United States
Department of
Agriculture

Forest Service

Forest Pest
Management

Davis, CA

SIXTH REPORT

NATIONAL STEERING COMMITTEE FOR MANAGEMENT OF WESTERN DEFOLIATORS

Healthy Forests
Make A World
Of Difference

FPM 93-14
September 1993

Pesticides used improperly can be injurious to human beings, animals, and plants. Follow the directions and heed all precautions on labels. Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S Environmental Protection Agency, consult your local forest pathologist, county agriculture agent, or State extension specialist to be sure the intended use is still registered.

FPM 93-14
September 1993

Sixth Report

National Steering Committee for Management of Western Defoliators

Prepared by:

John W. Barry
Chairperson

USDA Forest Service
Forest Pest Management
2121C Second Street
Davis, CA 95616
(916)551-1715
FAX (916)757-8383

SIXTH REPORT

National Steering Committee - For Management of Western Defoliators

A Report of the West Sacramento, CA Meeting - August 24-25, 1993

September 23, 1993

USDA Forest Service
Washington Office/Forest Pest Management
2121 C 2nd Street
Davis, CA 95616
(916)758-4600
(916)551-1715

CONTENTS

APPENDICES

A. Agenda

B. FPM Strategic Planning

C. Non-Target Sub-Committee Report

D. Registered Pesticides and Labels

E. Technology Development Needs - Letter to WO

F. 1995 Farm Bill Issues - Letter to WO

G. Strategic/Tactical Planning Documents

H. Member Reports

I. INTRODUCTION

A. Place and Purpose of Meeting

The Committee met at West Sacramento, CA, on August 24-25, 1993 to discuss and list technology development needs and to develop a Strategic/Tactical Plan for managing western defoliators. We were successful in realizing meeting objectives. The committee enthusiastically pursued discussions of the draft Strategic/Tactical Plan and actively participated in incorporating identified needs into goal and action statements.

B. Attendees

Jack Barry	WO/FPM (Davis, CA)
Dayle Bennett	FPM (Albuquerque, NM)
Nancy Campbell	FPM (Missoula, MT)
Dave Grimble	PNW Res. Sta. (Corvallis, OR)
Bruce Hostetler	FPM (Portland, OR)
Ladd Livingston	Idaho Department of Lands (Coeur d'Alene, ID)
Richard Reardon	NA/NCFH (Morgantown, WV)
Dave Rising	MTDC (Missoula, MT)
Sheri Smith	FPM (Sonora, CA)
Julie Weatherby	FPM (Boise, ID)
John Wenz	FPM (Sonora, CA)

C. Strategic Plan - Healthy Forests for America's Future

We reviewed the goals of the forest health strategic plan, distributed copies to attendees, and discussed this plan in the context of the Strategic/Tactical Plan for managing western defoliators. We also discussed the relationship of these referenced plans to ecosystem management and other FPM plans, and discussed the conceptual diagram enclosed in Appendix B that projects a relationship of FPM planning activities. These discussions served a useful purpose in setting the stage for the two day meeting.

D. Review 1992 Recommendations

We reviewed the committee's 1992 recommendations and deferred discussions until sub-committee and member reports were presented.

II. COMMITTEE REPORTS

A. Sub-Committee Reports

1. Strategic/Tactical Plan for management of Western Defoliators.

John Wenz presented a revised draft of the Strategic/Tactical Plan for Management of Western Defoliators (see Appendix G). The plan has 4 main elements as follows:

- Functions/interactions of Defoliators in Western Forest Ecosystem Dynamics
- Population Evaluation
- Management
- Technology Transfer

2. Registered Pesticides for Western Defoliators

Julie Weatherby presented a listing of insecticides that are registered for control of western defoliators. The packet includes specimen insecticide labels of the listed insecticides. Our special thanks to Julie and Sheri Smith for their hard work in producing this excellent reference. This will be published as a supplement to this report.

3. Impact of Biological Insecticides on Non-Target Insects

Dick Reardon provided an inclusive summary of US and Canadian activities on impact of Bt on non-target species (see Appendix C). This will be published as a joint AIPM and defoliator steering committee report. The committee extends its appreciation to Dick Reardon and Steve Munson and their cooperators for assembling the bibliography.

B. Member Reports

Reports of committee members are enclosed in Appendix H. In addition to these committee reports there is a Technology Development Progress Report (R4-91-100) and work plan by Lonne Sower on use of synthetic pheromone to disrupt Douglas-fir tussock moth mating.

III. DISCUSSION OF NATIONAL NEEDS

A. National Needs And Priorities

The Committee identified 19 needs and prioritized the list through member voting. Those with the highest priority are listed below along with the number of votes each received.

- Study natural roles and effects of major western defoliators and their natural enemies on resources. (6 votes)
- Pursue DFTM pheromone registration for mating disruption. This need includes all activities necessary to obtain registration. (5 votes)
- Identify data needs that prevent ecosystem management of WSBW. (5 votes)
- Enhance and adapt WSBW and DFTM population dynamics model for use in the Forest Planning Process. (5 votes)
- Evaluate TM Biocontrol-1 potency on wild populations collected from different geographical areas. (4 votes)
- Explore silvicultural options for prevention of unacceptable effects caused by defoliators. (4 votes)
- Develop DFTM pheromone application technology for formulations and delivery. (4 votes)
- Evaluate impact of Bt on non-target species, conduct field inventories and develop methodologies. (3 votes)
- Evaluate Entotech carrier for TM Biocontrol-1. (3 votes)
- Conduct field tests of DFTM pheromone to evaluate treatment timing in an outbreak cycle. (2 votes)
- Develop and evaluate a tree hazard rating system for WSBW and DFTM. (2 votes)

- Examine long-range forecasting of pest populations using pheromone technology and other methods. (2 votes)

- Evaluate effects and impact of a selected WSBW outbreak using a current outbreak by collecting, analyzing, and reporting data. (2 votes)

- Develop a sampling system for hemlock looper.

- Validate and calibrate WSBW damage model. Evaluate the capabilities and limitations of the WSBW population dynamics model.

- Evaluate natural enemies on DFTM populations.

- Develop procedures to assist in the decision making process and to plan and implement a spray project.

- Examine effects of larval feeding and defoliation on Douglas-fir seed production.

B. Other Needs and Issues

- Evaluate the DFTM early warning system to improve predictability and efficiency of the system.

- Long-term monitoring of permanent plots is a problem due to retirements, changes in management, reorganizations, changing priorities, etc.

- Emphasize prevention and seek funding.

- Pursue cooperation with National Center for Forest Health.

- Provide a national contact point for information on forest-use pesticides and labels.

- Need an expert system for information on biology, behavior, impact, management, etc. of major forest defoliators.

- Need processes for economic, biological, and socio/political analysis to support forest manager decisions.

- Need to determine what we want WO/FPM/MAG to provide field from the DFTM database.

- Need a resource directory that lists FPM and FIDR scientists - their speciality and interests. Such a directory would be useful in identifying specialists for specific questions that come from the public and private sector.

- Pest models need to be evaluated, improved, used, or scrapped.

- Need to evaluate needs related to hardwood defoliators.

IV. STRATEGIC / TACTICAL PLAN DISCUSSION

A. Purpose

The purpose of this Strategic/Tactical Plan (Plan) is to support the FPM Technology Development process by establishing a system of identifying goals and actions that support Forest Pest Management's strategic (long-range) and tactical (short-range) direction and goals to protect the health of America's forests. The scope of the Plan is primarily limited to managing western defoliators with the FPM Program. Basic research cannot be separated and for this reason, research, as essential to accomplishing the goals, is included in the Plan. In this context the Plan, therefore, becomes a rationale, logical, and sequential system to achieve stated goals. It provides management a roadmap and an instrument to monitor progress.

B. Background

The evolution of the FPM Technology Development Program is one of continued effort to improve its process, efficiency, productivity, and accountability. Prior to establishing national steering committees in 1988 the process of managing the technology development, or special projects, was generally undefined, focused on the near-term, lacked prudent accountability and was not tied to strategic goals. Given those shortcomings the program was productive but clearly there was the need for improvement. Each year since 1988 the FPM Technology Development Program has been improved to address its new needs and opportunities. Suggestions and support from field units, the FPM National Steering Committees, and availability of a WO Staff Scientist to manage the Program have contributed to an effective FPM Technology Development Program.

The National Steering Committee for Managing western defoliators and the other FPM National Steering Committees, were asked in 1993 by the Director, FPM to prepare 5-Year Tactical Plans. The plans are to specify short-term needs within a 5-Year span that are of high

priority and consistent with strategic forest health planning. The relationship of national steering committee tactical forest health and ecosystem management planning is outlined on the enclosed figure (not available on DG version of this report). The figure clearly identifies the role and relationship of the steering committee in support of forest health and ecosystem management.

C. Program Elements, Goals, and Actions

This committee identified 4 Program Elements that cover all proposed activities with the Strategic/Tactical Plan. If the need does not fit one of these categories, it is likely beyond the scope of this committee and its plan. The categories are:

- Functions/Interactions of Defoliators in Western Forest Ecosystem Dynamics
- Population Evaluation
- Management
- Technology Transfer

Within these categories, activities would include basic research, applied research, development, demonstrations, operations, and technology transfer. Under current law FPM is prohibited from funding basic research, but FPM can appropriately coordinate needs with researchers and form partnerships to address research needs that affect tactical planning goals.

D. Format of Plan

We have chosen a format that does not include a vision or mission statement to be consistent with the Chief's direction of one Forest Service vision and mission statement. Each Element is described by a Goal statement, followed by Action items to accomplish the goal, and a Rationale that clarifies and expands upon the Action, explaining why the Action is important and how it relates to the Goal. In case there is need for sub-actions, we can refer to these as Strategies in future updates of the plan. Each Action and Strategy will be assigned a time for completion with a 5-year to 7-year span.

V. SUMMARY

The National Steering Committee for Management of Western Defoliators met at West Sacramento, CA, August 24-25, 1993. The primary purpose of the meeting was to identify and prioritize FPM Technology Development Program needs and to develop the format and goals of a Strategic/Tactical Plan for managing Western Defoliators. This was a very productive meeting with each member giving a report on activities over the past year and actively participating in developing the Strategic/Tactical Plan. Needs identified during the meeting were integrated into the draft Strategic/Tactical Plan that had been drafted by John Wenz and his sub-committee. Ladd Livingston volunteered to host the next meeting April 12-13, 1994 in Spokane, WA, and the Sheraton Hotel has been booked for our meeting. Meanwhile committee members will continue to develop the Plan.

Appendix A

Agenda

Draft
(8-20-93)

AGENDA

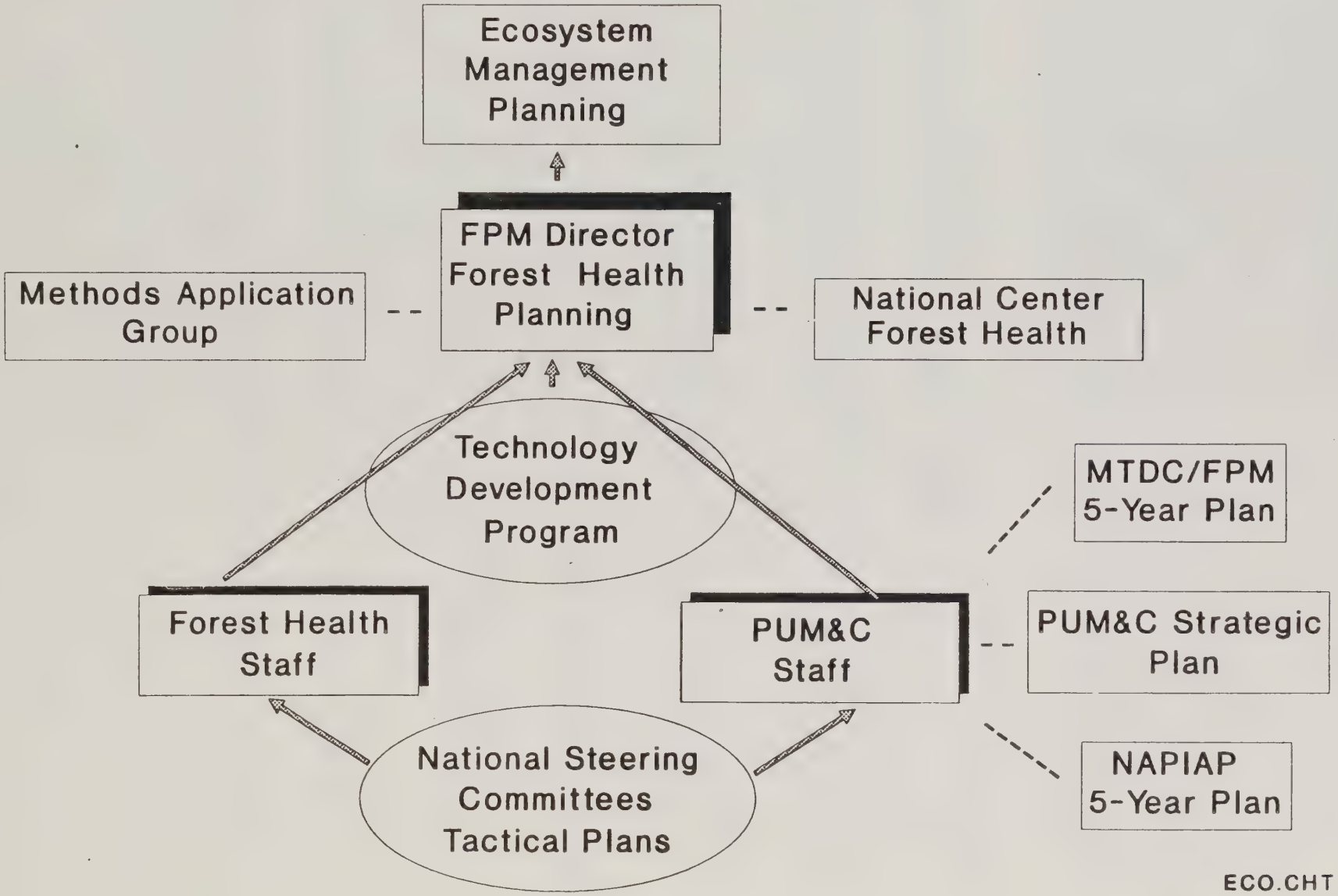
National Steering Committee - Western Defoliators
West Sacramento, CA
24-25 August 1993

August 24	Topic	Discussant
0800	**INTRODUCTION**	Jack Barry
	Purpose of Meeting Expectations	
	STRATEGIC PLAN - HEALTHY FORESTS FOR AMERICA'S FUTURE	Jack Barry
	REVIEW 1992 MEETING	
	Recommendations Follow-up activities	Jack Barry Members
	SUB-COMMITTEE REPORTS	
	Strategic Plan for Management of Western Defoliators	John Wenz
	Registered Pesticides for Western Defoliators	Julie Weatherby
	Impact of Biological Insecticides on Non-Target Insects	Dick Reardon
	MEMBER REPORTS AND NEEDS	Members
1700	Adjournment	
August 25		
0800	**TACTICAL PLAN**	
	Definition, Purpose, Format, & Sample	Jack Barry
	Relationship to Strategic Plans	
	List of Needs, Projects/Tasks	Members
	Priorities	Members
	Goals and Actions	Members
1700	Adjournment	

Appendix B

FPM Strategic Planning

Relationship of WO/FPM National Steering Committee Tactical Planning to Forest Health and Ecosystem Management Planning



ECO.CHT

TALKING POINTS ON FOREST HEALTH STRATEGIC PLAN

New plan available

The Chief's new forest health strategic plan is now available and will be mailed to the Regional Foresters, Area Director, Station Directors, and State Foresters in the next 2 weeks.

Relationship to 1988 plan

The new plan builds on the Chief's 1988 forest health strategic plan.

It continues the goals in the 1988 plan with new actions and adds new goals and actions for forest health restoration, management of introduced pests (like the gypsy moth), exclusion of exotic pests (for example, those that might be brought in with proposed log shipments from Russia or elsewhere), and international cooperation in forest health.

Purpose

The principle purpose of the plan is to further strengthen agency policies and direction for responding to forest health problems.

Major concerns addressed in the plan are the forests where ecological conditions have been or are being altered resulting in increased susceptibility to drought, pest epidemics, and wildfire. Other significant concerns are introduced pests and pest and wildfire problems in the urban-wildland interface.

The plan also responds to continuing Congressional and public concern about forest health, incorporates ecosystem management and an expanded international role, and renews the agency's committment to protecting and restoring forest health.

The plan identifies the major forest health concerns facing the country at this time and identifies the actions we need to take as an agency and with our partners to address these concerns.

Concerns closely related to forest health, for example, those related to protection of grasslands and wetlands are not addressed in this plan.

Major differences between this plan and the old plan

This plan specifically addresses forest health restoration, introduced pests, problems in the urban-wildland interface, and international forestry.

The relationship of fire to forest health receives much more attention.

Research programs are fully integrated.

Responsibility for plan development and implementation

The plan was developed under the direction of the W.O. Forest Health Steering Committee and the Ecosystem Management Task Team on Forest Health.

An implementation plan is now being developed.

Implementation requires joint action by a cross-section of Washington Office staffs in State and Private Forestry, Research, National Forest System, Programs and Legislation, and the Public Affairs Office.

The Chief has asked Al West and Jim Space to work with the other W.O. Deputies and Staffs to implement the new plan.

Role of the Regions, Area and Stations

The strengthening of national policies and direction will, in turn, enable the Regions, Area, and Stations to strengthen their plans and programs and better integrate forest health into planning and decision making.

Relationship to ecosystem management

The plan emphasizes the strong tie between ecosystem management and forest health.

Considering the ecological significance of pests and wildfire is a key part of ecosystem management and will lead to fewer forest health problems in the future.

Relationship to land management planning

In this plan, like the 1988 plan, a desired state of forest health is a condition where biotic and abiotic influences on the forest (for example, pests, atmosheric deposition, silvicultural treatments, and harvesting practices) do not threaten resource management objectives now or in the future.

This description links forest health to the formal land management planning process for the National Forest System.

The plan recognizes the critical need to integrate forest health as part of ecosystem management into the next round of forest plan revisions and forest plan implementation.

Recommendations in the plan will help ensure that forest health is a consideration in the LMP directives and the prototype forest plans.

State role

Forest health problems extend across jurisdictions and ownerships. Coordinated action is necessary.

The National Association of State Foresters participated in development of the plan.

The plan will strengthen Forest Service-State cooperative programs including the Cooperative Forest Health Program, Cooperative Fire Protection Program, Forest Health Monitoring Program, Forest Stewardship Program, and Urban and Community Forestry Program.

Relationship to Other Initiatives

Region/Area/Station initiatives are addressing on-the-ground needs using a variety of management strategies and practices, whereas this plan addresses national direction and policy needs.

The plan, by strengthening national direction and policies will complement Region/Area/Station forest health initiatives already underway. It does not take the place of regional programs, plans, or policies and regional initiatives underway should proceed at the same time national directions and policies are being strengthened.

Relationship to Forest Service Mission

The Forest Service mission includes "Advocating a conservation ethic in promoting the health, productivity, diversity, and beauty of forests and associated lands."

STRATEGIC GOALS

There are 12 strategic goals in the updated plan. Eight were carried forward from the 1988 plan and four additional goals were added to address new concerns

- PLANNING

  The ecological significance of pests and wildfire is considered in all forest resource management planning processes.

- PREVENTION

  Susceptibility to pests is decreased by applying available forest management options.

- SUPPRESSION

  Pest suppression and fire control options and funding are available to meet resource management objectives.

- ENVIRONMENTAL ANALYSIS

  Program-level National Environmental Policy Act documents are available prior to outbreaks of major pests.

- PESTICIDES

  Environmentally acceptible pesticdes are available to protect forest values and achieve resource management objectives.

- FOREST PROTECTION TECHNOLOGY

  Effective, economical, and environmentally acceptible forest protection technologies are available to meet forest resource management objectives.

- FOREST HEALTH MONITORING

  A Forest Health Monitoring Program is eventually established nationwide, and provides information on forest conditions and trends for formulation of national policy.

- FOREST HEALTH RESTORATION

  Those forests that have suffered recent severe mortality from drought, pests, and wildfire are eventually restored to sustainable and productive condition, and other forests highly susceptible to this same kind of event are treated to avert similar damage.

- MANAGEMENT OF INTRODUCED FOREST PESTS

  Plans and capabilities exist to limit spread or eradicate newly introduced forest pests, and to minimize ecosystem disruption from pests that have already been introduced or may be introduced in the future.

- EXCLUSION OF EXOTIC FOREST PESTS

  Plans and policies are developed and applied to prevent additional forest pest introductions into the United States.

- INTERNATIONAL COOPERATION IN FOREST HEALTH PROTECTION

  Forest health protection is recognized as a problem requiring international cooperation, common interests are identified with other countries, and long-term relationships are developed to amintain and protect forest health worldwide.

- PUBLIC INVOLVEMENT

  The public is informed about current forest health conditions and the role of pests and wildfire in forest ecosystems, and accepts and supports measures needed to restore and protect forests.

Appendix C

Non-Target Sub-Committee

Dick Reardon

United States Department of Agriculture | Forest Service | NA

Reply to: 1350 **Date:** August 19, 1993

Subject: FY93 Report of Non-target Impact Subcommittee

To: Jack Barry
Chairman, Eastern and Western Defoliator Nat'l Steering Committees

Overview

FY91 -- At the 1991 meeting (September 10-11, Blacksburg, VA) of the National Steering Committee for Managing Gypsy Moth and Eastern Defoliators, three subcommittees were formed: Pilot Training, Non-target Impact, and Canopy Characterization. In a letter (September 17, 1991) you requested that I chair the Non-target Impact subcommittee and include as subcommittee members: Leo Cadogan, FPMI/Canada and Steve Munson, R-4/FPM. In a follow up letter (March 10, 1992) you suggested two additional members: Dave Grimble, R-6/PNW and Dayle Bennett, R-3/FPM, and identified the charge of the subcommittee: to identify what is known and data gaps about the impacts of Bt and diflubenzuron (dimilin) on non-target Lepidoptera, aquatics, birds, and small mammals, and to submit a bibliography and recommendations to the steering committee at the 1992 meeting.

FY92 -- I was unable to attend the 1992 meeting (August 18-19, Albuquerque, NM) of the National Steering Committee for Managing Gypsy Moth and Eastern Defoliators but submitted a letter to you concerning progress by the Non-target Impact subcommittee. As a brief summary of that letter: Leo and I met at FPMI in April 1992 and discussed the need to identify scientists from the U.S. and Canada who would be interested in or were conducting non-target impact studies in forest ecosystems. In July 1992, Leo identified a preliminary group of scientists (list A) which was updated by Steve Holmes (list B). Leo and I intended to select a core group of scientists from list B and meet with them at the Pest Control Forum in Ottawa (November 1992).

Also, initial versions of Dimilin and Bt bibliography databases were developed through the efforts of Munson in association with the University of Utah and Amy Onken (Forest Health Protection, Morgantown) in conjunction with West Virginia University (see attachment). At that time, the databases contained about 700 and 900 citations concerning efficacy and non-target impacts, respectively.

Following the 1992 meetings of the Eastern and Western Defoliator Committees, Steve Munson sent a letter to me stating that 3 additional western representatives (Bruce Hostetler, R-6/FPM; John Wenz, R-5/FPM; and Larry Stipe, R-1/FPM) were selected to participate on the Non-target Impact subcommittee to help identify needs in the West. Steve Munson and I had the impression that these western representativies were added to the original Non-target Impact subcommittee but, in fact, you had intended Steve to chair another subcommittee "Impact of Biological Insecticides on Non-target Organisms" for the Western Defoliator Steering Committee.

In September 1992, I formed a technical review team composed of mostly eastern scientists (list C) to begin to develop guidelines and protocols for a proposed long-term evaluation of regional impacts of Bt and gypsy moth defoliation on selected non-targets in the East. This long-term regional project was proposed in response to data gaps identified during preparation of the EIS for the Appalachian Gypsy Moth Project (AIPM Project) and follow-up meetings with a coalition of environmental groups from Virginia and West Virginia.

FY93 Activities

Both bibliography databases were expanded and now contain approximately 950 and 1,500 citations, respectively. The databases are stored on disk and we are in the process of obtaining a reprint of each citation. The Dimilin database is nearing completion, whereas the Bt database can be expanded to include additional efficacy citations. There are no citations concerning human toxicology in either database.

Leo contacted most of the Canadian scientists from list B and identified a core group of scientists as members of the Non-target Impact subcommittee: Jan Volney, Imre Otvos, Steve Holmes and Kevin Barber.

To the best of our (Munson, Reardon, Cadogan) knowledge, the following is a list of non-target field evaluations involving the aerial application of Bt or Dimilin in forest ecosystems:

United States

East

Bt

* Impact of Bt on canopy and understory Lepidoptera associated with gypsy moth populations in oak-hickory forest in southern Virginia -- Talley/Peacock(Rockbridge CO., VA/NEFES) -- 3rd. year of 3-year effort.

Dimilin

* Impact of Dimilin on selected vert/invert. in closed broadleaved watersheds - conducted in West Virginia -- numerous investigators -- 5th. year of 5-year effort.

West

Bt

- Barry/Whaley/Anhold - Bt-drift/dispersion and effects on non-target Lepidoptera, Utah 1993 Phase III -- 3rd year of 4 -year effort

- Grimble - Impacts of Bt sprays on non-target Lepidoptera in mixed coniferous forests of eastern Oregon -- 2nd year of 3-year effort (NAPIAP funded)

- - Miller/Grimble - Impacts of Bt on non-target Lepidoptera on the Warm Springs Indian Reservation (Oregon) -- 1st year of 2-year effort

- Miller/Lighthart - Effects of large scale use of Bt var. kurstaki on non-target larval Lepidoptera: Cove Junction (Oregon) -- 2nd year of 2-year effort

General Survey

- Miller/Grimble - Survey of resident Lepidoptera populations across the central Cascades as a possible food source for Townsend's big-eared bat -- 1st of 2-year effort

- Kephart (Willimette University)

  - Investigations and literature survey of Region 6 sensitive plant species and potential Lepidoptera pollinators

- Bennett - Survey to determine effects of Bt on non-target moths: Carson National Forest (New Mexico) -- 1st of 3-year effort (WSB population collapsed)

Canada

- Volney - Potential impacts of operational Bt spray on Lepidoptera -- conducted in Saskatchewan -- ? year effort

- Kreutzweiser - Effects of Btk on aquatic microbial activity, detrital decomposition and invertebrate communities -- conducted in Ontario -- 2nd year of 2-year effort

There are several issues which need to be resolved in FY93:

1. The establishment of one or two Non-target Impact subcommittees. We (Munson, Cadogan, and Reardon) propose one Non-target Impact Subcommittee could represent both the Western and Eastern Defoliator National Steering Committees. Reardon would be the chairman of the subcommittee in FY94 in an effort to coordinate this subcommittee's activities with those of the National Center of Forest Health Management. The National Center was created in April 1993 with three major areas of work emphasis: non-target impacts, biological controls, and biorationals. The purpose of the National Center is to accelerate development and applications of environmentally acceptable new technologies to maintain and improve the health of America's trees and forests.

2. Updating (additional/fewer) members on the Non-target Impact Subcommittee . The suggested members and chairman for each region:

West/US

Steve Munson, John Anhold, Chairman
Dave Grimble, R-6/PNW
Dayle Bennett, R-3/FPM
Bruce Hostetler, R-6/RPM
John Wenz, R-6/FPM
Larry Stipe/Nancy Campbell, R-1/FPM

East/US

Richard Reardon, Chairman
John Omer, NA/FHP
John Peacock, NEFES
Sandy Liebhold, NEFES
Jeff Witcosky, R-8/FPM

Canada

Leo Cadogan, Chairman
Jan Volney, For. Can. N. Alts
Imre Otvos, For. Can, Pac & Yu
Steve Holmes, For. Can. FPMI
Kevin Barber, For. Can. FPMI

3. The need for the Non-target Impact Subcommittee to focus its activities on microbial insecticides used to manage defoliators in forest ecosystems. Specifically, the immediate emphasis areas in the West/US is on Btk and in the East/US is on Btk and Entomophaga maimaiga.

4. Identify the objectives of the Non-target Impact Subcommittee .

FY94 Activities

1. Initiate and complete 5-year plan of work which identifies regional priorities (e.g. data gaps) and contains baseline protocols/procedures for conducting non-target evaluations.

2. Publish and continue to update the Dimilin and Bt bibliography databases.

3. Focus efforts on Bacillus thuringiensis kurstaki:

   a. general surveys to obtain baseline data on populations of Lepidoptera (terrestrial and aquatic) for specific ecosystems

b. potential impacts on selected non-targets (e.g. indicator species, T/E species)

- one comparable study established in Western United States, Eastern United States, and Canada.

4. Identify and solicit input from amateur lepidopterists in developing the 5-year plan of work as well as for individual evaluations.

Richard

RICHARD C. REARDON
Program Manager
National Center of Forest Health Management

cc: Munson
Cadogen

(A)

Memo to: Steve Holmes
From: Leo Cadogan
Subject: Formation of a working group relating to the study of the effects of Bt on non target organisms.

As promised at our meeting with Dr. R. Reardon on 22/4/92 I contacted a number of people and the following have been identified as either working in the general areas or are interested in participating in such a working group.

Bill Ernst	CWS	Impact on stream invertebrates
Neil Burgess	CWS	Impact on Birds and/or amphibians
Guy Sirois	CWS Moncton	Impact on Fish
Wendy Sexmith	NB Environ	Funding, Regulatory Affairs
Nelson Carter	NB DNR	Funding and Participation
Jim Bendell	U of T Forestry	Impact of Grouse & Small Mammals
Brian Naylar	OMNR Tech Dev. Unit N Bay	Small Mammals
Candid Czuba	" "	"
Ross D. James	ROM	Song Birds
M.I. Bellocq	U of T Forestry	Small Vertebrates
Jan Volney	ForCan Northern Alta	Gen Bt studies in the Prairies
Imre Otvos	ForCan Pac & Yukon	Gen Bt studies on the West Coast

You can forward this list to Dick Reardon with your additions.

LCO

B.L. Cadogan

22/7/92.

Forestry Canada Forêts Canada

(B)

4 September 1992

Dr. Richard Reardon
AIPM Project Leader
USDA Forest Service
180 Canfield St.
Morgantown, West Virginia, USA
26505

Subject: Formation of a working group - Effects of B.t. on non-target organisms

Dear Richard,

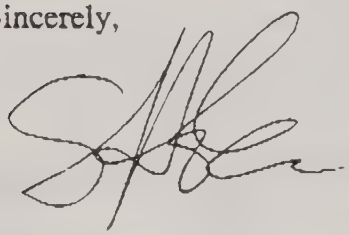
Leo Cadogan has provided me with a list of Canadian researchers who may be interested in participating in a working group on the effects of B.t. on non-target organisms. I have added a couple of names and am passing the complete list on to you.

Bill Ernst	Environment Canada, Halifax	stream invertebrates
Guy Sirois	Fisheries and Oceans Canada, Moncton	fish
Neil Burgess	Canadian Wildlife Service, Sackville	birds, amphibians
Pierre Mineau	Canadian Wildlife Service, Hull	birds, amphibians
Bruce Pauli	Canadian Wildlife Service, Hull	birds, amphibians
Dan Welsh	Canadian Wildlife Service, Ottawa	birds
Jan Volney	Forestry Canada, Northwest Region	general interest
Imre Otvos	Forestry Canada, Pacific & Yukon Region	general interest
Wendy Sexsmith	New Brunswick Department of the Environment, Fredericton	funding, regulatory affairs
Nelson Carter	New Brunswick Department of Natural Resources, Fredericton	funding, general interest
Pierre-Martin Marotte	Ministère de l'Énergie et des Ressources Charlesbourg	persistence, general interest
Ghislain Rousseau	Société de protection des forêts contre les insectes et maladies, Québec	general interest
Brian Naylar	Ontario Ministry of Natural Resources, North Bay	small mammals
Candid Czuba	Ontario Ministry of Natural Resources, North Bay	small mammals
Jim Bendell	University of Toronto	grouse, small mammals
M. Bellocq	University of Toronto	songbirds, small mammals
Ross James	Royal Ontario Museum	songbirds

Canada

I understand that you would like to try to get a group together at the time of the Forest Pest Control Forum in November. I think that this is an excellent idea. If you decide that you want to pursue it, let me know and I will make the necessary arrangements here (book a room, call potential Canadian participants, etc.). Hope to hear from you soon.

Sincerely,



Steve Holmes
Forestry Canada
Science and Sustainable Development
Place Vincent Massey, 21st Floor
351 St. Joseph Blvd
Hull, Quebec
K1A 1G5

Dimilin and Bacillus thuringiensis kurstaki Bibliographies

The National Center of Forest Health Management
Healthy Forests Make A World Of Difference
TechnologyTransfer

Dimilin and Bacillus thuringiensis kurstaki (Bt) bibliographies are installed and maintained in a computerized database, at the USDA Forest Service National Center of Forest Health Management in Morgantown, West Virginia. Anyone who needs information or data about Dimilin, Bt or both can search these bibliographies, using a Forest Service computerized retrieval program. These bibliographies contain references to efficacy and non-target data but not human toxicology.

The retrieval program allows the user to search for specific articles. A file search may be accessed several ways:

(1) Each field of the database can be searched for all articles that contain a certain value. For example, a search of the field "title" for the value "anni" would find any records that contain "anni" such as Tannins, tannin, or mannitol or the field "year" for 198_ would match records with the years from 1980 to 1989.

(2) To narrow the search, use more than one field. For example, searching the field "year" for "1986" and field "title "for "anni" will find all records for the year 1986 with "anni" in the title.

Any field may be searched for more than one value and any number of fields may be searched. When requesting records please include the fields to searched and the values to be found. Please narrow the search as much as possible.

The records may be printed as a bibliography citation (as for use in preparing a paper) which will not include the abstract, or printed including the abstract.

Searching the Bibliographic Database

The bibliographies have several different fields:

Name of Field	Type of Field and Width
Author	Character (240)
Year	Character (4)
Title	Character (240)
Source	Character (240)
ISSN (National Cataloging System)	Character (25)
NAL (National Agricultural Library)	Character (25)
Language	Character (80)
Abstract	Long

If you have any questions or would be interested in obtaining records from the Dimilin and Bt bibliographic databases, please contact:

Amy Onken
USDA Forest Service
National Center of Forest Health Management
180 Canfield Street
Morgantown, WV 26505
(304) 285-1565
DG Address: S24L08A

TECHNICAL TEAM MEMBERS

(1) Bruce Lighthart
US-EPA
Corvallis Environmental Research Lab
200 SW 35th Street
Corvallis, OR 97333
503-754-4879
FAX 503-754-4711

(2) Robert Gordon
Systematic Entomology Lab, USDA
c/o National Museum of Natural History
NHB Stop 168
Washington, DC 20560
202-382-1792
FAX 202-786-9422

(3) Ernest DelFosse
USDA-APHIS
National Biological Control Institute
Federal Building, Room 538
6505 Belcrest Road
Hyattsville, MD 20782
301-436-4329
FAX 301-436-7823

(4) Wayne Beresford
Entomology Department
University of Georgia
513 Bio-Science Building
Athens, GA 30602
706-542-7888
FAX 706-542-2279

(5) Joe Elkinton
Department of Entomology
University of Massachusetts
Fernald Hall
Amherst, MA 01003
413-545-4816
FAX 413-545-2115

(6) Jim Kotcon
Dept. of Plant & Soil Sciences
West Virginia University
401 Brooks Hall
P.O. Box 6057
Morgantown, WV 26506-6057
304-293-3911

(7) Jim Pierce
Environmental Action Foundation
6930 Carroll Ave., Suite 600
Takoma Park, MD 20912
301-891-1100
FAX 301-891-2218

(8) John Peacock
US Forest Service
Northeast Forest Exp. Station
51 Mill Pond Road
Hamden, CT 06514
203-773-2010
FAX 203-773-2183

(9) Sandy Liebhold
US Forest Service
Northeast Forest Exp. Station
180 Canfield Street
Morgantown, WV 26505
304-285-1609
FAX 304-285-1505

(10) Jeff Witcosky
George Washington National Forest
101 N. Main Street
P.O. Box 233
Harrisonburg, VA 22801
703-433-2491
FAX 703-433-8103

(11) Richard Reardon
US Forest Service
Forest Health Protection - AIPM
180 Canfield Street
Morgantown, WV 26505
304-285-1566
FAX 304-285-1505

Appendix D

Registered Pesticides for Western Defoliators - Sub-Committee Report

Julie Weatherby

Sheri Smith

1983

List of Registered Pesticides for Suppression of Western Defoliators

Common Name	Trade Name	Manufacturer	Aerial Rates		Ground Rates		Pest
			Rates/AC	Vol.Prod./AC	Rates/AC	Vol.Prod./AC	
Acephate	Orthene 75S (WP)	Valent U.S.A.	1/2 LB		2/3 LB		WSBW
			2/3-1 LB				DFTM(except CA)
							GM
	Orthene 9.4EC	Valent U.S.A.					
	Acecap 97 (ornamental sites)	Creative Sales	(# of implants depends on DBH)				WSBW
							GM
Bacillus thuringiensis	Dipel 4L (Agronomic label listing forests)	Abbott	8-16 BIU	32-64 OZ	See Aerial Rates	See Aerial Rates	WSBW
			8 BIU	32 OZ			DFTM
			8-16 BIU	32-64 OZ	4-16 BIU	16-64 OZ	GM
	Dipel 2X (Agronomic label listing forests)	Abbott	7-22 BIU	.5-1.5 LB	4-11 BIU	.25-.75 LB	WSBW
			7-22 BIU	.5-1.5 LB	4-11 BIU	.25-.75 LB	DFTM
			7-22 BIU	.5-1.5 LB	4-11 BIU	.25-.75 LB	GM
	Dipel 6L	Abbott	4-20 BIU	11-54 OZ	See Aerial Rates	See Aerial Rates	WSBW
			8-16 BIU	21-43 OZ			DFTM
			8-40 BIU	21-107 OZ	"	"	GM
	Dipel 8L	Abbott	8-20 BIU	16-40 OZ	"	"	WSBW
			8-16 BIU	16-32 OZ	"	"	DFTM
			8-40 BIU	16-80 OZ	"	"	GM
	Dipel 6AF	Abbott	4-30 BIU	11-80 OZ	"	"	WSBW
			8-16 BIU	21-43 OZ	"	"	DFTM
			8-40 BIU	21-107 OZ	"	"	GM
	Dipel 8AF	Abbott	8-20 BIU	16-40 OZ	"	"	WSBW
			8-16 BIU	16-32 OZ	"	"	DFTM
			8-40 BIU	16-80 OZ	"	"	GM
	Foray 48B	Novo	8-30 BIU	21-80 OZ	"	"	WSBW
			8-30 BIU	21-80 OZ	"	"	DFTM
			8-36 BIU	21-96 OZ	"	"	GM
	Foray 76B	Novo	8-30 BIU	13.5-50.5 OZ	"	"	WSBW
			8-30 BIU	13.5-50.5 OZ	"	"	DFTM
			8-40 BIU	13.5-67.5 OZ	"	"	GM
	Larvo-Bt	Fermone Corp.	8 BIU	2 OZ			GM
	Thuricide 32LV	Sandoz	6-40 BIU	24-160 OZ			WSBW
			4-32 BIU	16-128 OZ			DFTM
			8-40 BIU	32-160 OZ			GM
	Thuricide 48LV	Sandoz	6-40 BIU	16-106 OZ			WSBW
			4-16 BIU	11-44 OZ			DFTM
			8-40 BIU	22-106 OZ			GM
	Thuricide 64LV	Sandoz	6-40 BIU	12-80 OZ			WSBW
			4-16 BIU	8-32 OZ			DFTM
			8-40 BIU	16-80 OZ			GM

List of Registered Pesticides for Suppression of Western Defoliators

Common Name	Trade Name	Manufacturer	Aerial Rates		Ground Rates		Pest
			Rates/AC	Volume/AC	Rates/AC	Volume/AC	
Carbaryl	Sevin 4 oil ULV	Rhone-Poulenc	.5-1 LB	16-32 OZ			WSBW
			2 LB	64 OZ			DFTM
			1 LB	32 OZ			GM
	Sevin XLR Plus (Special Supplemental Label)	Rhone-Poulenc					GM
	Sevimol	Chipco				32-64 OZ	WSBW
						32-64 OZ	DFTM
						24-32 OZ	GM
Chlorpyrifos	Dursban 4E	DowElanco				8 OZ	WSBW
						16 OZ	DFTM
						16 OZ	GM
Diflubenzuron	Dimilin 4L	Uniroyal		2-4 OZ			DFTM
				.5-2 OZ			GM
	Dimilin 25W	Uniroyal		4-8 OZ			DFTM
				1-4 OZ			GM
Malathion	Malathion (Cythion)	American Cyanamid					
	Malathion ULV Cncn. (Clean Crop) 95%	American Cyanamid		13 OZ			WSBW
NPV	TM Bio-control-1	USDA-FS	.994 BPU	14.2 GR			DFTM
	Gypcheck	USDA-FS	.025-.125 BPU				GM

ABBOTT LABORATORIES

DiPel® 4L

Biological Insecticide
Emulsifiable Suspension

Active Ingredient:

Bacillus thuringiensis, subsp. *kurstaki*, 8,800 International Units of Potency per mg (32 Billion International Units per gallon)	1.76%
Inert Ingredients	98.24%

EPA Reg. No. 275-36
EPA Est. No. 33762-IA-1

INDEX:

KEEP OUT OF REACH OF CHILDREN

CAUTION

1.0 PRECAUTIONARY STATEMENTS

1.1 HAZARDS TO HUMANS (and Domestic Animals)

Avoid contact with skin, eyes or clothing. In case of contact immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

1.2 ENVIRONMENTAL HAZARDS

Keep out of lakes, ponds or streams. Do not contaminate water by cleaning of equipment or disposal of wastes.

2.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product through any type of irrigation system.

3.0 COMPATIBILITY

DiPel 4L should not be used in combination with Comite®, Bravo® (except celery), Captafol, Captan (except seed) or Dyrene®.

ALL STATES EXCEPT CALIFORNIA: The effects of combining DiPel 4L with fungicides (other than Benomyl, Maneb, Mancozeb, or Captan) and miticides are unknown.

FOR CALIFORNIA ONLY: The effects of combining DiPel 4L with insecticides, fungicides and other spray materials are unknown. Tank mixes should be avoided except where specific recommendations are made in the label for use in California.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage:
Keep containers tightly closed when not in use. At temperatures less than 0°F and greater than 100°F, DiPel 4L should be stored under cover.

Pesticide Disposal:
Wastes resulting from use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal:
Triple rinse (or equivalent), then puncture and dispose of in a sanitary landfill or by incineration, or if allowed by state and local authorities by burning. If burned, stay out of smoke.

5.0 GENERAL INFORMATION

Days To Harvest: There are no restrictions on applying DiPel 4L up to the time of harvest.

Sites: DiPel 4L may be used for any labeled pest in both field and greenhouse uses.

DiPel 4L is a highly selective insecticide for use against listed caterpillars (larvae) of lepidopterous insects. Close scouting and early attention to infestations is highly recommended. Larvae must eat deposits of DiPel 4L to be affected. Always follow these directions:

- Treat when larvae are young (early instars) before the crop is extensively damaged.
- Larvae must be actively feeding on treated, exposed plant parts.

- Thorough spray coverage is needed to provide a uniform deposit of DiPel 4L at the site of larval feeding. For some crops directed drop nozzles by ground machine are required.
- Under heavy pest population pressure, use the higher label rates, shorten the spray interval, and/or raise gallonage to improve spray coverage.
- Repeat applications at an interval sufficient to maintain control, usually 3 to 14 days depending on plant growth rate, moth activity, rainfall after treating, and other factors. If attempting to control a pest with a single spray, make the treatment when egg hatch is essentially complete, but before extensive crop damage occurs.
- A spreader-sticker which has been approved for use on growing and harvested crops should be added for hard-to-wet crops such as cole crops, or to improve weather-fastness of the spray deposits.

After eating a lethal dose of DiPel 4L, larvae stop feeding within the hour and will die within several days. Dying larvae move slowly, discolor, then shrivel, blacken and die.

DiPel 4L may be applied in conventional ground or aerial equipment with quantities of water sufficient to provide thorough coverage of infested plant parts. The amount of water needed per acre will depend on crop size, weather, spray equipment, and local experience. Unless otherwise indicated, use at least 2 gallons of water by air; except in the far west, 5 to 10 gallons is the usual minimum. Add water to the spray or mixing tank at the level that provides maximum agitation. With the agitator running, add the DiPel 4L. Continue agitation. Then add other spray materials (if any). Add the balance of the water. Maintain the suspension while loading and spraying. Do not mix more DiPel 4L than can be used in a 72-hour period. CAUTION: Rinse and flush spray equipment thoroughly with water following each use.

6.0 APPLICATION INSTRUCTIONS

6.1 APPLICATION RATE FOR MISC. CROPS

Crop	Pest	Pints/Acre
Cole Crops*	Loopers	1 to 2
Celery[1]	Imported Cabbageworm	½ to 1
Lettuce		
Spinach[1]	Diamondback Moth	⅔ to 1⅓

* Do not apply by air to plants after transplant or other stress before 6 weeks in the field. Use more than 25 gallons of water per acre by ground and 10 gallons of water per acre by air.

[1] For all states except California.

6.1 APPLICATION RATE FOR MISC. CROPS (cont.)

Crop	Pest	Pints/Acre
Soybeans	Loopers	1 to 2
Peanuts[1]	Green Cloverworm	½ to 1
Peas[1]	Velvetbean Caterpillar	⅔ to 1⅓
	Podworm (Heliothis zea)*	1 to 2
	Armyworms*[1]	2 to 4

* DiPel 4L suppresses early instar larvae of Podworms and Armyworms when populations are light to moderate.

[1] For all states except California.

Tobacco[1]	Tobacco Budworm	1
	Hornworms	½ to 1
	Loopers	1

[1] For all states except California.

Tomatoes	Loopers	1 to 2
	Tomato Fruitworm*	2
	Variegated Cutworm	2
	Saltmarsh Caterpillar	1 to 2
	Hornworms	½ to 1
	Armyworm**	2 to 4

* Apply weekly in a preventative program.

** DiPel 4L may be used to suppress small Armyworms (1st and 2nd instar) when populations are light and full coverage ground sprays are applied. DiPel 4L[1] may be tank-mixed with Benomyl, Maneb or Mancozeb for application on tomatoes. Observe all label precautions for all products used.

[1] For all states except California.

Alfalfa, Hay and Small Grains	Loopers	1 to 2
	Alfalfa Caterpillar	¼ to ½
	European Skipper (Essex Skipper)	½ to 1
Cotton	Tobacco Budworm*	½ to 2
	Cotton Bollworm*	½ to 2
	Loopers**	1 to 2

* Use DiPel 4L to control light to moderate populations of newly hatched worms in pest management conditions. Use under close scouting when beneficial insects are active or building. Repeat treatments at 4 to 5 day intervals as long as necessary and results are acceptable. If 15% or more terminals have eggs, add 1/8 lb. AI methomyl[1] (Lannate® or Nudrin®) per acre to 1/2 pt. DiPel 4L.

Once beneficial insects are no longer a factor, DiPel 4L (at 1/2 to 1-1/2 pts/acre) may be tank mixed with methomyl (Lannate® or Nudrin®) at .225 to .675 lbs. AI per acre to control light to moderate infestations of early instar larvae. Observe any rate, frequency, or boll load label restrictions for methomyl in your area. Methomyl will likely cause reddening of cotton foliage. Discontinue this tank mix if reddening becomes excessive.

Before using any tank mix, read the product labels for all environmental and usage cautions.

DiPel 4L[1] may be tank mixed with vegetable or cottonseed oil at the ratio of 1 pint 4L to 1 pint oil. DiPel 4L may also be mixed at a ratio of 40 parts 4L to 60 parts water, and applied in total spray volume not to exceed 80 fl. oz. per acre.

** Full plant coverage needed.

[1] For all states except California.

6.1 APPLICATION RATE FOR MISC. CROPS (cont.)

Crop	Pest	Pints/Acre
Avocados[1]	Amorbia Moth Omnivorous Leafroller Omnivorous Looper Orange Tortrix	Not more than 8

Use a minimum of 200 gallons water per acre by ground rig or 10 gallons by aircraft. Maximum of two applications per season.

[1] For all states except California.

Crop Seed[1]	Indian Meal Moth Almond Moth	1½ pts./100 bu

Mix thoroughly prior to bagging.

DiPel 4L is compatible with common seed treatments including Captan, Methoxychlor, Carboxin (Vitavax) and Malathion. Fumigation has not been found to decrease the effectiveness of DiPel 4L.

[1] For all states except California.

6.2 APPLICATION RATE FOR TREES AND SHRUBS[2] (Forest, Shade, Sugar Maple, Trees and Shrubs)

Pest	Pints/100 Gallons* (Ground Equip)	Pints/Acre (Aerial**)
Gypsy Moth	1[1] to 4	2[1] to 4
Bagworm	1 to 2	1 to 2
Redhumped Caterpillar	½ to 1	½ to 1
Spring & Fall Cankerworm	½ to 1	½ to 1
Fall Webworm	1	1
Elm Spanworm	1 to 2	1 to 2
Tent Caterpillars	½ to 1	1[1] to 2
California Oakworm	½ to 1	½ to 1
Pine Butterfly	2	2
Spruce Budworms[3]	2[1] to 4	2[1] to 4
Saddle Prominent Caterpillar	1 to 2	1 to 2[2]
Douglas Fir Tussock Moth	2	2
Western Tussock Moth	1 to 2	—
Fruittree Leafroller	1 to 2	—
Blackheaded Budworm	2	—
Mimosa Webworm	1 to 2	—
Jack Pine Budworm	1 to 2	1½ to 2
Saddleback Caterpillar	1 to 2	—

* Rate for hydraulic sprayer in California. In other states, less water may be used if adequate coverage is provided. For mist blowers, mix the applicable amount (pints) in zero to 10 gallons of water; except in California, mix the applicable amount (pints) in 10 gallons of water.

** For aerial application, use in zero to 10 gallons (in California, against all pests except Spruce Budworms, use in 1 to 10 gallons) of water depending on type and density of trees. For best results, spray systems which deliver droplet size of 200 microns or less should be used.

[1] Use only the low rate in California.

[2] All states except California.

[3] Use rates greater than 2 pints in Northern states for heavy populations. In California, tank mix ratio of water to DiPel 4L must be no less than 50:50.

6.3 APPLICATION RATE FOR SMALLER SPRAY VOLUMES

If Rate is	Use this Amount Per Gallon
1/2 pt./acre or 100 gals.	1/2 tsp.
1 pt./acre or 100 gals.	1 tsp.
1 qt./acre or 100 gals.	2 tsps.
2 qts./acre or 100 gals.	4 tsps.

7.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

Fundal, Comite, Galecron, Lannate, Nudrin, Bravo, Vitavax, and Dyrene are trademarks of companies other than Abbott Laboratories.

Abbott Laboratories – Quality Health Care Worldwide
Agricultural Products, North Chicago IL 60064 (800) 323-9597

ABBOTT LABORATORIES

DiPel® 4L

Biological Insecticide
Emulsifiable Suspension

Active Ingredient:

Bacillus thuringiensis, subsp. *kurstaki*, 8,800 International Units of Potency per mg (32 Billion International Units per gallon)	1.76%
Inert Ingredients	98.24%

EPA Reg. No. 275-36
EPA Est. No. 33762-IA-1

INDEX:

KEEP OUT OF REACH OF CHILDREN

CAUTION

1.0 PRECAUTIONARY STATEMENTS

1.1 HAZARDS TO HUMANS (and Domestic Animals)

Avoid contact with skin, eyes or clothing. In case of contact immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

1.2 ENVIRONMENTAL HAZARDS

Keep out of lakes, ponds or streams. Do not contaminate water by cleaning of equipment or disposal of wastes.

2.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product through any type of irrigation system.

3.0 COMPATIBILITY

DiPel 4L should not be used in combination with Comite®, Bravo® (except celery), Captafol, Captan (except seed) or Dyrene®.

ALL STATES EXCEPT CALIFORNIA: The effects of combining DiPel 4L with fungicides (other than Benomyl, Maneb, Mancozeb, or Captan) and miticides are unknown.

FOR CALIFORNIA ONLY: The effects of combining DiPel 4L with insecticides, fungicides and other spray materials are unknown. Tank mixes should be avoided except where specific recommendations are made in the label for use in California.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage:
Keep containers tightly closed when not in use. At temperatures less than 0°F and greater than 100°F, DiPel 4L should be stored under cover.

Pesticide Disposal:
Wastes resulting from use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal:
Triple rinse (or equivalent), then puncture and dispose of in a sanitary landfill or by incineration, or if allowed by state and local authorities by burning. If burned, stay out of smoke.

