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Nantucket pine tip moth control and loblolly pine growth in intensive pine culture: two-year results

David Kulhavy
Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, dkulhavy@sfasu.edu

Jimmie L. Yeiser
Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University

L. Allen Smith

NANTUCKET PINE TIP MOTH CONTROL AND LOBLOLLY PINE GROWTH IN INTENSIVE PINE CULTURE: TWO-YEAR RESULTS

David L. Kulhavy, Jimmie L. Yeiser, and L. Allen Smith[1]

Abstract—Twenty-two treatments replicated four times were applied to planted loblolly pine, *Pinus taeda* L. on bedded industrial forest land in east Texas for measurement of growth impact of Nantucket pine tip moth (NPTM), *Rhyacionia frustrana (*Comstock), and effects on pine growth over 2 years. Treatments were combinations of Velpar, Oust, and Arsenal herbicides and diammonium phosphate (DAP) fertilizer with treatments in 2000, or both 2000 and 2001. Ten of the treatments were treated with Mimic timed with pheromone traps to reduce NPTM infestations. Mimic was an effective control, and there was a small but significant increase in the loblolly pine growth at the end of the second growing season. The best growth of pines with the most intensive treatments was equal with and without NPTM control. NPTM control did, however, make a difference on intermediate treatments.

INTRODUCTION

The Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock) (NPTM), is an important pine regeneration insect in the Eastern and Southern United States (Berisford 1987). Larval feeding in meristematic tissue of young pines causes significant damage, particularly in areas where forest regeneration favors its proliferation (Yates and others 1981). Southeastern industrial forestry currently emphasizes establishment of large, homogeneous pine plantations to maximize production of wood and fiber. This forest management practice also creates optimal conditions for phytophagous insects, whose sole or primary hosts are pine trees. Increased damage by NPTM following vegetation control treatments may include improved suitability of pine tissue for larvae and a greater abundance of NPTM feeding sites (Ross and Berisford 1990). NPTM infestation rates tended to increase as site preparation intensity increased and levels of competing vegetation and overstory decreased (Berisford and Kulman 1967, Hertel and Benjamin 1977, Hood and others 1988, Lantagne and Burger 1988, White and others 1984, Zutter and others 1986). Miller and Stephen (1983) indicated competing herbaceous and woody vegetation provides food and shelter for NPTM predators and parasites.

Pritchert and Smith (1972) observed little change in NPTM infestation on trees fertilized with nitrogen. Application of phosphorus, however, resulted in a significant NPTM reduction, with potassium reducing NPTM even further. Tiarks and Haywood (1986), in a study measuring effects of fertilization and vegetation control on loblolly pine, observed uniform NPTM damage across all treatments, but NPTM infestation rates were not quantified. Meeker (1987) found a negative correlation between NPTM levels in soil and foliage, and NPTM infestation rates, with increasing levels of phosphorus associated with decreasing infestation rates. Reasons for this are not known, but increased vigor may serve to bolster the trees' natural defenses, particularly resin production (Berisford 1987).

Herbicides, including Sulfometuron methyl (Oust®) and Hexazinone (Velpar®-L), are commonly used to reduce competing herbaceous vegetation in loblolly pine plantations (Cantrell and others 1985, Creighton and others 1986, Michael 1985, Yeiser and Boyd 1989, Yeiser and Rhodenbaugh 1994). Use of herbicides for vegetation management continues to increase (Dubois and others 1999) along with growth (Glover and others 1994); fertilization at planting has been applied to 200,000 acres of southern pines. The resulting population of NPTM following herbicide applications and fertilizers, especially addition of phosphorus, warrants additional investigation. Ross and others (1990) found that the percentage of infested trees and the percentage of infested shoot tips were significantly higher in the banded and broadcast-treated plots than in check plots during the third NPTM generation.

