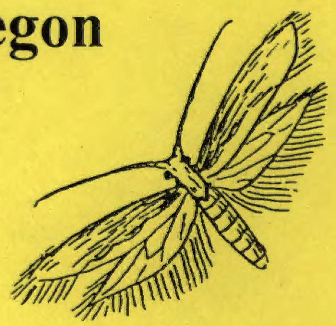
RESEARCH REPORTS
64TH ANNUAL PACIFIC NORTHWEST INSECT MANAGEMENT CONFERENCE

Hilton Hotel, Portland Oregon
January 3 & 4, 2005



Diamondback moth

Clearwing moth

Spider mite

Thrips

Aphid or plant louse

These are research reports only, NOT recommendations of the Conference. Recommendations may only be made by public service entomologists in their specific areas.

WASHINGTON STATE UNIVERSITY
EXTENSION

PAPERS SUBMITTED TO THE 2005 PNWIMC
PORTLAND OR, JANUARY 3 & 4, HILTON HOTEL

Monday Sessions 8 AM

Section I. Forage Insects. None to date

Section II. Bee Poisoning, Toxicology, and Regulatory Issues.

A. Schreiber (private company) "Results of First Year of WSDA Pesticide Testing of Surface Waters in the Yakima Valley".
A. Schreiber (private company) "Status Report on FQPA and Registrations of Pesticides".
A. Schreiber (private company) "Washington State Commission on Pesticide Registration Update".
A. Schreiber (private company) "Control of Wireworms in Washington Potatoes".

Section III. Biological and Cultural Controls

B. Bai, R A Worth, Kathleen JR Johnson, and Gary Brown. (OSDA) "Oregon cereal Leaf Beetle Biological Control Program, 2004".
D. Bruck (USDA-ARS) "*Metarhizum anisoplice* for Black Vine Weevil Control in Container Grown Nursery Stock".
D. L. Walenta and S. Rao. "Development Of An Integrated Pest Management Program For The Cereal Leaf Beetle (*Oulema melanoplus)* IN Oregon

Section IV. Cereal Crop Insects

D. Bragg, C. Donohue, (WSU) and K. Tetrick (USDA-ARS) " Russian Wheat Aphid Control in Spring Barley, 2004".
D. Bragg, C. Donohue, (WSU) and K. Tetrick (USDA-ARS)"Russian Wheat Aphid Control in Spring Wheat, 2004".
D. Bragg, C. Donohue, (WSU) and Kurt Tetrick (USDA-ARS) "Seed Treatment Insect Control in Spring Wheat, 2004".

Section V. Soil Arthropods

B. Quebbeman (AM Todd) "Timing of Lorsban Application for Optimum Control of Mint Root Borer in NE Oregon".
B. Quebbeman (AM Todd) Efficacy Trials of New Insecticides for Mint Root Borer Control".
B. Fouche (UCD) "Growers Control Garden Centipedes in Transplant Tomatoes with Fertilizer Application Equipment".
LK Tanigoshi and JR Bergen (WSU) "Control of Rough Strawberry Root Weevil in Strawberry".

LK Tanigoshi and JR Bergen (WSU) "Strawberry Crown Moth Control in Strawberry".
LK Tanigoshi and JR Bergen (WSU) "Management of Western Raspberry Fruitworm in Red Raspberry".
LK Tanigoshi and JR Bergen (WSU) "Lab and Field Trials to Control Root Weevil Larvae in Small Fruits".

TUESDAY SESSIONS
8:00 AM

Section VI. Vectors of Plant Pathogens

C. Dobie (private company)"Advances in Green Peach Aphid Management in Columbia Basin Potatoes".

Section VII. Foliage, Fruit, and Plant Feeding Insects

D. Bragg, and C. Donohue (WSU) "Insect Control in Spring Dry Peas, 2004".
D. Bragg ,C. Donohue,(WSU) and Kurt Tetrick (USDA-ARS) "Insect Control in Fall Seeded Canola, 2004".
B. Fouche (UCD) "Evaluations of Insecticides for Control of Worms in Fresh Market Tomatoes".
DA Prischman, D G James, LC Wright, and WE Snyder (WSU) "Effects of Chlorpyrophos and Sulfur on Pest Thrips and Spiders on Grape".
TD Waters, HJ Ferguson, RP Wright, and DB Walsh (WSU) "Insecticide Effects on Pest and Beneficial Arthropods in Alfalfa Seed".
TD Waters, HJ Ferguson, RP Wright, and DB Walsh (WSU) "A Comparison of Chemical Control Methods for Seedcorn Maggot, *Delia platura* On Dry Bean Field Establishment".
LC Wright, DG James, V. Reyna, S Castel del Conte, S Gingas, and PE Landolt(WSU) "Identification and Abundance of Cutworms in South-Central WashingtonVineyards".

Section VIII. Mites and Sap Sucking Insects

B. Fouche (UCD) "Control of Melon Aphids in Zucchini Squash".
B. Fouche (UCD) "Control of Twospotted Mites in Zucchini Squash".
LK Tanigoshi and JR Bergen (WSU) "Acaricidal Control of Cyclamen Mite in Strawberries".
TD Waters, HJ Ferguson. RP Wright, and DB Walsh (WSU) "Chemical Control of McDaniel Mite, *Tetranychus mcdanieli* Koch, in Timothy Hay".
TD Waters, HJ Ferguson, RP Wright, and DB Walsh (WSU) "Leafhopper Virginia Creeper, *Erythroneura zizac* Walsh, and the Western Grape Leafhopper, *Erythroneura elegantula* Osborn, in Wine Grapes var. Muscat Canelli".

SECTION I

Forage (Hay) Insects

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Section Leader

Dave Bragg

SECTION II

Bee Poisoning, Environmental Toxicology, Regulatory Issues

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Section Leader

Alan Schreiber

Section II
Bee Poisoning, Environmental Toxicology, Regulatory Issues

STATUS REPORT ON FQPA AND REREGISTRATION OF PESTICIDES

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Reregistration of the organophosphate insecticides is proceeding with no apparent loss of active ingredient for which there is user support. Several use sites for some products for which there were little or no use are being removed from labels. In come cases, significant use restrictions are being placed on the labels, particularly in regards to restricted entry intervals. For a few products, these intervals are significantly reduced the benefits associated with certain use patterns. Reregistration of ethoprop (Mocap), methamidophos (Monitor), disulfoton (Di-Syston), dimethoate, malathion and other organophosphate insecticides appear to be nearing completion. User group input and cooperation between grower groups and registrants have appeared to have been the key in saving many of these use patterns. It is interesting to note that the must feared cumulative risk assessment for organophosphates is expected to have minimal impact on the group. The original impetus for FQPA was the putative dietary risk from organophosphate and carbamate insecticides has largely been discredited and is not longer a regulatory issue of significance.

Carbamate insecticides are currently undergoing reregistration, including phorate (Thimet), Carbofuran (Furadan) and aldicarb (Temik). No carbamates are expected to be lost as a result of this process. The National Potato Council is planning to request to Bayer Crop Science to allow a layby application of aldicarb which would require a shortened preharvest interval. This would significantly expand the use of this product on potatoes.

FQPA and reregistration is not thought to pose any threat to any pesticides that has grower and registrant support. Perhaps the largest regulatory project currently underway at the Agency is a mega soil fumigant cluster analysis.

It is worthwhile to point that in the past four years, the regulatory environment at EPA has been significantly different that the previous four years. The precise reason for this difference is unclear, however, it has been suggested that it may be related to a change in philosophy among the Agencies senior management. There have been indications that as recently as November, 2004, that this more user group friendly philosophy at the Agency may continue for as much as another four years.

Section II
Bee Poisoning, Environmental Toxicology, Regulatory Issues

STATUS REPORT ON FQPA AND REREGISTRATION OF PESTICIDES

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Reregistration of the organophosphate insecticides is proceeding with no significant loss of active ingredients or crop uses of importance. Several minor uses for some products for which there were little or no sales are being removed from labels. In some cases, significant use restrictions are being placed on the labels, particularly in regards to restricted entry intervals. For a few products, these intervals are significantly reduced the benefits associated with certain use patterns. Reregistration of Lannate (Methomyl) methamidophos (Monitor), disulfoton (Di-Syston), azinphos-methyl (Guthion) and other organophosphate insecticides appear to be nearing completion. The grower input and cooperation between growers groups and researchers have appeared to have been the key to saving many of these use patterns. It is interesting to note that the most feared outcome, the risk assessment for organophosphates expected to have an immediate impact on their use. The original impetus for FQPA was the perceived dietary risk from organophosphate and carbamate insecticides has largely been discounted and is not an area of regulatory issue of significance.

Carbamate insecticides are generally undergoing reregistration, including oxamyl (Vydate), carbofuran (Furadan) and aldicarb (Temik). Several challenges are expected to be met as a result of this process. The National Potato Council is planning to request to Bayer Crop Science to allow aerial application of aldicarb which would require a shortened preharvest interval. This would significantly expand the use of this product on potatoes.

FQPA and reregistration is not thought to pose any threat to any pesticides that has grower and research support. Perhaps the biggest regulatory project currently underway at the Agency is a metam sodium risk and cluster analysis.

It is worthwhile to point that in the past four years, the regulatory environment at EPA has been significantly different that the previous four years. The precise reason for this difference is unclear; however, it has been suggested that it may be related to a change in philosophy among the Agency's senior management. There have been indications that as recently as early mid-2004 that this more user-friendly philosophy at the Agency may continue for as much as another four years.

Section II
Bee Poisoning, Environmental Toxicology, Regulatory Issues

WILL THE PACIFIC NORTHWEST SEE NEONICOTINOID RESISTANCE IN COLORADO POTATO BEETLE AND WHAT WILL DO ABOUT IT?

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Neonicotinoid resistance in Colorado potato beetle was documented three years ago in New York state potatoes. Since that time, resistance has been found in Maryland, New Jersey, Massachusetts, Maine, Pennsylvania and Michigan. Resistance is recessive and is thought to confer a significant reduction in fitness to resistance individuals. Several studies are underway to better characterize resistance strains.

Resistance has not been documented in Colorado potato beetle in the Pacific Northwest to any insecticides. With the moderate rate of reliance on neonicotinoid insecticides in potatoes in the PNW and the history of high degrees of susceptible populations of CPB, it is unclear whether resistance will develop. One of the most important determents of whether resistance develops is grower behavior and pesticide use patterns.

I recommend that PNW entomologists develop a consensus position on neonicotinoid resistance for potatoes. I have drafted a national position for the National Potato Council. This position urges growers to rotate potato fields and to rotation classes of insecticide chemistries. If a neonicotinoid is used at planting, then no neonicotinoid should be used post emergence to the crop.

Neonicotinoids – Grower Approach to Resistance Management CPB and GPA in Potato

What is resistance?

Resistance is an inherited change in an insect's susceptibility to an insecticide. It arises through overuse, extensive use or misuse of the pesticide against a pest species and results in resistant forms of the pest.

Mode of Action (MoA), Target-site resistance and Cross-resistance

In the majority of cases, not only does this resistance render the selecting compound ineffective, but it often also confers cross-resistance to other chemically related compounds. Because compounds within a specific chemical group usually share a common target site within the pest, they also share a common mode of action.

Effective IRM strategies use alternations or sequences of MoA

Experience has shown that all effective insecticide resistance management strategies seek to minimize conditions that create resistance. In practice, alternations, sequences or rotations of compounds from different modes of action groups provide a sustainable and effective approach to resistance management. This ensures that selection from compounds in the same mode of action group is minimized. Applications can be arranged by mode of action spray windows or blocks that are defined by the stage of crop development and the biology of the target pest. The development of resistance is localized, meaning resistance is caused by on-farm or nearby actions. The cause and prevention of resistance can only be controlled by growers. Local expert advice should always be followed with regard to spray windows and timings. Several sprays of a compound may be possible within each spray window. It is generally essential to ensure that successive generations of the pest are not treated with compounds from the same group.

What are neonicotinoids?

Neonicotinoids are a relatively new class of insecticides that are so named due to their similarity in structure to nicotine. Both neonicotinoids and nicotine belong to the Group 4 insecticide mode of action. The class contains five active ingredients and 13 products registered, or soon to be registered, on potatoes. All products have activity against Colorado potato beetle and green peach aphids; some products have activity against other potato insect pests. It is important to remember that all of these products act in the same manner to kill insects, thus selecting for the same resistance prone individuals within a population.

Why focus on neonicotinoids?

The neonicotinoid class of insecticides has been hugely successful in controlling aphids, beetles and other pests of potatoes. Approximately, 52% of U.S. potato acres were treated with this group of chemicals 1.2 times, and this amount is expected to increase in the coming years. Due to the widespread use of these products on potatoes, the historical ability of Colorado potato beetle and green peach aphid to develop resistance to insecticides and the molecular structure of the class of chemistry, there is significant potential for resistance development in insect pests of potatoes. Localized populations of Colorado potato beetles in the Eastern U.S. have already shown low to moderate levels of resistance to neonicotinoids. Development of resistance to one neonicotinoid insecticide is expected to confer resistance to all other neonicotinoid insecticides within a short period of time. The development of resistance to this class of chemistry is expected to result in a significant economic loss to potato growers and is therefore critical for growers to develop a strategy to prevent neonicotinoid resistance in potatoes.

Neonicotinoids - Registered or To Be Registered on Potatoes

Active Ingredient Brand Name	/Company	/Use Pattern
<u>imidacloprid</u>		
Admire	Bayer	in-furrow
Gaucho	Gustafson	seed trt
Genesis	Gustafson	seed trt
Provado	Bayer	foliar
Leverage[1/]	Bayer	foliar
<u>thiamethoxam</u>		
Platinum	Syngenta	in-furrow
Actara	Syngenta	foliar
Cruiser[2/]	Syngenta	seed trt
<u>acetamiprid</u>		
Assail[2/]	Cerexagri	foliar
<u>clothianidin</u>		
Poncho[2/]	Gustafson	seedtrt
Belay[2/]	Arvesta	in furrow
Clutch[2/]	Arvesta	foliar
<u>dinotefuran</u>		
??	Valent	in furrow/fol

[1/] (package mix with cyfluthrin)
[2/] (not yet registered)

Avoid resistance by....

- Use neonicotinoid insecticides within the framework of an integrated pest management program. Crop rotation is especially important for management of CPB.
- Apply insecticides only when necessary.
- Use research-based sampling procedures and action thresholds.
- If a neonicotinoid insecticide (Group 4) was applied at planting, either in furrow or as a seed treatment or at lay-by, do not use a foliar neonicotinoid insecticide later in the season.
- Do not treat all potato fields on one farm or in one localized area with products from the neonicotinoid class. For example, a grower could use an alternative treatment on one field out of five.
- Preserve natural controls by using selective insecticides when possible (Success/SpinTor, Rimon, Avaunt, Fulfill, etc.)
- Spot treat when feasible (e.g. field edges).
- Do not apply insecticides below labeled or recommended rates. Application of sub-lethal rates of any insecticide may result in poor product performance, insect damage and an increased risk of resistance development.
- Use only recommended neonicotinoid products and rates necessary to accomplish desired control.

How can I tell what group an insecticide belongs to?

In 2001, the EPA proposed a pesticide labeling scheme aimed at managing resistance based pesticide modes of action. In this scheme all registered pesticides were classified by mode of action (or target site) and each mode of action was assigned to a group with a specific number. For all insecticides there are 26 different groups with 110 insecticidal active ingredients fall. For potatoes, only 27 different active ingredients are registered and used on potatoes as of 2004 and these are classified into only 10 groups.

Adapted from the IRAC Mode of Action Classification v 3.3, October 2003 (Potato Specific Focus)

Group	Sub-group	Primary Target Site of Action	Chemical Sub-group or Active Ingredient	Product Name
1 *	A	Acetylcholine esterase inhibitors	Carbamates	Temik, Vydate, Lannate, Sevin, Furadan,
	B		Organophosphates	Dimethoate, Diazinon, Di-Syston, Mocap, Malathion, Methyl Parathion, Imidan, Penncap-M, Thimet/Phorate Monitor, Guthion
2 *	A	GABA-gated chloride channel antagonists	Cyclodiene organochlorines	Thiodan/Endosulfan
3		Sodium channel modulators	Pyrethroids, Pyrethrins	Asana, Baythroid, Pounce, Ambush, Leverage, others
4 *	A	Nicotinic Acetylcholine receptor agonists / antagonists	Neonicotinoids	Platinum, Admire, Cruiser, Gaucho, Genesis, Leverage, Actara, Provado
5		Nicotinic Acetylcholine receptor agonists (not group 4)	Spinosyns	Success/SpinTor
6		Chloride channel activators	Avermectins	Agri-mek
9 *	A	Compounds of unknown or non-specific mode of action (selective feeding blockers)	Cryolite	Kryocide
	B		Pymetrozine	Fulfill
	C		Flonicamid	Turbine
11 *		Microbial disruptors of insect midgut membranes (includes transgenic crops expressing *Bacillus thuringiensis* toxins)	*Bacillus thuringiensis* var. *kurstaki* *Bacillus thuringiensis var. tenebrionensis*	Javelin, Dipel
14		Inhibition of magnesium-stimulated ATPase	Propargite	Comite
22		Voltage-dependent sodium channel blocker	Indoxacarb	Avaunt
25		Neuroactive (unknown mode of action)	Bifenazate	Acramite
26		Unknown mode of action	Azadirachtin	Azadirect, Ecozin

Section II
Bee Poisoning, Environmental Toxicology, Regulatory Issues

RESULTS OF FIRST YEAR OF WSDA PESTICIDE TESTING OF SURFACE WATERS IN THE YAKIMA VALLEY

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This presentation is taken from a recent publication from two state agencies. I serve on an advisory committee for this project.

The Washington State Department of Agriculture (WSDA) and the Washington State Department of Ecology (Ecology) designed a multi-year monitoring effort to characterize pesticide concentrations in salmonid-bearing surface waters during the typical pesticide use season. The data collected will allow WSDA and the U.S. Environmental Protection Agency (EPA) to refine exposure assessments for pesticides registered for use in Washington State. Understanding the fate and transport of pesticides used in Washington allows regulators to make appropriate decisions to protect endangered species while minimizing the economic impacts to agriculture.

Two index watersheds, representing urban and agricultural land-use patterns, were sampled from April through December 2003. Thornton Creek in the Cedar-Sammamish watershed was chosen as the urban drainage. Marion Drain, Spring Creek, and Sulphur Creek Wasteway in the Lower Yakima watershed represented agricultural land-use patterns. Sampling frequencies included weekly, every other week, and during storm events.

Concentrations of all chemicals were generally low and close to analytical detection limits. 2,4-dichlorophenylacetic acid (2,4-D) was the most commonly detected chemical; however, pentachlorophenol was most commonly detected in the urban watershed. Pesticide detections were compared to Washington State promulgated and EPA recommended aquatic life criteria. Detections were also compared to EPA Environmental Fate and Effects Division acute and chronic toxicological endpoints. One detection of endosulfan sulfate exceeded a Washington State water quality standard. Azinphos-methyl, chlorpyrifos, diazinon, and 4,4'-DDE results were above the numeric component of various standards, but data were insufficient to characterize the time component of these standards. Most chemicals had limited or no criteria available with which to compare concentrations.

Urban run-off frequently contains other chemicals in addition to pesticides and, therefore, semivolatile organic compounds (SVOCs) were analyzed in Thornton Creek. Thirty-eight compounds were detected; the majority of detections occurred during three storm events. Phthalates and polynuclear aromatic hydrocarbons were the most frequently detected compounds in the SVOC analyses.

Sampling efforts in the urban and agricultural watersheds resulted in 644 pesticide (and degradate) detections out of 153 sampling events. Each sampling event was tested for 144 pesticides. Thus, 22,032 (153*144) chemical analyses were run in 2003.

Fifty-four sampling events were conducted within Thornton Creek (18 at each of Thornton 1, 2, and 3) between April and December 2003 (Table 3). Herbicides comprise the majority of the chemical profile. However, pentachlorophenol (0.0047 – 0.083 μg/L), a wood preservative, was the most commonly detected compound, followed by dichlobenil (0.0038 – 0.34 μg/L) and triclopyr (0.0094 – 0.19 μg/L). The most common organophosphorous insecticide, diazinon, was detected in 46% of the samples, and the maximum concentration was 0.21 μg/L at Thornton 2.

