United States
Department of
Agriculture

Forest Service

**Southern
Research Station**

Research Paper
SRS–43

Mechanical Removal of Chinese Privet

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Cover Photo: Small tracked machine with horizontal mulching head removing Chinese privet at the Botanical Gardens in Athens, GA, during October 2005.

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January 2007

Southern Research Station
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Abstract

Chinese privet (*Ligustrum sinense* Lour.), a highly invasive nonnative plant, is prevalent in the Southern United States. Chinese privet infestations can hinder regeneration of desirable species, reduce stand productivity, and have other undesirable consequences. A combined mechanical (mulching) and chemical (triclopyr) treatment was applied to Chinese privet in forest stands in Georgia on an experimental basis. The cost of removing Chinese privet was estimated to be $737 per acre when a tracked 110-horsepower mulching machine and a two-person herbicide application crew are employed.

Keywords: Chemical treatment, Chinese privet, Georgia, invasive nonnative plant, mechanical treatment, mulching machine, triclopyr.

Introduction

Chinese privet (*Ligustrum sinense* Lour.) is one of the most invasive nonnative plants in the Southern United States. It infests millions of acres and is extremely difficult to control due to its adaptability to various site conditions (http://www.gwf.org/vol14no2.htm). Introduced into the United States in the 1800s, it arrived without the natural controls of insects and diseases that keep plants in their natural balance (Miller 1999). Natural regeneration in stands infested with Chinese privet can be adversely affected, resulting in a loss in stand productivity. Miller suggests that invasive exotic plants impede forest productivity, hinder forest-use activities, and limit diversity and wildlife habitat (Miller 1997).

Recommended control measures (Miller 2003) include various applications of herbicide. Control by ground spraying can be very labor intensive, while aerial application can be extremely expensive. In many situations plants are too tall for effective treatment using ground application methods, making it essential to incorporate alternative treatment techniques. For example, injecting herbicide around the trunk into the cambium layer is one alternative but is labor intensive and time consuming. Using a combination of mechanical and chemical treatments to control this invasive species may reduce both labor requirements and treatment costs. Although ineffective by themselves, both mechanical and burning treatments can give additional kill of herbicide-weakened plants and may have a place in an integrated pest management program (Miller 1999).

Study Overview

This study was initiated by the Insects and Diseases of Southern Forests Research Work Unit of the USDA Forest Service, Southern Research Station. A total of four sites were treated, each measuring 3 to 5 acres and consisting of both bottomland hardwood and mixed pine-hardwood stands. Sites were all located within the floodplain of the Oconee, North Oconee, or Middle Oconee Rivers. The objective was to treat all Chinese privet having a diameter > 1 inch 1 foot above the ground using a mulching machine. Some privet exceeded 6 inches in diameter at the sites. No other trees with a diameter 4 inches or larger at 4.5 feet aboveground were cut. All preexisting coarse woody debris on the ground > 6 inches in diameter was avoided, if possible. After mulching, a three-person crew treated cut stumps with a 30-percent mixture of a triclopyr herbicide. The efficacy of the herbicide treatment will be reported in future publications.

Production data were collected on two of the sites—the Sandy Creek Nature Center (site 1) and the Georgia State Botanical Gardens (site 2). Both sites are located in Athens, GA. Site 1 was a bottomland hardwood stand comprised mainly of sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*), maple (*Acer* spp.), and elm (*Ulmus* spp.). Site 1 was flat over most of its area, with abrupt slopes of 12 to 15 percent along approximately half of its perimeter. Site 2 was also a bottomland hardwood stand with boxelder (*Acer negundo*), sweetgum, river birch (*Betula nigra*), sycamore (*Platanus occidentalis*), and pine (*Pinus* spp.) as the predominant species. Site 2 was flat over its entire area. However, this site did contain a beaver pond which measured approximately 1.65 acres. The pond was totally dry during data collection and no privet was present in this area, but ground conditions were too soft to permit machine operation on the dry pond bottom in any case.

