
CONTROL AND MANAGEMENT OF EASTERN BACCHARIS IN A RECENTLY ESTABLISHED BOTTOMLAND HARDWOOD PLANTATION

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ABSTRACT

Eastern baccharis (*Baccharis halimifolia* L.) is a frequent invader in bottomland hardwood plantations established in southeastern Arkansas. This dioecious shrub can affect the survival and growth of newly planted stems. This study evaluated the utility of various herbicides and mechanical control treatments to manage eastern baccharis in an established hardwood plantation. Of the four herbicide treatments used, a dormant season application of triclopyr was the most effective treatment. As a non-chemical treatment option, two annual dormant and growing season cuttings resulted in 43 and 26 percent mortality, respectively, of the eastern baccharis rootstock. No damage was visible to any of the planted hardwood stems after two growing season for any of the management options tested.

INTRODUCTION

The establishment of hardwood plantations has been used as a mechanism to restore many thousands of acres in the lower Mississippi Alluvial Valley (Allen and others 2001; Stanturf and others 2004). However, factors such as site-species relationships, alteration of hydrology, edaphic characteristics, herbivory, seedling quality, and others have been linked to poor establishment associated with these plantings. One of the most consistent factors that contribute to poor survival and/or growth of these hardwood plantations has been the failure to control competing vegetation (Allen and others 2001; Stanturf and others 2004).

Eastern baccharis, *Baccharis halimifolia* L., (referred to as baccharis hereafter) is a dioecious shrub reaching 10-12 feet in height and commonly found in coastal marshes, freshwater swamps and abandoned fields from Texas to Florida and north to Massachusetts (Kraft and Denno 1982, Boldt 1989). It can dominate areas with recent disturbance and is a significant invader on former agriculture lands in southern Arkansas that are being converted to hardwood plantations (authors' personal observation).

A number of herbicides (e.g., dicamba, glyphosate, and 2,4-D) have been used to control *Baccharis* spp. during the growing season (Westman and others 1975, Everitt and others 1978, Boldt 1989). However, most of the herbicides that would effectively control baccharis will also damage planted hardwood seedlings. One untested option for controlling baccharis in hardwood plantations is to utilize dormant season herbicide treatments. While baccharis is a deciduous shrub, its newer stem growth (e.g., <1 year old) tends to remain green during the winter and retains living foliage for a majority of the year (Miller and Skaradek 2002). Therefore, a dormant season foliar-acting herbicide might offer an approach to managing baccharis that minimizes impacts to non-target species (i.e., planted hardwoods). Since hardwood seedlings in southern Arkansas are typically dormant from December to mid-March, a dormant season application could be used to reduce the density of baccharis to the extent that the planted hardwoods would be released. Similar dormant season applications have been successfully used to control honeysuckle (*Lonicera* spp.) invasions in hardwood forests (Evans 1984, Regehr and Frey 1988, Nyboer 1992).

Despite their effectiveness, some landowners may not want to use herbicides to control baccharis. As an alternative, mechanical treatments (e.g., bush hogging) can be used to manage baccharis (Hoffman 1968, Everitt and others 1978, Hobbs and Mooney 1985). However, mechanical control methods are labor and equipment intensive, which makes them costly. In addition these treatments usually do not provide long-term control because cut stems readily sprout (DeLoach and others 1986, Boldt 1989). Nonetheless, information on sprouting frequency relative to stem size and/or age would be useful in order to best target treatment implementation.

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The objectives of this research were to (1) test dormant season applications of various herbicides to assess their efficacy for managing baccharis in established hardwood plantations, and (2) compare sprouting probabilities for baccharis stems cut during dormant and growing seasons.

METHODS

SITE DESCRIPTION

The study was located on former farmland in Chicot County, AR that was enrolled in the Wetlands Reserve Program. In 2002-03, bald cypress (*Taxodium distichum* (L.) Rich.), pecan (*Carya illinoensis* (Wangenh.) K. Koch), green ash (*Fraxinus pennsylvanica* Marsh.), Nuttall oak (*Quercus texana* Buckl.), Shumard oak (*Q. shumardii* Buckl.), water oak (*Q. nigra* L.), and willow oak (*Q. phellos* L.) were planted at densities totaling 303 stems/acre. A field survey conducted in 2005 reported average hardwood seedling density of 153 stems/acre, including volunteers, and several thousand rootstocks per acre of baccharis (Smith and others, 2006, unpublished data). The soil is classified as Perry clay (Very-fine, smectitic, thermic Chromic Epiaquerts), which are very deep, poorly drained, and very slowly permeable soils that formed in clayey alluvium (USDA 2002). The annual mean temperature for Chicot County, Arkansas is 64°F with a mean annual precipitation of 55.5 inches (NOAA 2002).

