Use of Herbicide to Reduce Stump-sprouting Following Thinning of an Eastern Black Walnut Agroforestry Planting

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ABSTRACT—When establishing an agroforestry practice, the number of trees planted will often exceed the densities needed to achieve a final spacing or configuration. While tight spacings may facilitate certain growth parameters, such as height development, timely thinnings of plantings are required in order to maintain desirable growth rates. In managed plantations especially, the stump sprouts that often result from thinnings may be deemed undesirable for aesthetic reasons, and inhibit other management activities, such as harvesting nuts and mowing. By applying select herbicides to the stump surface following thinning operations, sprouting that often develops can be eliminated. This study was established during the thinning of an eastern black walnut (*Juglans nigra* L.) plantation, with stumps treated immediately following tree felling. Four treatments, including 3 herbicides (Garlon 3A®, Banvel® and Roundup®) and a control (no stump treatment), were applied in a randomized complete block design to 36 stumps. Treatments were applied during April of 2001, with damage to adjacent crop trees assessed later that same growing season. For 2 years following stump treatment, sprouts were counted. Garlon 3A® provided the best results with no sprouting observed over the 2 year study period.

INTRODUCTION

Of all the hardwood species, eastern black walnut (*Juglans nigra* L.) is one of the most likely to be planted in a monoculture (single species) plantation setting. As a tree with production opportunities for growing both nuts and timber of high value, it has been widely planted in agroforestry practices that seek to realize the potential of a given land area for diversified production, as well as resource stewardship. However, embodied within the goals of stewardship and productivity is the maintenance of healthy trees and forests.

When striving to promote healthy forest stands, and optimize productivity, timely thinnings become invaluable tools for forest managers. In hardwood forest stands, thinnings are usually accomplished by either mechanical means that include cutting or girdling tree stems, by chemical release using injection and/or basal bark spray treatments, or by some combination of the two that will ensure removal of select stems and prevent further regrowth. The select removal of undesirable woody plants represents a low-impact, cost-effective means of forest thinning that may also be viewed as being more environmentally friendly than general broadcast treatment methods.

Today's forestry herbicides are rigorously tested in order to meet strict standards of environmental safety and human health protection. Further, most active ingredients in forestry herbicides are below lethal-dose levels associated with many household chemicals, food additives, and nonprescription drugs (McMahon and others 1994). However, for safety and to maximize the effectiveness of the herbicide on the intended target plant, label recommendations should always be followed.

To best ensure the realization of forest management goals and optimize the use of personnel time, thinnings should be designed to reduce the competition between trees for limited site resources (light, moisture, and nutrients). Thinnings that do not eliminate resource competition do not optimize the investment of time, or the likelihood of achieving management goals associated with a thinning

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operation. This can occur when trees identified for removal during a thinning practice either, do not suffer loss of upper-stem growth, have upper-stem die-back but resprout from the stump, or the main stem is killed but the tree suckers from the root stock. In all cases, the competition for light may have been eliminated, yet competition for moisture and nutrients continues. This does not optimize the outcomes associated with thinning activities. Proper application of herbicides can effectively minimize the likelihood that thinned trees remain in competition for onsite resources.

This study was designed to evaluate the effectiveness of three herbicides in eliminating stump sprouting following the conventional thinning of a black walnut plantation. Following tree felling with a chainsaw, cut surface application of three herbicide formulations occurred.

Study Site

Located in Southwest Missouri, the Sho-Neff Black Walnut Farm began planting eastern black walnut in 1975. It is currently owned and managed by the Hammons Products Company of Stockton, MO. The farm totals 480 acres that are divided into 25 areas. The stump treatment study was applied in area 16B which was established in 1976. With the primary goal of nut production, trees were planted at an initial spacing of 20 x 40 feet. Agroforestry was practiced on the site in years 1 through 11, with plantings of soybean, wheat and milo in the 40-foot alleyways. A thinning was conducted in 1998-1999 to remove inferior trees, with an additional thinning occurring in 2000 to maintain growth rates on the residual trees.

METHODS

Four treatments were assessed for their effectiveness in minimizing stump sprouting following thinning. These included (1) a control with no chemical stump treatment, (2) Garlon 3A® having 44.4% Triclopyr as the active compound, (3) Banvel® having 48.2% Dicamba as the active compound and (4) Roundup® having 41% Glyphosate as the active compound. Herbicide sprays were applied full strength in order to test the maximum effect that each would have on stump sprouting and the growth of adjacent trees.

Located across 7 rows (40 feet between rows) within a black walnut plantation, 36 trees were cut in 2001, and 1 of the 4 sprouting control treatments applied. Trees were cut with a chainsaw, and application of the treatment occurred immediately following each cut. Each stump was cut low to the ground, at an approximate height of no greater than 3 inches. Herbicide was applied to the outer 2 inches of each stump surface. The herbicides were applied using an adjustable spray bottle that held 1 quart of chemical. Using a similar setting between stream and mist, the outer 2 inches of each stump was covered in chemical. At the time of thinning, the DBH (diameter at breast height, 4.5 feet above ground line) of each study tree was measured. Study trees ranged in size from 6.6 to 12.3 inches in DBH across all treatments. However, the difference in mean DBH within each treatment varied by approximately 1 inch or less (Table 1).