5.0 GENERAL INFORMATION

Days To Harvest: There are no restrictions on applying DiPel 4L up to the time of harvest.

Sites: DiPel 4L may be used for any labeled pest in both field and greenhouse uses.

DiPel 4L is a highly selective insecticide for use against listed caterpillars (larvae) of lepidopterous insects. Close scouting and early attention to infestations is highly recommended. Larvae must eat deposits of DiPel 4L to be affected. Always follow these directions:

- Treat when larvae are young (early instars) before the crop is extensively damaged.
- Larvae must be actively feeding on treated, exposed plant parts.

6.1 APPLICATION RATE FOR MISC. CROPS (cont.)

Crop	Pest	Pints/Acre
Avocados[1]	Amorbia Moth Omnivorous Leafroller Omnivorous Looper Orange Tortrix	Not more than 8

Use a minimum of 200 gallons water per acre by ground rig or 10 gallons by aircraft. Maximum of two applications per season.

[1] For all states except California.

Crop Seed[1]	Indian Meal Moth Almond Moth	1½ pts./100 bu

Mix thoroughly prior to bagging.

DiPel 4L is compatible with common seed treatments including Captan, Methoxychlor, Carboxin (Vitavax) and Malathion. Fumigation has not been found to decrease the effectiveness of DiPel 4L.

[1] For all states except California.

6.2 APPLICATION RATE FOR TREES AND SHRUBS[2] (Forest, Shade, Sugar Maple, Trees and Shrubs)

Pest	Pints/100 Gallons* (Ground Equip)	Pints/Acre (Aerial**)
Gypsy Moth	1[1] to 4	2[1] to 4
Bagworm	1 to 2	1 to 2
Redhumped Caterpillar	½ to 1	½ to 1
Spring & Fall Cankerworm	½ to 1	½ to 1
Fall Webworm	1	1
Elm Spanworm	1 to 2	1 to 2
Tent Caterpillars	½ to 1	1[1] to 2
California Oakworm	½ to 1	½ to 1
Pine Butterfly	2	2
Spruce Budworms[3]	2[1] to 4	2[1] to 4
Saddle Prominent Caterpillar	1 to 2	1 to 2[2]
Douglas Fir Tussock Moth	2	2
Western Tussock Moth	1 to 2	—
Fruittree Leafroller	1 to 2	—
Blackheaded Budworm	2	—
Mimosa Webworm	1 to 2	—
Jack Pine Budworm	1 to 2	1½ to 2
Saddleback Caterpillar	1 to 2	—

* Rate for hydraulic sprayer in California. In other states, less water may be used if adequate coverage is provided. For mist blowers, mix the applicable amount (pints) in zero to 10 gallons of water; except in California, mix the applicable amount (pints) in 10 gallons of water.

** For aerial application, use in zero to 10 gallons (in California, against all pests except Spruce Budworms, use in 1 to 10 gallons) of water depending on type and density of trees. For best results, spray systems which deliver droplet size of 200 microns or less should be used.

[1] Use only the low rate in California.

[2] All states except California.

[3] Use rates greater than 2 pints in Northern states for heavy populations. In California, tank mix ratio of water to DiPel 4L must be no less than 50:50.

6.3 APPLICATION RATE FOR SMALLER SPRAY VOLUMES

If Rate is	Use this Amount Per Gallon
1/2 pt./acre or 100 gals.	1/2 tsp.
1 pt./acre or 100 gals.	1 tsp.
1 qt./acre or 100 gals.	2 tsps.
2 qts./acre or 100 gals.	4 tsps.

7.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

Fundal, Comite, Galecron, Lannate, Nudrin, Bravo, Vitavax, and Dyrene are trademarks of companies other than Abbott Laboratories.

Abbott Laboratories – Quality Health Care Worldwide
Agricultural Products, North Chicago IL 60064 (800) 323-9597

ABBOTT LABORATORIES

DiPel® 2X

Biological Insecticide
Wettable Powder

Active Ingredient:

Bacillus thuringiensis, subsp. *kurstaki*,
32,000 International Units of Potency per mg (14.52 Billion International Units per Pound) . . . 6.4% w/w
Inert Ingredients . . . . . 93.6% w/w

Potency units should not be used to adjust use rates beyond the specified in the Application Instructions section.

E.P.A. Registration No. 275-37
E.P.A. Est. No. 33762-IA-1

INDEX:

CAUTION:

KEEP OUT OF REACH OF CHILDREN

.0 PRECAUTIONARY STATEMENTS

1.1 HAZARDS TO HUMANS

Harmful if absorbed through the skin. Causes moderate eye irritation. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling.

1.2 STATEMENT OF PRACTICAL TREATMENT

If in Eyes:
Flush with plenty of water. Get medical attention if irritation persists.

If on Skin:
Wash skin with plenty of soap and water. Get medical attention if irritation persists.

1.3 RE-ENTRY STATEMENT

Do not enter treated areas without protective clothing until sprays have dried.

Because certain states may require more restrictive reentry intervals for various crops treated with this product, consult your State Department of Agriculture for further information.

Written or oral warnings must be given to workers who are expected to be in a treated area or in an area about to be treated with this product. Oral warnings must include the following information:

Inform workers of area of fields that must not be entered without appropriate protective clothing until sprays have dried. In case of accidental exposure, wash with plenty of water. If there is any irritation in eyes after washing, get medical attention.

When oral warnings are given, warnings shall be given in a language customarily understood by workers. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. Written warnings must include the following information:

"Area treated with DiPel 2X on (date of application). Do not enter without appropriate protective clothing until sprays have dried. In case of accidental exposure, wash with plenty of water. If there is any irritation in eyes after washing, get medical attention."

2.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product in such a manner as to directly or through drift expose workers or other persons. The area being treated must be vacated by unprotected persons.

3.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage:
Reclose containers of unused DiPel 2X. Store in a dry place.

Pesticide Disposal:
Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal:
Triple rinse (or equivalent). Then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

4.0 GENERAL INFORMATION

Do not apply this product through any type of irrigation system.

DiPel 2X is a highly selective insecticide for use against listed caterpillars (larvae) of lepidopterous insects. Close scouting and early attention to infestations is highly recommended. Larvae must eat deposits of DiPel 2X to be affected. Always follow these directions:

- Treat when larvae are young (early instars) before the crop is extensively damaged.
- Larvae must be actively feeding on treated, exposed plant parts.
- Thorough spray coverage is needed to provide a uniform deposit of DiPel 2X at the site of larval feeding. For some crops directed drop nozzles by ground machine are required.
- Under heavy pest population pressure, use the higher label rates, shorten the spray interval, and/or raise gallonage to improve spray coverage.
- Repeat applications at an interval sufficient to maintain control, usually 3 to 14 days depending on plant growth rate, moth activity, rainfall after treating, and other factors. If attempting to control a pest with a single spray, make the treatment when egg hatch is essentially complete, but before extensive crop damage occurs.
- A spreader-sticker which has been approved for use on growing and harvested crops should be added for hard-to-wet crops such as cole crops, or to improve weather-fastness of the spray deposits.
- DiPel 2X is a non-restricted use pesticide and does not require a restricted use permit for purchase and use.

After eating a lethal dose of DiPel 2X, larvae stop feeding within the hour, and will die within several days. Dying larvae move slowly, discolor, then shrivel, blacken and die.

DiPel 2X may be applied in conventional ground or aerial equipment with quantities of water sufficient to provide thorough coverage of infested plant parts. The amount of water needed per acre will depend on crop size, weather, spray equipment, and local experience. Unless otherwise indicated, use at least 2 gallons of water per acre by air; except in the Western U.S., where 5 to 10 gallons is the usual minimum. Add water to the spray or mixing tank at the level that provides maximum agitation. With the agitator running, slowly sprinkle in the DiPel 2X. Continue agitation. Then add other spray materials (if any). Add the balance of the water and agitate until mixed. Maintain the suspension while loading and spraying. Do not mix more DiPel 2X than can be used in a 12-hour period.

Days To Harvest: There are no restrictions on applying DiPel 2X up to the time of harvest.
Sites: DiPel 2X may be used for any labeled pest in both field and greenhouse uses.

5.0 APPLICATION INSTRUCTIONS

5.1 CHEMIGATION USE DIRECTIONS

Chemigation directions apply only to the state of Florida and to the following crop categories: Flowers, bedding plants, ornamentals, greenhouse/shadehouse and outdoor nursery crops. Refer to these label sections under Application Instructions for application rate information when chemigation is used.

Apply this product only through sprinkler including center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, or hand move irrigation systems. Do not apply this product through any other type of irrigation systems. Do not connect an irrigation system (including greenhouse systems) used for pesticide applications to a public water system.

5.2 SPRAY PREPARATION

First prepare a suspension of DiPel 2X in a mix tank. Fill tank with 1/2 to 3/4 the desired amount of water. Start mechanical or hydraulic agitation. Add the required amount of DiPel 2X, and then the remaining volume of water. Then set the sprinkler to deliver a minimum of 0.1 to 0.3 inch of water per acre. Start sprinkler and uniformly inject the suspension of DiPel 2X into the irrigation water line so as to deliver the desired rate per acre. The suspension of DiPel 2X should be injected with a positive displacement pump into the main line ahead of a right angle turn to insure adequate mixing. Any questions on calibration should be directed to your State Extension Service Specialists, to equipment manufacturers or other experts.

NOTE: When treatment with DiPel 2X has been completed, further field irrigation over the treated area should be avoided for 24 to 48 hours to prevent washing the material off the crop.

5.3 GENERAL PRECAUTIONS FOR APPLICATIONS THROUGH SPRINKLER IRRIGATION SYSTEMS

Maintain continuous agitation in the mix tank during the mixing and application to insure a uniform suspension.

Greater accuracy in calibration and distribution will be achieved by injecting a larger volume for a more dilute solution per unit time.

Crop injury, lack of effectiveness, or illegal residues in the crop can result from nonuniform distribution of treated water. A person knowledgeable of the chemigation system and responsible for its operation, or under the supervision of the responsible person, shall shut the system down and make necessary

adjustments should the need arise. Allow sufficient time for pesticide to be flushed through all lines and all nozzles before turning off irrigation water.

The system must contain a functional check valve, vacuum relief valve, and low pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from backflow.

The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.

The pesticide injection pipeline must also contain a functional, normally closed, solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation is either automatically or manually shut down.

The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.

The irrigation line or water pump must include a functional pressure switch which will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected.

Systems must use a metering pump, such as a positive displacement injection pump (e.g. diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock. Do not apply when wind speed favors drift beyond the area intended for treatment.

Do not apply when wind speed favors drift, when system connections or fittings leak, when nozzles do not provide uniform distribution or when lines containing the product must be dismantled and drained.

5.4 APPLICATION RATE FOR MISC. CROP GROUPS

Crop Group	Pest	Pounds/Acre
Alfalfa (Hay and Seed), **Hay and Other Forage Crops**	Alfalfa Caterpillar	½ - 1
	Armyworms*	½ - 2
	European Skipper (Essex Skipper)	½ - 1
	Loopers	½ - 1
Berry and Small Fruit Crops such as Blackberry, Cranberry, Grape and Strawberry	Achema Sphinx Moth (Hornworm)	½ - 1
	Armyworms*	½ - 2
	Grape Berry Moth	½ - 1
	Grape Leafroller	½ - 1
	Grapeleaf Skeletonizer (ground only)	½ - 1
	Loopers	½ - 1
	Oblique Banded Leafroller	½ - 1
	Omnivorous Leafroller (ground only)	½ - 1
	Orange Tortrix	½ - 1
	Saltmarsh Caterpillar (ground only)	½ - 1
	Tobacco Budworm	½ - 2

5.4 MISC. CROP GROUPS (continued)

Crop Group	Pest	Pounds/Acre
Bulb such as Garlic and Onion (green and bulb)	Armyworms*	½ - 2
	Cutworms	½ - 1
	Diamondback Moth	½ - 1
	Green Cloverworm	½ - 1
	Hornworms	½ - 1
	Imported Cabbageworm	½ - 1
	Loopers	½ - 1
	Omnivorous Leafroller	½ - 1
	Saltmarsh Caterpillar	½ - 1
	Webworm	½ - 1
Cucurbit Vegetables such as Cucumbers, Melons and Squash	Armyworms*	½ - 2
	Loopers	½ - 1
	Melonworms	½ - 1
	Rindworm complex	½ - 1
Flowers, Bedding Plants and Ornamentals	Armyworms*	½ - 2
	Azalea Caterpillar	¼ - ½
	Diamondback Moth	¼ - ½
	Ello Moth (Hornworm)	¼ - ½
	Io Moth	¼ - ½
	Loopers	¼ - ½
	Oleander Moth	¼ - ½
	Omnivorous Leafroller	¼ - ½
	Omnivorous Looper	¼ - ½
	Tobacco Budworm	¼ - ½
Fruiting Vegetables such as Eggplant, Pepper and Tomato	Armyworms*	½ - 2
	Hornworm	½ - 1
	Loopers	½ - 1
	Saltmarsh Caterpillar	½ - 1
	Tomato Fruitworm	½ - 1
	Variegated Cutworm	½ - 1
Greenhouse/Shade Trees and Outdoor Nursery Crops such as Brassica, Fruiting Groups, and Leafy Herbs	Heliothis	½ - 2
	Loopers	½ - 1
Herbs, Spices and Mint such as Basil, Chives, Dill, Leek and Peppermint	Armyworms*	½ - 2
	Looper	½ - 1
	Saltmarsh Caterpillar	½ - 1
Leafy and Cole Crops such as Broccoli, Brussel Sprout, Cabbage, Cauliflower, Celery, Chinese Cabbage, Collard, Endive, Kale, Kohlrabi, Lettuce (head and leaf), Mustard Greens, Parsley and Spinach	Armyworms*	½ - 2
	Cutworms	½ - 1
	Diamondback Moth	½ - 1
	Green Cloverworm	½ - 1
	Hornworms	½ - 1
	Imported Cabbageworm	½ - 1
	Loopers	½ - 1
	Omnivorous Leafroller	½ - 1
	Saltmarsh Caterpillar	½ - 1
	Webworm	½ - 1
Legume Vegetables such as Beans, Lentil, Peas and Soybean	Armyworms*	½ - 2
	Green Cloverworm	½ - 1
	Loopers	½ - 1
	Podworms*	½ - 1
	Soybean Looper	½ - 1
	Velvetbean Caterpillar	½ - 1

5.4 MISC. CROP GROUPS (continued)

Crop Group	Pest	Pounds/Acre
Pome Fruit such as Apple and Pear	Cankerworms	½ - 2
Pomegranate	Coddling Moth	½ - 2
Stone Fruit such as Cherry, Nectarine, Peach, Plum and Prune	Cutworms	½ - 2
	Fall Webworm	½ - 2
	Filbert Leafroller	½ - 2
	Fruittree Leafroller	½ - 2
	Gypsy Moth	½ - 2
Tree Nuts such as Almond, Filbert, Pecan and Walnut	Obliquebanded Leafroller	½ - 2
	Omnivorous Leafroller	½ - 2
	Redbanded Leafroller	½ - 2
	Redhumped Caterpillar	½ - 2
	Tent Caterpillars	½ - 2
	Tufted Apple Budmoth	½ - 2
	Variegated Leafroller	½ - 2
	Walnut Caterpillar	½ - 2
Root and Tuber such as Beet, Carrot, Potato and Sugarbeet	Armyworms*	½ - 2
	Cutworms	½ - 1
	Diamondback Moth	½ - 1
	Green Cloverworm	½ - 1
	Hornworms	½ - 1
	Imported Cabbageworm	½ - 1
	Loopers	½ - 1
	Omnivorous Leafroller	½ - 1
	Saltmarsh Caterpillar	½ - 1
	Webworm	½ - 1
Small Grains	Loopers	½ - 1
	Armyworms*	½ - 2
Tropical Fruits	Hornworm	½ - 2
	Leafrollers	½ - 2
	Loopers	½ - 2
	Omnivorous Looper	½ - 2

5.5 APPLICATION RATE FOR SPECIFIC CROPS

Other Crops	Pest	Pounds/Acre
Asparagus	Armyworms*	½ - 2
Avocado	Amorbia Moth	½ - 2
	Omnivorous Leafroller	½ - 2
	Omnivorous Looper	½ - 2
	Orange Tortrix	½ - 2
	Spanworm	½ - 2
Banana	Banana Skipper	½ - 1
Citrus	Citrus Cutworm***	½ - 2
	Fruittree Leafroller	½ - 2
	Orangedog	¼ - 1
Corn (Field, Sorghum and Sweet)	Armyworms*	½ - 2
	Headworms	½ - 1
Cotton	Armyworms*	½ - 2
	Cotton Bollworm**	½ - 2
	Loopers	½ - 1
	Saltmarsh Caterpillar	½ - 1
	Tobacco Budworm**	½ - 2
Hops	Armyworms*	½ - 2
	Loopers	½ - 1
Kiwi Fruit	Omnivorous Leafroller	½ - 2
Malanga	Armyworms*	½ - 2
	Saltmarsh Caterpillar	½ - 1

5.5 SPECIFIC CROPS (continued)

Crop Group	Pest	Pounds/Acre
Peanuts	Green Cloverworm	½ - 1
	Loopers	½ - 1
	Podworms*	½ - 1
	Velvetbean Caterpillar	½ - 1
Pineapple	Gummosos-Batrachedra comosae (Hodges)	¼ - ½
	Thecla-Thecla basilides (Geyr)	
Rape	Armyworms*	½ - 2
	Heliothis	½ - 2
	Looper	½ - 1
Safflower	Armyworms*	½ - 2
	Loopers	½ - 1
	Saltmarsh Caterpillar	½ - 1
Sunflower	Head Moth	½ - 1
	Loopers	½ - 1
Tobacco	Hornworms	¼ - ½
	Loopers	½ - 1
	Tobacco Budworm	½ - 1
Turf	Sod Webworm	1 - 2
Watercress	Armyworms*	½ - 2
	Diamondback Moth	½ - 1
	Loopers	½ - 1

* DiPel 2X may be used to control small armyworms (1st and 2nd instar) and/or podworms when populations are light and full coverage sprays are applied. Repeat treatment as necessary. If mature worms or heavy populations are present, a contact insecticide should be used to enhance control.

** Use to control light to moderate populations of newly hatched worms in integrated pest management conditions. Repeat treatments at 4 to 5 day intervals as long as necessary and results are acceptable. Use in combination with ovicidal rates of labeled *Heliothis* ovicides.

*** Apply to light to moderate populations of newly-hatched worms.

5.6 APPLICATION RATE FOR STORED AG COMMODITIES

Crop	Pest	Pounds/Acre
Grains, Soybeans, Sunflower Seed, Crop Seed, Condimental Seeds, Spices, Herbs, Birdseed[1] and Popcorn[1]	Indian Meal Moth Almond Moth	3/8 lb./100 bu (undiluted and diluted)[2]
Peanuts	Indian Meal Moth Almond Moth	1/4 lb./ton[3]
Flue-Cured Tobacco	Tobacco Moth	0.2 oz./100 lbs.[4]

[1] For all states except California.

For the control and prevention of these pests, apply DiPel 2X in a constantly agitated water suspension to the top four inch surface layer of grain in the bin. Use a sprinkler can or sprayer to apply the dosage into the grain stream as the last (top) four inch layer is augered into the bin. Mix 1/20 lb. DiPel 2X per gallon of water. Apply 0.6 pint of this mixture per bushel as grain is augered into storage. Or, sprinkle the dosage into the surface of the grain in the bin and mix thoroughly with a scoop or rake to the depth of four inches.

More thorough coverage may be achieved by dividing the recommended dosage into three applications and mixing the grain between applications.

For the protection of bagged grain including popcorn, apply the dosage to the entire grain mass and mix thoroughly prior to bagging.

Treatments can be applied to stored grain at any time, but for best results, make application immediately after harvest before moth activity occurs. In areas where late fall harvested grain is not subject to infestation because of low temperatures, application can be delayed until late winter or early spring before moth activity begins. Control for a full storage season should normally be expected; however, repeat application if infestation recurs.

This treatment controls the moth larvae. If an infestation is present when the grain is treated, moth emergence may continue for several days. If immediate control of severe infestations is desired, grain should be fumigated prior to application of this treatment. DiPel 2X will not control weevils or other beetles.

Grain treated with DiPel 2X can be used at any time after treatment for any use.

[2] As a surface treatment, apply ½ lb. DiPel 2X in 5-10 gals. of water per 500 sq. ft. of grain surface area, mix into top 4 inches. For commodities coarser than shelled corn, increased depth of treatment according to the habit of the pest.

[3] Apply this rate to the top four to eight feet of nuts when filling the warehouse.

To prevent and control these pests, spray an even coating of DiPel 2X on the farmer stock peanuts while filling the warehouse. To make the spray solution, mix 3¾ lbs. DiPel 2X per 5 gallons of water. Apply to 15 tons of commodity. Do not pre-mix more spray solution than will be used within 12 hours. Keep the spray suspension agitated during application, and use pressures and nozzles sufficient to handle this suspension.

Before filling the warehouse, clean thoroughly, then spray interior of the facility with a DiPel 2X suspension at the rate of ½ lb. DiPel 2X per 100 gallons water. Spray enough suspension to wet all cracks and crevices.

For bagged peanuts, treat the whole mass of commodity at the rate indicated.

[4] Apply 0.2 ounce (approx. 2½ tsps.) of DiPel 2X in one quart of water per 100 pounds of tobacco as a fine mist spray. Avoid overwetting. Tobacco should have just enough moisture to be handled without shattering at the time of application.

Tobacco to be Stored up to Twelve Months:
Spray loose leaves as the tobacco is being bundled from the curing barn. For tobacco on sticks, treat both sides of leaves.

Stored Tobacco:
For tobacco which is to be carried over, rebundle or restack sticks, fluff up tobacco and spray loose leaves. For tobacco that has been stored over three weeks, apply at first signs of infestation, promptly open bundles, spray loose leaves, then rebundle.

Treatment of Storage Barns:
If tobacco has been treated, or is going to be treated, treatment of the floors and walls may be made to aid in control. Sweep out the area, especially cracks and corners, and all of the loose tobacco pieces in which the moth might breed. Make a spray mixture containing ½ oz. DiPel 2X per 2½ gallons of water. Apply this at a rate of ½ gallon per 1,000 sq. ft. of surface area. Be sure to spray into cracks and between floorboards.

5.7 APPLICATION RATE FOR TREES AND FORESTS*

Pest	Lbs./100 Gallons** (Ground Equip)	Lbs./Acre (Aerial***)
Gypsy Moth	¼ - ¾	½ - 1½
Bagworm	¼ - ¾	½ - 1½
Redhumped Caterpillar	¼ - ¾	½ - 1½
Spring & Fall Cankerworm	¼ - ¾	½ - 1½
Fall Webworm	¼ - ¾	½ - 1½
Elm Spanworm	¼ - ¾	½ - 1½
Tent Caterpillars	¼ - ¾	½ - 1½
California Oakworm	¼ - ¾	½ - 1½
Pine Butterfly	¼ - ¾	½ - 1½
Spruce Budworms	¼ - ¾	½ - 1½
Saddle Prominent Caterpillar	¼ - ¾	½ - 1½
Douglas Fir Tussock Moth	¼ - ¾	½ - 1½
Western Tussock Moth	¼ - ¾	½ - 1½
Fruittree Leafroller	¼ - ¾	½ - 1½
Blackheaded Budworm	¼ - ¾	½ - 1½
Mimosa Webworm	¼ - ¾	½ - 1½
Jack Pine Budworm	¼ - ¾	½ - 1½
Saddleback Caterpillar	¼ - ¾	½ - 1½
Greenstriped Mapleworm	¼ - ¾	½ - 1½

* Forest, Shade, Sugar Maple trees and Ornamentals.

** Rate for hydraulic sprayer. For mist blowers, mix the applicable amount (lbs.) in 10 gallons of water.

*** For aerial application, use in one to five gallons of water depending on type and density of trees. For best results, spray systems which deliver droplet size of LESS THAN 150 microns should be used.

5.8 APPLICATION RATE FOR SMALLER SPRAY VOLUMES

If Rate is	Use This Amount Per Gallon
1/4 lb./acre or 100 gals.	1/2 tsp.
1/2 lb./acre or 100 gals.	1 tsp.
1 lb./acre or 100 gals.	2 tsps.
2 lbs./acre or 100 gals.	4 tsps.

6.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning the use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

ABBOTT LABORATORIES

DiPel® 6L

Biological Insecticide
Emulsifiable Suspension

Active Ingredient:

Bacillus thuringiensis, subsp. *kurstaki*, 13,200 International Units of Potency per mg (48 Billion International Units per gallon) . . .	2.6%
Inert Ingredients	97.4%

EPA Reg. No. 275-48
EPA Est. No. 33762-IA-1

INDEX:

CAUTION:

KEEP OUT OF REACH OF CHILDREN

1.0 PRECAUTIONARY STATEMENTS

1.1 HAZARDS TO HUMANS

Avoid contact with skin, eyes or clothing. In case of contact, immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

1.2 RE-ENTRY STATEMENT

Do not enter treated areas without protective clothing until sprays have dried.

2.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product through any type of irrigation system.

3.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Keep containers tightly closed when not in use. Do not store at temperatures below 0°F or above 90°F. Roll or shake the drum before dispensing.

Pesticide Disposal: Wastes resulting from use of this product may be disposed of on site or at an approved waste disposal facility. Do not contaminate water when disposing of equipment washwaters.

Container Disposal: Triple rinse (or equivalent), then puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

4.0 GENERAL INFORMATION

DiPel 6L is a highly selective insecticide for use against listed caterpillars (larvae) of lepidopterous insects. Close scouting and early attention to infestations is highly recommended. Larvae must eat deposits of DiPel 6L to be affected. Always follow these directions:

- Treat when larvae are young (early instars) before extensive damage has occurred.
- Larvae must be actively feeding on treated, exposed plant parts.
- Thorough spray coverage is needed to provide a uniform deposit of DiPel 6L at the site of larval feeding.
- Under heavy pest population pressure, use the higher label rates and/or consider a second application.
- If attempting to control a pest with a single spray, make the treatment when egg hatch is essentially complete, but before extensive crop damage occurs.
- An approved spreader-sticker may be added to diluted tank mixes to improve weather-fastness of the spray deposits. Do not add sticker to the undiluted product.

After eating a lethal dose of DiPel 6L, larvae stop feeding within the hour and will die within several days. Dying larvae move slowly, discolor, then shrivel, blacken and die.

DiPel 6L may be applied in conventional ground or aerial equipment with quantities of water sufficient to provide thorough coverage of infested plant parts. The amount of water needed per acre will depend on weather, spray equipment and plant canopy type. **DiPel 6L should always be mixed with at least an equal amount of water for diluted applications.** Fill the mix tank or plane hopper with the desired quantity of water excluding the anticipated volume of rinse water from containers. Start the mechanical or hydraulic agitation to provide moderate circulation before adding DiPel 6L. Add the desired volume of DiPel 6L to the tank or plane

hopper and continue agitation. Then add rinsate from the original containers. If a spreader-sticker is recommended, add the required volume to the water prior to the addition of DiPel and agitate until uniformly suspended. Mild agitation is sufficient to maintain mixture suspension during loading and spraying. Do not mix more DiPel 6L that can be used in a 144-hour period.

DiPel 6L can also be applied undiluted from aircraft for control of Spruce Budworm, Hemlock Looper, Jack Pine Budworm, and Gypsy Moth. It is recommended that rotary or other atomizers be used to provide droplet Volume Mean Diameters (VMD) of 20-80 microns for needle conifers and 50-150 microns for deciduous hardwoods. CAUTION: Rinse and flush spray equipment thoroughly following each use. Use oil solvent for flushing and rinsing undiluted DiPel 6L.

5.0 APPLICATION INSTRUCTIONS

DiPel 6L may be used to protect trees and shrubs such as in:

- Forests
- Residential, municipal, and shade trees
- Recreational areas such as campgrounds, golf courses, parks, and parkways.
- Shelterbelts, rights of ways, and other easements.

5.1 APPLICATION RATE FOR FORESTS, TREES AND SHRUBS*

Pest	Oz/100 Gal/ Acre[1] (Ground Equip.)	Oz/Acre (Aerial[2] Applica.)	BIU'S/A[3]
Bagworm	11 to 21	11 to 21	4 to 8
Blackheaded Budworm	21 to 32	21 to 32	8 to 12
Browntail Moth	21 to 54	21 to 54	8 to 20
California Oakworm	11 to 21	11 to 21	4 to 8
Douglas Fir Tussock Moth	21 to 43	21 to 43	8 to 16
Eastern Pine Looper	32 to 43	32 to 43	12 to 16
Eastern Tent Caterpillar	8 to 21	8 to 21	4 to 8
Elm Spanworm	11 to 21	11 to 21	4 to 8
Fall Webworm	11 to 21	11 to 21	4 to 8
Forest Tent Caterpillar	21 to 43	21 to 43	8 to 16
Fruittree Leafroller	11 to 21	—	4 to 8
Green Striped Maple Worm	21 to 32	21 to 32	8 to 12
Gypsy Moth	21 to 107	21 to 107	8 to 40
Hemlock Looper	32 to 43	32 to 43	12 to 16
Jack Pine Budworm	21 to 43	21 to 43	8 to 16
Mim osa Webworm	11 to 21	—	4 to 8
Oak Leaftier	21 to 32	21 to 32	8 to 12
Pine Butterfly	21 to 32	21 to 32	8 to 12
Redhumped Caterpillar	11 to 21	11 to 21	4 to 8
Saddleback Caterpillar	11 to 21	—	4 to 8
Saddled Prominent Caterpillar	11 to 21	11 to 21	4 to 8
Spring & Fall Cankerworm	11 to 21	11 to 21	4 to 8
Spruce Budworms[4]	11 to 54	11 to 54	4 to 20
Western Tussock Moth	11 to 21	11 to 21	4 to 8

* Forest, shade, sugar maple, trees and shrubs.

[1] Water dilution rate for hydraulic sprayer may be varied depending on coverage. For mist blowers, mix the applicable amount (oz.) in up to 10 gallons of water.

[2] For aerial application, use in up to 10 gallons of water depending on type and density of trees. For best results spray systems which deliver droplet VMD of 150 microns or less should be used. **Dipel 6L should always be mixed with at least an equal amount of water for diluted applications.** Note: For Hemlock Looper and Eastern Pine Looper use 1-2 applications, undiluted, beginning at peak first instar. When applying two applications, apply each application at a recommended rate of 32 ounces/A. First application is applied at peak first instar and second application is at second instar. For the high rate, i.e. 43 ounces/A, apply a single application only at peak first instar.

[3] Billion International Units per acre.

[4] Use rates greater than 21 ounces in Northern states for heavy populations.

6.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

ABBOTT LABORATORIES

DiPel® 8L

Biological Insecticide
Emulsifiable Suspension

Active Ingredient:

Bacillus thuringiensis, subsp. *kurstaki*, 17,600 International Units of Potency per mg (64 Billion International Units per gallon) . . .	3.5%
Inert Ingredients	96.5%

E.P.A. Reg. No. 275-51
E.P.A. Est. No. 33762-IA-1

INDEX:

CAUTION:

KEEP OUT OF REACH OF CHILDREN

1.0 PRECAUTIONARY STATEMENTS

1.1 HAZARDS TO HUMANS

Avoid contact with skin, eyes or clothing. In case of contact immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

1.2 RE-ENTRY STATEMENTS

Do not enter treated areas without protective clothing until sprays have dried.

2.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product through any type of irrigation system.

3.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Keep containers tightly closed when not in use. Do not store at temperatures below 0°F or above 90°F. Roll or shake the drum before dispensing.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Do not contaminate water when disposing of equipment washwaters.

Container Disposal: Triple rinse (or equivalent), then puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

4.0 GENERAL INFORMATION

DiPel 8L is a highly selective insecticide for use against listed caterpillars (larvae) of lepidopterous insects. Close scouting and early attention to infestations is highly recommended. Larvae must eat deposits of DiPel 8L to be affected. Always follow these directions:

- Treat when larvae are young (early instars) before extensive damage has occurred.
- Larvae must be actively feeding on treated, exposed plant parts.
- Thorough spray coverage is needed to provide a uniform deposit of DiPel 8L at the site of larval feeding.
- Under heavy pest population pressure, use the higher label rates and/or consider a second application.
- If attempting to control a pest with a single spray, make the treatment when egg hatch is essentially complete, but before extensive crop damage occurs.
- An approved spreader-sticker may be added to diluted tank mixes to improve weather-fastness of the spray deposits. Do not add sticker to the undiluted product.

After eating a lethal dose of DiPel 8L, larvae stop feeding within the hour and will die within several days. Dying larvae move slowly, discolor, then shrivel, blacken and die.

DiPel 8L may be applied in conventional ground or aerial equipment with quantities of water sufficient to provide thorough coverage of infested plant parts. The amount of water needed per acre will depend on weather, spray equipment, and plant canopy type. **DiPel 8L should always be mixed with at least an equal amount of water for diluted applications.** Fill the mix tank or plane hopper with the desired quantity of water excluding the anticipated volume of rinse water from containers. Start the mechanical or hydraulic agitation to provide moderate circulation before adding DiPel 8L. Add the desired volume of DiPel 8L to the tank

or plane hopper and continue agitation. Then add rinsate from the original containers. If a spreader-sticker is recommended, add the required volume to the water prior to the addition of DiPel and agitate until uniformly suspended. Mild agitation is sufficient to maintain mixture suspension during loading and spraying. Do not mix more DiPel 8L than can be used in a 144-hour period.

DiPel 8L can also be applied undiluted from aircraft for control of Spruce Budworm, Hemlock Looper, Jack Pine Budworm, and Gypsy Moth. It is recommended that rotary or other atomizers be used to provide droplet Volume Mean Diameters (VMD) of 20-80 microns for needle conifers and 50-150 microns for deciduous hardwoods. CAUTION: Rinse and flush spray equipment thoroughly following each use. Use oil solvent for flushing and rinsing undiluted DiPel 8L.

5.0 APPLICATION INSTRUCTIONS

DiPel 8L may be used to protect trees and shrubs such as in:

- Forests.
- Residential, municipal, and shade trees areas.
- Recreational areas such as campgrounds, golf courses, parks, and parkways.
- Shelterbelts, rights of ways, and other easements.

5.1 APPLICATION RATE FOR FORESTS, TREES AND SHRUBS*

Pest	Oz/100 Gal/ Acre[1] (Ground Equip.)	Oz/Acre (Aerial[2] Applica.)	BIU'S/A[3]
Bagworm	8 to 16	8 to 16	4 to 8
Blackheaded Budworm	16 to 24	16 to 24	8 to 12
Browntail Moth	16 to 40	16 to 40	8 to 20
California Oakworm	8 to 16	8 to 16	4 to 8
Douglas Fir Tussock Moth	16 to 32	16 to 32	8 to 16
Eastern Pine Looper	24 to 32	24 to 32	12 to 16
Eastern Tent Caterpillar	8 to 16	8 to 16	4 to 8
Elm Spanworm	8 to 16	8 to 16	4 to 8
Fall Webworm	8 to 16	8 to 16	4 to 8
Forest Tent Caterpillar	16 to 32	16 to 32	8 to 16
Fruittree leafroller	8 to 16	—	4 to 8
Green Striped Maple Worm	16 to 24	16 to 24	8 to 12
Gypsy Moth	16 to 80	16 to 80	8 to 40
Hemlock Looper	24 to 32	24 to 32	12 to 16
Jack Pine Budworm	16 to 32	16 to 32	8 to 16
Mimosa Webworm	8 to 16	—	4 to 8
Oak Leaftier	16 to 24	16 to 24	8 to 12
Pine Butterfly	16 to 24	16 to 24	8 to 12
Redhumped Caterpillar	8 to 16	8 to 16	4 to 8
Saddleback Caterpillar	8 to 16	—	4 to 8
Saddled Prominent Caterpillar	8 to 16	8 to 16	4 to 8
Spring & Fall Cankerworm	8 to 16	8 to 16	4 to 8
Spruce Budworms[4]	16 to 40	16 to 40	8 to 20
Western Tussock Moth	8 to 16	8 to 16	4 to 8

* Forest, shade, sugar maple, trees and shrubs.

[1] Water dilution rate for hydraulic sprayer may be varied depending on coverage. For mist blowers, mix the applicable amount (oz.) in up to 10 gallons of water.

[2] For aerial application, use in up to 10 gallons of water depending on type and density of trees. For best results spray systems which deliver droplet VMD of 150 microns or less should be used. Dipel 8L should always be mixed with at least an equal amount of water for diluted applications. NOTE: For Hemlock Looper and Eastern Pine Looper use 1-2 applications undiluted, beginning at peak first instar. When applying two applications, apply each application at a recommended rate of 24 ounces/A. First application is applied at peak first instar and second application is at second instar. For the high rate, i.e. 32 ounces/A, apply single application only at peak first instar.

[3] Billion International Units per acre.

[4] Use rates greater than 16 ounces in Northern states for heavy populations.

6.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

Abbott Laboratories – Quality Health Care Worldwide
Agricultural Products, North Chicago IL 60064 (800) 323-9597

ABBOTT LABORATORIES

DiPel® 6AF

Biological Insecticide
Aqueous Flowable

NOT REGISTERED IN CALIFORNIA

Active Ingredient:

Bacillus thuringiensis, subsp. *kurstaki*, 10,750 International Units of Potency per mg (48 Billion International Units per gallon) . . .	2.15%
Inert Ingredients	97.85%

EPA Reg. No. 275-59
EPA Est. No. 33762-IA-1

INDEX:

CAUTION:
KEEP OUT OF REACH OF CHILDREN

1.0 PRECAUTIONARY STATEMENTS

1.1 HAZARDS TO HUMANS

Avoid contact with skin, eyes or clothing. In case of contact immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

1.2 RE-ENTRY STATEMENT

Do not enter treated areas without protective clothing until sprays have dried.

2.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product through any type of irrigation system.

3.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Keep containers tightly closed when not in use. Do not store at temperatures below 0°F or above 90°F. Roll or shake the drum before dispensing.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Do not contaminate water when disposing of equipment washwaters.

Container Disposal: Triple rinse (or equivalent), puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

4.0 GENERAL INFORMATION

DIPEL 6AF is a highly selective insecticide for use against listed caterpillars (larvae) of lepidopterous insects. Close scouting and early attention to infestations is highly recommended. Larvae must eat deposits of DiPel 6AF to be affected. Always follow these directions:

- Treat when larvae are young (early instars) before the trees are extensively damaged.
- Larvae must be actively feeding on treated, exposed plant parts.
- Thorough spray coverage is needed to provide a uniform deposit of DiPel 6AF at the site of larval feeding.
- Under heavy pest population pressure, use the higher label rates and/or consider a second application.
- If attempting to control a pest with a single spray, make the treatment when egg hatch is essentially complete, but before extensive crop damage occurs.
- An approved spreader-sticker may be added to diluted tank mixes to improve weather-fastness of the spray deposits. Do not add a sticker to undiluted product.

After eating a lethal dose of DiPel 6AF, larvae stop feeding within the hour and will die within several days. Dying larvae move slowly, discolor, then shrivel, blacken and die.

DiPel 6AF is completely water miscible and may be applied through conventional ground or aerial equipment with quantities of water sufficient to provide thorough coverage of infested plant parts. The volume of water needed per acre will depend on weather, spray equipment and plant canopy type. It is recommended that DiPel 6AF be added to water and not in reverse order. Fill the mix tank with the appropriate quantity of water excluding the anticipated volume of rinse water from containers. Start the mechanical or hydraulic agitation to provide moderate circulation before adding

DiPel 6AF. Add the required volume of DiPel 6AF to the mix tank or plane hopper and continue agitation. Then add rinsate from the original containers. If a spreader-sticker is recommended, add the required amount to the water prior to the addition of DiPel and agitate until uniformly suspended. Mild agitation is sufficient to maintain mixture suspension during loading and spraying. Do not mix more DiPel 6AF that can be used in a 144 hour period.

CAUTION: Rinse and flush spray equipment thoroughly with water following each use.

DiPel 6AF can also be applied undiluted from aircraft for control of Spruce Budworm, Hemlock Looper, Jack Pine Budworm, and Gypsy Moth. It is recommended that rotary or other atomizers be used to provide droplet Volume Mean Diameters (VMD) of 20-80 microns for needle conifers and 50-150 microns for deciduous hardwoods. After prolonged storage, undiluted DiPel 6AF should be recirculated once to redistribute prior to use. During loading and spraying, agitation of the undiluted product is unnecessary and should be avoided.

5.0 APPLICATION INSTRUCTIONS

DiPel 6AF may be used to protect trees and shrubs such as in:

- Forests
- Residential, municipal, and shade tree areas.
- Recreational areas such as campgrounds, golf courses, parks, and parkways.
- Ornamental, shade tree, and forest nurseries.
- Shelterbelts, rights of way, and other easements.

5.1 APPLICATION RATE FOR FORESTS, TREES AND SHRUBS*

Pest	Oz/100 Gal/ Acre[1] (Ground Equip.)	Ounces/ Acre (Aerial[2] Applica.)	BIU'S/A[3]
Bagworm	11 to 21	11 to 21	4 to 8
Blackheaded Budworm	21 to 32	21 to 32	8 to 12
Browntail Moth	21 to 54	21 to 54	8 to 20
California Oakworm	11 to 21	11 to 21	4 to 8
Douglas Fir Tussock Moth	21 to 43	21 to 43	8 to 16
Eastern Pine Looper	32 to 43	32 to 43	12 to 16
Eastern Tent Caterpillar	11 to 21	11 to 21	4 to 8
Elm Spanworm	11 to 21	11 to 21	4 to 8
Fall Webworm	11 to 21	11 to 21	4 to 8
Forest Tent Caterpillar	21 to 43	21 to 43	8 to 16
Fruittree Leafroller	11 to 21	—	4 to 8
Green Striped Maple Worm	21 to 32	21 to 32	8 to 12
Gypsy Moth	21 to 107	21 to 107	8 to 40
Hemlock Looper	32 to 43	32 to 43	12 to 16
Jack Pine Budworm	21 to 43	21 to 43	8 to 16
Mimosa Webworm	11 to 21	—	4 to 8
Oak Leaftier	21 to 32	21 to 32	8 to 12

5.1 APPLICATION RATE FOR FORESTS, TREES AND SHRUBS* (cont.)

Pest	Oz/100 Gal/ Acre[1] (Ground Equip.)	Ounces/ Acre (Aerial[2] Applica.)	BIU'S/A[3]
Pine Butterfly	21 to 32	21 to 32	8 to 12
Redhumped Caterpillar	11 to 21	11 to 21	4 to 8
Saddleback Caterpillar	11 to 21	—	4 to 8
Saddled Prominent Caterpillar	11 to 21	11 to 21	4 to 8
Spring & Fall Cankerworm	11 to 21	11 to 21	4 to 8
Spruce Budworms[4]	11 to 80	11 to 80	4 to 30
Western Tussock Moth	11 to 21	11 to 21	4 to 8

* Forest, shade, sugar maple, trees and shrubs.

[1] Water dilution rate for hydraulic sprayer may be varied depending on coverage. For mist blowers, mix the applicable amount (oz.) in up to 10 gallons of water.

[2] For diluted aerial application, use in up to 10 gallons of water depending on type and density of trees. For best results spray systems which deliver droplet size of 150 microns VMD, or less should be used. NOTE: For Hemlock Looper and Eastern Pine Looper use 1-2 applications, undiluted, beginning at peak first instar. When applying two applications, apply each application at a recommended rate of 32 ounces/A. First application is applied at peak first instar and second application is at second instar. For the high rate, i.e. 43 ounces/A, apply single application only at first instar.

[3] Billion International Units per acre.

[4] Use rates greater than 21 ounces in Northern states for heavy populations.

6.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

Abbott Laboratories – Quality Health Care Worldwide
Agricultural Products, North Chicago IL 60064 (800) 323-9597

ABBOTT LABORATORIES

DiPel® 8AF

Biological Insecticide
Aqueous Flowable

NOT REGISTERED IN CALIFORNIA

Active Ingredient:

Bacillus thuringiensis, subsp. *kurstaki*, 14,500 International Units of Potency per mg. (64 Billion International Units per gallon) . . .	2.9%
Inert Ingredients	97.1%

EPA Reg. No. 275-67
EPA Est No. 33762-IA-1

INDEX:

CAUTION:

KEEP OUT OF REACH OF CHILDREN

1.0 PRECAUTIONARY STATEMENTS

1.1 HAZARDS TO HUMANS

Avoid contact with skin, eyes or clothing. In case of contact immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

1.2 RE-ENTRY STATEMENT

Do not enter treated areas without protective clothing until sprays have dried.

2.0 DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product through any type of irrigation system.

3.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Keep containers tightly-closed when not in use. Do not store at temperatures below 0°F or above 90°F. Roll or shake the drum before dispensing.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Do not contaminate water when disposing of equipment washwaters.

Container Disposal: Triple rinse (or equivalent), puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

4.0 GENERAL INFORMATION

DiPel 8AF is a highly selective insecticide for use against listed caterpillars (larvae) of lepidopterous insects. Close scouting and early attention to infestations is highly recommended. Larvae must eat deposits of DiPel 8AF to be affected. Always follow these directions:

- Treat when larvae are young (early instars) before extensive damage has occurred.
- Larvae must be actively feeding on treated, exposed plant parts.
- Thorough spray coverage is needed to provide a uniform deposit of DiPel 8AF at the site of larval feeding.
- Under heavy pest population pressure, use the higher label rates and/or consider a second application.
- If attempting to control a pest with a single spray, make the treatment when egg hatch is essentially complete, but before extensive crop damage occurs.
- An approved spreader-sticker may be added to diluted tank mixes to improve weather-fastness of the spray deposits. Do not add sticker to the undiluted product.

After eating a lethal dose of DiPel 8AF, larvae stop feeding within the hour and will die within several days. Dying larvae move slowly, discolor, then shrivel, blacken and die.

DiPel 8AF is completely water miscible and may be applied through conventional ground or aerial equipment with quantities of water sufficient to provide thorough coverage of infested plant parts. The volume of water needed per acre will depend on weather, spray equipment and plant canopy type. It is recommended that DiPel 8AF be added to water and not in reverse order. Fill the mix tank with the appropriate quantity of water excluding the anticipated volume of rinse water from containers. Start the mechanical or hydraulic agitation to provide moderate circulation before adding

DiPel 8AF. Add the required volume of DiPel 8AF to the mix tank or plane hopper and continue agitation. Then add rinsate from the original containers. If a spreader-sticker is recommended, add the required volume to the water prior to the addition of DiPel and agitate until uniformly suspended. Mild agitation is sufficient to maintain mixture suspension during loading and spraying. Do not mix more DiPel 8AF that can be used in a 144 hour period.

CAUTION: Rinse and flush spray equipment thoroughly with water following each use.

DiPel 8AF can also be applied undiluted from aircraft for control of Spruce Budworm, Hemlock Looper, Jack Pine Budworm, and Gypsy Moth. It is recommended that rotary or other atomizers be used to provide droplet Volume Mean Diameters (VMD) of 20 to 80 microns for needle conifers and 50-150 microns for deciduous hardwoods. After prolonged storage, undiluted DiPel 8AF should be recirculated once to redistribute prior to use. During loading and spraying, agitation of the undiluted product is unnecessary and should be avoided.

5.0 APPLICATION INSTRUCTIONS

DiPel 8AF may be used to protect trees and shrubs such as in:

- Forests
- Residential, municipal, and shade tree areas.
- Recreational areas such as campgrounds, golf courses, parks, and parkways.
- Ornamental, shade tree, and forest nurseries.
- Shelterbelts, rights of way, and other easements.

5.1 APPLICATION RATE FOR FOREST, TREES AND SHRUBS*

Pest	Oz/100 Gal/ Acre[1] (Ground Equip.)	Oz/Acre (Aerial[2] Applica.)	BIU'S/A[3]
Bagworm	8 to 16	8 to 16	4 to 8
Blackheaded Budworm	16 to 24	16 to 24	8 to 12
Browntail Moth	16 to 40	16 to 40	8 to 20
California Oakworm	8 to 16	8 to 16	4 to 8
Douglas Fir Tussock Moth	16 to 32	16 to 32	8 to 16
Eastern Pine Looper	24 to 32	24 to 32	12 to 16
Eastern Tent Caterpillar	8 to 16	8 to 16	4 to 8
Elm Spanworm	8 to 16	8 to 16	4 to 8
Fall Webworm	8 to 16	8 to 16	4 to 8
Forest Tent Caterpillar	16 to 32	16 to 32	8 to 16
Fruittree leafroller	8 to 16	—	4 to 8
Green Striped Maple Worm	16 to 24	16 to 24	8 to 12
Gypsy Moth	16 to 80	16 to 80	8 to 40
Hemlock Looper	24 to 32	24 to 32	12 to 16
Jack Pine Budworm	16 to 32	16 to 32	8 to 16
Mimosa Webworm	8 to 16	—	4 to 8
Oak Leaftier	16 to 24	16 to 24	8 to 12
Pine Butterfly	16 to 24	16 to 24	8 to 12
Redhumped Caterpillar	8 to 16	8 to 16	4 to 8

5.1 APPLICATION RATE FOR FOREST, TREES AND SHRUBS* (cont.)

Pest	Oz/100 Gal/ Acre[1] (Ground Equip.)	Oz/Acre (Aerial[2] Applica.)	BIU'S/A[3]
Saddleback Caterpillar	8 to 16	—	4 to 8
Saddled Prominent Caterpillar	8 to 16	8 to 16	4 to 8
Spring & Fall Cankerworm	8 to 16	8 to 16	4 to 8
Spruce Budworms[4]	16 to 40	16 to 40	8 to 20
Western Tussock Moth	8 to 16	8 to 16	4 to 8

* Forest, shade, sugar maple, trees and shrubs.

[1] Water dilution rate for hydraulic sprayer may be varied depending on coverage. For mist blowers, mix the applicable amount (oz.) in up to 10 gallons of water.

[2] For **diluted** aerial application, use in up to 10 gallons of water depending on type and density of trees. For best results spray systems which deliver droplet VMD of 150 microns or less should be used. NOTE: For Hemlock Looper and Eastern Pine Looper use 1-2 applications undiluted, beginning at peak first instar. When applying two applications, apply each application at a recommended rate of 24 ounces/A. First application is applied at peak first instar and second application at second instar. For the high rate, i.e. 32 ounces/A, apply single application only at peak first instar.

[3] Billion International Units per acre.

[4] Use rates greater than 16 ounces in Northern states for heavy populations.

6.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.

Abbott Laboratories – Quality Health Care Worldwide
Agricultural Products, North Chicago IL 60064 (800) 323-9597

Foray™ 48B

Flowable Concentrate

Forest, Trees and Shrubs

KEEP OUT OF REACH OF CHILDREN

CAUTION

If in eyes, flush with plenty of water. Get medical attention if irritation persists.

ACTIVE INGREDIENT:

Bacillus thuringiensis subsp. *kurstaki* 10,600 International Units (IU)/mg of product (equivalent to 48 billion IU/gallon)	2.1%
INERT INGREDIENTS:	97.9%
TOTAL	100%

PRECAUTIONARY STATEMENTS: *Hazards to Humans and Domestic Animals:* May cause eye irritation. Avoid contact with skin, eyes, open wounds or clothing. Wash thoroughly with soap and water after handling.

Environmental Hazards: Do not contaminate water when disposing of equipment washwaters.

DIRECTIONS FOR USE:

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. FORAY contains the spores and endotoxin crystals of *Bacillus thuringiensis kurstaki*. FORAY is a stomach poison and has high specific activity against lepidopterous larvae. After ingestion, larvae stop feeding within hours and die 2-5 days later. Maximum activity is exhibited against early instar larvae. FORAY 48B Flowable Concentrate may be used for both ground and aerial application. The product should be shaken or stirred before use. Add some water to the tank mix, pour the recommended amount of FORAY 48B into the tank and then add the remaining amount of water to obtain the proper mix ratio. Agitate as necessary to maintain the suspension. The diluted mix should be used within 72 hours.

Ground Application: Use an adequate amount of tank mix to obtain thorough coverage without excessive run off. Use the recommended per acre dosages of FORAY 48B in the following amounts of water:

High volume hydraulic sprayers	100 gallons
Mist blowers	10 gallons

Aerial Application: FORAY 48B may be applied aerially, either alone or diluted with water at the dosages shown in the application rates table. Spray volumes of 32-128 ounces per acre are recommended. Best results are expected when FORAY 48B is applied to dry foliage.

RE-ENTRY: FORAY may be applied up to and including the day of harvest.

STORAGE AND DISPOSAL: Do not contaminate water, food or feed by storage or disposal of waste.

Storage: Store in a cool, dry place. Keep containers tightly closed when not in use. Store in temperatures above freezing and below 32 degrees C (90 degrees F).

