Special Technology Development Program
New Project Proposal

PROJECT NUMBER: R3-2001-02

PROJECT TITLE: Biological control of Nantucket pine tip moth in shelterbelt, nursery, and landscape pines in New Mexico.

PROJECT STATUS: New

EXPECTED PROJECT DURATION: 3 years to establish permanent insectories

EXPECTED COMPLETION DATE OF THE PROJECT: FY 2003

SUBJECT: (mark all that apply using 1 for primary category and 2 for secondary categories): Biological Control-1 Invasive Species-1 Monitoring-2 Organism Biology-2

STATUS OF SUBJECT SPECIES: Non-native to New Mexico.

PROJECT OBJECTIVES: Our primary objective is to introduce the parasitoid wasp, *Campoplex frustranae* Cushman, in New Mexico as a biological control agent of the introduced pest, the Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock). Successful biological control will reduce the adverse impact of this insect in landscape, nursery and shelterbelt pine plantings, slow its spread to other parts of the Southwest, and reduce the use of pesticides currently used to control it. A secondary benefit of successful establishment of *Campoplex frustranae* would be the biological control of the western pine tip moth, Rhyacionia *bushnelli* (Busck), which also occurs in New Mexico as an introduced pest of landscape and shelterbelt plantings (Furniss and Carolin, 1977). In the absence of effective natural controls, damage is severe in many areas and these tip moth species are expanding their ranges in lower elevation tree plantings. Trees under fifteen feet tall are most susceptible to severe injury (Baker, 1972).

BRIEF DESCRIPTION OF PROJECT: This project will introduce the parasitoid *Campoplex frustranae* Cushman, (Hymenoptera: Ichneumonidae) to New Mexico for the biological control of Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock). The parasitoid will be obtained with the cooperation and assistance of the University of Georgia Department of Entomology. An outdoor insectory will be established at the New Mexico State University Agricultural Experiment Station in Los Lunas. Once established, the insectory can be used to supply the parasitoid to other areas of the Southwest to slow the spread and reduce the impact of this destructive tree pest.

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PRINCIPLE INVESTIGATORS:

- Robert Cain, Forest Entomologist, New Mexico State University Cooperative Extension Service, (505) 827-5833, sacrops@nmsu.edu fax (505) 827-3903.
- L. M. English, New Mexico State University Extension Entomologist and Superintendent of the Los Lunas Agricultural Science Center, (505) 865-7340, menglish@murphie.nmsu.edu, fax (505) 865-5163
- John Mexal, New Mexico State University, Professor, Agronomy and Horticulture, (505) 646-3335, jmexal@nmsu.edu.

COOPERATORS:

- C. Wayne Berisford, University of Georgia, Professor, Department of Entomology (706) 542-7888, beris@uga.edu, fax (706)542-2640
- David Thompson, New Mexico State University, Entomology, Plant Pathology and Weed Science Department (505) 646-2740, dathomps@nmsu.edu, fax (505) 646-8085
- John Harrington, New Mexico State University, Mora Research Station, (505) 387-2319, joharrin@nmsu.edu
- Gary Smith, University of New Mexico, Integrated Pest Management Specialist, (505) 277-2413 fax (505) 277-1250
- New Mexico State Forestry Division, Timber Management
- New Mexico State University County Agents
- New Mexico Urban Forest Council

COOPERATOR INVOLVEMENT

- Wayne Berisford: collect, rear and ship parasitoids to New Mexico.
- David Thompson: consultant in biological control and establishment of insectories, expertise in insect caging – as needed, estimated time commitment 1 –2 days.
- John Harrington: provide pine seedling stock to supplement Los Lunas plantation for host material.
- Gary Smith: secure and protect release sites on the UNM campus after insectories are established.
- NM Forestry Division personnel, NMSU County Agents and the New Mexico Urban Forest Council: identify potential release sites after insectories established.

JUSTIFICATION : Current integrated pest management strategies: (1) do little to limit the spread of Nantucket pine tip moth in the Southwest; (2) rely primarily on chemical insecticides; (3) require an extensive volunteer effort to monitor tip moth development to determine optimal chemical application periods (Cain and Parker, 1998). The introduction of a successful biological control organism could slow the spread of this tip moth species, reduce or eliminate the need for insecticide treatment and tree replacement, and reduce problems associated with improper chemical use in urban areas.

