



## Special Technology Development Program New Project Proposal

**PROJECT NUMBER:** R8-2002-01 New Proposal

**PROJECT TITLE:** Enhancement of the antiaggregation pheromone verbenone for disrupting southern pine beetle infestations by the addition of racemic endo-brevicommin.

**PROJECT STATUS:** New

**EXPECTED PROJECT DURATION:** 3 years

**EXPECTED COMPLETION DATE OF THE PROJECT:** December 31, 2004.

**SUBJECT:**

1. Total Suppression/Prevention Technology	%	2. Survey and Monitoring Technology	%
a. Total Biological Control		a. Advancements in Detection Technology	
i. Microbial %		b. Landscape Level Assessment Technology	
ii. Parasitoids %		i. Data Visualization	
iii. Synthetic hormones/pheromones %	X 100		
iv. Other %		c. Remote Sensing	
b. Total Modeling		i. Aerial %	
i. Pesticide (Insecticide) Application %		ii. Hyperspectral %	
ii. Disturbance %		iii. Satellite %	
iii. Growth and Yield %		d. Other	
iv. Organism %			
v. Population %			
vi. Terrain %			
c. Genetic, Cultural and Silvicultural Innovations For Controlling Pest Species		3. Assessment Technology	%
i. Fire %		a. GIS %	
ii. Methyl Bromide Alternatives %		b. Spatial Analysis %	
iii. Thinning/Regeneration Techniques and other Silvicultural Guidelines %		c. Landscape Analysis %	
iv. Resistance, Screening, and Breeding %		d. Decision Support % Risk and Hazard % Expert Systems %	
d. Pesticide Application (Special) Technology		4. Social Values	%



(Spray) Technology i. Equipment innovations % ii. Methods and Guidelines %			5. Technology Transfer Innovations	%	
e. Other		%	6. Other	%	

**STATUS OF SUBJECT SPECIES:** native

**PROJECT OBJECTIVES:** Refine an existing southern pine beetle spot disruption technique by adding the multifunctional pheromone endo-brevicomin to the anti-aggregation pheromone verbenone, to increase efficacy and range of application.

**BRIEF DESCRIPTION OF PROJECT:**

**Year 1 and Year 2:** Locate southern pine beetle (SPB) spots in late spring/early summer through state, USFS personnel and Natural Resource Management (Fort Benning) personnel. Monitor the identified infestations to insure that they are active and growing. Treat spots with the “Verbenone only” technique for spot disruption. Treat additional spots with reduced amounts of verbenone plus various rates of racemic endo-brevicomin. Monitor untreated control spots with similar SPB activity levels for growth along with the treated spots. Compare spot growth rates among the various treatments. Our goal is to treat a minimum of 3 spots with each treatment in each of the first 2 years..

**Year 3:** From the analysis of the first 2 years of treatments, select the most efficacious rate of verbenone plus endo-brevicomin. Treat spots with this combination and compare to spots treated with the standard verbenone only technique. As in other years, monitor untreated spots in the same area for comparison of growth with treated spots.

**FHP LEAD CONTACT (FHP person submitting proposal):**

<b><u>Name</u></b>	<b><u>Affiliation (Office or Dept.)</u></b>	<b><u>Phone, E-mail, Fax</u></b>
Stephen R. Clarke	USFS-FHP	(936) 639-8646 sclarke@fs.fed.us

**FHP LEAD INVOLVEMENT:**

	<b><u>Role</u></b>	<b><u>Time Commitment</u></b>
Stephen R. Clarke	Locate SPB spots in gulf area states if necessary	50 hours

**PRINCIPAL INVESTIGATOR(S):**

<b><u>Name</u></b>	<b><u>Affiliation (Office or Dept.)</u></b>	<b><u>Phone, E-mail, Fax</u></b>
C. Wayne Berisford	Dept. of Entomology, Univ. of Georgia	(706) 542-7888 berisford@bugs.ent.uga.edu

Mark J. Dalusky	Dept. of Entomology, Univ. of Georgia	(706) 542-2289 mjdalusky@arches.uga.edu
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**PRINCIPAL INVESTIGATOR(S) INVOLVEMENT:**

<b><u>Name</u></b>	<b><u>Role</u></b>	<b><u>Time Commitment</u></b>
C. W. Berisford	Spot evaluation and treatment Preparation of reports and publications	5 percent annually

M. J. Dalusky	Spot selection, evaluation, treatment monitoring for efficacy preparation of reports	25 percent annually
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**COOPERATORS:**

