Timber Stand Improvement

What is TSI?

There are circumstances when a forested area can be improved upon by doing more than just allowing the trees to grow. One such circumstance would be if an area had a timber harvest in which only the most desirable mature trees were taken out and mostly inferior trees—lower value species, or damaged or diseased trees—were left to occupy the forest canopy (a practice called "high grading"). Another case would be where a very dense stand of young trees needed to be thinned in order to optimize tree health and production of fruits and timber. In situations like these, timber stand improvement (TSI) can be applied to make the most of the species and number of trees present for wildlife and timber production. TSI involves actively managing a stand of trees to improve its species composition, structure, health, and growth.

In many cases TSI involves cutting down or deadening trees that are considered to be of poorer species or quality to improve the growing conditions for the remaining trees. Thus the term TSI is applied to "crop tree release" or "thinning" (Figure 1) operations, because some trees in an existing stand are removed or thinned out to favor selected trees ("crop trees") that should yield increased fruit or timber as a result of the improvement work. For the purposes of this article, we will refer to TSI primarily in terms of thinning and crop tree release operations.

Benefits of TSI

One benefit that can be obtained through TSI is increased acorn production. This is valuable to species that rely heavily on acorns during fall and winter like white-tailed deer, wild turkeys, squirrels, blue jays, and eastern chipmunks to name a few. Whereas trees in a dense stand tend to put most of their energy into vertical growth to obtain sunlight, trees that have been released from intense competition through TSI put more of their energy into crown growth. Increased crown growth in turn yields increased fruit production. TSI can

Figure 1. Comparison of a forest managed with timber stand improvement (bottom) to an unmanaged forest (top). Note the larger tree sizes and better developed understory in the managed woodland.

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Acorns are eaten by dozens of different wildlife species, ranging from white-tailed deer and wild turkeys, to eastern chipmunks and deer mice, to bluejays and northern bobwhite quail.

also reduce the time needed for crop trees to reach maturity and optimal fruit production; sapling and pole-sized trees that have more freedom to grow produce much sooner than crowded trees. Another benefit of TSI is increased timber production. With more sunlight, nutrients, and moisture going to fewer trees after TSI, released trees can put on more diameter—meaning increased timber volume, quality, and potential revenue for the landowner. Other benefits of TSI include the option of using culled trees for firewood, using the culled trees to create snags* or brush piles* for wildlife cover, and putting woody material on the forest floor. The latter benefits a number of wildlife species, such as ruffed grouse (that use downed logs to attract mates from), white-footed mice and eastern cottontails (that may hide under logs or treetops), and pileated woodpeckers (that feed on termites and grubs in decaying logs).

Tree Selection

Trees to be enhanced through TSI must be existing or future canopy trees. Crown level is where the most intense competition for sunlight is, so trees that are competing in the forest canopy should be examined for possible thinning. Understory trees should not normally be removed. A forest's understory provides structural diversity and food for wildlife, plus it retains moisture and nutrients that benefit overstory trees.

In terms of numbers of trees, generally a spacing of 20-25 feet between crop trees is optimal, with no substantial competition between them at crown level. Trees should have growing room at crown level on at least three sides so their crowns can develop more fully.

Oaks, ashes, and yellow poplar are tree species that are often managed for in TSI operations. These species are valuable for both wildlife and timber production. When TSI thinning is done, some individuals of other tree species are cut down or killed in place to release healthy and more valuable specimens. Species that are often culled out to some extent in thinning operations because of their competitiveness are maples and beech. The reason these species become dominant is that they are shade tolerant; that is, they grow in the shady understory, awaiting harvests or other disturbances to remove the historically dominant canopy trees (oaks, ashes and yellow poplar in much of Kentucky). The shade tolerant species' growth as understory trees gives them a decided height advantage over new seedlings that may spring up when the canopy is finally removed. At that time, the shade tolerant trees begin to form a new canopy, blocking the sunlight that the shade intolerant oak and ash seedlings need to grow. Without a thinning operation in such situations, desirable seedlings may never make it to fruiting age. However, even in stands where non-crop species are overabundant, they should never be completely eliminated from a stand. Also, healthy and well-formed specimens of any species should normally be left in the stand.