Pesticide Disposal: Pesticide waste resulting from the use of this product may be disposed of on site or at an approved waste disposal facility in accordance with federal and local regulations.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

APPLICATION RATES:

Crop	Pests	Rate* (pts/acre)	Dosage* (BIU/Acre)
Forests, Shade Trees, Ornamentals, Shrubs, Sugar Maple Trees, Seed Orchards, Ornamental Fruit, Nut and Citrus Trees	Gypsy moth	1.3-6	8-36
	Spruce budworm, browntail moth, Douglas fir tussock moth, coneworm	1.3-5	8-30
	Tussock moths, pine butterfly, bagworm, leafrollers, tortix, mimosa webworm, tent caterpillar, jackpine budworm, black headed budworm, elm spanworm, saddled prominent, saddleback caterpillar and hemlock looper	1-2.7	6-16
	Redhumped caterpillars, spring and fall cankerworm, California oakworm, fall webworm	0.7-1.3	4-8

*Use the higher recommended rates on advanced larval stages or under high density larval populations.

WARRANTY NOTICE: NOVO NORDISK MAKES NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PURPOSE OR OTHERWISE, EXPRESS OR IMPLIED, concerning this product or its uses which extend beyond the use of the product under normal conditions in accord with the statements made on this label. In no case shall the seller be liable for consequential, special, or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the buyer.

EPA Registration No. 58998-7
EPA Est. No. 58998-DN-001

FO48M91

MANUFACTURED FOR:
Novo Nordisk
33 Turner Road
Danbury, Connecticut 06813-1907

NET CONTENT

(U.S. GALLONS)

Foray® 76B

Flowable Concentrate
Forests, Trees and Shrubs

KEEP OUT OF REACH OF CHILDREN

CAUTION

If in eyes, flush with plenty of water. Get medical attention if irritation persists.

TIVE INGREDIENT:

...lus thuringiensis subsp. *kurstaki*

...idopteran Active Toxin.....3.3%

ERT INGREDIENTS.....96.7%

...AL.....100%

...TENCY: 16,700 International Units (IU)/mg of product (equivalent to 76 ...lion IU/GAL.). Potency units should not be used to adjust use rates ...ond those specified in the directions for use section.

...CAUTIONARY STATEMENTS: *HAZARDS TO HUMANS AND ...OMESTIC ANIMALS:* Causes moderate eye irritation. Harmful if ...sorbed through the skin. Do not get in eyes, on skin, or on clothing. ...d breathing spray mist. Wash thoroughly with soap and water after ...dling and before eating, drinking, or using tobacco. Remove ...ntaminated clothing and wash contaminated clothing before reuse.

...IRONMENTAL HAZARDS: Do not contaminate water when disposing ...uipment washwaters.

...TATEMENTS OF PRACTICAL TREATMENT: *If on Skin:* Wash with ...ty of soap and water. Get medical attention if irritation persists. *If ...:* Flush with plenty of water. Call a physician if eye irritati... ...sts.

...RECTIONS FOR USE: It is a violation of Federal Law to use this product ...manner inconsistent with its labeling.

...ORAY contains the spores and endotoxin crystals of *Bacillus ...uringiensis kursteki*. FORAY is a stomach poison and has high specific ...ity against lepidopterous larvae. After ingestion, larvae stop feeding ...n hours and die 2-5 days later. Maximum activity is exhibited against ... instar larvae. FORAY 76B may be used for both ground and aerial ...plication. The product should be shaken or stirred before use. Add ...me water to the tank mix, pour the recommended amount of FORAY ...into the tank and then add the remaining amount of water to obtain ...proper mix ratio. Agitate as necessary to maintain the suspension. ...he diluted mix should be used within 72 hours.

...und Application: Use an adequate amount of tank mix to obtain ...ough coverage without excessive run off. Use the recommended per ...re dosages of FORAY 76B in up to the following amounts of water:

High volume hydraulic sprayers	100 gallons
Mist blowers	10 gallons

...erial Application: FORAY 76B may be applied aerially, either alone or ...ed with water at the dosages shown in the application rates table. ...y volumes of 32-128 ounces per acre are recommended. Best results ... expected when FORAY 76B is applied to dry foliage.

...ENTRY: FORAY may be applied up to and including the day of harvest.

STORAGE AND DISPOSAL: Do not contaminate water, food or feed by storage or disposal of waste.

Storage: Store in a cool, dry place. Keep containers tightly closed when not in use. Store in temperatures above freezing and below 25 degrees C (77 degrees F).

Pesticide Disposal: Pesticide waste resulting from the use of this product may be disposed of on site or at an approved waste disposal facility in accordance with federal and local regulations.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. Reuse of thoroughly cleaned container is allowed.

APPLICATION RATES:

Crop	Pests	Rate* (oz./acre)	Dosage* (BIU/acre)
Forests, Shade Trees, Ornamentals, Shrubs, Sugar Maple Trees, Seed Orchards, Ornamental Fruit, Nut and Citrus Trees	Gypsy moth	13.5 - 67.5	8 - 40
	Spruce budworm, browntail moth, Douglas fir tussock moth, coneworm	13.5 - 50.5	8 - 30
	Tussock moths, pine butterfly, bagworm, leafrollers, tortrix, mimosa webworm, tent caterpillar, jackpine budworm, black headed budworm, elm spanworm, saddled prominent, saddleback caterpillar and hemlock looper	10.0 - 27.0	6 - 16
	Redhumped caterpillars, spring and fall cankerworm, California oakworm fall webworm	7.0 - 13.5	4 - 8

* Use the higher recommended rates on advanced larval stages or under high density larval populations.

WARRANTY: NOVO NORDISK MAKES NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PURPOSE, OR OTHERWISE, EXPRESS OR IMPLIED, concerning this product or its uses which extend beyond the use of the product under normal conditions in accord with the statements made on this label. In no case shall the seller be liable for consequential, or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the buyer.

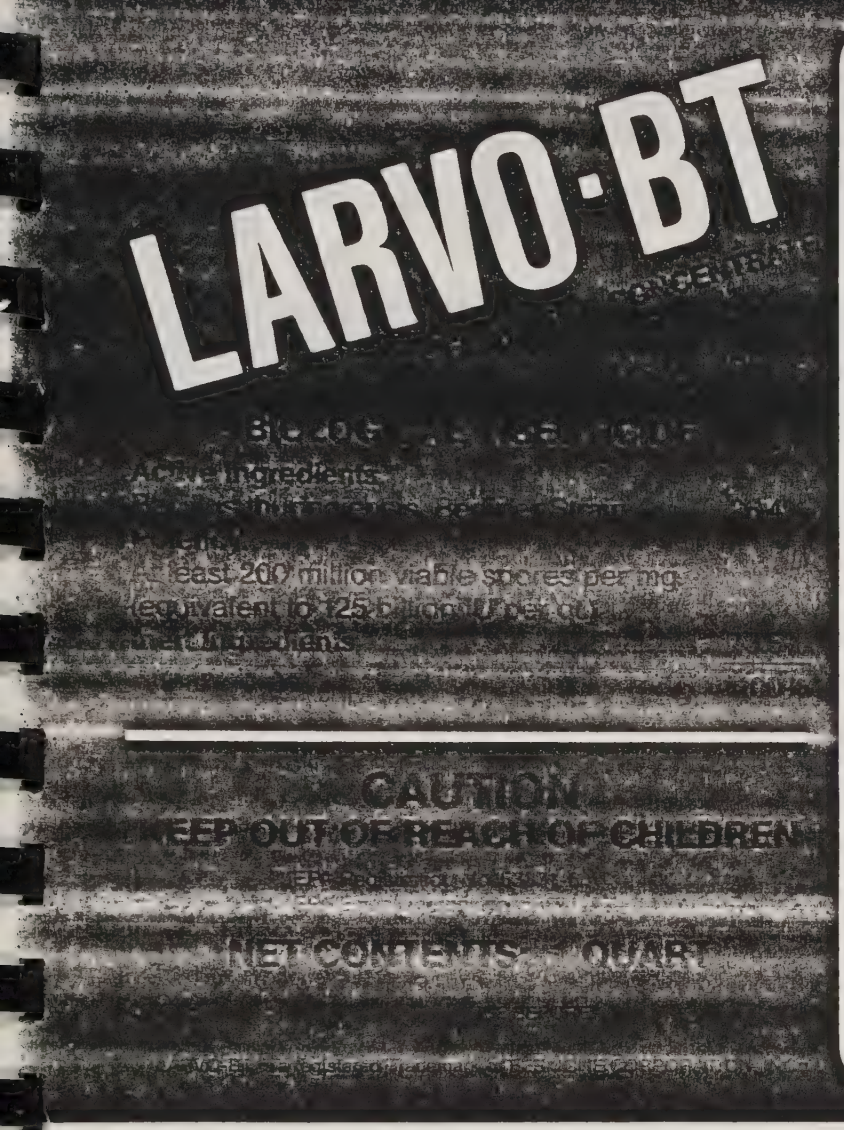
...Reg. No. 58998-17
...Est. No. 58998-DN-002

Manufactured For:
Novo Nordisk
33 Turner Road
Danbury, Connecticut 06813-1907

NET CONTENT

(U.S. GALLONS)

...076N82



PRECAUTIONARY STATEMENTS

HAZARDOUS TO HUMANS
Avoid inhalation or contact with eyes, skin, or open wounds. Do not inhale spray mist. In case of contact, immediately flush eyes or skin with plenty of water.

ENVIRONMENTAL HAZARD WARNING
Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public water unless this product is specifically identified and addressed in a NPDES permit. Do not discharge effluent containing this product to sewer systems without previously notifying the sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA. Do not contaminate water when disposing of equipment washwaters.

Forestry Use: Do not apply directly to water or wetlands (swamps, bogs, marshes, and potholes). Aerial application over such sites is permissible only when they are not visible from above the tree canopy. Do not contaminate water when disposing of equipment washwaters.

Direct Water Application: Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles.

STORAGE AND DISPOSAL
Storage: Store in cool place. Protect from freezing. Do not allow spray solution to stand more than 12 hours before use. Avoid contamination and loss of potency of opened containers by closing containers tightly after use.

Disposal: Do not reuse empty containers. Perforate or crush and discard container according to local trash disposal regulations.

FERMONE CORPORATION, INC.
2620 N. 37TH DR., PHOENIX, AZ 85009 • (602) 233-9047

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

LARVO-BT is recommended for aerial applications at rates of 1-10 gallons total spray solution per acre and for ground spray machine application at rates of 10-20 gallons total spray solution per acre. Complete coverage of plants is essential for effective pest control.

LARVO-BT is a highly concentrated insecticide. The recommended rate for control of the following pests on the following crops is: 2 fl. oz of LARVO-BT per acre.

CROP	PEST
Vegetables, Strawberries, beans, broccoli, brussel sprouts, cabbage, cauliflower, celery, cucumbers, lettuce, mustard greens, melons, potatoes, spinach, tomatoes, turnip greens	Cabbage looper Imported cabbageworm Diamondback moth Fall webworm Horn worm Beet armyworm Corn earworm
Orchards, Fruit Trees, Forest Land almond, apple, grape, orange, pecan, walnut, shade trees, spruce	Fall webworm Red humped caterpillar Tent caterpillar Leaf rollers, folders Orangedog Fruittree leafroller Eastern spruce budworm Gypsy moth Bag worm
Rangeland, Pastureland pasture, hay, small grains, forage crops	European Skipper Rangeland caterpillar Fall armyworm
Cotton	Cotton bollworm Tobacco budworm Cabbage looper Beet armyworm
Soybeans	Green cloverworm Velvetbean caterpillar Soybean looper Cabbage looper Cotton bollworm
Tobacco	Tobacco budworm Cabbage looper Horn worm
Greenhouse Flowers, Ornamentals	Cabbage loopers Omnivorous looper

WARRANTY

FERMONE CORPORATION, INC. warrants that this product (1) conforms to the ingredient statement on the label and (2) is reasonably fit for the purposes set forth in the Directions for Use. EXCEPT AS SO WARRANTEED THE PRODUCT IS SOLD AS IS. FERMONE CORPORATION, INC. MAKES NO OTHER WARRANTY EXPRESS OR IMPLIED.

THURICIDE® 32LV

AQUEOUS CONCENTRATE FOR AERIAL OR GROUND APPLICATION FOR CONTROL OF ORNAMENTAL, SHADE TREE, AND FOREST PESTS

SPECIMEN LABEL

ACTIVE INGREDIENT:

Bacillus thuringiensis, subspecies kurstaki potency of 8,000 International Units (at least 12 million viable spores) per milligram*	1.6%
INERT INGREDIENTS:	98.4%
TOTAL	100.0%

*Equivalent to 8.0 billion International Units per quart.

EPA Reg. No. 55947-69
EPA Est. No. 55947-CA-2

KEEP OUT OF REACH OF CHILDREN
CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS

Avoid inhalation or contact with eyes or open wounds.

ENVIRONMENTAL HAZARDS

Do not contaminate water when disposing of equipment washwaters.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Suspension must be shaken or stirred before use. Pour the recommended amount of THURICIDE® 32LV into the required volume of water in the spray tank. Agitate as necessary to maintain suspension. Do not allow diluted sprays to remain in the tank for more than 72 hours. THURICIDE 32LV is formulated to provide desirable coverage and stickability on leaf surfaces. Additional adjuvants, spreaders, or stickers may be added but are not essential.

Do not apply this product through any type of irrigation system.

GROUND APPLICATION

Use adequate water to obtain good foliar coverage. Wet foliage but do not allow excessive run-off. Apply the recommended per acre rates of THURICIDE 32LV with the following suggested amounts of water:

100 gallons with high-gallonage hydraulic sprayers
10 gallons with mist blower

AERIAL APPLICATION

Apply THURICIDE 32LV at recommended rates as a spray mix diluted with water. Use not less than one half gallon of spray mix per acre. Best results are obtained when THURICIDE 32LV is applied to dry foliage with a calibrated aircraft capable of obtaining droplet sizes below 300 microns and preferably in the range of 50-150 microns.

RECOMMENDATIONS

Thorough coverage is essential when using THURICIDE® 32LV. Use the lower rate for light to moderate infestations. Use the higher rates against heavier worm infestations.

Pest	Dosage Ounces Per Acre	Dosage BIU Per Acre	Directions For Use
Spring Cankerworm	16-64	4-16	Apply when leaf expansion reaches 40-50% as infestation warrants. If eggs hatch over a long period of time or if reinfestation occurs, respray about 14 days after the first application.
Fall Cankerworm	16-64	4-16	
Elm Spanworm	16-64	4-16	
Tent Caterpillar	16-64	4-16	
Gypsy Moth	32-160	8-40	
Spruce Budworm	24-160	6-40	Apply when most larvae are 3rd-4th instar. Also consider the opening of the bud cap to ensure foliage exposure.
Douglass Fir Tussock Moth	16-128	4-32	Apply after eggs have hatched and early instar larvae are feeding on exposed foliage.
Jack Pine Budworm	16-64	4-16	
Bagworm	16-64	4-16	
California Oak Moth	16-64	4-16	
Western Tussock Moth	16-64	4-16	
Fruit Tree Leafroller	16-64	4-16	
Mimosa Webworm	16-64	4-16	
Redhumped Caterpillar	8-48	2-12	
Fall Webworm	8-32	2- 8	
Pine Butterfly	24-96	6-28	

STORAGE AND DISPOSAL

STORAGE

Store in a cool place. Activity may be impaired by storage at temperatures above 90°F. Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE DISPOSAL

Wastes resulting from this product may be disposed on on-site or at an approved waste disposal facility.

CONTAINER DISPOSAL (Plastic)

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by State and local authorities, by burning. If burned, stay out of smoke. Reuse of thoroughly cleaned container is allowable.

CONTAINER DISPOSAL (Metal)

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and local authorities. Reuse of thoroughly cleaned drum is allowable.

LIMITATION OF WARRANTY AND LIMITATION OF LIABILITY

Notice: Read this Limitation of Warranty and Limitation of Liability before buying or using this product. If the terms are not acceptable, return the product at once, unopened, and the purchase price will be refunded.

It is impossible to eliminate all risks inherently associated with the use of this product. Crop injury, ineffectiveness, or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Sandoz or seller. All such risks shall be assumed by buyer or user.

Sandoz warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions for Use, under normal use conditions, subject to the risks described above. **Sandoz makes no other express or implied warranty of fitness or of merchantability or any other express or implied warranty.**

In no event shall Sandoz or seller be liable for any incidental, consequential or special damages resulting from the use or handling of this product. **The exclusive remedy of the user or buyer, and the exclusive liability of Sandoz or seller for any and all claims, losses, injuries or damages (including claims based on breach of warranty, contract, negligence, tort, strict liability or otherwise) resulting from the use or handling of this product, shall be the return of the purchase price of the product or, at the election of Sandoz or seller, the replacement of the product.**

Sandoz and seller offer this product, and buyer and user accept it, subject to the foregoing limitations of warranty and limitation of liability, which may not be modified by any oral or written agreement.

SANDOZ

SANDOZ AGRO, INC.
1300 EAST TOUHY AVENUE, DES PLAINES, ILLINOIS 60018

THURICIDE® 48LV

AQUEOUS CONCENTRATE FOR AERIAL OR GROUND APPLICATION FOR CONTROL OF ORNAMENTAL, SHADE TREE, AND FOREST PESTS

SPECIMEN LABEL

ACTIVE INGREDIENT:

Bacillus thuringiensis, subspecies kurstaki potency 12,000 International Units (at least 18 million viable spores) per milligram*	2.4%
INERT INGREDIENTS:	97.6%
TOTAL . . .	100.0%

*Equivalent to 12.0 billion International Units per quart.

EPA Reg. No. 55947-74
EPA Est. No. 55947-CA-2

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS

Avoid inhalation or contact with eyes or open wounds.

ENVIRONMENTAL HAZARDS

Do not contaminate water when disposing of equipment washwaters.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

Suspension must be shaken or stirred before use. Pour the recommended amount of THURICIDE® 48LV into the required volume of water in the spray tank. Agitate as necessary to maintain suspension. Do not allow diluted sprays to remain in the tank for more than 72 hours. THURICIDE 48LV is formulated to provide desirable coverage and stickability on leaf surfaces. Additional adjuvants, spreaders, or stickers may be added but are not essential.

Do not apply this product through any type of irrigation system.

GROUND APPLICATION

Use adequate water to obtain good foliar coverage. Wet foliage but do not allow excessive runoff. Apply the recommended per acre rates of THURICIDE 48LV with the following suggested amounts of water:

100 gallons with high-gallonage hydraulic sprayers
10 gallons with mist blower

AERIAL APPLICATION

Apply THURICIDE 48LV at recommended rates by air either alone or as a spray mix diluted with water. Spray volumes of 32-128 ounces per acre are recommended. Best results are expected when THURICIDE 48LV is applied to dry foliage with a calibrated aircraft capable of obtaining droplet sizes below 300 microns and preferably in the range of 50-150 microns.

RECOMMENDATIONS

Thorough coverage is essential when using THURICIDE 48LV. Use the lower rate for light to moderate infestations. Use the higher rates against heavier worm infestations.

Pest	Dosage Ounces Per Acre	Dosage BIU Per Acre	Directions For Use
Spring Cankerworm	11-44	4-16	Apply when leaf expansion reaches 40-50% as infestation warrants. If eggs hatch over a long period of time or if reinfestation occurs, respray about 14 days after the first application.
Fall Cankerworm	11-44	4-16	
Elm Spanworm	11-44	4-16	
Tent Caterpillar	11-44	4-16	
Gypsy Moth	22-106	8-40	
Spruce Budworm	16-106	6-40	Apply when most larvae are 3rd-4th instar. Also consider the opening of the bud cap to ensure foliage exposure.
Douglass Fir Tussock Moth	11-44	4-16	Apply after eggs have hatched and early instar larvae are feeding on exposed foliage.
Jack Pine Budworm	11-44	4-16	
Bagworm	11-44	4-16	
California Oak Moth	11-44	4-16	
Western Tussock Moth	11-44	4-16	
Fruit Tree Leafroller	11-44	4-16	
Mimosa Webworm	11-44	4-16	
Redhumped Caterpillar	5-32	2-12	
Fall Webworm	5-22	2- 8	
Pine Butterfly	16-64	6-24	

STORAGE AND DISPOSAL

STORAGE

Store in a cool place. Activity may be impaired by storage at temperatures above 90°F. Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE DISPOSAL

Wastes resulting from this product may be disposed on on-site or at an approved waste disposal facility.

CONTAINER DISPOSAL (Plastic)

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by State and local authorities, by burning. If burned, stay out of smoke. Reuse of thoroughly cleaned container is allowable.

CONTAINER DISPOSAL (Metal)

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and local authorities. Reuse of thoroughly cleaned container is allowable.

LIMITATION OF WARRANTY AND LIMITATION OF LIABILITY

Notice: Read this Limitation of Warranty and Limitation of Liability before buying or using this product. If the terms are not acceptable, return the product at once, unopened, and the purchase price will be refunded.

It is impossible to eliminate all risks inherently associated with the use of this product. Crop injury, ineffectiveness, or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Sandoz or seller. All such risks shall be assumed by buyer or user.

Sandoz warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions for Use, under normal use conditions, subject to the risks described above. **Sandoz makes no other express or implied warranty of fitness or of merchantability or any other express or implied warranty.**

In no event shall Sandoz or seller be liable for any incidental, consequential or special damages resulting from the use or handling of this product. **The exclusive remedy of the user or buyer, and the exclusive liability of Sandoz or seller for any and all claims, losses, injuries or damages (including claims based on breach of warranty, contract, negligence, tort, strict liability or otherwise) resulting from the use or handling of this product, shall be the return of the purchase price of the product or, at the election of Sandoz or seller, the replacement of the product.**

Sandoz and seller offer this product, and buyer and user accept it, subject to the foregoing limitations of warranty and limitation of liability, which may not be modified by any oral or written agreement.

SANDOZ

SANDOZ AGRO, INC.
1300 EAST TOUHY AVENUE, DES PLAINES, ILLINOIS 60018

SP-372

April 1992
Des Plaines, IL

THURICIDE® 64LV®

FOR CONTROL OF ORNAMENTAL, SHADE TREE, AND FOREST PESTS

SPECIMEN LABEL

ACTIVE INGREDIENT:

Bacillus thuringiensis, subspecies kurstaki potency of 16,000 International Units (at least 24 million viable spores) per milligram*	3.2%
INERT INGREDIENTS:	96.8%
TOTAL	100.0%

*Equivalent to 16.8 billion International Units per quart.

EPA Reg. No. 55947-76
EPA Est. No. 55947-CA-2

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS

Avoid inhalation or contact with eyes or open wounds.

ENVIRONMENTAL HAZARDS

Do not contaminate water when disposing of equipment washwaters.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

Suspension must be shaken or stirred before use. Pour the recommended amount of THURICIDE® 64LV into the required volume of water in the spray tank. Agitate as necessary to maintain suspension. Do not allow diluted sprays to remain in the tank for more than 72 hours. THURICIDE 64LV is formulated to provide desirable coverage and stickability on leaf surfaces. Additional adjuvants, spreaders, or stickers may be added but are not essential.

Do not apply this product through any type of irrigation system.

GROUND APPLICATION

Use adequate water to obtain good foliar coverage. Wet foliage but do not allow excessive run-off. Apply the recommended per acre rates of THURICIDE 64LV with the following suggested amounts of water:

100 gallons with high-gallonage hydraulic sprayers
10 gallons with mist blower

AERIAL APPLICATION

Apply THURICIDE 64LV at recommended rates by air either alone or as a spray mix diluted with water. Spray volumes of 32-128 ounces per acre are recommended. Best results are expected when THURICIDE 64LV is applied to dry foliage with a calibrated aircraft capable of obtaining droplet sizes below 300 microns and preferably in the range of 50-150 microns.

RECOMMENDATIONS

Thorough coverage is essential when using THURICIDE® 64LV. Use the lower rate for light to moderate infestations. Use the higher rates against heavier worm infestations.

Pest	Dosage Ounces Per Acre	Dosage BIU Per Acre	Directions For Use
Spring Cankerworm	8-32	4-16	Apply when leaf expansion reaches 40-50% as infestation warrants. If eggs hatch over a long period of time or if reinfestation occurs, respray about 14 days after the first application.
Fall Cankerworm	8-32	4-16	
Elm Spanworm	8-32	4-16	
Tent Caterpillar	8-32	4-16	
Gypsy Moth	16-80	8-40	
Spruce Budworm	12-80	6-40	Apply when most larvae are 3rd-4th instar. Also consider the opening of the bud cap to ensure foliage exposure.
Douglass Fir Tussock Moth	8-32	4-16	Apply after eggs have hatched and early instar larvae are feeding on exposed foliage.
Jack Pine Budworm	8-32	4-16	
Bagworm	8-32	4-16	
California Oak Moth	8-32	4-16	
Western Tussock Moth	8-32	4-16	
Fruit Tree Leafroller	8-32	4-16	
Mimosa Webworm	4-24	2-12	
Redhumped Caterpillar	4-16	2- 8	
Fall Webworm	12-48	6-24	
Pine Butterfly	16-64	8-32	

STORAGE AND DISPOSAL

STORAGE

Store in a cool place. Activity may be impaired by storage at temperatures above 90°F. Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE DISPOSAL

Wastes resulting from this product may be disposed on on-site or at an approved waste disposal facility.

CONTAINER DISPOSAL

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and local authorities. Reuse of thoroughly cleaned drum is allowable.

LIMITATION OF WARRANTY AND LIMITATION OF LIABILITY

Notice: Read this Limitation of Warranty and Limitation of Liability before buying or using this product. If the terms are not acceptable, return the product at once, unopened, and the purchase price will be refunded.

It is impossible to eliminate all risks inherently associated with the use of this product. Crop injury, ineffectiveness, or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Sandoz or seller. All such risks shall be assumed by buyer or user.

Sandoz warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions for Use, under normal use conditions, subject to the risks described above. **Sandoz makes no other express or implied warranty of fitness or of merchantability or any other express or implied warranty.**

In no event shall Sandoz or seller be liable for any incidental, consequential or special damages resulting from the use or handling of this product. **The exclusive remedy of the user or buyer, and the exclusive liability of Sandoz or seller for any and all claims, losses, injuries or damages (including claims based on breach of warranty, contract, negligence, tort, strict liability or otherwise) resulting from the use or handling of this product, shall be the return of the purchase price of the product or, at the election of Sandoz or seller, the replacement of the product.**

Sandoz and seller offer this product, and buyer and user accept it, subject to the foregoing limitations of warranty and limitation of liability, which may not be modified by any oral or written agreement.

SANDOZ

SANDOZ AGRO, INC.
1300 EAST TOUHY AVENUE, DES PLAINES, ILLINOIS 60018

SP-379

April 1992
Des Plaines, IL

Sevin® 4-Oil ULV

Brand Carbaryl Insecticide RHÔNE-POULENC

For Agricultural or Commercial Use Only

ACTIVE INGREDIENTS: Carbaryl (1-naphthyl N-methylcarbamate)..... **47.5% by wt.**
INERT INGREDIENTS:..... **52.5% by wt.**
This product contains petroleum distillates. (Contains 4 pounds carbaryl per gallon)

E.P.A. Reg. No. 264-422 **E.P.A. Est. No. 264-MO-02**

KEEP OUT OF REACH OF CHILDREN
CAUTION

For EMERGENCY Information ONLY Call 24 Hours A Day 1-800-334-7577
For PRODUCT USE Information Call 1-800-334-9745

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: Call a physician or Poison Control Center immediately. Give 1 to 2 glasses of water or milk to drink. Do not induce vomiting, may cause aspiration hazard.

IF IN EYES: Hold eyelids open and flush with a steady, gentle stream of water for at least 15 minutes. Get medical attention if irritation persists.

IF ON SKIN: Wash thoroughly with soap and water.

IF INHALED: Remove to fresh air. If not breathing, give artificial respiration. Administer oxygen if necessary. GET MEDICAL ATTENTION.

GENERAL

Contact a physician immediately in all cases of suspected poisoning. Transport patient to a physician or hospital immediately and SHOW A COPY OF THIS LABEL TO THE PHYSICIAN. If poisoning is suspected in animals, contact a veterinarian.

NOTE TO PHYSICIAN

PRECAUTION: To prevent aspiration of petroleum distillates, lay patient on side with head lower than waist.

Carbaryl is a carbamate insecticide, which is a cholinesterase inhibitor. Overexposure to this substance may cause toxic signs and symptoms due to stimulation of the cholinergic nervous system. These effects of overexposure are spontaneously and rapidly reversible. Gastric lavage may be used if this product has been swallowed. Carbaryl poisoning may occur rapidly after ingestion and prompt removal of stomach contents in indicated.

Specific treatment consists of parenteral atropine sulfate. Caution should be maintained to prevent overatropinization. Mild cases may be given 1 to 2 mg intramuscularly every 10 minutes until full atropinization has been achieved and repeated thereafter whenever symptoms reappear. Severe cases should be given 2 to 4 mg intravenously every 10 minutes until fully atropinized, then intramuscularly every 30 to 60 minutes as needed to maintain the effect for at least 12 hours. Dosages for children should be appropriately reduced. Complete recovery from overexposure is to be expected within 24 hours.

Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are NOT recommended.

To aid in confirmation of a diagnosis, urine samples should be obtained within 24 hours of exposure and immediately frozen. Analyses will be arranged by Rhône-Poulenc Ag Company

Consultation on therapy can be obtained at all hours by calling the Rhône-Poulenc emergency number 1-800-334-7577.

PRECAUTIONARY STATEMENTS

CAUTION
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

MAY BE HARMFUL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH THE SKIN. MAY CAUSE SKIN IRRITATION. Avoid breathing of spray mist. Do not take internally. Avoid contact with eyes, skin or clothing. Wear regular long-sleeved work clothing and head covering when making overhead applications. Change to clean clothing daily. Bathe and wash hair after each work day. Do not eat, drink or use tobacco while working with this product or spray solutions. Wash hands and face before eating, drinking or using tobacco. Keep out of reach of children and domestic animals.

OVEREXPOSURE MAY CAUSE: Salivation, watery eyes, pinpoint eye pupils, blurred vision, muscle tremors, difficult breathing, excessive sweating, abdominal cramps, nausea, vomiting, diarrhea, weakness, headache. IN SEVERE CASES CONVULSION, UNCONSCIOUSNESS AND RESPIRATORY FAILURE MAY OCCUR. SIGNS AND SYMPTOMS OCCUR RAPIDLY FOLLOWING OVEREXPOSURE TO THIS PRODUCT.

ANTIDOTE STATEMENT

ATROPINE SULFATE IS HIGHLY EFFECTIVE AS AN ANTIDOTE. Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are NOT recommended. See NOTE TO PHYSICIAN above.

ENVIRONMENTAL HAZARDS

This product is extremely toxic to aquatic and estuarine invertebrates. Do not apply directly to water and wetlands, except under the forest canopy. Do not apply when weather conditions favor drift from the area treated. Do not contaminate water by cleaning equipment or disposal of wastes.

BEE CAUTION: MAY KILL HONEYBEES IN SUBSTANTIAL NUMBERS

This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. Contact your Cooperative Agricultural Extension Service or your local Rhône-Poulenc Ag Company representative for further information.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.
Read entire label before using this product.

GENERAL WORKER PROTECTION STATEMENT

Do not apply this product in such a manner as to directly or through drift expose workers or other persons. The area treated must be vacated by unprotected persons. Do not enter treated areas without protective clothing until sprays have dried.

Because certain states may require more restrictive reentry intervals for various crops treated with this product, consult your State Department of Agriculture for further information.

Written or oral warnings must be given to workers who are expected to be in treated area or in an area about to be treated with this product. Advise workers to stay out of fields during application and until sprays have dried. Regular long-sleeved work clothing should be worn when working in treated fields. See PRECAUTIONARY STATEMENTS, STATEMENT OF PRACTICAL TREATMENT AND NOTE TO PHYSICIAN for information on accidental exposures. When oral warnings are given, warnings shall be given in a language customarily understood by workers. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. Written warnings must include the following information: Appropriate signal work (CAUTION), area treated with SEVIN® brand 4-OIL ULV Carbaryl Insecticide, date of application, appropriate clothing, and re-entry interval (i.e., until sprays have dried).

STORAGE AND DISPOSAL

STORAGE

Store unused SEVIN® brand 4-OIL ULV Carbaryl Insecticide in original container only, in cool, dry area out of reach of children and animals. Do not store in areas where temperatures frequently exceed 100°F

PESTICIDE DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL

Decontaminate empty bulk tanks. **For drums:** Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

Consult Federal, State or local disposal authorities for approved alternative procedures.

DIRECTIONS FOR USE AS A WHEAT BRAN BAIT

FOR END USE ONLY. NOT FOR REPACKAGING.

FOR USE ONLY BY GOVERNMENT PERSONNEL OR PERSONS UNDER THEIR DIRECT SUPERVISION.

Mixing Instructions

Mix the appropriate amount of SEVIN® brand 4-OIL ULV Carbaryl Insecticide with wheat bran to make carbaryl wheat bran bait containing 2% to 10% active carbaryl. For example, for a bait containing 5% carbaryl, mix 1 quart SEVIN® brand 4-OIL ULV Carbaryl Insecticide (contains 1 lb. active carbaryl) with each 19 pounds of wheat bran. Mix only the amount of bait necessary for each insect control program.

Storage Instructions

Store carbaryl bran baits in cool, dry area out of reach children and animals. Do not contaminate water, food, or feed by storage or disposal.

NOTE: Carbaryl bran baits should only be stored temporarily while awaiting application.

For population control and foliage protection of high value trees using ground mist blower application: Apply 0.8 pint of spray mixture containing equal volumes of this product and diesel fuel, kerosene or #2 fuel oil per 20 to 30 foot tree (0.2 lb. ai/tree) when larvae are in early instars. Cover foliage thoroughly, but avoid runoff.

PASTURE INSECT CONTROL

For grasshoppers: Apply 3/8 quarts (12 fl. oz.) to 1 1/2 (48 fl. oz.) of this product per acre in a total spray volume of at least 20 fluid ounces per acre.

For true armyworm, fall armyworm, black grass bug, chinch bugs, Essex skipper, striped grass looper, and thrips: Apply 1/2 to I quart of this product per acre. Use the lower rate for nymphs and immature insects on small plants or sparse vegetation. Apply the higher rate for adults or when vegetation is thick.

Apply a maximum of 2 applications per year. Allow at least 14 days between applications. Do not allow foraging or cut for hay within 14 days of last application by ground. Aerially treated pastures may be grazed or cut for hay on day of treatment.

Carefully marks swaths to avoid over-application.

RANGELAND INSECT CONTROL (FOR AERIAL APPLICATION ONLY)

For grasshoppers: Apply 3/8 quart (12 fl. oz.) to 1 quart (32 fl. oz.) of this product per acre in a spray volume of at least 15 fluid ounces per acre.

For black grass bugs, Mormon cricket, range cater-pillars, and range crane fly: Apply 1/2 to I quart of this product per acre. Use the lower rate for nymphs and immature insects on small plants or sparse vegetation. Apply the higher rate for adults or when vegetation is thick.

Apply a maximum of 2 applications per year. Allow at least 14 days between applications.

Carefully mark swaths to avoid over-application.

WASTELANDS, RIGHTS-OF-WAY, HEDGE-ROWS, DITCHBANKS, ROADSIDES INSECT CONTROL

For grasshoppers: Apply 3/8 quart (12 fl. oz.) to 1 quart (32 fl. oz.) of this product per acre in a spray volume of at least 20 fluid ounces per acre.

For black grass bugs, Mormon cricket range caterpillar, and range crane fly: Apply 1/2 to I quart of this product per acre. Use the lower rate for nymphs and immature insects on small plants or sparse vegetation. Apply the higher rate for adults or when vegetation is thick.

Apply a maximum of 2 applications per year. Allow at least 14 days between applications. Do not allow foraging or cut for hay within 14 days of last applications by ground. Aerially treated areas may be grazed or cut for hay on day of treatment.

Carefully mark swaths to avoid over-application.

WHEAT INSECT CONTROL (DO NOT USE IN CALIFORNIA.)

Do not apply within 21 days of harvest of grain. No time limitation on green wheat used as pasture or forage.

For grasshoppers: Apply 1/2 to 1 1/2 quarts of this product per acre. Lower rate is suggested for nymphs on small plants. Use higher rate when grasshoppers are mature or vegetation is thick.

For cereal leaf beetle: Apply 1 quart of this product per acre. Application is effective against eggs, larvae and adults.
For armyworm and fall armyworm: Apply 1 to 1 1/2 quarts of this product per acre.

NOTE: When treatment with SEVIN® brand 4-OIL ULV has been completed, further field irrigation over the treated area should be avoided until foliage has dried to prevent washing the chemical off the crop.

GENERAL PRECAUTIONS FOR APPLICATIONS THROUGH SPRINKLER IRRIGATION SYSTEMS

Maintain continuous agitation in mix tank during mixing and application to assure a uniform suspension.

Greater accuracy in calibration and distribution will be achieved by injecting a larger volume of a more dilute solution per unit time.

The system must contain a functional check value, vacuum relief valve, and low pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from backflow. The pesticide injection pipeline must contain a functional, automatic, quick-closing check value to prevent the flow of fluid back toward the injection pump. The pesticide injection pipeline must also contain a functional, normally closed solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation system is either automatically or manually shutdown. The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops. The irrigation line or water pump must include a functional pressure switch which will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected. Systems must use a metering pump, such as a positive displacement injection pump (e.g., diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock. Do not apply when wind speed favors drift beyond the area intended for treatment.

Do not apply when wind speed favors drift, when system connection or fittings leak, when nozzles do not provide uniform distribution or when lines containing the product must be dismantled and drained.

Crop injury, lack of effectiveness, or illegal pesticide residues in the crop may result from non-uniform distribution of treated water.

Allow sufficient time for pesticide to be flushed through all lines and all nozzles before turning off irrigation water. A person knowledgeable of the chemigation system and responsible for its operation shall shut the system down and make necessary adjustments should the need arise.

Do not connect an irrigation system (including greenhouse systems) used for pesticide application to a public water system unless the label-prescribed safety devices for public water supplies are in place.

INSECT CONTROL

Apply when insects or their damage appear. To maintain control, repeat at 7 to 14 day intervals or as necessary unless a shorter interval is specified below. Where a dosage range is indicated, use lower rate on young plants and early instars and higher rate on mature plants, advanced instars and adults. Thorough and uniform spray coverage is essential for effective control.

SEVIN® brand 4-OIL ULV Carbaryl Insecticide does not control spider mites. If spider mites are a problem, use a registered miticide.

Regional differences have been noted in the susceptibility of certain strains of fall armyworm to SEVIN® brand 4-OIL ULV Carbaryl Insecticide. If local experience indicates inadequate control, use an alternative pesticide.

Follow directions for most effective use. DOSAGES LISTED REFER TO QUARTS OF SEVIN® BRAND 4-OIL ULV CARBARYL INSECTICIDE PER ACRE, NOT TO VOLUME OF FINISHED SPRAY PER ACRE.

CAREFULLY CALIBRATE ALL APPLICATION EQUIPMENT

ALFALFA INSECT CONTROL

For grasshoppers: Apply 1/2 to 1 1/2 quarts of this product per acre. To avoid possible injury to tender alfalfa foliage, do not apply to wet foliage or when rain or high humidity is expected during the next two days.

Apply only once per cutting.

Do not apply to alfalfa within 7 days of harvest.

CORN INSECT CONTROL (field, pop)

For corn rootworm beetles: Apply 1 quart of this product per acre as needed at first silking if populations are at economic levels and/or apply later when needed to control adult population buildup to reduce larval damage to next year's crop. Do not make more than two applications.

For western bean cutworm: Apply a single application of 2 quarts of this product plus 2 quarts diesel fuel, kerosene or #2 fuel oil per acre when an average of 1 in 7 plants have western bean cutworm egg masses or newly hatched larvae and 90 to 100% of the tassels have emerged. Application after 100% of the silks have emerged will reduce effectiveness.

For Japanese beetle: Apply 1 quart of this product per acre when adult beetles are present.

For grasshoppers: Apply 1/2 to 1 1/2 quarts of this product per acre. Lower rate is suggested for nymphs on small plants. Use 1 1/2 quarts when grasshoppers of foliage are mature and greater coverage is required.

FOREST INSECT CONTROL

For control of gypsy moth, fall and spring canker-worms, saddled prominent, forest tent caterpillar, elm spanworm, oak leafroller complex and Japanese beetle: Apply 1 quart of this product per acre when larvae are in early instars and leaves are at least 1/3 grown, or when adult Japanese beetles are present.

For spruce budworm and western spruce budworm: East of the Rocky Mountains, apply 1/2 to 1 quart of this product per acre when a majority of the larvae are in the third through sixth instars. Lower rate is suggested for heavy spruce budworm infestations where 2 applications are necessary for adequate foliage protection. In the Rocky Mountains and west of the Rocky Mountains apply 1/2 to 1 quart of this product per acre when a majority of the larvae are in the third through fifth instars.

For Douglas-fir tussock moth: For maximum foliage protection apply 2 quarts of this product per acre when larvae are in first and second instars. Application to later instars will provide control but with reduced foliage protection.

APPLICATION INSTRUCTIONS

Applications may be made with ground equipment (hand cyclone spreader) or with aerial application equipment with a metered bait spreader attachment.

PASTURES, RANGELAND, WASTELAND, ROADSIDES

Use 0.50 to 1.50 lbs. active ingredient/acre for the control of grasshoppers and Mormon crickets. The lower rate is suggested for early instars on small plants or sparse vegetation. Use the higher rate for adults or dense vegetation. Use of low bait assay and higher rate is suggested for control of high grasshopper populations. Treatment may be repeated as necessary. Preharvest interval is 0 days.

GENERAL INFORMATION

SEVIN® brand 4-OIL ULV Carbaryl Insecticide is a dispersion of finely ground technical carbaryl in a non-aromatic, low volatile oil. It is designed for air application as a low volume or ultra low volume spray. It may also be applied by ground mist blower or cold fogging, if diluted with diesel fuel, kerosene or #2 fuel oil. READ THIS LABEL BEFORE USE. USE IN STRICT ACCORDANCE WITH DIRECTIONS AND CAUTIONS.

PREHARVEST AND GRAZING USE INFORMATION AND LIMITATIONS

Tolerances established under the Federal Food, Drug and Cosmetic Act permit the sale of crops bearing probable carbaryl residues when this product is used in accordance with label directions. If used as directed, treated forage may be grazed or used as feed for dairy and meat animals without causing illegal residues in meat or milk. See specific crop directions for grazing and preharvest interval restrictions and limitations.

Do not plant rotational food and feed crops not listed on this or other carbaryl labels in carbaryl treated soil.

Do not use reclaimed irrigation water from crops treated with carbaryl on upland crops for which carbaryl tolerances are not established.

PLANT RESPONSE PRECAUTION

To avoid possible injury to tender foliage, do not apply to wet foliage or when rain or high humidity is expected during the next 2 days.

SPRAY PREPARATION

SEVIN® brand 4-OIL ULV Carbaryl Insecticide thickens during storage. Roll or agitate drums or recirculate product in bulk tanks before use to reduce viscosity and restore homogeneity. SEVIN® brand 4-OIL ULV Carbaryl Insecticide may be held prior to use and transferred in any materials of construction suitable for use with fuel oil, kerosene or diesel oil. Protect from water. Before and after use, flush nurse tanks, pumps, lines, hoses and entire spray systems with diesel fuel, kerosene or #2 fuel oil until clean. Water, scale, rust and other residue must be removed from pumps, mixing and spray systems before use.

COMPATIBILITY

SEVIN® BRAND 4-OIL ULV CARBARYL INSECTICIDE IS NOT COMPATIBLE WITH AND SHOULD NOT BE MIXED WITH WATER, ALCOHOL OR AROMATIC SOLVENTS, but can be diluted with aliphatic oils (diesel fuel, kerosene or #2 fuel oil). Compatibility with other pesticides has not been thoroughly tested. DO NOT USE IN TANK MIX COMBINATIONS UNLESS YOUR EXPERIENCE INDICATES THAT THE MIXTURE IS EFFECTIVE AND WILL NOT RESULT IN PLANT INJURY OR MECHANICAL DIFFICULTY. For best mixing when preparing diluted SEVIN® brand 4-OIL ULV Carbaryl Insecticide, add diluent oil to mix tank before adding proper volume of SEVIN® brand 4-OIL ULV Carbaryl Insecticide. Provide complete recirculation of diluted suspensions once every 24 hours to maintain uniformity.

APPLICATION

On all crops use sufficient gallonage to obtain thorough and uniform coverage. Calibrate equipment to deliver the desired spray volume. Flat fan nozzles may be used to apply both undiluted and diluted SEVIN® brand 4-OIL ULV Carbaryl Insecticide. Rotary atomizing and hollow cone nozzles are not recommended for applying undiluted SEVIN® brand 4-OIL ULV Carbaryl Insecticide but can be used if 1 to 1 dilution is made. Use of a high-volume 50-mesh in-line strainer is suggested. Use of screens behind nozzles is not recommended. Apply by air undiluted, or diluted with kerosene, diesel fuel or #2 fuel oil. At temperatures below 50°F (10°C) dilution of 4 volumes of SEVIN® brand 4-OIL ULV Carbaryl Insecticide with 1 volume of diluent oil is recommended to assure uniform flow and spray distribution. Dilutions greater than 1 to 1 by volume are not recommended; higher dilutions will reduce residual properties. Dilute 1 to 1 by volume when applying with ground equipment. Apply only when weather conditions are favorable. Wind and rising air currents may cause undesirable spray drift and reduce insect control.

DIRECTIONS FOR USE THROUGH SPRINKLER IRRIGATION SYSTEMS

Apply this product only through sprinkler irrigation systems including center pivot and solid set. Do not apply this product through any other type of irrigation system.

SPRAY PREPARATION: Remove scale, pesticide residues, and other foreign matter from the chemical tank and entire injector system. Flush with clean water.

APPLICATION INSTRUCTIONS: First prepare a suspension of SEVIN® brand 4-OIL ULV Carbaryl Insecticide in a mix tank. Fill tank with 1/2 to 3/4 the desired amount of diesel. Start mechanical or hydraulic agitation. Add the required amount of SEVIN® brand 4-OIL ULV, and then the remaining volume of diesel. (Suspension concentrations using the appropriate dosage per acre recommended on this label of SEVIN® brand 4-OIL ULV per I to 4 gallons of diesel are recommended). Then set sprinkler to deliver 0.I to 0.3 inch of water per acre. Start sprinkler and uniformly inject the suspension of SEVIN® brand 4-OIL ULV into the irrigation water line so as to deliver the desired rate per acre. The suspension of SEVIN® brand 4-OIL ULV should be injected with a positive displacement pump into the main line ahead of a right angle turn to insure adequate mixing. If you should have any other questions about calibration, you should contact State Extension Service specialists, equipment manufacturers or other experts.

LIMITED WARRANTY AND DISCLAIMER

The manufacturer warrants (a)that this product conforms to the chemical description on the label; (b)that this product is reasonably fit for the purposes set forth in the directions for use when it is used in accordance with such directions; and (c) that the directions, warnings and other statements on this label are based upon responsible experts' evaluation of reasonable tests of effectiveness, of toxicity to laboratory animals and to plants, and of residues on food crops, and upon reports of field experience. Tests have not been made on all varieties or in all states or under all conditions. THE MANUFACTURER NEITHER MAKES, NOR INTENDS, NOR DOES IT AUTHORIZE ANY AGENT OR REPRESENTATIVE TO MAKE, ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, AND IT EXPRESSLY EXCLUDES AND DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANT-ABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY DOES NOT EXTEND TO, AND THE BUYER SHALL BE SOLELY RESPONSIBLE FOR, ANY AND ALL LOSS OR DAMAGE WHICH RESULTS FROM THE USE OF THIS PRODUCT IN ANY MANNER WHICH IS INCONSISTENT WITH THE LABEL DIRECTIONS, WARNINGS OR CAUTIONS.

BUYER'S EXCLUSIVE REMEDY AND MANUFACTURER'S OR SELLER'S EXCLUSIVE LIABILITY FOR ANY AND ALL CLAIMS, LOSSES, DAMAGES, OR INJURIES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER OR NOT BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY IN TORT OR OTHERWISE, SHALL BE LIMITED, AT THE MANUFACTURER'S OPTION, TO REPLACEMENT OF, OR THE REPAYMENT OF THE PURCHASE PRICE FOR, THE QUANTITY OF PRODUCT WITH RESPECT TO WHICH DAMAGES ARE CLAIMED. IN NO EVENT SHALL MANUFACTURER OR SELLER BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT.

NOTICE TO BUYER

Purchase of this material does not confer any rights under patents governing this product or the use thereof in countries outside of the United States.

THIS SPECIMEN LABEL IS INTENDED FOR USE ONLY AS A GUIDE IN PROVIDING GENERAL INFORMATION REGARDING THE DIRECTIONS, WARNINGS AND CAUTIONS ASSOCIATED WITH THE USE OF THIS PRODUCT. AS WITH ANY AGRICULTURAL CHEMICAL, ALWAYS FOLLOW THE LABEL INSTRUCTIONS ON THE PACKAGE BEFORE USING.

Rhône-Poulenc Ag Company
P.O. Box 12014, 2 T.W. Alexander Drive
Research Triangle Park, North Carolina 27709

Form No. 93062
Printed USA - 9/92

EPA Approval: 7/25/88

Sevin® XLR PLUS

Brand Carbaryl Insecticide RHÔNE-POULENC

For Agricultural or Commercial Use Only

ACTIVE INGREDIENT:

Carbaryl (1-naphthyl N-methylcarbamate) .....41.2% by wt.

INERT INGREDIENTS .....58.8% by wt.

(Contains 4 Pounds Carbaryl Per Gallon)

E.P.A. Reg. No. 264-333 **E.P.A. Est. No. 264-MO-02**

KEEP OUT OF REACH OF CHILDREN

CAUTION CUIDADO

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.

For MEDICAL And TRANSPORTATION Emergencies ONLY Call 24 Hours A Day 1-800-334-7577
For PRODUCT USE Information Call 1-800-334-9745

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: Never give anything by mouth to an unconscious or convulsing person. If conscious and not convulsing, drink 1 to 2 glasses of water and induce vomiting by touching the back of the throat with finger.

IF IN EYES: Flush eyes with plenty of water. Get medical attention if irritation persists.

IF ON SKIN: Wash thoroughly with soap and water.

IF INHALED: Move from contaminated atmosphere and call a physician.

GENERAL

Contact a physician immediately in all cases of suspected poisoning. Transport to a physician or hospital immediately and SHOW A COPY OF THIS LABEL TO THE PHYSICIAN. If poisoning is suspected in animals, contact a veterinarian.

NOTE TO PHYSICIAN

Treat symptomatically. Overexposure to materials other than this product may have occurred.

This product contains an oxime carbamate insecticide, which is a cholinesterase inhibitor. Overexposure to this substance may cause toxic signs and symptoms due to stimulation of the cholinergic nervous system. These effects of overexposure are spontaneously and rapidly reversible. Gastric lavage may be used if this product has been swallowed. Carbaryl poisoning may occur rapidly after ingestion and prompt removal of stomach contents is indicated.

Specific treatment consists of parenteral atropine sulfate. Improve tissue oxygenation as much as possible before administering atropine to minimize the risk of ventricular fibrillation. Mild cases may be given 1 to 2 mg intramuscularly every 10 minutes until full atropinization has been achieved and repeated thereafter whenever symptoms reappear. Severe cases should be given 2 to 4 mg intravenously every 10 minutes until fully atropinized, then intramuscularly every 30 to 60 minutes as needed to maintain the effect for at least 12 hours. Dosages for children should be appropriately reduced. Complete recovery from overexposure is to be expected within 24 hours.

Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are NOT recommended.

To aid in confirmation of a diagnosis, urine samples should be obtained within 24 hours of exposure and immediately frozen. Call Rhône-Poulenc, 1-800-334-7577 before sending samples. Analyses will be arranged by Rhône-Poulenc Ag Company.

PRECAUTIONARY STATEMENTS

CAUTION

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

MAY BE HARMFUL IF SWALLOWED OR INHALED. OVEREXPOSURE MAY CAUSE: Salivation, watery eyes, pinpoint eye pupils, blurred vision, muscle tremors, difficult breathing, excessive sweating, abdominal cramps, nausea, vomiting, diarrhea, weakness, headache. IN SEVERE CASES CONVULSION, UNCONSCIOUSNESS AND RESPIRATORY FAILURE MAY OCCUR. SIGNS AND SYMPTOMS OF OVEREXPOSURE OCCUR RAPIDLY FOLLOWING EXPOSURE TO THIS PRODUCT.

