Evaluation of Cogongrass Control Techniques for Nonindustrial Private Landowners in Mississippi*

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Abstract: Introduced in the winter of 1911-1912, cogongrass (*Imperata cylindrica* (L.) Beauv.) has invaded thousands of forested acres across the Southeast United States resulting in considerable negative impacts on forest regeneration and growth. Cogongrass grows in dense, monotypic stands which out-compete native vegetation thus decreasing biodiversity of flora and fauna. To successfully regenerate an infested pine stand, a "window" of reduced cogongrass competition must be provided. Control of this noxious grass can be obtained through the use of herbicides such as Arsenal AC and Accord Concentrate. Although long-term control is difficult to achieve, short-term control for the purpose of stand regeneration can be obtained through different combinations and levels of herbicides and surfactant. A hypothetical regeneration scenario was created to evaluate six herbicide combinations using Land Expectation Value as criteria to determine which combination is more efficient in terms of cost and cogongrass control. The herbicide combination of 3 oz/ac Arsenal AC, 15 oz/ac Accord Concentrate, 12 oz/ac SurfPro surfactant directly applied by wand at 35 gallons per acre provided an optimal combination of cost efficacy and cogongrass control.

Keywords: Cogongrass, forest land, herbicides, invasive species, land expectation value, monetary returns, pine

Introduction

Introduced from Asia in the winter of 1911-1912, cogongrass (*Imperata cylindrica* (L.) Beauv) has invaded the southeastern United States resulting in substantial biological and monetary losses to forest landowners. Cogongrass was accidentally introduced into Grand Bay, Alabama as packing material for a crate of Satsuma oranges. Shortly afterwards, it was planted at experiment stations in Mississippi, Alabama, and Florida to test its potential for use as a forage crop (Tabor 1949, Tabor 1952). From these points of original infestation, cogongrass has spread by seed, rhizome, and intentional planting to cover thousands of acres across the Southeast.

Cogongrass seed heads contain up to 3,000 wind disseminated inflorescences that have an average travel distance of 49 feet, but have been reported to travel over a much longer range (Holm et al. 1977). Seeds require bare soil for germination, and disturbances within a forest

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stand such as thinning or site preparation can facilitate the establishment of this noxious weed (Shilling et al. 1997). Rhizomes, or cogongrass roots, can reach levels of 16 tons per acre and comprise up to 60% of the total biomass of a cogongrass patch (Terry et al. 1997). High rhizome densities allow cogongrass to rapidly spread and dominate across a site. Rhizomes can be spread by contaminated fill material, tires, grapples, and blades of machinery used in or around cogongrass patches (Willard 1988, Dozier et al. 1998). All that is required for establishment is 0.0035 ounces of rhizome and one rhizome can spread to cover 172 square feet in 11 weeks (Soerjani and Soemartwoto 1969, Eussen 1980).

Although thriving under full sunlight, cogongrass can survive under canopy while receiving 1% ambient light (Gaffney 1996). Once established, cogongrass forms very dense, tall, monotypic stands that exclude most native vegetation other than large trees and dense shrubs resulting in lower quality wildlife habitat and an altered fire regime that can potentially damage larger pine trees (Lippincott 1997). These characteristics allow cogongrass to dominate the understory reducing biodiversity and making pine stand regeneration extremely difficult. Natural pine seedling recruitment is hampered due to the high foliar density of cogongrass which out-competes seedlings for light, water, and nutrients (Lippincott 1997). Clearcut pine sites also increase the competitive advantage of cogongrass. Increased sunlight and disturbed soil create ideal conditions for cogongrass to grow and spread (Dickens and Moore 1974). To successfully regenerate a pine stand, a "window" of control must be provided to allow for the establishment and early growth of planted or natural pine seedlings. Numerous studies have reported imazapyr and glyphosate based herbicides to be most effective in controlling cogongrass (Gaffney 1996, Willard et al. 1997, Dozier et al. 1998, Miller 2000). However, unknown are the monetary effects of controlling cogongrass for stand establishment in terms of after tax Land Expectation Value (LEV) for a pine forest management regime typical of the southeastern United States. The study objective was to analyze, compare, and discuss monetary and biological returns for alternative cogongrass control treatments and costs of site rehabilitation or planting.

Methods

Four cogongrass control treatments (Table 1) were compared as part of a hypothetical southern pine forest management regime using LEV as determinate criteria assuming a 6% interest rate. Treatments varied in level of Arsenal AC, Accord Concentrate, surfactant, and applied volume in gallons per acre (GPA). Treatments 1 and 2 were evaluated from 2004-2006 at the John C. Stennis Space Center in Hancock County, Mississippi. Data for treatments 3 and 4 were derived from a study done by Ramsey et al. (2003) in 1999-2001. PTAEDA3 was used to predict thin and harvest yields for a loblolly pine (*Pinus taeda*) plantation planted on a cogongrass infested cutover site. Four treatments were considered in conjunction with mechanical site preparation in year zero to provide a "window" of reduced cogongrass competition to allow for successful regeneration. Revenues included $651.21 from thinning at age 17, and $5,248.18 generated at final harvest. Timber prices were Mississippi statewide averages for 2006 from Timber Mart-South. Table 2 lists all cost information used in analyses. Treatments were compared in terms of monetary and biological returns to determine the most efficient cogongrass control treatment.

Table 1. Ounces of herbicide and surfactant applied per acre by tractor to create a "window" of cogongrass control for the establishment of a hypothetical southern pine forest management regime.