<u>Name</u>	<u>Affiliation (Office or Dept.)</u>	<u>Phone, E-mail, Fax</u>
Joe Fowler	USFS Oakmulgee District	(205) 926-9765
Bobby Lee	USFS Oakmulgee District	(205) 926-9765
Mike Aparicio	USFS Oconee NF	(706) 845-7110
Terry Price	Georgia Forestry Commission	(800) GA-TREES
Bob Larimore	Natural Resources, Ft. Benning	(706) 544-7319
Mark Byrd	Natural Resources, Ft. Benning	(706) 544-7066
David Wakarchuk	Phero Tech Inc.	(609) 940-9944 davidw@pherotech.com

**COOPERATOR INVOLVEMENT:**

<u>Name</u>	<u>Role</u>	<u>Time Commitment</u>
Joe Fowler Bobby Lee	Detection/ground check of SPB spots on Oakmulgee NF	100 hours*
Mike Aparicio	Detection of SPB spots on Oconee NF	100 hours
Terry Price	Detection of SPB spots on Georgia State and private lands	50 hours
Bob Larimore Mark Byrd	Detection of SPB spots on Ft. Benning Military Reserve	100 hours
Phero Tech Inc.	Will provide verbenone pouches and release devices for endo-brevicommin	na

\* SPB is currently epidemic in these areas. Detection and follow-up ground checks could take 3-4 days per week during May-September.

**JUSTIFICATION:** Frequently, the standard options for control of SPB are unavailable to the forest land manager. Environmental, aesthetic and public safety considerations may limit their ability to mediate SPB damage. Spot disruption and manipulation using pheromones has a distinct role to play in the array of available tools. This project is designed to explore the potential for reducing overall treatment costs and expanding the range of infestations that may be treated by adding the multi-functional pheromone endo-brevicommin. In past trapping studies (Salom et al. 1992), endo-brevicommin consistently reduced female:male trap catch ratio and inhibited female SPB response to a greater degree than verbenone alone (Dalusky and Berisford, unpublished data).

**URGENCY:** Southern pine beetle has been epidemic in most of the southern states east of Mississippi for the past 2-3 years. States which traditionally have not had serious SPB problems suffered particularly heavy infestations (eg. Florida, Tennessee and Kentucky ). Mortality due to rapid spot growth during the late spring and summer represents a massive loss of timber in the affected areas.

**NATIONAL FHP TECHNOLOGY DEVELOPMENT PRIORITY**

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

The project uses synthetic versions of natural pheromones to control SPB infestations and therefore falls into the biological control category as described in the guidelines.

**TECHNICAL COMMITTEE DEVELOPMENT PRIORITY: NA**

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

**SCOPE OF APPLICATION:** Results of this project can be applied throughout the southeastern U. S. from Delaware in the north to Texas in the west.

**RESEARCH BASIS :** The verbenone technique for SPB spot disruption is well-grounded in research. Trapping studies (Salom et al. 1992) demonstrated the efficacy of different enantiomeric ratios of verbenone in shutting down traps baited with the SPB aggregation pheromone frontalin. Several years of field trials using various release rates and release devices resulted in the development of two techniques for using verbenone to disrupt SPB spot growth (Clarke et al. 1999). Endo-brevicomin was shown by Vite' et al. (1985) to be a pheromone with multiple functions for SPB depending on which enantiomers were present and in what concentrations. Endo-brevicomin is particularly effective in disrupting the response of SPB females which initiate new attacks (Salom et al. 1992). Spot disruption using verbenone in a treated buffer zone at the spot head has been shown effective 70-80% of the time on small to moderate size, active SPB infestations. Several research projects and a TDP spanning the last decade have culminated in an EPA-registered product with a detailed protocol for transferring this technology to the field. The technique is currently limited in that to address infestations with large numbers of brood trees or in large diameter timber, felling is required and chemical costs may become prohibitive. Our working hypothesis is that by combining verbenone with endo-brevicomin, we may be able to reduce the amount of verbenone required and be able to treat somewhat larger spots with minimal felling.

**METHODS:**

Infestations located in the late spring to early summer will be monitored at least 1 week pre-treatment to ensure adequate spot growth and directionality. If subsequent monitoring indicates growth of at least 1 tree per day, spots will be treated with the "verbenone only" technique as described in Clarke et al. (1999). Spots treated with the published method will serve as internal standards with which to compare treatments involving variation in amounts of verbenone and addition of endo-brevicomin. Initially, we will place 2/3 the number of endo-brevicomin devices on the trees as verbenone pouches, but the endo-devices will elute at only 8 mg per day. From this starting point and as success and failure dictates, amounts of verbenone will be reduced by 25% and 50%, keeping the endo-brevicomin constant. Untreated control spots will be monitored in the same general area for spot growth parameters as they become available. A minimum of 3 replicates for each treatment at each location is our goal. Post-treatment spot growth expressed as number of trees killed per day is our efficacy criterion. Additionally, spots that fall outside of the established limits on numbers of infested trees and mean DBH will be treated with the standard amount of verbenone with endo-brevicomin devices added in equal numbers. A minimum of 3 reps per year will be attempted on these treatments also. Treated infestations will be monitored for a minimum of 6 weeks.

