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Supporting Sustainable Management of Private Woodlands

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Treatment of Single Stems of Undesired Woody Plants

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There are many circumstances and species of woody shrubs, subcanopy, and canopy trees for which treatment of individual stems might be the optimal strategy (Figure 1). These treatments might be mechanical or chemical, but because it is applied to a specific, individual stem the mode of treatment is known as "selective." The alternative is a "broadcast" treatment mode, where all stems within an area are treated. Broadcast treatments are the more efficient option if there are more than approximately 400 stems per acre or if the majority of the stems in an area are of undesired form or species. Broadcast treatments might be infeasible if there is a high proportion of desired stems, if stems are large (e.g., mature trees) or if treatment requires large but unavailable equipment.

In all forest vegetation management situations the project should start with a plan that details the interfering species, the desired plant species, the costs, how the interfering vegetation will be treated, and how the site will be re-vegetated. The word "treatment" is used here to describe the manner in which the vegetation is manipulated, often with the goal of killing the stems causing the interference. The treatment has two attributes – the method and the mode. Method is either mechanical or chemical and mode is either broadcast or selective. Each treatment can be describe by a method and a mode.

Figure 1. The crop tree on the right will grow faster if the poorly formed stem on the left is removed. A variety of individual stem treatments are available to favor the crop tree.

Individual stem treatments, known as selective treatments, involve selecting a specific stem and applying some manipulation to that stem to reduce its ability to function and survive. The goal is to control, or kill, individually selected stems based on species, form or spacing.

The manipulation of the stem disrupts the vascular system, interferes with a physiological function such as photosynthesis, or alters the structure of the plant's growth mechanisms or cell structure. Individual stems can be manipulated with either mechanical or chemical treatments. Mechanical and chemical treatment methods can vary in their efficiency, and both can have undesirable and/or unintended consequences. Owners and managers should understand all possible consequences and select a manner of treatment that satisfies their objectives.

The choice for mechanical versus chemical selective treatments depends on several factors. It is necessary for the owner to clarify their objectives for the property and the objectives of the treatment to resolve whether to use a mechanical or chemical treatment. There are several specific additional considerations. First, chemical treatments rely on the application of herbicides, a type of pesticide designed to impact plants. All pesticides are evaluated and approved for use by the US EPA, and regulated for their safety and effectiveness assuming the applicator follows the specifications of the label. Some people are reluctant to use herbicides, or the geo-political area (e.g., some municipal watersheds) restricts the use of herbicides. Second, most mechanical treatments do not immediately kill the plant, and plants may sprout from the stump or roots (Figure 2). If the desired outcome of the treatment is for a prolonged reduction in the abundance or vigor of the target plant, mechanical treatments may need to be applied multiple times. The lesser efficiency of mechanical treatments may be inconsequential for small-scale or noncommercial projects. Third, treatments may result in unacceptable collateral damage such as a large tree falling on smaller desirable trees or over-spray that extends beyond the target plant. Limiting collateral damage may be possible by gaining skill in applying the treatment, or changing the timing or equipment of the treatment. Fourth, the rapidity and duration of the effect of the treatment may vary between some mechanical and chemical treatments. For example, cutting gives an immediate effect, but with the potential for sprouting; also, injection can provide a fast response often within 3 to 4 weeks and death of the treated stem. Finally, some owners have skills, tools and equipment that facilitate either chemical or mechanical treatment options.

Figure 2. Mechanical cutting of mid- and upper-canopy beech trees resulted in a proliferation of understory beech seedlings and saplings. This type of cutting benefitted taller trees, but disfavored seedlings and limited access. (photo credit: L. Merle)

Selective Mechanical Treatments

Selective mechanical treatments include cutting, girdling with axe, saw or flame, or pulling. These treatments are effective because they physically disconnect the roots from the shoots, or remove the plant from the soil.

Cutting the stem is a common option for individual stem control. Stem cutting can be applied to small or large diameter stems using a variety of tools such as brush saws for stems up to approximately 3 inches diameter or chainsaws for larger stems. The advantage of cutting is that many owners have the tools necessary for cutting, the cut stem immediately opens canopy space for increased light to residual plants, and cutting may provide products such as firewood or brush for wildlife habitat. Caution with cutting is warranted, and related to the safe use of the equipment and the potential for extra work necessary to stack or pile cut stems. Also, many hardwood shrubs and trees sprout from the stump, and some species such as beech, black locust, tree-of-heaven, aspen and sassafras typically sprout from the roots following cutting. Resprouting may not interfere with some ownership objectives, but in other cases may complicate future goals.

