## Forest Stand Improvement - NRCS Practice Code 666 –

Refer to: Conservation Practice Standard Forest Stand Improvement (Code 666) (usda.gov)

Forest Stand Improvement (FSI), also known as Timber Stand Improvement (TSI), is used to remove undesirable trees and provide resources for the desirable trees that remain following treatment. With these resources (space, light, water, and nutrients) available, the desirable or crop trees survive increase their growth rate and vigor. FSI can also aid in producing more hard-mast (acorns, hickory nuts, walnuts, pecans) that serves as an important food for wildlife**. FSI should not be done until after invasive species are removed**, because extra resources can allow the invasive population to explode. Please see Woody Invasive Brush Management for more info on removing invasive species.

**Target Trees**

Usually, the desirable or crops trees to be left are Oaks, Hickories, and Black Walnuts. These trees have a high timber value, while at the same time provide exceptional wildlife benefit. Crop tree species can vary depending on the goals of the landowner. For example, sugar maples may want to be desired crop trees for syrup production. However, in most circumstances, sugar maples are often targeted to treat because that they provide little wildlife value, and shade out regenerating trees that may be more beneficial to wildlife.

Trees targeted to be removed depends on the landowners goals for the property. Generally, hollow trees or trees with poor form (excessive sweep, crook, forking etc.) are targeted. However, many of these trees can have great wildlife value. For example, a large oak tree with many low branches and pockets of rot may have little to no timber value to a logger, but it can produce many acorns for wildlife forage and the pockets of rot can be excellent shelter for small mammals and birds.

In upland situations, it is a good rule of thumb to start by removing trees that are or can become invasive like Osage orange (hedge), black locust, honey locust, white mulberry, Norway maple, Siberian elm, tree of heaven, and Bradford pear. Next, your mesic tree species should be targeted. These include trees such as eastern hophornbeam, maple species, elm species, hackberry, sassafras, boxelder, and ash species. These species should only be culled when competing directly with crop trees or inhibiting desired regeneration.

Bottomland hardwood forest management is a bit different than upland hardwood forest management because oftentimes mesic species may be your crop trees. Tree diversity is much lower in these scenarios because fewer species can thrive in these seasonally flooded forests. When present, a walnut, pecan, hickory, or oak should still be given priority over silver maple, cottonwood, willow, boxelder, hackberry or ash as a crop tree. Oftentimes, these hard-mast (nut) producers are not present within these landscapes and crop tree selection will based on the form of the less-desired trees. For instance, a healthy silver maple with one straight leader

as a trunk that is competing with another healthy silver maple that is forked should be favored if managing for timber value is a landowner goal.

In general, no more than one third of the trees should be removed from an area in a treatment. If too many are removed at once, there is a risk of wind throw (trees being blown over), epicormic sprouting (branches sprouting on the trunk), and invasive species explosion.

**DO NOT START FSI BEFORE INVASIVE SPECIES ARE REMOVED**

**Treatment Methods**

There are several ways to remove undesirable tree species from your property. These methods may be used in conjunction with each other over time in order to achieve desired results. The treatment types are:

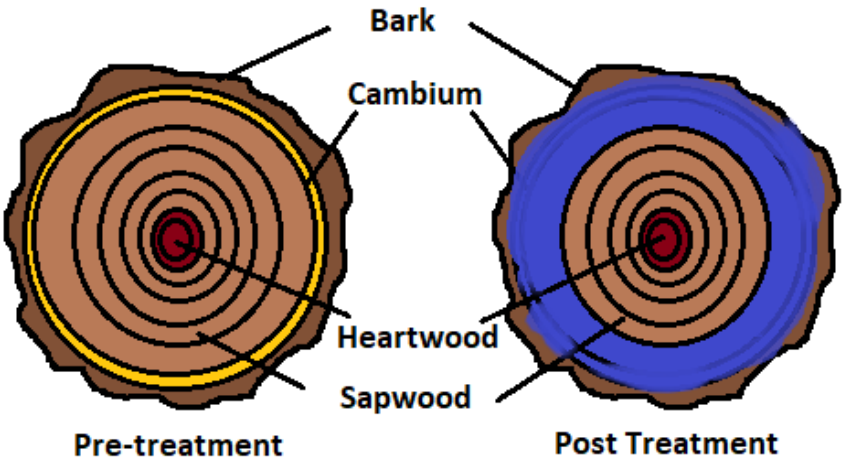
1. Cut Stump Method
2. Girdling
3. Hack and Squirt
4. Basal Bark Spraying
5. Prescribed Burning

