RESPONSE OF EASTERN BLACK WALNUT TO HERBICIDE STUMP TREATMENT

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ABSTRACT.—In both managed plantations and managed forests, thinnings are often required to maintain or enhance productivity. In managed plantations especially, resulting stump sprouts may be deemed undesirable for aesthetic reasons, as well as inhibiting other management activities, such as harvesting nuts and mowing. Herbicide applications can be an effective method for eliminating sprouts that may develop following tree thinning operations. 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 three 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. For 2 years following stump treatment, sprouts were counted. Stumps treated with Garlon 3A® provided the best results with no sprouting 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 seeking diversified production, as well as resource stewardship. However, embodied within the goals of stewardship and productivity is the maintenance of healthy trees and forests. In both managed plantations and managed forests, thinnings are often required to maintain or enhance productivity.

When striving to promote healthy forest stands of desirable species, while at the same time maximizing individual tree growth, timely thinning operations become an invaluable tool 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. However, in managed plantations thinning methods that result in stump sprouts may be especially undesirable because of their potential hindrance to other management activities, such as harvesting nuts and mowing. Herbicide applications can be an effective method for eliminating sprouts that may otherwise develop following tree thinning operations.

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. 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 on-site resources.

While other studies, including those by Miller (1993) and Van Sambeek et al. (1995), have identified the effectiveness of injection and basal spray treatments as measured by crown reduction and/or tree mortality, they did not measure herbicide effectiveness based on cut-stump application and a count of resulting stump

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sprouts. However, these studies have identified differences in effectiveness based on species, and diameter within a species. The Miller study looked at the response of sweetgum to applications of Pathway, Garlon 3A, and Arsenal AC, while the Van Sambeek study was more generally applied to hardwoods and compared herbicides containing Glyphosate, Dicamba, and Dicamba+2,4-D. Both studies reported varied success depending on the application method, and neither reported specifically on the response of eastern black walnut. Additionally, the Walnut Council Bulletin has published at least two landowner reports that detail the use of Roundup® in thinning operations (Pannill (1997) and Merrill (2002)). These reports provided results that also seem to present limited success at completely deadening selected trees through herbicide application.

Due to the number of chemicals available to landowners and professionals, and the various methods by which they may be applied, a controlled comparison of the effectiveness of chemicals can be useful to land managers. This study was designed to evaluate the effectiveness of three herbicides to control stump sprouting after the conventional thinning of a black walnut plantation. Following tree felling with a chainsaw, cut surface application of 3 herbicide formulations was carried out according to label recommendations. It is important, for safety and to maximize the effectiveness of the herbicide on the intended target plant, that label recommendations should always be followed.

Study Site

Located in Southwest Missouri, the Sho-Neff Black Walnut Farm was established in 1975. It is currently owned and managed by the Hammons Products Company of Stockton, Missouri. The farm totals 480 acres and is divided into 25 areas. The stump treatment thinning was applied in area 16B which was planted to black walnut in 1976. With the primary goal of nut production, trees were planted at an initial spacing of 20 by 40 feet. Agroforestry was practiced on the site in years 1 through 11, with plantings of soybean, wheat and milo produced in the 40-foot alley ways. A thinning was conducted in 1998-99 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 seven rows (40 feet between rows) within a black walnut plantation, 36 trees previously marked for removal during a thinning were cut in April of 2001, and one of the four sprouting control treatments applied. Trees were cut with a chainsaw, and application of the treatment occurred immediately following each cut. At the time of felling, the DBH (diameter at breast height, 4.5 feet above ground line) of each study tree was measured. Each stump was cut low to the ground, at an approximate height of no greater than 3 inches. Using an adjustable spray bottle that held 1-quart of chemical, herbicide was sprayed to cover the outer 2 inches of tree growth. Thinned trees ranged in size from 6.6 inches to 12.3 inches in diameter at breast height (DBH). However, the difference in mean DBH across all treatments 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. A replicate consisted of all herbicide stump treatments and a stump not treated (control), each randomly ordered within a row. This was done nine times and represents three blocks of treatments. Although slope is very slight (3% or less), micro-site variability and the unbiased assignment of each herbicide treatment to a stump is best ensured through use of the randomized complete block design and layout. Each cut-stump treatment was applied a total of nine times over seven rows.