Avoid breathing spray mist. Do not take internally. Avoid contact with eyes, skin or clothing. Wear regular long-sleeved work clothing and head covering. Change to clean clothing daily. Bathe and wash hair after each work day. Do not eat, drink or use tobacco while working with this product or spray solutions. Wash hands and face before eating, drinking or using tobacco. Keep out of reach of children and domestic animals.

ANTIDOTE STATEMENT

ATROPINE SULFATE IS HIGHLY EFFECTIVE AS AN ANTIDOTE. Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are NOT recommended. See NOTE TO PHYSICIAN below.

ENVIRONMENTAL HAZARDS

This product is extremely toxic to aquatic and estuarine invertebrates. Do not apply directly to water and wetlands, except under the forest canopy and use on rice. Discharge from rice fields may kill aquatic and estuarine invertebrates. Do not apply when weather conditions favor drift from area treated. Do not contaminate water by cleaning equipment. Do not contaminate water when disposing of equipment washwaters.

BEE CAUTION

This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. However, field studies have shown that SEVIN® brand XLR PLUS Carbaryl Insecticide is less hazardous to honey bees than other carbaryl products when direct application to bees is avoided and the spray residues have dried. For maximum honey bee hazard reduction, apply from late evening to early morning or when bees are not foraging. Do not apply this product or allow it to drift to blooming crops or weeds if bees are foraging in the treatment area. However, applications may be made during foraging periods if the beekeeper takes one of the following precautionary measures prior to bee flight activity on the day of treatment: (1) Confine the honey bees to the hive by covering the colony or screening the entrance or; (2) locate hives beyond bee flight range from the treated area. Precautionary measures may be discontinued after spray residues have dried. Contact your cooperative Agricultural Extension Service or your local Rhone-Poulenc Ag Company representative for further information.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.
Read entire label before using this product.

READ THIS LABEL BEFORE USE. STRICTLY OBSERVE LABEL DIRECTIONS AND CAUTIONS, AND APPLICABLE FEDERAL AND STATE REGULATIONS. DO NOT USE ON ANY CROP NOT LISTED ON THIS LABEL OR SUPPLEMENTAL LABELING AS ANY RESIDUES REMAINING MAY BE ILLEGAL OR HARMFUL.

GENERAL WORKER PROTECTION STATEMENT

Do not apply this product in such a manner as to directly or through drift expose workers or other persons. The area being treated must be vacated by unprotected persons.

Do not enter treated areas without protective clothing until sprays have dried.

Because certain states may require more restrictive reentry intervals for various crops treated with this product, consult your State Department of Agriculture for further information.

Written or oral warnings must be given to workers who are expected to be in a treated area or in an area about to be treated with this product. Advise workers to stay out of treated areas until spray deposits have dried unless suitable clothing is worn. This includes regular long-sleeved and long-legged work clothing as well as head covering (overhead applications). See PRECAUTIONARY STATEMENTS, STATEMENT OF PRACTICAL TREATMENT and NOTE TO PHYSICIAN for additional information. When oral warnings are given, warnings shall be given in a language customarily understood by workers. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. Written warnings must include the following information: appropriate signal word (CAUTION), area treated with SEVIN® brand XLR PLUS Carbaryl Insecticide, date of application, appropriate clothing, and re-entry interval (i.e, until sprays have dried) and actions to be taken in case of accidental exposure.

STORAGE AND DISPOSAL

STORAGE

Store unused SEVIN® brand XLR PLUS Carbaryl Insecticide in original container only, in cool, dry area out of reach of children and animals. Do not store in areas where temperatures frequently exceed 100°F.

If container is damaged, before cleaning up, put on long-sleeved shirt, full length trousers, head covering, and protective gloves.

PESTICIDE DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or dispose of in a sanitary landfill, or incineration, or if allowed by state and local authorities, by burning. If container is burned, stay out of smoke.

GENERAL INFORMATION

SEVIN® brand XLR PLUS Carbaryl Insecticide is a suspension of microfine SEVIN® brand carbaryl insecticide in an aqueous medium. It readily disperses in water to form a spray which may be applied by air or ground.

PREHARVEST AND GRAZING USE INFORMATION AND LIMITATIONS

Tolerances established under the Federal Food, Drug and Cosmetic Act permit the sale of labeled crops bearing probable carbaryl residues when this product is used in accordance with the label directions. If used as directed, treated forage may be grazed or used as feed for dairy and meat animals without causing illegal residues in meat or milk. This product may be applied up to and including the day of harvest or grazing of forage unless noted otherwise in use directions for specific crops. Do not apply at greater rates or at more frequent intervals than is stated on the label. To do so may result in illegal residues in crops, meat, and milk.

Do not plant rotational food and feed crops not listed on this or other carbaryl labels in carbaryl treated soil.

Do not use reclaimed irrigation water from crops treated with carbaryl on crops for which carbaryl tolerances are not established.

PLANT RESPONSE PRECAUTIONS

Application to wet foliage or during periods of high humidity may cause injury to tender foliage.

Do not use on Boston Ivy, Virginia creeper and maidenhair fern as injury may result. Carbaryl may also injure Virginia and sand pines.

The use of adjuvants may increase the potential for crop injury to sensitive crops.

SPRAY PREPARATION

TO ASSURE A UNIFORM SUSPENSION, AGITATE, STIR OR RECIRCULATE ALL CONTAINERS OF THIS PRODUCT PRIOR TO USE. Remove oil, rust, scale, pesticide residues and other foreign matter from mix tanks and entire spray system. Flush with clean water. Fill spray or mix tank with 1/2 to 3/4 the desired amount of water. Start mechanical or hydraulic agitation. Slowly add the required amount of SEVIN® brand XLR PLUS Carbaryl Insecticide, and then the remaining volume of water. Include rinse water from container. Prepare only as much spray mixture as can be applied on the day of mixing. MAINTAIN CONTINUOUS AGITATION DURING MIXING AND APPLICATION TO ASSURE A UNIFORM SUSPENSION. DO NOT STORE SPRAY MIXTURE FOR PROLONGED PERIODS OR DEGRADATION OF CARBARYL MAY OCCUR. Local water conditions may also accelerate the degradation of spray mixtures containing carbaryl. See COMPATIBILITY STATEMENT below.

WASHOFF RESISTANCE AND COVERAGE

Dilution of 1 volume of SEVIN® brand XLR PLUS Carbaryl Insecticide with 1 volume of water provides maximum resistance to washoff by rainfall or overhead irrigation. Dilutions higher than 1 part SEVIN® brand XLR PLUS Carbaryl Insecticide to 39 parts water (1:39) are not recommended when washoff resistance is desired.

To achieve washoff resistance, SEVIN® brand XLR PLUS Carbaryl Insecticide must be diluted as stated above, and droplets must dry on the foliage. When atmospheric humidity is low, a drying time of at least two hours is generally adequate. Under high humidity a longer drying time is required. Washoff resistance cannot be expected if this product is applied to wet foliage and has not thoroughly dried prior to rainfall or overhead irrigation.

On all crops, use sufficient spray volume to obtain thorough coverage. Optimum pest control under certain crop, pest or climatic conditions may require spray gallonages higher than the 1:39 dilution. For example in hot, arid weather (low humidity), higher spray gallonage per acre may be required to compensate for loss from evaporation and insure thorough coverage. The total spray volume required for effective pest control can best be determined by previous experience, pest and crop conditions and local recommendations.

COMPATIBILITY

SEVIN® brand XLR PLUS Carbaryl Insecticide, when diluted with at least an equal volume of water, is compatible with a wide range of pesticides. It is not compatible with diesel fuel, kerosene, fuel oil or aromatic solvents. If compatibility with another product and the resulting crop response is unknown, the mixture should be tested on a small scale. Curdling, precipitation, greasing, layer formation or increased viscosity are symptoms of incompatibility. Incompatibility will reduce insect control and may cause application and handling difficulties or plant injury. Observe all cautions and limitations on labeling of all products used in mixtures. WHEN PREPARING COMBINATION SPRAYS, FIRST ADD "SEVIN®" BRAND XLR PLUS CARBARYL INSECTICIDE TO AT LEAST AN EQUAL VOLUME OF WATER, MIX THOROUGHLY, AND THEN ADD COMBINATION PRODUCTS TO THE MIXTURE. DO NOT APPLY TANK MIX COMBINATIONS UNLESS YOUR PREVIOUS EXPERIENCE INDICATES THE MIXTURE IS EFFECTIVE AND WILL NOT RESULT IN APPLICATION PROBLEMS OR PLANT INJURY.

Carbaryl is unstable under highly alkaline conditions and mixtures with strong bases, such as Bordeaux, lime-sulfur and casein-lime spreaders, will result in chemical degradation of the insecticide. Do not use this product in water with pH values above 8.0 unless a buffer is added. If necessary, water should be buffered to neutral (pH = 7.0) before adding this product to the spray tank. Overhead irrigation with alkaline or muddy water after application will also accelerate chemical degradation and may result in reduced insect control.

APPLICATION

On all crops use sufficient gallonage to obtain thorough and uniform coverage. Observe crop label instructions for specific directions regarding spray volume where they occur. Calibrate spray equipment to deliver the required volume. The flow rate of this product diluted 1:1 with water is similar to water. Use of 50 mesh slotted strainers in spray system and 25 mesh slotted strainers behind nozzles is recommended.

To clean spray system after use, drain and flush with a water and detergent mixture. Rinse thoroughly with clean water. Refer to the STORAGE AND DISPOSAL section for disposal instructions.

NOTE: Staining may occur on certain surfaces such as stucco, brick, cinder block, and wood. Spray deposits on painted or stained surfaces or finishes (i.e., cars, houses, trailers, boats, etc.) should be immediately removed by washing to prevent discoloration. Avoid applications to surfaces where visible spray residues are objectionable.

DIRECTIONS FOR USE THROUGH SPRINKLER IRRIGATION SYSTEMS
Apply this product only through sprinkler irrigation systems including center pivot and solid set. Do not apply this product through any other type of irrigation system.

SPRAY PREPARATION: First prepare a suspension of SEVIN® brand XLR PLUS Carbaryl Insecticide in a mix tank. Fill tank with 1/2 to 3/4 the desired amount of water. Start mechanical or hydraulic agitation. Add the required amount of SEVIN® brand XLR PLUS, and then the remaining volume of water. (Suspension concentrations using the appropriate dosage per acre recommended on this label of SEVIN® BRAND XLR PLUS, per 1 to 4 gallons of water are recommended). Then set sprinkler to deliver 0.1 to 0.3 inch of water per acre. Start sprinkler and uniformly inject the suspension of SEVIN® brand XLR PLUS into the irrigation water line so as to deliver the desired rate per acre. The suspension of SEVIN®brand XLR PLUS should be injected with a positive displacement pump into the main line ahead of a right angle turn to insure adequate mixing. If you should have any other questions about calibration, you should contact State Extension Service specialists, equipment manufacturers or other experts.

NOTE: When treatment with SEVIN® brand XLR PLUS has been completed, further field irrigation over the treated area should be avoided for 24 to 48 hours to prevent washing the chemical off the crop.

GENERAL PRECAUTIONS FOR APPLICATIONS THROUGH SPRINKLER IRRIGATION SYSTEMS
Maintain continuous agitation in mix tank during mixing and application to assure a uniform suspension.

Greater accuracy in calibration and distribution will be achieved by injecting a larger volume of a more dilute solution per unit time.

The system must contain a functional check valve, vacuum relief valve, and low pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from backflow. The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump. The pesticide injection pipeline must also contain a functional, normally closed solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation system is either automatically or manually shutdown. The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops. The irrigation line or water pump must include a functional pressure switch which will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected. Systems must use a metering pump, such as a positive displacement injection pump (e.g., diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock. Do not apply when wind speed favors drift beyond the area intended for treatment.

Do not apply when wind speed favors drift, when system connection or fittings leak, when nozzles do not provide uniform distribution or when lines containing the product must be dismantled and drained.

Crop injury, lack of effectiveness, or illegal pesticide residues in the crop may result from nonuniform distribution of treated water.

Allow sufficient time for pesticide to be flushed through all lines and all nozzles before turning off irrigation water. A person knowledgeable of the chemigation system and responsible for its operation shall shut the system down and make necessary adjustments should the need arise.

Do not connect an irrigation system (including greenhouse systems) used for pesticide application to a public water system unless the label-prescribed safety devices for public water supplies are in place.

INSECT CONTROL
Begin application when insect populations reach recognized economic threshold levels. Consult the Cooperative Extension Service, Professional Consultants or other qualified authorities to determine appropriate threshold levels for treatment in your area. Where a dosage range is indicated, use the lower rate on light to moderate infestations, young plants and early instars and the higher rate on heavy infestations, mature plants, advanced instars and adults. Thorough and uniform spray coverage is essential for effective control.
NOTE: All references to armyworm on the crops listed below refer to the species, *Pseudaletia unipuncta*, often called the "true armyworm". Except where indicated otherwise, this product is not registered for the control of other armyworm species. Regional differences have been noted in the susceptibility of certain strains of fall armyworm, diamondback moth, Colorado potato beetle, spotted tentiform leafminer, Southern green stink bug and tobacco budworm (on cotton) to carbaryl. If local experience indicates inadequate control, use an alternative pesticide.

GRASSHOPPERS

CROP	QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
All Crops on this label	1/2 to 1 1/2	See specific crop sections	Apply 1/2 to 3/4 quarts per acre of this product for nymphs on small plants or sparse vegetation. Apply 1 to 1 1/2 quarts per acre for mature grasshoppers or applications to dense vegetation or if extended residual control is desired. Be certain spray volumes are appropriate to assure adequate coverage.

FORAGE, FIELD AND VEGETABLE CROPS

Apply in sufficient spray volume to obtain thorough coverage. Do not dilute greater than 1:39 (volume product: volume water) where washoff resistance is desired. Where maximum washoff resistance is needed, do not exceed a 1:1 dilution. To prepare small volumes of spray mixture use 1 tablespoonful ($^1/_2$ fluid ounce) of SEVIN® brand XLR PLUS Carbaryl Insecticide per gallon of water where rates of 1 quart per acre or 1 quart per 100 gallons are indicated in the tables below.

CROP	INSECT		QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Alfalfa, Clovers, Birdsfoot trefoil (DO NOT USE ON BIRDSFOOT TREFOIL IN CALIFORNIA)	Blister beetles Mexican bean beetle		1/2 to 1	0 (clovers & birdsfoot trefoil) 7 (alfalfa)	OBSERVE BEE CAUTION Observe plant response precautions. Carbaryl may cause a temporary bleaching of tender alfalfa foliage. Apply only once per cutting for alfalfa up to 1 1/2 quarts. On dense growth, use 25 to 40 gallons of water per acre with ground equipment to ensure adequate coverage. For alfalfa weevil larvae, if pretreatment damage is extensive, cut alfalfa and treat the stubble. This product is not effective against adult alfalfa weevils. For grasshopper control, refer to the GRASSHOPPER section above.
	Alfalfa caterpillar Bean leaf beetle Cucumber beetles Green cloverworm Japanese beetle Leafhoppers	Potato leafhopper Three cornered alfalfa hopper Thrips Velvetbean caterpillar	1		
	Alfalfa blotch leafminer Armyworm Cloverhead weevil Corn earworm Cutworms Egyptian alfalfa weevil larvae Essex skipper	European alfalfa beetle Fall armyworm Lygus bugs Stink bugs Webworms Yellowstriped armyworm	1 to 1 1/2		
	Alfalfa weevil larvae (West of the Rocky Mountains)		1 to 1/2		
	(East of the Rocky Mountains)		1 1/2		
Asparagus	Aspargus beetle		1 to 2	1	Treat ferns or brush growth. Do not treat more than once every 3 days. For grasshopper control, refer to the GRASSHOPPER section.
	Apache cicada Asparagus beetle		2 to 4	Post harvest application only	
Beans (including blackeyed peas, cowpeas, southern peas, dry beans, green beans, lima beans, navy beans, and snap beans) Lentils (DO NOT USE ON LENTILS IN CALIFORNIA)	Blister beetles Mexican bean beetle		1/2 to 1	0 (except cowpeas and lentils)	Observe plant response precautions. For grasshopper control, refer to the GRASSHOPPER section.
	Alfalfa caterpillar Bean leaf beetles Cucumber beetles Flea beetles Green cloverworm Japanese beetle Leafhoppers	Three-cornered alfalfa hopper Thrips Velvetbean caterpillar Western bean cutworm	1	3 (cowpeas)	
	Armyworm Corn earworm Cutworms European corn borer	Fall armyworm Stink bugs Tarnished plant bug Webworms	1 to 1 1/2	7 (lentils)	
	Alfalfa looper		1 1/2		
	Cowpea curculio		2		
	Corn earworm Limabean podborer	Lygus bugs Stink bugs	2		CALIFORNIA ONLY

CROP	INSECT		QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Cabbage Broccoli Brussels sprouts Cauliflower Kohlrabi	Flea beetles	Harlequin bug	1/2 to 1	3	For grasshopper control, refer to the GRASSHOPPER section.
	Armyworm Corn earworm Diamondback moth	Fall armyworm Imported cabbageworm	1 to 2		
Chinese cabbage Collards Hanover salad Horseradish Kale Mustard greens Radishes Rutabagas Turnips	Flea beetles Harlequin bug	Leafhoppers	1/2 to 1	3 (horseradish, radishes, rutabagas and turnip roots)	For grasshopper control, refer to the GRASSHOPPER section.
	Aster leafhopper		1 to 1 1/2		
	Armyworm Corn earworm Fall armyworm Imported cabbageworm	Stink bugs Tarnished plant bug	1 to 2	14 (Chinese cabbage, collards, Hanover salad, kale, mustard greens, and turnip tops)	
Carrots Celery Parsley Parsnips (DO NOT USE ON CELERY IN CALIFORNIA)	Flea beetles	Leafhoppers	1/2 to 1	0 (carrots) 3 (parsnips) 14 (celery & parsley)	For grasshopper control, refer to the general GRASSHOPPER section.
	Aster leafhopper Lygus bugs	Spittlebugs	1 to 1 1/2		
	Armyworm Corn earworm Fall armyworm	Stink bugs Tarnished plant bug	1 to 2		
Corn (field, sweet, pop)	Armyworm Chinch bugs Corn earworm Corn rootworm adults Fall armyworm	Flea beetles Japanese beetle Sap beetles Southwestern corn borer Leafhoppers	1 to 2	0	OBSERVE BEE CAUTION. For insects attacking silks and ears, apply at 1 to 6 day intervals starting when first silks appear and continuing until silks begin to dry. For larvae in whorl and foliage feeders, apply as necessary. Optimum timing and good coverage are essential for effective control. For optimum chinch bug control, apply at least 20 gallons of water per acre by ground and direct spray toward stalk to provide thorough coverage. For grasshopper control, refer to the general GRASSHOPPER section.
	European corn borer		1 1/2 to 2		For optimum control, do not apply in less than 3 gallons of water per acre by air and 15 gallons of water per acre by ground.
	Western bean cutworm		2		Treat when infestation averages 15% and at 90% to 100% tassel emergence. Treatment after 100% silk emergence will reduce effectiveness.
	Cutworms		2 to 3		For optimum control, apply in a 12 inch band, over the row, using sufficient volume of water to obtain thorough coverage. For broadcast application, use at least 20 gallons (ground) or 5 gallons (air) of water per acre.

CROP	INSECT		QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Cotton	Cotton fleahopper Cotton leafworm Flea beetles	Striped blister beetle Thrips	1/2 to 1	7	Use banded and/or directed sprays for optimum control of early season pests. Total coverage is essential for maximum control. For grasshopper control, refer to the general GRASSHOPPER section.
	Boll weevil Cotton bollworm Fall armyworm Leafrollers Leafhoppers	Tarnished plant bug Yellowstriped armyworm (cotton cutworm)	1 to 2		Treat on a 5 to 7 day schedule for as long as control is necessary. Mid and late season insect control. May be applied after bolls open.
	Lygus bugs		1 to 2		For light to moderate populations in Western irrigated cotton.
	Pink bollworm		1 1/2 to 2 1/2		Aphid populations will be suppressed by repeated applications of this insecticide.
	Cutworms Stink bugs	Saltmarsh catepillar	2		
Cucumber Melons Pumpkin Squash	Pickleworm	Melonworm	1/2 to 1	0	Observe plant response precautions. For optimum control of squash bugs, apply sufficient spray volume for thorough coverage. Time sprays for early morning or late afternoon. For grasshopper control, refer to the general GRASSHOPPER section.
	Cucumber beetles Flea beetles	Leafhoppers Squash bugs	1		
Dandelion Endive (Escarole) Lettuce Salsify	Flea beetles Harlequin bug	Leafhoppers	1/2 to 1	3 (head lettuce & salsify roots) 14 (dandelion, endive (escarole), leaf lettuce & salsify tops)	Observe plant response precautions. For grasshopper control, refer to the general GRASSHOPPER section.
	Aster leafhopper Lygus bugs	Spittlebugs	1 to 1 1/2		
	Armyworm Corn earworm Fall armyworm Imported cabbageworm	Stink bugs Tarnished plant bug	1 to 2		
Flax Proso Millet (DO NOT USE IN CALIFORNIA)	Armyworm		1 to 1 1/2	42	Do not graze treated areas or harvest for dairy feed prior to crop maturity. For grasshopper control, refer to the general GRASSHOPPER section.
Garden beet Spinach Swiss chard	Flea beetles Harlequin bug	Leafhoppers	1/2 to 1	3 (garden beet roots) 14 (garden beet tops, spinach, Swiss chard)	For grasshopper control, refer to the general GRASSHOPPER section.
	Aster leafhopper		1 to 1 1/2		
	Armyworm Corn earworm Fall armyworm	Stink bugs Tarnished plant bug	1 to 2		

CROP	INSECT	QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Okra	Corn earworm Stink bugs	1 to 2	0	For grasshopper control, refer to the general GRASSHOPPER section.
Pasture	Armyworm Chinch bugs Essex skipper Fall armyworm Striped grass looper Thrips Range caterpillar Range crane fly Ticks	1 to 1 1/2	0 (aerial application) 14 (ground applications)	To control thrips in grasses grown for seed, use high spray pressure to improve penetration into boot. Apply a maximum of 2 applications per year. Allow at least 14 days between applications. Do not allow foraging or cut for hay within 14 days of last application by ground. Aerially treated pastures may be grazed or cut for hay on day of treatment. Carefully mark swaths to avoid over-application. For grasshopper control, refer to the general GRASSHOPPER section. Not for use on ticks in California.
Peanuts	Blister beetles Mexican bean beetle	1/2 to 1	0	Observe plant response precautions. Use directed sprays for optimum control of thrips. Ensure adequate coverage for the underside of leaves. For grasshopper control, refer to the general GRASSHOPPER section.
	Alfalfa caterpillar Bean leaf beetle Cucumber beetles Green cloverworm Japanese beetle Leafhoppers Rednecked peanutworm Three cornered alfalfa hopper Thrips Velvetbean caterpillar	1		
	Armyworm Corn earworm Fall armyworm Stinkworms Webworms	1 to 1 1/2		
	Whitefringed beetle adults Cutworms	2		
Peas	Colorado potato beetle Leafhoppers	1	3	For grasshopper control, refer to the general GRASSHOPPER section.
	Armyworm	1 to 1 1/2		
	Alfalfa caterpillar Cutworms Pea leaf weevil Pea weevil Yellowstriped armyworm	1 1/2		
	Alfalfa looper	2 1/2		WASHINGTON STATE ONLY

CROP	INSECT		QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Potato Tomato Eggplant Pepper	Flea beetles	Leafhoppers	1/2 to 1	0	Thorough coverage is essential to effectively suppress stink bugs. When disease transmission is suspected, monitor fields following application and re-treat if reinfestation occurs. For grasshopper control, refer to the general GRASSHOPPER section.
	Colorado potato beetle European corn borer Fall army worm Lace bugs	Stink bugs (suppression) Tarnished plant bug Tomato fruitworm Tomato hormworm Tomato pinworm	1 to 2		
	Cutworms		2		
Prickly Pear cactus	Cochineal scale (crawlers)		2	1	Apply as needed at 7 - 10 day intervals. Do not make more than 7 applications per season. For grasshopper control, refer to the general GRASSHOPPER section.
Rangeland	Black grass bug Mormon cricket Range caterpillar Range crane fly		1/2 to 1	0	FOR AERIAL APPLICATION ONLY. Apply a maximum of 2 applications per year. Allow at least 14 days between applications. Carefully mark swaths to avoid over-application. For grasshopper control, refer to the general GRASSHOPPER section.
	Ticks		1 to 1 1/2		Not for use on ticks in California.
Rice	Armyworm Chinch bugs	Fall armyworm Stink bugs	1 to 1 1/2	14	**Mississippi Delta & Texas** CAUTION: May kill shimp and crabs. Do not use in areas where these are important resources. Do not use on rice fields in which crayfish and catfish farming are included in the cultural practice. DO NOT APPLY PROPANIL HERBICIDES WITHIN 15 DAYS BEFORE OR AFTER APPLICATION OF THIS PRODUCT OR PLANT INJURY WILL RESULT. For grasshopper control, refer to the general GRASSHOPPER section.
	Armyworm Leafhoppers	Tadpole shrimp	2		**California Only** For optimum tadpole shrimp control, apply to water when pest first appears.

CROP	INSECT		QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Sorghum (milo, grain sweet and hybrid)	Sorghum midge		3/4 to 1	21 (grain) 0 (forage)	Direct spray into forming heads for optimum insect control. Treat for sorghum midge when 25 to 30 percent of heads have emerged from boot and are in bloom. Use high pressure spray in sufficient volume to ensure penetration into heads. Repeat application 3 to 5 days later if adults are still active. A third application may be necessary in late planted sorghum or if midge are abundant. For chinch bugs, use high gallonage ground application directed at the base of plants. For grasshopper control, refer to the general GRASSHOPPER section.
	Armyworm Chinch bugs Corn earworm	Fall armyworm Stink bugs Webworms	1 to 2		
	Southwestern corn borer		1 1/2		
	Cutworms		2		
Soybeans	Bean leaf beetle Blister beetle Cucumber beetles Grape colaspis Green cloverworm	Japanese beetle Mexican bean beetle Velvetbean caterpillar	1/2 to 1	0	DO NOT APPLY A COMBINATION OF THIS PRODUCT AND 2,4 DB HERBICIDES TO SOYBEANS AS CROP INJURY MAY RESULT. Use lower rates for light to moderate populations and smaller instars and to provide maximum survival of beneficial insects and spiders. Use the higher rates for heavy populations and larger instars. For grasshopper control, refer to the general GRASSHOPPER section.
	Corn earworm		1/2 to 1 1/2		
	Alfalfa caterpillar Leafhoppers	Three cornered alfalfa hopper Thrips	1		
	Armyworm Cutworms	Fall armyworm Webworms	1 to 1 1/2		
	Painted lady (Thistle caterpillar) Saltmarsh caterpillar (Woollybear caterpillar)	Yellowstriped armyworm	1 1/2 to 2		
Sugar beets	Armyworm Beet leaf beetle Fall armyworm	Flea beetles Leafhoppers Webworms	1 to 1 1/2	14	For grasshopper control, refer to the general GRASSHOPPER section.
	Cutworms		1 1/2		
Sunflower (DO NOT USE IN CALIFORNIA)	Cutworms		1 1/2	60	For grasshopper control, refer to the general GRASSHOPPER section.
	Armyworm Fall armyworm Sunflower moth		1 1/2 to 2		
	Stem weevil	Sunflower beetle	1 to 2		
Sweet Potato (DO NOT USE IN CALIFORNIA)	Corn earworm Cucumber beetles Flea beetles	Sweet potato hornworm Tortoise beetles	1 to 2	0	Apply as a foliar spray as needed. For grasshopper control, refer to the general GRASSHOPPER section.
	Yellowstriped armyworm		2		
	Sweet potato weevil		1 to 2		

CROP	INSECT	QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Tobacco Plant bed treatment	Flea beetle	1	0	OBSERVE PLANT RESPONSE PRECAUTIONS. For flea beetle control, use 4 tsps. (0.7 fl. oz.) in 6 gallons of water and apply to 100 square yards.
	Green June beetle grubs	8		For green June beetle grup control, mix 11 tablespoons (5.5 fl. oz.) in 50 to 100 gallons of water and apply to 100 square yards. Applications should be made to areas that larvae have uprooted by sprinkling mixture as a drench treatment.
Field treatment	Budworms Fall armyworm Flea beetles Hornworms Japanese beetle June beetle Suckfly	1 to 2		Use lower rate on young plants (up to knee height). Use at least 10 gallons of prepared spray per acre. Begin treatments when worms are small. For grasshopper control, refer to the general GRASSHOPPER section.
Wasteland, Rights-of Way, Hedgerows, Ditch banks, Roadsides	Black grass bug Mormon cricket Range caterpillar Range crane fly	1/2 to 1	0 (aerial application) 14 (ground application)	Apply a maximum of 2 applications per year. Allow at least 14 days between applications. Do not allow foraging or cut for hay within 14 days of last application by ground. Aerially treated areas may be grazed or cut for hay on day of treatment. Carefully mark swaths to avoid over-application. For grasshopper control, refer to the general GRASSHOPPER section.
	Ticks	1 to 1 1/2		Not for use on ticks in California.
Wheat (including triticale) (DO NOT USE IN CALIFORNIA)	Flea bettles	1/2 to 1	0 (forage) 21 (grain)	
	Cereal leaf beetle	1		Application is effective against eggs, larvae and adult of the cereal leaf beetle
	Armyworm Fall armyworm	1 to 1 1/2		Application for armyworm control should be made when armyworms are actively feeding on the upper foliage and night temperatures are not expected to drop below 55° F. If applying by air, use a minimum of 5 GPA for optimal coverage. For grasshopper control, refer to the general GRASSHOPPER section.

TREE FRUIT AND NUT CROPS

For dilute sprays, apply the specified dosage per each 100 gallons of water. For concentrate and aerial sprays, maintain the recommended rate per acre equivalent to that used in a dilute spray. The optimum spray gallonage will depend on tree size, density and stage of growth. Typical spray gallonages per acre range from but are not limited to 100 - 600 gallons for dilute sprays, 20 - 100 gallons for concentrate sprays and 3 - 25 gallons for aerial sprays. Do not exceed maximum label rate per acre per application.

APPLE THINNING

CROP	QUARTS OF SEVIN® BRAND XLR PLUS/100 GAL.	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
APPLES	1/4 to 1/2	1	OBSERVE BEE CAUTION. Apply 1 full coverage dilute spray between 10 and 25 days after full bloom. Factors such as tree age, variety, nutrition, previous crop, pruning, bloom and degree of set favor excessive fruit thinning with this product. Exercise caution to avoid possible yield reduction. Rates may vary depending on variety and local orchard conditions. Consult with your County Extension Service or other experts for advice on the proper use of this product. In Eastern apple growing areas, tank mix combinations of Carbaryl and Naphthaleneacetic Acid (NAA) or Naphthaleneacetamide (NAD) have successfully thinned several early-maturing, heavy-setting varieties, as well as hard-to-thin varieties such as Golden Delicious and Rhode Island Greening. The higher rate of Carbaryl and reduced rates of NAA or NAD are recommended for the combination. Also, a petal fall application of NAA or NAD followed 7 to 10 days later by an application of Carbaryl has improved thinning on these varieties. For easily thinned varieties including Cortland, Grimes, Jonathan, McIntosh, Orleans, Rome Beauty, Puritan, Red Delicious, Winesap, Yellow Newton.
	1/2 to 1	1	For difficult to thin varieties including Baldwin, Ben Davis, Duchess, Early McIntosh, Golden Delicious, Lady Apple, Northern Spy, Rhode Island Greening, Steele Red, Turley, Wealthy, Yellow Transparent, and York Imperial.

CROP	INSECT	QUARTS OF SEVIN® BRAND XLR PLUS/100 GALS.	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Almond	Peach twig borer San Jose scale Fruittree leafroller	1	28	OBSERVE BEE CAUTION. For peach twig borer, apply in "popcorn" or petal fall stages when the May brood begins to hatch or thereafter as needed. For dormant or delayed dormant timing, apply in combination with a recommended dormant oil.
	Navel orangeworm			Time early and mid season applications to correspond to moth flight peaks. Do not apply more than 5 quarts per acre. For grasshopper control, refer to the general GRASSHOPPER section.

CROP	INSECT	QUARTS OF SEVIN® BRAND XLR PLUS/100 GALS.	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Avocados (FOR CALIFORNIA USE ONLY)	Gypsy moth Japanese beetle	1/2	1	FOR USE IN JAPANESE BEETLE AND GYPSY MOTH ERADICATION PROGRAMS IN CALIFORNIA ONLY. Use with ground equipment and spray to run off. Apply when insects or their damage appear. Do not make more than 1 application per season. For grasshopper control, refer to the general GRASSHOPPER section.
Chestnuts (DO NOT USE IN CALIFORNIA)	Chestnut weevil	2 to 3	0	Make 4 applications at weekly intervals beginning in late July for adult chestnut weevil control. Last application should be made prior to shuck split. For grasshopper control, refer to the general GRASSHOPPER section.
Citrus Fruits (such as grapefruit, lemons, limes, oranges, tangelos, tangerines, citrus citron, kumquats and hybrids)	Avocado leafroller California orangedog Citrus cutworm Citrus root weevils Citrus rust mite Fruittree leafroller Fuller rose beetle Little leaf notcher (Adult) Orange tortrix Western tussock moth West Indian sugarcane borer (adults)	1	5	OBSERVE BEE CAUTION. Do not apply more than 20 quarts of this product per acre per application. May be mixed with petroleum oils commonly used on citrus. For grasshopper control, refer to the general GRASSHOPPER section.
	Black scale Brown soft scale California red scale Citricola scale Citrus snow scale Eriophyid mites Yellow scale	3/4 to 1		
Filbert	Filbert aphid Filbert leafroller Filbertworm	1	0	Apply when leafroller eggs are hatching. Repeat on first appearance of adult filbert moths and again 3 to 4 weeks later. For grasshopper control, refer to the general GRASSHOPPER section.
Olives	Olive scale	3/4 to 1	0	For optimum scale control add 1 1/2 gallons of summer oil and apply mixture when crawlers are present. Do not exceed 2 applications per year. Do not apply more than 15 quarts of this product per acre per application. For grasshopper control, refer to the general GRASSHOPPER section.

CROP	INSECT		QUARTS OF SEVIN® BRAND XLR PLUS/100 GALS.	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Peaches Apricots Nectarines	Apple pandemis Codling moth Cucumber beetles European earwig Fruittree leafroller Gypsy moth Japanese beetle June beetle Lecanium scales Lesser peachtree borer Olive scale	Orange tortrix Oriental fruit moth Peach twig borer Periodical cicada Plum curculio Redbanded leafroller San Jose scale Tarnished plant bug Tussock moth Variegated leafroller	1	1 (peaches) 3 (apricots & nectarines)	Do not apply more than 6 quarts of this product per acre per application to apricots. For optimum scale control, apply when crawlers are present. For lesser peachtree borer, spray limbs and trunk thoroughly at weekly intervals during moth flight. For grasshopper control, refer to the general GRASSHOPPER section.
Pecans	Black margined aphid Fall webworm Hickory shuckworm Lesser webworm Pecan leaf phylloxera	Pecan stem phylloxera Pecan nut casebearer Pecan spittlebut Pecan weevil Twig girdler Walnut caterpillar	1 to 2 1/2	0	Do not apply more than 7.2 quarts of this product per acre per application. For grasshopper control, refer to the general GRASSHOPPER section.
Pistachios	Navel orangeworm		1/2 to 2	14	Do not apply more than 6 quarts
	Brown soft scale		2		of this product per acre per application. For brown soft scale, apply 4 to 6 quarts per acre per application. For dormant or delayed dormant timing, apply in combination with a recommended dormant oil. For grasshopper control, refer to the general GRASSHOPPER section.
Plums Prunes Cherries	Codling moth Eastern tent caterpillar	Orange tortrix Tussock moth	3/4	1	Do not apply more than 6 quarts of this product per acre per application. For optimum scale control, apply when crawlers are present. For lesser peachtree borer control, spray limbs and tree trunks thoroughly at weekly intervals during moth flight. For grasshopper control, refer to the general GRASSHOPPER section.
	Black cherry aphid Brown soft scale Cherry fruitworm Cherry maggot Eyespotted bud moth European earwig Forbes scale Fruittree leafroller Green fruitworm Gypsy moth Japanese beetle Lecanium scales	Lesser peachtree borer Mealy plum aphid Oystershell scale Peach twig borer Plum curculio Prune leafhopper Redbanded leafroller Rose chafer San Jose scale Variegated leafroller	1		

CROP	INSECT	QUARTS OF SEVIN® BRAND XLR PLUS/100 GALS.	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Pomefruit (including apples, pears, loquats, crabapples, oriental pears and quince)	Apple aphid Apple maggot Apple rust mite Apple sucker Bagworms California pearslug (pear sawfly) Eastern tent caterpillar European apple sawfly Eyespotted bud moth Forbes scale Fruittree leafroller Green fruitworm Gypsy moth Lecanium scales Lesser appleworm Lygus bugs Orange tortrix Oystershell scale Pearleaf blister mite Pear psylla Pear rust mite Periodical cicada Plum curculio Redbanded leafroller Rosy apple aphid San Jose scale Tarnished plant bug Tentiform leafminers Woolly apple aphid Yellowheaded fireworm	3/4 to 1	1	OBSERVE BEE CAUTION. To avoid undesired apple thinning, delay use until at least 30 days after full bloom. For psylla control apply when eggs hatch or young nymphs are present. To control scale insects, apply when crawlers are present. For grasshopper control, refer to the general GRASSHOPPER section.
	Apple mealybug Apple aphid	1/2		
	Codling moth White apple leafhopper	1/2 to 1		
	Japanese beetle	3/4		Apply as needed with ground equipment at 7 - 14 day intervals.
Walnut	Calico scale European fruit lecanium Filbertworm Fruittree leafroller Frosted scale	1/2	0	For optimal coverage, 1000 gallons of dilute spray per acre are suggested for mature trees.
	Codling moth	1/2		For codling moth apply first spray when average cross-sectional diameters of developing nuts are 1/2 to 3/4 inch. Repeat during middle or late June as needed. Apply dilute sprays in 200-500 gallons of water per acre.
	European earwig	2		Spray tree trunks to point of run-off. For grasshopper control, refer to the general GRASSHOPPER section.

SMALL FRUIT CROPS

Recommended dosages refer to quarts of SEVIN® brand XLR PLUS Carbaryl Insecticide per acre. The optimum spray gallonage will depend on plant size, density and stage of growth. Typical spray gallonage per acre range from 100-300 gallons for dilute sprays, 25-100 gallons for concentrate sprays and 5-25 gallons for aerial sprays. Do not exceed maximum label rate per acre per application.

CROP	INSECT		QUARTS OF SEVIN® BRAND XLR PLUS/ACRE	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Blackberries Raspberries Dewberries (including boysenberries and loganberries)	European raspberry aphid Japanese beetle Leafhoppers	Leafrollers Rose chafer Snowy tree cricket	1 to 2	7	For grasshopper control, refer to the general GRASSHOPPER section.
	Omnivorous leafroller Raspberry sawfly		2		California Only
Blueberries	Blueberry maggot Cherry fruitworm Cranberry fruitworm	European fruit lecanium Japanese beetle	1 1/2 to 2	0	Apply 3 weeks before harvest and repeat as necessary. For grasshopper control, refer to the general GRASSHOPPER section.
Cranberries	Cutworms Cranberry fireworms Cranberry fruitworms Cranberry twig girdler	Elm spanworm Gypsy moth Japanese beetle Leafhoppers Rose chafer Spaganothus worm	1 1/2 to 3	1	OBSERVE BEE CAUTION. CAUTION: May kill shrimp and crabs. Do not use in areas where these are important resources. For grasshopper control, refer to the general GRASSHOPPER section.
Grapes	European fruit lecanium Grape leaffolder Grape leafhopper	Western grapeleaf skeletonizer Western Yellowstriped armyworm	1 to 2	7	For grape leaffolder, apply before first brood larvae emerge from rolls.
	Cutworms Eight-spotted forester Grape berry moth Japanese beetles June beetles	Orange tortrix Omnivorous leafroller Redbanded leafroller Saltmarsh caterpillar	2		For grasshopper control, refer to the general GRASSHOPPER section.
Strawberries	Flea beetles Meadow spittlebug (strawberry fruitworm) Omnivorous leaftier	Strawberry clipper Strawberry bud weevil Strawberry leafroller Strawberry weevil	1 to 2	1	Carbaryl may injure Early Dawn and Sunrise varieties. For grasshopper control, refer to the general GRASSHOPPER section.

CONTROL OF TICKS WHICH VECTOR LYME DISEASE

For control of juvenile and adult ticks which vector Lyme Disease, apply the recommended amount in sufficient volume for thorough coverage. To prepare small amounts, use 1 tablespoon (1/2 fluid ounce) of SEVIN® brand XLR Plus Carbaryl Insecticide per gallon of water.

1 Tablespoon=1/2 fluid ounce SEVIN® brand XLR Plus Carbaryl Insecticide

SITE	PEST	QUARTS OF SEVIN® brand XLR Plus/ACRE	SPECIFIC DIRECTIONS
Pastures, Rangeland, Wasteland, Rights-of Way, Hedgerows, Ditchbanks and Roadsides, Non-Residential Trees (Forests, Shelter belts and Plantations only)	*Ixodes* spp. Deer tick, Bear tick, and Black legged tick *Amblyomma* spp. Lone Star tick	1 to 2	Use the high rate for heavy tick infestations. Use higher spray volumes for dense ground cover or heavy leaf litter. Target applications for nymphal control in late spring or early summer. Control of adult ticks can be achieved with late summer and fall applications. Do not use spot treatments. Treat entire area and perimeter areas where exposure to ticks may occur. Ticks may be reintroduced from surrounding areas on host animals. Retreat as necessary to maintain adequate control levels. DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATION OR UNTIL SPRAYS HAVE DRIED.

IMPORTED FIRE ANT CONTROL

SITE	AMOUNTS OF SEVIN® BRAND XLR PLUS/ VOLUME OF WATER	SPECIFIC DIRECTIONS
Pastures Rangeland Forested Lands and Wasteland	1 1/2 quarts/100 gallons or 1 1/2 tablespoons/gallon	Apply a total of 2 gallons of the diluted solution over the surface of each mound or at least 1 quart per 6 inches of mound diameter using a bucket, can or other appropriate equipment. Thoroughly wet mound and surrounding areas to a 4 ft. diameter (12 sq. ft.). Do not disturb mounds prior to treatment. Pour solution from a height of about three feet to give sufficient force to break mound apex and flow into ant tunnels. For best results apply in cool weather, 65°-80°F or in early morning or late evening hours. Repeat application if mound activity resumes after 10 days. Treat new mounds as they appear. Pressurized sprays may disturb the ants and cause migration, reducing product effectiveness. DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATIONS OR UNTIL SPRAYS HAVE DRIED.
Nursery Stock, Vegetable Transplants, Foliage Plants and Bedding Plants	1 1/2 quarts/100 gallons	DO NOT USE ON ANY FOOD CROP NOT LISTED ON LABEL. DO NOT USE IN GREENHOUSES. Do not make more than one application, either as a root-dip or a drench treatment (applied to the point of saturation). Avoid contact with foliage and treat only the growing media when using on bedding plants.

ADULT MOSQUITO CONTROL

For dilute-spray ground applications to trees (including shade trees, shelter belts, forests, plantations, parks and recreational areas), ornamentals, woody plants and shrubs, apply the specified dosage per 100 gallons of water. For concentration-spray ground applications, apply the specified dosage per acre in sufficient spray volume to provide thorough coverage. To prepare small volumes of spray, use 1 table spoon (1/2 fluid ounce) of SEVIN® brand XLR PLUS Carbaryl Insecticide per gallon of water, where rates of 1 quart are indicated.

CROP	QUARTS OF SEVIN® BRAND XLR PLUS / 100 GAL.	SPECIFIC DIRECTIONS
Pastures, Rangelands, Parks, Recreational Areas, Logging Camps, Military Posts and Adjacent Forested lands or Wastelands	1/4 to 1 (1/2 to 1 tablespoonful per gallon)	DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATION OR UNTIL SPRAYS HAVE DRIED. CAUTION: May kill shrimp and crabs. Do not use in areas where there are important resources. OBSERVE BEE CAUTION Treat shrubbery and areas where adult mosquitoes congregate. Treat when adult mosquitoes are active in early mornings or late evenings. Repeat at 7 to 10 day intervals. Use 1/4 to 1/2 quart per 100 gallons in mistblowers, 1/2 to 1 quart per acre in aerial sprays and 1 quart per acre in low pressure ground sprayers.
	25	For residual control in subtropical regions apply 4 gallons of prepared spray per 2000 square feet of surface area. Repeat in 3 to 6 months or when necessary.

POULTRY INSECT CONTROL

POULTRY QUARTERS	QUARTS OF SEVIN® BRAND XLR PLUS/ EACH 100 GAL. OF WATER	SPECIFIC DIRECTIONS
Bed bugs Chicken mite Fleas Lice Northern fowl mite	4	Apply 1 to 2 gallons of spray mixture with conventional power spray or knapsack equipment per 1000 square feet of wall, litter or roost surface. Force spray into cracks. Repeat as needed. Avoid spraying nests, eggs and feeding and watering troughs.
Fowl tick	16	Ventilate while spraying. Do not treat premises within 7 days of slaughter.
Darkling beetle (Lesser mealworm or Litter beetle)	50	Apply 1 to 2 gallons of spray mixture with conventional power spray or knapsack equipment per 1000 square feet of floor space, litter surface, walls, cracks, posts, crevices, and around ventilation areas to insulation. Optimum spray timing is immediately after flock is removed from the house when beetles are most active. Ventilate while spraying. Do not treat premises within 7 days of slaughter.

LIMITED WARRANTY AND DISCLAIMER

The manufacturer warrants (a)that this product conforms to the chemical description on the label; (b)that this product is reasonably fit for the purposes set forth in the directions for use when it is used in accordance with such directions; and (c) that the directions, warnings and other statements on this label are based upon responsible experts' evaluation of reasonable tests of effectiveness, of toxicity to laboratory animals and to plants, and of residues on food crops, and upon reports of field experience. Tests have not been made on all varieties or in all states or under all conditions. THE MANUFACTURER NEITHER MAKES NOR INTENDS, NOR DOES IT AUTHORIZE ANY AGENT OR REPRESENTATIVE TO MAKE, ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, AND IT EXPRESSLY EXCLUDES AND DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY DOES NOT EXTEND TO, AND THE BUYER SHALL BE SOLELY RESPONSIBLE FOR, ANY AND ALL LOSS OR DAMAGE WHICH RESULTS FROM THE USE OF THIS PRODUCT IN ANY MANNER WHICH IS INCONSISTENT WITH THE LABEL DIRECTIONS, WARNINGS OR CAUTIONS.

BUYER'S EXCLUSIVE REMEDY AND MANUFACTURER'S OR SELLER'S EXCLUSIVE LIABILITY FOR ANY AND ALL CLAIMS, LOSSES, DAMAGES, OR INJURIES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER OR NOT BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY IN TORT OR OTHERWISE, SHALL BE LIMITED, AT THE MANUFACTURER'S OPTION, TO REPLACEMENT OF, OR THE REPAYMENT OF THE PURCHASE PRICE FOR, THE QUANTITY OF PRODUCT WITH RESPECT TO WHICH DAMAGES ARE CLAIMED. IN NO EVENT SHALL MANUFACTURER OR SELLER BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT.

THIS SPECIMEN LABEL IS INTENDED FOR USE ONLY AS A GUIDE IN PROVIDING GENERAL INFORMATION REGARDING THE DIRECTIONS, WARNINGS AND CAUTIONS ASSOCIATED WITH THE USE OF THIS PRODUCT. AS WITH ANY AGRICULTURAL CHEMICAL, ALWAYS FOLLOW THE LABEL INSTRUCTIONS ON THE PACKAGE BEFORE USING.

Rhône-Poulenc Ag Company
P.O. Box 12014, 2 T.W. Alexander Drive
Research Triangle Park, North Carolina 27709

Form No. 93012
Printed USA - 9/91

EPA Approval: 2/2/91

chipco® Sevimol®

brand Carbaryl Insecticide

RHÔNE-POULENC

FOR COMMERCIAL USE ONLY

ACTIVE INGREDIENT:

Carbaryl (1-naphthyl N-methylcarbamate) ..... 40% by wt.

INERT INGREDIENTS: ..... 60% by wt.

E.P.A. Reg. No. 264-321 **E.P.A. Est. No. 264-MO-02**

KEEP OUT OF REACH OF CHILDREN
CAUTION

For MEDICAL And TRANSPORTATION Emergencies ONLY Call 24 Hours A Day 1-800-334-7577
For PRODUCT USE Information Call 1-800-334-9745

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: Never give anything by mouth to an unconscious or convulsing person. If conscious and not convulsing, drink 1 to 2 glasses of water and induce vomiting by touching the back of the throat with finger.

IF IN EYES: Flush eyes with plenty of water. Get medical attention if irritation persists.

IF ON SKIN: Wash thoroughly with soap and water.

IF INHALED: Move from contaminated atmosphere and call a physician.

GENERAL

Contact a physician immediately in all cases of suspected poisoning. Transport to a physician or hospital immediately and SHOW A COPY OF THIS LABEL TO THE PHYSICIAN. If poisoning is suspected in animals, contact a veterinarian.

NOTE TO PHYSICIAN

Carbaryl is a carbamate insecticide, which is a cholinesterase inhibitor. Overexposure to this substance may cause toxic signs and symptoms due to stimulation of the cholinergic nervous system. These effects of overexposure are spontaneously and rapidly reversible. Gastric lavage may be used if this product has been swallowed. Carbaryl poisoning may occur rapidly after ingestion and prompt removal of stomach contents is indicated.

Specific treatment consists of parenteral atropine sulfate. Caution should be maintained to prevent overatropinization. Mild cases may be given 1 to 2 mg intramuscularly every 10 minutes until full atropinization has been achieved and repeated thereafter whenever symptoms reappear. Severe cases should be given 2 to 4 mg intravenously every 10 minutes until fully atropinized, then intramuscularly every 30 to 60 minutes to maintain the effect for at least 12 hours. Dosages for children should be appropriately reduced. Complete recovery from overexposure is to be expected within 24 hours.

Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are NOT recommended.

To aid in confirmation of a diagnosis, urine samples should be obtained within 24 hours of exposure and immediately frozen. Analyses will be arranged by Rhône-Poulenc Ag Company.

Consultation on therapy can be obtained at all hours by calling the Rhône-Poulenc emergency number 1-800-334-7577.

PRECAUTIONARY STATEMENTS

CAUTION

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

MAY BE HARMFUL IF SWALLOWED, OVEREXPOSURE MAY CAUSE: Avoid breathing spray. Do not take internally. Avoid contact with eyes, skin or clothing. Wear regular long-sleeved work clothing and head covering. Change to clean clothing daily. Bathe and wash hair after each work day. Do not eat, drink or use tobacco while working with this product or spray solutions. Wash hands and face before eating, drinking or using tobacco. Keep out of reach of children and domestic animals.

Salivation, watery eyes, pinpoint eye pupils, blurred vision, muscle tremors, difficult breathing, excessive sweating, abdominal cramps, nausea, vomiting, diarrhea, weakness, headache. **IN SEVERE CASES CONVULSION, UNCONSCIOUSNESS AND RESPIRATORY FAILURE MAY OCCUR. SIGNS AND SYMPTOMS OF OVEREXPOSURE OCCUR RAPIDLY FOLLOWING EXPOSURE TO THIS PRODUCT.**

ANTIDOTE STATEMENT

ATROPINE SULFATE IS HIGHLY EFFECTIVE AS AN ANTIDOTE. Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are not recommended. See NOTE TO PHYSICIAN .

ENVIRONMENTAL HAZARDS

This product is extremely toxic to aquatic and estuarine invertebrates. Do not apply directly to water and wetlands, except under the forest canopy and use on rice. Discharge from rice fields may kill aquatic and estaurine invertebrates. Do not apply when weather conditions favor drift from area treated. Do not contaminate water when disposing of equipment washwaters.

BEE CAUTION: MAY KILL HONEYBEES IN SUBSTANTIAL NUMBERS.
This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. Contact your Cooperative Agricultural Extension Service or your local Rhône-Poulenc Ag Company representative for further information.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.
Read entire label before using this product.

STRICTLY OBSERVE LABEL DIRECTIONS AND CAUTIONS, AND APPLICABLE FEDERAL AND STATE REGULATIONS. DO NOT USE ON ANY CROP NOT LISTED ON THIS LABEL OR SUPPLEMENTAL LABELING AS ANY RESIDUES REMAINING MAY BE ILLEGAL OR HARMFUL.

GENERAL WORKER PROTECTION STATEMENTS

Do not apply this product in such a manner as to directly or through drift expose workers or other persons. The area treated must be vacated by unprotected persons.

