

EFFICACY OF 'HACK AND SQUIRT' APPLICATION OF IMAZAPYR, TRICLOPYR, AND GLYPHOSATE TO CONTROL THE INVASIVE TREE SPECIES CHINESE TALLOWTREE

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Abstract—In May 2005, 12 plots approximately 21 by 27 m each were established on the exterior bank of a dredge spoil area in Georgetown, SC. The tree cover was primarily Chinese tallowtree, but there were also live oak trees in each plot. Also in May 2005, Chinese tallowtrees (d.b.h. > 2.4 cm) in three randomly selected plots received a 'hack and squirt' application of imazapyr (50 percent v/v Habitat), tallowtrees in three plots received triclopyr (50 percent v/v Garlon 4) by 'hack and squirt' injection, and the tallowtrees in three plots received glyphosate (undiluted AquaNeet) by 'hack and squirt' injection. Three plots were an untreated control. The d.b.h. and percent defoliation of all trees (d.b.h. > 2.4 cm) were tallied in July 2005 and May 2006. The imazapyr treatment had the highest percent (96 percent in May 2006) of tallowtrees in the highest defoliation class (75 to 100 percent defoliated). Triclopyr plots had 41.3 percent in the highest class in 2006. Glyphosate plots had 62 percent in the highest class in 2006. The live oak trees (4 to 84 cm d.b.h.) did not show any herbicide damage in any treatment. These results indicate that imazapyr can be used to eradicate Chinese tallowtree by 'hack and squirt' injection without short-term (12 months) damage to dominant live oak trees.

INTRODUCTION

South Carolina's Coastal Plain forests and wetlands are rich with invasive species; some are widespread throughout the state and some are restricted to the coastal counties. Species that occur throughout the state include kudzu (*Pueraria lobata*), privet (*Ligustrum sinense*), tree of heaven (*Ailanthus altissima*), and cogon grass (*Imperata cylindrica*). Chinese tallowtree (*Sapium sebiferum*), beach vitex (*Vitex rotundifolia*), and tamarisk (*Tamarix gallica*) are restricted to coastal habitats in South Carolina. One approach to eradicating these species is either ground or aerial broadcast spraying of one of several modern herbicides. Although this technique is effective over large areas, species selectivity is achieved only by avoiding the non-target species, which negates some of the economy of the broadcast spraying. 'Hack and squirt' injection of herbicides gives users techniques to not only select which species to treat, but also which size class within each species to treat or leave. This highly selective technique allows the user to inject a powerful, non-selective herbicide to kill undesirable species. There are at least two disadvantages to using the hack and squirt technique. First, the method is slow, thus expensive, because it is a labor-intensive, manual operation. Second, soil active herbicides may be released from the target trees to the soil and subsequently be picked up by non-target vegetation. This second concern is especially critical when a crop species is to be planted where the previous vegetative cover was injected with a soil active herbicide or where a crop species is already established among the target species. The purpose of this research was to determine the effectiveness of a hack and squirt injection of three herbicides (glyphosate, imazapyr, and triclopyr) in killing Chinese tallowtrees and to monitor the live oak (*Quercus virginiana*) trees growing among the Chinese tallowtrees for possible herbicide sensitivity.

METHODS

The study area was the outer bank slope of a dredge spoils area on Winyah Bay in Georgetown County, SC (33° 20' 12.63 sec N, 79° 15' 15.04 sec W). The soil was the dredged

spoils from Winyah Bay and was fine-textured. On March 29, 2005, 12 plots were established on the exterior slope of the east spoils area dike. The plots were bounded on the west (upper) side by the access road on the crown of the dike, on the east (lower) side by the freshwater marsh that surrounds the spoil area; the north and south sides were set to produce a 27-m wide plot. Plot depth varied with the height of the dike and ranged from 15 to 20 m.

Three 'hack and squirt' treatments were applied to each of three randomly selected plots the morning of May 9, 2005 and the three untreated plots were controls. Chinese tallowtrees (d.b.h. > 2.4 cm) only received a 'hack and squirt' application of imazapyr (50 percent v/v Habitat), triclopyr (50 percent v/v Garlon 4) or glyphosate (undiluted AquaNeet). A hatchet was used to wound the trees at d.b.h. and the appropriate solution was sprayed in the wound from a handheld spray bottle. Trees were wounded at approximately 3-cm intervals along the circumference. The d.b.h. and percent defoliation of all trees (d.b.h. > 2.4 cm) in all plots were tallied on June 6, and July 25, 2005 and again on May 8, 2006. Percent defoliation was visually estimated to four defoliation classes: 0 to 25, 25 to 50, 50 to 75 and 75 to 100 percent. For the May 2006 survey, a 0 percent and a 100 percent defoliation class was added, and the lowest class was changed to 1 to 25 percent and the highest class changed to 75 to 99 percent defoliation. Stem frequencies were tallied by treatment and defoliation class and the Pearson Chi-square statistic was used to compare treatments or groups of treatments.

RESULTS AND DISCUSSION

The study area tree cover consisted of a few large live oak trees and many Chinese tallowtrees (table 1). Loblolly pine, sugarberry and groundsel tree were minor components. Treatment effects were observed one year after treatment (table 2). The Chi-square statistic for all treatments was highly significant ($P < 0.01$) indicating that one or more of the treatments was different. Chi-square tests of the three

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Table 1—Mean (and standard error of the mean) pretreatment basal area and stem density by species for all 12 plots

Species	Basal Area	Density
	<i>m²ha⁻¹</i>	<i>stems ha⁻¹</i>
<i>Baccharis halimifolia</i>	0.01 (0.027)	4.6 (11.4)
<i>Quercus virginiana</i>	8.74 (4.91)	47.96 (37.81)
<i>Pinus taeda</i>	0.57 (1.32)	17.14 (42.82)
<i>Celtis laevigata</i>	0.10 (0.20)	6.69 (9.90)
<i>Sapium sebiferum</i>	7.31 (4.74)	722.88 (507.12)
Total species	16.74 (3.08)	849.22 (474.07)

Table 2—Defoliation class frequencies of *Sapium sebiferum* 12-months after treatment

Treatment	Defoliation Class					
	0 %	1 to 25 %	26 to 50 %	51 to 75 %	76 to 99 %	100 %
Control	14	147	42	13	8	4
Triclopyr	16	37	20	11	28	31
Glyphosate	1	18	9	16	49	23
Imazapyr	1	2	0	0	11	61

herbicide treatments were highly significant, indicating the three herbicides produced different levels of defoliation. Chi-square tests of the defoliation class distributions of imazapyr and control, glyphosate and control, triclopyr and and glyposate were all significantly different. These tests indicate that each of the herbicide treatments were different from the controls, thus the herbicides were effective. The defoliation class distribution of the imazapyr treatment has all but three trees in the two highest defoliation classes, indicating that this was very effective. The defoliation class distribution of live oak trees only was not significantly different among the four treatments ($P = 0.27$), which indicates that the herbicides did not significantly affect the live oak trees. From these results we concluded that all three herbicides

were effective in killing Chinese tallowtrees when applied with a 'hack and squirt' technique. Among the three herbicides, imazapyr as a 50 percent Habitat solution was the most effective at defoliation. Finally, live oak trees were not affected by the Chinese tallowtree treatments.

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