METHODS

Twenty-two six-tree by six-tree plots with a two-row buffer were established on an Upper Coastal Plain industrial forest site with a fine sandy silt loam near Diboll, Angelina County, TX, in early 2000. The study was a complete randomized block with 22 treatments (table 1) replicated four times. The area was site prepared with pre-emergent herbicides and combination plowed with loblolly pine planted on the beds.

Mimic® 2LV Insecticide (active ingredient, tebufenozide) was applied following label instructions on a per-acre basis five times each season timed with pheromone traps baited with synthetic NPTM lures. Mimic registration changed from Rohm and Haas, and ownership of the product to Dow AgroSciences LLC, June 1, 2001. Dr. Don Grosman, Forest Pest Management, Texas Forest Service, Lufkin, provided NPTM trap catch data and advice on Mimic timing for application. NPTM infestations were counted on a whole-tree basis after the third generation in 2000, at the end of the season (fifth generation overwintering in the tips), after the third generation in 2002, and at the end of the season (fifth generation). Infestations were counted on

[1]Regents Professor and T. L. L. Temple Professor, Arthur Temple College of Forestry, Stephen F. Austin State University, Nacogdoches, TX 75962; and Southern Pine Beetle Specialist, Texas Forest Service, Forest Pest Control, Lufkin, TX, respectively.

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Table 1—Herbicide and fertilizer treatments, 2000–2001

March Herbicide/ Fertilizer[a]	June Herbicide[b]	March Herbicide/ Fertilizer[a]
- - - - - - - - - - - - 2000	- - - - - - - - - - - -	2001
VO[c]		
VO/125 DAP[c]		
VO/250 DAP[c]		
VO/125 DAP[c]	AO	
VO[c]	AO	
VO[c]		AO
VO/125 DAP[c]		AO/125 DAP
VO/250 DAP[c]		AO
VO/	AO	AO
VO/125 DAP[c]	AO	AO/125 DAP
VO/250 DAP[c] AO[c]	AO	AO
CHECK		

[a] VO = Velpar (10.7 ounces) + Oust (2 ounces.); AO = Arsenal (4 ounces.) + Oust (2 ounces.)
[b] DAP = diammonium phosphate.
[c] Mimic = Treatments replicated with and without Mimic; five applications of 8 ounces of product per acre Mimic each season, 2000 and 2001 timed to the 1st instar larvae of the Nantucket Pine Tip Moth with pheromone traps.

the (1) terminal (infested or not infested); (2) top whorl except for the top terminal; (3) top 1/2 of the tree; and (4) bottom 1/2 of the tree. Each tip was examined as infested or uninfested. A total tree count was taken for the site for each of the treatments over the replications. Data were analyzed with SAS, with an ANOVA using New Duncan's Multiple Range Test at the p=0.05 (SAS 1988).

RESULTS AND DISCUSSION

Data were analyzed for NPTM infestation at the end of the second growing season (2002). In additional to NPTM, coneworms, *Dioryctria* spp. infested nodes of the main stem causing either breakage of lateral branches or the main stem in limited instances. There was no difference in survival for either year 1 or year 2 for the Mimic and non-Mimic treatments, with 88.1-percent survival with Mimic in year 1 and 87.9-percent survival without Mimic; and 86.3-percent survival for both Mimic and no Mimic treatments in year 2.

Height was significantly greater for Mimic treatments in year 1 and year 2. In year 1, Mimic treatments averaged 2.2 feet, non-Mimic 2.1 feet. In year 2, Mimic treatments averaged 7.2 feet, non-Mimic 6.6 feet. For cubic foot volume, Mimic-treated plots were greater in year 1, 0.0102 cubic feet volume index compared to 0.0095 for non-Mimic treatments. In year 2, Mimic-treated plots averaged 0.26 cubic feet and non-Mimic plots 0.21 cubic feet. Ground-line diameter (inches) was significantly greater in Mimic treatments, 0.72 inches Mimic, 0.69 inches non-Mimic in year 1 and 2.13 inches Mimic, 1.98 inches non-Mimic in year 2.