Do not enter treated areas without protective clothing until sprays have dried.

Because certain states may require more restrictive reentry intervals for various crops treated with this product, consult your State Department of Agriculture for further information.

STORAGE AND DISPOSAL

STORAGE
Store unused CHIPCO® SEVIMOL® brand Carbaryl Insecticide in original container only, in cool, dry area out of reach of children and animals. Do not store in areas where temperatures frequently exceed 100°F. Product may be used after freeze thaw conditions.

PESTICIDE DISPOSAL
Do not contaminate water, food, or feed by storage or disposal. Open dumping prohibited. Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL
Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If container is burned, stay out of smoke.

GENERAL INFORMATION

CHIPCO® SEVIMOL® brand Carbaryl Insecticide is a suspension of microfine SEVIN® brand Carbaryl Insecticide in an aqueous medium. It readily disperses in water to form a spray which may be applied by air or ground.

Written or oral warnings must be given to workers who are expected to be in treated area or in an area about to be treated with this product. Advise workers to stay out of fields during applications and until sprays have dried. Regular long-sleeved work clothing should be worn when working in treated fields. See PRECAUTIONARY STATEMENTS, STATEMENT OF PRACTICAL TREATMENT and NOTE TO PHYSICIAN for information on accidental exposures. When oral warnings are given, warnings shall be given in a language customarily understood by workers. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. Written warnings must include the following information: Appropriate signal word (CAUTION), area treated with CHIPCO® SEVIMOL® brand Carbaryl Insecticide, date of application, appropriate clothing and reentry interval (i.e., until sprays have dried).

PREHARVEST AND GRAZING INFORMATION AND LIMITATIONS
Tolerances established under the Federal Food, Drug and Cosmetic Act permit the sale of crops bearing probable carbaryl residues when this product is used in accordance with label directions. If used as directed, treated forage may be grazed or used as feed for dairy and meat animals without causing illegal residues in meat or milk. See specific crop directions for grazing and preharvest interval restrictions and limitations. Do not apply at greater rates or at more frequent intervals than are stated on the label. To do so may result in illegal residues in crops, meat and milk.

Do not plant rotational food and feed crops not listed on this or other carbaryl labels in carbaryl treated soil.

Do not use reclaimed irrigation water from crops treated with carbaryl on upland crops for which carbaryl tolerances are not established.

PLANT RESPONSE PRECAUTIONS

To avoid possible injury to tender foliage, do not apply to wet foliage or during periods of high humidity.

Do not use on Boston ivy, Virginia creeper and maidenhair fern as injury will result. Carbaryl may also injure Virginia and sand pines.

Carefully observe label instructions on apple thinning to avoid excessive thinning. Combinations with certain herbicides on rice and soybeans may be phytotoxic. Refer to specific directions for appropriate crop.

SPRAY PREPARATION

TO ASSURE A UNIFORM PRODUCT, AGITATE, STIR OR RECIRCULATE ALL CONTAINERS OF THIS PRODUCT PRIOR TO USE. Remove oil, rust, scale, pesticide residues and other foreign matter from mix tanks and entire spray system. Flush with clean water. Fill spray or mix tank with 1/2 to 3/4 the desired amount of water. Start mechanical or hydraulic agitation. Slowly add the required amount of CHIPCO® SEVIMOL® brand Carbaryl Insecticide and then the remaining volume of water. Include rinse water from container. Prepare only as much spray mixture as can be applied on the day of mixing. MAINTAIN CONTINUOUS AGITATION DURING MIXING AND APPLICATION TO ASSURE A UNIFORM SUSPENSION. DO NOT STORE SPRAY MIXTURES FOR PROLONGED PERIODS OR DEGRADATION OF CARBARYL MAY OCCUR. Local water conditions may also accelerate the degradation of spray mixtures containing carbaryl. See COMPATIBILITY STATEMENT below.

COMPATIBILITY

CHIPCO® SEVIMOL® brand Carbaryl Insecticide, when diluted with an equal volume of water, is compatible with a wide range of pesticides. It is not compatible with diesel fuel, kerosene, fuel oil or aromatic solvents. If compatibility with another product and the resulting crop response is unknown, it should be tested on a small scale. Curdling, precipitation, greasing, layer formation or increased viscosity are symptoms of incompatibility. Incompatibility will reduce insect control and may cause mechanical difficulties or plant injury. Observe all cautions and limitations on labeling of all products used in mixtures. WHEN PREPARING COMBINATIONS SPRAYS, FIRST ADD CHIPCO® SEVIMOL® BRAND CARBARYL INSECTICIDE TO AT LEAST AN EQUAL VOLUME OF WATER, MIX THOROUGHLY, AND THEN ADD COMBINATION PRODUCTS TO THE MIXTURE. DO NOT APPLY TANK MIX COMBINATIONS UNLESS YOUR PREVIOUS EXPERIENCE INDICATES THE MIXTURE IS EFFECTIVE AND WILL NOT RESULT IN APPLICATION PROBLEMS, OR PLANT INJURY.

Carbaryl is unstable under highly alkaline conditions and mixtures with strong bases, such as Bordeaux, lime-sulfur and casein-lime spreaders, will result in chemical degradation of the insecticide. Do not use this product in water with pH values above 8.0 unless a buffer is added. If necessary, water should be buffered to neutral (pH=7.0) before adding this product to the spray tank. Overhead irrigation with alkaline or muddy water after application will also accelerate chemical degradation and may result in reduced insect control.

APPLICATION

Do not apply this product through any type of irrigation system.

May be applied undiluted to cotton. On all crops, use sufficient gallonage to obtain thorough and uniform coverage. Observe crop label instructions for specific directions regarding spray volume where they occur. Calibrate spray equipment to deliver the required volume. The flow rate of this product diluted 1:1 with water is similar to water. Use 50 mesh slotted strainers in spray system and 25 mesh slotted strainers behind nozzles.

To clean spray system after use, drain and flush with water and detergent mixture. Rinse thoroughly with clean water. Refer to the Storage and Disposal directions for disposal instructions.

INSECT CONTROL

Begin application when insect populations reach recognized economic threshold levels. Consult the Cooperative Extension Service, professional consultants or other qualified authorities to determine appropriate threshold levels for treatment in your area. Where a dosage range is indicated, use lower rate on light to moderate infestations, young plants and early insect instars and the higher rate on heavy infestations, mature plants, advanced insect instars and adults. Thorough and uniform spray coverage is essential for effective control.

NOTE: All references to armyworm on the crops listed below refer to the species, *Pseudaletia unipuncta*, often called the "true armyworm." Except where indicated otherwise, this product is not registered for the control of other armyworm species. Regional differences have been noted in the susceptibility of certain strains of fall armyworm, Colorado potato beetle, spotted tentiform leafminer, and tobacco budworm (on cotton) to carbaryl. Control can only be claimed for stink bugs other than the Southern green stink bug for which only suppression is claimed. If local experience indicates inadequate control, use an alternative pesticide.

TREES AND ORNAMENTALS

For dilute-spray ground applications to the sites listed below, apply the specified dosage per 100 gallons of water. For concentrate-spray ground applications, apply the specified dosage per acre in sufficient spray volume to provide thorough coverage. To prepare small volumes of spray, use specified dosage in parenthesis in sufficient spray volume to provide thorough coverage. Avoid direct application to lakes, streams and ponds.

1 Tablespoon = 1/2 fluid ounce CHIPCO® SEVIMOL® brand Carbaryl Insecticide.

CROP	INSECT			QUARTS OF CHIPCO® SEVIMOL® BRAND/100 GALS.	SPECIFIC DIRECTIONS
Trees (including syrup producing sugar maple, shade trees, shelter belts, forests, plantations, parks and recreational areas). Ornamentals (including roses, flowers and other herbaceous plant), Woody Plants and Shrubs	Ants Apple aphid Armyworm Azalea leafminer Bagworms Birch leafminer Blister beetle bug Boxwood leafminer Brown tail moth Cankerworms Catalpa sphinx Chiggers Cutworms Cypress tip moth Eastern spruce gall aphid Elm leaf aphid Elm leaf beetle Elm spanworm Eriophyid mites European pine shoot moth Fall armyworm Flea beetles Fuller rose beetle Gall midges Gall wasps Green striped mapleworm Grasshoppers Hackberry nipplegall maker	Holly bud moth Holly leafminer Jackpine budworm Japanese beetle Jeffrey pine needleminer June beetles Lace bugs Leafhoppers Leafrollers Locust borer Maple leafcutter Mealy bugs Mimosa webworm Nantucket pine tip moth Oak leafminers Oak leaf skeletonizer Oak moth Oakworm complex Oleander caterpillar Olive ash borer Orange striped oakworm Orange tortrix Periodical cicada Pine looper Pine sawfly Pine spittlebug Pitch pine tip moth Plant bugs	Poinsettia hornworm Psyllids Puss caterpillar Redhumped oakworm Rose chafer Rose aphid Boxelder Roseslug Saddled prominent Sawflies (exposed) Scale insects Sowbugs Spiney elm caterpillars Springtails Spruce budworm Spruce needleminer Subtropical pine tip moth Tent caterpillars Thorn bug Thrips (exposed) Ticks Walnut caterpillar Webworms Western hemlock looper Western spruce budworm Willow leaf beetles Yellow poplar weevil	1 (1/2 oz./gal.)	Observe plant response precautions. Apply dilute sprays to obtain thorough coverage of upper and lower leaf surfaces. To control scale insects, treat trunks, stems and twigs in addition to plant foliage. For optimum worm control, treat when in early instars. Addition of a sticker may improve residual control. Applications for control of maple leafcutter on sugar maple should be made when larvae are in second insect instar after mining and as cases are being formed. **DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATIONS OR UNTIL SPRAYS HAVE DRIED.**
	Cooley spruce gall aphid	Douglas-fir tussock moth Spruce budworm	Western spruce budworm Woolly gall aphid	1 to 2	Use the higher rate when large larvae or heavy populations are present.
	Gypsy moth			3/4 to 1	
	Ips engraver beetles Mountain pine beetle Roundheaded pine beetle Spruce beetle Western pine beetle			20 (6.5 oz/gal.)	Effective as a preventive treatment only. Repeat annually as required to prevent beetle attacks. Apply 1 gallon of spray per 50 square feet of bark in late May to early June, or prior to beetle attack. Treat tree trunks from ground level up, until trunk diameter is less than 5 inches.
	Elm bark beetle				Apply approximately 20-30 gallons of spray mixture for each 50 feet of elm tree for thorough coverage of all bark surfaces on trunks, limbs and twigs.

LAWNS AND RECREATIONAL AREAS

For control of turfgrass pests, apply the specified dosage in sufficient spray volume for thorough coverage and turf thatch penetration. Where a dosage range is indicated, use the higher rate on large pest populations, advanced instars and dense vegetation. Repeat treatment as necessary.

SITE	INSECT		AMOUNT OF CHIPCO®SEVIMOL® FL. OZ/ 1000 SQ. FT.	AMOUNT OF CHIPCO®SEVIMOL® QUARTS ACRE	SPECIFIC DIRECTIONS
Turf grasses	Ants Armyworm Centipedes Chiggers Cutworms Earwigs Essex skipper European chafer Fall armyworm Fiery skipper Grasshoppers Green June beetle grub	June beetles Leafhoppers Lucerne moth Millipedes Mosquitoes (adults) Sowbugs Spittlebugs Springtails Ticks Yellowstriped armyworm	1.5 to 3	2 to 4	**DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATIONS OR UNTIL SPRAYS HAVE DRIED.** **For Armyworm, Cutworm and Fall Armyworm Control:** Do not irrigate treated areas following insecticide application. **For Green June Beetle Grub Control:** Make applications when grubs are feeding near the soil surface. Irrigation of turf grass soon after treatment will aid in penetration of insecticide into thatch.
	Chinch bugs Mole crickets	Sod webworms (lawn moths)	4.4 to 6	6 to 8	**For Chinch Bug Control:** Treat entire grass area rather than just damaged areas. Irrigation of turf grass area before treatment will aid in penetration of insecticide into turf grass. **For Mole Cricket Control:** Treatment should be made in the afternoon or early evening following turf grass irrigation. Do not irrigate treated areas following insecticide application. **For Sod Webworm Control:** Do not irrigate treated areas following insecticide application.
	Bluegrass billbug European crane fly Fleas White grubs (such as Japanese beetle, Chafer beetle, and *Phyllophaga spp.* larvae)		6	8	**For European Crane Fly Control:** Treatments should be applied in early spring, April 1 to April 15, or as recommended by local Agricultural Extension Service agents. Irrigation of turfgrass soon after treatment will aid in penetration of insecticide into thatch. **For White Grub Control:** Applications should be made when grubs are feeding near the soil surface, usually during late March through May, or July to early September, or as recommended by local Agricultural Extension Service agents. Irrigation of turfgrass soon after treatment will aid in penetration of insecticide into thatch.

IMPORTED FIRE ANT CONTROL

For use as a mound treatment to control imported fire ants, apply the specified dosage directly to the mound. To prepare small amounts, use 1 tablespoon (1/2 fluid ounce) of CHIPCO® SEVIMOL® brand Carbaryl Insecticide per gallon of water.

1 Tablespoon = 1/2 fluid ounce of CHIPCO® SEVIMOL® brand Carbaryl Insecticide

SITE	QUARTS OF CHIPCO® SEVIMOL®/100 GALLONS OF WATER	SPECIFIC DIRECTIONS
Lawns, Cemeteries and Recreational Areas (including turf, golf courses, and parks), Pastures, Rangeland, Forested lands, and Wasteland	1 1/2 (1/2 oz./gallon)	DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATIONS OR UNTIL SPRAYS HAVE DRIED. Apply a total of 2 gallons of the diluted solution over the surface of each mound or at least 1 quart per 6 inches of mound diameter using a bucket, can or other appropriate equipment. Thoroughly wet mound and surrounding area to a 4 ft. diameter (12 sq. ft). Do not disturb mounds prior to treatment. Pour solution from a height of about three feet to give sufficient force to break mound apex and flow into ant tunnels. For best results apply in cool weather, 65-80° F, or in early morning or late evening hours. Repeat application if mound activity resumes after 10 days. Treat new mounds as they appear. Pressurized sprays may disturb the ants and cause migration, reducing product effectiveness.
Nursery Stock, Vegetable Transplants, Foliage Plants and Bedding Plants	1 1/2	DO NOT USE ON ANY FOOD CROP NOT LISTED ON LABEL. Do not make more than one application, either as a root-dip or a drench treatment (applied to the point of saturation). Avoid contact with foliage and treat only the growing media when using on bedding plants.

ADULT MOSQUITO CONTROL

For dilute-spray ground applications to trees (including shade trees, shelter belts, forests, plantations, parks and recreational areas), ornamentals, woody plants and shrubs, apply the specified dosage per 100 gallons of water. For concentrate-spray ground applications, apply the specified dosage in sufficient spray volume to provide thorough coverage. To prepare small volumes of spray, use specified dosage in parentheses in sufficient spray volume to provide thorough coverage.

1 Tablespoon = 1/2 fluid ounce of CHIPCO® SEVIMOL® brand Carbaryl Insecticide

SITE	QUARTS OF CHIPCO® SEVIMOL® BRAND/100 GALLONS OF WATER	SPECIFIC DIRECTIONS
Pastures, Rangelands, Parks, Recreational Areas, Logging Camps, Military Posts and Adjacent Forested lands or Wastelands	1/4 to 1 (1/4 to 1/2 oz./gallon)	**DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATIONS OR UNTIL SPRAYS HAVE DRIED.** CAUTION: May kill shrimp and crabs. Avoid direct application to lakes, streams, and ponds. Do not use in areas where these are important resources. **Observe Bee Caution** Treat shrubbery and areas where adult mosquitoes congregate. Treat when adult mosquitoes are active in early mornings or late evenings. Repeat at 7 to 10 day intervals. Use 1/4 to 1/2 quart per 100 gallons in mistblowers, 1/2 to 1 quart per acre in aerial sprays and 1 quart per acre in low pressure ground sprayers.
	25 (17 oz./gallon)	For residual control in subtropical regions apply 4 gallons of prepared spray per 2000 square feet of surface area. Repeat in 3 to 6 months or when necessary.

CONTROL OF TICKS WHICH VECTOR LYME DISEASE

For control of juvenile and adult ticks which vector Lyme Disease, apply the recommended amount in sufficient volume for thorough coverage. To prepare small amounts, use 1 tablespoon (1/2 fluid ounce) of CHIPCO® SEVIMOL® brand Carbaryl Insecticide per gallon of water.

1 Tablespoon=1/2 fluid ounce CHIPCO® SEVIMOL® brand Carbaryl Insecticide

SITE	PEST	QUARTS OF CHIPCO® SEVIMOL® PER ACRE	SPECIFIC DIRECTIONS
Lawns and Recreational Turfgrass (Including: Lawns & Perimeters, Golf Courses, Sports Fields, Cemetaries, Parks, and Pastures) Shrubs, Ornamentals, Wooded Areas (Including: Military Posts, Logging camps, and Campsites) Wastelands	*Ixodes spp.* Deer tick, Bear tick, and Black legged tick *Amblyomma spp.* Lone Star tick	1 to 2	Use the high rate for heavy tick infestations. Use higher spray volumes for dense ground cover or heavy leaf litter and on lush turf with thatch buildup. Target applications for nymphal control in late spring or early summer.Control of adult ticks can be achieved with late summer and fall applications. Do not use spot treatments. Treat entire area and perimeter areas where exposure to ticks may occur. Ticks may be reintroduced from surrounding areas on host animals. Retreat as necessary to maintain adequate control levels. **DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATION OR UNTIL SPRAYS HAVE DRIED.**

PEST CONTROL AROUND BUILDINGS
(FOR EXTERNAL USE AROUND BUILDINGS ONLY)
LIMITED TO PEST CONTROL OPERATORS ONLY

For use as an **external** perimeter treatment to prevent infestations of buildings, apply the specified dosage in a band 6 to 10 feet wide around the outside perimeter of the structure.

1 Tablespoon = 1/2 fluid ounce of CHIPCO® SEVIMOL® brand Carbaryl Insecticide

INSECT		QUARTS OF CHIPCO® SEVIMOL® BRAND/ 100 GALLONS	SPECIFIC DIRECTIONS
Ants	Firebrats	20 (6.5 oz./gallon)	DO NOT ALLOW PUBLIC USE OF TREATED AREAS DURING APPLICATIONS OR UNTIL SPRAYS HAVE DRIED. Apply as a course wet spray in a band 6 to 10 feet wide around the outside perimeter of buildings. Confine applications to areas immediately adjacent to the building. Direct application to the structure should be minimal and restricted to cracks, crevices, and areas where insects tend to congregate. May be applied to outdoor sleeping quarters of pets. Do not treat animals. Staining may occur on certain surfaces such as stucco, brick, cinder block, and wood. Avoid application to surfaces where visible spray residues are objectionable.
Bees	Fleas		
Brown dog tick	Millipedes		
Centipedes	Scorpions		
Cockroaches	Silverfish		
Crickets	Spiders		
Earwigs	Wasps		

TREE FRUIT AND NUT CROPS

For dilute sprays apply the specified dosage per each 100 gallons of water. For concentrate and aerial sprays, maintain the recommended rate per acre equivalent to that in a dilute spray. The optimum spray gallonage will depend on tree size, density and stage of growth. Typical spray gallonages per acre range from, but are not limited to, 200-300 gallons for dilute sprays, 30-100 gallons for concentrate sprays and 5-25 gallons for aerial sprays. Do not exceed maximum label rate per acre per application.

APPLE THINNING

CROP	QUARTS OF CHIPCO® SEVIMOL®/100 GALS.	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Apples	1/4 to 1/2	1	**Observe Bee Caution.** Apply 1 full coverage dilute spray between 10 and 25 days after full bloom. Factors such as the tree age, variety, nutrition, previous crop, pruning, bloom and degree of set favor excessive fruit thinning with this product. Exercise caution to avoid possible yield reduction. Rates may vary depending on variety and local orchard conditions. Consult with your County Extension Service or other experts for advise on the proper use of this product. In Eastern apple growing areas, tank mix combinations of carbaryl and naphthaleneacetic acid (NAA) or naphthaleneacetamide (NAD) have successfully thinned several early-maturing, heavy-setting varieties, as well as hard-to-thin varieties such as Golden Delicious and Rhode Island Greening. The higher rate of carbaryl and reduced rates of NAA or NAD are recommended for the combination. Also, a petal fall application of NAA or NAD followed 7 to 10 days later by an application of carbaryl has improved thinning on these varieties. For easily thinned varieties including Cortland, Grimes, Jonathan, McIntosh, Orleans, Rome Beauty, Puritan, Red Delicious, Winesap, Yellow Newton.
	1/2 to 1	1	For difficult to thin varieties including Baldwin, Ben Davis, Duchess, Early McIntosh, Golden Delicious, Lady Apple, Northern Spy, Rhode Island Greening, Steele Red, Turley, Wealthy, Yellow Transparent and York Imperial.

CROP	INSECT		QUARTS OF CHIPCO® SEVIMOL® BRAND/100 GALS.	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Almond	Peach twig borer San Jose Scale Fruittree leafroller		1	28	**Observe Bee Caution.** Apply in "popcorn" or petal fall stages and again when the May brood of the peach twig borer begins to hatch or thereafter as needed.
	Navel orangeworm				Time early and mid season applications to correspond to moth fight peaks. Make a late season application at initiation of hull split or up to 10% hull split. Do not apply more that 5 quarts per acre.
Citrus Fruits (such as grapefruit, lemons, limes, oranges, tangelos, tangerines, citrus, citron, kumquats and hybrids)	Avocado leafroller California orangedog Citrus cutworm Citrus root weevil Fruittree leafroller	Orange tortrix Western tussock moth West Indian sugarcane borer (adults)	1	5	**Observe Bee Caution.** Do not apply more than 20 quarts of this product per acre per application.
	Black scale Brown soft scale California red scale	Citriocla scale Citrus snow scale Yellow scale	3/4 to 1		To insure thorough coverage, do not apply less than 10 gallons of dilute spray mixture per mature trees. May be mixed with petroleum oils commonly used on citrus. Apply dilute sprays in 300 to 500 gallons per acre.
Filbert	Filbert aphid Filbert leafroller Filbertworm		1	0	Apply when leafroller eggs are hatching. Repeat on first appearance of adult filbert moths and again 3 to 4 weeks later. Apply dilute sprays in 300 to 400 gallons per acre.
Olives	Olive scale		3/4 to 1	0	For optimum scale control add 1 1/2 gallons of summer oil and apply mixture when crawlers are present. Do not exceed 2 applications per year. Do not apply more than 15 quarts of this product per acre per application.
Peaches Apricots Nectarines	Apple pandemis Codling moth Cucumber beetles European earwig Fruittree leafroller Japanese beetle June beetles Lecanium scales Lesser peachtree borer Olive scale Orange tortrix	Oriental fruit moth Peach twig borer Periodical cicada Plum curculio Redbanded leafroller San Jose scale Tarnished plant bug Tussock moths Variegated leafroller	1	1 (peaches) 3 (apricots & nectarines)	Do not apply more than 6 quarts of this product per acre per application to apricots. For optimum scale control apply when crawlers are present. Spray limbs and trunk thoroughly, weekly during moth flight. Apply dilute sprays in 200 to 400 gallons per acre.

CROP	INSECT		QUARTS OF CHIPCO® SEVIMOL® BRAND/100 GALS.	PREHARVEST INTERVAL (DAYS)	SPECIFIC DIRECTIONS
Pecans	Black margined aphid Fall webworm Hickory shuckworm Lesser webworm Pecan leaf phylloxera	Pecan stem phylloxera Pecan nut casebearer Pecan spittlebug Pecan weevil Twig girdler Walnut caterpillar	1 to 2 1/2	0	Do not apply more than 7.2 quarts of this product per acre per application. Apply dilute sprays in 200 to 400 gallons of water per acre.
Plums Prunes Cherries	Codling moth Eastern tent caterpillar	Orange tortrix Tussock moth	3/4	1	Do not apply more than 6 quarts of this product per acre per application.
	Black cherry aphid Brown soft scale Cherry fruitworm Cherry maggot European earwig Eyespotted bud moth Forbes scale Fruittree leafroller Green fruitworm Japanese beetle Lecanium scales	Lesser peachtree borer Mealy plum aphid Oystershell scale Peach twig borer Plum curculio Prune leafhopper Redbanded leafroller Rose chafer San Jose scale Variegated leafroller	1		For optimum scale control apply when crawlers are present. For lesser peachtree borer control spray limbs and tree trunks thoroughly, weekly during moth flight. Apply dilute sprays in 200 to 400 gallons of water per acre.
Walnut	Calico scale European fruit lecanium	Filbertworm Fruittree leafroller Frosted scale	1/2	0	Apply 1000 gallons of dilute spray per acre for mature trees.
	Codling moth				For codling moth apply first spray when average cross sectional diameters of developing nuts are 1/2 to 3/4 inch. Repeat during middle or late June as needed. Apply dilute sprays in 200 to 500 gallons of water per acre.
	European earwig		2		Spray tree trunks to point of run-off.

LIMITED WARRANTY AND DISCLAIMER

The manufacturer warrants (a) that this product conforms to the chemical description on the label; (b) that this product is reasonably fit for the purposes set forth in the directions for use when it is used in accordance with such directions; and (c) that the directions, warnings and other statements on this label are based upon responsible experts' evaluation of reasonable tests of effectiveness, of toxicity to laboratory animals and to plants, and of residues on food crops, and upon reports of field experience. Tests have not been made on all varieties or in all states or under all conditions. THE MANUFACTURER NEITHER MAKES NOR INTENDS, NOR DOES IT AUTHORIZE ANY AGENT OR REPRESENTATIVE TO MAKE, ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, AND IT EXPRESSLY EXCLUDES AND DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY DOES NOT EXTEND TO, AND THE BUYER SHALL BE SOLELY RESPONSIBLE FOR, ANY AND ALL LOSS OR DAMAGE WHICH RESULTS FROM THE USE OF THIS PRODUCT IN ANY MANNER WHICH IS INCONSISTENT WITH THE LABEL DIRECTIONS, WARNINGS OR CAUTIONS.

BUYER'S EXCLUSIVE REMEDY AND MANUFACTURER'S OR SELLER'S EXCLUSIVE LIABILITY FOR ANY AND ALL CLAIMS, LOSSES, DAMAGES, OR INJURIES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER OR NOT BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY IN TORT OR OTHERWISE, SHALL BE LIMITED, AT THE MANUFACTURER'S OPTION, TO REPLACEMENT OF, OR THE REPAYMENT OF THE PURCHASE PRICE FOR, THE QUANTITY OF PRODUCT WITH RESPECT TO WHICH DAMAGES ARE CLAIMED. IN NO EVENT SHALL MANUFACTURER OR SELLER BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT.

NOTICE TO BUYER

Purchase of this material does not confer any rights under patents governing this product or the use thereof in countries outside of the United States.

THIS SPECIMEN LABEL IS INTENDED FOR USE ONLY AS A GUIDE IN PROVIDING GENERAL INFORMATION REGARDING THE DIRECTIONS, WARNINGS AND CAUTIONS ASSOCIATED WITH THE USE OF THIS PRODUCT. AS WITH ANY AGRICULTURAL CHEMICAL, ALWAYS FOLLOW THE LABEL INSTRUCTIONS ON THE PACKAGE BEFORE USING.

Rhône-Poulenc Ag Company
P.O. Box 12014, 2 T.W. Alexander Drive
Research Triangle Park, North Carolina 27709

Form No. SP94092
Printed USA - 1/92

EPA Approved 5/10/90

Specimen Label

Dursban* 4E
Insecticide

To Be Applied Only by or Under the Direct Supervision of Commercial Applicators Responsible for Insect Control Programs. Sale to or Use by Persons Owning or Occupying a Dwelling is Strictly Prohibited.

Active Ingredient(s):

Chlorpyrifos [O,O-diethyl O-(3,5,6-trichloro-2-pyridinyl)phosphorothioate]	44.9%
Inert Ingredients	55.1%

Contains 4 pounds of chlorpyrifos per gallon.
Contains xylene range aromatic solvents.
E.P.A. Registration No. 62719-11
E.P.A. Est. 464-MI-1

KEEP OUT OF REACH OF CHILDREN

WARNING
AVISO:

PRECAUCION AL USUARIO:

Si usted no lee inglés, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

MAY BE FATAL IF SWALLOWED • ABSORPTION THROUGH SKIN MAY BE FATAL • CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY • CAUSES SKIN IRRITATION

Do Not Get In Eyes, On Skin Or Clothing • Avoid Breathing Vapors And Spray Mist • Handle Concentrate In A Ventilated Area • When Handling Concentrate Wear Eye Protection And Protective Clothing Such As Long-Sleeved Shirt, Long-Legged Pants, Rubber Gloves And Footwear, i.e. Neoprene Or Nitrile Butadiene Rubber, Resistant to Aromatic Solvents • Wash Thoroughly With Soap And Water After Handling And Before Eating Or Smoking • Remove Contaminated Clothing And Wash Before Reuse • Keep Away From Food, Feedstuffs And Water Supplies

STATEMENTS OF PRACTICAL TREATMENT:
If Swallowed: Call a physician or Poison Control Center immediately. Do not induce vomiting. Contains an aromatic petroleum solvent. Do not give anything by mouth to an unconscious person. **If On Skin:** Immediately wash with plenty of soap and water. Get medical attention. **If In Eyes:** Flush with plenty of water for 15 minutes. Get medical attention. **If Inhaled:** Remove to fresh air if symptoms of cholinesterase inhibition appear and get medical attention immediately.

NOTE TO PHYSICIAN: Chlorpyrifos is a cholinesterase inhibitor. Treat symptomatically. If exposed, plasma and red blood cell cholinesterase tests may indicate significance of exposure (baseline data are useful). Atropine, only by injection, is the preferable antidote. Oximes, such as 2-PAM/ protopam, may be therapeutic if used early; however, use only in conjunction with atropine. In case of severe acute poisoning, use antidote immediately after establishing an open airway and respiration.

Physical or Chemical Hazards

COMBUSTIBLE • Do Not Use or Store Near Heat or Open Flame. • Do Not Cut or Weld Container.

Environmental Hazards

This pesticide is toxic to birds and wildlife, and extremely toxic to fish and aquatic organisms. Do not apply directly to water. Drift and runoff from treated areas may be hazardous to aquatic organisms in adjacent aquatic sites. Cover or incorporate spills. Do not contaminate water when disposing of equipment washwaters. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

Dursban* 4E

Tree and Forest Pests (Nurseries, Plantations, and Felled Trees)

Use DURSBAN 4E insecticide to treat shade and flowering trees, plantation trees, transplant trees, and evergreens found to be infested with pests listed in the following table. Felled trees, such as elms, should be treated as necessary. Dilute DURSBAN 4E with water according to directions given in the table and apply using suitable hand- or power-operated spray equipment in a manner to provide complete and uniform coverage. For best results, apply a coarse spray to thoroughly wet both upper and lower leaf surfaces and to infested limb and trunk areas. Attempt to penetrate dense foliage, but avoid overspraying to the point of excessive runoff. **Attention:** For felled trees, treat after cutting; do not handle until spray has dried or wear suitable protective clothing. **Do not treat bearing fruit and nut trees** with DURSBAN 4E except as indicated in the Dormant Spray section. Treat when pests appear and repeat at 7 to 10 day intervals, if needed.

Consult your State Agricultural Experiment Station or Extension Service specialist for application timing and other specific use information.

Pest†	Amount of DURSBAN 4E in Water to Make:			Specific Directions
	1 gallon	3 gallons	100 gallons	
Adelgids (Such as: Cooley and Eastern spruce gall, Pine bark) Aphids (Such as: Apple, Chrysanthemum, Cottonwood, Elm leaf, Peach, Rose, Spirea, Woolly) Bagworms(1) Boxelder bugs Cankerworms Catalpa sphinx Citrus mealybugs Elm spanworms Fall webworms Greenstriped mapleworms Jackpine budworms Juniper webworms Katydids Lace bugs Leafhoppers Leafrollers(2) Maple leafcutters(3) Mites (Such as: Clover, Red spider, Southern red)(4) Oak skeletonizers Poplar tentmakers Puss caterpillars Sawflies, exposed (Such as: Pine, Pin oak) Spring elm caterpillars Spruce budworms Tent caterpillars (Such as: Eastern, Forest, Western) Walnut caterpillars Western spruce budworms Yellownecked caterpillars	1/12 fl. oz.	1/4 fl. oz.	8 fl. oz.	1. For **bagworms**, treat when insects are in the crawler stage. 2. For effective control of **leafrollers**, spray should be applied before leaves are tightly rolled. 3. For **maple leafcutter** on maple trees, apply spray to larvae as cases are being formed. Do not treat sugar maple trees intended for maple syrup production. 4. For effective control of **spider mites**, when large numbers of eggs are present, apply a second spray after 3 to 5 days in the South or 7 to 10 days in the North after initial treatment to control newly-hatched nymphs.

†Numbers in parentheses refer to Specific Directions.

Pest†	Amount of DURSBAN 4E in Water to Make:			Specific Directions
	1 gallon	3 gallons	100 gallons	
Beetles (Fuller rose, Native elm bark)(1) Leafhoppers Mahogany webworms Mealybugs Mimosa webworms Moths (Such as: Browntail, Cypress tip, Douglas fir tussock, European pine shoot, Gypsy(2), Holly bud, Nantucket pine tip, Pandora, Pitch pine tip, Subtropical pine tip, Tussock) Oakworms (Such as: California, Orangestriped, Redhumped) Redhumped caterpillars Thrips (exposed) Weevils (Such as: Blackvine(3), Yellow poplar, Pine reproduction)	⅛ fl. oz.	½ fl. oz.	1 pt.	1. To reduce **twig** and **branch** feeding by **bark beetles**, applications should be made in the spring or early summer. 2. To kill migrating and invading **gypsy moth larvae**, treat trunk and foliage. 3. **Blackvine weevils** are night feeders. Late afternoon spraying will give control in some areas.
Beetles (Such as: Cottonwood leaf(1), Elm leaf, Flea, Willow leaf)	⅛ to ⅓ fl. oz.	½ to 1 fl. oz.	1 pt. to 1 qt.	1. For **cottonwood leaf beetles**, use DURSBAN 4E in water to control larvae and adults infesting cottonwoods. Make the treatment when field counts indicate damaging beetle populations are developing or present. For seedlings use 8 to 20 gallons of spray volume per acre.
Borers(1): Clearwing moths (Such as: Ash, Dogwood, Lesser peachtree, Lilac, Oak, Rhododendron), Metallic wood (Such as: Bronze birch, Flatheaded appletree, Twolined chestnut), Longhorned beetles (Such as: Locust, Red oak) Cranberry girdler larvae(2) Leafminers Needleminers (Such as: Jeffrey pine, Lodgepole pine, Spruce) Scale crawlers (Such as: Cottonycushion, Cottonymaple, Euonymus, Fletcher, Florida wax, Golden oak, Hemispherical, Lecanium, Magnolia, Oak kermes, Oystershell, Pine needle, San Jose, Tea, White birch)	⅓ fl. oz.	1 fl. oz.	1 qt.	1. For **borers**, apply DURSBAN 4E to the trunks and lower limbs of trees and shrubs when the adults begin to emerge. Consult your local State Agricultural Experimental Station or Extension Service specialist for proper time to treat. Apply uniformly as a coarse low-pressure spray. 2. For **cranberry girdler larvae**, infesting Douglas fir seedlings apply 1 quart of DURSBAN 4E per acre. Direct spray at the lower crown and stems using 50 gallons of water per acre. Irrigate immediately after application for soil penetration of 1-2 inches. Treat after egg laying during the summer.
Borers (Such as: Cottonwood, Peachtree)(1)	1 fl. oz.	3 fl. oz.	3 qt.	1. For **peach tree borers**, apply DURSBAN 4E in water to flowering trees and shrubs of the genus *Prunus* as a trunk spray before newly-hatched larvae enter the trees. Apply as a coarse low-pressure spray. Thoroughly wet all bark areas from ground level to scaffold limbs.

†Numbers in parentheses refer to Specific Directions.

Pest†	Amount of DURSBAN 4E In Water to Make:			Specific Directions
	1 gallon	3 gallons	100 gallons	
Beetles(1) (Such as: Cottonwood leaf, Elm leaf, Flea, Fuller rose, Native elm bark(2), Willow leaf)	1⅓ fl. oz.	4 fl. oz.	1 gal.	1. For **preventive** treatment, apply the spray to the main **trunk** of trees in the early spring or when threat of attack exists from nearby infested trees. For **remedial** treatment, apply the spray to the main trunk of infested trees or logs when damage occurs but before adult beetles begin to emerge. For **plantation** trees, apply to individual trees using suitable hand- or power-operated spray equipment. 2. To prevent **native elm bark beetles** from overwintering in uninfested trees, apply DURSBAN 4E in water to the bottom 9 feet of the trunk. Wet the trunk thoroughly but do not spray to runoff. Care should be taken to apply the spray right to the base of the root flare. Application can be made with either a backpack mistblower or a hydraulic pressure sprayer from spring through to early fall. To reduce the twig and branch feeding on uninfested trees deemed to be of high value, apply a water spray to the tree crown. Application should be made in the spring or early summer using a sprayer that will give thorough coverage to the tree crown.
Beetles (Such as: Ambrosia, Anobiidae, Black turpentine, Blister, European elm bark, Japanese, June, Southern pine, Spruce)(1) Carpenter ants Termites	2⅔ fl. oz.	8 fl. oz.	2 gal.	1. For **preventive** treatment, apply the spray to the main **trunk** of trees in the early spring or when threat of attack exists from nearby infested trees. For **remedial** treatment, apply the spray to the main **trunk** of infested trees or logs when damage occurs or before adult beetles begin to emerge. For **plantation trees**, apply to individual trees using suitable hand- or power-operated spray equipment.
Weevils (Such as: Northern pine, Pales, Pitch-eating, Twig)(1)	5⅓ fl. oz.	1 pt.	4 gal.	1. For Southern pine seedlings, treat immediately after transplanting. Treat each seedling with enough spray to thoroughly wet the foliage and stems to the point of runoff but do not use more than 6 gallons of spray dilution per acre.

†Numbers in parentheses refer to Specific Directions.

RESTRICTED USE PESTICIDE
Due to toxicity to aquatic invertebrate animals.
For retail sale to and use only by Certified Applicators, or persons under their direct supervision, and only for those uses covered by the Certified applicator's certification.

DIMILIN® 4L

UNIROYAL CHEMICAL

COMPOSITION

Active Ingredient: (% by weight)	
N-[[(4-Chlorophenyl)amino]carbonyl]-2,6-difluorobenzamide*	40.4%
Inert Ingredients:	59.6%
TOTAL	100.0%

*Diflubenzuron: U.S. Patent Numbers 3,933,908; 3,989,842; 4,013,717; 4,110,469; 4,399,152 and other patents pending.
*Contains 4 lbs. diflubenzuron per gallon.

EPA REG. NO. 37100-54-400 003
EPA EST. NO. 7-31-91

Net Contents:

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS
CAUTION

Avoid contamination of feed and foodstuffs.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to crab, shrimp and other aquatic invertebrates. Do not apply directly to water or wetlands, (swamps, bogs, marshes, and potholes), except under the forest canopy when aerially applied to control forest pests. Drift or runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwaters..

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

Do not apply this product through any type of irrigation system.

DIRECTIONS FOR USE
FORESTS, TREES AND SHRUBS

DIMILIN 4L will control larvae of gypsy moth, forest tent caterpillar, Nantucket pine tip moth and tussock moth in forests, trees and shrubs.

Action of DIMILIN 4L is slow because it disrupts the normal molting process of insect larvae. In most instances, several days may be needed before full effect can be seen. DIMILIN 4L applied at label rates does not affect bees or other beneficial insects.

DIMILIN 4L may be used to protect trees and shrubs such as in:

- Forests
- Residential, municipal and shade tree areas
- Recreational areas such as campgrounds, golf courses, parks, parkways
- Ornamental, shade tree and forest nurseries
- Forest plantings
- Shelterbelts
- Rights of way and other easements

Insect	Rate DIMILIN 4L Per Acre	Timing	Spray Volume Per Acre-Gallons[1,2] Aerial	Ground	
				Air Blast	Hydraulic
Gypsy Moth[3]	0.5 - 2 fl. oz.	Early instar (1st, 2nd, or 3rd) preferred, but prior to full leaf expansion.	0.5 - 2.5	5 - 20	100 - 400
Forest Tent Caterpillar	1 - 4 fl. oz.	Early instar (1st, 2nd, or 3rd) preferred, but prior to full leaf expansion.	1.0 - 2.0	5 - 20	100 - 400
Nantucket Pine Tip Moth	2 fl. oz.	Early instar or when 75% of pupal cases are empty.	2.0 - 5.0	5 - 30	100 - 400
Tussock Moth	2 - 4 fl. oz.	Early instar	1.0 - 2.0	5 - 20	100 - 400

1. Uniform coverage of the foliage is essential. The higher volumes are recommended for mature or very large or dense tree stands or high population pressures. The higher water volumes in aerial application should be used when conditions of application are less than ideal and/or after larvae have reached 3rd instar.

2. Continuous agitation during mixing and application is required to maintain suspension of DIMILIN 4L. Do not use equipment without adequate agitation.

3. Gypsy Moth - To provide maximum protection from defoliation and reduce egg mass deposition treatment can begin at 5 to 20% leaf expansion provided egg hatch is underway. Because of its slowness of action applications later than 3rd instar may result in reduced foliage protection. Higher rates of DIMILIN 4L should be used if larvae have reached 3rd or 4th instar.

If it is determined that a single spray of 0.5 to 1.0 fl. oz. of DIMILIN 4L per acre does not result in adequate control of gypsy moth larvae, a second application may be made 7 to 14 days later.

4. Use 5 to 15 gallons per acre if trees are less than 3.5 feet tall. Use 15 to 30 gallons per acre for taller trees. Application should be made at peak emergence which can be determined by twig sampling, pheromone traps, degree days, etc.

Do not exceed 2 fl. oz. of DIMILIN 4L per acre, per season for gypsy moth or Nantucket pine tip moth. Do not exceed 4 fl. oz. per season for forest tent caterpillar or tussock moth.

In campgrounds or other recreational areas applications should be made during periods of minimal use. Notify persons using recreational facilities or living in the area to be sprayed before application of this or any other pesticide.

QUARANTINE PROGRAMS (Gypsy Moth)

For use in Quarantine programs conducted by State Cooperators as well as USDA personnel of both Plant Protection and Quarantine, APHIS and the U.S. Forest Service. For use in eradication of isolated infestations make two applications of 0.5 to 1 fluid ounces of DIMILIN 4L per acre 7-14 days apart. For use in quarantine programs involving the movement of nursery stock from infested to non-infested areas, make two applications of 0.5 to 1 fluid ounces of DIMILIN 4L per acre 7-14 days apart on nursery stock.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE—Store in a dry location.

PESTICIDE DISPOSAL—Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL—Triple rinse or equivalent. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or if allowed by State and local authorities, by burning. If burned, stay out of smoke.

IMPORTANT NOTICE—Seller warrants that this product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with the directions and instructions specified on the label under normal conditions of use, **but neither this warranty nor any other warranty of merchantability or fitness for a particular purpose, express or implied, extends to the use of this product, contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.**

DIMILIN® is a Registered Trademark of Solvay Duphar B.V., Weesp, the Netherlands

Distributed by:

Uniroyal Chemical Company, Inc., Middlebury, Connecticut 06749

RESTRICTED USE PESTICIDE
Due to toxicity to aquatic invertebrate animals.
For retail sale to and use only by Certified Applicators, or persons under their direct supervision, and only for those uses covered by the Certified applicator's certification.

DIMILIN® 25W

INSECT GROWTH REGULATOR

UNIROYAL CHEMICAL

COMPOSITION

Active Ingredient: (% by weight)	
N-[[(4-Chlorophenyl)amino]carbonyl]-2,6-difluorobenzamide*	25.0%
Inert Ingredients:	75.0%
TOTAL	100.0%

*Diflubenzuron: U.S. Patent Numbers 3,933,908; 3,989,842; 4,013,717; 4,110,469; 4,399,152 and other patents pending.

EPA REG. NO. 37100-8-400
EPA EST. NO. 010
10-31-91

Net Contents:

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS
CAUTION

Avoid contact with skin. Avoid contamination of feed and foodstuffs.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to crab, shrimp and other aquatic invertebrates. Do not apply directly to water or wetlands, (swamps, bogs, marshes, and potholes), except under the forest canopy when used to control forest pests. Drift or runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwaters..

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

Do not apply this product through any type of irrigation system.

DIRECTIONS FOR USE
FORESTS, TREES AND SHRUBS

DIMILIN 25W will control larvae of gypsy moth, forest tent caterpillar, Nantucket pine tip moth and tussock moth in forests trees and shrubs.

Action of DIMILIN 25W is slow because it disrupts the normal molting process of insect larvae. In most instances, several days may be needed before full effect can be seen. DIMILIN 25W applied at label rates does not affect bees or other beneficial insects.

DIMILIN 25W may be used to protect trees and shrubs such as in:

- Forests
- Residential, municipal and shade tree areas
- Recreational areas such as campgrounds, golf courses, parks, parkways
- Ornamental, shade tree, and forest nurseries
- Forest plantings
- Shelterbelts
- Rights of way and other easements

Insect	Rate DIMILIN 25W Per Acre	Timing	Spray Volume Per Acre-Gallons[1,2] Aerial	Ground	
				Air Blast	Hydraulic
Gypsy Moth[3]	1 - 4 oz.	Early instar (1st, 2nd, or 3rd) preferred, but prior to full leaf expansion.	0.5 - 2.5	5 - 20	100 - 400
Forest Tent Caterpillar	2 - 8 oz.	Early instar (1st, 2nd, or 3rd) preferred, but prior to full leaf expansion.	1.0 - 2.0	5 - 20	100 - 400
Nantucket Pine Tip Moth	4 oz.	Early instar or when 75% of pupal cases are empty.	2.0 - 5.0	5 - 30[4]	100 - 400
Tussock Moth	4 - 8 oz.	Early instar	1.0 - 2.0	5 - 20	100 - 400

1. Uniform coverage of the foliage is essential. The higher volumes are recommended for mature or very large or dense tree stands or high population pressures. The higher water volumes in aerial application should be used when conditions of application are less than ideal and/or after larvae have reached 3rd instar.

2. Continuous agitation during mixing and application is required to maintain suspension of DIMILIN 25W. Do not use equipment without adequate agitation.

3. Gypsy Moth - To provide maximum protection from defoliation and reduce egg mass deposition treatment can begin at 5 to 20% leaf expansion provided egg hatch is underway. Because of its slowness of action applications later than 3rd instar may result in reduced foliage protection. Higher rates of DIMILIN 25W should be used if larvae have reached 3rd or 4th instar.

If it is determined that a single spray of 1 to 2 ounces of DIMILIN 25W per acre does not result in adequate control of gypsy moth larvae, a second application may be made seven to fourteen days later. Do not exceed 4 oz. DIMILIN 25W per acre per season for gypsy moth or Nantucket pine tip moth. Do not exceed 8 oz. DIMILIN 25W per acre per season for control of forest tent caterpillar or tussock moth.

4. Use 5 to 15 gallons per acre if trees are less than 3½ feet tall. Use 15 to 30 gallons per acre for taller trees. Application should be made at peak emergence which can be determined by twig sampling, pheromone traps, degree days, etc.

In campground or other recreational aeas, application should be made during period of minimal use. Notify persons using recreational facilities or living in the area to be sprayed before application of this or any other pesticide.

QUARANTINE PROGRAMS (Gypsy Moth)

For use in Quarantine programs conducted by State Cooperators as well as USDA personnel of both Plant Protection and Quarantine, APHIS and the U.S. Forest Service. For use in eradication of isolated infestations make two applications of 1 to 2 ounces of DIMILIN 25W per acre 7-14 days apart. For use in quarantine programs involving the movement of nursery stock from infested to non-infested areas, make two applications of 1 to 2 ounces of DIMILIN 25W per acre 7-14 days apart on nursery stock.

ORNAMENTALS

BEET ARMYWORM: For control of beet armyworm on field or greenhouse grown chrysanthemums apply 0.5 to 1 pound of DIMILIN 25W per acre in a dilute spray not to exceed 200 gallons of water per acre. Begin applications when larvae appear and repeat at weekly intervals as required. The insect dies during molting following contact and full effect will not be seen for 3 to 5 days following application. The user should initially treat only a small portion of his crop to confirm plant safety under his growing conditions.

CHRISTMAS TREES AND PINE TREE NURSERIES

NANTUCKET PINE TIP MOTH: DIMILIN 25W controls Nantucket pine tip moth in Christmas tree plantations and pine tree nurseries. Apply 4 ounces DIMILIN 25W per acre in the early larval stages of development, preferably at the beginning of egg hatch of the second tip moth generation.

Aerial Application: Apply the recommended amount in 2.0 to 5.0 gallons of water per acre for uniform coverage.

Ground Application: Apply recommended amount in sufficient water for uniform, full coverage of foliage (5 to 400 gallons per acre, depending on spray equipment used).

MUSHROOMS

DIMILIN 25W will control larvae of sciarid flies in mushroom growing facilities. DIMILIN 25W in the mushroom growing media will prevent the development of the larval stages of the sciarids. This effectively stops reproduction in the growing medium and prevents damage to the mushrooms. Because of its unique type of activity do not expect immediate reductions in adult fly populations. DIMILIN 25W does not directly affect adults but kills the larvae in the growing medium.

Compost treatment: Apply 2.4 to 4 pounds of DIMILIN 25W per 1000 square feet to the compost at spawning time by thorough incorporation such as with a spawning machine. This is equivalent to 30 to 50 ppm active ingredient assuming a compost wet weight of 40 pounds per cubic foot.

Casing treatment: Apply 13.5 ounces of DIMILIN 25W per 1000 square feet at the time of casing by thorough incorporation into the casing or in sufficient water to obtain a thorough drench. This is equivalent to a rate of 30 ppm active ingredient assuming a casing weight of 6700 pounds per 1000 square feet.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage age or disposal.

STORAGE—Store in a dry location.

PESTICIDE DISPOSAL—Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL—Completely empty bag into application equipment Then disposed of empty bag in a sanitary landfill or by incineration, or if allowed by State and local authorities, by burning If burned, stay out of smoke.

IMPORTANT NOTICE—Seller warrants that this product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with the directions and instructions specified on the label under normal conditions of use, **but neither this warranty nor any other warranty of merchantability or fitness for a particular purpose, express or implied, extends to the use of this product, contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.**

DIMILIN® is a Registered Trademark of Solvay Duphar B.V., Weesp, the Netherlands

Distributed By: Uniroyal Chemical Company, Inc., Middlebury, CT 06749

DIRECTIONS FOR USE
GENERAL CLASSIFICATION

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For population reduction of the Douglas-fir tussock moth, apply by air at the rate of ½ ounce (14.2 grams) TM Biocontrol-1 in 1 to 2 gallons finished spray per acre. Stickers and u.v. protectants may enhance performance of this product. Refer to technical bulletin for mixing and application instructions. Spray tank mixture pH should be 6.0 to 7.2 NEVER USE CHLORINATED WATER IN THE SPRAY FORMULATION.

PRECAUTIONARY STATEMENTS
CAUTION
ENVIRONMENTAL HAZARDS

Avoid application to lakes, streams, or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.

STORAGE AND DISPOSAL

Activity may be impaired by storage above 80°F.

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

Pesticide, spray mixture, or rinsate that cannot be used should be disposed of in a landfill approved for pesticides or buried in a safe place away from water.

Container disposal: Triple rinse and dispose of in an approved landfill or bury in a safe place.

Consult Federal, State, or local disposal authorities for approved alternative procedures.

TM BIOCONTROL-1
BIOLOGICAL INSECTICIDE
FOR THE
DOUGLAS-FIR TUSSOCK MOTH

Active Ingredient:*	
Polyhedral inclusion bodies of Douglas-fir tussock moth nucleopolyhedrosis virus)	3.5%
Inert ingredients:	96.5%
TOTAL	100.0%

*Contains at least 70 million activity units per gram.

KEEP OUT OF THE REACH OF CHILDREN
CAUTION
See back of tag for additional precautionary statements.

For use by or under the supervision of the U.S. Forest Service.

NOTICE: The U.S. Forest Service makes no warranty, express or implied including the warranties or merchantability and/or fitness for any particular purpose, concerning this material except those which are contained on the U.S. Forest Service's label.

MFG. BY: U.S. Forest Service, USDA
14th and Independence Avenues
Washington, D.C. 20250

EPA REG. NO. 27586-1

NET WEIGHT:_____ **LOT NO.:**_____

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS

WARNING
Causes eye irritation. Do not get in eyes.

FIRST AID

In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. For eyes, call a physician.