Machine Overview

The mulching machine used has a 110-horsepower engine and is mounted on 8-foot-long rubber tracks. It has a low ground pressure (4.2 pounds per square inch) and was appropriate for use in these low areas. The head has a horizontal shaft and 24 flail-type teeth, which rotate at 2,200

revolutions per minute. Teeth are attached to the head with pins. Tooth life is around 150 hours, while pin life is about 450 hours (Personal communication. 2005. Don Pennington, Contractor, GFA Land Clearing, 1224 Devon Street, SE, Palm Bay, FL 32907). The machine makes a 5.5-foot swath as it works through an area. The contractor estimated fuel consumption at 6 gallons per hour.

Methods

Time study data were collected to determine machine productivity in terms of acres per hour. A stopwatch was used to time the machine during operation. Observations of the machine working were taken throughout the day. After timing was completed for an observation, a global positioning system unit was used to determine the size of the treated area. Four observations were collected on site 1 and three on site 2. In addition to time study data, travel speeds were also estimated. For this, the track length was measured to the nearest 0.1 foot using a logger's tape and the machine was timed as the length of the track was traversed.

While the machine progressed through a stand, a three-person crew followed up the mechanical treatment by applying a 30-percent mixture of the triclopyr herbicide to the exposed cambium of severed stumps using a handheld pressurized chemical sprayer.

Results

Time study data are provided in table 1. The mulching machine averaged 0.19 acres per productive machine hour (pmh) overall. Time spent treating 1 acre averaged 6.43 hours for the two sites. Total productive time for site 1 was 11.5 hours. Total area treated was about 2.85 acres, which resulted in a gross productivity of 0.25 acres per pmh. Time study data estimated a productivity of 0.18 acres per pmh for site 1. For site 2, total treated area was around 3.20 acres. Total machine time for site 2 was 20.5 hours, which gave a gross production rate of 0.16 acres per pmh. A productivity of 0.22 acres per pmh was estimated from the time study data. Figures 1 and 2 illustrate pre- and post-treatment conditions of a bottomland hardwood site infested with Chinese privet.

Table 1—Summary of elementary statistics for time study

Variable	Site 1	Site 2	Site 1	Site 2
	acres/pmh		*hours/acre*	
Mean	0.18	0.22	6.97	5.72
Standard deviation	0.070	0.120	4.511	3.166
Minimum	0.07	0.11	4.58	2.88
Maximum	0.22	0.35	13.73	9.13

pmh = productive machine hour.

Figure 1—Site 1: Pretreatment.

Figure 2—Site 1: Post-treatment.

Mechanical Costs

Owning and operating costs for the mulching machine were estimated using a machine rate analysis (Miyata 1980) and are summarized in table 2. Salvage value was estimated to be 20 percent of the purchase price (Brinker and others 2002). An interest rate of 10 percent and an insurance rate of 4.5 percent (Brinker and others 2002) of the purchase price were assumed. Fuel cost was calculated using $2.15 per gallon for diesel fuel and a fuel consumption rate of 0.0545 gallons per horsepower hour. A rate of 36.8 percent of fuel cost was used to estimate lube cost (Brinker and others 2002). A repair and maintenance rate of 100 percent of annual depreciation was assumed (Brinker and others 2002). Costs for teeth and pins were calculated using figures obtained from talking with the owner. For a forestry heavy equipment operator (occupation code 8160), a rate of $15 per scheduled machine hour was used, plus 30 percent for benefits. Machine utilization was assumed to be 75 percent.

The estimated total cost of $71.40 per scheduled hour includes owning, operating, plus labor and benefits, and 20 percent for profit and overhead. Cost per acre is the ratio of total cost on a pmh basis to a productivity of 0.18 acres per

Table 2—Cost summary for the mulching machine

Variable	Cost	Owning	Operating	Total cost	$/acre
Purchase price ($)	110,000				
Salvage value ($)	22,000				
Depreciation ($/yr)	17,600				
Average yearly investment ($/yr)	74,800				
Interest ($/yr)	7,480	14.22	25.78	71.40	529
Insurance ($/yr)	3,366				
Fuel and lube ($/pmh)	17.63				
Repair and maintenance ($/pmh)	11.73				
Teeth and pins ($/pmh	5.01				
Labor and benefits ($/smh)	19.50				

pmh = productive machine hour; smh = scheduled machine hour.

pmh. These machine costs reflect the average costs over the life of the machine and do not account for taxes.