Ninety-nine sample events were conducted within the Lower Yakima watershed between April and October 2003. Several chemical classes were detected, including organophosphate and chlorinated and carbamate pesticides.

Herbicides were the most frequently detected compounds. 2,4-D, atrazine, and bromacil were detected in 87%, 58%, and 52% of all agricultural samples, respectively. Chlorpyrifos and azinphos-methyl (Guthion) were the most frequently detected organophosphate pesticides and had a detection rate of 38% and 13%, respectively. Marion Drain samples differed slightly from the average. Terbacil was the most frequently detected herbicide within Marion Drain and was present in 73% of samples. Similarly, dimethoate was the second most common organophosphate pesticide and was present in 24% of samples within the Marion drainage. Chlorinated pesticides are principally represented by á-endosulfan and its degradate endosulfan sulfate. Relative to other samples collected, singular high concentrations of carbaryl (1.8 μg/L at Spring 2 and 10 μg/L at Spring 1) and 2,4-D (1.9 μg/L at Marion 1) were detected. The majority of pesticide/herbicide results were estimated between the method detection limit and the practical quantitation limit.

Forty-five sampling events were conducted in the Spring Creek drainage: 12 samples from Spring 1 (upstream), 12 samples from Spring 2 (midstream), and 21 samples from Spring 3 (downstream). Spring 3 represents the reach terminating at the confluence with the Lower Yakima River.

Herbicides account for the majority of detections, 79%, and were dominated by 2,4-D, bromacil, and atrazine. 2,4-D and bromacil were the most frequently detected chemicals and were present in 73% and 62% of the samples, respectively. Organophosphorous pesticides made up 15% of the chemical detections. The most abundant organophosphorous pesticide, chlorpyrifos, was detected in 36% of the samples.

The Sulphur Creek Wasteway drainage had one sampling station located near the confluence of the Lower Yakima River. Sulphur 1 was tested on 21 different occasions for pesticides. Herbicides account for 81% of the chemical detections within Sulphur Creek Wasteway. 2,4-D, bromacil, and atrazine were detected in 95%, 67%, and 48% of the sampling events, respectively. Organophosphorous insecticides make up 13% of the chemical detections. The frequency of organophosphorous detection is spread between chlorpyrifos (14%), azinphosmethyl (14%), diazinon (10%), and dimethoate (10%).

in 49% and 62% of the samples, respectively. Organophosphorus pesticides made up 15% of the chemical detections. The most abundant organophosphorus pesticide, chlorpyrifos, was detected in 36% of the samples.

The Sulphur Creek Wasteway drainage had one sampling station located near the confluence of the lower Yakima River, Sulphur 1. We tested for 26 different compounds. For pesticides, herbicides account for 81% of the chemical detections within Sulphur Creek Wasteway. 2,4-D, bromacil, and simazine were detected in 95%, 67%, and 48% of the sampling events, respectively. Organophosphorus insecticides made up 13% of the chemical detections. The frequency of organophosphorus detection is spread between chlorpyrifos (14%), azinphos-methyl (14%), diazinon (10%), and disulfoton (10%).

Section II
Bee Poisoning, Environmental Toxicology, Regulatory Issues

WASHINGTON STATE COMMISSION ON PESTICIDE REGISTRATION

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In response to the unmet pest management needs, the Washington legislature unanimously voted to create the Washington State Commission on Pesticide Registration (WSCPR) in 1995. The purpose of the Commission was to obtain and maintain pesticide registration for minor uses and minor crops in Washington State. The Commission was to be made up of 12 voting members from various stakeholder groups and 5 public sector state agencies. The Commission was given a $500,000 budget. In 1999, the WSCPR's mandate was expanded to cover all aspects of integrated pest management. Accordingly, the budget of the Commission was expanded.

Since its inception, the Commission has funded more than 400 projects impacting approximately 100 crops. The past, present and expected economic impact of these projects is estimated to be more than $1 billion. The primary recipient of WSCPR funds has been Washington State University, which has received in excess of 66% of Commission funds. University of California – Davis has been the second largest recipient of funds, followed by Oregon State University. Private entities have received less than 5% of Commission funds.

The Commission continues to seek out worthwhile projects. Proposals must be submitted by a group, formally structured or not, that controls pests. Universities, researchers and extension specialists are not qualified to submit proposals, but may do so on behalf of a requesting group. Anyone wishing to submit a proposal to the Commission should first carefully review its Request for Proposals, which may be found at www.wscpr.org.

October 27, 2004 Yakima Meeting

#	WSCPR #	Commodity	Chemical or Pest	Project Type	Researcher and Institution	Old Mandate	New Mandate	Matching in cash	Matching in kind	Total Project Cost
1	05AN001	Apple	Post Harvest Codling Moth	Quarantine	Neven / USDA		15,090	15,090	15,090	45,270
2	05PN002	Forestry	Spray Drift	E	Ice/ NCASI		49,246	105,000	70,500	224,746
3	05AN003	Grapes	Mites and Leafhoppers	IPM	James/ WSU		15,056	15,056		30,112
4	05AN004	Hops	Mites and Leafhoppers	IPM	James/ WSU		15,056	15,056		30,112
5	05PN005	Onion Seed	Virus and thrips	E / P	duToit/ WSU	9,852		7,500	1,300	18,652
6	05PN006	Carrot seed	Bacterial Blight	E/ IPM	duToit/ WSU	6,800	1,700	5,000	500	14,000
7	05PG007	Hops	Spider Mite and Weed	R	Walsh / WSU		25,940	25,200		51,140
8	05AN008	Wheat	Aphids/ BYDV	IPM	Pike / WSU		14,001	14,928		28,929
9	05AN009	Organic Vegetables	Weeds	IPM	Miles / WSU		14,691	14,691		29,382
10	05PG010	Potato	Spider Mite / Hexythiazox	R	Hebert / WSU	6,400		6,400		12,800
11	05AN011	Wine grapes	Imazethapyr	persistance	Ball / OSU	17,150			500	17,650
12	05PN012	Stonefruit	Peach Twig Borer	E / IPM	Walsh / WSU	25,238	8,412	33,500	2,400	69,550
13	05AN013	Stonefruit	Thrips	E / IPM	Walsh / WSU	5,950	13,884	15,000	2,000	36,834
14	05PN014	Poplar	Carpenterworm	E / IPM	Walsh / WSU	21,016	21,017	41,177	89,600	172,810
15	05AN015	Alfalfa Seed	Lygus	E / IPM	Walsh / WSU	9,350	9,350	19,500	500	38,700
16	05PN016	Grapes	Pyrethroids	E / IPM	Walsh / WSU	8,773	8,773	34,863		52,409
17	05PN017	Mint	Caterpillar Control	E / IPM / PR	Walsh / WSU	7,500	7,500	17,000	1,000	33,000
18	05PN018	Bulbs	Weeds	E / P	Miller / WSU	3,150		3,000	150	6,300
						121,179	219,716	387,961	183,540	912,396

Portland, Oregon Meeting January 4 and 5, 2005

#	WSCPR #	Commodity	Chemical or Pest	Project Type	Researcher and Institution	Old Mandate	New Mandate	Matching in cash	Matching in kind	Total Project Cost
19	05AN019	Potatoes	Wireworm	IPM	Horton / USDA-ARS		15,400	19,300		34,700
20	05PN020	Mint	Weeds	E,P	Boydston / USDA	4,000		12,889		16,889
21	05PN021	Snap Beans	Weeds	E,P	Boydston / USDA	3,000		2,000	100	5,100
22	05AN022	Pest Controllers	Ants	IPM, O	Hansen / SFCC		3,132		3,132	6,264
23	05AN023	Red Raspberries	Various pests	Equipment	Nicholson / WSU	1,178	2,750	3,000		6,928
24	05AN024	Pest Controllers	WDOs	IPM	Foss / WSU		11,990	20,504	5,383	37,877
25	05AN025	Tree Fruit	Leafrollers	E, IPM, PR	Brunner / WSU	6,152	18,453	25,898		50,503
26	05AN026	Red Raspberries	Root Rot	IPM	MacConnell/WSU		30,000	10,000		40,000
27	05PN027	Peas/Limas	Disease	E, IPM	Hamm / OSU	6,000	6,000	6,000		18,000
28	05AN028	Carrot	Disease	E,IPM,PR	Hamm / OSU	1,800	7,200	5,000		14,000
29	05AN029	Grass seed	Disease	E, IPM	Hamm / OSU	2,800	5,200	8,000		16,000
30	05PN030	Cranberry	Multiple Pests	E, P, IPM	Patten/Bristow/WSU	18,800		18,170	7,800	44,770
31	05PN031	Oyster	Burrowing Shrimp	E, IPM	Patten / WSU	19,286	4,821	18,467	1,000	49,074
32	05AN032	Wheat	Weeds/Disease	IPM	Gallagher / WSU		14,000	14,000		28,000
33	05AN033	Hops	Mites and Aphids	IPM	James/ WSU		4,037	4,037		8,074
34	05AN034	Hops	Hop Looper	IPM	James/ WSU		7,293	7,293		14,586
35	05AN035	Tree Fruit	Weather System	IPM	Pierce/Elliot/WSU		35,000	115,022		150,022
36	05AN036	Potatoes	Potato Tuber Moth	E, IPM	Hamm / OSU	5,381	9,994	38,050		53,425
37	05PN037	Christmas Trees	Root Aphids	E	Stark / WSU	7,782		7,782		15,564
38	05PN038	Christmas Trees	Disease	E, P	Chastagner/Hansen	13,242		26,374		39,616
39	05PN039	Apple	Rot	E, IPM	Chang-Lin Xiao	10,080	2,520	13,372		25,972
40	05AN040	Butterflies	Herbicides	IPM	Schultz / WSU		18,164	17,969	4,866	40,999
41	05PN041	Asparagus	Aphids/ Weeds	E, P	Schreiber/ ADG	26,500		26,500	4,500	57,000
42	05AN042	Grains	Cereal Leaf Beetle	IPM	Miller/Pike/Roberts		6,980	15,592		23,072
43	05AN043	Organic Vegetables	Green Peach Aphid	IPM	Miller/Pike/Snyder		7,400	9,800		17,200
44	05PN044	Dill Growers	Weed Control	E, P	Schreiber/ ADG	6,000		3,000		9,000
45	05PN045	Bean Seed	Leafhoppers	E, P	Schreiber / ADG	3,500		2,500		6,000

46	05PN046	Nursery	Structural Pests	E, IPM, PR	Walsh / WSU	22,500	7,500	30,000	12,750	72,750
47	05AN047	Potato	Green Peach Aphid	IPM	Pike/ Rayapati		29,690	24,685	20,347	74,722
48	05PN048	Concord Grapes	Thrips	E, IPM	Walsh / WSU	5,148	572	9,000		14,828
49	04AN049	Carrots	Carrot Rust	IPM	Muehleisen/Riga		15,615		15,500	31,115
50	05AN050	Bees	Mites	IPM	Sheppard / WSU	2,977	11,907	2,000	6,000	22,884
51	05AN051	Bees	Mites	IPM	Sheppard / WSU		16,660		14,000	30,660
52	05AN052	Oysters	Herbicide Toxicity	O	Grue		13,890	2,250	21,403	37,543
53	05PN053	Blueberries	Weed Control	E, P, IPM	Miller/ WSU	1,790	1,790	3,564		7,144
54	05PN054	Beet/Chard Seed	Weed Control	E, P	Miller/ WSU	4,340		3,280		7,620
55	05AN055	Oysters	Burrowing Shrimp	IPM, O	Booth/Cheney/ PSI					
56	05AN056	Apples	Thrips	IPM	Horton / WSU		10,000	15,000		25,000
57	05PN057	Grass seed	Weeds	E, P	Ball / OSU	14,500		15,150		29,650
58	05PN058	Peas/Lentils	Broadleaf Weeds	E, P, IPM, O	Yenish/ WSU	7,500	2,500	5,000		15,000
59	05PN059	Blueberries	Aphids/Root Weevils	E	Tanigoshi / WSU	3,775		3,775		7,550
								564,223	116,781	1,205,101
				FY 2005 Proposed Projects Totals:		**198,031**	**$320,458**	**$564,223**	**$367,180**	**$1,881,481**

Total Requested: $518,489 **Total Match $931,403**

Key: E-Efficacy Trial; E. Fate-Environmental Fate; IPM-Integrated Pest Manageme P-Phytotoxicity PR- Pesticide Resistance R- Residue B-Biocontrol O-Other

SECTION III

Biological & Cultural Controls

****

Section Leader

Barry Bai

Section III.
Biological & Cultural Control

Metarhizium anisopliae for Black Vine Weevil Control in Container-Grown Nursery Stock

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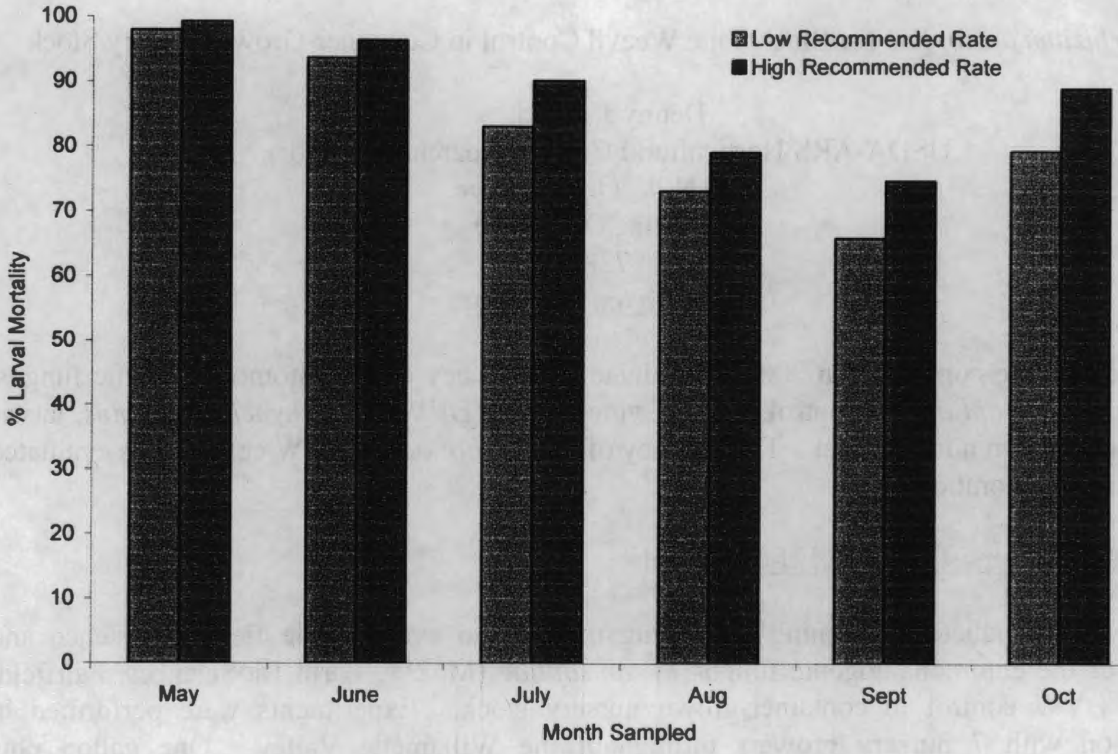
Experiments were conducted in 2004 to evaluate the efficacy of the entomopathogenic fungus, *Metarhizium anisopliae*, for control of black vine weevil (BVW), *Otiorhynchus sulcatus*, larvae in container-grown nursery stock. The efficacy of *M. anisopliae* for BVW control was evaluated as a media incorporation.

2003 Container Persistence and Efficacy Trials

Studies were conducted beginning the spring of 2004 to evaluate the field persistence and efficacy of the entomopathogenic fungus *M. anisopliae* (M52™, Earth BioSciences, Fairfield, CT) for BVW control in container-grown nursery stock. Experiments were performed in cooperation with 7 nursery growers throughout the Willamette Valley. One gallon pots containing a variety of woody ornamentals were incorporated with the low (2.27×10^{11} spores/yd^3) and high (4.54×10^{11} spores/yd^3) recommended rates of M52. Containers at each nursery were arranged in a completely randomized design with 3 replications and placed in the can yard at each respective nursery. Containers were randomly selected each month from May-October 2004 and returned to the laboratory. At the laboratory the soil from each container was infested with 10 late instar BVW (obtained from a BVW colony maintained at the USDA-ARS Horticultural Crops Research Laboratory). After two weeks, the numbers of dead larvae in each treatment were determined. The results from the 2004 growing season are presented below (Figure 1). The study will continue through the 2005 growing season to determine the long-term persistence and efficacy of the fungus at controlling BVW infestations.

Figure 1 Average Larval Mortality From All Locations



Section III
Biological & Cultural Control

OREGON CEREAL LEAF BEETLE BIOLOGICAL CONTROL PROGRAM, 2004

B.B. Bai[1], R.A. Worth[1], Kathleen J. R. Johnson[1], and Gary Brown[2]
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Introduction
Cereal leaf beetle, *Oulema melanopus* (CLB), was first identified in Michigan in 1962 as an introduced pest from Europe. It spread to many states east of the Mississippi River and by the early 1990's, the pest was found in four western states – Wyoming, Montana, Utah and Idaho. Oregon first found CLB in 1999 in Malheur County. A statewide survey for CLB continued for a sixth year in 2004. CLB was not found in any new counties in 2004. To date, CLB has been detected in 19 counties: Benton, Clackamas, Columbia, Lane, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill in western Oregon and Baker, Crook, Deschutes, Jefferson, Malheur, Umatilla, Union, and Wallowa in central and eastern Oregon.
Biological control has been effective in the eastern US where the invasive beetle first caused serious damage. The biological control program for CLB in Oregon began immediately after its detection in 1999 with field releases of parasitoids in growers' fields from 1999 through 2003. Through USDA funding, administered by ODA, a specialty crop grant from the Oregon Hay and Forage Association was awarded to continue the bio-control program by starting two field insectaries in 2002 with the long term goal of rearing and redistributing CLB biocontrol agents within the state. In 2004, we continued work in a three-year old insectary near Banks in Washington County, which was started for the rearing of *Anaphes flavipes*, a CLB egg parasitoid. A second insectary for *A. flavipes* was started near Scholls in 2004 so that releases could be made there without interfering with recovery efforts at the Banks insectary. We also monitored a second, three-year old insectary, started in cooperation with OSU at the research station in Union County, for *Tetrastichus julis*, a larval parasitoid of CLB. In 2003 a third insectary, also for *T. julis,* was established at the OSU research station near Vale in Malheur County. Unfortunately, the insectary was moved after only one year to a private grower's field in Ontario in 2004. Also in 2004, two new volunteer insectaries were started for rearing *T. julis*, one at the OSU Hyslop Farm research station near Corvallis in Benton Co. and the other near Madras in Jefferson Co.

The egg parasitoid – *Anaphes flavipes*
An estimated 26,213 *A. flavipes* were released into the new insectary in Scholls. As in 2003, most of the *A. flavipes* wasps received from the APHIS-Niles biocontrol lab in Michigan were released as parasitized CLB eggs on picked oat leaves and placed with a sponge inside small, modified paper milk cartons mounted on wooden stakes in the field. The rest were released as parasitized CLB eggs in small petri dishes inside the same carton and stake assembly. About 7,000 adult CLB were also released into the insectary to augment CLB egg density.

This year marked our first true recovery (successful overwintering) of *A. flavipes* from the Banks insectary after two years of releases. The field, which was again planted to winter wheat and spring oats, was closely monitored and CLB eggs were collected and tested on a regular basis for presence of *Anaphes* wasps. Early development of *A. flavipes*, particularly the red eye stage, can be viewed through the side of the CLB egg. Also, an additional 8,500 CLB adults were released to increase egg numbers. *A. flavipes* was detected in 6 out of 16 samples collected. The parasitism rate (PR) ranged between 1.5% to 50% with an average of 21.3%.

The larval parasitoid – *Tetrastichus julis*

CLB larvae, parasitized by *T. julis*, were released in two counties, and only in the insectary fields (estimated numbers released): Benton (45,066) and Malheur (5,628). Parasitized CLB larvae were acquired from Pennsylvania (7,927), Wyoming (2,500), and Montana (2,275). The parasitism rates among CLB larvae from those states, ranged from about 20% to 100%. Additional CLB larvae and adults collected from Union County were also released into the *T. julis* insectaries in Ontario (900), Madras (2,900), and Corvallis (5,000) in an effort to augment CLB populations in those fields.