There are limitations on the effectiveness of thinning. Usually, trees must be relatively young to benefit from thinning. Trees that are 10-30 years old will often grow taller, produce greater crowns, and yield more fruit as a result of being released from competition, but trees that are 50 or more years old may not respond to a thinning. Also, the site and soil types in an area will largely dictate the growth potential of a forest stand. TSI should not be used on poor quality sites because the returns will be minimal.

For the reasons mentioned above, TSI is prescribed on a case-by-case basis. Landowners interested in enhancing a woodland for wildlife through TSI can be guided by a Kentucky Department of Fish and Wildlife Resources (KDFWR) wildlife biologist.

If improvements are to be done specifically with future timber harvesting in mind, a professional forester should be consulted. The best way to gain the most out of a woodland is to have it evaluated by a professional forester. Kentucky Division of Forestry (KDF) foresters can examine woodlands and make management recommendations free of charge or obligation. If a TSI operation is recommended, the forester can specify how it can be implemented, such as marking the inferior trees in a woodland to be culled out. This eliminates the guesswork and makes the job much easier for the landowner. Landowners can then either perform the work themselves or contract with local vendors to do the work. KDF maintains lists of vendors who perform thinning or pruning, tree planting, timber harvesting, and other forestry work. KDF may also be able to refer landowners who need TSI work done to cost-share programs that reimburse a portion of landowners' expenses for pre-approved work. KDF can be reached at their local district offices, or by calling 1-800-866-0555.

Timing of TSI

TSI can be done year round, but some seasons are better than others for getting effective kills on cull trees. Generally, it is best to avoid doing TSI during spring (April to June) when trees are growing most rapidly; they will more likely seal over wounds and flush out herbicides during that period. The hottest part of summer can be a good time to perform TSI, but many landowners prefer to avoid that time of year because of heat, insects, and thick understory vegetation. Fall and winter are when most TSI is completed because of the more comfortable conditions of working outside, and because visibility in the woods is better.

Methods of TSI

Cutting

The two main ways of performing the actual removal of specific cull trees are cutting ("felling") and girdling. Cutting simply involves severing a tree all the way through at or near ground level. Although many trees that are cut will vigorously sprout from a stump or from the roots, this should pose no problem for the crop trees if there is a nearly complete canopy. The sprouts will normally never reach sufficient heights or attain large enough canopies to compete with the trees that are left. For safety reasons, two or more people should work together on TSI operations in the event that one is injured and needs assistance. Also be sure to obtain proper training on safe chain saw operation and felling techniques before attempting to perform TSI yourself.

Girdling

Girdling ("ringing"), on the other hand, involves killing the tree but leaving it standing upright. Girdling is sometimes easier and safer than felling trees—especially large ones. However, this procedure should not be done on hollow trees, as they can unexpectedly fall when girdled. One benefit of girdling done on 6" or larger diameter trees is the creation of snags, or standing dead trees, which are used by a variety of forest wildlife. Girdling with a chainsaw is done by making a 1" deep cut all the way around the tree at about waist height. A second, identical girdle cut approximately 6-12" above the first helps ensure that the cambium tissues beneath the bark are not able to carry the necessary nutrients and water up and down the tree. Be sure that each cut is continuous, making a complete ring around the tree. You should connect the ends of the cuts as necessary (Figure 2), or the wounds may seal over and render your work ineffective. Girdling may also be done

Oaks and ashes, very important trees for wildlife and timber, do not tolerate much shade, and need proper management to persist in our forestlands.