Treatment	Arsenal AC	Accord Concentrate	Surfactant
1[a]	2	15	10
2[a]	2	15	7
3[1b]	16	-	8
4[b]	-	188[2]	94

[1]Applied in consecutive years.
[2]Accord not Accord Concentrate.
[a]Treatments 1 and 2 applied by wand at 35 gallons per acre in April 2004.
[b]Treatments 3 and 4 applied by ATV boom sprayer in November 1999 and 2000 (Ramsey et al. 2003).
[b]Applied volume per acre not reported, 25 gallons per acre assumed for analysis.

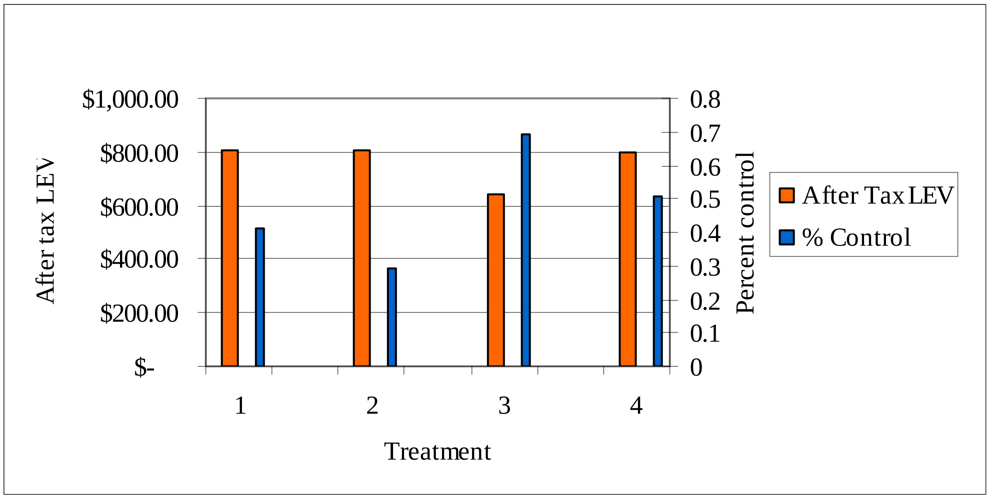
Table 2. Herbicide, application, site preparation, tree planting, tax, and management costs in 2006 dollars used in financial analysis of four alternative cogongrass control treatments considered for a hypothetical southern pine forest management regime.

Treatment	Cost ($)	Other Activities	Cost ($)
1[a]	16.59	Tractor Application (25 gpa)	45.00
2[b]	16.43	Tractor Application (35 gpa)	65.00
3[c]	57.09	Site Preparation	60.00
4[d]	43.66	Planting 537 Seedlings/Acre	57.40
		Land Use Tax	4.46
		Management Fees	2.06

[a]Treatment 1 consists of 2 oz Arsenal AC, 15 oz Accord Concentrate, 10 oz surfactant.
[b]Treatment 2 consists of 2 oz Arsenal AC, 15 oz Accord Concentrate, 7 oz surfactant.
[c]Treatment 3 consists of 16 oz Arsenal AC applied in consecutive years (Ramsey et al. 2003).
[d]Treatment 4 consists of 188 oz Accord, 94 oz surfactant (Ramsey et al. 2003).

Results

Treatment 1 (2oz Arsenal AC, 15oz Accord Concentrate, 10oz surfactant, applied at 35GPA) resulted in a before tax LEV of $807.32 and provided 41% control two years after treatment. Treatment 2 (2oz Arsenal AC, 15oz Accord Concentrate, 7oz surfactant, applied at 35 GPA) had a before tax LEV of $807.52 but provided only 29% cogongrass control two years after treatment. Treatment 3 (16oz Arsenal AC, 8oz surfactant, applied twice in consecutive years) had the lowest before tax LEV of $643.11 but provided good control two years after treatment at 69%. Treatment 4 (188oz Accord, 94oz surfactant) had a before tax LEV of $798.79 and provided 51% control two years after treatment.



Treatment 1 consists of 2 oz Arsenal AC, 15 oz Accord Concentrate, 10 oz surfactant.
Treatment 2 consists of 2 oz Arsenal AC, 15 oz Accord Concentrate, 7 oz surfactant.
Treatment 3 consists of 16 oz Arsenal AC applied in consecutive years (Ramsey et al. 2003).
Treatment 4 consists of 188 oz Accord, 94 oz surfactant (Ramsey et al. 2003).

Figure 1. Before tax Land Expectation Value in 2006 dollars and percent control comparison of four alternative cogongrass control treatments considered for a hypothetical southern pine forest management regime.

Discussion and Conclusions

Treatments 1 (2oz Arsenal AC, 15oz Accord Concentrate, 10oz surfactant, applied at 35GPA) and 2 (2oz Arsenal AC, 15oz Accord Concentrate, 7oz surfactant, applied at 35 GPA) produced the greatest monetary returns, but the lowest percentages of cogongrass control. This was primarily due to lower herbicide rates, thus lowering the herbicide cost used in these treatments. Treatment 3 (16oz Arsenal AC, 8oz surfactant, applied twice in consecutive years), although providing good cogongrass control, had the lowest LEV of all treatments evaluated. Higher rates of Arsenal AC and two applications resulted in a much higher cost for this treatment. Further decreasing LEV was the opportunity cost of delaying the harvest one year for the split herbicide application. However, this cost was minimal compared to herbicide and application costs. Treatment 4 (188oz Accord, 94oz surfactant) produced a high LEV, approximately $10 less than treatments 1 and 2, and provided greater than 50% cogongrass control two years after treatment. Overall, treatment 4 provided the best combination of monetary returns and cogongrass control for this hypothetical southern pine forest management regime.

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