A more detailed analysis of volume index (cubic feet) for year 2 indicated significant differences in whole tree NPTM infestations (table 2). There were no differences in NPTM infestation for all Mimic treatments, with a mean of 0.6 infested tips for the whole tree. Without Mimic treatments, there was an average of 8.0 infested tips per tree.

For non-Mimic treatments, NPTM infestations were significantly higher on the check plots (10.46 infested tips); VO (Velpar/ Oust) + 125 pounds DAP (diamonnium phosphate fertilizer), VO + AO (Arsenal/ Oust) + 125 pounds DAP (2000), and VO + AO (2000) and AO (2001) had the highest infestations among the treatments whereas VO + 250

Table 2—Whole tree infestations, NPTM, 2002, for fertilizer, herbicide, Mimic and check treatments

Treatments				Volume index (cubic feet)[a]		NPTM whole tree infestation	
- - - - 2000	- - - -	- - - 2001	- - -	- - - - - - - - - - - - - -	Mimic	- - - - - - - - - - - - - -	
Herb.	Fert.	Herb.	Fert.	No	Yes	No	Yes
VO				0.1325f	0.1730d	7.47dc	0.30f
VO	125			0.1758e	0.1923cd	9.70a	0.46f
VO	250			0.1987de	0.2128c	7.50dc	0.54f
VO/AO	125			0.2249d	0.2280c	9.50ba	0.45f
VO/AO	250			0.1835e	0.2090cd	8.42cb	0.40f
VO		AO		0.2070de	0.2774b	5.65e	0.60f
VO	125	AO	125	0.2871bc	0.3263a	7.07d	0.63f
VO	250	AO		0.2649c	0.3481a	5.19e	0.71f
VO/AO		AO		0.2215d		9.32ba	
VO/AO	125	AO	125	0.3114ab	0.3304a	8.14dc	1.00f
VO/AO	250	AO		0.3234a	0.3307a	7.35dc	0.68f
CHECK				0.0834g		10.46a	
			Mean	0.2174b	0.2615a	8.00	0.60

NPTM = Nantucket Pine Tip Moth.
[a] Means significantly different, $p < 0.05$; means followed by the same letter are not significantly different, Duncan's New Multiple Range Test.

pounds DAP (2000) and AO (2001), and VO (2000) and AO (2001) had the lowest. Intermediate infestations ranged from 7.07 to 8.42 infested tips.

The least volume growth occurred on the check plots (0.0834 cubic feet). The greatest volume growth occurred on six treatments, four with Mimic and two without Mimic, with the highest being VO + 250 pounds DAP (2000) and AO (2001) + Mimic. Those treatments without Mimic that had significantly greater volume were VO + 250 pounds DAP (2000) and AO (2001), and VO + 125 pounds DAP (2000) and AO + 125 pounds DAP (2001) (table 2).

NPTM infestations ranged from 7.35 to 8.14 infested tips for the intensive treatments that did not differ in cubic foot volume with or without Mimic (table 2). For intensive treatments where Mimic applications were significant, NPTM infestations were lowest on the VO + 250 lbs. DAP (2000) and VO (2001) treatments.

During a year of low to moderate NPTM infestations (2001), the most intensive cultural treatments had similar volume growth with or without Mimic for NPTM control (table 2). Mimic applications were significant with intermediate treatments (VO + 125 pounds DAP (2000) and AO + 125 pounds DAP (2001); and VO + 250 pounds DAP (2000) and AO (2001).

SUMMARY

For 2001, a year of low to moderate NPTM infestations, the most intensive cultural treatments showed no difference in cubic feet volume growth with or without Mimic. For intermediate cultural treatments, Mimic applications yielded a significant increase in tree volume. The timing of spraying coupled with the cost of the insecticide and the labor for application need to be considered in long-term intensive management of industrial pine plantations. Timing and frequency of Mimic applications need to be examined in years of high NPTM infestations.

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