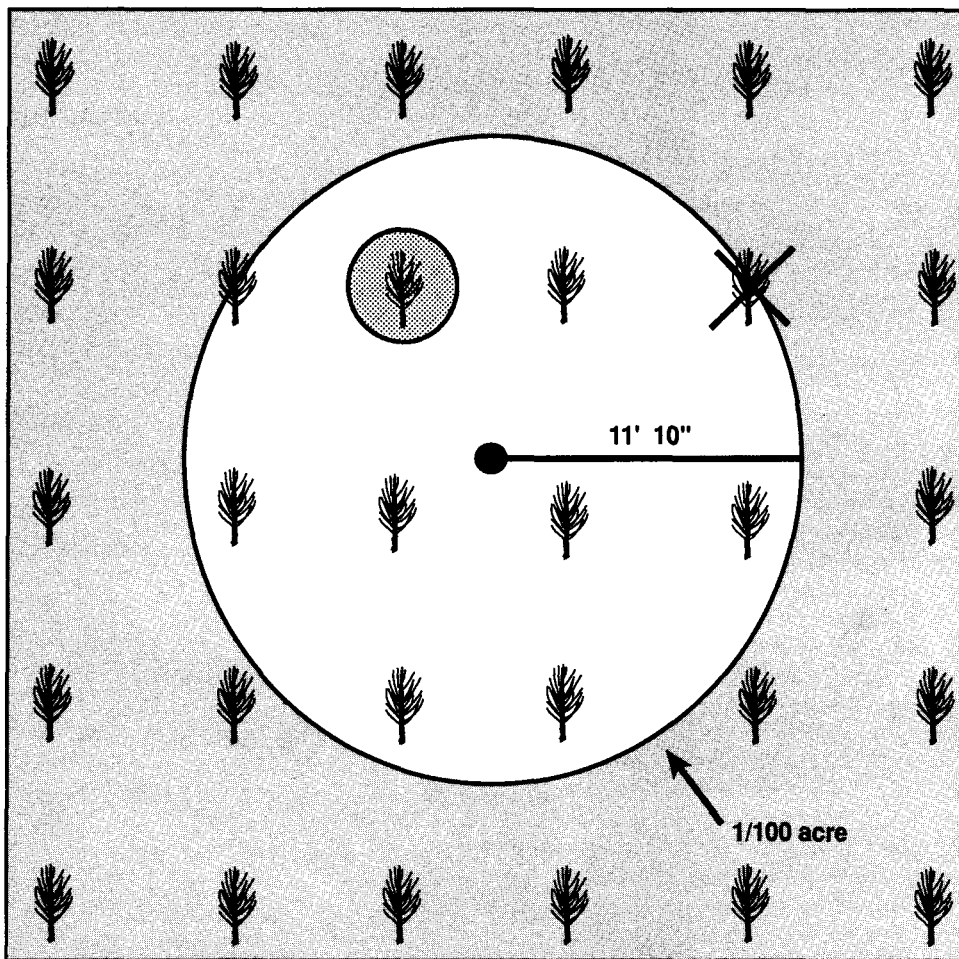




Figure 1. The “circular plot” technique for determining seedling survival. Stake an 11'10" rope into the ground. Walk around the circle and count every live and dead tree that falls within the circle. For trees that fall on the border of the circle, count only every other tree. To calculate the survival percentage, divide the number of live trees by the total. Sample at least 10 plots and average the percentages. For example, in the plot pictured,

Total dead trees = 1
 Total live trees = 8
 Total trees counted = 9
 Survival % for this sample =
 (Total live trees/Total trees counted) x 100 = 8/9 x 100 = 89%

	Dead seedling
	Border seedling #2 (not counted)

Row Method

Using the row method, count the total number of trees and the number of live trees as you walk down a row. If your row is particularly long, pace out a 100 ft section and count both live and dead trees along that strip. Repeat this procedure along at least 10 rows randomly chosen throughout the plantation. Average the survival from all rows to estimate survival in the whole plantation.

Controlling Competing Vegetation

All vegetation growing in the same soil and air space competes for sunlight, water and nutrients. In plantations where weeds and seedlings grow together, the “losing competitor” will be the tree seedling, since weeds and grasses grow faster. Competition is one of the most common reasons for poor seedling development. To help your seedlings grow well, plan on controlling vegetation both before and after planting (see “Site Preparation” in G3481, *Plantation Establishment Series: Planting*).