A variation of cutting is called "high-stumping" (R. Nyland, pers. comm.; Nyland and Kiernan, 2017, For. Chron.) and suitable for control of American beech saplings. Beech stems up to a few inches diameter can be severed below the lowest branch and resulted in a high stump that averaged 2.5 feet tall. The stumps typically sprout, but those sprouts on the stump and stem die within a few years resulting in a reduction in the abundance of beech.

Girdling a stem severs the phloem, which is the vascular tissue that transports the sugars made in the leaves during photosynthesis (Figure 3). The sugars, primarily glucose, not used immediately for energy are transported as sucrose to the roots for future use as energy. Girdling prevents the movement of these sugars, which prevents storage, and ultimately starves the plant. The phloem is a thin layer of tissue that fully surrounds the stem like a sleeve just inside the bark. Thus, the action of girdling needs to be applied to the full circumference of the stem, but to a shallow depth beneath the bark sufficient to interrupt the connectivity of the phloem. Girdling is relatively quick compared to cutting, does not create accumulations of stems and tops on the ground during the treatment, and requires relatively few tools. However, if the intent is to increase sunlight, the action of girdling may require a year or more to provide full sunlight. Also, girdling leaves behind a dead standing stem that might represent a future hazard, but also provides a snag as habitat for some wildlife.

Figure 3. Mechanical girdling, in this instance with a chainsaw to a wolf white pine, is an organic method that increases growing space and light in the canopy. The tree can slowly drop branches, rather than trying to fell the tree among smaller desirable stems.

Pulling, like cutting, provides the immediate gratification of effect. Pulling is obviously limited by the size of the plant and typically only for plants without thorns or spines. In some areas, citizen groups gather for pulling of invasive species, but current recommendations dissuade this for some species. At a practical level, native species often have well established root systems that limit the ability of pulling except for the smallest stems. Many non-native shrubs (e.g., honeysuckle) have shallow root systems which facilitates the ease of pulling. One result of pulling is the potential for soil disturbance that may stimulate or facilitate the germination of additional undesirable plant species.

Selective Chemical Treatments

Selective chemical treatments include foliar spraying, basal bark, hack-and-squirt, and injection/drill-and-fill. These treatments are effective because they either alter essential functions such as photosynthesis or alter the structure of the plant in a way that simulates mechanical treatments. The effect of chemical treatments are usually apparent within three to four weeks during the growing season and result in death or significant stunting of growth. The effects are not as immediate as cutting, but are more immediate than girdling and result in a relatively permanent solution.

All chemical treatments use herbicides; in NY, herbicides are regulated through the NYS DEC. Some herbicides can be purchased over the counter and others can only be purchased by a certified pesticide applicator. Home-based recipes should not be used. Every herbicide has a label which stipulates which target species are controlled, the appropriate minimum personal protective equipment, and the manner of application.

Figure 4. Selective foliar spraying can isolate individual plants. In the instance illustrated, because of excessive deer impact there were no desirable species among the multiflora rose, so collateral damage was not a concern (photo credit: L. Merle)

Several on-line resources are available to assist owners who are considering herbicide treatments. Webinars about forest vegetation management are archived at www.youtube.com/ForestConnect. Every label that is legal for use in NY is available on the container at the time of purchase or online at http://www.dec.ny.gov/nyspad/products. The US Forest Service has a publication on manual methods of herbicide application here https://www.nrs.fs.fed.us/pubs/40792 Finally, Penn State University Cooperative Extension offers a handbook that covers fundamental principles of techniques, methods and products of herbicide application in forests here https://extension.psu.edu/downloadable/download/sample/sample_id/347/

Foliar spray treatments apply a fine mist or spray to the foliage of actively growing plants (Figure 4). The treatment is a dilute mixture of the herbicide, usually in water. The plants need to be actively growing, so periods of early-season leaf expansion, drought stress, or senescence at the end of the growing season may limit the effectiveness of the treatment. Common foliar treatments include products such as Accord XRT II, Escort, Oust, or Gordon's Brush Killer (product names are listed as examples, and not as an endorsement or recommendation). The suitability and details for specific use of these products are provided through their label via the DEC website mentioned previously. Most woodland owners use a back-pack sprayer and target plants that are small enough to allow for controlled applications to the target plant. Foliar treatments are dilute, thus limiting the total volume of the product per acre. Also, foliar treatments are only effective on plants that are sprayed and only through foliage. The water-based foliar sprays do not penetrate bark or affect dormant plants. Chemicals applied by foliar spray do not move to untreated plants through root grafts, a phenomenon known as "flash." Caution is warranted to avoid overspray that contacts non-target plants. In some cases, the foliage of the target plant species is seasonally accessible before or after the foliage of non-target plants has emerged or senesced and thus reduces the potential for collateral damage.