ENVIRONMENTAL HAZARDS

Avoid application to lakes, streams, or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.

DIRECTIONS FOR USE
GENERAL CLASSIFICATION

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For foliar protection from gypsy moth larvae make 2 applications 7 to 10 days apart at the rate of 25.0 to 125.0 million gypsy moth potency units per acre in sufficient water for thorough and uniform coverage. Stickers and u.v. protectants may enhance performance of this product. Refer to technical bulletin for mixing and application instructions.

NEVER USE CHLORINATED WATER IN THE SPRAY FORMULATION.

STORAGE AND DISPOSAL

Activity may be impaired by storage above 90°F.

Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

Pesticide, spray mixture, or rinsate that cannot be used should be disposed of in a landfill approved for pesticides or buried in a safe place away from water.

Container disposal: Triple rinse and dispose of in an approved landfill or bury in a safe place.

Consult Federal, State, or local disposal authorities for approved alternative procedures.

GYPCHEK

BIOLOGICAL INSECTICIDE
FOR THE
GYPSY MOTH

Active Ingredient*: (Polyhedral inclusion bodies of gypsy moth nucleopolyhedrosis virus)	20%
Inert Ingredients	80%
Total	100%

*This lot contains at least ___ million gypsy moth potency units per gram.

KEEP OUT OF REACH OF CHILDREN

WARNING

See back of tag for additional precautionary statements.

For use by or under the supervision of U.S. Forest Service.

Notice: The U.S. Forest Service makes no warranty, expressed or implied including the warranties or merchantability and/or fitness for any particular purpose, concerning this material except those which are contained on the U.S. Forest Service's label.

MFG. BY: U.S. Forest Service, USDA
P.O. Box 2417
Washington, D.C. 20013

EPA ESTABLISHMENT NO. _____

EPA REGISTRATION NO. 27586-2

Net Weight _____ Lot No. _____

TECHNICAL BULLETIN

GYPCHEK BIOLOGICAL INSECTICIDE

Gypchek Biological Insecticide consists of polyhedra of the gypsy moth nucleopolyhedrosis virus. Care must be taken in the mixing and application of this product. Stickers and u.v. protectants may enhance performance of this product. Apply in sufficient spray mixture for thorough and uniform coverage.

Tank Mixture

Gypchek	Amount to result in 2.5 to 12.8 million gypsy moth potency units per acre.
Molasses	0.25 gallon
Chevron Sticker	3 fl. oz.
Shade^{R}	1.0 lb.
Water	0.72 gallon

IMPORTANT: Check pH of water from field source. If pH exceeds 7.5 or is below 5.5, add sufficient acid or base to adjust pH to approximately 7. NEVER USE CHLORINATED WATER IN THE SPRAY FORMULATION.

Mixing sequence for conventional mixing equipment.

1. Fill tank with water and start agitation.
2. Add acid or base if necessary to adjust pH.
3. Add sunscreen (Shade^{R}) by slowly pouring onto the surface of mixture under agitation. Avoid large lumps of powder.
4. Add molasses by slowly pouring into water and mix thoroughly.
5. Add sticker.
6. Add GYPCHEK. Mixing time can be reduced by premixing Gypchek with a small amount of water in a blender before adding to tank mix. Final formulation should be mixed for 10-30 minutes.

Note: Read label thoroughly before using. Follow all label cautions and directions.

Appendix E

Technology Development

Needs Letter to WO

United States Department of Agriculture | Forest Service | Washington Office | 2121 C Second Street
Davis, CA 95616
PH (916) 551-1715
FAX (916) 757-8383

Reply To: 3400

Date: August 26, 1993

Subject: Recommendations - Western Defoliators

To: Nancy Lorimer

The National Steering Committee for Management of Western Defoliators met at West Sacramento, CA on August 24-25. The purpose of the meeting was to identify Technology Development Program needs and to continue development of the Strategic and Tactical Plan for Managing Western Defoliators. This was a highly productive meeting with active participation by each attendee.

The Committee identified 19 needs and prioritized the list through member voting. Those with the highest priority are listed below along with the number of votes each received.

- Study natural roles and effects of major western defoliators and their natural enemies on resources. (6 votes)
- Pursue DFTM pheromone registration for mating disruption. This need includes all activities necessary to obtain registration. (5 votes)
- Identify data needs that prevent ecosystem management of WSBW. (5 votes)
- Enhance and adapt WSBW and DFTM population dynamics model for use in the Forest Planning Process. (5 votes)
- Evaluate TM Biocontrol-1 potency on wild populations collected from different geographical areas. (4 votes)
- Explore silvicultural options for prevention of unacceptable effects caused by defoliators. (4 votes)
- Develop DFTM pheromone application technology for formulations and delivery. (4 votes)
- Evaluate impact of Bt on non-target species, conduct field inventories and develop methodologies. (3 votes)
- Evaluate Entotech carrier for TM Biocontrol-1. (3 votes)

- Conduct field tests of DFTM pheromone to evaluate treatment timing in an outbreak cycle. (2 votes)

- Develop and evaluate a tree hazard rating system for WSBW and DFTM. (2 votes)

- Examine long-range forecasting of pest populations using pheromone technology and other methods. (2 votes)

- Evaluate effects and impact of a selected WSBW outbreak using a current outbreak by collecting, analyzing, and reporting data. (2 votes)

A few qualifying comments are appropriate concerning this list and the tactical plan. The needs, viewed out of context from both a strategic and tactical perspective, might be argued to a wish list. This is not the case. After the needs were identified, initially to satisfy the technology development call letter schedule, the needs were rewritten by the Committee as Goal or Action items and plugged into the strategic plan developed by John Wenz and his sub-committee. In doing so we expanded the Strategic Plan for the Management of Western Defoliators into a combined strategic and tactical plan. This approach was the unanimous suggestion of the committee and in the committee activity that followed we made impressive progress in developing the Plan. We plan to submit the draft plan to you in September. Meanwhile we encourage your WO/FPM Review Committee to consider funding proposals that may be submitted by the Regions and Area within the scope of the 12 needs listed in this letter.

/s/ John W. Barry
JOHN W. BARRY
Chairperson

cc: Committee Members
Jesus Cota

Appendix F

1995 Farm Bill Issues -

Letter to WO

United States Department of Agriculture | Forest Service | Washington Office | 2121 C Second Street
Davis, CA 95616
PH (916) 551-1715
FAX (916) 757-8383

Reply To: 3400

Date: August 27, 1993

Subject: 1995 Farm Bill

To: Mel Weiss
Acting Director, FPM

Mel, at the 1993 meeting of the National Steering Committee for Managing Western Defoliators we discussed three issues that the committee suggested I bring to your attention. These relate to Forest Pest Management's emerging role in ecosystem management. The issues are:

1. Biological Control of Vegetation. The committee expressed concern that use of insects to control vegetation was not within FPM's mission. The committee feels that biological control of vegetation is an important ecosystem function and one appropriately suited for FPM coordination and action. The same concern was expressed by the National Steering Committee for Managing Seed, Cone, and Regeneration Insects. It is recommended that the 1995 Farm Bill include wording that permits FPM involvement in biological control of vegetation.

2. Funding for Prevention. The committee expressed concern that FPM is not funded for prevention which is in contrast to FPM's role in forest health and ecosystem management. It is recommended that the 1995 Farm Bill include work that allows use of FPM funds for prevention.

3. Ecological Approach to Forest Health. Ecological and ecosystem approachs will be the driving forces toward improving the health of the nation's forest. The Committee recommends that the 1995 Farm Bill be strengthen to further emphasize the word ecological along with ecosystem approaches to forest health.

/s/ John W. Barry
JOHN W. BARRY
Chairperson

cc: Committee Members
Jesus Cota
Dave Johnson

Appendix G

Strategic / Tactical

Planning Documents

United States Department of Agriculture
Forest Service
Stanislaus National Forest
19777 Greenley Road
Sonora, CA 95370-5909

Reply To: 3400

Date: 31 August 1993

Subject: Western Defoliator Strategic/Tactical Plan

To: John W. Barry
Chairperson, Western Defoliator Steering Committee

Enclosed, on behalf of the sub-committee charged with developing a "western defoliator strategic management plan" (WO, 2150 memo, 11 March 1992), is the final version of the Strategic/Tactical Plan for the Management of Western Defoliators. Committee members included Bruce Hostetler, Nancy Campbell, Katharine Sheehan, Beth Willhite and John Wenz. The Plan reflects changes developed at the sub-committee meeting held in Portland, OR, on June, 10-11, 1993, written input from FPM in R1, R3, R4, R5 and R6, and comments received during the full steering committee on August 24-25, 1993 in Davis, CA.

/s/ John M. Wenz
JOHN M. WENZ
Sub-committee Chairperson

cc: N.Campbell, FPM-R1
B.Hostetler, FPM-R6
K.Sheehan, FPM-R6
B.Willhite, FPM-R6

NATIONAL STEERING COMMITTEE FOR WESTERN DEFOLIATORS

Combined Strategic/Tactical Plan for the Management of Western Defoliators

1993

Background: The current emphasis on Ecosystem Management and Forest Health has surfaced the need to re-evaluate traditional approaches and strategies for managing defoliators. Management emphasis is changing from attaining predetermined resource targets to watershed protection/ restoration and the health of sustainable forest ecosystems. Increasingly entomologists and plant pathologists are being asked for information on the roles, functions and interrelationships of insects, including defoliators, and pathogens in, and their effects on, western forest ecosystems. Such questions/issues are part of attempts to define forest health and the "range of natural variability" for given ecosystems and how they are affected by defoliator activity. The following strategic plan outline is intended to help focus FPM activities along these lines.

It is recognized that considerable information already exists, and work is currently in progress, that addresses components of the elements outlined in the plan. One approach toward implementing the plan would be to designate small, functional, working groups to initiate consolidation, evaluation and summarization of existing information and work currently in progress for specific western defoliators (e.g., western budworms, Douglas-fir tussock moth, pandora moth). The groups could then develop defoliator specific plans, with as much detail as needed, that identify additional data gaps and information needs within the context of the current emphasis on ecosystem management, and the actions and support needed to obtain the data and/or information. This west-wide approach would help minimize duplication of effort and facilitate the efficient use of funding.

Assumptions: This Strategic Plan was developed with the following assumptions:

(1) The primary objective of the Strategic Plan is to provide guidance in identifying and prioritizing needs for understanding and managing defoliators of western hardwood and coniferous forest ecosystems. The Strategic Plan is intended to provide a framework for: (1) identifying critical issues and information needs relative to understanding the functions and interactions of western defoliators in forest ecosystems; (2) integrating traditional defoliator management strategies and methodologies with current emphases on forest health and ecosystem management; and (3) developing a tactical plan that prioritizes short-term (5 year) defoliator management technology development needs.

(2) The basic objective of western defoliator management is to determine, evaluate and maintain defoliator ecosystem/resource effects at acceptable levels within the context of defined management goals and objectives, the

"range of natural variability", and the health ("desired condition") of the ecosystem.

(3) The following basic information is needed for effective defoliator management:

(a) Identification, understanding and prediction of defoliator effects on diverse resource management goals and objectives, forest health, and ecosystem structure, processes and functions.

(b) When and where unacceptable defoliator ecosystem/resource effects are going to occur.

(c) Strategies, technologies and methodologies needed to implement effective management of western defoliators.

Elements: The following elements and goal statements are intended to focus on these basic issues and help facilitate identification of information and technology needs.

Element 1. Functions/Interactions of Defoliators in Western Forest Ecosystem Dynamics.

A) Identification and Measurement of Effects. The capability exists to quantitatively measure defoliator effects on forest vegetation. For example, effects can be described/measured in terms of host mortality, top-kill, loss of foliage, growth loss, and changes in stocking levels, species composition, age and stand structure.

1) Evaluate the effects of western budworm (WBW) larval feeding and defoliation on Douglas-fir cone crops.

2) Analyse and summarize existing permanent plot data to evaluate effects of a current WBW outbreak.

3) Continue monitoring/re-measuring permanent plots for effects of defoliation on mortality, top-kill ansd growth.

4) Identify potentially important hardwood defoliators.

B) Assessment of Effects (Resource Impact Analysis). The capability exists to assess the impact, meaning, or significance of the defoliator effects (as defined in 1-A, above) on resource management goals and objectives, ecosystem structure and function, ecosustem sustainability, and the health (desired condition) of the ecosystem. This includes determining how ecological conditions and management activities affect defoliator population dynamics and the consequent effects of defoliators on ecosystems.

1) Determine the impacts of WBW and Douglas-fir tussock moth (DFTM) effects on resources and ecosystem structure and function.

2) Determine the history of defoliator outbreaks to help define the "range of natural variability".

C) Assessment of Treatment Effects. The capability exists to assess (as described in 1-B, above), the effects of "treatments" (i.e., no action, direct suppression, prevention [including silviculture], etc.) implemented to manage defoliators. This assessment includes evaluation of treatment effects on the defoliator, the resulting effects on resources and ecosystems (as defined in 1-B, above), as well as non-target organisms.

1) Evaluate the impacts of microbials on non-target lepidoptera and other organisms as appropriate including the initiation of baseline inventory surveys.

2) Evaluate the impacts of population suppression methodologies on threatened, endangered, ans sensitive species.

3) Evaluate the efficacy of silvicultural treatments designed to prevent/reduce unacceptable effects of defoliation on vegetation, resources and ecosystems.

D) Prediction of Effects. The capability exists to predict defoliator ecosystem effects with and without treatment.

1) Validate and calibrate the WBW damage model.

2) Evaluate the capabilitiesd and limitations of the WBW/DFTM population dynamics models.

3) Develop procedures for using the WBW/DFTM population dynamics models in the forest planning process.

E) Hazard/Risk Rating. Effective hazard/risk rating systems exist for use in predictive ecosystem effects modelling and focusing detection and prevention efforts.

1) Compare existing, evaluate, and improve risk and hazard rating systems for WBW/DFTM over different geographical areas.

Element 2. Population Evaluation

A) Survey/Detection. Effective survey and detection systems exist to predict when and where populations will reach levels that might cause unacceptable ecosystem effects.

1) Evaluate the DFTM early warning pheromone system to improve predictability and efficiency of the system.

2) Examine capabilities for long range forcasting of DFTM populations using historical pheromone trapping data (MAG data base and other sources).

B) Population Dynamics. An adequate understanding of defoliator population dynamics, including the relationship between populations levels and resource/ecosystem effects, exists.

1) Evaluate the role of natural enemies in the population dynamics of WBW/DFTM.

2) Continue to evaluate the potential of using WBW pheromone trap catches to predict subsequent defoliation.

C) Population Assessment. Effective population sampling/ monitoring methodologies exist.

1) Evaluate the need to continue the monitoring of existing population plots established by PNW (Wickman, Mason).

2) Develop a sampling system for hemlock looper.

Element 3. Management. Biologically effective, environmentally sensitive, economically defensible, defoliator management (prevention/ suppression) strategies are available to maintain defoliator resource/ecosystem effects at acceptable levels.

A) Habitat Management. Effective silvicultural techniques/ approaches are available to reduce unacceptable defoliator effects. Defoliator effects are considered in the development and implementation of silvicultural prescriptions.

1) Explore silvicultural options for preventing/reducing unacceptable defoliator effects.

B) Population Management. Effective strategies/ techniques/ methodologies, including semiochemicals, microbials, growth regulators, biological controls and chemical insecticides are available to manage defoliator populations.

1) Determine the potency of TM BioControl-1 on wild populations of the DFTM from different geographical areas including a) lab bioassays and b) field tests.

2) Pursue and obtain registration of the DFTM pheromone for mating disruption.

3) Improve DFTM pheromone application and delivery technology and formulation for mating disruption.

4) Conduct field tests of DFTM pheromone for mating disruption to determine optimal time of treatment (population level) within an outbreak cycle.

5) Evaluate the potential for using natural enemies for population management off DFTM/WBW.

6) Field test Entotech virus carrier for TM BioControl-1 for rain fastness, persistence, and viability.

7) Evaluate the potential of Entomophaga (fungus) for suppression of DFTM under western conditions.

Element 4. Technology Transfer. Timely transfer of information to, and coordination with, cooperators (NFS, Research, States, community interest groups), is occurring.

1) Develop procedures to assist in the decision-making, planning, and implementation of suppression pro jects.

United States Department of Agriculture | Forest Service | Washington Office
2121 C Second Street
Davis, CA 95616
PH (916) 551-1715
FAX (916) 757-8383

Reply To: 3400

Date: 9 September 1993

Subject: Action Items - National Steering Committee for Management of Western Defoliators

To: Committee Members

At our August 24-25 meeting at West Sacramento, CA we originated a list of 28 "Action Items". These Action Items have been incorporated into the appropriate Elements of the Combined Strategic/Tactical Plan for the Management of Western Defoliators (see enclosure).

Time constraints at the meeting did not allow for a complete, in-depth discussion of the Items under each Goal nor the development of rationale statements for each Item. As one aspect of implementing the Committee's Strategic/Tactical Plan and to expand upon the Committee's FY94 recommendations and work priorities, it would be very useful to review the Action Items and develop a brief rationale statement for each one. This would help clarify the specific intent and realtionship of the Action to the Goal.

To accomplish this, I have tentatively assigned a member of the Committee to each Action Item (see enclosure) to review the Item as currently stated and come up with a rationale statement. Suggestions from other committee members are invited. John Wenz has volunteered to coordinate the responses and to see that they are consolidated and distributed for review by the entire Committee.

I ask that you send your input to John (DG:R05F16A) by October 17, 1993. Please contact John or me if you have any questions.

/s/ John W. Barry
JOHN W. BARRY
Chairperson

Enclosure

NATIONAL STEERING COMMITTEE FOR WESTERN DEFOLIATORS

Combined Strategic/Tactical Plan for the Management of Western Defoliators

September 8, 1993

Background: The current emphasis on Ecosystem Management and Forest Health has surfaced the need to re-evaluate traditional approaches and strategies for managing defoliators. Management emphasis is changing from attaining predetermined resource targets to watershed protection/ restoration and the health of sustainable forest ecosystems. Increasingly entomologists and plant pathologists are being asked for information on the roles, functions and interrelationships of insects, including defoliators, and pathogens in, and their effects on, western forest ecosystems. Such questions/issues are part of attempts to define forest health and the "range of natural variability" for given ecosystems and how they are affected by defoliator activity. The following strategic plan outline is intended to help focus FPM activities along these lines.

It is recognized that considerable information already exists, and work is currently in progress, that addresses components of the elements outlined in the plan. One approach toward implementing the plan would be to designate small, functional, working groups to initiate consolidation, evaluation and summarization of existing information and work currently in progress for specific western defoliators (e.g., western budworms, Douglas-fir tussock moth, pandora moth). The groups could then develop defoliator specific plans, with as much detail as needed, that identify additional data gaps and information needs within the context of the current emphasis on ecosystem management, and the actions and support needed to obtain the data and/or information. This west-wide approach would help minimize duplication of effort and facilitate the efficient use of funding.

Assumptions: This Strategic Plan was developed with the following assumptions:

(1) The primary objective of the Strategic Plan is to provide guidance in identifying and prioritizing needs for understanding and managing defoliators of western coniferous and hardwood forest ecosystems. The Strategic Plan is intended to provide a framework for: (1) identifying critical issues and information needs relative to understanding the functions and interactions of western defoliators in forest ecosystems; (2) integrating traditional defoliator management strategies and methodologies with current emphases on forest health and ecosystem management; and (3) developing a tactical plan that prioritizes short-term (5 year) defoliator management technology development needs.

(2) The basic objective of western defoliator management is to determine, evaluate and maintain defoliator ecosystem/resource effects at acceptable levels within the context of defined management goals and objectives, the

"range of natural variability", and the health ("desired condition") of the ecosystem.

(3) The following basic information is needed for effective defoliator management:

(a) Identification, understanding and prediction of defoliator effects on diverse resource management goals and objectives, forest health, and ecosystem structure, processes and functions.

(b) When and where unacceptable defoliator ecosystem/resource effects are going to occur.

(c) Strategies, technologies and methodologies needed to implement effective management of western defoliators.

Elements: The following elements and goal statements are intended to focus on these basic issues and help facilitate identification of information and technology needs.

Element 1. Functions/Interactions of Defoliators in Western Forest Ecosystem Dynamics.

A) Identification and Measurement of Effects. The capability exists to quantitatively measure defoliator effects on forest vegetation. For example, effects can be described/measured in terms of host mortality, top-kill, loss of foliage, growth loss, and changes in stocking levels, species composition, age and stand structure.

1) Evaluate the effects of western budworm (WBW) larval feeding and defoliation on Douglas-fir cone crops. **(Campbell)**

2) Analyse and summarize existing permanent plot data to evaluate effects of a current WBW outbreak. **(Hostetler)**

3) Continue monitoring/re-measuring permanent plots for effects of defoliation on mortality, top-kill and growth. **(Hostetler)**

4) Identify potentially important hardwood defoliators. **(Wenz)**

B) Assessment of Effects (Resource Impact Analysis). The capability exists to assess the impact, meaning, or significance of the defoliator effects (as defined in 1-A, above) on resource management goals and objectives, ecosystem structure and function, ecosystem sustainability, and the health (desired condition) of the ecosystem. This includes determining how

ecological conditions and management activities affect defoliator population dynamics and the consequent effects of defoliators on ecosystems.

1) Determine the impacts of WBW and Douglas-fir tussock moth (DFTM) effects on resources and ecosystem structure and function. **(Weatherby)**

2) Determine the history of defoliator outbreaks to help define the "range of natural variability". **(Campbell)**

C) Assessment of Treatment Effects. The capability exists to assess (as described in 1-B, above), the effects of "treatments" (i.e., no action, direct suppression, prevention [including silviculture], etc.) implemented to manage defoliators. This assessment includes evaluation of treatment effects on the defoliator, the resulting effects on resources and ecosystems (as defined in 1-B, above), as well as non-target organisms.

1) Evaluate the impacts of microbials on non-target lepidoptera and other organisms as appropriate including the initiation of baseline inventory surveys. **(Bennett)**

2) Evaluate the impacts of population suppression methodologies on threatened, endangered, and sensitive species. **(Bennett)**

3) Evaluate the efficacy of silvicultural treatments designed to prevent/reduce unacceptable effects of defoliation on vegetation, resources and ecosystems. **(Weatherby)**

D) Prediction of Effects. The capability exists to predict defoliator ecosystem effects with and without treatment.

1) Validate and calibrate the WBW damage model. **(Hostetler)**

2) Evaluate the capabilities and limitations of the WBW/DFTM population dynamics models. **(Hostetler)**

3) Develop procedures for using the WBW/DFTM population dynamics models in the forest planning process. **(Hostetler)**

E) Hazard/Risk Rating. Effective hazard/risk rating systems exist for use in predictive ecosystem effects modelling and focusing detection and prevention efforts.

1) Compare existing, evaluate, and improve risk and hazard rating systems for WBW/DFTM over different geographical areas. **(Livingston)**

Element 2. Population Evaluation

A) Survey/Detection. Effective survey and detection systems exist to predict when and where populations will reach levels that might cause unacceptable ecosystem effects.

1) Evaluate the DFTM early warning pheromone system to improve predictability and efficiency of the system. **(Wenz)**

2) Examine capabilities for long range forcasting of DFTM populations using historical pheromone trapping data (MAG data base and other sources). **(Weatherby)**

B) Population Dynamics. An adequate understanding of defoliator population dynamics, including the relationship between populations levels and resource/ecosystem effects, exists.

1) Evaluate the role of natural enemies in the population dynamics of WBW/DFTM. **(Campbell)**

2) Continue to evaluate the potential of using WBW pheromone trap catches to predict subsequent defoliation. **(Hostetler)**

C) Population Assessment and Monitoring. Methodologies exist for spatial and temporal assessment/ monitoring of defoliator populations, and for summarizing and analyzing the data obtained through use of these methodologies.

1) Evaluate the need to continue the monitoring of existing population plots established by PNW (Wickman, Mason). **(Hostetler)**

2) Develop a sampling system for hemlock looper. **(Hostetler)**

Element 3. Management. Biologically effective, environmentally sensitive, economically defensible, defoliator management (prevention/ suppression) strategies are available to maintain defoliator resource/ecosystem effects at acceptable levels.

A) Habitat Management. Effective silvicultural techniques/ approaches are available to reduce unacceptable defoliator effects. Defoliator effects are considered in the development and implementation of silvicultural prescriptions.

1) Explore silvicultural options for preventing/reducing unacceptable defoliator effects. **(Weatherby)**

B) Population Management. Effective strategies/ techniques/ methodologies, including semiochemicals, microbials, growth regulators, biological controls and chemical insecticides are available to manage defoliator populations.

1) Determine the potency of TM BioControl-1 on wild populations of the DFTM from different geographical areas including a) lab bioassays and b) field tests. **(Livingston)**

2) Pursue and obtain registration of the DFTM pheromone for mating disruption. **(Wenz)**

3) Improve DFTM pheromone application and delivery technology and formulation for mating disruption. **(Livingston)**

4) Conduct field tests of DFTM pheromone for mating disruption to determine optimal time of treatment (population level) within an outbreak cycle. **(Livingston)**

5) Evaluate the potential for using natural enemies for population management off DFTM/WBW. **(Campbell)**

6) Field test Entotech virus carrier for TM BioControl-1 for rain fastness, persistence, and viability. **(Bennett)**

7) Evaluate the potential of Entomophaga (fungus) for suppression of DFTM under western conditions. **(Bennett)**

Element 4. Technology Transfer. Timely transfer of information to, and coordination with, cooperators (NFS, Research, States, community interest groups), is occurring.

1) Develop procedures to assist in the decision-making, planning, and implementation of suppression projects. **(Livingston)**

United States Department of Agriculture | Forest Service | R-1

Reply To: 3400 Date: June 18, 1993

Subject: Management of Western Defoliators

To: Jack Barry

We have reviewed the draft Strategic Plan for the Management of western defoliators and agree that there is a strong need for the development and implementation of both a strategic and tactical plan for managing these insects. The steering committee has made an excellent start at developing the plan. The three basic issues outlined in the document soundly illustrate what the important elements are for managing western spruce budworm: trends, prediction capabilities, and sound technologies and methodologies. An important item also covered in the basic issues deals with accepting some loss/impact from defoliators on the resource. This can be addressed by evaluating insects in the context of their multiple functions in the forest ecosystem instead of only focusing on loss in terms of board feet. The plan covers most of the traditional approaches/technologies needed to manage western defoliators. What is lacking in the plan is the link between traditional technologies, and forest health and ecosystem management. In addition to developing technologies, we need to characterize the health of forest ecosystems by evaluating the roles, functions and interrelationships of western defoliators in forest ecosystem dynamics. The following questions should be addressed in the strategic plan: (1) how have defoliators (and their effects) varied in intensity and distribution before and since the influence of European man in this country? (2) how do we assess current forest health? (3) is the current status of forest health within the range of "normal" for pre-EuroAmerican forest conditions? and (4) how do we predict the effects of management alternatives on the health of forest ecosystems.

Information on the role of defoliators on forest health and ecosystem function would fit nicely under Element 1 (Functions/Interactions-evaluating roles/functions of western defoliators in forest ecosystem dynamics). This element should be expanded considerably.

With the current emphasis on forest health, and declining budgets, more attention should be given to non-traditional technologies such as biological control and other non-chemical management strategies such as pheromone technology. Also, non-chemical management should include evaluations of effects on non-target organisms just as chemical suppression should. For instance, harvesting a stand most likely effects many of the beneficial insects such as ants and other organisms in the ecosystem. Monitoring of non-target insects should be done whenever treatment effects are being evaluated.

Under Element 4, the plan mentions the need to coordinate with various resource managers to effectively link defoliator management strategies with new resource

management approaches such as ecosystem management. Before we can accomplish this, we need to re-evaluate our approach to managing western defoliators to ensure that we are asking the right questions. We need to ask the questions in the broader context of ecosystem management and not just from a timber perspective.

A considerable amount of work has been accomplished and documented on managing western defoliators. The CANUSA program was a multi-million dollar research/technology development/implementation effort aimed at reducing the impacts of budworm on our forests. Even though Integrated Pest Management was the main philosophy, very little attention was paid to assessing the impact of budworm based on ecological and social values. However, much of the work needed to evaluate this has been done and now needs to be re-structured within a broader ecological context.

We strongly agree that one of the first steps toward implementing the plan is to consolidate, evaluate and summarize existing information from both past and current projects. Then we need to identify gaps in our knowledge and understanding of the functional role of budworm in the ecosystem. Evaluating traditional management approaches within the context of ecosystem management, will ensure that the plan we develop better relates the long-range management of western defoliators with forest health and ecosystem management.

Please contact Jed Dewey (406-329-3637) if you have further questions.

/s/ Bill Boettcher

WILLIAM W. BOETTCHER
Assistant Director
Timber, Cooperative Forestry
and Pest Management

cc:
N.Campbell
L.Stipe

United States Department of Agriculture | Forest Service | Washington Office | 2121 C Second Street
Davis, CA 95616
PH (916) 551-1715
FAX (916) 757-8383

Reply To: 3400

Date: August 27, 1993

Subject: Western Defoliator
Action Item

To: Director, FPM

This memorandum is in follow-up to the 1993 meeting of the National Steering Committee for Managing Western Defoliators. Within the background discussion of the Strategic Plan for the Management of Western Defoliators the sub-committee identified the need for further committee work to explore approaches to gather, sort, analyze, and apply existing information and data on western defoliatory insect biology, dynamics, impact, management, and data gaps. To initiate action on this need the sub-committee, under the chair of John Wenz, will evaluate this need, identify the lead insect (Douglas-fir tusseck moth or western spruce budworm), and develop a detailed contract scope of work for a contractual effort. The final product of the contract is invisioned to be an expert system database or comparable system which will serve as a resource in pursuing resources management and technology development activities.

The committee believes that this is an appropriate activity for considered sponsorship by the National Center for Forest Health.

/s/John W. Barry
JOHN W. BARRY
Chairperson

cc: Committee Members
Jesus Cota

United States Department of Agriculture | Forest Service | Southwestern Region | 517 Gold Avenue SW. Albuquerque, NM 87102-0084

Reply to: 3400 **Date:** April 15, 1993

Subject: Management of Western Defoliators (Your ltr. 4/6)

To: John Barry, FPM-WO

I commend those members of your Western Defoliators Steering Committee, in particular John Wenz, for having prepared this comprehensive strategic plan. The plan appears to relate very well to forest health and to ecosystem management, and should provide a good basis from which to develop appropriate tactical plans. While implementation of these plans may be time consuming, we believe we should proceed with this plan and we will support the committee members' efforts to do so within our Regional capabilities and workload demands.

/s/ Thomas G. Schmeckpeper

THOMAS G. SCHMECKPEPER
Director of State and Private Forestry
and Forest Pest Management

United States Department of Agriculture | Forest Service | Intermountain Region | 324 25th Street Ogden, UT 84401-2310

Reply to: 3400 Date: August 12, 1993

Subject: Strategic Plan for Management of Western Defoliators

To: John W. Barry,
through Chief

In response to your letter of April 6, I have asked Julie Weatherby to review the draft strategic plan proposed by the National Steering Committee for the Management of Western Defoliators.

This strategic plan reflects the change in national emphasis toward forest health and ecosystem management. This plan expands the charge of the committee beyond pest population management to include a more holistic approach to understanding the role of pests in the forest ecosystem and appropriate management strategies given diverse resource management objectives.

A broad based strategic plan can be very useful in focusing tactical plans and specific projects designed to fulfill identified needs.

In the cover letter, it was proposed that the committee would form subcommittees assigned to specific elements. These subcommittees would compile existing information and research results so that the tactical plans could be developed without duplication. Julie believes this strategic plan will help direct these efforts.

Julie emphasizes that this strategic plan is very broad based, and in order to be of much value tactical plans must be tiered to the strategic plan. The plan is general but very inclusive, and seems to provide a good framework to direct the development of tactical plans.

/s/ Roland M. Stoleson (for)
LAURA B. FERGUSON
Director
State and Private Forestry

cc:
FPM/BFO (J.Weatherby)
S&PF (G.Baxter)

Appendix H

Member Reports

Dayle Bennett R-3

Nancy Campbell R-1

Dayle Grimble PNW

Bruce Hostetler R-6

Ladd Livingston
Idaho Dept. of Lands

Dave Rising MTDC

Lonnie Sower PNW

Julie Weatherby R-4

John Wenz R-5

Dayle Bennett
R-3

R-3 REPORT TO THE WESTERN DEFOLIATOR STEERING COMMITTEE
AUGUST 24-25, 1993
Dayle Bennett

Status of Defoliators--Western spruce budworm (WSB) populations are once again on the increase throughout northern New Mexico. Light defoliation was recorded on the Carson, Cibola, and Santa Fe, National Forests, and on the Navajo Indian Reservation. We expect these populations will continue to increase, causing moderate to heavy defoliation over large portions of our mixed-conifer forests in 1994. This may generate an interest to protect foliage by ground application of Bt in 10-15 campgrounds, and has raised the possiblity of a small-scale (5000-6000 acre) aerial application of Bt to protect visual quality in a corridor of the Carson NF.

Aspen defoliation, caused by western tent caterpillar or large aspen tortix, is occuring at scattered locations throughout the Region. Such defoliation generates little concern and no suppression action is warranted.

Douglas-fir tussock moth (DFTM) populations were at suboutbreak levels on a few hundred acres in the Pinal Mountains near Globe, Arizona, in 1993. However, these populations apprear to have collapsed in 1993.

Status of Projects/Reports--

Nontarget Moth Study (Flammulated Owl Food Base)--We are still sorting, pinning, and counting moths collected in 1991. (See project summary following this report for more details about the project). We are about 70 percent through this baseline information effort and have pinned and counted approximately 3,500 individual moths, representing an estimated 80-100 different species. In July, 1993, we sent representative moths from most of the "morphologically similiar" groups that we have collected to the ARS insect identification lab to be identified to family, genus, and species. Thus far, we have received no determinations from the lab.

There apprears to be a great deal of variability in types and numbers of moths caught between sample sites and between sampling dates per site. We hope to have this information summarized, analyzed, and reported on in 1994, but priority is low as there are no current plans to treat this area with Bt. However, this year's increase in WSB populations in the study area may prompt renewed interest in an aerial application of Bt, thus affording us the opportunity to resume this study and increase the priority of finalizing our 1991 baseline study information.

WSB-Caused Damage Survey(s), Red River, NM--A summary of these surveys, including preliminary results was presented in the 1992 report to this committee. Those results have not changed, and a draft report is nearly out for review. The final report will be issued this coming winter!

WSB Permanent Plots--Over the past 2 summers, we have established a total of 27 permanent plots throughout the Region that will be used to gather longterm information for model validation, evaluation of silvicultural treatment efforts, and refinement of risk/hazard rating systems. We will begin annual monitoring of these plots in 1994.

WSB Pheromone Traps--We are continuing to assist Chris Niwa, PNW, in assessing the effectiveness of WSB pheromone traps. Over the next couple of weeks, defoliation levels will be determined from trees where pheromone traps were located during 1992. Chris will compare these defoliation levels with 1992 moth catches to determine the level of correlation between moth catches and the following year's defoliation.

DFTM Pheromone Traps--We have deployed DFTM traps in three areas of central Arizona again in 1993, and did some lower crown beating. These populations appear to have collapsed.

Gypsy Moth (GM) Pheromone Traps--We deployed 326 GM pheromone traps on federal forested (high-use recreational area) lands in 1993. Traps will soon be retrieved. We have received information from APHIS that one European GM male has been confirmed from a state-deployed trap in San Miguel county, NM. More traps are being deployed in the immediate area of that "catch" to determine if any additional moths are present.

Michelle Frank and Steve Dudley, AZ Zone Office, have assisted APHIS and military personnel in trapping and monitoring the potention introduction of gypsy moths as a large number of military personnel are being moved from a base in Massachusetts where GM populations are high to a base near Sierra Vista, AZ.

WSB Risk/Hazard Rating System--We are currently working with Ann Lynch, RM, to develop a usable risk/hazard rating system for WSB in R-3. Our current system, modified from Carlson and Wolf, is too cumbersome, not being used, and not validated. This year we are sampling from approximately 50 stands on the Santa Fe NF in an effort to develop this system.

Technology Development Needs--

Development, validation, and implementation of a usable and accurate hazard/risk rating system for western spruce budworm.

Studies to determine the effects of defoliators on forest health, forest resiliency, and forest sustainability.

Specific FSM guidelines to fund defoliator prevention projects.

Documentation of procedures for conducting and analyzing projects to determine the effects of Bt on ontarget organisms.

SUMMARY OF A SURVEY TO DETERMINE EFFECTS OF BT ON NONTARGET MOTHS
FY93 STATUS REPORT

In response to concerns raised during a 1991 environmental analysis of a western spruce budworm (WSB) outbreak on the Camino Real Ranger District, Carson National Forest, the New Mexico Zone of Forest Pest Management began a multi-year survey to obtain information concerning the effects of B.t. on nontarget moths within and adjacent to areas of potential treatment. Specefic concerns were that an aerial application of B.t. could potentially cause a significant and possibly adverse impact on the primary food base (moths) of flammulated owls, a state listed sensitive species for New Mexico, during the critical nesting period of mid-May through mid-July.

The objectives of this multi-year survey were to:

A. Determine species diversity and relative abundance of moths within areas of potential aerial applications of B.t. on the Camino Real Ranger District (Rio Pueblo Canyon, La Junta Canyon, and U.S. Hill) and within similar areas where B.t. would not be applied (Rio Pueblo Canyon, La Junta Canyon or possibly Rio Grande del Rancho Canyon), 1991.

B. Monitor the effects of B.t. on nontarget moth populations during the year of proposed B.t. application, 1992.

C. Monitor the longterm effects of B.t. on nontarget moth populations for one to three years following B.t. application or until affected nontarget moth populations returned to pretreatment levels.

The primary purpose of sampling in 1991 was to obtain baseline information on the moth populations and to develop and refine our survey techniques (light trapping). A battery-powered (12-volt) black light insect collector fitted with a photo-sensitive cell was placed at each of eight different sample locations (four within areas proposed for aerial application of B.t. and four within similar areas not proposed for aerial application of B.t.). These traps were simultaneously operated twice weekly (Monday night and Friday night) between sunset and sunrise from June 12 through July 12.

Traps were cleaned each morning following black light operation (Tuesday and Friday mornings). Specimens collected from each trap were boxed, labelled by individual traps, then stored in a freezer. Over the past two winters (1992 and 1993) a New Mexico Zone biological technician has been sorting, relaxing, pinning, labelling, and counting the moths (macrolepidopterans) collected during this survey. Thus far, he has processed about two-thirds of the moths collected, keeping track of the numbers of moths collected by morphological "type" (assumed separate species) for each trap location and trapping date. We have recently shipped several representative specimens to the Systematic Insect Identification Lab on Beltsville, MD, for species determination. All microlepidopterans have been lumped into one category as they are not considered a part of the owls food base.

We expect to finish processing all of the moths that were collected from the 1991 survey within the next six months. At that time statistical tests will be performed on the following hypotheses:

Ho: Moth densities are not statistically different between sample locations (potential treatment and nontreatment areas), 1991.

Ho: Species diversity (representative moth genera) are not statistically different between sample location (potential treatment and nontreatment areas), 1991.

The WSB population within the study area collapsed in the fall of 1991 and remained low in 1992. Therefore, no Bt applications nor additional moth collections have been made. Although WSB populations did increase in 1993, it is uncertain whether or not any future Bt applications will be made in this area.

Western Defoliators Steering Committee Report
Region 1
24-25 August 1993

Western Spruce Budworm

Defoliation

Through 1992, the western spruce budworm caused defoliation increased across many forests in R-1. The increase was probably due in part to an early, warm summer and a late fall. Populations have also been building over the last three years following a major decline in 1989 caused by winter damage.

In 1993, we expect to see a general decline in budworm populations across the region. However, budworm populations will continue to increase in small isolated areas. The general decline is a result of a number of factors including starvation, disease, and an unusually wet, late summer.

Projects

All of the studies we have and will initiate in our region support the proposed national guidelines for managing defoliators in western forests.

The objectives of our regional plan are to: 1) provide long-term direction to our current budworm management programs; 2) outline monitoring strategies that might be incorporated into Forest Health Monitoring both regionaly and nationally; 3) inform others of current projects related to budworm in R-1; and 4) facilitate coordination and cooperations with other regions, stations, etc.

A considerable amount of effort has already been directed toward achieving these objectives. The establishment of permanent plots across forest types and with varying levels of budworm damage will provide a baseline for many ecological studies and other data needs in the future. Currently, we have permanent plots established in 27 stands across seven national forests in R-1. Plots were placed in stands that have been: 1) recently managed (within the last 5 years), 2) not harvested during the last 25 years, and 3) in wilderness areas. Permanent plots, or long-term plots, provide information on budworm population trends and effects on long-term processes such as succession. Certain variable monitored on long-term plots can also be used a indicators of forest health. Long-term plots can also provide us with a foundation for examining relationships between organisms in an ecosystem that short-term studies can not. Information collected from the plots will also be used to validate and calibrate hazard, damage and population dynamics models for budworm, and in the future to develop multi-pest and ecosystem process models.

During 1993, we are continuing to cooperate with Dr. Chris Niwa on the pheromone trapping study. Eight plots, located near long-term plots, were established during 1992. In 1992 and 1993 we collected data on larval density, percent defoliation and moth counts per trap.

We are also continuing to sample natural enemies across our permanent plots. During 1992, predator pitfall traps were placed throughout the permanent plots. The objective of the study is to collect predators as they travel up tree trunks in search of budworm larvae or pupae. We also sampled the parasite complex of the western spruce budworm at several locations. We selected one

area where the budworm population was low and building and two areas where the populations was high.

Douglas-fir Tussock Moth

Our trap counts for 1992 increased a small amount, but still remain well below the 25 moths per trap target level. For the first time in five years, every trap site caught at least one moth. No visible defoliation was reported via aerial survey.

Gypsy Moth

Through several cooperative agreements, land managers in R-1 deployed over 8,000 traps in Montana and Idaho. During 1992 in Region 1, one moth was caught near Pinehurst, Idaho and one moth was caught near Chester, Montana.

Sawflies and Pine Tussock Moth

Populations of Neodiprion autumnali defoliated an estimated 1,989 acres on the Ashland RD on the Custer NF in 1992. A number of pine tussock moth larvae were observed feeding on ponderosa pine on the Ashland and Sioux RDs of the Custer as well. We will continue to monitor these populations during 1993.

Dayle Grimble
PNW

MESSAGE SCAN FOR JACK BARRY

To J.Barry:R05H

From: David G. Grimble:S26L05A
Postmark: Aug 19,93 2:37 PM Delivered: Aug 19,93 2:33 PM
Status: Certified
Subject:

Comments:
Jack-- attached is a DG copy of the Report I intend to bring to your Defoliatormeeting in Sacramento next week. I'll bring 15 hard copies with me, but I thought that if you expect to use this or parts of it in your Committee meeting report, it might help to have it already on DG. So your Asst. can change this, modify it, alter it, or ZAP IT if its of no interest to you. Suit yourself. See you in Sacramento.

-------========X========-------

REPORT TO : NATIONAL STEERING COMMITTEE- WESTERN DEFOLIATORS
West Sacramento, CA 24-25 August 1993

by

David G. Grimble
Pacific Northwest Research Station
Corvallis, OR

A. CURRENT NATIONAL NEEDS AND ISSUES

Priority 1
...studies to address data gaps on impacts of Bacillus thuringiensis insecticides on nontarget organisms ...

1. Evaluation of possible impacts of Bt sprays on nontarget Lepidoptera in mixed coniferous forests of eastern Oregon.

This (1993) is the second year of a planned 3-year effort, funded partly by FPM-NAPIAP Program, to evaluate the unintended impacts of Bt application on nontarget Lepidoptera in eastern Oregon mixed-coniferous forests. Paired plots were established in 1992 on both the Umatilla and the Wallowa-Whitman National Forests. ULV blacklight traps will be operated in these plots three nights per week from the first week of May till October each year. A lepidopterist will identify collected moths to the species level. In addition, numerous shrubs on the plots will be sampled yearly to collect lepidopterous larvae for rearing to the adult stage. One plot of each pair was sprayed on 29 June 1993 with an aqueous formulation of THURICIDE, at the rate of 16 BIU in 96 Oz./A.

Partial results to date: Blacklight trapping (and limited aerial net collecting of diurnal species) in 1992 has identified 438 species, mostly Noctuidae (55%) and Geometridae (24%). Most species were represented by few specimens; for 42% of the species, we caught 5 or less specimens in all eight traps during the entire summer. Eight species caught were previously unknown to Oregon. The weather conditions this year (1993) were drastically different from 1992. The drought in Oregon is apparently broken and spring 1993 was about 2-3 weeks "late", when compared to 1992. So far, most of 1993 summer weather has been relatively cool, with frequent rain showers, all of which seems to have had a depressing effect on lepidopterous populations. We found much reduced larval populations on shrubs and are catching fewer moths in all traps than in 1992. Plans are to continue trapping and branch sampling through 1994.

2. Evaluation of possible unintended impacts of Bt sprays on nontarget lepidoptera on the Warm Springs Indian Reservation.

In 1993, FPM conducted an aerial suppression project to reduce defoliation by western spruce budworms on the Warm Springs Indian Reservation, near Madras, OR. As part of this project, we have been operating four pairs of ULV blacklight traps in an attempt to detect and evaluate any unintended negative impacts on nontarget lepidoptera on spray areas. One trap of each pair is located about 0.5 mi. inside a spray compartment; the other is about 0.5 mi. outside. Trapping period will be from 15 May till October. Trapped moths will be identified to the species level. Along with this effort, and in the same immediate areas, Jeff Miller, OSU Ento. Dept, will be systematically sampling

shrubs for lepidopterous larvae on a weekly basis all summer. Collected larvae will be reared to the adult stage for identification.

3. Survey of resident lepidopterous populations across the central Cascades Mountains as a possible food source for Townsend's big-eared bats.

In 1993, proposed aerial suppression projects to reduce defoliation by western spruce budworms on the Deschutes and the Willamette National forests, primarily along the Santiam River corridor, were cancelled because of undetermined but possible deleterious impacts on the food supply of the "sensitive" (not yet classified as "endangered") Townsend's big-eared bat (Plecotus townsendii townsendii), known to occur in the area. Little information exists about the precise location of bat colonies, or even about some important details of the bat's biology. We also know little about the lepidopterous species complex or quantities of moths which might serve as a food source for bats in this area. Thus, under FPM suppression funds support, we are operating 8 ULV blacklight traps in a transect across the Santiam corridor this summer, to gather background data on nocturnal Lepidoptera populations, with some emphasis on lava fields where some bats occur. As above, the trapping period will be early May till October, collected moths will be identified to species, and Jeff Miller, OSU Ento Dept., will collect larvae from shrubs for rearing to adults.

B. OTHER DEFOLIATOR-RELATED ACTIVITIES AT PNW STATION

1. ALASKA:

__A. From RICHARD WERNER-

In 1992, approximately 160,000 acres of white spruce (Picea glauca) were defoliated by spruce budowrms (Choristoneura orae and C. fumiferana) in interior Alaska and another 5,000 acres of Sitka spruce (P. sitchensis) were defoliated by either C. orae or C. biennis in southeast Alaska. Areas infested with spruce budworm increased from 20,000 acres in 1991.

High population levels of the eastern spruce budworm (C. fumiferana) and the 2-year-cycle budworm (C. orae) were first observed in the Bonanza Creek Experimental Forest near Fairbanks in July 1989. Samples of foliage shot from the tops of white spruce contained large numbers of budworm pupae; however, only light defoliation was observed on this foliage and no defoliation was visible on the lower crowns. Populations increased dramatically from 1990 through 1993 and high numbers of larvae were detected on all sizes of spruce from 2-year seedlings to mature trees.

Budworm population levels have been monitored from 1990 to 1993 using pheromone baited traps and the population is predicted to decline in 1994 as mature spruce trees were entirely covered with silk webbing in June 1993, pupae were found in old-growth needles, and pupal weights were smaller in 1993; all indicators of a collasping population. Impact plots were established in stands of spruce in 1990 and will be remeasured periodically.

Larch Sawfly

Extensive areas of tamarack (Larix laricina) east of Fairbanks in interior Alaska were defoliated by the larch sawfly (Pristiphora erichsonii). The sawfly was also found in Fairbanks feeding on Siberian larch (L. sibirica), an introduced tree used for ornamental plantings. The occurrence of the sawfly was the first since it was first reported in Alaska in 1962. Most trees have sustained 100 percent defoliation.

There were no suppression projects undertaken in Alaska.

2. From CORVALLIS,OR:

A. CHRIS NIWA-

Am continuing to work on SBW monitoring with pheromone traps. I have 3 efforts in this: 1) trapping to predict subsequent defoliation (no trapping this year, will be taking last defoliation counts this season); 2) continued trapping to compare commercial baits and traps with our PVC baits and milk carton traps. Had hoped to trap high populations this year in order to test trap saturation, this probably won't be the case given low densities; 3) trapping in sprayed areas to determine spray efficacy and to measure inflight into treated blocks. Am trapping in Hood River County area sprayed with Sevin and possibly in B.t. sprayed area on the Warm Springs IR this year.

B. From LONNE SOWER-

DFTM Disruption

DFTM disruption tests (Idaho): Incompletely reported to committee last year as still collecting data in July. Full draft of Final FPM TECHNOLOGY DEVELOPMENT PROGRESS REPORT now available.

A pilot project demonstrating the feasibility of using the mating disruption technique in an operational suppression project against Douglas-fir tussock moth was completed. Six, 200-acre plots were established on the Weiser RD, Payette National Forest. On 3 of the blocks No-Mate® DFTM pheromone loaded in center sealed fibers and mixed with a sticker was applied via helicopter. Applications were completed during the 3rd week of August 1991. Coverage was satisfactory and materials performed adequately. Only 16% of emerged females in treated plots mated and produced fertile eggs vs 72% in untreated plots. Larval populations declined from about 45.4 larvae/m sq before treatment to about 8.5 larvae per m sq the season following treatment whereas larval populations remained about the same in untreated plots. Results were statistically significant and consistent with those of previous field tests. Treatment had no measurable effect on capenter ant, western spruce budworm, or spider populations. No impact was expected on these non-target arthropods and none was found. An 81% reduction in larvae the next season after treatment should be considered good efficacy, particularly for a method that has little adverse environmental impact.

RECOMMENDATION: Defoliator steering committee has recommended registration of DFTM pheromone be pursued. This should be mentioned again to FPM.

Changes in DFTM survey trap baits

Users will have noticed that the baits for the DFTM survey traps look different than in previous years. These are a new type bait purchased from Pherotech rather than the old type manufactured at Corvallis by us. Previous lots of Pherotech baits were tested against the old baits and had identical results. The new baits should work the same although the silver color is something new, why they added the color is a mystery to me too as the previous baits provided for testing worked just fine. The new baits, just as sent out, will be tested again this year against the old baits just to be certain we have things callibrated properly. We will also be doing further tests using the new baits in a commercially available trap (USDA gypsy moth trap). This trap has worked OK in the past as long as the ends were left open. The idea here is to get all commercial products available for tussock moth trapping and hopefully let MAG and the Corvalis research lab get out of manufacturing.

Some generalities so far regarding the Pherotech baits etc: Pherotech baits in the past were equal to ours from Klamath Falls north but appeared to catch more males from Klamath Falls south into California. This indicates that Pherotechs pheromone was probably purer, and that purity mattered more to California DFTM.

Other DFTM trapping and related:

Two years ago we placed traps, for other purposes indicated, in an apparently increasing population of DFTM on the Malheur NF. We placed a transect of survey plots down a ridge and more or less across the host type for the population in 1992. Survey methods included traps in standard clusters of 5, lower crown beating, cryptic shelters, and single traps at 1/4 mile intervals completely through the host area. The deployment and methods were instigated by John Wenz who did something similar in CA.

Standard survey traps, cryptic shelters, and single traps all had fairly high numbers of insects, indicating that the population was approaching pre-outbreak. Larvae surveys, and visual searches for cocoons did not agree. We deemed the 1992 larval survey inadequate because it was taken too late in the season. Single traps at 1/4 mile intervals yeilded the same information as 5-trap clusters, with significantly fewer total traps required to get the information. All this tends to confirm my own bias that any of the above survey methods are likely to tell you about the same thing if done consistently and interpreted with reasonable perspective.

The method that "DID NOT WORK" this time was the old reliable larval beating, but that was because we applied it incorrectly, not because of anything inherent in the method.

In 1993 the larval survey was "on-time" and indicated a pre-outbreak population with some areas over 30 1/1000. Trapping and shelter data will be collected later in the year.