There was widespread recovery of *T. julis* from nearly all places where it had been previously released and numbers were exceptionally high in a few locations. An early, warm spring and early season spraying kept the number of CLB larvae low in production fields in Malheur County in 2004. A small number of recovery samples were taken in the area and the PR was still at a low 1.5%. The Union County insectary was left alone after 2003 to let *T. julis* numbers increase naturally. Collections there indicated that the PR was still low, ranging from 2.3 to 5%. However, other previous release sites in private grower fields near La Grande yielded an outstanding PR of 77% in one location and 50% in another. Similarly, Baker County had a high PR of 72% in one location. This year also marked the recovery of *T. julis* in western Oregon in Multnomah County on Sauvie Island, where releases have been made since 2000. It was collected from two locations where the PR ranged from 1.8 to 11.4%.

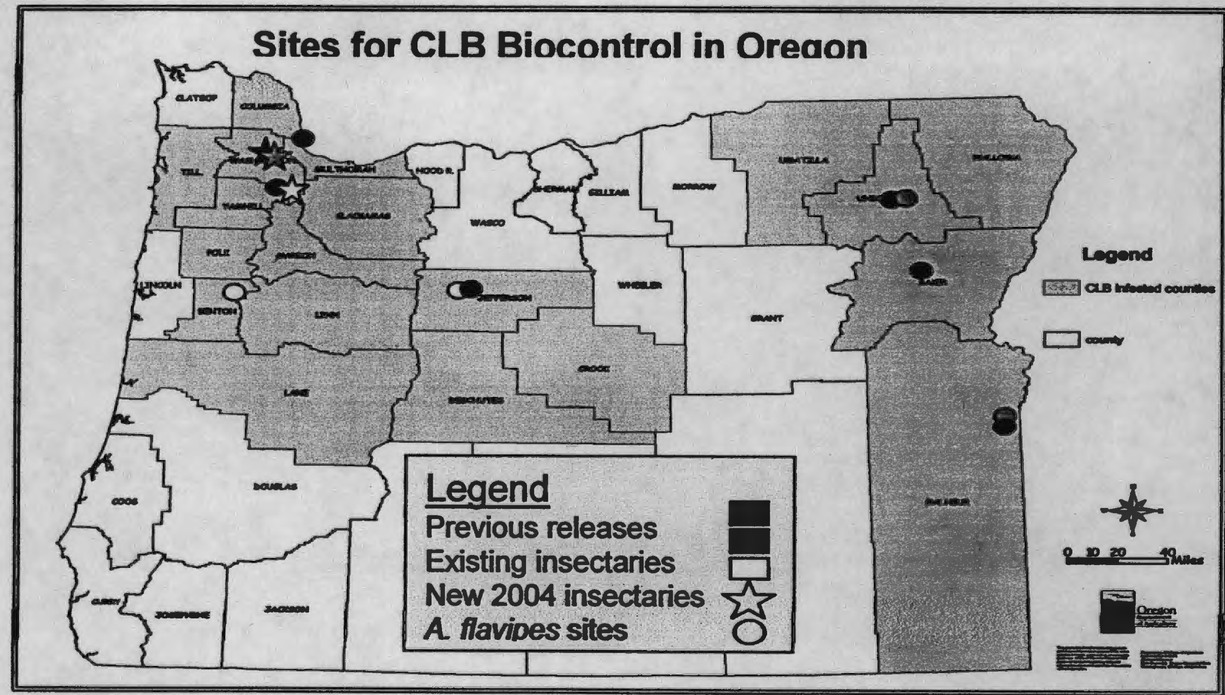
Pesticide use

Successful biological control is needed for a healthier farm and landscape environment. A pesticide warehouse survey by USDA in 2003 indicated that insecticide-treated acreage for CLB in Oregon had dramatically increased from none in 1999, to 1,390 acres in 2000, 12,217 acres in 2001, 26,703 acres in 2002, and 38,309 acres in 2003. The number jumped to 64,200 acres in 2004.

Conclusions

All of the pyrethroid treatments applied with the transplant fertilizers in large scale plots provided control of garden centipedes in transplanted tomato fields with a history of extensive damage. These materials are currently registered for use in tomatoes. The lack of damage in the untreated control plots this year prevents us from analyzing these results. While in the past three years we have been able to treat small areas in the middle of large problem spots and show differences, it is not understood why we were not able to treat large areas and show differences in small untreated sections.

The thorough incorporation of these pyrethroids prior to transplanting with a rototiller was very effective in the small plots, as in previous year's research trials.


Sites for CLB Biocontrol in Oregon
Legend
Previous releases
Existing insectaries
New 2004 insectaries
A. flavipes sites
Legend
CLB infested counties
county
0 10 20 40 Miles
CLATSOP
COLUMBIA
MULTNOMAH
HOOD R.
WASCO
SHERMAN
GILLIAM
MORROW
UMATILLA
WALLOWA
YAMHILL
CLACKAMAS
POLK
LINCOLN
BENTON
LINN
JEFFERSON
WHEELER
GRANT
BAKER
CROOK
DESCHUTES
LANE
DOUGLAS
COOS
CURRY
JOSEPHINE
JACKSON
MALHEUR

Section III
Biological and Cultural Controls

DEVELOPMENT OF AN INTEGRATED PEST MANAGEMENT PROGRAM FOR THE CEREAL LEAF BEETLE (*Oulema melanopus*) IN OREGON.

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The cereal leaf beetle (*Oulema melanopus*) is a serious new pest of cereal grains and other grass-host species in Oregon and the Pacific Northwest region. Cereal leaf beetle (CLB) was first identified in Oregon in 1999. In the absence of natural predators, the pest continues to rapidly expand its range and population levels throughout Oregon and the region. Adult and larvae feeding damage to host crop plant foliage results in crop yield loss and increased production costs. Currently, insecticide application provides the only effective means of control available to growers.

In the absence of quantifiable regional information on crop yield impacts and threshold levels, insecticide usage for CLB control increased significantly in Oregon during the short period of time since its introduction. Insecticides are often applied to cereal crops when adults, larvae, or damage are first observed. In some cases, early-season prophylactic insecticide treatments are included in herbicide tank mixtures in order to avoid additional costs of later applications. Such applications do not always provide adequate CLB control and require follow-up insecticide application to mitigate further damage. In Oregon, no acres were treated for CLB control prior to 2000. In 2004, approximately 64,000 acres were treated with an insecticide at an estimated cost of $770,000 to Oregon growers. CLB establishment in areas of major grass seed production cause concern due to observations of damage to grass seed crops during the last two years.

In response to the CLB threat, a series of research and biological control projects have been conducted during the last three years in an effort to develop an integrated CLB management program (ICLBMP). The goal of the ICLBMP is to develop economic yield threshold levels for winter and spring wheat varieties typically grown in the PNW, reduce production costs through judicious insecticide use, reduce the potential for development of CLB insecticide resistance, and enhance the establishment of CLB bio-control agents. Data and knowledge gained from this effort will benefit growers and bio-control agent establishment efforts in Oregon and the PNW. Projects to date include:

Winter and Spring Wheat Yield Impact/Economic Threshold:

In spring of 2004, a field study was initiated in Union County, OR to determine wheat yield loss due to cereal leaf beetle damage. Cereal leaf beetle infestation levels will be correlated with yield loss for the development an economic threshold which will improve the insecticide application decision-making process. The 2004 study was conducted in 3 soft white winter, 3 soft white spring, and 1 dark northern spring wheat commercial production fields. Treatments were replicated 3 times and included: 1) insecticide application; and 2) no inspective. Replicated treatment plots were 1/3 of an acre in size. Cereal leaf beetle egg and larvae populations were collected immediately prior to insecticide applications. Wheat flag and F-1 leaf samples were collected when approximately 90% of the larvae population entered the pupation stage. Leaf samples were laminated for later foliage damage assessment. Yield data was collected using commercial combines and a weigh wagon. The study will be continued in 2005.

Host Range of Cereal Leaf Beetle:

A 2-year study was conducted near LaGrande, OR in Union County to examine the response of over-wintering and late summer adults to fall and spring planted grasses in the presence of oats and triticale. Grass species included in the study were perennial ryegrass, annual ryegrass, orchardgrass, Kentucky bluegrass, fine fescue, and tall fescue. The experiment was a randomized complete block design with 3 replications. Weekly observations were made on the number of adults, eggs, and larvae in 1-ft row samples from the end of April till the first week in July.

Aggregation Pheremone:

A CLB aggregation pheremone identified, isolated, and synthesized by Cosse et al. was evaluated for the development of a monitoring tool for use in a CLB management program. A dose response and trapping mechanism study was conducted for two years in collaboration with Allard Cosse and Robert Bartelt (USDA-ARS, Peoria, IL), and with Pherotech, a commercial pheremone-lure manufacturing company (British Columbia). The study determined that a 5 mg pheremone dose added to rubber septa and attached to an inverted-T sticky trap was most effective in capturing and retaining adult CLB. The next step is to develop a marketable product for use in monitoring programs conducted by federal/state agencies responsible for invasive species monitoring, researchers, and field consultants.

Biological Control:

In cooperation with the USDA-APHIS and the Eastern Oregon Agricultural Research Center in Union, OR, a field insectary was established in 2002 to facilitate the rearing of *Tetrastichus julis*, a parasitoid wasp which attacks CLB larvae, in a protected area. The 12-acre field is arranged in a series of winter and spring grain plantings to provide adequate habitat for the development of both pest and parasitoid wasp. Three years after establishing the insectary, surveys conducted by USDA-APHIS reported 77% parasitism rate of CLB larvae collected from a commercial wheat field located 10 miles away.

Tri-State CLB Working Group:
Since the CLB poses a threat to the PNW region, a Tri-State CLB Working Group was organized by Diana Roberts, WSU Extension, in September 2004. The group is made up of several members representing the state departments of agriculture, land grant universities, and USDA-APHIS in Oregon, Washington, and Idaho. The goal of this working group is to coordinate biological control, research, and education efforts in the PNW region. To date, the group has identified and demonstrated the biological control needs in each state, sought formal assistance at the federal level to continue support for rearing CLB parasitoids, and obtained cooperative support from the Colorado State Department of Agriculture, Pallisades Laboratory, and the USDA-PPQ, Mission, TX, as a source for the CLB egg parasitoid, *Anaphes flavipes*.

Acknowledgments: Sujaya and I would like to thank Bryon Quebbeman for his professional contributions to CLB research in Union County.

a parasitoid wasp, which attacks CLB larvae, in a protected area. The 12-acre field is arranged in a series of winter and spring grain plantings to provide adequate habitat for the development of both pest and parasitoid wasp. Three years after establishing the insectary, surveys conducted by USDA-APHIS reported 97% parasitism rate of CLB larvae collected from a commercial wheat field located 10 miles away.

PNW State CLB Working Group

Since the CLB poses a threat to the PNW region, a Tri-State CLB Working Group was organized by Diana Roberts, WSU Extension, in September 2004. The group is made up of several members representing the state departments of agriculture, land-grant universities, and USDA-APHIS in Oregon, Washington, and Idaho. The goal of the working group is to coordinate biological control research and education efforts in the PNW region. To date, the group has identified and documented the biological control needs in each state, sought financial assistance at the federal level to continue support for rearing CLB parasitoids, and obtained cooperative support from the Colorado State Department of Agriculture, Palisade Laboratory, and the USDA-APHIS Mission, TX, as a source for the CLB egg parasitoid, *Anaphes flavipes*.

Acknowledgments: Sujaya and I would like to thank Bryon Quebbeman for his professional contributions to CLB research in Union County.

SECTION IV

Cereal Crop Insects

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Section Leader

Byron Quebbeman

Section IV Cereal Crop Insects

WHEAT: *Triticum avenae* L. 'Alpowa'

SEED TREATMENT INSECT CONTROL IN SPRING WHEAT, 2004

David Bragg, Cathlin Donohue, Washington State University, Extension Entomology, P O Box 190,Pomeroy WA 99347-0190, and Kurt Tetrick, USDA-ARS WREPMIC Central Ferry, WA99347

Pacific Coast Wireworm (WW): *Limonius canus* LeConte
Russian wheat aphid (RWA): *Diuraphis noxia* (Mordvilko)

An experiment consisting of a RCB of 6 seed treatments (4 replicates) was seeded using a small plot drill on 7 Apr (60 lb acre) at the USDA-ARS Western Regional Plant Materials Introduction Center at Central Ferry, WA. Seeding was into failed winter wheat which had been seeded on sweet corn ground to encourage wireworm presence. The crop emerged on 12 Apr. Wireworm damage was evaluated by mean plant stand counts per 18 inches of row at 10 DAPE. Mean grain heads per plant were counted prior to harvest as a measure of plant vigor. Differences in plant stand varied between treatments with the two rates of Poncho and Gaucho 480 0.32 fl/oz cwt being significantly higher than the other treatments and UTC.
Heads per plant were significantly higher for the two rates of Poncho compared to the other treatments and the UTC. Since RWA appeared after plant stand and head counts were established, differences in plant stand are attributed to wireworm attack on the seedling plants. RWA appeared at just prior to anthesis, and at 48 DAPE counts of mean percent RWA infested tillers were made. Yield data in bu per acre were collected by small plot combine 22 Jul.
All 5 seed treatments provided better control of RWA compared to the UTC. Poncho™ 600 provided slightly better yields compared to the 0.32 fl oz/cwt Gaucho 480 treatment. These 3 treatments were better than the other treatments, and the UTC.

Treatment/formulation	Rate fl/oz cwt	Mean percent RWA infested tillers 48 DAPE
Poncho 600 (5 lb/gal)	0.20	0.25c
Poncho 600	0.10	0.50c
Gaucho 480	0.32	1.00c
Cruiser	0.19	2.50b
Gaucho 480	0.16	2.50b
UTC	-------	18.50a

Means followed by same letter are NSD. ANOVA; LSD $p = 0.05$.

Treatment/formulation	Rate fl/oz cwt	Bu wheat per acre yield
Poncho 600	0.20	79.75a
Poncho 600	0.10	79.70a
Gaucho 480	0.32	75.83b
Cruiser	0.19	69.73c
Gaucho 480	0.16	67.88c
UTC	--------	67.40d

Means followed by same letter are NSD. ANOVA; LSD p= 0.05.

Treatment/formulation	Rate fl/oz cwt	Mean plants/18 inches of row 10 DAPE
Poncho 600	0.20	16.00a
Poncho 600	0.10	15.50a
Gaucho 480	0.32	14.00a
Gaucho 480	0.16	11.00c
Cruiser	0.19	10.75c
UTC	-------	9.00d

Means followed by same letter are NSD. ANOVA; LSD p = 0.05.

Treatment/formulation	Rate fl/oz cwt	Mean mature grain heads/plant at harvest
Poncho 600	0.20	4.96a
Poncho 600	0.10	4.27ab
Cruiser	0.19	3.86b
Gaucho 480	0.32	3.86b
Gaucho 480	0.16	3.65b
UTC	------	3.81b

Means followed by same letter are NSD. ANOVA; LSD $p = 0.05$.

RUSSIAN WHEAT APHID CONTROL IN SPRING BARLEY, 2004

David Bragg, and Cathlin Donohue
Washington State University Extension Entomology
P O Box 190
Pomeroy WA 99347-0190

Russian wheat aphid (RWA): Diuraphis noxia (Mordvilko) on BARLEY: *Hordeum vulgare* L. 'Baronesse'

An experiment consisting of a RCB of 4 treatments (4 replicates) was seeded using a small plot drill on 7 Apr (60 lb acre) at the USDA-ARS Western Regional Plant Materials Introduction Center at Central Ferry, WA. The crop emerged on 13 Apr. RWA appeared at just prior to anthesis, and foliar applications of 2-rates Flonicamid 50SG and Mustang Max were made 47 DAPE using a CO2 back pack sprayer at 20gpa/20psi after a pre-count of mean percent RWA infested tillers. Mean percent infested tillers were counted at 15-DAT, and Yield data in lbs per acre were collected by small plot combine 22 Jul.

All 3 treatments provided control of RWA compared to the UTC. The higher rate of Flonicamid and Mustang Max provided slightly better yields compared to the lower Flonicamid rate and the UTC. The value of the Mustang Max and higher Flonicamid treatments was $31 per ton over the UTC based on harvest price, with the lower Flonicamid treatment returning $15 per ton over the UTC.

Mean percent RWA infested tillers

Treatment/formulation	Rate lb aia	47 DAPE	15-DAT
Mustang Max 2E	0.02	18.00a	0.63b
Flonicamid 50SG	0.089	18.25a	0.38b
Flonicamid 50SG	0.0623	18.25a	1.25b
UTC	-------	18.00a	29.00a

Means followed by same letter are NSD. ANOVA; LSD $p = 0.05$.

Treatment/formulation	Rate lb aia	Lbs barley per acre yield
Mustang Max 2E	0.02	4772.9a
Flonicamid 50SG	0.089	4748.0a
Flonicamid 50SG	0.0623	4348.5b
UTC	--------	3957.6c

Means followed by same letter are NSD. ANOVA; LSD $p = 0.0$

Section IV Cereal Crop Pests

RUSSIAN WHEAT APHID CONTROL IN SPRING WHEAT, 2004b

David Bragg, Cathlin Donohue, Washington State University, Extension Entomology, P O Box 190, Pomeroy WA 99347-0190, and Kurt Tetrick, USDA-ARS Plant Introduction Manager, Central Ferry, WA 99347

Russian wheat aphid (RWA): *Diuraphis noxia* (Mordvilko) Wheat: *Triticum avenae* L. 'Alpowa'

An experiment consisting of a RCB of 4 treatments (4 replicates) was seeded using a small plot drill on 7 Apr. (60 lb acre) at the USDA-ARS Western Regional Plant Materials Introduction Center at Central Ferry, WA. The crop emerged on 12 Apr. RWA appeared at just prior to anthesis, and foliar applications of 2-rates Flonicamid 50SG and Mustang Max were made 48 DAPE using a CO2 back pack sprayer at 20gpa/20psi after a pre-count of mean percent RWA infested tillers. Mean percent RWA infested tillers were counted at 15-DAT, and yield data in bu per acre were collected by small plot combine 22 Jul.
All 3 treatments provided control of RWA compared to the UTC. The higher rate of Flonicamid and Mustang Max provided slightly better yields compared to the lower Flonicamid rate and the UTC.

		Mean percent RWA infested tillers	
Treatment/formulation	Rate lb aia	48-DAPE	15-DAT
Mustang Max 2E	0.02	18.50a	0.13b
Flonicamid 50SG	0.089	18.75a	0.25b
Flonicamid 50SG	0.0623	18.75a	0.25b
UTC	-------	19.25a	29.50a

Means followed by same letter are NSD. ANOVA; LSD $p = 0.05$.

Treatment/formulation	Rate lb aia	Bu/Acre wheat yield
Mustang Max 2E	0.02	72.43a
Flonicamid 50SG	0.089	75.38a
Flonicamid 50SG	0.0623	67.33c
UTC	--------	63.10d

Means followed by same letter are NSD. ANOVA; LSD $p= 0.05$.

SECTION V

Soil Arthropods

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Section Leader

Juan Alvarez

Section V.
Soil Arthropods

EVALUATION OF SOIL APPLIED INSECTICIDES FOR CONTROL OF GARDEN CENTIPEDES, *Scutigerella immaculata*, IN TOMATO FIELDS

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Experimental plots were established at Hal and Keith Robertson Farms, Tracy, California, and Bill Alderson Farms in Vernalis, California, in order to evaluate the effectiveness of four different materials for control of the garden centipede in transplanted tomato fields. The plot areas were selected based on evidence of garden centipede damage from previous years. The treatments were applied by mixing the materials with the preplant fertilizers and placed into the beds using two shanks per bed approximately 6 inches apart at a depth of 5-6 inches. The amount of fertilizer applied was between 25 and 28 gallons/acre. All materials were applied on April 5, 2004.

The plots at Hal and Keith Robertson Farms were 5 beds wide by 2,400 feet long or 1.7 acres replicated 6 times through the field. The variety was NP 113. Untreated control plots 1 bed wide by 60 feet long were left in the middle of the field in the center of the area with the most damage from previous years. Damage was not observed this year in the untreated controls in the small plots, probably due to the high level of control of surrounding treatments. The field was furrow irrigated immediately after the application to help the transplants establish in the field. There were no measurable differences between treatments in this field. All materials were very effective in controlling damage from the centipede.