URGENCY: The problem has existed and has been expanding in New Mexico for nearly twenty years. It was one of the factors in the decline of a Christmas tree growing effort in southern New Mexico using Afghan pines. It has severely limited the usefulness of native ponderosa pine and introduced pines for urban and shelterbelt plantings in the southern two thirds of New Mexico, and has damaged nursery stock grown for landscape and land reclamation efforts. Recent reports indicate the Nantucket pine tip moth has expanded its

range into southern Arizona and west Texas. It is moving north in New Mexico and could eventually threaten pine plantings in Colorado. The biological control strategy proposed here has been successfully accomplished by the State of California, which had experienced a similar infestation of Nantucket pine tip moth (Frank and Foltz, 1997).

NATIONAL FHP TECHNOLOGY DEVELOPMENT PRIORITY:

Priority 1: X Priority 2: Priority 3: Priority 4:

TECHNICAL COMMITTEE DEVELOPMENT PRIORITY:

Priority 1: Priority 2: Priority 3: Priority 4:
Priority 5: Priority 6: Priority 7 Priority 8:

SCOPE OF APPLICATION: Successful introduction of this biocontrol agent has the potential to drastically reduce damage from this pest in pine plantations, nurseries, shelterbelts and landscapes in New Mexico and neighboring states.

RESEARCH BASIS: Two historic introductions of the parasitoid *Campoplex frustranae* have been made in the past. In 1925, the insect was released in Nebraska for control of western pine tip moth *Rhyacionia bushnelli* (Busck) which is closely related to *R. frustrana* and also part of the tip moth complex in New Mexico (Furniss and Carolin, 1972). Within five years 80% parasitism was seen (Baker, 1972). The presence of *Rhyacionia neomexicana* (Dyar) in the same area is believed to have impacted the success of the parasite because it was unable to complete development in this tip moth species. *Rhyacionia neomexicana* does occur in the higher elevation ponderosa pine plantings and forests in New Mexico but is not common in the lower elevation plantings where pine tip moth problems are most significant. A more successful introduction occurred in 1974 when releases of *Campoplex frustranae* were made in San Diego to control *R. frustranae* damage in *Pinus radiata* plantations. Pest population reduction and damage prevention were seen within three to four years (Frank and Foltz, 1997; Yates III, Overgaard, and Koerber, 1981).

METHODS

Campoplex frustanae will be collected with the assistance of University of Georgia Professor of Entomology, Wayne Berisford. To minimize the possibility of introducing a hyperparasite, the wasp will be reared to the adult stage in Georgia and then shipped to New Mexico. Due to the delicate nature of this insect, tree cages will be built around infested trees in a plantation at the Los Lunas Agricultural Science Center to minimize loss of the parasitoid to windy conditions common in New Mexico.

The initial phase of this project will be to establish the parasitoid at the Los Lunas Agricultural Science Center. Timing of collection and release for successful establishment need to be determined due to climatic differences between Georgia and New Mexico. This information will also be needed for subsequent movement of parasitoids within New Mexico. The number of parasitoids available will influence the number of caged releases possible. Three tree cages will be purchased to isolate and protect the releases.

Releases will be made as parasitoids become available. If parasitoids are available from different regions in Georgia they will be released into separate tree cages. Reproductive success and evaluation of establishment can be determined by bagging branches and

monitoring adult emergence. A small sample of emerging adults will be collected for species confirmation.

Cooperators will identify areas of infestation to serve as potential release sites and control sites. Areas will be grouped by intensity of infestation, tree species and site conditions to insure valid comparisons.

Once the population is established in Los Lunas, parasitoids will be introduced to landscape pines with cooperator agreement not to spray insecticides in the release area. Pine shoot damage within release areas will be compared to untreated trees in neighboring control areas. Parasitism will be evaluated by sampling shoots from trees in and near release areas beginning one year after initial release.

MEASURES OF SUCCESS

Standard of Success: Establishment of a reproducing population of *Campoplex frustranae* to reduce the population of *Rhyacionia frustranae* below damage thresholds will be the standard of success. Shoot surveys to determine percent parasitism and damage surveys of infested shoots will be used to measure project success. It is recognized that when populations of both the insect host and the parasitoid reach endemic levels, they will be more difficult to detect.

Expected outcomes: Control and tree replacement costs will be reduced by at least 50% in New Mexico in twenty years. Introductions of *Campoplex frustranae* elsewhere have proven very successful with 80% parasitism achieved within five years at a release site in Nebraska and significant pest reduction within three years in southern California. Similar results are expected in the Rio Grande Valley, plains, and high dessert communities of New Mexico. Foothills and mountain communities above 7,000 feet may have less success due to the greater abundance of *Rhyacionia neomexicana* which in Nebraska attracted unsuccessful oviposition and reduced parasite populations. Releases will not be made in areas where *R. neomexicana* is commonly caught in pheromone traps.

