MANUAL HERBICIDE APPLICATION METHODS FOR MANAGING VEGETATION IN APPALACHIAN HARDWOOD FORESTS

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Extended abstract—Controlling undesirable vegetation is a major component of any silvicultural system involving the management of oaks. It has long been recognized that controlling understory and midstory layers of competing vegetation before harvest and timely release after harvest are critical to successfully regenerating and retaining oaks in future stands. Herbicides are a very versatile, cost-effective tool that can be used in a variety of ways to help manage forest vegetation. Manual herbicide application methods reviewed here are well suited for the small forest ownerships in the rugged Appalachians, where the use of mechanical methods and prescribed burning are often limited by steep terrain and fragmented ownerships. Some herbicide treatment methods also have the advantage of being very target-specific, especially when treatments are restricted to species different from those considered desirable. The effects of herbicide treatments on interfering vegetation can last for several years thereby providing slower growing seedlings like oak (*Quercus* spp.) species time to develop and become competitive. Four commonly used manual herbicide application methods used are reviewed here:

- Stem injection,
- Basal spray,
- Cut-stump, and
- Foliar spray

Recommendations on which herbicides to use, rates of application, and timing are also discussed.

Stem injection involves cutting incisions though the bark of a treated tree using a hatchet with a ground-down narrow blade 1.75 inches wide. While leaving the blade in the incision, twist the hatchet slightly to open the incision, and squirt the herbicide solution directly into the incision on the cambium layer of the tree. A plastic spray bottle or a gunjet herbicide gun attached to a backpack sprayer is often used to dispense the herbicide. Make one incision per inch of DBH (diameter at breast height) evenly spaced around the tree; spacing between incisions should not exceed 1.5 inches. Squirt approximately 1.5 milliliters of herbicide solution in each incision. A 50-percent solution of Garlon® 3A (active ingredient triclopyr) or glyphosate product (41.0-percent a.i.), in a water carrier is recommended for stem injection. When treating maple (*Acer* spp.) species, a 6-percent solution Arsenal® (active ingredient imazapyr) mixed with water is recommended. The glyphosate and Arsenal® treatments should not be used to control competing trees closer than 5 feet of the same species as crop trees or to competing stump sprouts originating from the same stump as crop trees. Stem injection treatments are best applied when trees are in full leaf (June 1–November 1), and avoid periods of heavy sap flow (January–April). Chemical stem injection treatments are often used in crop tree release treatments and to control cull trees in order to increase the future value of Appalachian hardwood stands.

Stem injection treatments are usually not recommended for stems less than 1 inch DBH. A similar cut-surface treatment that can be used to treat small stems is the cut-stub treatment. Dense understories of shade-tolerant species develop naturally in Appalachian forest stands and respond rapidly to overstory disturbance such as cutting. In some stands, a larger percentage of these stems are <1 inch DBH in size. Stems 6 feet tall to 1 inch DBH are bent over and completely severed about 2 feet above the ground and the cut-surface sprayed with the same herbicide concentrations recommended for the regular stem injection treatment. A Swedish brush ax works better on these small stems than the hatchet recommended for injecting larger stems. Incisions can also be made on scattered larger stems up to 6–8 inches DBH with this ax permitting them to be injected in the conventional manner.

Basal spraying is a manual application method where herbicide is mixed with an oil carrier and applied using a backpack sprayer to the lower 12–15 inches of the treated stem. A 10-percent solution of Garlon® 4 (active ingredient triclopyr) mixed with an oil carrier is recommended. Basal spraying works best on thin-barked species, such as American beech (*Fagus gradifolia* Ehrh.), birch (*Betula* spp.), and maple less than 6 inches DBH. It normally costs more than tree injection or cut-stump treatments, and triclopyr, the active ingredient in Garlon® 4,

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is not readily translocated to attached root sprouts. Apply the herbicide solution completely around the stem until it begins to run off. This treatment is especially effective on tall shrubs like autumn olive (*Elaeagnus umbellata* Thrunb.) and witch hazel (*Hamamelis virginiana* L.) which are difficult to inject or foliar spray. This treatment can be applied at any time of the year, if the stems are dry.

The cut-stump treatment is a target specific application method applied to the outer 2 inches of tree stumps using a backpack sprayer to control stump sprouting and to disperse herbicide to attached root sprouts. Some herbicide transmission may also occur through intraspecific root grafts of the same species. The cut-stump treatment enables large numbers of small stems to be controlled by treating one large stem. It can be used in site preparation treatments to control understories of interfering vegetation. The cut-stump treatment is very cost effective when used in conjunction with mechanized feller-buncher harvesting operations because it is not necessary to cut the stems, stumps are usually more exposed, and access is easier, especially after whole-tree harvesting operations. It is similar to stem injection in that the herbicide is being applied directly to the cambial layer of the treated trees; however, this treatment will control a much higher percentage of root sprouts on trees like American beech, blackgum (*Nyssa sylvatica* March.), sassafras (*Sassafras albidum* Nutt.) than stem injection. Research has demonstrated that treatment efficacy around individual beech stumps was strongly correlated with stump size; as stump diameter increased, so did the effective range of root sprout control. Use a 50-percent solution of glyphosate (41.0-percent a.i.) or a 6-percent solution of Arsenal® and a surfactant in a water carrier. Treat stumps as soon as possible after cutting, but research has demonstrated that this treatment can be effective up to 4 days after cutting in the central Appalachians. This treatment is best applied from June 1 to November 1 and avoid heavy sap periods (January–April).

Manual supplication methods can be used to foliar spray around individually protected plants (e.g., planted seedlings), clumps of undesirable plants, or to broadcast spray areas of interfering plants like fern beds. Herbicide solutions are usually applied using a backpack sprayer to completely wet the foliage of target plants. A 2-percent solution of glyphosate or 1-percent solution of Arsenal® AC (active ingredient imazapyr) are recommended. Add a non-ionic surfactant to the solution if the herbicide being used does not already have one. Adding 0.25 ounces of Oust® XP (active ingredient sulfometuron-methyl) per 3 gallons of solution when controlling herbaceous weeds and grass adds longevity to treatments. Foliar treatments can be applied after full leaf-out until leaves begin to change color in the fall. The foliage should be dry when sprayed, and a 2-hour rain free period is recommended after spraying.