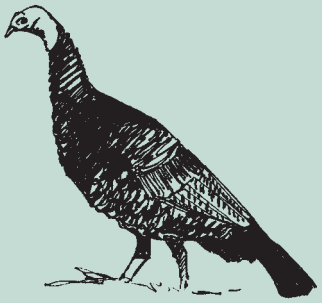
white ash

northern red oak

white oak

Figure 2. Girdle cutting performed with a chainsaw. Be sure to connect your cut so that it completely rings the cull tree's trunk.

Figure 3. Girdle cutting performed with a hatchet.



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with a hatchet, in which cull trees are hacked or frilled all the way around in one or two cuts (Figure 3). Hatchet hacks should be 1-2" deep and continuous all the way around a tree. Hacks can be notch shaped (where downward and horizontal hacks create a V notch and cut out the bark and into the cambium) or frilled (where only successive downward hacks are used to encircle the tree and some of the bark and cambium are left attached at the base of the hack).

Girdling's effectiveness can be greatly increased by the application of a herbicide into the girdle cuts *immediately* (within 30 minutes) after girdling. Apply a woody plant herbicide inside the fresh girdle cuts all the way around culled trees. The herbicide will help kill the cull trees' roots. If TSI is done during the growing season, while leaves are still on the trees, Roundup® or an equivalent herbicide should suffice. Garlon 3A®, Crossbow®, or other woody plant herbicides can be used year round. Tordon is also effective, but may leech out from cull tree roots and kill neighboring yellow poplars. Consult your local KDF district office or farm supply store about specific herbicides, and always follow herbicide label instructions.

Injecting

A less popular, but effective, method of carrying out TSI is to use an injection device. Specially designed jab-poles and injector hatchets release a calibrated dosage of herbicide into a cull tree upon impact. These are used mostly by forestry contractors, but may be feasible for a landowner with a large TSI operation. You can consult your district KDF office regarding other possible methods of killing cull trees.

Other Considerations

Managing Vines and Invasive Plants

Another aspect of TSI is controlling harmful vines. Grape vines provide excellent food and cover for many different kinds of wildlife, including deer, opossums, and a variety of birds. However, they tend to be problematic for some trees on productive sites, particularly for black walnut, cherry, and oaks that are being managed for timber or optimum fruit production. The weight of older grape vines can actually break out branches or entire tree tops, and strongly compete with host trees for sunlight. Thus in crop trees, removal of grape vines by cutting them a few feet above ground is recommended. Grape vines can be identified by their dangling growth form (they are usually attached to trees only at a few points, and mainly in the crown). This is different from Virginia creeper, poison ivy, and other native plant vines that are not problematic because their weight is supported by the trunks of trees (they are attached by many rootlike fingers of tissue), plus they usually do not compete with host trees' crowns. Because of the wildlife values mentioned above, grape vines should be left alone in non-crop trees and cull trees, and other native plant vines should normally be left to grow undisturbed.

Some woodlands have other competition problems, such as an overabundance of Japanese honeysuckle, or the presence of kudzu or bush-honeysuckle. In these cases, intensive manual removal or herbiciding may be needed. Large infestations of kudzu may require a spray truck or aerial application to adequately control the vine.

Retaining Soft Mast and Diversity

When doing TSI, be sure to leave ample soft mast trees. Soft mast (fleshy fruit) producers are important to wildlife year round, especially when their fruits are in season. This is usually not difficult to do, because these trees are normally not dominant trees that you would be thinning out, or they are already very

abundant and thinning some of them will not be detrimental. Species such as dogwoods, sassafras, persimmon, and blackgum are soft mast trees that should be retained as part of a properly managed forest. Some hard mast trees, such as American beech and red maple, are problematic in terms of competition with species most often selected as crop trees. However, some of these trees should also be left in any forest stand because they also contribute to the food and cover value of woodlands.