Good site preparation will give your trees a critical period of non-competitive growth. However, you will need to continue surveying and controlling competition until the seedlings are the dominant vegetation on the site. This will last at least several years but may continue 7 or 8 years with slow growing seedlings and/or poor sites.

Though not the only alternative, herbicide application is the most commonly used control measure. This is because herbicides kill the entire plant, root and stem, and control is not labor intensive. Contact your forester or local herbicide dealer for names and application rates of appropriate chemicals.

You can also use mechanical means such as mowing, clipping and uprooting to control vegetation (especially on small plantations). Be aware that good control using mechanical cultivation requires extra vigilance and time because it does not eliminate the roots so the vegetation will continue to resprout.

Limiting Animal Damage

Anything that attracts wildlife to your land will increase the potential for wildlife damage to your seedlings. For this reason, when you're planning to attract wildlife it is important to remember that seedlings are less resilient than older trees (see G3480, *Plantation Establishment Series: Planning*). To control browsing, you may need to discourage wildlife for the first few years. By temporarily discouraging wildlife, you will give your seedlings a chance to establish themselves and you will preserve your long-term management options.

Many animals find young plantations irresistible because the seedlings are succulent and accessible. Invariably, some damage will occur. You should aim to control the amount of

damage, rather than to eliminate it completely. Also, low levels of some animals can be advantageous, For example, low populations of some mice may help a plantation by spreading a beneficial root fungus.

There are two approaches to limiting animal damage in a plantation: prevention and containment. Prevention, when possible, is done by manipulating the environment to discourage animal invasion. This is best done in the planning and plantation design phase of establishing a plantation. However, once you've found animal damage in your plantation, you will need to treat and contain the damage. Temporary techniques can control further damage.

What to Look For

Animals can damage trees in several ways. In Wisconsin, deer and rodents (mice, voles, rabbits, gophers, porcupines) typically cause most of the damage. Being able to identify the types of damage will help your forester assist you in choosing the correct control. The types are described below.

Clipping leaves smooth, diagonal cuts on woody shoots (Figure 2) and is usually caused by rodents. Because clipping is very damaging to young seedlings, carefully monitor your plantation for several years. Clipping may occur on roots, stems, terminal and/or lateral shoots.

Browsing injuries are more torn and irregular than clipping, and result from deer or larger animals feeding on the succulent new foliage or buds (Figure 3).

Barking is when the bark of trees is either stripped or gnawed off (Figure 4). Gnawing is the most frequent damage and is caused by a number of common rodents.

Pulling, trampling, rubbing are three types of "big game" and livestock injuries. In areas of high deer population, rubbing can be a serious problem in the fall. Otherwise, they are not common injuries in Wisconsin unless livestock are allowed access to new plantations.

Managing Deer Browse

Due to the physiology and growth habits of conifers, browsing at any time of the year will damage conifer seedlings. Consequently, with a conifer or mixed species plantation it is vital that your plantation design includes ways of discouraging deer during the first few years.

For hardwoods, browsing during the growing season will damage seedlings. Browsing is extensive when the shoots are green and succulent. Usually browsing does not directly kill trees; rather, repeated browsing during the growing season means seedlings will take longer to get established, will be less competitive for nutrients and water and will have poor growth form.

In contrast, "dormant season" browsing on hardwoods causes significantly less damage to the trees. With the shoots being less palatable during the winter, deer normally feed on less than 25 percent of the current year's shoot growth. Further, if the terminal bud is browsed during the winter, the lateral buds will take over and replace the terminal during the following season, allowing form to correct itself as trees mature.

These differences become important when planning control options. If your hardwood plantation is on a winter feeding path only, you may need to implement fewer controls than if it is browsed in summer.

Deer Control Options

Planting alternative food. One successful control option is planting or managing alternative, preferred browse species. Providing preferred vegetation such as wildlife shrubs will draw the deer away from your seedlings and toward the intended food. This is a good technique if you are in a low deer population area to begin with, and if you remove other less palatable growth. By making your seed-

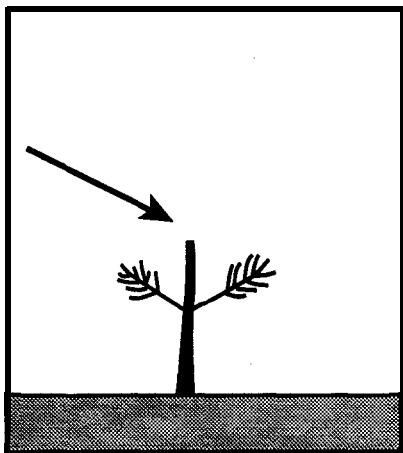


Figure 2. Typical rodent damage on stem. This smooth cut is known as "clipping." Minimize damage by keeping grasses mowed between rows and around trees.