C From RICK KELSEY-

<u>Douglas-fir as a host for European gypsy moth populations</u>

Over the past decade localized outbreaks of European gypsy moth have occurred in the forests of Oregon, Washington, and California. At some locations

Douglas-fir has been utilized as a host. Cooperative studies between the Pacific Northwest Research Station and Oregon State University have been conducted to evaluate the suitability of Douglas-fir as a host. The soft and succulent new fir needles in spring are acceptable to first instars, but not suitable for good growth. Mature fir needles are not acceptable to first instars because of toughness, but they are more suitable for growth than new needles. Early instar survival was best when both new and old foliage was available. Switching II, III, or IV instars from white alder, a suitable host, to mature Douglas-fir needles increased instar duration and decreased relative weight gain, but only for the instar switched.

Nitrogen concentrations in Douglas-fir foliage appear to be the most important nutritional component for gypsy moth growth. Terpenes in the fir tissue seems to have little affect on larval fitness and growth. The effects of Douglas-fir phenolics on larval growth have not been clearly demonstrated because the concentrations are inversely correlated with nitrogen concentrations in fir foliage, and incorporation of phenolic rich extracts into artificial diet were toxic, causing unnatural levels of mortality. In the absence of other more preferred hosts, it appears that the foliage from Douglas-fir could maintain gypsy moth populations in western forests.

Joseph, G., R.G. Kelsey, A.F. Moldenke, J.C. Miller, R.E. Berry, and J.G. Wernz. 1993. Effects of nitrogen and Douglas-fir allelochemicals on developemnt of the gypsy moth, Lymantria dispar. J. Chem. Ecol. 19: 1245-1263

Joseph, G., and R.G. Kelsey. Submitted. Acceptability and suitability of Douglas-fir as a secondary host for gypsy moth, Lymantria dispar (Lepidoptera: Lymantriidae). Environ. Entomol.

3. LAGRANDE, OR:

A. From TOROLF R. TORGERSEN-

CURRENT EMPHASIS:

1. Dynamics of selected populations of western forest defoliators.

   Continuing: (a) Abbreviated life-tables for determination of dynamical processes influencing long-term population behavior of western spruce budworm; (b) determining average survivorship for budworm populations in the Blue Mountains; (c) comparing budworm population trends in carbaryl- and Bt-treated and untreated areas (John Day suppression project - 1983, and Meacham Pilot Project - 1988).

2. Predator-prey systems for stabilizing forest insect pests at low densities.

   Objectives: To advance the concept of ecological management by describing features of forest structure, composition, and management practices to conserve and enhance the role of predation processes in stabilizing defoliator systems. In particular, characteristics of standing and down dead wood will be related to the occurrence and composition of predatory ant communities, the pileated woodpecker, and other dead-wood dependent avian species that prey on the budworm. Results will potentially influence

standards and guidelines for conservation and recruitment of dead wood structure in managed stands.

Completed: Field observations on 240 plots in 12 pileated woodpecker home ranges are complete. The study will describe the number, size, volume, and species of down logs in the home ranges. The results show relationships of these paramenters to foraging by woodpecker and occupation of deady woody material by foliage-foraging ants that prey on western budworm. A manuscript titled---Occurrence of log-inhabiting cnats in home ranges of pileated woodpecker in Northeastern Oregon---is in preparation.

New: A study was initiated on the Five-Lock Demonstration Area (North Fork John Day District, UMA) to census dead woody debris and log-inhabiting ants in selected managment situations. Represented are: old-growth, ponderosa pine, riparian areas, clear-cuts, and mixed conifers. One of the objectives is to compare amounts of down woody debris, woodpecker foraging, and ant-occurrence between these selected sites, and also compare with similar information from pileated woodpecker home ranges (see above completed study). Funded in part by Blue Mountains Natural Resources Institute.

New: A study is underway in a old-growth site that is utilized by pileated woodpeckers and Vaux's swifts. The site will be selectively logged to remove some snags and down woody debris to reduce the fire hazard. A portion of the study will examine characteristics of both living trees and standing and down dead wood before and after logging. Additional observations will also document foraging by pileated woodpecker and occurrence and species composition of the ant complex on the site. Study is being done in conjuction with the La Grande Ranger District and E. Bull, Research Wildlife Biologist.

4. Sampling and monitoring technology.

Completed: A study examining larval distribution in crowns as it affects sampling. Sixty-three plots/years of data are used to describe how inter- and intra-tree larval distribution affects sampling of budworm. Results suggest that densities in the middle of the lower crown of tall trees (rather than the traditional midcrown) can be used to characterize populations on whole trees and stands. Data are presented that describes foliated area of 45-cm tips in mixed and pure stands of the hosts. Paper titled---Patterns of occurrence and new sampling implications for instar IV western spruce budworm---in press (Forest Science).

In Progress: Adaptation of Mason's lower crown sampling method to defoliator sampling in Southeastern Alaska. Relationships of densities of blackheaded budworm, hemlock sawfly, and other selected defoliators to whole-tree beating samples are being analized. Work done cooperatively with Region 10 FPM (R.Mask).

In Progress: Development of equations to relate lower crown sampling densities of western spruce budworm to midcrown density after treatment with B.t. Manuscript in preparation. In cooperation with D. Scott, A. Gillespie, and K. Hosman.

Completed: Fred Schmidt has completed a Station Research Note titled---A spruce budworm sampling program for Husky Hunter field data reocrders. The program is designed to expedited data entry in the field, and to calculate sampling precision for determining the need for more sampling.

B. From RICHARD R. MASON-

1. Dynamics of Selected Populations of Western Forest Defoliators. These are continuing long-term studies of the behavior of natural populations of the western spruce budworm, Douglas-fir tussock, and lodgepole needle miner. Populations are monitored annually on series of permanent plots representing parts of national forests or geographical provinces. Some data bases now include 25+ consecutive years of population data for a species and are now being analyzed for diagnostic purposes and final publication. A most significant finding this year is the apparent collapse of a population of the western spruce budworm which has been in outbreak status in the Blue Mountains and much of the Pacific Northwest for the last 12 years. Population densities of nominal 4'th instar budworm on monitoring plots in 1993 declined over 95 percent from the densities of 1992. Populations of the Douglas-fir tussock moth also appear to be in decline after going through a population upswing over the last 3-4 years. We have recorded three such tussock moth cycles since 1971.

2. Predator-Prey Systems for Stabilizing Forest Insect Pests at Low Densities. These studies concentrate on the relative abundance and diversity of arthropod predators in relation to the major defoliators. Recent work has emphasized the arboreal spiders which we believe are highly important predators of tussock moth and budworm larvae. Unfortunately, very little is known about this group of arthropods. Cooperative studies in 1992 with the Department of Forestry, Oregon State University, have shown that important differences may exist in the structure of arboreal spider communities between forests east and west of the Cascade Range.

3. Prevention and Control of Insect Pests by Silvicultural Practices. Current studies emphasize the effect of fertilizer treatments on the impact of tree defoliation and the dynamics of budworm outbreaks. This is a large scale cooperative study involving scientists from several disciplines looking at fertilizer effects on a variety of ecosystem components. Final measurements are being made in 1993 for this 5-year study with analyses and the reporting of results planned thereafter

4. Sampling and Monitoring Technology. A simple method for predicting the density of tussock moth larvae from the density of cocoons in the previous generation was published in 1993. The technique is based on many years of data from a wide range of populations and should be useful for forecasting outbreaks where direct control may be necessary. Another manuscript has been completed this year that summarizes the most efficient procedures for monitoring tussock moth and budworm larvae on permanent plots. The recommendations given are based on many years of studying the abundance and variation of these species in eastern Oregon and Washington.

C. From BOYD E. WICKMAN-

The Cooperative Study with Tom Swetnam, University of Arizona , tree ring lab, on long term out break histories of defoliators in the Blue Mountains is about

half finished. The Northern Blue Mountains portion of the study has been analyzed and is being prepared for publication.

There have been 5 budworm and several tussock moth outbreaks over the past 250 years on most of the 22 old-growth forests sampled. The periodicity and severity of these outbreaks has been surprising and has implications for ecosystem management of old growth, mixed conifer forests in the Northern Blue Mountains. Defoliators are apparently playing an important role as regulators of primary productivity in true fir and mixed conifer stands.

The relationship of climate prior to, during, and at outbreak collapse is also being investigated. This is in cooperation with Dick Mason using his long term population data on fixed plots to determine population dynamic relations to tree growth responses, particularly lag times, on the same plots.

The Southern Blue Mountains portion of the study has been started under a new cooperative agreement with Tom Swetnam - cores were collected in July and August by La Grande Lab personnel and are being prepared for measurements. Results will be reported next year.

-4. ETC.-

Roy Beckwith retired on January 8, 1993.
Boyd Wickman retired on August 3, 1993.

REPORT TO : NATIONAL STEERING COMMITTEE- WESTERN DEFOLIATORS
West Sacramento, CA 24-25 August 1993

by

David G. Grimble
Pacific Northwest Research Station
Corvallis, OR

A. CURRENT NATIONAL NEEDS AND ISSUES

Priority 1
...studies to address data gaps on impacts of Bacillus thuringiensis insecticides on nontarget organisms ...

1. Evaluation of possible impacts of Bt sprays on nontarget Lepidoptera in mixed coniferous forests of eastern Oregon.

This (1993) is the second year of a planned 3-year effort, funded partly by FPM-NAPIAP Program, to evaluate the unintended impacts of Bt application on nontarget Lepidoptera in eastern Oregon mixed-coniferous forests. Paired plots were established in 1992 on both the Umatilla and the Wallowa-Whitman National Forests. ULV blacklight traps will be operated in these plots three nights per week from the first week of May till October each year. A lepidopterist will identify collected moths to the species level. In addition, numerous shrubs on the plots will be sampled yearly to collect lepidopterous larvae for rearing to the adult stage. One plot of each pair was sprayed on 29 June 1993 with an aqueous formulation of THURICIDE, at the rate of 16 BIU in 96 Oz./A.

Partial results to date: Blacklight trapping (and limited aerial net collecting of diurnal species) in 1992 has identified 438 species, mostly Noctuidae (55%) and Geometridae (24%). Most species were represented by few specimens; for 42% of the species, we caught 5 or less specimens in all eight traps during the entire summer. Eight species caught were previously unknown to Oregon. The weather conditions this year (1993) were drastically different from 1992. The drought in Oregon is apparently broken and spring 1993 was about 2-3 weeks "late", when compared to 1992. So far, most of 1993 summer weather has been relatively cool, with frequent rain showers, all of which seems to have had a depressing effect on lepidopterous populations. We found much reduced larval populations on shrubs and are catching fewer moths in all traps than in 1992. Plans are to continue trapping and branch sampling through 1994.

2. Evaluation of possible unintended impacts of Bt sprays on nontarget lepidoptera on the Warm Springs Indian Reservation.

In 1993, FPM conducted an aerial suppression project to reduce defoliation by western spruce budworms on the Warm Springs Indian Reservation, near Madras, OR. As part of this project, we have been operating four pairs of ULV blacklight traps in an attempt to detect and evaluate any unintended negative impacts on nontarget lepidoptera on spray areas. One trap of each pair is located about 0.5 mi. inside a spray compartment; the other is about 0.5 mi. outside. Trapping period will be from 15 May till October. Trapped moths will be identified to the species level. Along with this effort, and in the same immediate areas, Jeff Miller, OSU Ento. Dept, will be systematically sampling

shrubs for lepidopterous larvae on a weekly basis all summer. Collected larvae will be reared to the adult stage for identification.

3. Survey of resident lepidopterous populations across the central Cascades Mountains as a possible food source for Townsend's big-eared bats.

In 1993, proposed aerial suppression projects to reduce defoliation by western spruce budworms on the Deschutes and the Willamette National forests, primarily along the Santiam River corridor, were cancelled because of undetermined but possible deleterious impacts on the food supply of the "sensitive" (not yet classified as "endangered") Townsend's big-eared bat (Plecotus townsendii townsendii), known to occur in the area. Little information exists about the precise location of bat colonies, or even about some important details of the bat's biology. We also know little about the lepidopterous species complex or quantities of moths which might serve as a food source for bats in this area. Thus, under FPM suppression funds support, we are operating 8 ULV blacklight traps in a transect across the Santiam corridor this summer, to gather background data on nocturnal Lepidoptera populations, with some emphasis on lava fields where some bats occur. As above, the trapping period will be early May till October, collected moths will be identified to species, and Jeff Miller, OSU Ento Dept., will collect larvae from shrubs for rearing to adults.

B. OTHER DEFOLIATOR-RELATED ACTIVITIES AT PNW STATION

1. ALASKA:

__A. From RICHARD WERNER-

In 1992, approximately 160,000 acres of white spruce (Picea glauca) were defoliated by spruce budowrms (Choristoneura orae and C. fumiferana) in interior Alaska and another 5,000 acres of Sitka spruce (P. sitchensis) were defoliated by either C. orae or C. biennis in southeast Alaska. Areas infested with spruce budworm increased from 20,000 acres in 1991.

High population levels of the eastern spruce budworm (C. fumiferana) and the 2-year-cycle budworm (C. orae) were first observed in the Bonanza Creek Experimental Forest near Fairbanks in July 1989. Samples of foliage shot from the tops of white spruce contained large numbers of budworm pupae; however, only light defoliation was observed on this foliage and no defoliation was visible on the lower crowns. Populations increased dramatically from 1990 through 1993 and high numbers of larvae were detected on all sizes of spruce from 2-year seedlings to mature trees.

Budworm population levels have been monitored from 1990 to 1993 using pheromone baited traps and the population is predicted to decline in 1994 as mature spruce trees were entirely covered with silk webbing in June 1993, pupae were found in old-growth needles, and pupal weights were smaller in 1993; all indicators of a collasping population. Impact plots were established in stands of spruce in 1990 and will be remeasured periodically.

Larch Sawfly

Extensive areas of tamarack (Larix laricina) east of Fairbanks in interior Alaska were defoliated by the larch sawfly (Pristiphora erichsonii). The sawfly was also found in Fairbanks feeding on Siberian larch (L. sibirica), an introduced tree used for ornamental plantings. The occurrence of the sawfly was the first since it was first reported in Alaska in 1962. Most trees have sustained 100 percent defoliation.

There were no suppression projects undertaken in Alaska.

2. From CORVALLIS,OR:

A. CHRIS NIWA-

Am continuing to work on SBW monitoring with pheromone traps. I have 3 efforts in this: 1) trapping to predict subsequent defoliation (no trapping this year, will be taking last defoliation counts this season); 2) continued trapping to compare commercial baits and traps with our PVC baits and milk carton traps. Had hoped to trap high populations this year in order to test trap saturation, this probably won't be the case given low densities; 3) trapping in sprayed areas to determine spray efficacy and to measure inflight into treated blocks. Am trapping in Hood River County area sprayed with Sevin and possibly in B.t. sprayed area on the Warm Springs IR this year.

B. From LONNE SOWER-

DFTM Disruption

DFTM disruption tests (Idaho): Incompletely reported to committee last year as still collecting data in July. Full draft of Final FPM TECHNOLOGY DEVELOPMENT PROGRESS REPORT now available.

A pilot project demonstrating the feasibility of using the mating disruption technique in an operational suppression project against Douglas-fir tussock moth was completed. Six, 200-acre plots were established on the Weiser RD, Payette National Forest. On 3 of the blocks No-Mate® DFTM pheromone loaded in center sealed fibers and mixed with a sticker was applied via helicopter. Applications were completed during the 3rd week of August 1991. Coverage was satisfactory and materials performed adequately. Only 16% of emerged females in treated plots mated and produced fertile eggs vs 72% in untreated plots. Larval populations declined from about 45.4 larvae/m sq before treatment to about 8.5 larvae per m sq the season following treatment whereas larval populations remained about the same in untreated plots. Results were statistically significant and consistent with those of previous field tests. Treatment had no measurable effect on capenter ant, western spruce budworm, or spider populations. No impact was expected on these non-target arthropods and none was found. An 81% reduction in larvae the next season after treatment should be considered good efficacy, particularly for a method that has little adverse environmental impact.

RECOMMENDATION: Defoliator steering committee has recommended registration of DFTM pheromone be pursued. This should be mentioned again to FPM.

Changes in DFTM survey trap baits

Users will have noticed that the baits for the DFTM survey traps look different than in previous years. These are a new type bait purchased from Pherotech rather than the old type manufactured at Corvallis by us. Previous lots of Pherotech baits were tested against the old baits and had identical results. The new baits should work the same although the silver color is something new, why they added the color is a mystery to me too as the previous baits provided for testing worked just fine. The new baits, just as sent out, will be tested again this year against the old baits just to be certain we have things callibrated properly. We will also be doing further tests using the new baits in a commercially available trap (USDA gypsy moth trap). This trap has worked OK in the past as long as the ends were left open. The idea here is to get all commercial products available for tussock moth trapping and hopefully let MAG and the Corvalis research lab get out of manufacturing.

Some generalities so far regarding the Pherotech baits etc: Pherotech baits in the past were equal to ours from Klamath Falls north but appeared to catch more males from Klamath Falls south into California. This indicates that Pherotechs pheromone was probably purer, and that purity mattered more to California DFTM.

Other DFTM trapping and related:

Two years ago we placed traps, for other purposes indicated, in an apparently increasing population of DFTM on the Malheur NF. We placed a transect of survey plots down a ridge and more or less across the host type for the population in 1992. Survey methods included traps in standard clusters of 5, lower crown beating, cryptic shelters, and single traps at 1/4 mile intervals completely through the host area. The deployment and methods were instigated by John Wenz who did something similar in CA.

Standard survey traps, cryptic shelters, and single traps all had fairly high numbers of insects, indicating that the population was approaching pre-outbreak. Larvae surveys, and visual searches for cocoons did not agree. We deemed the 1992 larval survey inadequate because it was taken too late in the season. Single traps at 1/4 mile intervals yeilded the same information as 5-trap clusters, with significantly fewer total traps required to get the information. All this tends to confirm my own bias that any of the above survey methods are likely to tell you about the same thing if done consistently and interpreted with reasonable perspective.

The method that "DID NOT WORK" this time was the old reliable larval beating, but that was because we applied it incorrectly, not because of anything inherent in the method.

In 1993 the larval survey was "on-time" and indicated a pre-outbreak population with some areas over 30 1/1000. Trapping and shelter data will be collected later in the year.

C From RICK KELSEY-

<u>Douglas-fir as a host for European gypsy moth populations</u>

Over the past decade localized outbreaks of European gypsy moth have occurred in the forests of Oregon, Washington, and California. At some locations

Douglas-fir has been utilized as a host. Cooperative studies between the Pacific Northwest Research Station and Oregon State University have been conducted to evaluate the suitability of Douglas-fir as a host. The soft and succulent new fir needles in spring are acceptable to first instars, but not suitable for good growth. Mature fir needles are not acceptable to first instars because of toughness, but they are more suitable for growth than new needles. Early instar survival was best when both new and old foliage was available. Switching II, III, or IV instars from white alder, a suitable host, to mature Douglas-fir needles increased instar duration and decreased relative weight gain, but only for the instar switched.

Nitrogen concentrations in Douglas-fir foliage appear to be the most important nutritional component for gypsy moth growth. Terpenes in the fir tissue seems to have little affect on larval fitness and growth. The effects of Douglas-fir phenolics on larval growth have not been clearly demonstrated because the concentrations are inversely correlated with nitrogen concentrations in fir foliage, and incorporation of phenolic rich extracts into artificial diet were toxic, causing unnatural levels of mortality. In the absence of other more preferred hosts, it appears that the foliage from Douglas-fir could maintain gypsy moth populations in western forests.

Joseph, G., R.G. Kelsey, A.F. Moldenke, J.C. Miller, R.E. Berry, and J.G. Wernz. 1993. Effects of nitrogen and Douglas-fir allelochemicals on developemnt of the gypsy moth, Lymantria dispar. J. Chem. Ecol. 19: 1245-1263

Joseph, G., and R.G. Kelsey. Submitted. Acceptability and suitability of Douglas-fir as a secondary host for gypsy moth, Lymantria dispar (Lepidoptera: Lymantriidae). Environ. Entomol.

3. LAGRANDE, OR:

A. From TOROLF R. TORGERSEN-

CURRENT EMPHASIS:

1. Dynamics of selected populations of western forest defoliators.

   Continuing: (a) Abbreviated life-tables for determination of dynamical processes influencing long-term population behavior of western spruce budworm; (b) determining average survivorship for budworm populations in the Blue Mountains; (c) comparing budworm population trends in carbaryl- and Bt-treated and untreated areas (John Day suppression project - 1983, and Meacham Pilot Project - 1988).

2. Predator-prey systems for stabilizing forest insect pests at low densities.

   Objectives: To advance the concept of ecological management by describing features of forest structure, composition, and management practices to conserve and enhance the role of predation processes in stabilizing defoliator systems. In particular, characteristics of standing and down dead wood will be related to the occurrence and composition of predatory ant communities, the pileated woodpecker, and other dead-wood dependent avian species that prey on the budworm. Results will potentially influence

standards and guidelines for conservation and recruitment of dead wood structure in managed stands.

Completed: Field observations on 240 plots in 12 pileated woodpecker home ranges are complete. The study will describe the number, size, volume, and species of down logs in the home ranges. The results show relationships of these paramenters to foraging by woodpecker and occupation of deady woody material by foliage-foraging ants that prey on western budworm. A manuscript titled---Occurrence of log-inhabiting cnats in home ranges of pileated woodpecker in Northeastern Oregon---is in preparation.

New: A study was initiated on the Five-Lock Demonstration Area (North Fork John Day District, UMA) to census dead woody debris and log-inhabiting ants in selected managment situations. Represented are: old-growth, ponderosa pine, riparian areas, clear-cuts, and mixed conifers. One of the objectives is to compare amounts of down woody debris, woodpecker foraging, and ant-occurrence between these selected sites, and also compare with similar information from pileated woodpecker home ranges (see above completed study). Funded in part by Blue Mountains Natural Resources Institute.

New: A study is underway in a old-growth site that is utilized by pileated woodpeckers and Vaux's swifts. The site will be selectively logged to remove some snags and down woody debris to reduce the fire hazard. A portion of the study will examine characteristics of both living trees and standing and down dead wood before and after logging. Additional observations will also document foraging by pileated woodpecker and occurrence and species composition of the ant complex on the site. Study is being done in conjuction with the La Grande Ranger District and E. Bull, Research Wildlife Biologist.

4. Sampling and monitoring technology.

Completed: A study examining larval distribution in crowns as it affects sampling. Sixty-three plots/years of data are used to describe how inter- and intra-tree larval distribution affects sampling of budworm. Results suggest that densities in the middle of the lower crown of tall trees (rather than the traditional midcrown) can be used to characterize populations on whole trees and stands. Data are presented that describes foliated area of 45-cm tips in mixed and pure stands of the hosts. Paper titled---Patterns of occurrence and new sampling implications for instar IV western spruce budworm---in press (Forest Science).

In Progress: Adaptation of Mason's lower crown sampling method to defoliator sampling in Southeastern Alaska. Relationships of densities of blackheaded budworm, hemlock sawfly, and other selected defoliators to whole-tree beating samples are being analized. Work done cooperatively with Region 10 FPM (R.Mask).

In Progress: Development of equations to relate lower crown sampling densities of western spruce budworm to midcrown density after treatment with B.t. Manuscript in preparation. In cooperation with D. Scott, A. Gillespie, and K. Hosman.

Completed: Fred Schmidt has completed a Station Research Note titled---A spruce budworm sampling program for Husky Hunter field data reocrders. The program is designed to expedited data entry in the field, and to calculate sampling precision for determining the need for more sampling.

B. From RICHARD R. MASON-

1. Dynamics of Selected Populations of Western Forest Defoliators. These are continuing long-term studies of the behavior of natural populations of the western spruce budworm, Douglas-fir tussock, and lodgepole needle miner. Populations are monitored annually on series of permanent plots representing parts of national forests or geographical provinces. Some data bases now include 25+ consecutive years of population data for a species and are now being analyzed for diagnostic purposes and final publication. A most significant finding this year is the apparent collapse of a population of the western spruce budworm which has been in outbreak status in the Blue Mountains and much of the Pacific Northwest for the last 12 years. Population densities of nominal 4'th instar budworm on monitoring plots in 1993 declined over 95 percent from the densities of 1992. Populations of the Douglas-fir tussock moth also appear to be in decline after going through a population upswing over the last 3-4 years. We have recorded three such tussock moth cycles since 1971.

2. Predator-Prey Systems for Stabilizing Forest Insect Pests at Low Densities. These studies concentrate on the relative abundance and diversity of arthropod predators in relation to the major defoliators. Recent work has emphasized the arboreal spiders which we believe are highly important predators of tussock moth and budworm larvae. Unfortunately, very little is known about this group of arthropods. Cooperative studies in 1992 with the Department of Forestry, Oregon State University, have shown that important differences may exist in the structure of arboreal spider communities between forests east and west of the Cascade Range.

3. Prevention and Control of Insect Pests by Silvicultural Practices. Current studies emphasize the effect of fertilizer treatments on the impact of tree defoliation and the dynamics of budworm outbreaks. This is a large scale cooperative study involving scientists from several disciplines looking at fertilizer effects on a variety of ecosystem components. Final measurements are being made in 1993 for this 5-year study with analyses and the reporting of results planned thereafter

4. Sampling and Monitoring Technology. A simple method for predicting the density of tussock moth larvae from the density of cocoons in the previous generation was published in 1993. The technique is based on many years of data from a wide range of populations and should be useful for forecasting outbreaks where direct control may be necessary. Another manuscript has been completed this year that summarizes the most efficient procedures for monitoring tussock moth and budworm larvae on permanent plots. The recommendations given are based on many years of studying the abundance and variation of these species in eastern Oregon and Washington.

C. From BOYD E. WICKMAN-

The Cooperative Study with Tom Swetnam, University of Arizona , tree ring lab, on long term out break histories of defoliators in the Blue Mountains is about

half finished. The Northern Blue Mountains portion of the study has been analyzed and is being prepared for publication.

There have been 5 budworm and several tussock moth outbreaks over the past 250 years on most of the 22 old-growth forests sampled. The periodicity and severity of these outbreaks has been surprising and has implications for ecosystem management of old growth, mixed conifer forests in the Northern Blue Mountains. Defoliators are apparently playing an important role as regulators of primary productivity in true fir and mixed conifer stands.

The relationship of climate prior to, during, and at outbreak collapse is also being investigated. This is in cooperation with Dick Mason using his long term population data on fixed plots to determine population dynamic relations to tree growth responses, particularly lag times, on the same plots.

The Southern Blue Mountains portion of the study has been started under a new cooperative agreement with Tom Swetnam - cores were collected in July and August by La Grande Lab personnel and are being prepared for measurements. Results will be reported next year.

4. ETC.-

Roy Beckwith retired on January 8, 1993.
Boyd Wickman retired on August 3, 1993.

The Effect of Two Different Dosages of TM Biocontrol-1 on the Douglas-fir Tussock Moth in Central Idaho

by

Roy C. Beckwith and David G. Grimble

Research Entomologists

Forestry Sciences Laboratory
3200 Jefferson Way
Corvallis, Oregon 97331

and

Julie C. Weatherby

Entomologist

Forest Pest Management, Intermountain Region
1750 Front Street
Boise, Idaho 83702

(Final Report)

The Douglas-fir tussock moth, Orgyia pseudotsugata (McDunnough)(DFTM), is a serious pest in mixed coniferous forests throughout the western United States and Canada (Wickman et al. 1981). Periodically, dense populations cause heavy defoliation, reduction in tree growth, top-kill, and tree death. The last major outbreak in the United States occurred in the Blue Mountains of Oregon, Washington, and Idaho during 1972-1974. A small outbreak occurred on the Boise and Sawttoth National Forests in Idaho in 1983 and an intense outbreak over smaller acreage occurred on the Plumas and Lassen National Forests in California in the late 1980's.

A nuclear polyhedrosis virus (NPV) was isolated from and tested against the DFTM (Stelzer et al. 1975, 1977). The NPV was registered in 1976 as TM Biocontrol-1 for use against the DFTM by the Environmental Protection Agency. The NPV has been produced by Forest Pest Management's Virus Production Facility since 1979. In the United States, TM Biocontrol-1 has only been used operationally on about 1400 acres in New Mexico (Hofacker et al. 1980) and on 2000 acres in Idaho in 1986 (Stipe, personal communication). Since NPV was not registered for use in California, Bacillus thuringiensis was used to suppress the outbreak occurring in California during the late 1980's. In the 1980's, the NPV was tested on small research plots by the Canadian Forestry Service (Shepherd et al. 1984; Otvos et al. 1987a, 1987b). The production, processing, freeze-drying, packaging, and storage represents a substantial investment by the U.S. Forest Service; therefore, it should be tested and used operationally whenever DFTM populations require direct control.

The more recent packaged NPV stored at Corvallis is considered more potent than the earlier stored material. Therefore, it is possible that less material can be used per gallon of spray to achieve adequate population reduction in field application. The packaged NPV, however, needs to be field-tested before a reduced dosage can be used operationally. The recent resurgence of the DFTM

in Idaho provided the means to conduct a field test using this packaged material.

OBJECTIVE

The primary objective of the field evaluation was to compare the efficacy of different dosages of the TM Biocontrol-1 at a constant spray volumne. To meet the objective, the variables measured were:

1. Population density changes as a result of aerial treatment.

2. Short-term persistence on coniferous foliage.

3. Long-term persistence of the NPV in soil.

METHODS

The field test was a cooperative effort between Forest Pest Management, Region 4, the Boise National Forest, and the Pacific Northwest Research Station. The Washington Office of Forest Pest Management, Forest Service provided partial funding to conduct the study.

The study was conducted on the Boise Ranger District, northwest of Featherville, Idaho. Fifteen 16-hectare (40 acre) plots were selected within the general study site (Table 1). The study plots were established in five blocks; each block contained three plots. Within each block, the two treatments and an untreated check were randomly assigned to the plots (Fig.1); therefore, five replicates were established for each of the following:

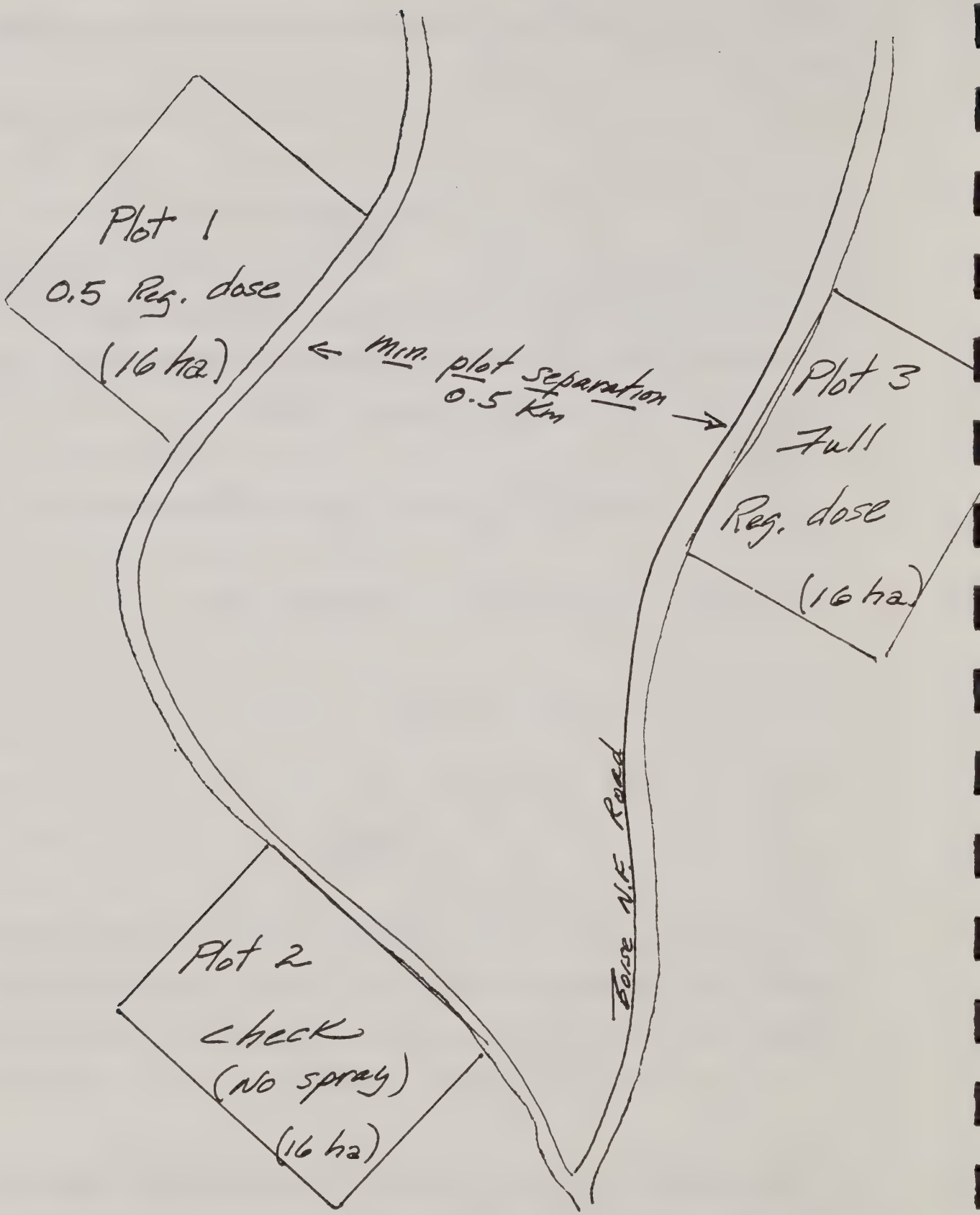


Figure 1. Schematic drawing of one test block showing randomly selected treatment plots, Boise National Forest, Idaho.

Normal dosage in 9.3 liters per hectare.

0.5 normal dosage in 9.3 liters per hectare.

Untreated check

The spray was applied by helicopter that had been calibrated by James Warner, Siuslaw National Forest, at the McMinneville Airport prior to delivery at the spray site. The spray mixture sans the virus was used in the calibration. A Hiller-Soloy helicopter equipped with a standard boom and six 360A Beecomist rotary atomizers was used for spray application. The helicopter applied the microbial insecticide at about 95 mph airspeed at an elevation of 50 feet above the forest canopy.

The first spray application on the lower elevation plots occurred on July 12th; the last spray was applied on July 16. Both treated plots in any one block were sprayed the same day; only one block was completed in a day. Plot corners were marked with blaze-orange panels at each corner; the two corners delineating the first flight line were also marked with balloons above the forest canopy for pilot orientation.

Sampling

Larval samples were taken within 48 hours prior to spray application and again 21 days after spraying to determine population densities on all plots. Density values were obtained from 30 randomly selected trees per plot using the lower crown beating method (Mason 1987). The tree species were sampled according to their proportion in the stand. The lower elevation plots were primarily Douglas-fir, Pseudotsuga menzeisii var. glauca, and the highest

plots were primarily subalpine fir, Abies lasiocarpa. Five DFTM larvae per sample tree were reared individually in Lok-Tight petri dishes to determine natural mortality from the prespray sample. In addition, five DFTM larvae per sample tree were collected from the 21-day postspray sample and reared to determine the natural mortality plus NPV-caused mortality rate.

Foliage bioassay samples were taken at periodic intervals from 15 trees per plot to determine residual activity of the NPV. The samples were collected from mid-crown using a pole pruner immediately after the spray application and at 1-, 5-, and 10-days postspray. Current shoots from each tree were excised into a 200 ml plastic cup and stocked with ten 2nd-3rd instars obtained from a disease-free laboratory colony. The cups were examined after 14 days to record mortality; all dead larvae were examined under a compound microscope to verify death by NPV.

Defoliation

Estimates for each plot were obtained during the postspray sampling by estimating the defoliation on 25 shoots (new foliage) for each of two branches per tree. Defoliation classes for estimating each shoot were: (1 = 0 - 25%; 2 = 26 - 50%; 3 = 51 - 75%; 4 = 76 - 100%). The data were used to compute the average defoliation for each plot.

Persistence In Soil

The persistence of NPV in the soil was determined by using the established method of Thompson and Scott (1979). NPV extracted from the soil samples would include the NPV sprayed on the stand as well as virus added by dying larvae after spray application. Soil samples were collected prespray, postspray during the postspray larval sampling and in 1992. Fifteen soil samples per plot were taken beneath the drip-line of every other sample tree. The soil was

processed at the Forestry Sciences Laboratory, Corvallis, OR. A standard bioassay using disease-free DFTM larvae reared in the laboratory was conducted to determine the presence of the NPV. All dead larvae were examined under a compound microscope to verify death by NPV.

Results and Discussion

The spring and early summer of 1991 was unseasonably cold resulting in a delay in hatching of the DFTM. General eclosion did not occur until late in June or early in July depending upon the elevation. Spraying started on July 12 and was completed by July 16. The population was primarily composed of 2nd instars with a few 1st and 3rd instars. Only one block of two treatments was completed in any one day.

Population density

Mean prespray larval density per 45-cm branch based on lower crown beating ranged from 23.1 to 39.3 for the half-dose treatment to the untreated checks,respectively. Because of the variation (Table 2) the treatment means were not significantly different. Population densities taken 21 days after spray application were lower than prespray densities but still higher than expected. The percentage of NPV infected larvae in our postspray rearings (Table 3) was fairly high for all treatments indicating that control was probably better than shown by the postspray sampling. The percentage of NPV-infected larvae collected per plot averaged 31.9, with a range of 10.7 to 66.2 %. The control plots also contained a relatively high level of virus (4.9%) in the postspray rearings. Obviously this resulted from an increase of naturally occurring virus.

Defoliation

Defoliation of the current growth in 1991 ranged from 28.6 to 100 percent. Treatment means ranged from 49.5 to 67.8 percent for the normal dose and untreated checks respectively (Table 4). The treatment means were not significantly different because of the variance within treatment.

Virus in soil

The laboratory bioassay of soil collected before spraying showed that slightly over half the study plots contained a low percentage of naturally occurring virus (Table 5). As expected, a general increase occurred in the 1991 postspray soil samples as a result of the application, the natural virus, and the addition of the virus from dead larvae. Samples obtained the year after spraying indicated a high incidence of the virus in the bioassay. This high percentage is indicative of a general collapse of the DFTM population in the study site. It also makes it difficult to interpret the spray test because of the buildup of virus in our untreated check plots.

Bioassay

Because of the apparent poor control by the NPV in 1991, a bioassay was conducted to determine the LD_{50} required for two "wild strains" versus the standard Goose Lake strain maintained at the Corvallis Laboratory. Egg masses were collected from two different locations in Idaho in the fall of 1991 and kept under cold temperatures until diapause requirements were completed. One area was adjacent to the general area of the 1991 field test; the other was near Ketchum, Idaho where the infestation probably developed one year after the area around Featherville, Idaho. We only had enough insects to conduct one

bioassay using two replicates of 30 insects for each dilution per population. The bioassay consisted of six dilutions from 44 to 1.37 ng/cup plus an untreated control. The data were subjected to probit analyses using the POLO program for a PC. The results indicated that the slopes were parallel for each population but the LD_{50}s were different. It required 1.82, 3.26 and 8.84 ng/cup for the Goose Lake, Featherville, and Ketchum populations respectively to kill 50% of the test animals. This indicates a large difference in the amount of NPV required to kill the different populations.

Appendix

Table 1. Plot location, elevation, and spray date for the TM Biocontrol-1 test against the Douglas-fir tussock moth in Idaho.

Plot Number	Location T (N)	Location R (E)	Location S	Elevation (Meters)	Treatment	Spray Date
1	4	10	30	1829	Normal	7/12/91
2	4	10	32	1890	None	-------
3	3	10	4	1725	Half	7/12/91
4	4	9	14	1829	None	-------
5	4	9	1	1829	Normal	7/15/91
6	4	9	14	1982	Half	7/15/91
7	3	9	3	1951	Half	7/16/91
8	3/4	9	4/3/34	2012	None	-------
9	4	9	33	2073	Normal	7/16/91
10	5	9	31	1829	Half	7/14/91
11	5	8	36	1829	Normal	7/14/91
12	4	9	7	2195	None	-------
13	4	10	18	1890	None	-------
14	4	10	6	1829	Normal	7/13/91
15	4	10	5	1829	Half	7/13/91

Table 2. Mean number of Douglas-fir tussock moth larvae per 45-cm branch collected by lower crown beating during a NPV-rate study on the Boise National Forest, Idaho.[1]

Treatment	Plot Number	1991 Prespray	1991 Postspray	1992 Postspray
Normal	3	4.3	5.1	6.6
	5	18.8	19.3	13.2
	9	54.7	31.2	11.1
	11	8.6	4.3	4.5
	14	34.7	12.1	23.1
	Treatment Mean	24.24	14.40	11.70
Half	1	13.1	4.9	12.7
	6	22.8	9.8	24.6
	7	44.1	28.5	24.3
	10	24.7	6.8	20.1
	15	10.9	14.0	25.9
	Treatment Mean	23.12	12.80	21.52
Check	2	33.2	20.0	31.6
	4	16.5	8.1	31.0
	8	79.4	50.1	8.5
	12	23.2	33.1	15.3
	13	44.0	21.0	18.7
	Treatment Mean	39.26	26.46	21.02

[1] Based on 3, 45-cm branches per tree; 30 trees per plot.

Table 3. Percentage of larvae[1] containg the nuclear polyhedrosis virus in rearings collected before and after spray application, Boise National Forest, 1991.

Treatment	Plot Number	Prespray	Postspray
Normal	3	0.0	25.2
	5	8.7	51.0
	9	2.7	56.7
	11	4.0	54.2
	14	0.0	35.2
Treatment Mean		3.08	44.46
Half	1	2.7	27.9
	6	1.3	29.3
	7	1.4	59.0
	10	0.0	38.5
	15	0.7	23.0
Treatment Mean		1.22	35.54
Check	2	0.0	10.7
	4	6.7	33.6
	8	12.0	66.2
	12	1.3	30.0
	13	4.7	19.2
Treatment Mean		4.94	31.94

[1] Prespray based on 150 larvae per plot; postspray sample ranged from 96 to 150 larvae per plot.

Table 4. Mean percent defoliation of new growth by the Douglas-fir tussock moth taken twenty one days after spray application, Boise National Forest, Idaho.

Treatment	Plot Number	Percent Defoliation
Normal	3	34.8
	5	41.6
	9	89.6
	11	28.6
	14	52.8
Treatment Mean		49.48
Half	1	35.7
	6	47.5
	7	97.0
	10	52.8
	15	39.0
Treatment Mean		54.40
Check	2	48.3
	4	33.7
	8	92.2
	12	100.0
	13	64.9
Treatment Mean		67.82

[1]Based on 25 shoots per branch; two branches per tree; 30 trees per plot.

Table 5. Percentage[1] of NPV in laboratory bioassays of soil collected from the test plots during the TM Biocontrol-1 test in Idaho.

Treatment	Plot Number	1991 Prespray	1991 Postspray	1992 Postspray
Normal	3	0.0	13.6	61.5
	5	0.9	24.8	97.3
	9	4.2	72.7	87.5
	11	0.0	20.7	52.1
	14	0.0	11.0	93.6
		1.02	28.56	78.40
Half	1	0.2	13.6	54.3
	6	0.0	9.1	78.7
	7	6.0	42.2	86.9
	10	0.0	48.5	57.3
	15	1.1	9.9	75.6
		1.46	24.66	70.56
None	2	0.0	10.2	86.7
	4	0.0	11.8	84.7
	8	0.6	32.9	89.3
	12	0.0	5.6	89.1
	13	3.4	21.2	37.3
		0.80	16.34	77.42

[1] Based on 15 soil samples per plot; 30 test larvae per sample.

Region 6 Report to National Steering Committee for
Management of Western Defoliators

September 30, 1993

Western Spruce Budworm

Budworm defoliation was detecton on approximately 3.3 million acres in Oregon and Washington during the 1992 aerial detection survey. Preliminary estimates are that only 0.5 to 0.7 million acres were detected in Region 6 in 1993, with only about 60,000 of that occurring in Oregon along the eastern slope of the Cascade Mountains. No defoliation was detected in the Blue Mountains of northeastern Oregon.

One suppression project covering 64,000 acres was conducted in 1993 on the Warm Spring Indian Reservation. Insecticide application began on June 19 and was completed on July 19. Budworm development was slower than normal due to a cool, wet spring and early summer.

Pre-treatment budworm poplations for the three analysis untes ranged from 3.3 to 7.1 larvae per 45-cm branch midcrown branch tip, and post-treatment populaitons ranged from 0.5 to 0.8 larvae per branch. Population reductions, as determined by pre- and post-treatment larval sampling, were 86, 93, and 94 percent (uncorrected for natural mortality) for the three analysis units. The project objective was to reduce the budworm populations by at least 90 percent.

Budworm larval population levels were estimated for several potential analysis units on the Mt. Hood, Willamette, Colville and Wenatchee National Forests. Only two areas had high enough populations to warrant sampling of adult males using pheromone traps. Determination of whether to continue with the analysis process will be made after all data have been collected and analyzed.

Measuring of defoliation, topkill, and mortality of trees in the 33 stands with permanent plots is being done for the eighth consecutive year. These stands are located on the Malheur and Wallowa-Whitman National Forests in northeastern Oregon. We plan to format the data to be compatible with the new PTIPS software being developed by MAG. We hope that some preliminary analysis of these data can be accomplished this winter. We plan to collect tree growth data from these plots in 1995 or 1996, three or four years after the budworm populations have decreased to low levels.

Ecologists from the Mt. Hood and Willamette National Forests are collecting increment cores from old trees in several stands along the Cascade Crest. These cores will be examined using established dendrochronology techniques to try and determine the patterns of previous budworm outbreaks. If this preliminary data shows promise, more stands may be sampled in the future.

All budworm defoliation data for Region 6 since the start of the current outbreak (1980) are being entered into our geographic information system. We hope to do some spatial analyses of these data in the future.

Douglas-fir Tussock Moth

Defoliation was detected during on 7,500 acres on the Malheur National Forest in 1992, and on approximately 46,000 acres in 1993. Predictions are that this population will collapse in 1994 due to natural mortality factors.

Modoc Budworm

Defoliation was detected on 30,000 acres in southern Oregon in 1992. No defoliation was detected in 1993.

Western Hemlock Looper

Western hemlock looper was detected on a little over 2,000 acres on the Mt. Baker-Snoqualmie National Forest in 1992. In 1993 it was detected on approximately 35,000 acres scattered across the Mt. Baker and Darrington Ranger Districts. Some understory hemlocks have been killed, and a few larger hemlocks appear to be dead in some of the more severely defoliated pockets. Much of the defoliation is located within northern spotted owl Habitat Conservation Areas.

Ladd Livingston
Idaho Dept. of Lands

IDAHO DEPARTMENT OF LANDS
P.O. BOX 670, COEUR D'ALENE, IDAHO 83816-0670

STANLEY F. HAMILTON
DIRECTOR

Jack Barry, Program Manager
USDA Forest Service
2121C, SECOND St.,Ste. 102
Davis, CA 95616

2 September 1993

Dear Jack,

Enclosed are my listing of needs and interests for defoliators. I forgot to give you a copy at the meeting. I have also included a report which I prepared outlining the incidence of defoliating, or foliage feeding insects in Idaho. I appreciate participating in the Western Defoliator Steering Committee and being able to attend the meeting.

Sincerely,

R. Ladd Livingston, Supervisor
Insect and Disease Section

WESTERN DEFOLIATOR STEERING COMMITTEE MEETING
24 - 25 August, 1993 Sacramento, CA

Technology development needs/interests
R. Ladd Livingston, Idaho Department of Lands

1. REEVALUATE THE EFFICACY OF TM BIOCONTROL - 1 FOR THE DOUGLAS-FIR TUSSOCK MOTH. TEST IT AGAINST WILD POPULATIONS

2. DEVELOP A STANDARDIZED PROCEDURE FOR CONDUCTING A COST BENEFIT ANALYSIS FOR A TREATMENT PROJECT

3. DEVELOP A STANDARDIZED PROCEDURE FOR PLANNING AND CONDUCTING A TREATMENT PROJECT

4. PROMOTE USE OF THE TI-59 CALIBRATION PROGRAM DEVELOPED BY DAN TWARDUS AND STEPHEN SMITH

5. DEVELOP AND TEST SCHEMES TO DETERMINE THE MOST EFFECTIVE USE OF THE PHEROMONE CONFUSANT TECHNIQUES FOR DFTM, ie. SHOULD THEY BE USED EARLY IN THE OUTBREAK CYCLE, OR CAN THEY BE USED AT ANYTIME

6. DEVELOP SILVICULTURAL MANAGEMENT TECHNIQUES FOR DFTM AND WSBW

7. PROMOTE FURTHER WORK TO TEST THE SUITABILITY OF NATIVE WESTERN PLANTS, ESPECIALLY CONIFERS AND RIPARIAN AREA HARDWOODS, TO BOTH EUROPEAN AND ASIAN STRAINS OF THE GYPSY MOTH.

STATE OF IDAHO REPORT
TO THE WESTERN DEFOLIATOR STEERING COMMITTEE
AUGUST 24-25, 1993
R. Ladd Livingston

Status of defoliators

Gypsy moth

In 1992 a total of 4953 gypsy moth survey traps were placed in Idaho by all cooperators. There were three confirmed gypsy moth catches at widely separated sites; one each at Filer in south-central Idaho, and Shelly in south eastern Idaho, and one in northern Idaho at Pinehurst. For 1993, approximately the same number of traps have been placed, but checks of the traps will not be finished until mid to late September.

Douglas-fir tussock moth

There has been no visible defoliation by Douglas-fir tussock moth in northern Idaho for several years. We are continuing to monitor populations using the early-warning pheromone baited survey traps, lower crown beating plots and in some areas, counts of pupae. Pheromone trap counts in 1992 indicated a slight population increase in a few localized areas in northern Idaho, but only two larvae were found in a spring 1993 lower crown beating survey of these sites.

Black pineleaf scale

We have a continuing population of the black pineleaf scale in the Clearwater Valley of northern Idaho, upstream from Lewiston. This insect has caused the decline of thousands of trees, and in certain sites there has been substantial tree mortality, most of which has been removed in salvage efforts.

Pine needle sheath miner

In 1992, there was an extensive outbreak of the pine needle sheath miner infesting both ponderosa and lodgepole pine, from the Canadian border south to the Salmon River. In 1993 there has not been any damage show up.

Western tussock moth

In 1992, there was extensive defoliation of brush species by the western tussock moth from the Canadian border south into the St. Joe River drainage. Huckleberry was a

preferred host, and even the berries themselves were consumed, much to the disgust of the local berry pickers. In areas where the foliage of the brush was completely consumed, the caterpillars moved onto adjacent conifers and caused light defoliation in the lower crown. Western white pine, lodgepole pine, western larch, and grand fir were the conifers most readily feed on. In 1993, the populations seem to have collapsed.

Willow leaf beetle

High populations of an unidentified leaf beetle were found skeletonizing willow and cottonwood near Priest Lake in northern Idaho in 1992.

Elm leaf beetle

This insect continues to cause extensive damage to the elms in Boise. Occasionally it is found in other cities throughout Idaho.

Dave Rising
MTDC

MTDC PROGRAM BRIEFING

Forest Pest Management

Technical Services (FPM) - TE02P18

Aircraft Guidance - 3E12P73

Block Marking Methods Guide - 3E12P92

Characterizing Spray From Ground Sprayers - 3E22P80

Ground & Aerial Pheromone Applicator Evaluation - 3E22P82

Thermal Insect Control - 3E32P11

Technology Transfer of Computer Models - 5E52P29

Program Leader: David W. Rising
Mechanical Engineer

Lonnie Sower
PNW

MESSAGE SCAN FOR BARRY, JACK

To Barry, Jack:R05H

From: Lonne L. Sower:S26L05A
Postmark: Jun 04,93 1:44 PM Delivered: Jun 04,93 1:42 PM
Status: Certified Previously read
Subject: DFTM disruption

Comments:
Attached is a final report for a pilot test of tussock moth disruption done in Idaho and completed last year. Results were pretty good and consistent with previous tests.

-------========X========-------

FPM TECHNOLOGY DEVELOPMENT PROGRESS REPORT

PROJECT NUMBER: R4-91-100

PROJECT TITLE: Cooperative Pilot Test Using Synthetic Pheromone to Disrupt Mating of Douglas-fir Tussock Moth, Orgyia pseudotsugata.

PROJECT STATUS: Planned work was completed on schedule. Some discretionary follow up, further consideration of data, and publication of results will finish the project. No additional funds are requested.

SUBJECT: Douglas-fir tussock moth

RESPONSIBLE REGION: R-4

FPM PERSON LEADING THE PROJECT: Julie Weatherby, State and Private Forestry USDA-FS, Boise Field Office, 1750 Front st., Boise, ID 83702.

DATE OF THIS REPORT: Aug., 1992.

PROJECT OBJECTIVES: To demonstrate the feasibility of using the mating disruption technique to control Douglas-fir tussock moth. Also, to determine the effect, if any, on selected non-target arthropods.