Herbicide Study

The effects of dormant season herbicide applications on baccharis and hardwood saplings were assessed on 20 plots (approximately 75 feet long by 20 feet wide) established in the six year-old bottomland hardwood plantation. Ten hardwood saplings and 15 dominant baccharis rootstocks were tagged per plot. Hardwood seedlings were predominately Nuttall oak and green ash with the occasional willow oak. The height and basal diameter of each tagged hardwood sapling were measured before treatments were applied.

Four chemical treatments consisting of Clearcast, Milestone, RazorPro, and Tahoe 4E (imazamox, aminopyralid, glyphosate, and triclopyr, respectively; Table 1) were applied in early March before planted seedlings broke dormancy. All treatments were replicated four times. Four additional plots were left untreated to serve as controls. Herbicides were applied using a CO₂ sprayer attached to a 20 foot boom with the predetermined herbicide and concentration mixed with the equivalent of 20 gallons/acre of water. The 20 foot boom consisted of 12 spray nozzles 20 inches apart to assure equal and uniform application of the chemical to each plot.

To determine the long-term effects of the herbicide treatments on the baccharis and hardwood saplings, a damage assessment was performed on the tagged baccharis and hardwood saplings in September 2010, which corresponded to the end of the second growing season following treatment. Plants were assigned one of five crown damage categories: 0 percent (undamaged), 1-34 percent (minor dieback), 35-65 percent (moderate dieback), >65 percent (severe dieback), and dead. Non-parametric ANOVA (Friedman's test) with a Tukey-type mean separation test was used to assess the effects of the herbicide treatments on sprayed hardwood and baccharis saplings. The basal diameter and height of the tagged hardwood saplings were also recorded in September 2010. The annual height and diameter increment among treatments were compared using ANOVA and Tukey's HSD test for mean separation testing. Survival data for the herbicide study were analyzed using an arcsine transformation. Significance testing was conducted at alpha=0.05.

MECHANICAL CONTROL

Eight plots containing 25 tagged shrubs each were established in 2009. All baccharis stems in four plots were cut during the dormant season in January 2009, while all stems in the remaining four plots were cut during the growing season in May 2009. An additional 6 foot wide buffer strip was created around each plot. Each cut stem was aged using a disk cut from the basal end. Each stem on the dormant and growing season plots was re-cut in 2010 during its respective season to assess the effect of repeated harvesting on survival. Survival was checked for each rootstock in September 2009 and 2010. A binary logistic regression was used to predict the sprouting probability of baccharis by age, season of cut, and the interaction of age and season using a significance level of alpha=0.05.

RESULTS

HERBICIDE STUDY

Two growing seasons after treatments were initiated, no visible damage was observed to any of the tagged hardwood stems. Baccharis stems were highly impacted by the Tahoe treatment. Baccharis survival was 72, 77, 95, 97, and 12 percent for stems on the control, Clearcast, Milestone, Razor Pro, and Tahoe treatments (Table 2). The only differences among treatments were between the Tahoe treatment and all others.

The total height and basal diameters of the planted hardwood stems were not different among treatments (Table 2). However, the herbicide treatments were taller and had larger diameters than the control stems, possibly indicating a treatment effect in coming years.

MECHANICAL CONTROL

Average survival at the end of the first growing season was 72 and 58 percent for the dormant and growing season treatments, respectively. By the end of the second growing season, 43 percent of the original rootstocks for the dormant season treatment and 26 percent of the original rootstocks for the growing season treatment had re-sprouted and continued to survive. However, there were no statistical treatment or age effects on resprouting probabilities (Figure 1).

DISCUSSION

Control of broadleaf competition in established hardwood stands is one of the most challenging aspects of hardwood plantation management (Schuler and others 2004). The delayed or brief dormancy period exhibited by eastern baccharis provides an opportunity to manage this species in hardwood plantations in a way that is effective and efficient. The application of 6 quarts/ac of Tahoe 4E over the top of foliated baccharis during a period when the planted hardwood stems were dormant (e.g., early March), resulted in no obvious damage to the hardwood crop trees after two growing seasons, while the treated baccharis stems had 88 percent mortality (Table 2).