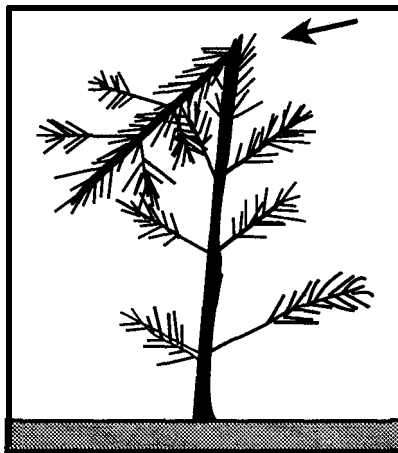


Figure 3. Typical deer damage. "Browsing" damages the buds and upper levels of foliage. On conifers, browsing at any time of the year will hurt the seedling. On hardwoods, browsing is primarily a problem only during the growing season.

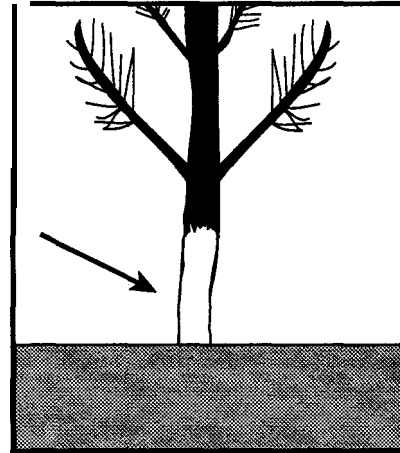


Figure 4. Rodent damage to the bark and stem. "Barking" is where the bark is stripped or gnawed off. Porcupines, voles, rabbits and gophers typically cause most of the damage.

lings the “most unpalatable” vegetation around, browsing will be minimal.

However, in areas with potentially large deer populations, providing food may only help increase the population. Your efforts to protect your seedlings one year may increase the potential damage in subsequent years. When large populations are a problem, you may wish to minimize plantation edge and other preferred deer habitats until the seedlings are safely established and growing well. Later, you could actively and safely encourage wildlife in your plantation. See *Plantation Establishment Series: Planning* (G3480) for more information.

Browse protectors. In small or high-value plantations “browse protectors” have been used successfully to protect seedlings. These come in different forms and sizes and all work by putting a barrier between the seedling and hungry deer. Some fit just over the growing bud, some resemble personalized “cages” for the seedlings (Figure 5). No matter what form of browse protector you use, the important thing is to make sure that the protector stays intact and in place. Properly staked browse protectors may limit browsing by 50- 90% per year.

Repellents. Another temporary control uses objects or scents which deer find repellant. For example, perfumed soap hung from branches, human hair clippings and some sprays are all said to be effective temporary repellents.

Controlling Rodent Damage

High grasses and forbes are an ideal environment for most rodents because they provide both excellent shelter and food. Logically, then, by keeping grasses mowed (or controlled with herbicides) between rows, and clear around trees, you will limit these rodents’ access to your seedlings. For rabbits a simple control measure is to eliminate their primary shelter—hedgerows and brush piles. Because these animals rarely venture far from their shelter, you can reduce damage by eliminating shelters within your stand.

While trapping can be effective, rodenticides and repellents should only be used as a last resort, when other techniques have proven ineffective. Baits are hazardous because of their effect on non-target animals. Remember, you can’t eliminate the animals entirely. The best you can do is minimize damage.

An often overlooked approach to reducing rodent damage is to encourage the presence of their predators on your land. Foxes, coyotes, owls and hawks will all provide good population control of rodents if their den and nesting sites are undisturbed.