Figure 3 illustrates the sensitivity of cost per acre to productivity, especially in the range from 0.1 to 0.5 acres per pmh. An increase in productivity from 0.2 acres per pmh to 0.3 acres per pmh results in a 33-percent reduction in cost per acre. Alternatively, going from 0.9 acres per pmh to 1 acre per pmh results in a 10-percent reduction in cost.

Chemical Costs

About 6.75 gallons of the herbicide were applied to cut stumps at each site. The market price for this type of herbicide is around $89 per gallon. This results in a total chemical cost of approximately $200 per acre. To effectively treat freshly cut stumps, the chemical application needs to be concurrent with the mechanical treatment. In this study, a three-person crew followed the machine and sprayed cut stumps. However, a two-person crew seems adequate for this size machine. U.S. Department of Labor wage rates for brush thinners (occupation code 8010) in Georgia are $11.53 per hour. With 30 percent benefits the labor cost for a two-person crew would be around $30 per hour. If the operation is proceeding at 0.2 acres per hour, the total cost of chemical and labor would be $350 per acre. Assuming 20 percent for profit and overhead results in a total chemical and labor cost of $420 per acre.

Discussion

The mulching machine used is small and maneuverable, and maneuverability is an important factor when operating in a residual stand. However, the small size of the machine also resulted in low productivity in terms of acres per hour treated and, thus, higher total treatment costs. It seems unlikely the machine used would be capable of treating more than 0.3 acres per pmh under the conditions observed in this study. At this production rate, mechanical treatment cost would be around $317 per acre. Therefore, chemical and manual labor costs for chemical application are an additional $420 per acre for a total treatment cost of $737 per acre. A larger machine would be more productive, although higher owning and operating costs would also be incurred. For example, one available machine would likely be able to treat at least 0.75 acres per pmh. With a machine price of $300,000 mechanical treatment cost would be around $292 per acre. A production rate of 1.25 acres per pmh would result in a mechanical cost of $175 per acre, which is also possible for the larger size machine.

It is important to recognize that mechanical treatment of privet, by itself, is not a complete tool. Effective herbicide application is required to control sprouting. The combined operational costs measured in this study are about $700 per acre with over half associated with the chemical application. However, the mulching machine ground the stumps down to the level of the soil and distributed mulched privet over the entire site. This made finding and treating stumps difficult. Postponing herbicide treatment until stump sprouts appear and then applying foliar herbicide to kill residual privet would reduce costs because a follow-up foliar application will be required to kill seedlings and stumps that were missed. A late fall or early winter foliar application should effectively kill the privet with minimal impact on the native plant community (Harrington and Miller 2005).

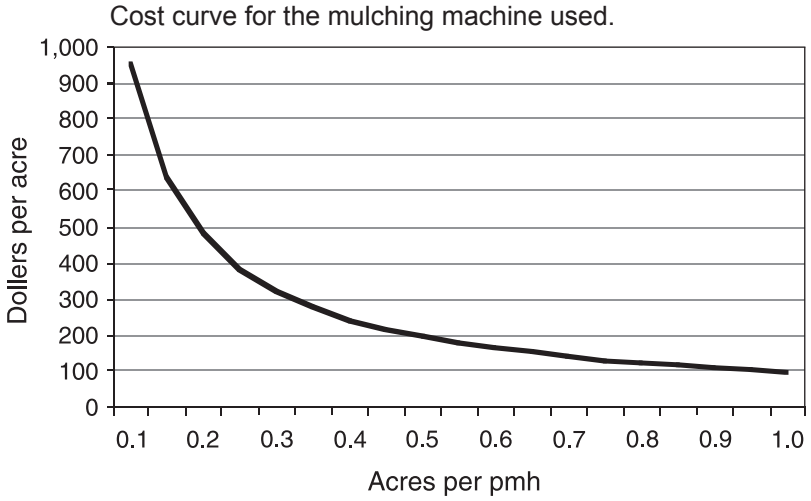

Figure 3—Effect of productivity on cost per acre for the mulching machine used.
pmh = production machine hour.

Acknowledgments

Funding for the Chinese privet removal study was provided through the USDA Forest Service, State and Private Forestry, Forest Health Protection, Special Technology Development Grant R8–2005–01. Funding for the production study provided by the USDA Forest Service, Southern Research Station, Forest Operations Research Work Unit.

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The Forest Service, United States Department of Agriculture (USDA), is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.