Each method has advantages and disadvantages. Cut Stump Method will ensure a higher kill percentage but is labor intensive. Girdling is a cost-effective way to kill trees, but areas must also be chemically treated and checked for re-sprouting. Hack and Squirt is quicker than girdling but has a higher need for retreatment. Basal bark spraying is a cost-effective way to kill trees under 6", but with some species it is hard to get near the stem to spray directly on the bark. Prescribed burning will help reduce non fire tolerant species (i.e. many undesirable trees) but is more effective on smaller diameter trees (<5" in diameter). In truth, the best approach is a combination of many or all of these practices.

**Cut Stump Method**

Cut stump method involves severing the trunk near the ground (within about 6") and applying herbicide to the freshly cut surface. Generally, herbicides used are glyphosate-based or triclopyr-based. Make sure the cut surface is clean (not covered in dirt) and apply herbicide within 10 minutes of cutting. On stems 2" or less in diameter, the entire surface may be treated but only the outer living ring of tissue known as the cambium (outer 1") must be treated. See Figure 1. Adding a dye to your herbicide is highly recommended and will aide in preventing duplicate application and preventing missed treatments. Herbicide can be applied with a spray bottle, sponge, or paint brush. Do not use solutions that are mixed with water when temperatures are below freezing. Do not use this application from February – April when trees are in peak sap flow. Always consult professional herbicide dealers for specifics on herbicides. Follow label instructions and take precautions to not mix or load chemicals near waterways or riparian areas.

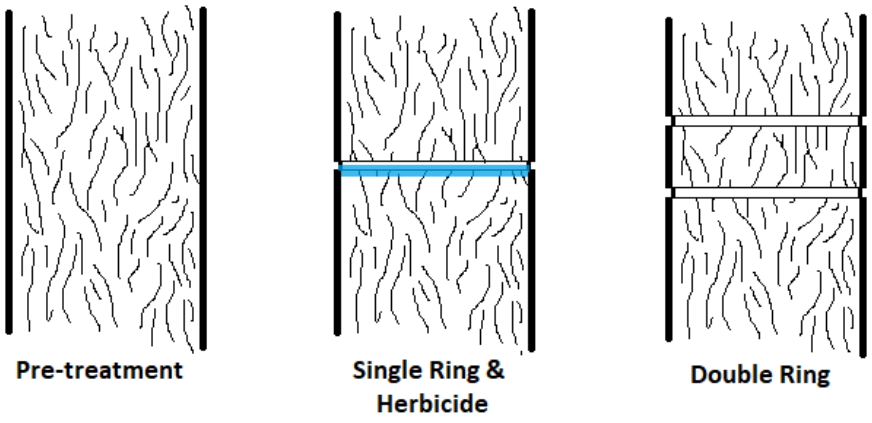
Figure 1. Cut stump treatment diagram.




**Girdling**

Girdling is an effective technique to cull larger trees while keeping them standing for wildlife habitat. Two complete and connecting rings spaced about 3”- 4” apart and 1”- 2” deep (through the cambium) will top kill the target tree. Many hardwood tree species will stump-sprout from this method if herbicide is not used. They can be followed up with a foliar spray or the initial treatment can be one concentric ring with herbicide applied around the entire cut to reduce survival. In some instances, trees may be allowed to stump sprout for wildlife forage. However, most girdling should be followed with herbicide to ensure target tree mortality. Common herbicides used with the girdling technique include glyphosate and triclopyr and dyes are recommended. Do not use this application with herbicide from February – April when trees are in peak sap flow. Always consult professional herbicide dealers for specifics on herbicides. Follow label instructions and take precautions to not mix or load chemicals near waterways or riparian areas.

Figure 2. Girdling treatment diagram.