Recognizing Insect and Disease Problems

Insects and diseases are present throughout the life of all trees. Whether or not their presence is considered harmful depends on how you intend to use the trees, as well as on the specific pest. This section cannot describe all of the pest

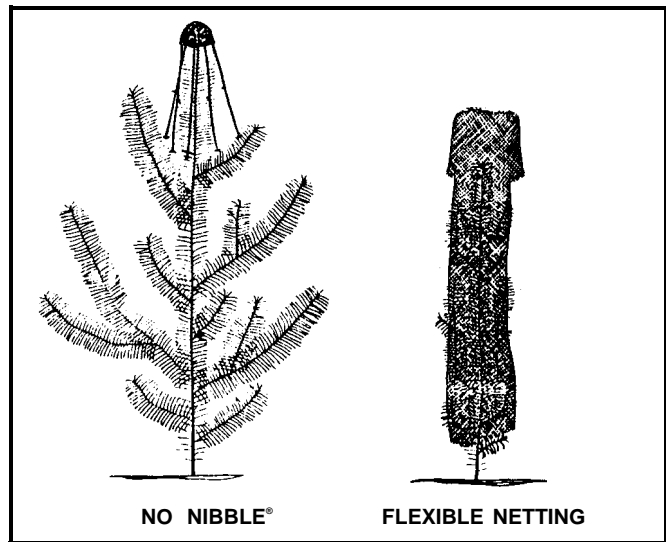


Figure 5. Browse protectors fit over either the terminal bud or the whole seedling and limit deer’s access to the foliage. Two kinds are illustrated here.

problems you may encounter as a forest manager. Instead, Table 1 lists what to consider when evaluating damage and may help you narrow down insects and diseases. Get a positive identification before applying any control measures. Learning what clues to look for is often more important than learning all the different species. Also, identification can be complicated by the fact that, once weakened, trees are very susceptible to further attacks. Thus, two or more problems are frequently found on injured trees. For more details on pest problems, see *Plantation Establishment Series: Planning* (G3480) as well as the list of publications on page 7 for help identifying common tree diseases and insects.

What to Look For

Insects. Insects causing damage on trees fall into three broad categories — *defoliators* which eat the leaves or needles, *shoot borers* which eat into and reproduce in the shoot, and *stem girdlers* which feed on the stems and branches. Because defoliators are easily visible caterpillars they are the most obvious of the insects. Borers and stem feeders tend to be small and are often hidden against or inside the tree.

Diseases. Disease problems fall into three main categories— *root rots*, *cankers and rusts*, and *foliage diseases*. While some symptoms are similar between these causal agents, the identification guidelines provided below should give you a starting point for recognizing problems.

Root rots: Infected trees usually have slow twig and leader growth along with a yellowing crown. Yellowing may be especially obvious in the leader. Changes in wood color and texture as well as mushrooms growing around the base or stem of an infected tree may help confirm the presence of root rot. Because root rots usually spread by direct contact between roots, these diseases often occur in recognizable infection pockets.

Table 1. A basic guide for evaluating disease and insect damage common to seedlings. This table can aid you in looking for signs and narrowing down possible culprits. Consult your forester for positive identification before treating the problem.

Type of Damage	Tree Species	Signs	Area Found	Season	Pest Name	Control
Defoliation (insect)	Jack Pine and Red Pine	Needles eaten, hairy caterpillars.	Far northwest WI and northeast MN.	Spring	Pine tussock moth	Options vary; talk to forester.
Shoot damage (fungus)	Red Pine	Dead, drooping needles.	Northern areas of WI, MN, and MI.	Symptoms occur all year, but first appear in spring.	Red pine shoot blight	Harvest infected tree.
		Dead shoots and branches, pitchy canker on stem.	Regionwide		Diplodia shoot blight	Do not prune in wet weather.
		Dead shoots and branches, cankers may appear on stem.	Northern areas of WI, MN, and MI.		Scleroderris canker	Do not plant in frost pockets.
Shoot damage (shoot borer)	White Pine	Top branches brown or dead.	Highest hazard in northern WI, MN, and MI.	Seen all year, but begins in spring.	White pine weevil	Options vary; talk to forester.
	Red Pine	Dead, hollow shoot tips, foliage loss.	Southeast areas of WI, southern MN, and lower peninsula of MI.	Seen all year, but begins in spring.	European shoot moth	Prune branches growing below snow line.
	Jack Pine	Brown shoots or entire branches dead.	Regionwide, especially where Jack and Scotch pine occur together.	Summer	Pine root tip weevil	None
Root or root collar feeder	Red Pine	Resinous trunk wounds at or below ground.	Statewide for WI, northeast MN, and northern portion of MI's lower peninsula.	Summer	Pine root collar weevil	Not practical.
	White Pine	Dead or dying trees near large ant mounds.	Regionwide	All year	Mound ant	Accept loss or treat with insecticide.
Root rot (fungus)	Red Pine	Sheets of white fungus under bark at root collar; fall mushrooms.	Regionwide	All year	Armillaria root rot	Not practical.
Rust (fungus)	Jack Pine	Swellings on branches and stems.	Statewide for WI, northern MN, and MI.	All year	Pine gall rust	Not practical.
	White Pine	Dead branches, pitchy cankers on branches and stems.	Severity decreases in south, see regionwide map.	All year	White pine blister rust	Prune cankered branches, accept some loss.
Stem and branch feeder	White Pine	Dead branches and bark injuries covered with white resin.	Regionwide	Spring to fall	Pales weevil	Not practical.