RESPONSIBLE PARTIES: Overall coordinator- Julie Weatherby. Planning and data management- Lonne Sower, PNW Station USDA-FS, 3200 Jefferson Way, Corvallis OR, 97331. Materials and application equipment- Iain Weatherston, Scentry Inc., Billings MT and Charles Doan, Scentry, Inc., Buckeye, AZ. Land managers- Michael Stayton and Sue Stafford. Weiser Ranger District, Payette National Forest, Weiser ID.

FIRST YEAR FUNDED: FY91
YEAR SCHEDULED TO END: FY93
ACTUAL YEAR TO END: FY93

FUNDS OBLIGATED: Funds obligated from beginning of project through end of FY92: Approximate $44,000 was spent during FY91. Approximately $6,000 was spent during FY92.

PRODUCTS AND DUE DATES IDENTIFIED IN THE ORIGINAL PROPOSAL: Final report, due December 20, 1992.

STATUS OF PRODUCTS: On schedule

BRIEF DESCRIPTION OF PROJECT: Six, 200-acre plots were established in the Hitt mountains, Weiser RD, Payette National Forest. No-Mate® DFTM pheromone loaded in center sealed fibers and mixed with a sticker was applied via helicopter to 3 plots in August, 1991. Dose was 10g/acre of Z-6-heneicosen-11-one, the synthetic DFTM pheromone, with 90g/acre of inert material. Pre-treatment larval populations were sampled in July, 1991 by lower crown beating of 40 trees per plot. A post-treatment sample was taken in June 1992. Counts of selected non-target arthropods were taken with the larval samples. Cocoons and egg masses were collected from branches in October 1991 to determine oviposition rates of females.

The treated population had the following known characteristics: Host trees were true firs, douglas firs, and occasional Engleman spruce. Before the start of tests the tussock moth larval population averaged 35 larvae/m sq of foliage. These larvae were mostly 2nd or 3rd instar at the time of sampling. Samples of cocoons from the treated generation indicated 19% of females emerged as adults, 48% were killed by parasitic insects, and 33% died of indeterminate causes. Wild tussock moth virus was present in the population and 13% of larvae emerging from the eggs collected in fall 1991 were infected.

BRIEF DESCRIPTION OF ACCOMPLISHMENTS AND RESULTS: Applications were completed in mid Aug. 1991. Coverage appeared good and timely (Table 1). Materials performed adequately with considerable pheromone material remaining in releasors at the end of the season. This was expected, but indicates that the formulation has potential for improved efficiency. Application equipment is non-standard and applicators will require technical assistance to install and use it the first time.

Treatment reduced the next years larvae population by about 81% in treated vs check plots (Table 2) and in treated plots only 16% of emerged females produced fertile eggs vs 72% in untreated plots (Table 3). Results are statistically significant and consistent with those of previous tests.

Treatment had no measurable effect on carpenter ants (Camponotus spp.), western spruce budworms (Choristoneura occidentalis), or spiders (Table 2). DFTM eggs collected from some locations in both treated and check plots harbored significant numbers of a beneficial parasite, Trichogramma sp. probably minutum. Interestingly, sterile egg masses produced about as many Trichogramma as fertile masses. Previous tests showed no adverse impact on populations of another DFTM egg parasite, Telenomus californicus.

In sum, mating disruption treatment has substantial impact on Douglas-fir tussock moth populations and is unlikely to effect non-traget arthropods. Preservation of beneficial insects should result in further pressure on the tussock moth population in the next year. Efficacy is arguably as good, or better, than for most of the alternatives such as B.t., or conventional pesticides, but probably lower than that of the DFTM virus at high population densities where virus is likely most effective.

VARIANCES FROM ORIGINAL PROTOCOLS: Work was completed on time and as planned with these exceptions. Plots were 200 acres not 330 acres. Cocoon samples were taken from 15 rather than 20 trees in each plot. 6 marked larvae sampling trees (of 40) in treated plot 1 were lost to logging.

ATTACHMENTS: Three data tables and a copy of those portions of the original work plan dealing with protocols are attached.

Table 1: Distribution of male flight and residual pheromone in fibers through 1991 season. 5 sets of 5 traps with 0.1% baits were placed in the general study area, but away from treated plots, and tended weekly beginning 8/14/91. 9,264 moths were caught total. Traps were replaced if several moths were present. Releasors were located in treated plot 1, they were found on fir foliage following treatment and marked with flagging. Each week, 4 releasors were gathered and sent to the lab for residue analysis.

Week	0	1	2	3	4	5	6	7	8	9	10
% Catch	0	1.8	9.5	14	29	26	13	3,8	2,3	0.3	0.3
% Residual pheromone*	100	59	67	99	59	42	42	37	56		

*Average from 4 fibers each date, 293 microgram/fiber=100%.

Table 2. Efficacy of Douglas-fir tussock moth disruption as indicated by lower crown beating samples: Beating counts for DFTM larvae and other insects as obtained from Hitt mtn. plots before treatment in July, 1991 and after treatment in June 1992. Samples were taken from 3 branches from each of 40 trees per plot and the same trees were sampled both years. Each branch sampled had about 1/3 m sq of foliage.

		Items per meter square of foliage			
Plot		DFTM larvae	Carpenter ants	Spiders (any)	Budworm larvae
Check 2	1991	13.7	0.09	4.41	36.4
	1992	13.4	0.63	1.65	48.9
Check 5	1991	45.3	3.00	2.19	8.5
	1992	44.4	3.24	4.35	29.2
Check 6	1991	16.4	0.99	2.49	16.8
	1992	14.5	2.55	2.94	40.2
Mean	1991	25.1	1.36	3.03	20.6
	1992	24.1	2.14	2.98	39.4
Treat 1	1991	45.3	0.36	4.77	69.0
	1992	2.1	1.86	2.73	31.2
Treat 4	1991	44.1	0.30	2.10	24.6
	1992	4.6	2.19	2.73	34.7
Treat 8	1991	46.9	0.60	1.14	18.9
	1992	18.8	2.10	2.94	79.4
Mean	1991	45.4	0.42	2.67	37.5
	1992	8.5	2.05	2.80	48.4

Efficacy = [1 - (8.5/45.4)/(24.1/25.1)]100= 81%.

As determined by analysis of covariance (1991 items vs 1992 items in checks vs treated plots) the effect of treatment on DFTM larvae was significant with F = 24 at 1/3 df and P = 0.02. Treatment had no statistically significant effect on budworms, carpenter ants, or spiders. Eight sampled trees from plot 8 may have been just outside of the treated area but were included. Deletion of those trees would increase the efficacy estimate slightly.

Table 3: Efficacy of Douglas-fir tussock moth disruption as indicated by egg Mass survey: Collected November 1991. Corrected for sterile egg masses (= no emergence after diapause). Six branches (1.5-2 m long) per tree and 15 trees per plot were sampled for cocoons. Total Cocoons are what we found from all branches in each plot, these include male cocoons and dead cocoons. Emerged Females = those cocoons from which a female emerged based on presence of eggs, or on dissection of the cocoon and examination of pupal exuva to determine sex and successful emergence. sterile Eggs = number of egg masses, including "spews" of just a few eggs, producing no larvae after holding through a diapause period (5 months at 0 deg C). Fertile Eggs = egg masses producing larvae after holding through diapause. % females reproducing = no of fertile egg masses divided by number of emerged females times 100.

Plot	Total Cocoons	Emerged Females	sterile Eggs	Fertile Eggs	% females reproducing
Check 2	15	8	1	5	63%
Check 5	205	26	3	19	73%
Check 6	83	16	1	13	81%
				Mean =	72.3%
Treat 1	52	8	4	0	0%
Treat 4	105	23	13	6	26%
Treat 8	180	62	31	15	23%
				Mean =	16.3%

Efficacy = [1- (16.3/72.3)]100 = 77%.

Females in check vs treated plots produced significantly different percentages of fertile eggs (F = 33.2, P = <0.01, DF = 1/4. For 72.3% in check SD = 9.0%. For 16.3% in treated SD = 14.2%).

Note: sterile egg masses are characteristic of pheromone treated plots. Some of these sterile egg masses can be identified by small size and rough appearance, particularly those very small masses we call "spews" which are found almost exclusively in pheromone treated areas. Identification of sterile masses by appearance alone however is not completely reliable. The best check for fertility is to hold all egg masses through diapause and then see whether larvae emerge.

-Work Plan-

Cooperative Pilot Test Using Synthetic Pheromone to Disrupt Mating of Douglas-fir Tussock Moth

Cooperators: Deleted, listed on report, LS.

Approved:

_____	_____
Forest Supervisor Payette National Forest	Project Leader PNW
_____	
Boise Field Office Rep. FPM	

-WORK PLAN-

Cooperative Pilot Test Using Synthetic Pheromone to Disrupt Mating of Douglas-fir Tussock Moth

INTRODUCTION

The Douglas-fir tussock moth is a potentially serious defoliator of Douglas-fir and true fir in western North America. Several Outbreaks have been documented in southern Idaho since 1927 (Tunnock et al. 1985).

In 1990 approximately 50,000 acres of defoliation was detected during aerial detection surveys (Knapp et al. 1991). Most of the defoliation was located within a 15 mile radius of Featherville, Idaho in Elmore County. Additional defoliation was detected in the Manns Creek drainages in Washington County.

Tussock moths overwinter in the egg stage. Larvae hatch and begin feeding in June. Defoliation is not noticeable until mid-July when the larvae reach the later instars and consume considerable foliage. Pupation occurs in late July or early August. Pupal cocoons are usually found on the underside of branches but under extremely heavy populations pupal cocoons can be found in bark crevices on the boles of trees, on rocks or just about anywhere. Adults emerge in August. Male tussock moths have well developed wings and are relatively good fliers. Female moths have vestigal wing pads and are unable to fly. Females emerge from their cocoons, crawl to the outer surfaces, and begin producing a pheromone which attracts males for the purpose of mating. Eggs are laid on the outer surfaces of the pupal cocoon where they can be found during the winter.

Research efforts to disrupt tussock moth mating by inundating the treatment area with synthetically produced pheromone sources have shown promise as a suppression alternative. Field trials reported by Sower and Daterman (1977), Sower, et al. (1983) and Sower et al. (1990) established that a 70 percent reduction of reproduction in high density populations occurs when pheromone is released at 10 grams per acre. Lower rates (0.81 - 3.64 g/ac) produce lower effects. Limited tests also suggested that at much lower insect population densities, higher efficacy might be obtained (Sower and Daterman 1977).

Here we describe a work plan for a cooperative pilot test using synthetic pheromone to disrupt mating of Douglas-fir tussock moth.

MATERIALS AND METHODS

Project Area: This pilot project is planned for areas within and adjacent to the Manns Creek drainages on the Weiser Ranger District, Payette National Forest. Implementation of the project is contingent on DFTM populations continuing to increase toward outbreak levels. Desirable population levels for treatment are 20 to 130 larvae per 1,000 square inches of foliage as detected by larval sampling in early summer.

Treatment Design: The intent is to treat at least 3 plots of approximately 330 acres each with a single dosage of pheromone. If treatment plots are less than 330 acres additional replications will be identified. Total treated acreage will not exceed 1,000 acres. An equal number of comparable untreated plots will be designated. Individual plot size and shape will be determined by local geography and pest distribution. All treatments will be assigned at random.

The formulated pheromone and specialized aerial application equipment will be obtained from Scentry, Inc. per a Technology Transfer Agreement between the Forest Service and Scentry, Inc. The proposed dosage is 10 grams of pheromone per acre in 50 to 100 grams of hollow celcon fibers coated with 0.33 pints of polybutene sticker per acre. The pheromone is loaded into fibers and packaged into sealed ___ lb containers for shipping. The product will be shipped to the Weiser Ranger District approximately __ weeks before the application for temporary storage. The polybutene sticker will also be shipped to the Weiser Ranger District in __ gallon containers. The polybutene sticker is mixed with the fibers in the field using a hand mixer.

Plot Designation: All plots will be designated on aerial resource photography. Boundaries will be marked on the ground with ground panels and, where necessary, boundaries will be designated with flourescent plastic panels raised to the tops of the trees. The trails into the plots, the corners trees, and the sample trees will be flagged at eye level in order to facilitate their relocation.

Application Procedures: Applications will be done by helicopter fitted with special application equipment developed by Scentry, Inc. Two application pods will be installed on the helicopter and run off of the aircraft hydraulic system. The decision concerning the makes and models of helicopters acceptable for use on this project will be made by the project director with consensus from the District Ranger, the Air Operations Officer on the Forest, and personnel from Scentry, Inc. This decision will be reached based on an assessment of the specific terrain to be sprayed and the application system requirements.

Heliports will be designated on forest transportation maps and on aerial resource photography. The Forest Aviation Officer will assist in the selection of all heliports and will approve all heliports for use.

Treatment Schedule: Treatments will occur coincident with, or up to 10 days before, the first emergence of adult Douglas-fir tussock moths from cocoons (usually between August 1 and 15). Twenty pheromone traps baited with detection strength baits will be deployed in the treatment areas in order to monitor male moth emergence. Traps will be monitored weekly beginning in late July through late September. The total number of moths captured per trap per week will be recorded.

Sampling Plan: Efficacy will be evaluated by sampling larval population density on foliage pre- (1991) and post- (1992) treatment in control versus treated plots. We plan to sample 40 trees scattered through each plot using a lower crown beating method similar to those of Shepherd (1985) and Mason (1979). Three 18-inch green branches per tree located approximately 5 feet above the ground will be beaten over a cloth. The total number of larvae from all three branches per tree will be counted and recorded. Samples will be

taken in June and an attempt will be made to coincide sampling with peak second instar larval densities. Trees sampled in 1991 will be flagged and sampled again in 1992. Numbers of larvae from lower-crown branch samples will be compared in terms of the ratio of 1992 larvae to 1991 larvae using Abbot's formula. In addition, rough counts of other arthropods (identified at the Order or Family level) falling on beating sheets will be kept as indices of the effect of pheromone disruption on non-target species. It is assumed that pheromone disruption will have no impact on arthropods other than the tussock moth.

The relative rate of fertile egg production per female will also be determined in check versus treated plots. This method of estimating efficacy is a contingency in case larval populations begin to crash, due to natural causes unrelated to treatment, before the 1992 sampling. The egg sample has another advantage in that it can be completed several months before larval samples. A disadvantage is increased potential for bias. Egg samples are more labor intensive than larval samples, and so less geographic area will be covered in a plot. Further, there is some potential for vertical bias since cocoons high in trees, which could respond differently to treatment, will not be sampled.

Cocoons will be collected from the bottom 6 meters of 20 trees scattered through each plot. The cocoon collection will be made by November of 1991. Ten cocoons will be removed from each tree with a pole pruner. Cocoons will then be examined and the sex and status of each (male/female, emerged/deceased, egg mass/no egg mass) will be determined. Egg mass counts will be made for each cocoon from which a female emerged. Eggs will be refrigerated at $5^{o}C$ for 5 months to break diapause, then larvae will be allowed to hatch to determine fertility of eggs. This is necessary because females prevented from mating will sometimes lay infertile egg masses. The criterion of efficacy will be the number of larvae hatching from eggs per emerged female in check versus treated plots.

To monitor pheromone loss through the season, fibers filled with pheromone will be found on foliage, and their location marked, at the time of application. At 2 week intervals, 5 fibers will be collected. Pheromone will be extracted in the laboratory by cutting fibers in pieces, and soaking the pieces in hexane. Residual pheromone in the extract will be measured by gas chromatography.

Statistical Analysis: All data of the same kind from subsamples from a single plot will be combined and treated as one replicate. A completely randomized analysis of variance will be used to compare means of control versus treated plots. Data reported as percentages (egg masses per female) and proportions (larvae will be transformed by the arcsine before analysis. All analyses will be done after of Snedecor & Cochran (1967). Where efficacy is discussed in terms of reproduction rates, percent control = 1 - (mean egg mass per cocoon treated/ mean egg mass per cocoon check)* 100. For efficacy based on beating samples, percent control = 1 - {(larvae per plot treated 1992/larvae per plot treated 1991)/(larvae in check plot 1992/larvae in check 1991 plot)]*100. There will be a minimum of 3 treated plots and 3 check plots with treatment assigned to plots at random.

WORK SCHEDULE AND RESPONSIBILITIES

Deleted, LS

LITERATURE CITED

Knapp, A., J. Weatherby, J. Hoffman, D. Hansen, L. LaMadeleine and R. Williams. 1991. Forest insect and disease conditions in the Intermountain Region 1990. FPM Report. Ogden, UT: USDA Forest Service, Intermountain Region. 33 p.

Mason, R.R. 1979. How to sample larvae of the Douglas-fir tussock moth. USDA Combined For. Pest R & D Program. USDA, Agricultural Handbook 547.

Shepherd, T., T.G. Gray, R.J. Chorney & G.E. Daterman. 1985. Pest management of Douglas-fir tussock moth, Orgyia pseudotsugata (Lepidoptera: Lymantriidae): monitoring endemic populations with pheromone traps to detect incipient outbreaks. Can. Entomol. 117: 839-48.

Sower, L.L. & G.E. Daterman. 1977. Evaluation of synthetic sex pheromone as a control agent of Douglas-fir tussock moths. Environ. Entomol. 6: 889-892.

Sower, L.L., G.E. Daterman, W. Funkhouser & C. Sartwell. 1983. Pheromone disruption controls Douglas-fir tussock moth (Lepidoptera: Lymantriidae) reproduction at high insect densities. Can. Entomol. 115: 965-969.

Sower, L.L., J.M. Wenz, D.L. Dahlsten & G.E. Daterman. 1990. Field Testing of pheromone disruption on preoutbreak populations of Douglas-fir tussock moth (Lepidoptera: Lymantriidae). J. Econ. Entomol. 83(4): 1487-1491.

Tunnock, S., M. Ollieu & R.W. Thier. 1985. History of Douglas-fir tussock moth and related suppression efforts in the Intermountain and Northern Rocky Mountain Regions 1927 through 1984. FPM Report 85-13. USDA Forest Service, Intermountain and Northern Regions. 51 p.

SAFETY PLAN

Deleted, LS

Julie Weatherby
R-4

REPORT TO: Western Defoliators Steering Committee
August 24 - 25, 1993
West Sacramento, CA

SUBMITTED BY: Julie Weatherby, R4

Gypsy Moth

In 1992 over 10,000 pheromone baited traps were retrieved within the potential eradication project areas in Utah. Only 94 moths were captured. Nine treatment blocks located around these positive catches were established in 1993 (5,135 AC). These treatment blocks were sprayed 3 times in 1993 using a Bell 206 B III. Dipel 6AF was applied NEAT at a rate of 64 OZ/AC. Applications were completed on June 18, 1993.

Special projects conducted in conjunction with this eradication project included:

1) Detection, Quantification, and Persistence of B.t. in Mountain Soils
2) Release and Recapture of Gypsy Moth in Mountainous Terrain
3) Quantification of Drift deposits on Foliage Down Canyon from Spray Blocks
4) Effects of Feeding Non-Target Lepidoptera Foliage with Drift Deposits in the Range Found in Special Project 3.
5) Effects of Aspect, Elevation, and Exposure on Survival Rates of Gypsy Moth Pupae

In 1992, 2 moths were captured in southern Idaho. One moth was captured in Filer and the other in Shelley, ID. Trapping was intensified in these areas during 1993. Traps deployed in 1993 will be retrieved this fall.

Western Spruce Budworm

In 1992 approximately 32,000 acres of defoliation attributed to western spruce budworm was detected during the annual aerial detection survey. Defoliation was located primarily on the Salmon and Challis NFs and mixed with Douglas-fir tussock moth on the Payette NF. Ground observations during the 1993 field season indicate that populations are extremely low with little if any visible defoliation.

Douglas-fir Tussock Moth

Populations of Douglas-fir tussock moths collapsed throughout the Region in 1991 or 1992 depending upon the location. In 1992 more than 406,000 AC of defoliation was detected during the annual aerial detection survey before the population collapsed probably as a result of starvation, parasites, predators and virus epidemics.

We have installed a series of impact plots in areas which have been defoliated. These plots will be read annually for 5 years. Mortality estimates based upon intensity of defoliation will be quantified. Mortality of subalpine fir which was completely defoliated is high. In some areas particularly the drier sites mortality of Douglas-fir is also higher than expected. Grand fir seems to be

surviving better than these other species despite significant amounts of top-kill. Results will be reported after the plots have been revisited in 1993.

A preliminary hazard rating system was reported in 1993. The stand characteristics which were included in the hazard rating system were aspect, relative elevation, species composition, and location in relationship to historical outbreak centers. The model accurately classified 65 percent of the stands used to develop this procedure into appropriate vulnerability classes.

The results of the 1991 Virus Rate Study conducted by Roy Beckwith, Dave Grimble and Julie Weatherby is included in this report. In summary there was no statistically significant difference between treated and control blocks. Lab bioassays indicate that field population from southern Idaho may require higher rates of virus in order to obtain effective population suppression.

3420
Report No. R4-93-04
March 12, 1993

A DOUGLAS-FIR TUSSOCK MOTH HAZARD RATING SYSTEM FOR USE IN SOUTHERN IDAHO

By

Julie C. Weatherby[1]
Brian R. Gardner[2]
Tom N. Barbouletos[3]

ABSTRACT

This report documents our efforts to develop a 2 phase hazard rating system which could be used by land managers to predict the likelihood of a Douglas-fir tussock moth outbreak in a particular stand (phase 1 - probability of occurrence) and the anticipated damage which may occur (phase 2 - vulnerability). Relative outbreak probabilities defined as highly likely, likely, or possible but infrequent, are assigned to broad geographical areas based upon historical outbreak frequencies. All timbered stands within each geographical area are assigned a likelihood value or probability of occurrence associated with that geographical area. Relationships between site and stand characteristics and damage levels as measured by defoliation intensity are evaluated. Site and stand characteristics with the strongest relationships to damage are used to develop a procedure to classify stands into one of 3 vulnerability rating classes. Classification accuracy using this procedure is 65 percent for stands used to develop this procedure and 68 percent for an independent group of stands.

[1] Entomologist, Forest Pest Management, Intermountain Region, USDA Forest Service.
[2] Biological Technician, Forest Pest Management, Intermountain Region, USDA Forest Service.
[3] Forester, Forest Pest Management, Intermountain Region, USDA Forest Service.

INTRODUCTION

The Douglas-fir tussock moth, *Orgyia pseudotsugata* McDunnough (DFTM), is a serious defoliator of Douglas-fir and true firs in western North America. Populations cycle periodically, rapidly increasing from endemic to outbreak levels. Outbreak cycles usually last 3 to 4 years before the population collapses as a result of a combination of mortality factors, including parasites, predators, diseases, and starvation.

Tussock moth populations overwinter in the egg stage. Egg hatch occurs after bud break in late May or early June. Small larvae disperse from egg masses redistributing themselves throughout the forest canopy. Long distance dispersal is accomplished when small larvae spin down from branches and are passively blown by winds. Such dispersal is usually limited to a distance of approximately 1/4 mile (Wickman et al. 1981).

Larval stages feed first on new foliage and move to older foliage after the new foliage has been consumed. When populations are extremely dense, trees can be almost completely defoliated in 1 year. Larval feeding occurs over a period of 40 to 60 days. Full-grown larvae seek out pupation sites during late July or August. Pupal cocoons are usually found on the undersides of branches; however, when populations are extremely dense, increasing numbers of larvae seek out other pupation sites such as tree trunks, rocks, fence posts, etc. Pupal cocoons consist of grayish, silken coverings each surrounding a single pupa.

Male moths begin emerging from pupal cocoons in August followed by the emergence of female moths. Male moths are gray-brown to black-brown with a wingspan of approximately 1 inch. Large, plumose antennae are conspicuous. Female moths are flightless and remain on or near their pupal cocoons for the duration of their lifespan. Females produce a pheromone which attracts males for the purpose of mating. Oviposition of eggs occurs directly on top of the pupal cocoon from which the female emerged. An average egg mass contains 150 to 200 eggs.

Feeding by DFTM results in varying degrees of defoliation. Light defoliation can cause top-kill and growth reduction. Heavy defoliation may culminate in tree mortality. During the 1990 - 1992 tussock moth outbreak in southern Idaho, we predicted that tree mortality resulting from very heavy defoliation could be as high as 73 trees per acre (Weatherby et al. 1992). Impacts of this magnitude significantly alter timber production and future management plans.

In southern Idaho, periodic outbreaks have occurred. Tunnock et al. (1985) documented the occurrence of several DFTM outbreaks between 1927 and 1984. Many of these outbreaks seem to reoccur in certain areas.

Researchers have recognized this pattern of reoccurrence and have attempted to predict where future DFTM outbreaks may occur and where impacts may be most severe. Stoszek et al. (1981) developed a risk rating system using the following site and stand characteristics: physiographic location, depth of volcanic ash layer, site occupancy, age of host trees, and proportion of stand in grand fir. This model was developed from data collected in the Palouse Range of northern Idaho. Heller and Sadir (1980) developed a risk rating system which used standard photo interpretation techniques to extract site and stand characteristics from resource photography. Site and stand characteristics incorporated into the Heller and Sadir model include: elevation, percent slope, aspect, physiographic location, percent cover, average crown diameter, and percent cover in fir.

Data used to develop this model were collected from the Blue Mountains during the 1973 DFTM outbreak.

Neither of these models adequately address risk ratings for Douglas-fir habitat types which are some of the most frequently defoliated sites in southern Idaho.

This report documents our efforts to develop a simple risk rating or hazard rating system for use in southern Idaho.

METHODS

Our approach to developing a DFTM hazard rating system is a 2 phase approach. Phase 1 involves developing a method to determine the probability of an outbreak occurring in a defined geographical area. Phase 2 involves classifying stands where damage is expected to be significant.

Phase 1 – Historical outbreak frequencies were gleaned from the literature. Broad geographical areas where outbreaks have occurred approximately once every 7 to 10 years, once every 15 years and zero to one time within the last 30 years were defined and highlighted on a map of southern Idaho. Outbreak probabilities defined as highly likely, likely, or possible but infrequent, were assigned to each of the 3 broad geographical areas, respectively.

Phase 2 – Scientific literature and field observations indicate that several site and stand characteristics may be important components of a DFTM hazard rating system. For this study the following site and stand characteristics were investigated: habitat type, aspect, elevation, position on the slope, proportion of the basal area in host, stand structure (multi-storied, single storied), age and radial growth.

Site, stand and damage data used in this analysis were collected during 1991 and 1992 from 45 5-plot transects distributed throughout infested areas in southern Idaho. The sampling design and methods used to collect these data have been described by Weatherby et al. (1992).

Each site or stand characteristic was evaluated individually against an area damage index (ADI) measured at the same site. The procedures used to develop this ADI are described by Weatherby et al. (1992). The range of ADI's (0.00 - 4.00) obtained from all sampled areas was partitioned into the following area damage classes: non-defoliated (ADI = 0.00), lightly to moderately damaged (0.00 < ADI = 2.00), and heavily to very heavily damaged (2.00 < ADI = 4.00).

Continuous site or stand characteristics such as age, elevation, radial growth, position on the slope, and proportion of the stand basal area in host species, were plotted against area damage indices. Subjective interpretation of these scattergrams was used to evaluate possible relationships between site or stand characteristics and area damage indices. Site and stand characteristics which appeared to be unrelated to area damage indices were eliminated from further evaluation.

Discrete site or stand characteristics such as aspect, habitat type (Steele et al. 1981), and stand structure, and continuous characteristics, selected after the scattergram interpretation, were subjectively partitioned into classes and compared to area damage classes. Five stand frequency tables with rows representing stand characteristic classes and columns representing area damage classes were developed. Chi-square tests of significance were performed on all cross tabulations. Significant

characteristics ($p < .10$) were included in the vulnerability model. The vulnerability model is an additive model which is explained in the results sections of this publication.

After the vulnerability model was developed, an independent data set, collected from 20 stands within Logging Gulch on the Boise National Forest, was used to validate the model. Each stand was classified into one of 3 predicted vulnerability rating classes using the vulnerability model and the predicted vulnerability rating class was compared to the actual damage class measured in the field.

RESULTS

Historical records of tussock moth outbreaks in southern Idaho were used in the development of outbreak probabilities (Phase 1). Historical literature (Tunnock et al. 1985) documenting DFTM outbreaks indicates that frequencies of outbreaks vary by geographical areas. The most frequent outbreaks in southern Idaho occur in the Owyhee Mountains where 6 detectable outbreaks have occurred in the last 43 years. Another area where frequent outbreaks have been detected is a broad geographical area within the drainages of the Boise River. Outbreaks in this area have been detected 2 times in 30 years. Stringer Douglas-fir stands in several drainages east of Bellevue and Hailey have similar defoliation histories as stands within the Boise River drainages. Many new areas of defoliation were detected for the first time during the 1990 - 1992 outbreak. History indicates that outbreaks within these areas are relatively infrequent. Figure 1 is a map of southern Idaho highlighting the outbreak areas with similar defoliation frequencies.

Habitat type, aspect, elevation, and position on the slope are site characteristics which were evaluated as potential discriminating variables to classify expected damage or vulnerability (Phase 2).

Sample stands represented a range of 12 habitat types, 6 habitat types in the Douglas-fir series (PSME), 4 in the grand fir series (ABGR), and 2 in subalpine fir series (ABLA). The most commonly sampled habitat types were PSME/ACGL (Douglas-fir/mountain maple), PSME/BERE (Douglas-fir/Oregon grape), and ABGR/ACGL (grand fir/mountain maple). Heavy to very heavy defoliation occurred on 6 of the 12 habitat types. Table 1 displays the frequencies of stands cross classified by habitat type and damage class. A relatively broad range of habitat types were impacted by defoliation. No really clear trend or relationship is apparent for this cross classification. Additional data from the less well represented habitat types are necessary if relationships between habitat types and damage classes are to be understood.

Data were obtained from stands on all aspects. Defoliation was heaviest on the easterly and southeasterly facing slopes where 71 and 80 percent of the sample stands on those aspects were classified as heavily defoliated. Table 2 summarizes the frequencies of stands cross classified by aspect and damage class. In order to statistically evaluate whether aspect and damage are independent variable, 3 aspect classes were developed. Class 1 consisted of all stands with a northern, western or northwestern aspect. Class 2 consisted of all stands with a southern or southwestern aspect. Class 3 consisted of all stands with an eastern, southeastern or northeastern aspect. Two stands were deleted from the analysis because they were essentially flat and therefore were not assigned to one of the 3 aspect classes. A chi-square test of significance indicated that aspect class and damage class are not independent ($X^2 = 11.69$ with 4 d.f., $p < .05$).

Field observation indicated that defoliation was usually found across relatively sharp elevational

Figure 1. Areas in southern Idaho with a history of defoliation caused by DFTM.

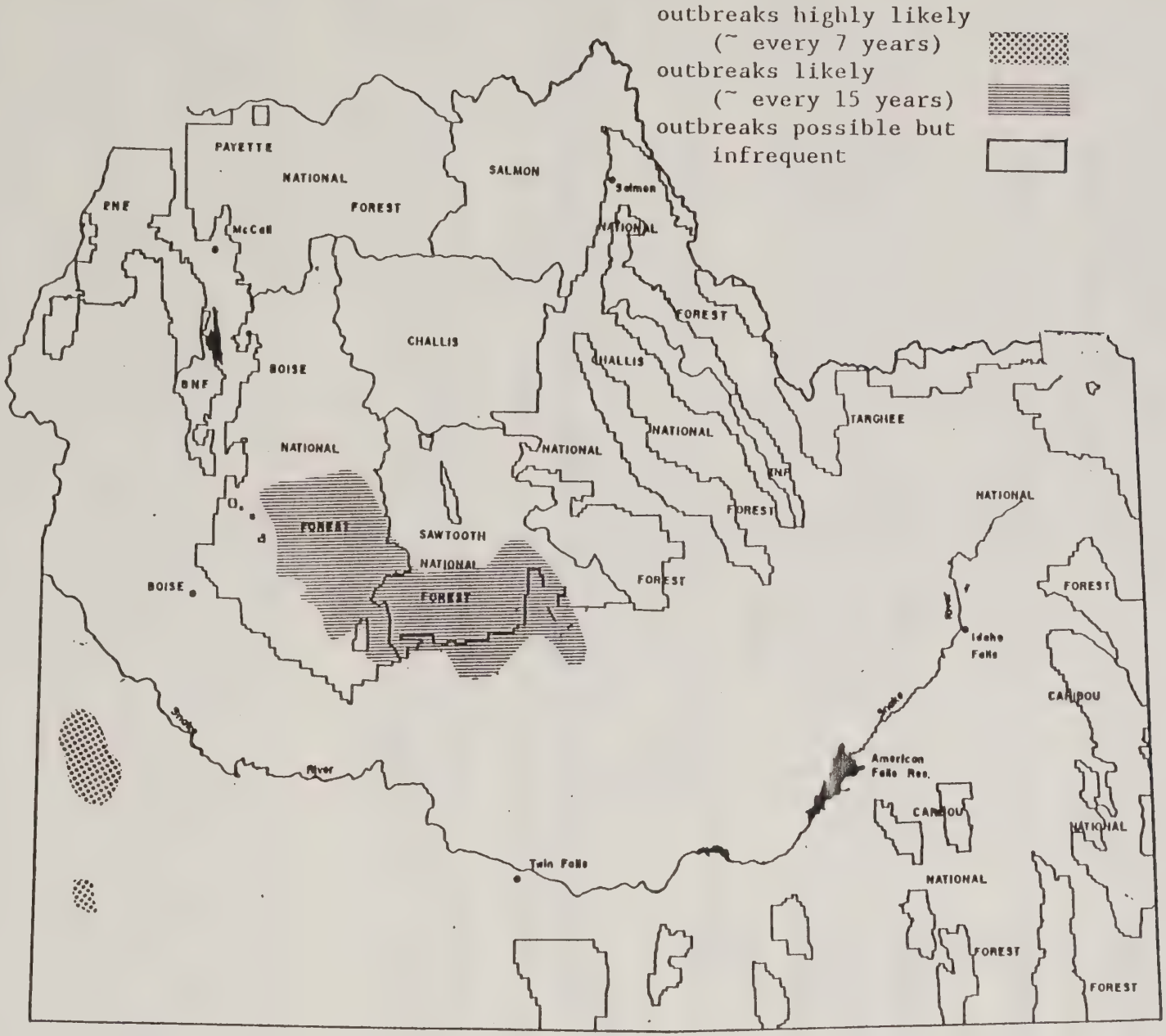


Table 1. Frequency table of sampled stands classified by habitat type and area damage class from the 1990 - 1992 DFTM outbreak in southern Idaho.

Habitat Type[a]	Area Damage Class			
	V. Heavy-Heavy	Light - Mod.	Non-defol.	Total
PSME/ACGL	3	7	0	10
PSME/BERE	6	3	1	10
PSME/CAGE	1	1	1	3
PSME/PHMA	0	0	1	1
PSME/SPBE	0	1	1	2
PSME/SYOR	0	1	0	1
ABGR/ACGL	4	4	0	8
ABGR/BERE	0	1	0	1
ABGR/SPBE	3	2	0	5
ABGR/VAGL	1	1	0	2
ABLA/ACGL	0	1	0	1
ABLA/CAGE	0	1	0	1
Total	18	23	4	45

[a] Habitat types as discribed by Steele et al. (1981)

bands. Therefore elevation was evaluated as a potential discriminating variable. Elevations of sample stands ranged from 4,800 to 8,850 feet while heavily defoliated stands ranged from 5,240 to 6,800 feet. None of the sample stands above 7,400 feet were defoliated. A scattergram (figure 2) of elevation and defoliation did not reveal any clear relationship. Because the sampled stands were located in at least 4 geographically separated areas which varied considerably in elevation, we decided to look at position on the slope. Position on the slope was defined as the elevation of each stand divided by the elevation of the forested ridgeline for the geographical area. If the ridgeline exceeded 7,400 feet, 7,400 feet was used as the ridgeline elevation. Ninety five percent of the heavily defoliated stands were located in an elevational band within 15 percent of the highest forested ridgeline for the area (table 3). A chi-square test of significance indicated that position on the slope and damage class are not independent ($X^2 = 15.72$ with 8 d.f., $p < .05$)

Proportion of the total stand basal area in host, stand structure, age and radial growth are stand characteristics which were evaluated as potential discriminating variables.

Approximately 70 percent of the sample stands had more than 85 percent of the total stand basal area in host species (Douglas-fir, grand fir, and subalpine fir). Forty two percent of these stands were heavily damaged. In stands with less than 85 percent of the stand basal area in host species, only 20 percent were heavily damaged. This information is displayed in table 4. A chi-square test of significance indicated that the proportion of the basal area in host and damage class are not independent ($X^2 = 4.81$ with 2 d.f., $.05 < p < .10$).

Stand structure defined as the number of stories of host trees within a stand was evaluated. Little if any relationship was apparent between stand structure and damage class.

Most of the sample stands were between 60 and 120 years of age. Within this range of ages all levels of defoliation were encountered (figure 3). None of the stands older than 120 years of age were significantly defoliated, however stands in this age category were probably under represented. Therefore this trend was not considered.

The last stand variable evaluated was 5-year radial growth. This variable was analyzed as an indicator of stress and growth potential of the site. Growth rates ranged from less than .10 to approximately .50 inches in 5 years. A scattergram (figure 4) of damage classes versus 5-year radial growth indicated little if any relationship between levels of defoliation and 5-year radial growth rates.

Eight site and stand variables were evaluated and only three, position on the slope, aspect class, and basal area in host species, were significantly related to damage classes. Each of these variables were included in the stand vulnerability model (table 5). Numerical values were assigned to each site and stand variable class. For example, position on the slope was divided into 3 classes. A numerical value of 3 indicating a high degree of vulnerability was assigned to the class ranging between 86 percent of the slope and the ridgeline; a numerical value of 2 indicating a lesser degree of vulnerability was assigned to the class ranging between 76 and 85 percent of the slope, and a numerical value of 1 was assigned to the least vulnerable class ranging between 0 and 75 percent of the slope. Similar numerical values were assigned to the aspect classes and the basal area classes. In order to determine the vulnerability of a stand, the position on the slope, the aspect class, and the percent basal area in host must be known. Appropriate numerical values associated with these characteristics are summed to obtain a composite rating ranging between 3 and 8. Composite

Figure 2. Scattergram of elevation versus area damage index associated with sampled areas within the 1990 - 1992 DFTM outbreak in southern Idaho.

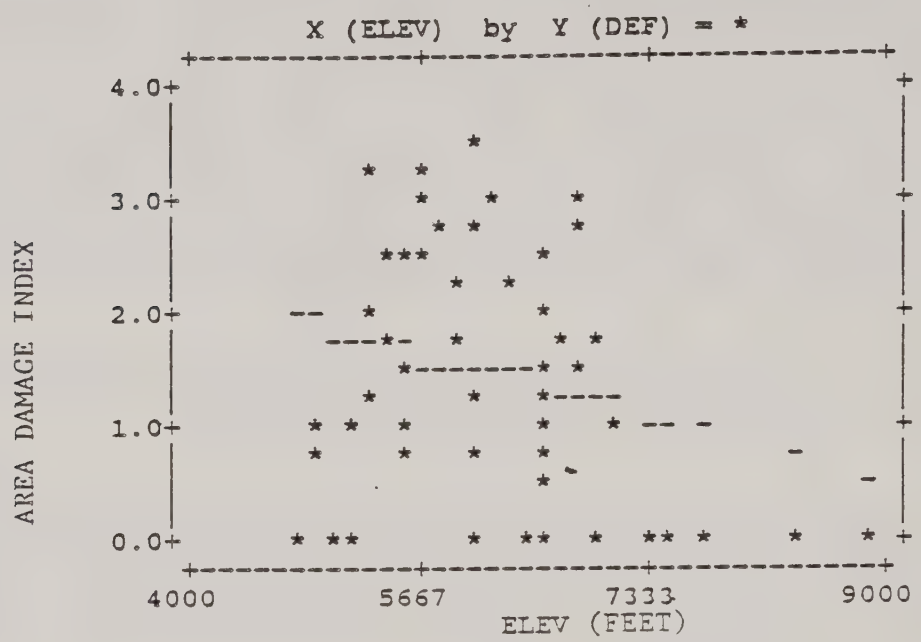


Table 3. Frequency table of sampled areas classified by position on the slope and area damage class from the 1990 - 1992 DFTM outbreak in southern Idaho.

Slope Position	Area Damage Class			
	V. Heavy-Heavy	Mod. - Light	Non-defol.	Total
0 - 75 %	0	2	3	5
76 - 85 %	1	5	0	6
86 - 100 %	18	16	0	34
Total	19	23	3	45

Table 4. Frequency table of sampled areas classified by percent of total stand basal area in host and area damage class from 1990 - 1992 DFTM outbreak in southern Idaho.

	Area Damage Class			
% BA in Host	V. Heavy-Heavy	Mod. - Light	Non-defol.	Total
0 - 85 %	3	11	1	15
86 - 100 %	16	12	2	30
Total	19	23	3	45

Figure 3. Scattergram of stand age versus area damage index associated with sampled areas within the 1990 - 1992 DFTM outbreak in southern Idaho.

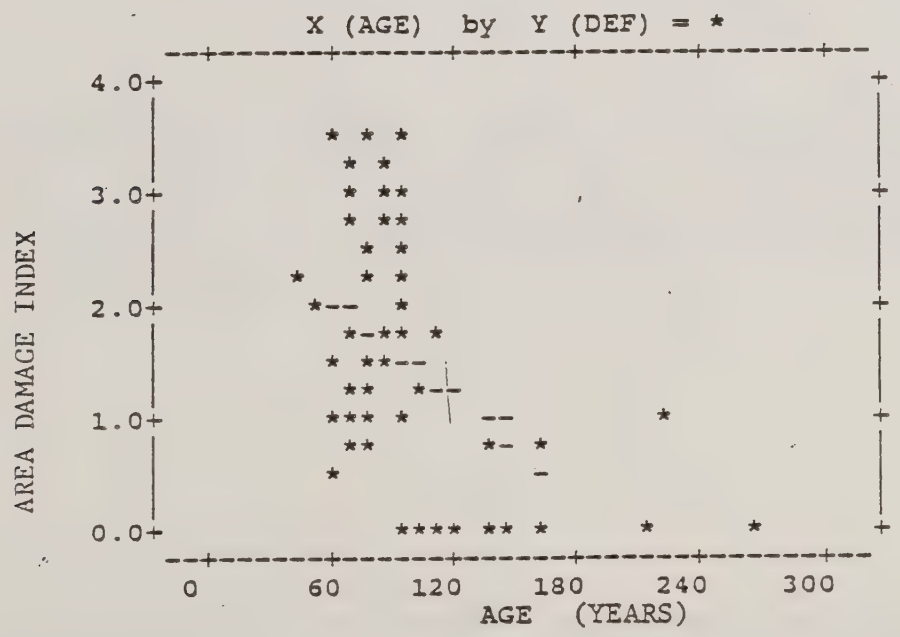


Figure 4. Scattergram of 5 year radial growth versus area damage index associated with sampled areas within the 1990 - 1992 DFTM outbreak in southern Idaho.

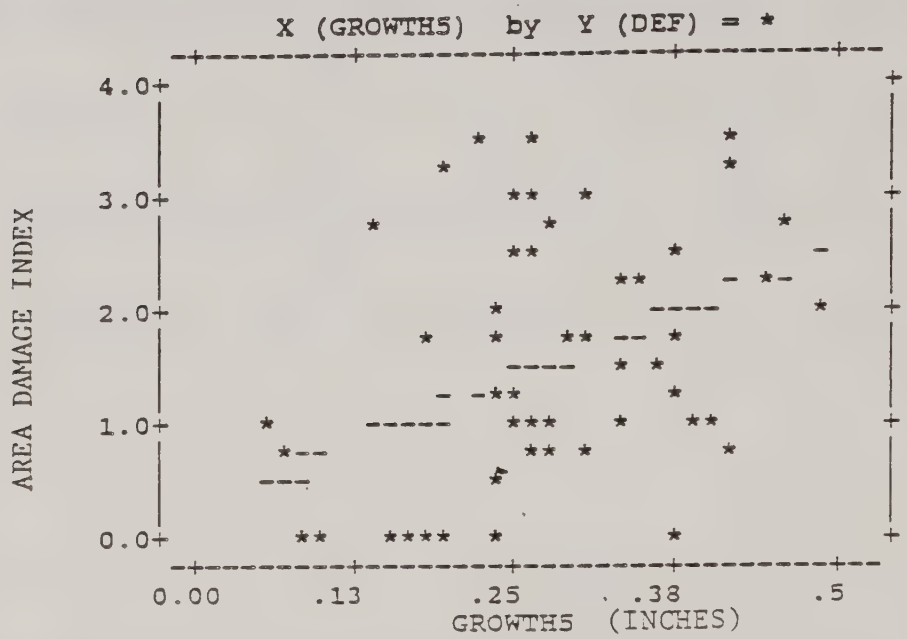


Table 5. Vulnerability model used to predict damage in infested DFTM stands.

Aspect	Position on slope[a]	% Basal Area in host
E, SE, NE (3)	.86 - 1.00 (3)	.86 - 1.00 (2)
S, SW (2)	.76 - .85 (2)	.00 - .85 (1)
N, W, NW (1)	.00 - .75 (1)	

[a] Position on the slope is defined as the elevation of the stand divided by the elevation of the highest forested ridgeline in the area. If the highest forested ridgeline exceeds 7,400 ft, the ridgeline elevation defaults to 7,400 ft.

ratings of 7 and 8, 5 and 6, and 3 and 4 indicate high vulnerability, moderate vulnerability, and low vulnerability, respectively.

The vulnerability model is intended to be used to predict the vulnerability rating or a qualitative level of damage which could be expected if a DFTM outbreak were to occur in a particular stand. Highly vulnerable stands could sustain tree mortality as a result of defoliation. Moderately vulnerable stands are more likely to suffer top-kill and growth reduction with little tree mortality. Stands with low vulnerability are expected to suffer minor and usually temporary damage. The vulnerability model accurately classified 65 percent of the stands used to develop this procedure into appropriate vulnerability rating classes.

The same vulnerability model was used to rate an independent group of infested stands in the Logging Gulch drainage on the Boise National Forest. When the vulnerability rating classes, as predicted by the model, were compared to actual defoliation classes, the predicted vulnerability rating classes agreed with the actual defoliation classes 68 percent of the time (table 6).

SUMMARY

This 2 phase hazard rating system could be used by land managers to predict the likelihood of a DFTM outbreak in a particular stand and the anticipated damage which may occur. This information is expected to be useful for long and short range planning and to prioritize silvicultural treatments.

In order to hazard rate a stand, the probability of an outbreak must be estimated by locating the stand within an area with a known outbreak frequency. If the stand is located in an area where outbreaks are highly likely or likely then the expected impacts caused by a tussock moth outbreak could be predicted using the vulnerability model. Stands which are classified as highly likely to have an outbreak and which have a high vulnerability rating are of greatest concern. These stands could be prioritized as needing prompt treatment. Stands where outbreaks are possible but infrequent and vulnerability ratings are high would have a lower overall hazard rating because the probability of an outbreak is low. However these stands could suffer tree mortality if an outbreak were to occur. Stands where outbreaks are possible but infrequent and vulnerability ratings are low would have a very low priority for treatment.

Table 6. Vulnerability ratings for selected stands in Logging Gulch, Boise NF.

Comp.	Stand	Aspect	Rating	Pos. Slope[a]	Rating	% BA Host	Rating	Vul. Rating	Pred. Vul. Cl.	Act. Damage Cl.	
406	2	NE	3	.81	2	7	1	6	M	M	
	4	S	2	.84	2	0	1	5	M	M	
	17	E	3	.84	2	50	1	6	M	M	
	21	E	3	1.00	3	100	2	8	H	M	*
	28	N	1	.57	1	95	2	4	L	M	*
413	2	W	1	.90	3	63	1	5	M	M	
	4	W	1	.87	3	67	1	5	M	M	
	6	E	3	.84	2	68	1	6	M	M	
	21	E	3	.93	3	52	1	7	H	M	*
	23	N	1	.81	2	100	2	5	M	H	*
	24	E	3	.81	2	94	2	7	H	H	
	25	NE	3	.93	3	77	1	7	H	H	
	26	S	2	.93	3	66	1	6	M	M	
	29	NE	3	.81	2	88	2	7	H	H	
414	9	E	3	.85	2	45	1	6	M	M	
	118	W	1	.79	2	30	1	4	L	M	*
	120	E	3	.85	2	31	1	6	M	M	
	121	SE	3	.87	3	36	1	7	H	M	*
	122	SW	2	.87	3	83	1	6	M	M	

[a] Position on the slope is the elevation of a stand divided by the elevation of the forested ridgeline for the local area.

LITERATURE CITED

Heller, R.C.; Sader, S.A. 1980. Rating the risk of tussock moth defoliation using aerial photographs. USDA, For. Serv. Douglas-fir Tussock Moth Res. & Dev. Prog. Agric. Handbook 569.

Steele, R.; Pfister, R.D.; Ryker, R.A.; Kittams, J.A. 1981. Forest Habitat Types of Central Idaho. USDA, For. Serv., Int. For. & Range Expt. Station, Gen. Tech. Rpt. INT-114, 138 p.

Stoszek, K.J.; Mika, P.G.; Moore, J.A.; Osborne, H.L. 1981. Relationship of Douglas-fir tussock moth defoliation to site and stand characteristics in northern Idaho. For. Sci. 27:431-442.

Tunnock, S.; Ollieu, M.; Thier, R.W. 1985. Hostory of Douglas-fir tussock moth and related suppression efforts in the Intermountain and Northern Rocky Mountain Regions - 1927 through 1984. USDA For. Serv., Rpt. No. 85-13. Int. and North. Regions, Missoula, MT. 51 p.

Weatherby, J.C.; Knapp, K.A.; Gardner, B.R.; Roberts, J.; Mocettini, P. 1992. A biological evaluation of the Douglas-fir tussock moth outbreak in southern Idaho, 1991. USDA For. Serv., Rpt. No. R4-92-01. Ogden, UT. 51 p.

Wickman, B.E.; Mason, R.R.; Trostle, G.C. 1981. Douglas-fir tussock moth. USDA For. Serv. Forest Insect & Disease Leaflet 86. 10 p.

John Wenz
R-5

NATIONAL STEERING COMMITTEE
FOR
MANAGEMENT OF WESTERN DEFOLIATORS

R5- Pacific Southwest Region Report
August 24-25, 1993

John M. Wenz

Current Status

Defoliator activity in California continued at generally low to moderate levels in 1993. No defoliator suppression or eradication projects were conducted.

1) Modoc budworm. Defoliation of true fir (white fir, Abies concolor, and red fir, A. magnifica) by the Modoc budworm, Choristoneura viridis, first detected in June, 1992, on the Modoc National Forest in northeastern California, continued in 1993. Activity levels declined from high/moderate in 1992 to moderate/low in 1993 over approximately 200,000 acres.

2) Gypsy Moth. As of August 18, 1993, ten gypsy moths have been trapped in California. Catches have been reported from the following counties (cities): Los Angeles (Downey- 1); Alameda (Albany- 3); Orange (Anaheim- 1; Irvine- 1; Newport Beach- 1); Mariposa (Wawona- 1); Santa Clara (Saratoga- 1); and Shasta (Redding- 1).

3) Fruittree Leafroller: Scattered light to heavy defoliation of oaks by the fruittree leafroller, Archips argyrospilus, has been reported from several locations in the San Bernardino Mountains (San Bernardino National Forest) and Mt. Palomar (Cleveland National Forest) in southern California and in the Sacramento River Canyon (Shasta-Trinity National Forest) in northern California.

4) Black Pineleaf Scale. As in 1992, light to heavy feeding by the black pineleaf scale, Nuculaspis californica, on ponderosa and sugar pine has been reported from several locations throughout California. Defoliation of sugar pine continues to be of concern in that it may help predispose white pine blister rust resistant, and resistant-candidate (untested) trees, to bark/engraver beetle attack.

5) White Fir Sawfly. Defoliation by the white fir sawfly, Neodiprion sp., detected in 1992 over about 10,000 acres in several areas of central and northeastern California, declined to low levels in 1993.

Current Needs

1) Initiate implementation of the Western Defoliator Strategic Plan. This should help focus discussion on how to integrate FPM expertise into ecosystem management and begin to answer related questions concerning the roles of insects (and pathogens) in forest ecosystems, defoliator effects (impacts) on non-commodity resources etc.

2) Evaluate effects of defoliator suppression on non-target organisms (Bt-Lepidoptera a priority).

3) Pursue registration of the Douglas-fir tussock moth (DFTM) pheromone for mating disruption.

4) Develop new/improve existing application technology and pheromone formulation for the DFTM pheromone for mating disruption.

5) Continue to pursue registration of DFTM BioContro-1 in California.

6) Evaluate DFTM pheromone early warning system results and assess ways to improve predictability and efficiency.