At Bill Alderson's farm, plot size was 3 beds wide by 1,700 feet long or 0.7 acres replicated 3 times. The transplant variety was 9780. The field was sprinkler irrigated 4 times followed by furrow irrigations for the rest of the season. All treatments were effective in controlling damage from garden centipedes. Outside of the treated area, extensive damage was observed as the centipedes apparently had spread to a new area of the field.

Materials Applied with Preplant Fertilizers, Large Plots

Products	Active Ingredient	Method of Application	Formulation	Product/Acre
Mustang	Zeta-cypermethrin	Shank in with fertilizer	1.5EW	4.3 oz
Danitol	Fenpropathrin	Shank in with fertilizer	2.4EC	10.7 oz
Warrior	Lambda-cyhalothrin	Shank in with fertilizer	1CS	3.8 oz
Baythroid	Cyfluthrin	Shank in with fertilizer	2E	2.8 oz
Untreated Control	fertilizer only			

Results from Large Plots at Bill Alderson's Farm

Products	Method of Applicatio	Formulation	Product/Acre	Mean # of Grams/Plant
Baythroid	Band & Incorporate	2 E	2.8 oz	111.5a
Mustang	Band & Incorporate	1.5 EW	4.3 oz	107.1a
Danitol	Band & Incorporate	2.4 EC	10.7 oz	96.3a
Warrior	Band & Incorporate	1 CS	3.8 oz	98.3a
Untreated Control				19.9b

Means in a column followed by the same letter are not significantly different at the 5% Level.
DMR

Small Plots in Transplanted Field

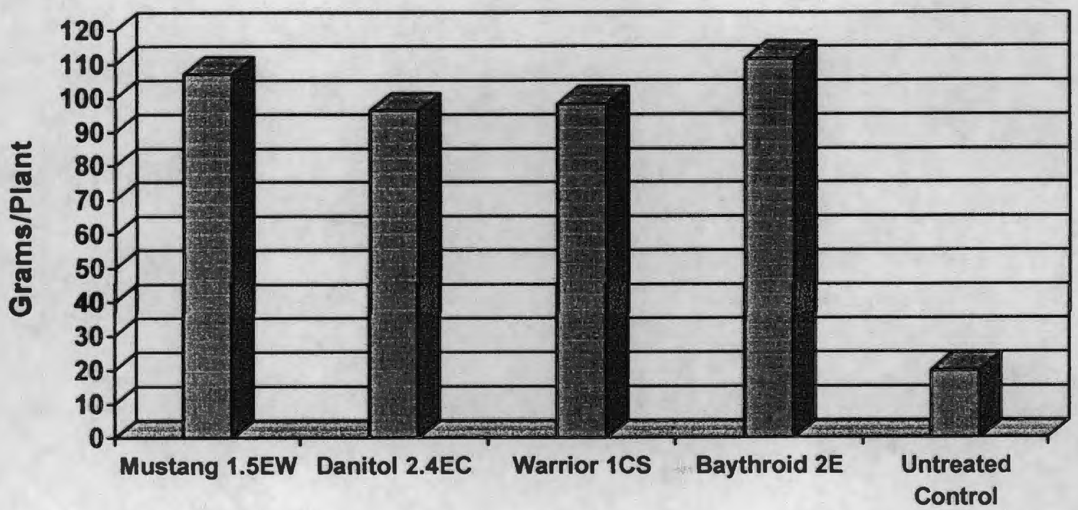
A small plot was established in the middle of the Bill Alderson's field with plots 1 bed wide by 80 feet long. The following materials were sprayed on the beds and incorporated with a rototiller before transplanting two days later. Plants were sprinkler irrigated following the applications. On May 14th, twenty plants from each of the treatments were cut off at the soil line, and weighed.

Materials Applied on Top of Beds and Incorporated with Rottwiller

Products	Method of Applicatio	Formulation	Product/Acre	Mean # of Grams/Plant
Baythroid	Band & Incorporate	2 E	2.8 oz	69.5a
Mustang	Band & Incorporate	1.5 EW	4.3 oz	72.5a
Capture	Band & Incorporate	2 EC	6.4 oz	74.6a
Warrior	Band & Incorporate	1 CS	3.8 oz	76.2a
Untreated Control				61.8a

Means in a column followed by the same letter are not significantly different at the 5% Level.
DMR

Mean Weight of Tomato Plants from Large Plots
Bill Alderson's Farm - Vernalis, CA, May 14, 2004



Conclusions

All of the pyrethroid treatments applied with the transplant fertilizers in large scale plots provided control of garden centipedes in transplanted tomato fields with a history of extensive damage. These materials are currently registered for use in tomatoes. The lack of damage in the untreated control plots this year prevents us from analyzing these results. While in the past three years we have been able to treat small areas in the middle of large problem spots and show differences, it is not understood why we were not able to treat large areas and show differences in small untreated sections.

The thorough incorporation of these pyrethroids prior to transplanting with a rototiller was very effective in the small plots, as in previous year's research trials.

Section V.
Soil Arthropods

EFFICACY TRIALS OF NEW INSECTICIDES FOR MINT ROOT BORER CONTROL

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INTRODUCTION

Lorsban (chlorpyrifos) is the only chemical pesticide registered for mint root borer (MRB) control. Tilling of mint fields also provides partial control, but is not always an option on verticillium wilt infested fields. Lorsban and other organophosphate insecticides may have their use limited or eliminated in the future due to the Food Quality Protection Act. Therefore, new products that can provide consistent, cost effective control of MRB are needed. We tested the effectiveness of two new experimental insecticides as well as Pounce 3.2 EC (permethrin) against the standard treatment of Lorsban for MRB control.

MATERIALS AND METHODS

Experiment 1

A completely randomized design was used for this bioassay experiment. Mint root borer larvae were collected from peppermint fields and placed in open containers with 11 larvae per container. The following treatments were replicated three times: (1) untreated check (water only), (2) experimental insecticide 1 (referred to as EXP-1), (3) experimental insecticide 2 (referred to as DPX-A), (4) Pounce 3.2 EC (permethrin) at 0.5 lb ai/a, and (5) Lorsban 4E at 2 lb ai/a. Treatments were applied directly to the exposed larvae with a $C0_2$ powered backpack sprayer (20 psi at 20 GPA). No surfactants were used with any treatment. The treated larvae were moved to jars filled with untreated soil and mint rhizomes and treatments were evaluated five, eight and thirteen days after treatment (DAT) by counting the number of live, sick and dead MRB larvae.

Experiments 2 and 3

These experiments were located in production peppermint fields in the LaGrande, Oregon area. All experimental plots were 6'x 15'sections of a peppermint field with a natural infestation of MRB larvae. A randomized block design was used with the following treatments replicated seven and nine times for Experiments 2 and 3, respectively: (1) untreated check, (2) EXP-1 (experimental insecticide 1), (3) DPX-A (experimental insecticide 2), (4) Pounce 3.2 EC (permethrin) at 0.5 lb ai/a, and (5) Lorsban 4E at 2 lb ai/a.

For both experiments, treatments were applied on September 6 with a CO_2 backpack sprayer (20 GPA at 20 psi) to pre-irrigated plots. The insecticides were immediately washed into the soil with approximately 1 inch of water. Experiments were evaluated by taking four, 1-ft^2 soil sample in each plot. The soil was shaken off the mint rhizomes and sifted though a 0.125" screen while the rhizomes were placed in Berlese funnels until dry. The number of MRB larvae recovered from soil sifting was combined with that from Berlese funnel extraction and recorded. Experiment 2 was evaluated 11 DAT while Experiment 3 was evaluated 24 and 49 DAT.

RESULTS AND DISCUSSION

Experiment 1

Lorsban 4E and Pounce 3.2EC provided complete control within the first five days after treatment (Table 1). EXP-1 provided 100% control within eight DAT. DPX-A killed 82% of the MRB larvae by 13 DAT, and the remaining larvae did not exhibit normal movement and appeared to be sick.

Table 1

Comparison of four insecticides for efficacy against mint root borer larvae in a bioassay evaluated after five, eight and thirteen days after treatment (DAT).

Treatment	Five DAT		Eight DAT		Thirteen DAT	
	% dead	% sick	% dead	% sick	% dead	% sick
UTC	12	0	18	0	25	0
EXP-1	96	4	100	0	---	---
DPX-A	0	97	42	58	82	18
Pounce 3.2EC (0.5 lb ai/ac)	100	0	---	---	---	---
Lorsban 4E (2 lb ai/ac)	100	0	---	---	---	---

Experiments 2 and 3

For both experiments, EXP-1 failed to provide significant control compared to the untreated check (Table 2). Pounce 3.2EC provided control similar to the standard treatment of Lorsban at Experiment one and in the second sampling of experiment three. At the first sampling of Experiment three, Pounce did not provide control similar to the Lorsban, but it was observed at this first sampling that Pounce had reduced hibernaculum formation compared to the other treatments. (Table 3) This reduction of hibernaculum formation led us to sample Experiment two a second time. MRB control with DPX-A was similar to the standard treatment of Lorsban in Experiment two and at both sample dates of Experiment three.

Table 2

Results of field efficacy trials for mint root borer control.

Treatment	Rate (lb ai/a)	Experiment 2 Live mint root borers per sq. ft. 11 DAT	Experiment 3 Live mint root borers per sq. ft. 24 DAT	Experiment 3 Live mint root borers per sq. ft. 49 DAT
UTC		5.9 a	7.3 a	10.0 a
EXP-1		4.2 ab	5.4 ab	---
Pounce 3.2 EC	0.5	3.0 bc	3.4 b	1.8 b
DPX-A		2.1 c	1.3 c	1.3 b
Lorsban 4E	2.0	1.5 c	0.7 c	0.8 b

Sample means were compared with Fisher's Protected LSD ($p=0.05$). Means with the same letter are not significantly different (Petersen 1985).

Experiment 2: LSD =2.04, $p<0.05$

Experiment 3, (24 DAT): LSD=2.07, $p<0.05$

Experiment 3, (49 DAT): LSD=2.07, $p<0.05$

Table 3

Mint root borer stage at the time of sampling of insecticide efficacy trial of experiment three.

	Rate (lb ai/a)	Percent MRB in larvae stage	Percent MRB in hibernaculum stage
UTC		50%	50%
EXP-1		60%	40%
Pounce 3.2 EC	0.5	88%	12%
DPX-A		37%	63%
Lorsban 4E	2.0	50%	50%

CONCLUSION

Although EXP-1 had good direct contact activity against MRB larvae, it did not perform well under field conditions. Pounce had good activity when directly applied and provided control similar to Lorsban under field conditions. In the bioassay, DPX-A was slower and provided less control than the other products, but under field conditions DPX-A was similar to Lorsban. Further research should be conducted to verify the results of DPX-A. DPX-A is a new chemistry insecticide that appears to provide MRB control on par with the standard treatment of Lorsban.

Section V.
Soil Arthropods

TIMING OF LORSBAN APPLICATION FOR OPTIMUM CONTROL OF MINT ROOT BORER CONTROL IN EASTERN OREGON

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INTRODUCTION

The mint root borer (MRB), *Fumibotys fumalis*, is a serious pest in Northwest mint production areas. In the last several years, MRB infestation levels have been consistently high in the La Grande, Oregon area. Lorsban is the standard treatment for MRB control, and it has become important to obtain maximum control to reduce levels below the treatment threshold. It would be prudent to determine if better timing of Lorsban could maximize the level of control.

MATERIALS AND METHODS

Two sites, approximately nine miles apart, were located in production peppermint fields near LaGrande, Oregon. At each site, a randomized block design with nine replications was set up on four separate treatment dates. Experimental plots were 12'x 15'sections of the peppermint field with a natural infestation of MRB larvae. On each treatment date, Lorsban 4E at 2 lb ai/a was compared to a water-only control.

Treatments were applied with a CO_2 backpack sprayer (20 GPA at 35 psi) to pre-irrigated plots. The plots were then immediately irrigated with approximately one inch of water using garden sprinklers fed by a water tank via a pump.

The first of the Lorsban treatments was applied as soon after harvest as possible. The four application dates were August 24, September 6, September 20, and October 2. Because the 2004 harvest was delayed by rain, August 24 was the earliest possible treatment date. In a typical year, harvest starts around August 10, making it possible to start treating fields with Lorsban by mid-August. Evaluation of each experiment occurred approximately two weeks after the treatment date. Four 1 ft^2 soil samples were taken in each plot and the soil shaken off the mint rhizomes and sifted through a 0.125" screen. The rhizomes were placed in Berlese funnels until dry and the total number of MRB larvae (combined data from soil sifting and Berlese funnel extraction) was recorded.

Twenty-two MRB larvae from each treatment date were collected and preserved in 70% ethanol. Head capsule widths, measured with a microscope micrometer, were averaged to give an approximation of MRB larval development on each of the four treatment dates.

RESULTS AND DISCUSSION

For the first two treatment dates, MRB control exceeded 80% at both sites compared to the control. At site 1, percent control with Lorsban was 83% and 90% for the first and second treatment dates, respectively (Table 1). The increase in percent control between the first and second treatment dates can be interpreted in different ways. The increase is perhaps coincidental due to the uneven spatial distribution of MRB larvae. Alternatively, MRB control may have improved slightly by a two week delay in the Lorsban application. Unfortunately, data for the last two treatment dates at site 1 is unavailable because the plot area was accidentally oversprayed with Lorsban.

Mean head capsule widths of MRB larvae collected at sites 1 and 2 increased from August 24 to September 20 (Table 2). For the first two collection dates, mean head capsule width at site 1 was smaller than that at site 2, suggesting that MRB larvae were behind in development at the first site. Field observations confirm that MRB development was lagging at site 1. On September 20, mean head capsule widths were the same at both sites; however, there was a difference in the percentage of the population that had formed hibernacula.

Hibernacula are cocoon-like structures in which the MRB overwinters as a prepupa. Once hibernacula form, the MRB has entered a resistant stage and is not affected by Lorsban. Therefore, variability in MRB development within the same growing district is an important consideration in properly timing Lorsban applications. Hibernacula were not found on any of the collection dates at site 1 whereas hibernacula were present at site 2 on September 20. The missing data for site 1 on October 2 was unfortunate in that we would have expected hibernacula to have formed by that date. Nevertheless, the presence of hibernacula at site 2 and their absence at site 1 on September 20 is another indicator that MRB development was accelerated at the second site.

At site 2, good MRB control (~89%) was achieved for the first and second treatment dates; however, percent control decreased to 71.9% and 28.5% on the third and fourth treatment dates, respectively (Table 1). The drop in control is correlated to the presence of MRB hibernacula. Between September 20 and October 2, the portion of the population comprised of hibernacula increased from 18% to 64%. Lorsban applied on these dates were apparently too late in controlling MRB that had already entered the overwintering stage and failed to reduce MRB numbers below the treatment threshold of 2-3 per ft^2.

Table 1
Percent control of mint root borer in field plots treated with Lorsban 4E on four application dates.

Treatment date	Site 1			Site 2		
	Mean number of live MRB per ft^2		Mean % MRB control	Mean number of live MRB per ft^2		Mean % MRB control
	UTC	Lorsban		UTC	Lorsban	
Aug, 24	2.9	0.5	83%	8.4	0.9	89.2%
Sept. 6	4.2	0.4	90%	8.6	1.1	89.6%
Sept 20	---	---	---	8.9	2.5	71.9%
Oct. 2	---	---	---	11.1	7.9	28.5%

Table 2
Mean head capsule widths of MRB larvae and percent hibernacula formation on five sample dates.

Sample Date	Site 1		Site 2	
	Mean head capsule width (mm)	Percent of MRB in Hibernaculum	Mean head capsule width (mm)	Percent of MRB in Hibernaculum
Aug 24	0.73	0%	0.94	0%
Sep 6	0.93	0%	1.15	0%
Sep 20	1.35	0%	1.35	18%
Oct 2	---	---	1.40	64%
Oct 16	---	---	1.43	96%

CONCLUSION
Lorsban applications need to be properly timed for maximum MRB control. Results from this study indicate that optimum timing of Lorsban occurred between late August and mid-September 2004. Because field-to-field variability in MRB development was observed, treatment recommendations should be customized to a certain degree for each field.
This study demonstrates reduction in MRB control when Lorsban is applied too late; however, it was not clear whether control is also compromised if Lorsban is applied too early.

Section V
Soil Arthropods

CONTROL OF ROUGH STRAWBERRY ROOT WEEVIL IN STRAWBERRY

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Lab bioassays were conducted with 3 neonicotinoids, Brigade (Brigade) and experimental Mustang Max (zeta-cypermethrin). The latter is another FMC pyrethroid they would like to label on red raspberry with the possibility of 5 application per season as the Brigade label is written for strawberry. Groups of five mature 'Totem' strawberry plants in 1 gallon pots were treated with the 5 compounds and allowed to dry for 2-3 hours. Then fifteen leaflet replicates per treatment were each placed in water vials and one unit was placed in a 6 inch Petri dish with 3 rough strawberry root weevil adults. Weevil mortality was then observed daily for 4 days and again at 8 days posttreatment. Brigade served as our standard treatment.

Six compounds known to possess root weevil toxicity were field tested in a 3 year-old 'Totem' field in Woodland, WA. Applications were applied the same day the field was mowed on 12 July with a 3 row application kit equipped with 9 D6 45 disc cone nozzles at 100 psi in 114 gpa. Treatments were replicated five times and plots measured 3 rows wide by 30 feet long. Sampling consisted of 3 randomly selected areas in each plot of about 1 ft^2 each. Population levels of primarily adult rough strawberry root weevil were ascertained with visual-hand searches in the soil-debris around plant crowns from the middle to the shoulder of a row, including runner foliage that escape mowing. We found congregations of the rough strawberry root weevil commonly in moistened microclimates beneath patches of green runner foliage. Renovation trials next season will include methods to cut runner foliage that extends into the strawberry rows.

Under the laboratory conditions of this bioassay, the 87% mortality observed for Brigade to adults of the rough strawberry root weevil was expected (Table 1). However, the poor performance of Mustang Max at 0.03 lb(AI)/acre should be re-evaluated at rates comparable to that of its companion pyrethroid, Brigade/Capture. We will follow-up with this in collaboration with FMC. The 3 neonicotinoids performed comparably at 4 and 8 days posttreatment. The known systemic mode of entry for the neonicotinoids may provide complimentary residual persistence to the shorter-lived foliar residues of bifenthrin. We will test the relative efficacy of combinations of the neonicotinoids with the pyrethroids next season.

Hands and knee searches for populations of adult, rough strawberry root weevils were taken at 3, 7 and 14 days post-renovation. Malathion 8EC provided excellent activity compared with the untreated checks to 14 days posttreatment (Table 2). At 7 days after treatment, Brigade, Malathion and Clutch (clothianidin) had fewer adults found with our visual search method under foliage around the crown and within the soil as well. Given the random distribution and numerical variability of these root weevils, results in part at 14 days posttreatment were not significantly different from the untreated plots at the 5% level of significance. Adult weevil suppression with foliar application of neonicotinoids in the field require 5-7 days before they impact adult mortality compared with the generally fast acting OPs and pyrethroids.

Table 1. Rough strawberry weevil bioassay.

		Percent Mortality				
Treatment	lb(AI)/acre	1DAT	2DAT	3DAT	4DAT	8DAT
Actara 25W	0.06	22ab	27bc	56b	71a	93a
Clutch 50WDG	0.09	9ab	40b	60b	76a	91a
Brigade 10WP	0.10	22ab	87a	87a	87a	87ab
Provado 1.6F	0.04	31a	51b	62ab	69ab	91a
Mustang Max 0.8EC	0.03	2b	44b	44b	58b	67b
Untreated check		2b	2c	2c	2c	4c

Percentage within columns followed by the same letter are not significantly different (Tukey HSD test, $P<0.05$).

Table 2. Rough strawberry root weevil trial.

Treatment	lb(AI)/acre	Mean Weevils/ft2 3DAT	7DAT	14DAT
Actara 25WG	0.06	4.1bc	6.9bc	1.1b
Provado 1.6F	0.04	18.6a	19.7a	2.5b
Mustang Max	0.03	5.5bc	0.2c	0.1b
Brigade 10WP	0.10	8.5bc	1.6c	1.1b
Malathion 8EC	1.25	0.0c	0.5c	1.2b
Clutch 50WDG	0.09	7.0bc	0.3c	9.9a
Untreated Check		11.5ab	13.1ab	6.8ab

Means within columns followed by the same letter are not significantly different (Tukey HSD test, *P* <0.05). 12 July 04.