continued on next page

Table 1 (continued). A basic guide for evaluating disease and insect damage common to seedlings. This table can aid you in looking for signs and narrowing down possible culprits. Consult your forester for positive identification before treating the problem.

Type of Damage	Tree Species	Signs	Area Found	Season	Pest Name	Control
Insect defoliator	Walnut	Hairy caterpillar.	Throughout walnut range.	Late summer	Walnut caterpillar	Clip off infected twigs, destroy or spray as recommended.
		Web enclosing branches, hairy caterpillar.	Throughout walnut range.	Mid to late summer	Fall webworm	Remove webs, spray with chemical insecticide.
	Oaks	Leaves rolled, tied or eaten.	Varies with each insect.	Spring	Cankerworm, oak leaf roller, leaf tier, tent caterpillar, and others	Maintain stocking, reduce competition, accept loss.
		Eaten, skeletonized hole-ridden leaves.	Varies with each insect.	Late summer	Skeletonize, red-himped-oakworm, orangestriped oakworm, and others	Not practical and usually unnecessary.
Discolored leaves	Walnut	Dark spots and yellowing on leaves, leaf drop.	Throughout walnut range.	June through August	Anthraco-nose and Myco-sphaerella leaf spot	Maintain good soil fertility, treat with fungicide only if severe.
	Oaks	Yellow foliage.	Regionwide	Summer	Iron chlorosis	Avoid sites with high pH, rarely serious enough to treat.
		Dark spots on leaves.	Regionwide	Late May to early July	Anthraco-nose fungal leaf spot	Control not practical or necessary.
Bud and shoot destruction	Walnut	Webbing and frass (insect droppings) at base of buds and shoots.	Throughout walnut range.	Early to mid-summer	Case bearer insects	Corrective pruning, spray insecticide just before bud break.
Stem canker	Walnut	Canker or scarred area on main stem.	Throughout walnut range.	All year	Fungal stem canker	Cut and remove infected material.

Cankers and stern rusts: While these diseases usually cause dieback, the most reliable sign of a canker or rust is the presence of a swelling and/or lesion on stems and branches.

Foliage diseases: Foliage diseases on conifers, such as needle casts, cause mottled spots to appear on the affected needles. Other diseases cause needle browning. On hardwoods, leaves can spot, curl or become discolored.

Recognizing Weather and Environmental Injury

Drought. Young seedlings are particularly susceptible to drought damage because they lack reserves which would let them withstand moderate drought. Trees require water for all their growth processes. Without water, trees cannot function. Typical signs of drought damage (moisture stress) are wilting and yellowed or brown leaf/needle tips. One way to tell drought damage from insect or disease damage is that it is likely to affect most of your seedlings. Check the soil moisture. If it's dry to the depth of the roots, your seedlings are at risk of permanent damage. Recovery is possible if the seedlings get adequate water before the roots are extensively damaged. In some cases, seedlings recover but are weakened and more susceptible to infection by disease or insects.

Frost damage. Frost damage causes foliage to curl and die rapidly. It occurs most frequently in depressions in the landscape or at the base of hills where cold air settles. If seedlings are only marginally hardy for your area, a particularly early or late frost may cause damage to all the seedlings. While frost damage is rarely the sole cause of seedling death, it will slow seedling growth and predispose it to infection from insects and disease.

Winter injury. Occasionally, dry winter winds will cause conifer seedlings to turn red with the first warm days of spring. This may occur in pockets that are particularly windy or, if the winds are severe enough, over the whole plantation.

Herbicide damage. Some herbicides can damage conifers if they're applied during the wrong season or at improper application rates. Herbicide damage usually includes yellowed needles and distorted growth of the needles or leaders. Further, it will probably affect the entire sprayed area.

Pollutant damage. This broad category of problems covers everything from ozone damage to road salt. With the exception of salt damage to trees near paved roads, most sources are not only hard to identify but symptoms are similar to many diseases. Consult your forester or county agent if you suspect pollutant-caused injury.