Implementation of Products/Methods: A publication will be prepared which describes the methods and results of this project.

PRODUCTS AND DUE DATES:

REPORTS: Progress reports will be submitted annually as required by the STDP program.

PUBLICATIONS: If establishment is successful, a New Mexico State University publication will be produced detailing the methods and results of this project. A joint publication with the Forest Service is another possibility. Because successful establishment of the wasp cannot be confirmed without several years of monitoring, preparation of these documents would not be attempted before 2005.

OTHER MEDIA: The New Mexico State University Agricultural Communications Department will develop radio, press and print materials detailing the project. Current integrated pest management strategies involve pheromone trap monitoring and timely

insecticide sprays. Mass media will be needed make sure insecticides are not applied in release areas.

TECHNOLOGY TRANSFER: A publication suitable for use by other agencies wishing to undertake similar introductions of this species in the Southwest will be prepared after wasp establishment is confirmed.

LONG-TERM BUDGET REQUEST

	Item	**Requested FHP STDP Funding**	**Other – Source Funding**	**Source**
FIRST YEAR				
Administration	Salary	$ 5,000	$13,000	NMSU
	Overhead	$ 4,018		
	Travel	$ 5,000	$ 500	NMSU
Procurements	Contracting			
	Equipment	$ 3,000	$ 1,000	NMSU
	Supplies	$ 1,000	$ 500	NMSU
Year Totals		**$**18,018	$15,000	NMSU
SECOND YEAR				
Administration	Salary	$ 3,000	$14,000	NMSU
	Overhead	$ 2,726		
	Travel	$ 5,000		
Procurements	Contracting			
	Equipment			
	Supplies	$ 1,500		
Year Totals		$12,226	**$**14,000	NMSU
THIRD YEAR				
Administration	Salary	$ 3,000	$14,000	NMSU
	Overhead	$ 2,726		
	Travel	$ 5,000		
Procurements	Contracting			
	Equipment			
	Supplies	$ 1,500		
Year totals		$ 12,226	14,000	NMSU
PROJECT TOTALS		**$ 42,470**	**$43,000**	

BENEFIT AND COST:
See production function worksheet below

LITERATURE, CITATIONS, ATTACHMENTS, etc.:

Baker, Whiteford L., 1972. Eastern Forest Insects. USDA Forest Service. Misc. Pub. 1175

Cain, Robert and Doug Parker. 1998. Conifer Pests in New Mexico. USDA Forest Service. Southwestern Region. 50 pp.

Frank, J. Howard and John L. Foltz. 1997. FHTET-96-20 Classical Biological Control of Pest Insects of Trees in the southern United States: A Review and Recommendations. p. 57.

Yates III, H. O., N. A. Overgaard, and T. W. Koerber. 1981. Nantucket pine tip moth. USDA Forest Serv. Forest Insect & Disease Leaflet 70. 7pp.

Personal communications cited:

- Dr. Gary Smith, IPM specialist and Manager of Grounds and Landscaping at University of New Mexico
- Kim Kostelnik, Program Manager of New Mexico State Forestry Conservation Seedling Program
- Dodie Suhr, Manager Bryan Suhr Tree Care Company
- Clinton Daugherty, Manager Rowlands Nursery, Albuquerque / Las Cruces
- Sherry Sanderson, Entomology and Nursery Industries Bureau Chief, New Mexico Department of Agriculture.

Production Function Analysis

Project number: R3-2001-02
Project cost : $42,470 FHP + $43,000 NMSU = $85,470

PROJECT OBJECTIVE: This project will attempt to establish an effective biological control of *Rhyacionia frustrana*, a devastating pest of landscape, nursery plantation and shelterbelt pines in New Mexico. The effectiveness of the selected parasitoid has been demonstrated in California and Nebraska. The primary benefits of this introduction would be to slow the spread and reduce the adverse impacts of this introduced insect in the Southwest, as well as to reduce pesticide use. Secondary benefits include increased success of landscape and shelterbelt pine plantings, reduced growing costs by eliminating the need for monitoring, insecticide application, and tree replacement, and reduced environmental effects from pesticide exposure and runoff. Environmental benefits, urban landscape cost savings and potential nursery industry benefits are difficult to quantify.