LAB AND FIELD TRIALS TO CONTROL ROOT WEEVIL LARVAE IN SMALL FRUITS

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The residual persistence of the experimental neonicotinoid Actara (thiamethoxam) was bioassayed with black vine and rough strawberry root weevils collected from a 'Totem' field in Woodland, WA. Actara was applied at 0.086 lb(AI)/acre from a low pressure boom sprayer equipped with 3 Floodjet TK-SS20 nozzles calibrated to apply 114 gpa at 58 psi at 2.1 mph on 12 July 2004. Four days after treatment, 45 leaves were collected and divided into 3 sets of 15 leaves placed in water vials capped with cotton plugs. These field-weathered leaves were held under lab condition for another 6 days. Forty-five black vine weevil and 45 rough strawberry root weevil adults were placed in groups of 3 per treated leaf and observed for mortality from day 5 to day 10 after field application. A mixture of both weevil species was used as the untreated check for which no mortality occurred over the testing period.

Compared with excellent contact/stomach activity of foliar applied Brigade/Capture, mortality on 5 day old Actara residue was 29% for both species (Table 1). Maximum mortality of 76% and 84% was recorded for the black vine weevil and rough strawberry root weevil, respectively, on 10 day-old residue held under lab conditions. Data from Syngenta showed that as much as 60% of the active ingredient moved into sprayed tomato leaves by day 9 and 50% remained by day 21. Because of the translaminar movement of Actara, its extended residual control is at least 2-fold more than foliar applied Capture/Brigade.

The contact and translaminar mode of entry for Actara was measured at varying times after application on red raspberry foliage for adult, rough strawberry root weevil. Several 'Meeker' plants were sprayed with Actara at 0.06 lb(AI)/acre on 12 July at the Vancouver REU. Ten leaves were sampled daily for 9 days posttreatment from treated and untreated plants. Three adult, rough strawberry root weevils were placed on each leaf whose petiole was placed in a water-filled vial capped with a cotton plug and held in 6 inch Petri dishes. Daily cohorts of 30 weevils each for both treatments were held for 5 days. Excellent contact and stomach poison activity was observed within 24 hours of the application through 8 days posttreatment (Table 2).

The contact activity of Admire (imidoclopyrid), Platinum (thiamethoxam) and Belay (clothianidin) was evaluated with a simulated test tube, soil drench bioassay for activity to both spring and fall populations of rough strawberry root weevil larvae. Maturing late-spring root weevils were placed on top of field soil contained in 3.75 inch long glass test tubes on 19 May and 24 May. These larvae migrated 1-2 inches into the soil before they were drenched with 4 ml of field rates of Admire and Platinum. Cohorts of 15 and 20 larvae/treatment at the two respective treatment dates were destructively sampled 14 days post-drench. Larval/prepupal mortality averaged 42% for Admire and 40% for Platinum (Table 3). These levels suggest that a late spring drench application(s) may not be optimal for economic control of new generation root weevils.

Similar drench tests were conducted in late August to control early instar, rough strawberry root weevil that will feed on roots over the following 8 months. From 31 August to 9 September, second instar rough strawberry root weevil larvae were collected from an infested strawberry field in Vancouver, WA. Each of four treatments consisted of 10 larvae placed in soil filled test tubes. These were treated with 6 ml of field rates of Admire, Platinum, Belay and water control one day later. Each regime was repeated at 5 different dates and larval mortality was determined with destructive sampling at 3 to 7 days posttreatment, respectively. Belay and Platinum provided excellent control from 4-7 days posttreatment; Admire was somewhat variable but significantly different from the control at the same time intervals (Table 4). General contact mortality of immatures in soil tend to be slightly delayed compared with foliar formulations when exposed to adult root weevils.

Table 1. Actara's translaminar residual on strawberry at rennovation.

	Percent Mortality					
Actara 25WG	5DAT	6DAT	7DAT	8DAT	9DAT	10DAT
Rough strawberry weevil	29a	38a	67a	82a	82a	84a
Black vine weevil	29a	42a	60a	64a	73a	76a
Untreated check	0b	0b	0b	0b	0b	0b

Percentages within columns followed by the same letter are not significantly different (Tukey HSD test, $P<0.05$).

Table 2. 2004 residual activity of Actara to rough strawberry root weevil on red raspberry foliage

	Percent Mortality								
	1DAT	2DAT	3DAT	4DAT	5DAT	6DAT	7DAT	8DAT	9DAT
Actara 25WG	80	90	97	80	83	80	97	83	33
Untreated check	0	7	14	14	0	0	0	0	3

Cohorts fed for 5 days.

Table 3. Spring, RSRW larval drench test.

Treatment	lb(AI)/acre	Percent mortality	
Admire 2F	0.5	53a	30a
Platinum 2SC	0.125	40ab	40a
Untreated check		0b	15a

Percentage within columns following by the same letter are not significantly different (Tukey HSD test, *P<0.05*).

Late instar RSRW larvae.

Table 4. Fall, RSRW larval drench test.

		Percent mortality				
Treatment	lb(AI)/acre	3DAT	4DAT	5DAT	6DAT	7DAT
Admire 2F	0.5	10b	100a	70b	90a	50b
Belay 16WSG	20 fl. oz.	60ab	100a	100a	100a	100a
Platinum 2SC	0.125	80a	100a	100a	100a	90a
Untreated check		20b	0b	0c	0b	0c

Percentages within columns following by the same letter are not significantly different (Tukey HSD test, *P* <0.05).

Fall (small) instar larvae.

SECTION VI

Vectors of Plant Pathogens

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Section Leader

Lynell K. Tanigoshi

SECTION VI
Vectors of Plant Pathogens

ADVANCES IN GREEN PEACH APHID MANAGEMENT IN COLUMBIA POTATOES

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Green peach aphid is the most destructive insect pest of Pacific Northwest potatoes. In recent years, foliar management of this pest has changed from almost total reliance on methamidophos (Monitor) to a mixture of Monitor, thiamethoxam (Actara) and pymetrozine (Fulfill). This combination has provided significant opportunity to develop integrated pest management programs. These products have also allowed secondary pests, historically controlled by broad spectrum organophosphate insecticides, to flourish. These pests, including western flower thrips, cabbage looper, armyworm species and stinkbugs, have required additional applications of insecticides. The potato industry is in the midst of a flurry of new insecticide registrations, more so than in any time in the history of the potato industry. With a 12 month period of the Portland meetings in 2005, more than six insecticides are expected to be registered on potatoes.

These new insecticides have potential for great value to the industry, however in order to achieve their maximum potential and to retain this potential will require changes in grower and crop protection professionals behavior. For example, with in the next one to two calendar year, there will be 14 products registered on potatoes belonging to the neonicotinoid class of insecticides based on five active ingredients. These active ingredients are imidacloprid, thiamethoxam, acetamidiprid, dinotefuran and clothinadin. Bayer Crop Sciences has yet to decided whether to register thiacloprid on potatoes, which would be a sixth neonicotinoid.

Turbine, an FMC insecticide, will be registered on potatoes in 2005. Prev Am a citrus oil, boric acid product was registered in 2004 on potatoes. Other non aphicidal products have been registered on potatoes recently, including novaluron (Rimon) and Indoxacarb. Three miticides are nearing registration on potatoes.

Significant research is needed to determine how to maximize the benefit these products have. Additionally, the specter of neonicotinoid resistance in Colorado potato beetle will have a tremendous impact on how potato insecticides are used.

Foliar Aphid Insecticide Trial - 2004

Eltopia WA

Rating Unit					/plant	/plant	/plant	
Insect Stage					wingless	winged	both	
Trt No.	Treatment Name	Form Conc	Form Type	Produc Rate	Product Rate Unit				
1	UNTREATED CHECK					18.3 a	32.8 a	51 a	
5	Assail	30	WSG	4	OZ/A	9.3 b	15.0 abc	24.3 bc	Ground
10	Dinotefuran	20	SG	8.5	G/100 ROW-	8.8 b	18.0 abc	26.8 b	Chemigation
19	Turbine	50	WG	2.28	OZ/A	8.5 b	24.0 ab	32.5 ab	Ground
3	Assail	30	WSG	1.33	OZ/A	8.3 b	20.0 ab	28.3 b	Ground
8	Dinotefuran	20	SG	8.5	G/100 ROW-	6.8 b	19.8 ab	26.5 b	Ground
6	Assail	30	WSG	2.67	OZ/A	5.5 b	22.0 ab	27.5 b	Chemigation
7	Dinotefuran	20	SG	6.4	G/100 ROW-	5.3 b	13.3 bc	18.5 bc	Ground
9	Dinotefuran	20	SG	20	G/100 ROW-	4.8 b	19.5 ab	24.3 bc	In Furrow
21	Beta			1	% V/V	4.8 b	19.5 ab	24.3 bc	Ground
14	Fulfill	50	WG	5.7	OZ/A	4.5 b	12.3 bc	16.8 bc	Ground
13	Monitor	4	EC	1.5	PT/A	4.5 b	12.0 bc	16.5 bc	Ground
2	Actara	25	WG	3	OZ/A	3.3 b	13.0 bc	16.3 bc	Ground
15	Pencap Methyl	2	EC	4	PT/A	2.5 b	20.5 ab	23.0 bc	Ground
16	Prev Am			1	OZ/GAL	2.5 b	14.8 abc	17.3 bc	Ground
4	Dinotefuran	30	WSG	2.67	OZ/A	2.5 b	10.3 bc	12.8 bc	Ground
20	Turbine	50	WG	2.85	OZ/A	1.3 b	12.8 bc	14.0 bc	Chemigation
12	Admire	2	F	19	FL OZ/A	0.8 b	19.8 ab	20.5 bc	In Furrow
11	Dinotefuran	20	SG	8.5	G/100 ROW-	0.8 b	0.0 c	0.8 c	Aerial
LSD (P=.05)						8.33	15.87	19.81	
Standard Deviation						5.89	11.22	14.01	
CV						99.64	67.6	62.22	
Bartlett's X2						78.904	44.325	61.182	
P(Bartlett's X2)						0.001*	0.001*	0.001*	

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

SECTION VII

Foliage & Plant Feeding Insects

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Section Leader

Joe DeFrancesco

Section VII. Foliage and plant feeding insects

INSECT CONTROL IN SPRING DRY PEAS, 2004 PEA:

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Pea weevil (PW): *Bruchus pisorum* (L.) on *Pisum sativum* L. "Columbia"

A trial consisting of a RCB of 4 foliar insecticide treatments and a UTC with 4 replicates of 6 x 20 feet each was established near Walla Walla, WA on Jun 17. Applications at 50% bloom using a CO2 back pack sprayer at 20 gpa/20 psi were made using GNW-1975, a new formulation of Imidan, plus Dimethoate and Zetacypermethrin, and Zetacypermethrin alone, as the standard in solutions buffered to pH 5.5. Pea harvest was completed on Jul 20. Evaluation of PW damage was assessed by counts of damaged peas per 100 pea sample per replicate after post-harvest diapause and emergence of adult weevils.
All insecticide treatments provided similar control of PW compared to the UTC, with the lower rate of Imidan + Dimethoate being slightly different than the other treatments.

		PW per 100 pea sample
Treatment/formulation	Rate lb aia	Mean PW
Zetacypermethrin 2E	0.025	0.00a
GWN-1975 + Zetacypermethrin	0.7/ 0.017	0.75a
GWN-1975 + Dimethoate	1.0/0.017	0.50a
GWN-1975 + Dimethoate	0.7/0.017	3.00b
UTC	-------	19.25c

ANOVA; LSD t Test p = 0.05.

INSECT CONTROL IN FALL SEEDED CANOLA, 2004

David Bragg, Washington State University, Extension Entomology, P O Box 190 Pomeroy WA99347-0190, and Kurt Tetrick, USDA-ARS WREPMIC, Central Ferry, WA 99347

CANOLA: *Brassica x napus* 'Olsen'; Cabbage Aphid (CA): *Brevicoryne brassicae* (L.)Cabbage Seedpod Weevil (CSPW): *Ceutorhynchus assimilis* (Paykull)

An experiment consisting of a RCB of 3 foliar insecticide treatments and a UTC was established on full bloom fall seeded Canola on 27 Apr at the USDA-ARS Western Regional Plant Materials Introduction Center at Central Ferry, WA. Foliar applications were applied using a CO2 back pack sprayer at 20 gpa/20psi. Pre-counts of CA colonies/M2 were made prior to treatment. Post treatment counts of CA Colonies/M2 were made 10 DAT. CSPW damage was determined by counts of mean exit holes/100 pods when seedpods were ripe at 70 DAT. Mean number of mummies of *Diaeretiella rapae* (Mordvilko) (DR) per CA colony were counted at 10-DAT. Mean number of foraging *Hippodamia convergens* Guerin (HC) adults were also made at 10 DAT. A Pteromalid parasitoid was found to be active in CSPW, and their exit holes per 100 CSPW infested seedpods were also counted 70 DAT.
All 3 Pyrethroid insecticide treatments performed equally in controlling CA and CSPW compared to the UTC.
DR, HC, and Pteromalid exit holes were found only in the UTC. This was due to no CA or CSPW in the treatments, rather than toxicity to these insects per se'..

Insect numbers in Canola pre and post treatment

Treatment/formulation	Rate lb aia	CA PrCt	CA10 DAT	CSPW exit holes/100
Mustang Max 2E	0.25	6.75a	0a	0a
Capture 2E	0.04	6.75a	0a	0a
Warrior Zeon	0.30	6.75a	0a	0a
UTC	------	6.50a	7.25b	11.25b

Means followed by the same letter are NSD. ANOVA; LSD $p = 0.05$.

Mean numbers of natural enemies in Canola

Treatment/formulation	% D. rapae mummies	H. convergens/M2	%Pteromalids/CSPW
UTC	20.25a	5.00a	40.50a
Mustang Max	0.00b	0.00b	0.00b
Capture 2E	0.00b	0.00b	0.00b
Warrior Zeon	0.00b	0.00b	0.00b

Means followed by the same letter are NSD. ANOVA; LSD $p = 0.05$.

Section VII.
Foliage and Seed Feeding Insects

EVALUATION OF INSECTICIDES FOR THE CONTROL OF APHID & WORM PESTS IN FRESH MARKET TOMATOES IN CENTRAL CALIFORNIA-2004

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This trial was established at the Two Bees Research Farm in Escalon, California in order to evaluate the effects of products on aphid and worm pests in fresh market tomatoes. The tomato variety was Bobcat, spaced 18 inches between plants in 60-inch wide centers, by 30 feet long. The plot size was .013 acre, drip irrigated on flat beds, with four replications. An untreated area equal to the size of the trial was maintained in order to continue high pest populations once the applications began in the trial area. The tomato plants were not trained on stakes.

The materials in the worm trial were applied over the same plants receiving the earlier aphid treatments. The multiple Avaunt treatments were intended to maintain plots with materials having only aphid activity so they could be evaluated at harvest for yield differences without excessive worm damage. All foliar treatments were applied with a CO_2 powered backpack sprayer. The soil application for aphids was made with a syringe using Platinum and Admire placing the solution under the drippers using 8ml of volume/plant. The next day foliar sprays of the other aphid materials were made with 2 TXVS10 nozzles operating at 60 psi for a volume of 29 gallons/acre.

The following 3 foliar applications for control of worms were made with 3 flat fan, low-drift air induction type nozzles. An AVI 11003 nozzle was used over the center of the row and an 80025VS nozzle on each side of the plant operating at 40 PSI at 58 gallons/acre. The boom was expanded in width from 20 inches to 60 inches so that the nozzles were at optimum distance from the plants as the plants grew larger.

Materials were applied on 20 & 21 July for aphids and 11 Aug, 31 Aug, and 16 Sep for worms. Aphid evaluations were made by selecting one compound leaf per plant from 5 plants in each plot and examining the leaf surfaces. After the first evaluation, numbers of aphids in the untreated plots declined to very low levels. Worm evaluations were made by selecting 2 plants in each plot and shaking fruit onto a white tarp. Fruit was inspected and counted both for worm damage and worms present. Fruit was cut open, if any entry wounds were visible, to determine which species of worm was present. The white tarp was inspected for any worms that might have fallen off during the shaking process.

Control of Potato Aphids from 5 leaf sample - 2004

Products	Formulation	Prod/Acre	27 Jul # Aphids/leaf
Assail	70 WP	1.2 oz. Prod.	0.9 a
TD 2480	30 WDG	3 oz. Prod.	0.3 a
V10112	20 SG	10.6 oz. Prod.	0.9 a
V10112	20 SG	21.2 oz. Prod.	1.0 a
Provado	1.6 F	3.75 oz. Prod.	0.5 a
Asana	0.66 EC	9.6 oz. Prod.	0.1 a
Capture	2 E	3.8 oz. Prod.	1.1 a
Mustang	1.5 EW	2.8 oz. Prod.	2.8 a
Warrior	1 SC	3.84 oz. Prod.	0.1 a
Platinum (Soil)	2 SC	8 oz. Prod.	1.0 a
Platinum (Soil)	2 SC	11 oz. Prod.	0.3 a
Fulfill	50 WG	2.75 oz. Prod.	0.3 a
Fulfill	50 WG	5.5 oz. Prod.	0.2 a
Admire (Soil)	2 SC	16 oz. Prod.	0.1 a
Knack	0.86 EC	6 oz. Prod.	6.0 a
Untreated Control			30.0 b

Means in a column followed by the same letter are not significantly different at the 5% Level. DMR

Control of Worm Damage in Tomatoes – 2004 Date of Harvest 09/23/04

Materials, Formulation and Product/Acre	#Fruit Total	#Damage	%Damage
Assail 70 WP 1.2 oz.+ Avaunt 30 WG 2.5 oz.	82.5 abcd	1.7 abc	1.8 ab
TD 2480 30 WDG 3 oz. + Avaunt 30 WG 2.5 oz.	77.2 abcd	0.7 a	0.8 a
V10112 20 SG 10.6 oz + S1812 35 WP .15 LB	76.7 abcd	5.7 cd	7.3 cd
V10112 20 SG 21.2 oz. + S1812 35 WP .20 LB	72.7 abc	1.7 abc	2.7 abc
Provado 1.6 F 3.75 oz. + Renounce 20 WP 2.5 oz.	85.0 bcd	8.0 d	9.6 d
Provado 1.6 F 3.75 oz. + Renounce 20 WP 3.5 oz.	79.7 abcd	3.7 abcd	5.1 abcd
Assail 70 WP 1.2 oz. + Diamond 0.83 EC 9 oz.	68.7 ab	2.5 abc	3.9 abc
Assail 70 WP 1.2 oz. + Diamond 0.83 EC 12 oz.	81.2 abcd	1.7 abcd	2.1 abc
Assail 70 WP 1.2 oz. + Intrepid 2 F 8 oz.	94.5 d	1.0 ab	1.3 ab
Assail 70 WP 1.2 oz. + Entrust 80 2 oz.	74.5 abc	4.5 abcd	6.0 abcd
Asana 8.4 EC 9.6 oz. + Asana 8.4 EC 9.6 oz.	74.5 abc	2.7 abc	4.1 abc
Asana 8.4 EC 9.6 oz. + Avaunt 30 WG 2.5 oz.	73.2 abc	1.0 ab	1.77 ab
Capture 2 E 3.8 oz. + Capture 2 E 3.8 oz.	77.2 abcd	1.0 ab	1.5 ab
Mustang 1.5 EW 2.8 oz. + Mustang 1.5 EW 2.8 oz.	88.2 cd	5.5 bcd	6.1 bcd
Warrior 1 SC 3.84 oz. + Warrior 1 SC 3.84 oz.	83.7 abcd	1.5 abc	1.8 ab
Platinum (Soil) 2 SC 8 oz. + Proclaim 5 SG 4.8 oz.	80.0 abcd	2.0 abc	2.25 abc
Assail 70 WP 1.2 oz. + Avaunt 30 WG 2.5 oz.	71.0 abc	1.0 ab	1.4 ab
Untreated Control	66.0 a	22.0 e	32.4 e

Means in a column followed by the same letter are not significantly different at the 5% Level. DMR

Results-Aphids

All treatments controlled potato aphids, *Macrosiphum euphorbiae* compared to the untreated check. Unfortunately the population of pests declined after the first application. Numbers in the untreated controls declined to the point where no differences could be detected between the untreated checks and any of the treatments.