Creating Snags

Cull trees 6" or more in diameter at breast height should be girdled instead of cut down. Trees of this size will make snags or potentially even den trees if they are hollowed out by a woodpecker. Girdle cuts on cull trees make excellent points of entry for heart rot fungi, which weaken the insides of trees and allow woodpeckers to peck out some of the trees' heartwood to make homes. Many different types of wildlife, ranging from flying squirrels to bats to owls, use hollowed-out den or cavity trees.*

Excluding Livestock

An important part of maintaining or improving the quality of woodlands for both wildlife and timber is keeping livestock out of them by proper fencing*. Cattle, horses, and other livestock graze forest understory plants, damage tree roots, and compact the soil. These harmful effects shorten the life-span of trees, decrease food and cover availability for wildlife, cause erosion, and render many trees virtually useless for timber. Compared to good pasture, livestock gain very little from grazing woodlands. Losses of timber and wildlife value far exceed any benefits of grazing forests. Simply excluding cattle from the majority of forested areas on a farm by fencing can dramatically improve the use of a farm by game and other wildlife species alike. Shade can be provided by allowing livestock to use a narrow strip of trees along portions of a forest edge instead of an entire woodland. Good pasture management* eliminates the perceived need to graze forestlands.

Fire Breaks

An often overlooked dimension of improving timber stands is the creation and maintenance of fire breaks ("fire lanes") to help prevent the potential spread of wildfire. Existing logging roads, access paths, and trails can serve as fire breaks. While cleared strips with widths of 10-15' are ideal, and are most easily maintained, any fire break is better than none. The value of a cleared fire break is greatly enhanced by seeding down a cool-season legume* that will be green most of the year. White Dutch clover is an excellent choice because of its tolerance to shade. It can be established by broadcasting 3 pounds of seed per acre onto bare ground (freshly cleared or disked) during mid February-March, or mid August-September. On steeper areas, mix in Kentucky bluegrass or orchardgrass* (10 pounds of grass seed per acre) with the clover seed. Cover seeded areas lightly with soil if possible by disking or rolling/cultipacking. Overlaying a moderate amount of wheat straw is advisable to improve germination and reduce erosion potential. Liming and fertilizing* per a soil test's recommendations also will improve the productivity of any cover planted on a fire break.

If new fire breaks are created, avoid cutting any crop trees during clearing. Hand clear or bulldoze 10-15' paths along the contour of the land, or gently uphill (instead of straight up and down slopes) to avoid erosion problems. If possible, strive to separate different forest management units or stand types with fire breaks. Also, try to surround your property with fire breaks to minimize the risk of a neighbor's forest fire becoming yours also.

Grape vines should be left in cull trees and non-crop trees to provide food and cover for wildlife.

SUMMARY OF OPTIONS:

Objectives:
- Increase hard mast
- Improve timber
- Cut firewood

Cull Tree Selection:
- Unhealthy/inferior trees
- Undesirable species

Timing:
- Winter, Fall, Summer

Methods:
- Cutting, Girdling

Other Considerations
- Vines
- Soft mast & Diversity
- Snags and Den trees
- Fencing
- Fire Breaks

KDF should be contacted about specific questions regarding fire break construction. Maintain fire breaks by mowing* vegetation to a height of 6-8" annually during March or mid August-September. This timing will avoid disturbance of ground-nesting birds, and the clipping will stimulate lush growth of the cover on the fire breaks.

Management is the Key

Any form of forest management will affect wildlife habitat. It is important to realize that a well managed forest is a productive forest, not only for timber and other wood-based products, but also for wildlife. TSI is one tool available to landowners for properly managing their forestlands to meet their objectives and to enhance wildlife.

Note: Mention of trade names does not constitute an endorsement of specific products. Consult your local farm supply store for availability of equivalent herbicides.

***Related *Habitat How To* references:**

Edge Feathering
Legumes
Soil Amendments
Brush Piles
Snags and Cavity Trees
Fencing
Cool Season Grasses
Forest Regeneration
Grazing and Haying
Mowing

Planning for My Property

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