Using a randomized complete block design, treatments were applied to the trees marked for thinning. As many replicates as possible were applied within each tree row. Each cut-stump treatment was applied a total of nine times over seven rows.

Table 1.—Comparison of the mean number of stump sprouts during years 1 and 2 for walnut stumps treated with Garlon 3A®, Banvel® and Roundup® or left untreated (Control).

Cut-Stump Treatment	Active Ingredient	Mean DBH of Treated Stumps	Mean Number of Stump Sprouts	
			Year 1	Year 2
Control	no chemical treatment	10.47	5.7A	5.7A
Garlon 3A®	44.4% Triclopyr	10.92	0B	0C
Banvel®	48.2%Dicamba	9.83	2.3B	2.8B
Rounup®	41% Glyphosate	10.56	0.2B	2.9B

** Mean number of sprouts followed with the same letter within a given year are not significantly different at alpha = 0.05 as compared by Duncan's Mutliple Range Test.*

First in July of 2001 and again in January 2003, sprouts from the stump of each tree were counted and the height of the tallest sprout measured. Statistical analyses were conducted using SAS (1999) to determine whether 1 stump treatment was superior to the others at reducing the number of stump spouts. Means of the number of sprouts occurring in year 1 and year 2 were compared using Duncan's Multiple Range Test at alpha = 0.05. By using General Linear Model (GLM) the influence of chemical and DBH of thinned trees was also assessed.

RESULTS

At the end of years 1 and 2, the number of sprouts occurring on each stump was counted. The control treatment (no herbicide applied to the cut surface) had the greatest number of sprouts in both years 1 and 2, with a range of 2-18 sprouts in year 1 and 2-10 sprouts in year 2. The stump with the most spouts occurred within the control treatment. A 9.3-inch DBH stump produced 18 sprouts in year 1. By year 2, the most sprouts counted on a single stump was 10, and they also occurred on a control stump. By comparison, Garlon 3A® had the fewest sprouts. In both years, zero-sprouts were observed across all stumps.

In year 1 no significant differences were found between the three treatments receiving herbicides, but all three were significantly different from the control (no herbicide) (Table 1). However, by year 2 treatment differences, as measured by the number of sprouts, had changed. The mean number of sprouts per stump increased in both the Banvel® and Roundup® treatments resulting in Garlon 3A® having significantly fewer sprouts than all other treatments (Table 1).

In measuring the influence of chemical treatment and DBH on the propensity of a treated stump to sprout, chemical treatment exerted greater significance. The GLM (General Linear Model) of stump sprouting based on chemical treatment and DBH had an R-square of 0.52, indicating that all variance is not accounted for by the two independent variables. However, within the model, the chemical treatment was significant at a 0.99% confidence level.

DISCUSSION

Properly applied herbicide's can be an effective tool for maximizing the benefits from a thinning operation. Numerous studies have examined the use of chemicals for their effectiveness when applied as cut-surface, injection and basal sprays. Thomas and others (1988) used several cut-surface treatments on sugar maple stumps in an effort to eliminate sprouting. He identified a change over time in the number of sprouts, with stumps that initially appeared dead (without sprouts), developing sprouts during the second year. Tordon RTU® and Garlon 3A® were identified as maintaining good control of sprouts for 2 years in the study (Thomas and others 1988).

Other studies, including those by Miller (1993) and Van Sambeek and others (1995), have identified the effectiveness of injection and basal spray treatments as measured by crown reduction and/or tree mortality. These studies have identified differences in effectiveness based on species, and diameter within a species. Their studies tested a variety of chemicals and chemical rates, with varied success. Pannill (1997) expressed dissatisfaction with the results of the hack-and-squirt method when applying Roundup®. He identified an associated mortality of 75% of treated trees.

Additionally, in plantings of like species trees, there should always be a concern with flashback when applying herbicides to thin trees in plantations. Flashback is the unintended negative impact of chemical application on trees adjacent to those treated during the thinning process. This occurs when a chemical translocates from the stem into the root system and via root grafting, moves into an adjacent tree. Often flashback is first evidence in the dieback or yellowing of the foliage of adjacent trees. Our study identified flashback in two separate cases. One resulted from a stump treated with Banvel® and was evidenced by approximately 20% crown dieback of the adjacent tree. The second occurred with Roundup® and caused 30-40% crown dieback. Both trees recovered, but when a thinning is designed to enhance growth and development of released crop trees, any flashback is undesirable. Only the control and Garlon 3A® treatments did not result in any occurrences of flashback.

Our study demonstrates significant differences between herbicides in controlling walnut stump sprouting. Furthermore, it is clear from our results that 1 year is an insufficient time frame within which to evaluate the true effects of herbicides. While all three herbicides tested were found to significantly reduce sprouting after 1 year from that observed when no herbicide was applied, no significant differences were found between the herbicides. However, as a result of the recovery of stumps treated with Banvel® and Roundup®, both had significantly more sprouts after 2 years than were observed on stumps treated with Garlon 3A®.

Clearly, Garlon 3A® was the superior herbicide tested in this trial and a minimum of 2 years following the application of the chemical were required to make a valid comparison.

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