Results-Worms

During the shaking of the fruit onto tarps on harvest day, 4 cabbage loopers *Trichoplusia ni* and 3 tomato fruit worms *Heliocoverpa zea* were detected in the samples. Much of the damaged fruit reflected the mixed population of worm species found at harvest. Avaunt, Intrepid, Capture and Warrior appeared to provide the highest level of control of worms but there was much overlap with the other materials and rates as shown by the statistical analysis. All materials and rates provide control superior to the untreated control which sustained over 32% damage. It is interesting to note that the Intrepid treatment provided the highest number of fruit in this experiment.

Section VII.
Foliage & Seed Feeding Pests

EFFECTS OF CHLORPYRIFOS AND SULFUR ON PEST THRIPS AND SPIDERS ON GRAPE

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In 2003, we conducted a field experiment, replicated in two separate plots (A and B) within an abandoned vineyard in Umatilla, Oregon. We followed the impacts of the broad-spectrum insecticide chlorpyrifos and the fungicide sulfur, alone and in combination, on pest thrips nymphs and canopy-dwelling spider phenology from May-September.

The experiment was a completely random 2 X 2 factorial design, with two replicates assessed simultaneously and located approximately 100 m apart. Unmanaged vegetation surrounded each site, including grapevines (*Vitis vinifera* L.), Russian olive trees (*Elaeagnus angustifolia* L.), and blackberry bushes (*Rubus armeniacus* Focke), and both replicates had weedy groundcover dominated by Russian thistle (*Salsola* sp.).

There were 10 vines in each of the following four treatments:

1) -C-S = a control without spray applications.
2) +C-S = chlorpyrifos-only (Lorsban®-4E, Dow AgroSciences LLC, Indianapolis IN) applied once in May at a rate of 1.12 kg/ha.
3) -C+S = sulfur-only, (Microthiol® Disperss™ micronized wettable sulfur, Elf Atochem North America Inc., Agrichemicals Group, Philadelphia PA) applied at 2-3 wk intervals at a rate of 11.21 kg/ha.
4) +C+S = a combination treatment with Lorsban®-4E and Microthiol® Disperss™ applied at the same timing and rates previously mentioned.

Chemicals were applied using a Stihl® powered backpack sprayer (Model SR420, STIHL Inc., Virginia Beach VA). Chlorpyrifos was only applied once on 5-22-03, while sulfur was applied on the following dates: 5-22-03, 6-12-02, 7-1-03, 7-31-03, and 8-14-03.

Leaf and canopy suction sampling were used to assess the grape arthropod fauna. Twenty leaves of average size and age were taken monthly from the central region of each vine to obtain data on thrips nymphs. A leaf blower (Model PB-1010, Echo Inc., Lake Zurich, IL) modified to suck air, and thus draw insects into a collecting bag, was used to sample spiders. The collecting bag (18 by 24 cm) was constructed from 55 μ mesh material (NITEX® Screen, Dynamic Aqua-supply Ltd., Surrey, BC) and inserted into the end of the blower suction tube, folded over the tube lip, and fastened using a rubber band or plastic ring covered with a seven mm wire screen to keep out debris. Canopy suction samples were taken prior to any chemical applications in May (A, 5-22-03; B, 5-21-03) and again after spraying had been terminated on 8-19-03. Due to differences in vine stature, on each sampling date vines in the A replicate were each sampled for 10 seconds, while in the B replicate each vine was sampled for 30 seconds.

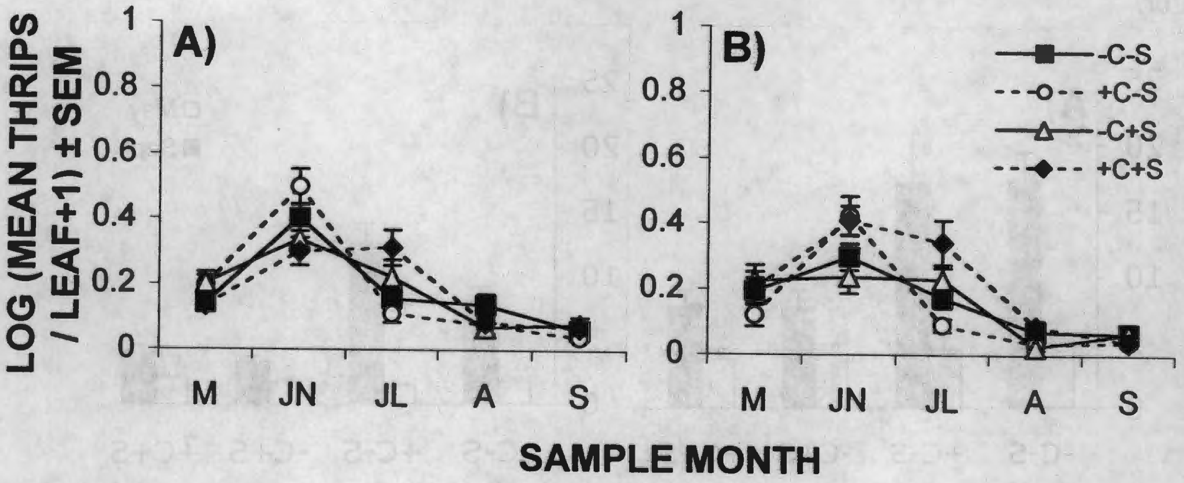
Arthropod densities were converted to arthropods/leaf or arthropod/10 sec of suction and log (X+1) transformed. Time series data were analyzed using repeated measures MANOVA, with initial arthropod density prior to spray applications as a covariate.

Replicate did not have a significant effect on pest thrips densities, and so data were combined for analysis *(replicate* X *chlorpyrifos* X *sulfur:* $P = 0.62$; *replicate* X *chlorpyrifos:* $P = 0.15$; *replicate* X *sulfur:* $P = 0.50$). Densities of pest thrips were low in May, peaked in June, and then declined, leading to a significant time effect ($P < 0.001$; Figs. 1a-b). Chlorpyrifos increased but sulfur decreased thrips densities, leading to a statistically significant interaction (*chlorpyrifos* X *sulfur:* $P = 0.008$), which was strongest in mid-season (*chlorpyrifos* X *sulfur* X *time*: $P = 0.04$). Positive effects of chlorpyrifos and suppressive effects of sulfur on thrips densities became less dramatic as the season progressed (*chlorpyrifos* X *time:* $P < 0.001$; *sulfur* X *time:* $P = 0.002$).

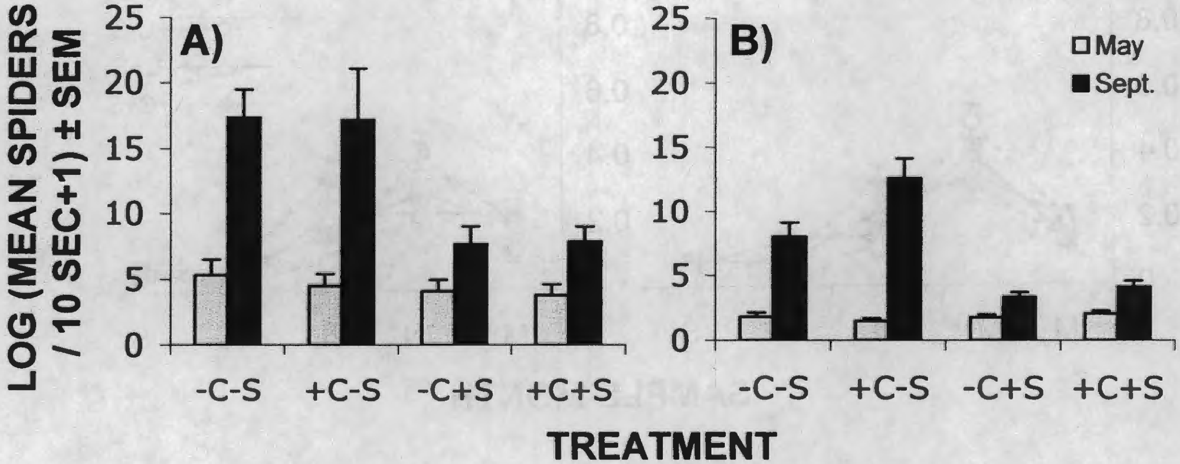
Before chemicals were applied, there were no significant differences in SP densities in either replicate (A, *chlorpyrifos* X *sulfur*: $P = 0.98$; *chlorpyrifos:* $P = 0.58$; *sulfur:* $P = 0.52$; B, *chlorpyrifos* X *sulfur*: $P = 0.32$; *chlorpyrifos:* $P = 0.91$; *sulfur:* $P = 0.22$; Figs. 2a-b). There was no interactive effect of chemicals on spider densities (*chlorpyrifos* X *sulfur*: A, $P = 0.54$; B, $P = 0.21$), while sulfur had a detrimental effect on spiders in both replicates (A, $P < 0.001$; B, $P < 0.001$), and chlorpyrifos was only harmful in the B replicate (A, $P = 0.74$; B, $P = 0.01$).

Overall, densities of pest thrips nymphs were higher immediately after chlorpyrifos application, perhaps due to negative effects of this organophosphate chemical on predator densities. Sulfur was weakly suppressive to pest thrips early in the season. However, it is not known how these chemicals affect thrips development. Thus, high densities of thrips nymphs in July in treatments with sulfur may reflect negative effects of this fungicide on thrips developmental rates. Sulfur appeared to suppress canopy-dwelling spider densities, while chlorpyrifos only had a negative effect on spiders in one replicate. Vines in this replicate were taller, and had cooler, more humid canopies compared to vines in the other replicate, which may have influenced chlorpyrifos efficacy and/or degradation.

Figs. 1a-b. Pest thrips nymphs densities from leaf sampling, (A) A and (B) B replicates. -C-S = control, +C-S = chlorpyrifos only, -C+S = sulfur only, +C+S = chlorpyrifos and sulfur.



Figs. 2a-b. Canopy-dwelling spider densities from canopy suction sampling, (A) A and (B) B replicates. -C-S = control, +C-S = chlorpyrifos-only, -C+S = sulfur-only, +C+S = chlorpyrifos and sulfur.



CHEMIGATION OF ORTHENE 75S (acephate) FOR CONTROL OF CUTWORMS IN PEPPERMINT

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Objective: Control of foliar feeding cutworms with Orthene applied through irrigation water.

INTRODUCTION

Foliar cutworms can be a significant problem for many mint production areas. In the past, these cutworms in the La Grande area have been identified as mostly Bertha armyworm (*mamestra configurata*) with the remainder being spotted cutworm (*xestia c-nigrum*). It would be beneficial to be able to chemigate Orthene to control this pest there by reducing the need to drive on the field or incur the expense of aerial application. It is unknown if Orthene can effectively control foliar cutworms when chemigated. In addition, Orthene does not have a label allowing it to be applied by chemigation.

In experiment one, the effectiveness of Orthene 75S was tested when chemigated in 0.44 inch and 0.22 inch irrigation water, using small garden sprinklers against a conventional spray application of Orthene 75S. In experiment two, the effectiveness of Orthene 75S was tested by chemigating it in 0.08 inch water, compared with a conventional spray application of Orthene 75 SP. In addition Entrust (spinosad), an organic insecticide was applied with a conventional spray application in experiment two. In experiment three the effectiveness of Orthene 75S was tested in 0.15 inch water when applied by a conventional center pivot irrigation system, compared to a standard spray application of Orthene 75S.

MATERIALS AND METHODS

Plots were located in peppermint fields with a natural infestion of foliar feeding cutworms and armyworms in the La Grande, Oregon area. A randomized block design (RBD) was used for experiments one and two with four replications in experiment one and three replications in experiment two. The chemigation treatments were applied by injecting the Orthene 75S into the water source supplying small garden sprinklers. A pump attached to large water tanks supplied water for the sprinklers, which covered a circular area with an approximate diameter of 17 feet. The Orthene 75S was mixed with approximately 2 liters of water and then injected into the sprinkler water by pressurizing the Orthene 75S solution with $C0_2$. The standard treatment of conventional foliar spraying of Orthene 75S in all experiments were applied with a $C0_2$ powered backpack sprayer (20 GPA at 42 psi). In experiment two, Entrust insecticide was also applied with a conventional spray application using a $C0_2$ powered backpack sprayer (20 GPA at 42 psi). Experiment three was conducted by injecting the Orthene 75S into a grower's irrigation pivot on part of a cutworm-infested field. All three experiments were evaluated by beating the mint foliage causing the cutworms to drop to the soil and inspecting the soil surface in a 2' x 2' area. No surfactants were used in any experiment.

Experiment 1:

The mint was approximately 18 inches high at the time of application. Plots measured 17' diameter for the chemigated trial and 24' x 20' for the conventional spray application. The following treatments were replicated four times: (1) untreated check (0.44 in. water only), (2) Orthene 75S at 1 lb ai/a, applied in 0.22 in water (3) Orthene 75S at 1 lb ai/a, applied in 0.44 in. water, (4) Orthene 75S at 1 lb ai/a, applied in 20 GPA with conventional sprayer. Treatments were applied on July 11. Plots were evaluated July 15 by searching 4 sq. ft. and counting the number of live, dead and sick larvae.

Experiment 2:

The mint was approximately 20 inches high at the time of application. Plots measured 17' diameter for the chemigated trial and 24' x 20' for the conventional application spray. The following treatments were replicated three times: (1) untreated check (no water), (2) Orthene 75S at 1 lb ai/a applied in 0.08 in water, (3) Orthene 75S at 1 lb ai/a applied in 20 GPA with conventional sprayer. (4), Entrust 0.15 lb ai/a, applied in 20 GPA with conventional sprayer. Treatments were applied on July 16. Plots were evaluated July 19 and July 21 by searching 4 sq. ft. and counting the number of live, dead and sick larvae.

Experiment 3:

The mint was approximately 16 inches high at the time of application. Approximately four acres of the field were treated with Orthene 75S through the irrigation pivot in approximately 0.15 in. of irrigation water. This trial was not replicated because only one area of the field was treated. The following treatments were applied: (1) untreated check (tarped areas), (2) 1 lb ai/ac Orthene 75S applied with a commercial center pivot irrigation system in approximately 0.15 in water, (3) 1 lb ai/ac Orthene 75S applied with CO_2 powered backpack sprayer in 20 GPA of water. Treatments were applied on July 18 and were evaluated on July 22, and 24. Plots were evaluated by counting the number of live, dead and sick cutworms in 4 sq. ft, in five different areas of each treatment.

RESULTS AND DISCUSSION

Experiment 1:

Both chemigated applications of Orthene 75S failed to provide significantly better control than the untreated check. The conventional sprayed Orthene 75S application provided significantly better control than the untreated check (Table 1).

Table 1. Experiment 1: Mean number of live cutworms found per ft^2, four days after treating

Treatment	Rate lb ai/a	Irrigation water (inches/ acre)	Mean no. alive
Untreated check	---	0.4	6.25 a
Orthene 75S	1.0	0.22	5.75 a
Orthene 75S	1.0	0.4	6.5 a
Orthene 75S	1.0	Sprayed on	0.75 b

Sample means were compared with Fisher's Protected LSD (p=0.05). Means with the same letter are not significantly different (Petersen 1985). F=8.81; df =3,9; p<0.05

Experiment 2:
The Orthene chemigated in 0.08 inch of water performed as well as the Entrust treatment but was not similar to the sprayed on application on the first sample date. By the second sample date the chemigated Orthene 75S and the Entrust treatments were similar to the standard application of spraying on Orthene 75S. All treatments provided significantly more control than the untreated check. (Tables 2 and 3)

Table 2. Experiment 2: Mean number of cutworms found per ft^2 three days after treating

Treatment	Rate lb ai/a	Mean no. alive	Mean no. sick	Mean no. dead
Untreated check	---	5.5 a	0.0 a	0.1 a
Orthene 75S (chemigated*)	1.0	1.6 b	0.1 a	0.2 a
Entrust 80% (sprayed)	0.15	1.0 bc	0.1 a	0.3 a
Orthene 75 S (sprayed)	1.0	0.3 c	0.1 a	0.7 a

Sample means were compared with Fisher's Protected LSD (p=0.05). Means with the same letter are not significantly different (Petersen 1985). Live, F=109.5; Sick, F=0.33; Dead, F=2.09 df =3,6; p<0.05
* Chemigated in 0.08 inch of irrigation water

Table 3. Experiment 2: Mean number of cutworms found per ft^2 five days after treating

Treatment	Rate lb ai/a	Mean no. alive	Mean no. sick	Mean no. dead
Untreated check	---	5.9 a	0.0	0.1 a
Orthene 75S chemigated*)	1.0	1.4 b	0.0	1.0 ab
Entrust 80% (sprayed)	0.15	1.5 b	0.0	1.7 b
Orthene 75 S (sprayed)	1.0	0.1 b	0.0	0.7 a

Sample means were compared with Fisher's Protected LSD (p=0.05). Means with the same letter are not significantly different (Petersen 1985). Live, F=12.59; Dead, F=6.66; df =3,6; p<0.05
* Chemigated in 0.08 inch of irrigation water

Experiment 3:
The cutworm control in the chemigated Orthene application is similar to the sprayed Orthene application. It should also be noted that there were some cutworms that were counted as sick at both four and six DAT in the chemigated treatment. It is unknown if these sick cutworms were still feeding and would survive (Tables 4 and 5). There was a reduction of live cutworms in the untreated check between four and six DAT. This reduction was probably caused by the soil becoming dry and causing some cutworms to hide in cracks in the soil.

Table 4. Experiment 3: Mean number of cutworms found per ft^2, four days after treating

Treatment	Rate lb ai/a	Mean no. alive	Mean no. sick	Mean no. dead
Untreated check	---	5.6	0.0	0.0
Orthene 75S(chemigated*)	1.0	1.1	1.7	0.6
Orthene 75S (sprayed)	1.0	0.05	0.2	1.4

* Chemigated with 0.15 inch irrigation water.

Table 5. Experiment 3: Mean number of cutworms found per ft^2, six days after treating				
Treatment	Rate lb ai/a	Mean no. alive	Mean no. sick	Mean no. dead
Untreated check	---	3.7	0.0	0.0
Orthene 75S(chemigated*)	1.0	0.8	1.4	0.3
Orthene 75S (sprayed)	1.0	0.1	0.0	0.9

* Chemigated with 0.15 inch irrigation water.

Conclusion

Chemigating Orthene 75S in 0.44 or 0.22 inch of irrigation water for control of foliar feeding cutworms in mint is ineffective compared to a conventional spray application. Chemigating Orthene 75S in 0.15 inch or less water can significantly improve the effectiveness of the cutworm control.

Section VII
Foliage and Seed Feeding Pests

BORING RESEARCH: A LOOK AT SHOTHOLE BORERS IN OREGON NURSERIES

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ABSTRACT

To determine the seasonal activity of key borer species in Pacific Northwest nursery production areas Lindgren funnel traps baited with ethanol lures were placed in nurseries at various locations in the North Willamette Valley of Oregon during the 2003 and 2004 growing seasons. Four traps (one non-baited) were monitored weekly from May 29 through September 3 during 2003 and nine traps (one non-baited) were monitored weekly from February 18 through September 1 during 2004. The traps were set in approximation to *Fraxinus, Quercus*, and *Prunus* spp. and also near burn (cull) piles. Infested trees and bolts damaged by borers were collected from various nurseries and beetles removed or reared out, and identified. Collected borers were originally identified by Dr. James LaBonte at the Oregon Department of Agriculture and kept in a reference collection housed at NWREC. There have been three dominant species of beetles found in our traps and also collected directly from infested trees from nursery sites or trees transferred to NWREC and reared out. Those species are *Xyleborus dispar*, the European shot-hole borer; *Monarthrum scutellare*; and *Xyleborinus saxeseni*. *X. dispar* was found to be the most common beetle isolated from damaged nursery stock.