Differences in the effectiveness of the herbicides used may be due to differences in their modes of action or the application rates. For example, the active ingredients in Tahoe 4E and Milestone are both auxin growth regulators (Duke 1990, Gunsolus and Curran 1991, Bukun and others 2009); however, Tahoe was almost completely effective, whereas Milestone had essentially no effect on the treated baccharis. This difference could be due to the differences in compounds and their pathway through the plant, although the exact pathway has not been described for each chemical. Glyphosate is the active ingredient in RazorPro, and is an amino acid inhibitor. Some plants are able to deactivate this compound (Gunsolus and Curran 1991, Feng and others 2004). Another possibility is that the limited leaf function during the late winter/early spring may result in limited plant uptake. Clearcast is an imidazolinone herbicide that inhibits the acetolactate synthase in plants, which is similar to imazapyr products (Gunsolus and Curran 1991). Imazapyr-containing products are often used in pine forests to manage hardwoods, with excellent control of many species (Fortson and others 1996, Harrington and Edwards 1999). However, Clearcast did not exhibit any visible impact on the baccharis at the end of the growing season, which again could reflect the differences in the pathways that the herbicide takes in the plant.

MECHANICAL MANAGEMENT OF BACCHARIS

Since chemical treatments may not be options in certain areas or where personal and social pressures prohibit their use, mechanical alternatives to herbicides are sometimes used (Zutter and others 1987, Willoughby and McDonald 1999). As with many woody species, eastern baccharis is capable of coppicing when harvested (Fig. 3). Although no differences were detected, numerically the highest mortality induced by the two harvesting events occurred with the oldest stems (Fig. 1). However, deferring treatments also prolongs competition. The lack of differences between seasons may be due to a drought that occurred during the second year of this study. Annual rainfall during the second year was about 35 inches, which was about 20 inches below the long-term average (NOAA 2002).

CONCLUSION

Baccharis in established bottomland hardwood plantations can be controlled by a broadcast herbicide application in the late winter/early spring (i.e., after baccharis begins to leaf out but before bud swelling occurs in the hardwood seedlings) of 6 quarts/acre of Tahoe 4E. Further testing of this product may indicate reduced rates are equally effective. Similarly, increasing rates of RazorPro, Milestone, and Clearcast may show opportunities. Since most baccharis stems are only partially foliated during the dormant season, the higher rates of some herbicides or adjuvents might improve control of baccharis. The alternative control measure of severing the baccharis stems have been found effective, but in our study the differences between dormant and growing season treatments may have been impacted by droughty conditions.

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Table 1—Herbicides and application rates used in this study

Trade Name	Common Name	Rate (per acre)
Clearcast	imazamox	2 quarts
Milestone	aminopyralid	7 oz
Razor Pro + LI700 (surfactant)	glyphosate	4 quarts + 0.025% v/v
Tahoe 4E	triclopyr	6 quarts

Table 2—The diameter, total height of planted 8-year-old planted hardwoods and the survival of baccharis two years following herbicide applications.

Treatment	Planted Hardwood Stems		Baccharis Survival (%)
	Basal Diameter (inches)	Total Height (feet)	
Control	1.97	9.5	72
Clearcast	2.24	9.8	77
Milestone	2.13	10.1	95
Razor Pro	2.09	9.6	87
Tahoe	2.20	9.7	12

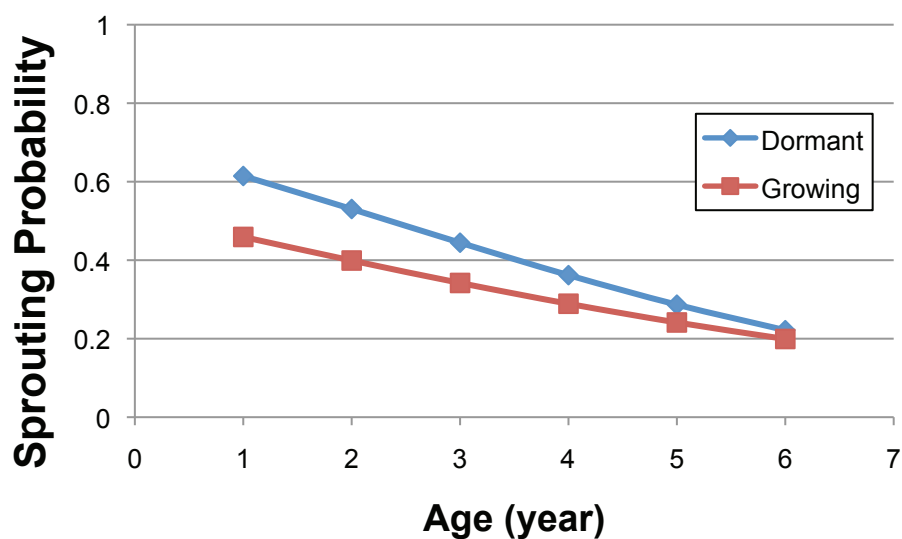


Figure 1—The predicted sprouting probabilities of eastern baccharis as a function of stem age for dormant and growing season harvests.