**Hack and Squirt**

This herbicide application technique consists of applying herbicide to a series of downward angled cuts into the target trees cambium layer. The number of cuts depends on the diameter of the target and herbicide selected. Generally, one cut is needed per every 1”- 2” in diameter. An axe or machete, herbicide with dye, and a spray bottle are the only items needed for this practice making it a very cost-effective treatment. Cuts are generally 2”- 3” wide and should be treated immediately after the cut occurs. Oftentimes, applicators will leave the hatchet in the wound to guide the herbicide into the cut. Be sure not to overfill the cuts as any herbicide not taken up by the tree will just be wasted or can potentially cause off-target harm. Common herbicides used in this practice include glyphosate, dicamba, imazapyr, and triclopyr and dye is recommended to reduce misses and double treatment. Do not use this application with herbicide from February – April when trees are in peak sap flow. Always consult professional herbicide dealers for specifics on herbicides. Follow label instructions and take precautions to not mix or load chemicals near waterways or riparian areas.

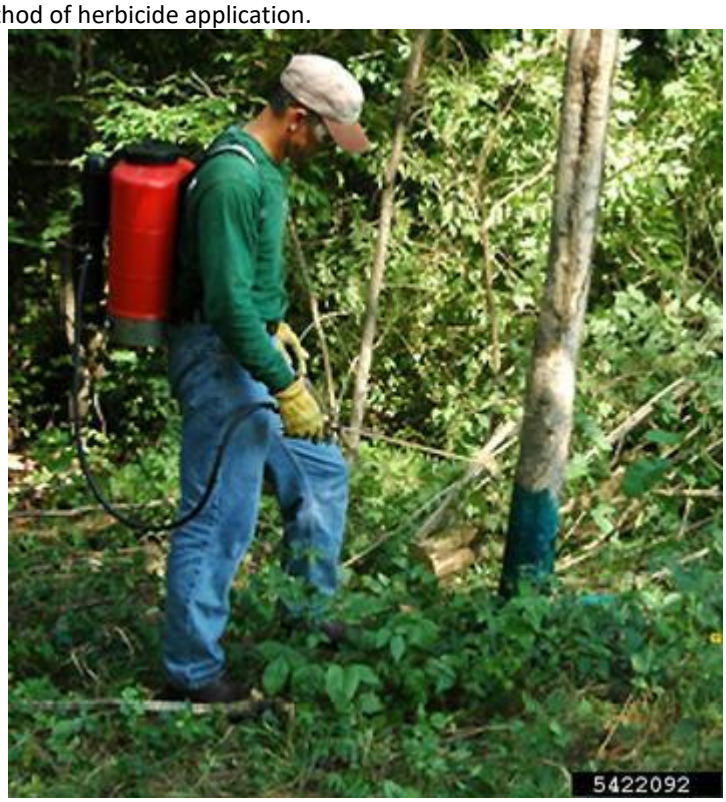
Figure 3. Hack and Squirt herbicide application.


James H. Miller, USDA Forest Service, Bugwood.org.

**Basal Bark Spraying**

This herbicide application technique involves the spraying of the bark at the base of the tree with herbicide usually in basal oil solution. The bottom 15” of the tree should be covered on all sides and if the target species is multi-stemmed all stems should be coated. This is a faster method than cut stump but will require more herbicide. Treatment can be carried out year-round if stems are not covered with ice or snow, but it is most effective in the fall. Ester-based triclopyr mixtures in basal oil are the most suitable herbicides for this application method and dyes are highly recommended to ensure adequate coverage. It is effective on most invasives and undesirable tree species but will produce increased mortality the thinner the target species bark is.

Figure 4. Basal Bark method of herbicide application.

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**Prescribed Burning:**

Prescribed burning is a useful tool in aiding in the reduction of undesirable species. Most undesirables are not fire tolerant like many desirable species are. This technique is especially helpful in reducing small-stemmed targets and is very cost efficient. Prescribed fires are conducted by establishing firebreaks around a pre-determined burn unit and then conducting a burn on the area. It is the landowner's sole responsibility to prepare their property for a prescribed burn. Landowners should consult professionals when planning and implementing prescribed burns. Please see more information on prescribed burning on the prescribed burning and firebreak establishment section.

Figure 5. Rx burn in an upland oak forest aimed at reducing understory American beech.

Josh Nickelson, Illinois Department of Natural Resources.