ASSUMPTIONS

Significant levels of parasitism will be achieved and damage reduction will occur at the release site within 3-5 years after successful wasp introduction. Twenty years will be required for the parasite to become established within all the currently infested areas of the state. Movement of the parasite will be enhanced by maintaining additional insectories in the future and actively introducing the parasite to new areas. An 80% reduction in population could result in an even greater reduction of control and tree replacement costs; however, to be conservative we will assume a 50% reduction in these costs in 20 years.

Justification for the following assumptions is in the Background Data appendix.

For shelterbelt plantings assume the following:

- Number of trees is based on New Mexico State Forestry Conservation Seedling sales for year 2000.
- All Afghan pine and 50% of the ponderosa, Scots and Austrian pine seedlings purchased are planted in pine tip moth infested areas.
- Fifty percent of tree seedlings purchased will survive transplanting and become susceptible to pine tip moth damage.
- Seedling trees will be susceptible for at least ten years after planting (until they are over fifteen feet tall).
- Fifty percent of surviving trees are sprayed annually.
- Twenty five percent of the untreated trees need to be replaced because they were not sprayed. Replacement cost for a seedling is $ 2.00 including labor.
- Shelterbelt landowners do the treatment themselves with their own equipment at a cost for insecticide of $3.33 per tree.

For nursery production plantations assume the following:

- 100 % of the Afghan pine growing stock is sprayed at least once a year for three years.
- There are 680 trees per acre.
- 87 acres of Afghan pine are ready for nursery sale each year.

- Due to the smaller size of nursery growing stock, insecticide cost is $1.33 per tree and labor and equipment costs are not a factor.

For urban landscape trees assume the following:

- Each year at least 10,000 host trees are planted in urban landscapes in pine tip moth infested areas.
- Trees will be susceptible to damage for at least five years after planting.
- An average cost for treating an urban landscape tree is $19.77
- Fifty percent of susceptible urban landscape trees are sprayed each year.
- Annually, twenty-five percent of urban landscape trees need to be replaced, at a cost of $50.00 per tree, because they were not treated.

QUANTATIVE ANALYSIS

Expenditures and Output Values (EOV) Without Project:
cost of insecticide treatment + tree replacement in the shelterbelt + nursery plantation + urban landscape settings x 20 annual treatments x discount factor

EOV without project =[(144,497 +10,848) + (236,048 + 0) + (494,250 + 625,000)] x 20 x .45639 = $**13,788,847**

EOV With Project
This assumes a 50% reduction in control costs in twenty years. Discount using method 2.

EOV with project = [13,788,847 – (.5 x 13,788,847)] x .45639 = $**3,146,546**

Benefit Attributable to Project

EOV without – EOV with = 13,788,847 – 3,146,546 = **$10,642,301**

Benefit/Cost Ratio

B/C = 10,579,341 / (42,470 + 43,000) = **124**

Benefit Attributable to STDP Funds

124 x 42,470 = **$5,266,280**

PNV of Project

10,642,301 – (42,470 + 43,000) = **$10,556,831**

PNV of STDP

5,266,280 – (42,470 + 43,000) = **$5,180,810**

APPENDIX:

BACKGROUND DATA USED IN DEVELOPING THE ECONOMIC ANALYSIS

Costs to control the Nantucket pine tip moth in New Mexico have been considerable. Expense to the homeowner varies depending on treatment strategy. Insecticides are ideally applied within a few weeks of egg laying by the first generation. One pesticide application at the correct time appears to be sufficient to reduce damage for landscape trees. Nursery production stock may require a second pesticide application for the second generation of pine tip moth depending on the infestation levels and tolerance for damage. An assumption of only one treatment period will be used to simplify cost benefit calculations.

Optimal periods for insecticide application are best determined by monitoring with pheromone traps. Pheromone trapping is done by individual landscape managers as well as by volunteer Master Gardeners with the NMSU Extension Service in several counties in New Mexico. Monitoring costs for traps and pheromones for the Master Gardener program in Valencia, Bernalillo and Santa Fe counties were $88 / 50 lures and $50 / 50 traps plus significant volunteer hours. These costs will not be considered in the benefit cost analysis.