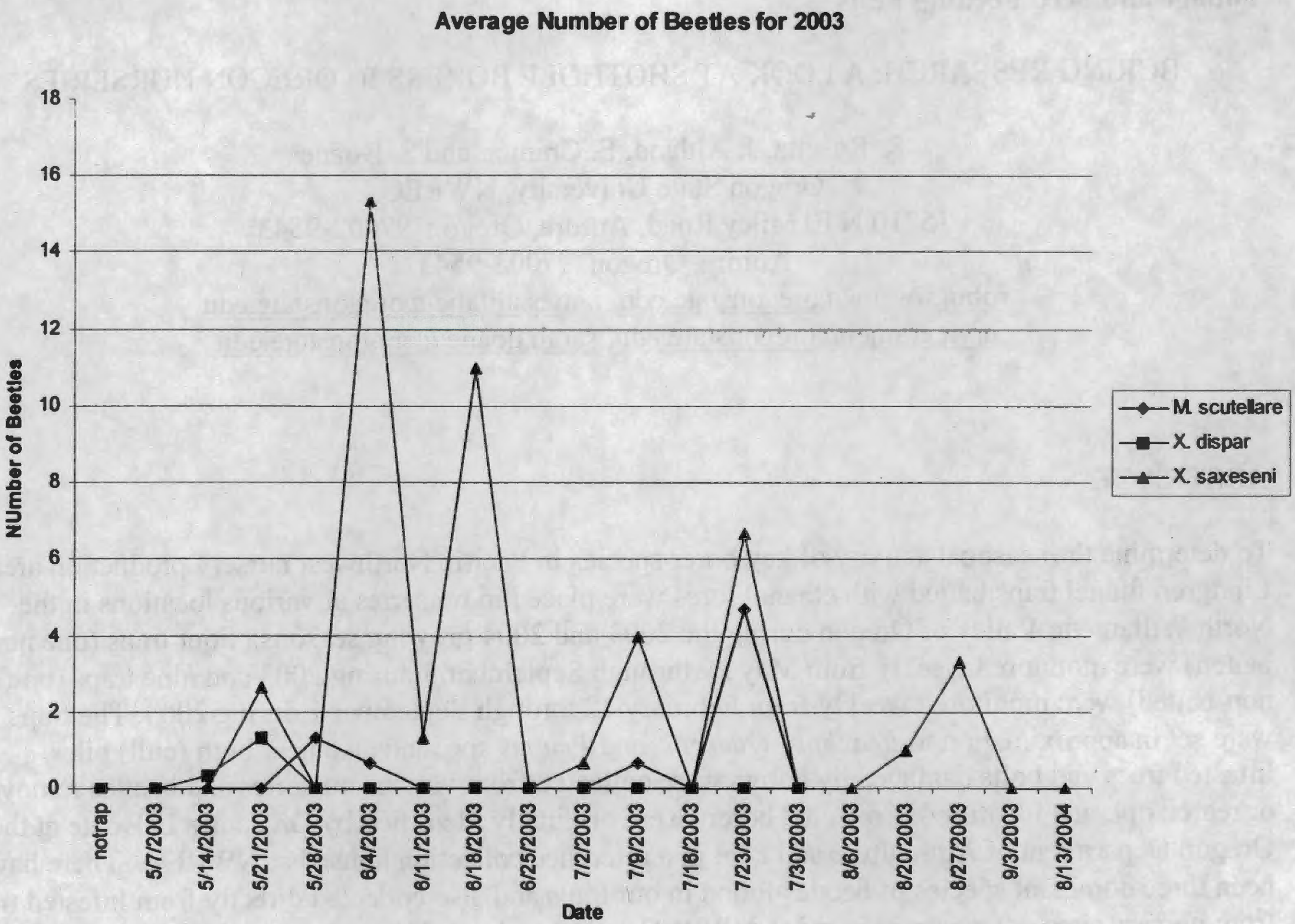

Chart 1. Average number of three beetle species collected from four traps in 2003 (Rosetta et al).

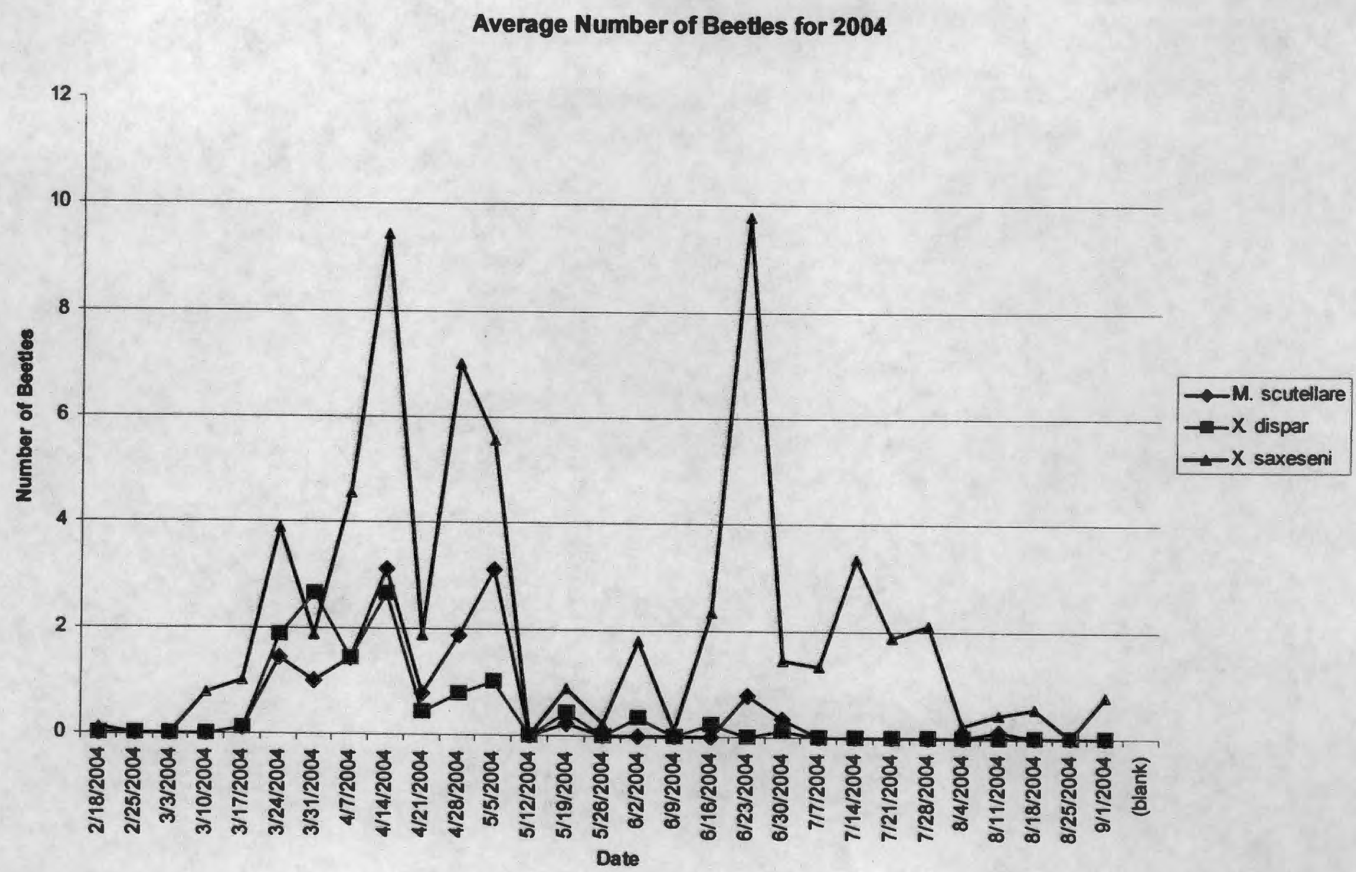

Chart 2. Average number of three beetle species collected from nine traps in 2004 (Rosetta et al).

MANAGEMENT OF WESTERN RASPBERRY FRUITWORM IN RED RASPBERRY

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Five insecticides were compared with our diazinon standard for efficacy and labeling/registration to control the western raspberry fruitworm, *Byturus unicolor*. Five adult fruitworm per Petri dish were place on 3-4 inch long, air-dried fruit buds that were uniformly treated with field rates applied with a Precision Spray Tower and replicated five times. Mortality was evaluated at 1, 2 and 3 days posttreatment (Table 1). These fruitworms were collected from Whatcom County, WA in early May. One day after treatment, 100% mortality was observed for the Diazinon standard. At 48 hours posttreatment, there was no significant difference for the remaining 4 insecticides compared with the untreated check. Complete mortality was obtained for Actara (thiamethoxam), Capture (bifenthrin) and Imidan (phosmet) and Success (spinosad) after 72 hours posttreatment. These data corroborate similar bioassays reported last year. Success was registered on red raspberry in 2003 for leafroller/worm control during the pre-harvest interval. These data show excellent efficacy for western raspberry fruitworm larval and adult control as well.

Table 1. Adult western raspberry fruitworm bioassay.

		Mean mortality		
Treatment	lb(AI)/acre	1DAT	2DAT	3DAT
Actara 25G	0.06	4.0ab	4.6a	5.0a
Capture 2EC	0.10	2.4b	4.6a	5.0a
Diazinon 50W	1.0	5.0a		
Imidan 70W	0.94	4.0ab	4.8a	5.0a
Success 2SC	0.09	3.2ab	4.4a	4.8a
Untreated check		0.0c	0.0b	0.0b

Mean within columns followed by the same letter are not significantly different (Tukey HSD test, $P<0.05$).

size: 5 beetles/5reps/6 treatment.

Diazinon and Capture were compared with Success and experimental Actara and Imidan for field efficacy to adult raspberry beetle, *Byturus unicolor*. The test was conducted at the Puyallup REC's Farm 5. Western raspberry fruitworm plots consisted of 3 hills each and 30 plots were randomized amongst 64 total plots based on plant vigor and relative beetle feeding on raspberry leaves. Adult beetle activity was monitored with 2 Rebel Bianco UV non-reflectance traps placed on the top trellis wire, 9 April 2004. Because of the mix of selections, bloom at time of treatment ranged from flowers still closed to 15% bloom and bee activity. Field rates were applied with a Solo backpack sprayer to run off on 5 May and presence of adults assessed on 11 May. Two teams of two persons each scanned and examined flowers and primocane terminals for live beetles for 3 minutes per plot. Capture and Actara provided good adult beetle control compared with the untreated check (Table 2). Imidan, Diazinon and Success were also significantly different from the untreated check, as well. Because the primocanes were not burned-back, the population levels of raspberry beetle were higher than we observed in adjacent cane burned blocks. The cultural practice of primocane burning in April may be associated with relative raspberry beetle abundance.

Table 2. Raspberry fruitworm field trial.

Treatment	lb(AI)/acre	Mean mortality
Actara 25G	0.06	7.8bc
Capture 2EC	0.10	3.4c
Diazinon 50W	1.0	23.2b
Imidan 70W	0.94	12.8bc
Success 2SC	0.09	23.4b
Untreated check		47.4a

Mean within columns followed by the same letter are not significantly different (Tukey HSD test, $P<0.05$).

Section VII Foliage & Seed Feeding Pests.

A Comparison of Chemical Control Methods for Seedcorn Maggot *Delia platura* on Dry Bean Field Establishment.

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Seedcorn maggot (SCM) can significantly reduce dry bean field stand establishment. Seed treatment with insecticide (ST), over the top (OTT) insecticide application and in furrow (IF) insecticide application were methods tested with several insecticides for control of SCM. A field trial was established on June 25, 2004 near Mattawa, Washington State USA. IF applications were all applied as the dry bean seeds were planted. OTT was applied 3 hrs after planting. Plot design was a randomized complete block of 4 replicates. OTT plot size was 6 ft. wide by 20 ft. ST and IF plots were 6 ft. by 80 ft. Seedling establishment was rated on July 6, 2004 to determine efficacy after germination had occurred.

Seedling stand establishment was significantly greater in the Cruiser and Poncho ST treatments compared to the untreated check. The Diazinon and Malathion OTT treatments did not protect seedlings better than the untreated check. The Warrior and Lorsban OTT treatments significantly increased stand counts compared to the untreated check. The Empower, Force, and Thimet IF treatments did not significantly increase stand counts compared to the untreated check. The Fortress IF treatment significantly increased stand counts compared to the untreated check. Stand counts were somewhat higher in the ST treatments compared to the IF or OTT treatments. The IF treatments appeared to be least effective at increasing bean stand establishment.

Trade name	Active ingredient	Rate	Mean seedling establishment
Untreated check			60.500a
Cruiser ST	thiamethoxam	1.28 fl oz/1000 lbs seed	74.500b
Diazinon OTT	diazinon	2.00 lb ai/A	62.750a
Empower IF	bifenthrin	0.006 lb/1000 row ft.	63.500a
Force IF	tefluthrin	5 oz./1000 row ft.	67.500a
Fortress IF	chlorethoxyfos	0.15 oz/1000 row ft	75.000b
Lorsban 15G IF	chlorpyrifos	0.5 lb/1000 row ft.	72.750b
Lorsban 4E OTT	chlorpyrifos	1.00 lb ai/A	69.000b
Malathion OTT	malathion	1.75 lb ai/A	65.500a
Poncho ST	clothianidin	2.00 oz./kg. seed	75.250b
Thimet IF	phorate	6 oz./1000 row ft.	62.500a
Warrior OTT	lambda-cyhalothrin	0.03 lb ai/A	71.000b

Section VII
Foliage & Seed Feeding Pests

IDENTIFICATION AND ABUNDANCE OF CUTWORMS IN SOUTH CENTRAL WASHINGTON VINEYARDS

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Cutworms climb grape vines at night and during the spring they feed on the developing buds causing a reduction in yield. One cutworm can damage several buds, so a small number of cutworms can cause economic losses. The two most important cutworms were believed to have been the spotted cutworm, *Xestia c-nigrum* (L.), and the redbacked cutworm, *Euxoa ochrogaster* (Guenee). However, we suspected that more species were involved. We surveyed vineyards in south central Washington to determine the cutworm species composition and relative abundance.

Materials and Methods. In 2003, we sampled the vineyard floors using a 40 cm circular sampling unit. The sampling was done by searching each quadrat using a small trowel. The number of samples per vineyard varied depending on the search time and the time needed to search each sample. Four vineyards were sampled for 2 person-hours each. These vineyards were sampled three times each at about two week intervals from 1 April to 2 May. Eighteen vineyards were sampled once per season for 1 person-hour each from 8 to 23 April. Pitfall traps (7.5 cm in diameter, 25 per vineyard) were placed in the 2 h vineyards from 28 March to 2 May and were checked weekly. Cutworms from all methods of sampling were collected and reared on artificial diet (Multiple Species Diet, Southland Products Inc., Lake Village, AR) in 35 ml plastic cups. The moths were pinned, wings spread, and identified.

In 2004, we did the 2 h and 1 h sampling as in the previous year. Seven vineyards were sampled for 2 h each starting on 22 March and ending on 21 April. We sampled 33 vineyards for 1 h each from 29 March to 15 April. We did no pitfall trapping in 2004 but we added night sampling and bark sampling. In the night sampling we searched vines for set periods of time using flashlights. One vineyard was searched for 5 person-hours and four were searched for 3 person-hours each. Sampling started on 7 April and ended on 20 April. The bark sampling was done in two vineyards on 8 and 15 April. We searched for cutworms under the loose bark during the day for 1 person-hour in each vineyard. The cutworms were reared on the artificial diet.

Results and Discussion. The cutworms that were found by the different sampling methods is listed in Tables 1 and 2 for 2003 and 2004. The percent of larvae reared to adults was 46.2 in 2003, and 54.2 in 2004. Parasitoids, mostly Hymenoptera, killed 11.7% of the larvae in 2003 and 11.1% in 2004. Parasitism accounted for 21.8% of the mortality in 2003 and 24.1% in 2004.

Probably the most unexpected finding was that no spotted or redbacked cutworms were found. These were previously believed to be the most important cutworm pests of grapes. The larvae of *Abagrotis orbis* resemble the spotted cutworm larvae. At this time we do not know if the spotted cutworm was missidentified by earlier workers or if it was not common during 2003 and 2004. The redbacked cutworm is reported to feed at or below the ground surface. Based on this information it seems unlikely that the cutworm would climb vines. Therefore, we suspect that the redbacked cutworm is not a pest of grapes.

Table 1. Species and number of cutworms found in vineyards, 2003.

Cutworm species	Reported Food Plants	Collected from vine-yard floor 2 hr search	Collected from vine-yard floor 1 hr search	Cutworms Caught in pitfall traps	Total
Agrotis vetusta	Unknown	20	2	1	23
Euxoa albipennis	Potato, corn, etc.	1		1	2
Euxoa hollemani	Unknown			3	3
Euxoa infausta	Cabbage, alfalfa	1			1
Euxoa messoria, Darksided cutworm	Trees, herbs, grasses	2	2	4	8
Euxoa olivia	Strawberries, corn	6	12	3	21
Euxoa rockburnei	Unknown	2			2
Euxoa septentrionalis	Unknown	15	8	8	31
Euxoa subandera	Unknown	2			2
Euxoa tesselata, Striped cutworm	Herbs and trees	4			4
Lacinipolia pensilis	Unknown		1		1
Parabagrotis exertistigma	Grasses	1			1
Platyperigea montana	Alfalfa	1			1
Protorthodes curtica	Unknown		1		1
Not Identified (wings shriveled)		8	2	3	13
Total moths reared		63	28	23	114
Total cutworms collected		121	90	36	247
Number of vineyards sampled		4*	18	4	

*Each vineyard was sampled 3 times. Pitfall trap vineyards were the same as the 2 hr. vineyards.

Although most cutworms feed on a wide range of host plants, many are restricted to herbaceous plants or grasses. Most of the cutworms found in the vineyards were probably feeding on the ground cover rather than on the vines. Two species, *Abagrotis orbis* (Grote) and *Agrotis vetusta* Walker were found on the vines, strong evidence that they were responsible for bud damage. *Abagrotis orbis* was previously known as *Abagrotis barnesi* (Benjamin) and was reported to feed on apple, peach, cherry, grape, and some non-fruit trees. It was first reported as a pest of peaches in Yakima in 1932. It has also been reported to hide under bark during the day rather than return to the ground. Apparently little is known of the biology of *Agrotis vetusta*.

Table 2. Species and number of cutworms found in vineyards, 2004.

Cutworm Species	Reported Food Plants	Collected on vines at night	Collected on vines during the day	Collected from vine-yard floor 2 hr search	Collected from vine-yard floor 1 hr search	Total
Abagrotis orbis (=*A. barnesi*)	Fruit trees, grapes	29	13	1		43
Abagrotis reedi	Willow, cotton-wood, etc				1	1
Agrotis vetusta	Unknown	9			1	10
Autographa californica, Alfalfa looper	Alfalfa, lettuce, canola, tree fruits				1	1
Euxoa catenula	Wheat, clover, etc.			1	1	2
Euxoa hollemani	Unknown				7	7
Euxoa messoria, Darksided cutworm	Trees, herbs, grasses			4	2	6
Euxoa olivia	Strawberries, corn			6	28	34
Euxoa septentrionalis	Unknown			4	6	10
Euxoa spp.					3	3
Euxoa tessellata, Striped cutworm	Herbs and trees				2	2
Feltia jaculifera, Dingy cutworm	Forage crops, vegetables				1	1
Platyperigea extima	Weeds				2	2
Platyperigea montana	Alfalfa				1	1
Protorthodes curtica	Unknown				11	11
Not Identified					3	
Total moths reared		38	13	16	70	137
Total cutworms collected		58	15	38	142	253
Number of vineyards sampled		5	2	7*	33	

*Each 2 hr. vineyard was sampled 3 times.

SECTION VIII

Mites & Sap-Sucking Insects

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Section Leader

Robin Rosetta

Section VIII.
Mites and Sap-sucking Insects

EVALUATION OF FOLIAR APPLIED INSECTICIDES FOR CONTROL OF MELON APHIDS, *Aphis gossypii* in Vegetable Spaghetti Squash

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Experimental plots were established at Two Bees Ag Research and Consulting Farms in Escalon California. The purpose of the research was to evaluate the effectiveness of eight different materials for control of the melon aphids in direct seeded squash fields. The treatments were applied with a Solo 5 hp backpack mist blower from both sides of the bed. A volume of 107 gallons/ acre was used. Two applications were made, one on July 8th and the second on July 27th.