Sprouts from the stump of each tree were counted twice, first in July of 2001 and again in January 2003. Statistical analysis was conducted using GLM (general linear means) as computed by SAS (1999), to

Table 1.—Comparison of the mean number of stump sprouts during years 1 and 2 for walnut trees of a given mean Diameter at Breast Height (DBH) following felling and stump treatment of either Garlon 3A®, Banvel®, Roundup®, or left untreated (Control).

Cut Stump Treatment[1]	Active Ingredient	DBH Mean	DBH Range	Mean Number of Stump Sprouts[2] Year 1	Mean Number of Stump Sprouts[2] Year 2
		——inches——			
Control	no chemical treatment	10.47	9.3 – 12.1	5.7 A	5.7 B
Garlon 3A®	44.4% Triclopyr	10.92	9.6 – 12.3	0 B	0 C
Banvel®	48.2% Dicamba	9.83	8.7 – 11.6	2.3 B	2.8 B
Roundup®	4 % Glyphosate	10.56	8.4 – 12.3	0.2 B	2.9 B

[1]n for all treatments is nine

[2]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 Multiple Range Test.

determine whether one 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.

Results

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. By comparison, stumps treated with Garlon 3A® produced no sprouts during the two-year study.

Due to the fact that Garlon 3A® had zero sprouts on all stumps for years one and two of the study, the mean and variance for both years was also zero. This made statistical comparison to other treatments difficult. However, it is obvious that when compared to treatments that developed stump sprouts, the complete control of sprouting by Garlon 3A® is significantly different.

Removing Garlon 3A® (with zero mean and variance), the influence of DBH and chemical treatment on sprouting were assessed using GLM. The model output identifies only the chemical treatment as being significant at an alpha=0.05, or 95 percent confidence level. In year one, no significant differences were found between the other two treatments receiving herbicides, yet both were significantly different from the control (no herbicide) (Table 1). The same trend held for year-two, with the Banvel® and Roundup® treatments identified as similar, yet significantly different from the control. As the mean number of sprouts per stump increased for tree stumps in the Banvel® and Roundup® treatments, the difference with Garlon 3A® also increased as compared to all other treatments (Table 1).

Discussion

Properly applied, herbicides can be an effective tool for optimizing a thinning operation by eliminating, or reducing, the sprouting of stems cut during a thinning. Numerous studies have examined the use of chemicals for their effectiveness when applied as cut-surface, injection (of which "hack and squirt" is a form) and basal sprays. Thomas et al. (1988) used several cut-surface treatments on sugar maple stumps in an effort to eliminate sprouting. They identified a change over time in the number of sprouts, with stumps that initially appeared dead (without sprouts), developing sprouts in the second year. Tordon RTU® and Garlon 3A® were identified as maintaining good control of sugar maple for at least two years in the study.

However, in plantings of like-species trees, there should always be a concern with flashback when applying herbicides to thin trees in plantations. Personal communication with various forest resource professionals resulted in recommendations to avoid Tordon RTU® in black walnut plantations due to flashback potential. 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 evidenced by the dieback or yellowing of the foliage of adjacent trees. We observed 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. Neither tree died, but when a thinning is designed to enhance growth and development of released crop trees, their foliage dieback due to flashback is undesirable. Only the control and Garlon 3A® treatments did not result in any incidents 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 timeframe within which to evaluate the effects of herbicides. While all three herbicides tested were found to greatly reduce sprouting after 1 year from that observed when no herbicide was applied (control), no differences were identified between the herbicides. However, as a result of the recovery of stumps treated with Banvel® and Roundup®, both had an increase in stump sprouts occurring after 2 years, and results then indicated differences with the absence of sprouts 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 was required to make a valid comparison.

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