Mean trees killed per day for each treatment and control will be compared via ANOVA at alpha=0.05. A significant F-test will result in an attempt to separate treatment means via Student-Newman-Keuls (SNK) or the Kruskal-Wallis one-way ANOVA on ranks with mean separation done by a Tukey Test or SNK (SigmaStat V2.03; Jandel Corp. 1997).

**MEASURES OF SUCCESS:**

**Standard of Success:** Treatments will be considered successful when their spot growth compared to pre-treatment and control spot growth is reduced by at least 50%, and the spot is contained within the treated buffer.

**Expected Outcomes:** We expect that by adding endo-brevicomin, we can reduce verbenone costs and increase the range of infestations that may be treated with this technique.

**Implementation of Products/methods:** If the addition of endo-brevicomin can effectively reduce the use of verbenone and increase the types of infestations that can be treated, our industrial cooperator is prepared to make endo-brevicomin release devices available along with the verbenone pouches which are currently being registered for use.

**PRODUCTS AND DUE DATES:** Any modification to existing verbenone technology that reduces costs and increases applicability in regard to spot size and mean DBH will be incorporated into existing technology transfer programs. The release devices for endo-brevicomin should be ready for distribution shortly after the culmination of this evaluation.

**PUBLICATIONS:** A publication will be prepared and published in an appropriate scientific journal after year 3 of the program detailing the results from this project.

**TECHNOLOGY TRANSFER :** Positive results from this project will be incorporated into an existing technology transfer program for training federal, state and private employees (Salom et al. 1998).

**PRODUCT LEVERAGING :** This project is part of a long-term research program and builds on approximately 15 years of field and laboratory research.

**LONG-TERM BUDGET REQUEST:**

	<b>Item</b>	<b>Requested FHP STDP Funding</b>	<b>Other- Source Funding</b>	<b>Source</b>
<b>FY 2002</b>				
<b>Administration</b>	Salary	\$8,000	\$13,000	UGA
	Overhead		\$11,550	UGA
	Travel	\$2,000		
<b>Procurements</b>	Contracting			
	Equipment			
	Supplies	\$10,000		
<b>YEAR TOTALS</b>		\$20,000	\$24,550	UGA

<b>FY 2003</b>				
<b>Administration</b>	Salary	\$8,000	\$13,000	UGA
	Overhead		\$8,750	UGA
	Travel	\$2,000		
<b>Procurements</b>	Contracting			
	Equipment			
	Supplies	\$2,000		
<b>YEAR TOTALS</b>		\$12,000	\$21,750	UGA

<b>FY 2004</b>				UGA
<b>Administration</b>	Salary	\$8,000	\$13,000	UGA
	Overhead		\$8,750	UGA
	Travel	\$2,000		
<b>Procurements</b>	Contracting			
	Equipment			
	Supplies	\$2,000		
<b>YEAR TOTALS</b>		\$12,000	\$21,750	UGA
<b>PROJECT TOTALS</b>		\$44,000	\$68,050	UGA

**LONG-TERM BUDGET REQUEST EXPLANATION:** The first year budget includes a one-time purchase of endo-brevicomin that should be adequate for the study. Salary requests are for hourly labor only.

**BENEFITS:** Reduced costs and increased efficacy and a potentially wider range of application of this pheromone based control technique.

**LITERATURE, CITATIONS, ATTACHMENTS, etc.:**

Clarke, S. R., S.M. Salom, R. F. Billings, C.W. Berisford, W.W. Upton, Q.C. McClellam, and M.J. Dalusky. 1999. A scentsible approach to controlling southern pine beetles. *J. Forestry*. 97:26-31.

Salom, S.M., R. F. Billings, W. W. Upton, M. J. Dalusky, D. M. Grosman, T. L. Payne, C. W. Berisford, and T. M. Shaver. 1992. Effect of verbenone enantiomers and racemic endo-brevicomin on response of *Dendroctonus frontalis* (Coleoptera: Scolytidae) to attractant-baited traps. *Can. J. For. Res.* 22: 925-931.

Salom, S. M., R. F. Billings, C. W. Berisford, S. R. Clarke, Q. C. McClellam, M. J. Dalusky, T. J. Robinson, and J. E. Johnson. 1998. Basis for technology transfer of inhibitor-based suppression tactics for the southern pine beetle. *South. J. Appl. For.* 22: 24-34.

Vite', J. P., R. F. Billings, C. W. Ware, and K. Mori. 1985. Southern pine beetle: Enhancement or inhibition of aggregation response mediated by enantiomers of endo-brevicomin. *Naturwissenschaften* 72: 99-100.