Reducing Fire Risk

You can't predict when wildfires will strike or how severe they will be. However, severity of damage depends on weather factors (humidity, wind speed, etc.), as well as the amount and relative dryness of fuel. Since you cannot control the weather or the fuel dryness, your only option for prevention

lies in reducing the amount of fuel. Keep your plantation clear of debris and make sure that a ready supply of water is available in case a fire does break out.

While you may not be able to prevent a fire from starting, you can do much to prevent the spread of a fire. Your biggest insurance against ground fires spreading throughout your plantation is to maintain fire breaks and disked, weed-free access roads. Fire breaks and cleared roads serve two functions. First, because of the lack of fuel, fires are less likely to jump the disked strip and spread throughout your woodland. Second, fire trucks and fire crews will be able to quickly reach and contain the burning section of your plantation. Disk or plow fire breaks annually and keep them 15 to 20 feet wide. On highly erodible lands, your forester may suggest planting a legume crop on the fire break instead of disking it.

If practical, place barrels of water throughout the plantation. This will help ensure that water is always available for fire fighting. Adding a small amount of detergent quenches fires well.

Final Word

Your ability to distinguish frost damage from root rot, canker damage from needle casts, and deer browse from rodent injury will make you an educated partner in your plantation's care. This knowledge will help you work with your forester to develop a successful maintenance plan for your plantation.

Knowing what problems you might expect can give you great power to keep these problems under control. Vigilance and care will give you a fast growing, healthy plantation and help you realize your management goals.

Further Reading

A Guide To Common Insects and Diseases of Forest Trees in the Northeastern United States. Forest Insect and Disease Management NA-FR-4. 1979. U.S.D.A. Forest Service, Northeastern Area. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Wisconsin Woodlands: Identifying and Managing Pine Pests in Wisconsin, by Heather Goulding, David Hall, Kenneth Raffa and A. Jeff Martin. 1988. University of Wisconsin-Extension Publication G3428. Agricultural Bulletin, Rm 245, 30 N. Murray St., Madison, WI 53715.

A Guide to Insect Injury of Conifers in the Lake States. U.S.D.A. Forest Service. Agriculture Handbook No. 501. 1977. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Oak Pests: A Guide to Major Insects, Diseases, Air Pollution and Chemical Injury. U.S.D.A. Forest Service Southern Region. Protection Report R8-PR7. 1987. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Main Steps in Maintaining Your Plantation

1. Check your plantation's survival percentage. Estimating survival allows you to identify problems and find appropriate solutions.
 - Use consistent sample area (circle or row).
 - Count the number of live and dead trees in each sample area.
 - Divide live trees by total trees for each sample.
 - Average at least 10 samples to estimate plantation survival percentage.
 - Talk to your forester—they may recommend replanting if survival is low and below your planned tree density.
2. Vigilantly control competing vegetation. Control weeds and grasses to maximize seedling growth and minimize rodent damage.
3. Limit animal damage. The extent of injuries will indicate the degree of control needed.
 - Clean cuts on the stem are usually from rodents.
 - Ragged cuts to the leaders or buds are usually from deer.
 - Bark damage is usually from rodents.
 - Trampling or pulling is usually from livestock or big game.
4. Watch for signs of disease or insect infestation; contact your forester for advice.
 - Look for yellowed, brown, mottled or withered shoot tips, needles or leaves.
 - Look for mushrooms around base of seedlings.
 - Look for localized swelling or lesions on the stem or branches.
 - Frost and drought damage may have symptoms similar to other problems; evaluate carefully.
5. Keep fire breaks clear of brush and obstructions; make sure water is available for fire control.

Authors: Leigh Klein was a forestry outreach specialist with the Department of Forestry, University of Wisconsin-Madison. A.J. Martin is a professor of forestry with the College of Agricultural and Life Sciences, University of Wisconsin-Madison and the University of Wisconsin-Extension, Cooperative Extension. Jane Cummings Carlson is a forest pathologist with the Wisconsin Department of Natural Resources, Bureau of Forestry.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Wisconsin-Extension, Cooperative Extension. University of Wisconsin-Extension provides equal opportunities in employment and programming, including Title IX and ADA requirements. If you need this information in an alternative format, contact the UWEX Affirmative Action Office or call Extension Publications at (608)262-2655.

This publication is available from your Wisconsin county Extension office or from Cooperative Extension Publications, Rm. 245, 30 N. Murray St., Madison, WI 53715. Phone: (608)262-3346.