Insecticide costs vary on the product purchased and the number of trees treated, the equipment used and whether the product is applied by the homeowner or a commercial pesticide applicator. Bryan Suhr Tree Care Company charges $35 for one tree and a sliding scale for additional trees (Suhr, personal communication). Cost on commercial and public landscapes also vary considerably. Landscape companies may subcontract insecticide treatment costs to pesticide applicators and charge separate monitoring and treatment costs to the property owner. Public landscapes vary considerably in the monitoring and treatment of pine tip moth. The University of New Mexico in Albuquerque has an active integrated pest management program in place and provides the most reliable estimate of control costs. Cost analysis done by Dr. Gary Smith, Manager of Grounds and Landscaping at the University of New Mexico campus in Albuquerque included labor ($30.53 /hour for 2 employees), vehicle and equipment fuel and depreciation ($7.85/ hour), cost of insecticide (Telstar $3.33/ tree at 5 gallons per tree) and average time taken (4 trees per hour). He determined an average per tree treatment cost of $21 not including the cost of pheromone trap monitoring. The University of New Mexico spends over $4,000 annually for a single insecticide treatment of 197 host trees on campus (Smith, personal communication, 2,000).

Another hidden cost is planting failure and tree replacement where no treatment occurs.

Conservative estimates will be made due to the difficulty of determining the amount of susceptible plant material in New Mexico.

- Estimates for the number of trees in shelterbelt plantings are based on annual conservation seedling sales by the state of New Mexico. In 2000 this included, 10,045 Afghan pine, 5008 Austrian pine, 2,640 Scots pine and 6,976 ponderosa pine (Kostelnik, personal communication). All of the Afghan pine and about 50% of the other tree species were planted in Nantucket pine tip moth infested areas (17,357 trees). This does not

include private tree purchases or federal government conservation tree planting programs. Trees will be susceptible to tip moth damage until they are fifteen to twenty feet tall. Conservatively, this will take at least ten years. Assuming a seedling survival rate of 50%, each year, approximately 86,785 trees will be at risk to damage by pine tip moth. If preventive sprays were applied to fifty percent of these trees at a cost of $3.33 per tree the total cost would be **$144,497.** This includes only the cost of insecticide and does not include labor, monitoring costs or equipment costs and depreciation. Untreated trees damaged by tip moth are unsuitable in a windbreak. Assume 25% of these trees (12.5% of 86,785) are replaced at a cost of $1 per seedling and $1 for labor. Replacement cost due to tip moth equals **$10,848**

- Estimates of numbers of host trees in commercial nursery production is based on New Mexico Department of Agriculture nursery licenses which track acres of plant material only during the year in which it is sold. Not included are growing stock acres, noncommercial pine plantations and operations operating illegally without a state license. In 2000, 87 acres of Afghan pine nursery stock were licensed for sale (Sanderson, personal communication). Smaller operations also produce Scots, Austrian and ponderosa pine nursery stock. No acreage figures were available for these species. Assuming 680 trees per acre on the 87 licensed acres and three years worth of susceptible growing stock each on a similar acreage, this would equal about 177,480 trees requiring treatment each year. Assuming 100 % of nursery stock production is sprayed at least once annually, the insecticide cost alone equals **$236,048**.

- Estimates of the numbers of host trees in urban landscapes is the most difficult to determine and this is where the insect has its most noticeable impact. Host pine trees are an important part of the xeric landscapes of southern New Mexico. Mediterranean pines (*Pinus eldarica, P. halepensis*) are among the most important landscape trees of the rapidly growing southern part of the state. Native ponderosa pine and introduced European pines (*P. nigra, P. sylvestris*) are important evergreen landscape trees in the Albuquerque area. The states largest nursery outlet, Rowlands Nusery has four stores in the Albuquerque area and one in the Las Cruces area. Manager Clinton Daugherty reports they sell 500 Afghan pine, 500 Austrian pine, 1,000 mugho pine and 80 Scots pine annually. There are over one thousand other tree vendors in the state that sell host tree species for home landscapes. An estimate of host trees sold and planted within infested urban areas of the state is conservatively five times that sold by Rowland's nusery. This would be approximately 10,000 trees planted annually, each requiring monitoring and possible treatment for at least five years after planting. Assuming consistent numbers, then there would be 50,000 landscape trees susceptible to damage from pine tip moth annually. Per tree costs could vary from $35 from a commercial pesticide applicator, $ 21.00 for the cost of labor and equipment for public pesticide applicators or $3.33 for a homeowner using his own equipment. Assuming an equal number of the above situations the average cost per tree sprayed in urban landscapes would be $19.77. If fifty percent of the susceptible trees were sprayed the cost would be **$ 494,250** and the gallons of mixture sprayed would equal 125,000. Severely tip moth damaged trees are unsuitable in the urban landscape. Assume that twenty five percent of the trees need to be replaced because they were not treated. At a cost of $50 per tree the replacement cost would equal **$625,000.**

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