Figure 5. Basal bark treatments can be completed during the growing season to avoid the potential negative impacts of over-spray onto desired species.

Basal bark treatments are most often done with the active ingredient triclopyr as Garlon 4 Ultra in an oil-based carrier that penetrates the bark. Vegetable oils are effective as carriers except in cold temperatures (Figure 5). The mixture is sprayed onto the lower 15 to 20 inches of the stem of trees and shrubs with sufficiently thin bark to allow the oil carrier to penetrate the bark. The active ingredient causes a rapid growth expansion and rupture of cells that chemically girdles the tree. Similar to foliar treatments, basal bark applications do not result in movement from the treated plant to neighboring plants through root grafts. Basal bark treatments are more time consuming to apply than hack or injection treatments (see below). Basal bark treatments result in standing dead trees that may be good for wildlife, but potentially hazardous for humans and structures. Caution is also warranted because Garlon 4 Ultra as a liquid can convert to a vapor (i.e., volatilize) and under specific conditions those fumes can aggregate beneath a closed canopy and negatively impact the overstory trees. This problem is controlled by following label directions regarding the amount that can be applied per acre. Additional details for basal bark treatment are available online https://extension.psu.edu/using-basal-bark-herbicide-applications-to-control-understory-tree-species or as a downloadable fact sheet here https://extension.psu.edu/downloadable/download/sample/sample_id/522/

Figure 6. Hack-and-squirt (or drill-and-fill) exposes wood to the active ingredient glyphosate or imazapyr. In this illustration, a dilute mixture required incisions more frequently than necessary with a concentrated solution.

The third type of selective chemical treatments include hack-and-squirt (HS) and injection/drill-and-fill (DF). These involve puncturing the bark and applying products such as Accord XRT II or Arsenal to the freshly exposed wood (Figure 6). The active ingredients for these products are glyphosate and imazapyr, respectively. HS uses a hatchet, machete or ax to puncture the bark and the product mixture is sprayed between the flap and the freshly exposed wood. DF uses a cordless drill or impact driver to create a hole into which the product is sprayed or injected. A benefit or defect of the HS and DF techniques, depending on perspective, is that the herbicide may “flash” to nearby trees via root grafts that may occur among stems of the same species. Root grafts between different species are unlikely. The extent of flash varies by species, the number and size of stems treated, and likely the season. HS and DF, similar to girdling or basal bark treatments result in standing dead trees. For many species, the recommended dose of these products by HS or DF is a concentrated mixture of the product (see label for details), and applied as one milliliter (ml) for each 3 inches of diameter. One ml is a small quantity, about the volume of a single garden pea. There are 5 ml in one teaspoon. Avoid over treatment during HS and DF.

The DF technique has the advantage over HS of causing less physical impact to the wrist of the applicator. Also, DF can better regulate the use of the herbicide and loss to dripping onto the stem. Specifically, when DF uses a 3/8” bit and one-inch deep hole at a 45^{o} angle to the surface of the stem the hole has a volume of approximately 1.5 ml (a vertical hole of these dimensions has a volume of 1.8 ml). Woodland owners can participate in a citizen science project coordinated by Cornell University Cooperative Extension that uses DF to control cull trees. Details about this project are here http://cornell-forestconnect.ning.com/profiles/blogs/cull-tree-treatment.

Integrated Selective Treatments

In some circumstances there is greater effectiveness, efficiency, or control of effect by integrating or blending mechanical and chemical treatments. One example is known as cut-stump treatments. With cut-stump treatments the shrub or tree is fully severed and a concentrated solution of, usually, Accord XRT II or another glyphosate-based product is immediately applied onto the freshly exposed wood surface (Figure 7). This treatment provides the immediate benefits of cutting and the prolonged benefits of killing the root system. The cut-stump treatment maximizes the potential for flash. A second option for integration is the frill-spray treatment where the bark of a tree is excised on the full circumference by chainsaw or ax and a triclopyr-based herbicide such as Garlon 3A or Garlon 4 ultra is applied into the frill onto the freshly exposed wood. Garlon products have limited capacity to flash. The frill-spray treatment is useful on stems too large and thick-barked for basal bark treatments and in circumstances attempting to avoid a flash of the product to potentially root-grafted trees.

Figure 7. Cut-stump treatment of beech using glyphosate. This treatment can result in up to 85% kill of surround beech root suckers.

For additional information on woodland management go to:
www.ForestConnect.com & www.CornellForestConnect.ning.com

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