Materials in Trial

Products	Formulation	Prod/Acre
Untreated Control		
Provado	1.6 F	3.75 oz. Prod.
Actara	25 WG	0.25 Lb Prod.
Warrior	1 CS	3.76 oz. Prod.
Knack	.86 EC	8.5 oz. Prod.
Assail	70 WP	0.92 oz. Prod.
Hexacide	5%	1.5 qt/Acre
Proud	5.6 EC	1.5% oil Prod.
Fulfill	50 WG	2.70 oz. Prod

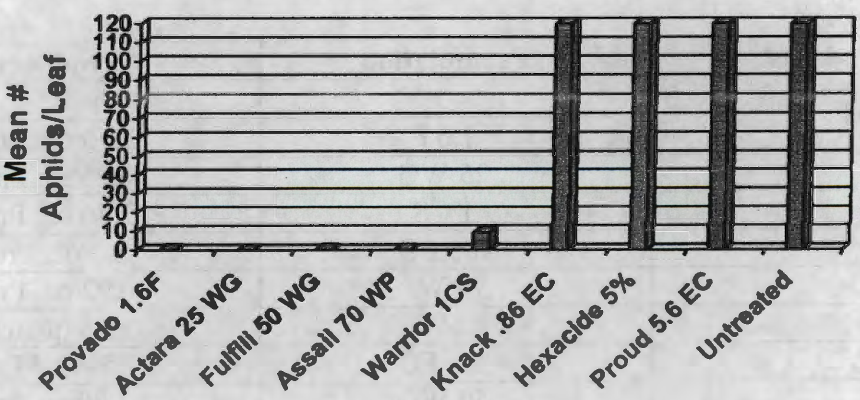
Aphid evaluations were made by selecting 10 leaves per plot from the center of the squash plant and counting aphids while observing through a 4-power head-mounted magnifier. When numbers of aphids were above 300, groups of 25 were estimated and totaled for the counts. When numbers of aphids were above 1000, groups of 100 were estimated and totaled for the counts. Very little biological control from either predators or parasites was observed in this trial. At the end of the trial some pressure from mites and powdery mildew was observed. Fruit was removed from the plants at frequent intervals in order to keep the growth vegetative and lush.

Control of Melon Aphid, *Aphis gossypii* inVegetable Spaghetti Squash – 2004

Products	Prod/Acre	13 Jul # Aphids/leaf	20 Jul # Aphids/leaf	03 Aug # Aphids/leaf
Untreated Control		0.7 ab	3.3 ab	153.9 bc
Provado 1.6 F	3.75 oz. Prod.	0.1 a	1.2 a	0.2 a
Actara 25 WG	0.25 Lb Prod.	0.0 a	0.4 a	0.0 a
Warrior 1 CS	3.76 oz. Prod.	0.0 a	0.3 a	9.2 a
Knack .86 EC	8.5 oz. Prod.	2.4 ab	8.7 b	168.6 bc
Assail 70 WP	0.92 oz. Prod.	0.0 a	0.2 a	0.1 a
Hexacide 5%	1.5 QTS/Acre	0.8 ab	8.0 b	143.6 b
Proud 5.6 EC	1.5% oil Prod.	3.6 b	1.6 a	179.7 c
Fulfill 50 WG	2.70 oz. Prod	0.1 a	0.6 a	0.2 a

Means in a column followed by the same letter are not significantly different at the 5% Level.
DMR

Zucchini Squash - Escalon, CA, August 3, 2004



Provado, Actara, Warrior, Assail and Fulfill provided excellent control of aphids for the duration of the trial. Proud provided control following the first application but levels of control weakened by August 3rd. Knack and Hexacide were not able to reduce populations below the levels exhibited in the untreated controls. Previous work has shown better performance from Knack and Hexicide so we are assuming that the lack of beneficial arthropods was deleterious to these treatments.

Section VIII.
Mites and Sap-sucking Insects

EVALUATION OF FOLIAR APPLIED INSECTICIDES FOR CONTROL OF TWOSPOTTED SPIDER MITES, *Tetranychus urticae*, In Vegetable Spaghetti Squash

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Experimental plots were established at Two Bees Ag Research and Consulting Farms in Escalon, California. The purpose of the research was to evaluate the effectiveness of five different materials for control of the twospotted spider mites in direct seeded squash fields. The treatments were applied with a Solo 5 hp backpack mist blower from both sides of the bed. A volume of 107 gallons/ acre was used. One application was made on July 27th.

Materials in Trial

Products	Formulation	Prod/Acre
Untreated Control		
Acramite	4 SC	12 oz. Prod.
Acramite	4 SC	16 oz. Prod.
Acramite	50 WS	12 oz. wt.
Fujimite	50 SC	32 oz. Prod.
Agrimek + ¼ % oil	.15 EC	12 oz. Prod.

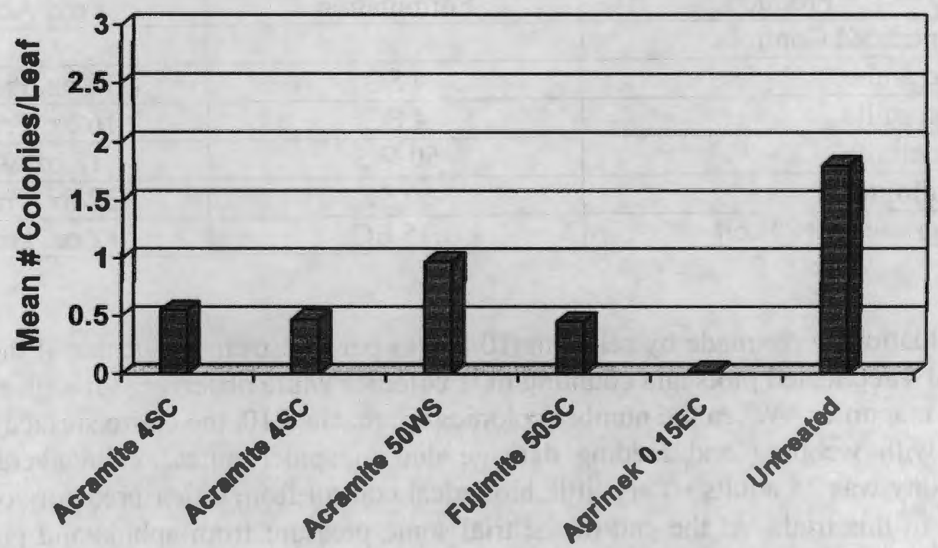
Mite evaluations were made by selecting 10 leaves per plot from the center of the squash plants in each of 4 replicated plots and counting mite colonies while observing through a 4-power, head mounted magnifier. When the number colonies approached 10, the entire surface of the leaf was covered with webbing and feeding damage due to spider mites. The average number of mites/colony was 24 adults. Very little biological control from either predators or parasites was observed in this trial. At the end of the trial some pressure from aphids and powdery mildew was observed and complicated the evaluation of spider mite activity. Fruit was removed from the plants at frequent intervals in order to keep the growth vegetative and lush.

Control of Twospotted Spider Mites, *Tetranychus urticae,* in Spaghetti Squash 2004

Products	Formulation	Prod/Acre	Rating 03 Aug	Rating 10 Aug	Rating 17 Aug
Untreated Control			1.6 b	1.8 b	1.8 d
Acramite	4 SC	12 oz. Prod.	0.17 a	0.75 a	0.55 bc
Acramite	4 SC	16 oz. Prod.	0.12 a	0.59 a	0.47 b
Acramite	50 WS	12 oz. wt.	0.20 a	2.01 b	0.97 c
Fujimite	50 SC	32 oz. Prod.	0.02 a	0.81 a	0.45 ab
Agrimek + ¼ % oil	.15 EC	12 oz. Prod.	0.12 a	0.81 a	0.02a

Means in a column followed by the same letter are not significantly different at the 5%Level.DMR

Mean Number of Mite Colonies/Leaf of Zucchini Squash - Escalon, CA, August 17, 2004



All materials provided good control of spider mites by the end of the trial. On the August 10 evaluation the Acramite 50WS appeared to weaken, however the levels of mite colonies in this treatment dropped by the next evaluation. The Agrimek + oil provided the best level of control by the final rating. Overall, considering the population increase due to the early squash bug treatment with a pyrethroid, all materials performed well in this study.

BAMBOO SPIDER MITE CONTROL WITH FOLIAR APPLIED ACARICIDES

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Bamboo spider mites, *Stigmaeopsis celarius* Banks (=*Schizotetranychus celarius*) live in protected web nests and are difficult to control. Current recommendations are outdated and do not reflect the new acaricide chemistries. Nine acaricides were evaluated for bamboo spider mite control. Bioassays were performed with a Precision Spray Tower. Acaricides were applied at 15 psi in 1 ml of an aqueous suspension on to 0.5 inch long sections of bamboo leaves, *Phyllostachys nigra* inverted on water moistened cotton wool pads placed in Petri dishes. Spider mites were scored as alive or dead based on the presence/absence of motile live stages at 1, 2 and 3 days posttreatment. Replicated bioassays were performed on 23, 28 and 30 September 2004. Data for corresponding replications for the trial dates were from 25 leaf arenas per treatment.

Talstar (bifenthrin) provided complete control of the heavily webbed bamboo spider mite colonies after 24 hours. Metasystox-R (oxydemeton-methyl), Tame (fenpropathrin), Sanmite (pyridaben) and Mesa (milbemectin) provided comparable results with Talstar at 2 and 3 days posttreatment. The selective contact miticides Avid (abamectin), Floramite (bifenazate) and Kanemite (acequinocyl) performed poorly against the bamboo spider mite after 3 days. Specialty bamboo growers require quick knockdown of incipient bamboo spider mite colonies that can rapidly construct dense web nests reducing pesticide contact, making conventional control methods difficult.

Table 1. Bamboo spider mite bioassay on *Phyllostachys nigra* foliage.

Treatment	amt/100 gal	lb(AI)	Percent mortality		
			1DAT	2DAT	3DAT
Avid 0.15EC	118 ml	0.005	15c	30b	44b
Floramite SC	113 g	0.25	15c	15bc	23bc
Kanemite 15EC	917 ml	0.3	11c	15bc	26bc
Metasystox-R	946 ml	0.5	96a	96a	100a
Mesa EC	946 ml	0.02	60b	78a	78a
Sanmite 75WP	113g	0.2	84ab	96a	100a
Talstar F	592 ml	0.1	100a		
Tame 2.4EC	473 ml	0.3	89a	100a	
Untreated check			0.0c	0.0c	0.0c

Means within columns followed by the same letter are not significantly different (Tukey HSD test, P <0.05).

Section VIII
Mites & Sap-Sucking Pests

ACARICIDAL CONTROL OF CYCLAMEN MITE IN STRAWBERRIES

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Four acaricides were evaluated for cyclamen mite, *Phytonemus pallidus,* efficacy as a renovation treatment on 'Totem' strawberries at the Vancouver REU. Treatments were applied on 2 August to pre-selected 3 year-old plants. To simulate postharvest renovation, we used a rotary lawnmower to form one ft^2 plots from cyclamen mite damaged plants. Treatments were applied to run-off with a Solo backpack pressure sprayer at 40 psi with a 5500 adjustable conejet nozzle. The trial consisted of two rates of Acramite (bifenazate), Mesa (milbemectin) and single rates of Thiodan (endosulfan), Kanemite (acequinocyl) and untreated check. Treatments were replicated three times with 3 crowns removed at 4 and 7 days posttreatment and placed in a Berlese-Tullgren funnel for controlled heat extraction into 70% ethanol.

Compared with the untreated check, all of the treatments were significantly different at 4 days posttreatment. Acramite was registered on strawberries for spider mite control at 0.75-1.0 lb(AI)/acre in early 2002. This year's data indicate again that Acramite's cyclamen mite activity at the 1.0 rate is comparable with Thiodan to 7 days posttreatment. Mesa was registered last year on strawberry for spider mites, eriophyids and tarsonemids (broad and cyclamen mite species). Thiodan remains the most effective cyclamen mite control in strawberry. However, Mesa at the rate of 0.192 lb(AI)/acre and the recently registered Kanemite (acequinocyl) provided comparable control with Thiodan to 7 days. We concur with Gowan that 2 applications 7-10 days apart should be applied when cyclamen mite symptoms are apparent either in the spring or postharvest. The maximum number of spray applications per crop season is 4 for Mesa and 2 for Thiodan and Kanemite. The traditional recommendation for cyclamen mite control in PNW strawberries is at the dormant and prebloom periods. The spring application(s) for cyclamen mite control is confronted with the physical problem of dense canopy growth that reduces effective penetration into crowns where adult females overwinter. Past research indicate the optimum period to apply a contact miticide for cyclamen mite is when the population is migrating into the fall maturing crown inflorescences. The ideal timing is soon after field renovation

Table 1. 2004, Cyclamen mite trial in strawberry.

Treatment	lb(AI)/acre	Mean/ ft^2 Precount	4DAT	7DAT
Acramite 50WS	0.5	19.0a	27.3b	11.3bc
Acramite 50WS	1	19.3a	8.7b	2.3bc
Thiodan 3EC	2	16.7a	5.0c	0.7c
Mesa 1%EC	0.0145	14.7a	14.0c	16.7b
Mesa 1%EC	0.0194	18.0a	6.3c	8.7bc
Kanemite 15SC	0.3	16.0a	8.0c	13.0bc
Untreated check		19.7a	38.3a	34.0a

Means within columns following by the same letter are not significantly different (Tukey HSD test, *P* <0.05).

Chemical Control of McDaniel Mite *Tetranychus mcdanieli* Koch in Timothy Hay.

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Acaricides were screened for ability to control McDaniel spider mite on timothy grass hay *(Phleum pratense* L.). On April 22, 2004, field plots were established near Ellensburg, Washington State, USA. Plots were 5 ft. wide and 20 ft. long and were replicated four times in a complete random block design. Acaricide applications were made on April 22, 2004 using a backpack mounted boom sprayer. Ten grass blades per plot were collected weekly and transported to the laboratory where mites were counted under a stereoscope.

The first week after treatment all compounds tested, with the exception of the .125 lb. a.i./acre Onager treatment and the JMS Stylet Oil, controlled mites significantly better than the untreated check. The second week post-treatment, predatory mites reduced the McDaniel spider mite population to a density that an acaricide treatment effect was no longer detectable.

Trade name	Active Ingredient	Rate	Mean mites per leaf 22 April	Mean mites per leaf 5 May	Mean mites per leaf 13 May
Untreated check			6.000a	6.400a	1.050a
Agrimek w/oil	abamectin	0.019 lb ai/A	11.480a	1.950b	0.300a
Acramite 4SC[2]	bifenazate	0.75 lb ai/A	5.600a	0.200b	2.00a
Acramite 50WS[2]	bifenazate	0.50 lb ai/A	6.433a	0.900b	0.250a
Capture 2EC	bifenthrin	0.100 lb ai/A	7.440a	0.050b	0.050a
Secure	etoxazole	0.135 lb ai/A	7.300a	1.600b	5.100b
Fujimite	fenpyroximate	0.15 lb ai/A	8.350a	0.550b	0.550a
Onager 1E/oil	hexathiozox hi	0.125 lb ai/A	10.560a	7.053a	0.800a
Onager 1E/oil	hexathiozox lo	0.094 lb ai/A	9.633a	0.050b	1.200a
Supracide 2E	methidathion	3 pt/A	6.920a	0.850b	0.150a
JMS Stylet Oil	oil	2% sol.	11.560a	3.800a	1.350a
Comite	propargite	1.00 lb ai/A	11.160a	1.800b	3.050a

[2] = Ad-Wet adjuvant was added to the solution at label rate

Leafhopper Virginia creeper *Erythroneura ziczac* Walsh, and the western grape leafhopper, *Erythroneura elegantula* Osborn Control in Wine Grapes var. 'Muscat Canelli'

Waters, T. D., H. J. Ferguson, R. P Wight, and D. B. Walsh
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Insecticides were screened for their ability to control leafhopper nymphs in wine grapes. On August 19, 2004, field plots were established near Horsethief Point, Washington State, USA. Plots were 10 ft. wide and 40 ft. long and were replicated four times in a complete random block design. Insecticides were applied on August 19, 2004 using a hand gun on an ATV mounted sprayer. Ten leaves per plot were collected weekly and transported to the laboratory where leafhopper nymphs were counted under a stereoscope.

The first week after insecticide applications all compounds tested reduced leafhopper nymph abundance better than the untreated check, with the exception of the Applaud treatment of 0.525 lb. a.i./acre. The second week after insecticide application all compounds tested provided better leafhopper nymph control compared to the untreated check, with the exception of the Avaunt treatment of 0.11 lb. a.i./acre.

Trade name	Active Ingredient	Rate	Mean nymphs per leaf 19 August	Mean nymphs per leaf 23 August	Mean nymphs per leaf 31 August
Untreated check			3.950a	16.850a	18.600a
Actara	thiamethoxam	0.043 lb ai/A	5.350a	0.900b	1.200b
Applaud 70 WP	buprofezin	0.394 lb ai/A	1.650a	1.850b	2.800b
Applaud 70 WP	buprofezin	0.525 lb ai/A	2.000a	10.100a	2.525b
Assail	acetimiprid	0.02 lb ai/A	0.300a	0.733b	0.350b
Avaunt	indoxacarb	0.09 lb ai/A	2.900a	1.725b	1.788b
Avaunt	indoxacarb	0.11 lb ai/A	3.175a	5.475b	7.800a
Danitol 2.4 EC	fenpropathrin	0.4 lb ai/A	0.250a	4.300b	0.667b
Fujimite 5%	fenpyroximate	2 pt/A	1.600a	4.150b	2.367b
NNI-750C	buprofezin & chlorpyrifos	0.5 lb ai/A	1.333a	2.350b	5.950b
Provado	imidacloprid	0.033 lb ai/A	1.400a	1.200b	1.067b

2004 PNWIMC Meeting Minutes

Beginning Business Meeting opened at 8:57 Am by President Jim Todd.
Jim asked for help with breaks from anyone wishing to contribute to the cause.
A moment of silence was held for Norm Waters, deceased during 2003.
Jim recognized the efforts of Joe De Francesco, Sharon, Robin, Dave, (and Jim) to prepare for the 2004 PNWIMC.
Dave Bragg reported that the Checking Account balance just prior to the Conference contained \$1365.98. \$765.18 was paid to the Hilton Hotel during the meeting.
A committee Chaired by Sharon Colman, and interested parties, was selected by Jim Todd to meet during lunch on Monday to discuss issues such as dates, locations, e-mail vs. snail mail, and how to attract students to the meetings.
A nominations committee, resolutions committee, and the Tumble Bug Award Committee were appointed. Reports began at 9:25 AM.

Final Business session was held Tuesday PM after all reports were presented. A moment of levity occurred when Master Tumble Bug Bragg announced that he just went totally blind Not enough to prevent his awarding the TBA to Benny Fouche of UCD who has tried to win for some time, using all of the techniques used by past winners. There were the usual runners up. This means Fouche' and Bragg will serve on the committee in 2005.
Local arrangements committee for 2005 will consist of Jim Todd, Denny Bruck, Glenn Fisher, Dave Bragg (as Treasurer), and Joe DeFrancesco. In a surprise move the Nominations Committee (Sharon Chair) announced Benny Fouche as President for 2005, Craig Collins as President Elect, and Bragg to continue as Exalted Dung Beetle (Secy/Treas).
Resolutions Committee (Benny, Robin, Dave) asked for thanks and recognition for all who served as Section Leaders, Mary Koska of the Hilton Hotel, Robin for the AV equipment, Joe for getting recertification credits, and all who made the meetings a success. A request for e-mails between people with suggestions was made for during the 2004 research year. Calls to be sent to all possible people by e-mail, and a newer list is greatly need with volunteers from each state to coordinate the sending of the Call each year.

2005 Treasurers Report
12/20/04 by Dave Bragg

Deposit of \$1490.00 made after paying bills to account in January 2004.
Balance\$2223.18
Check to Joe Francesco in March for \$90 for California Credits
Check to Hilton Hotel 12/09/04 for \$727.20 pre-payment
Balance in account 12/10/04 \$1405.98

EXOTIC SNAIL AND SLUG SURVEY IN OREGON, PRELIMINARY RESULTS 2003-2005

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Over the past ten years, over 20 species of exotic snails and slugs have been intercepted on foreign cargo at the U.S. port of entry in Oregon. Follow-up domestic survey is intended to monitor high-risk sites for certain agriculturally-significant species. Survey sites include areas within and adjacent to maritime ports, shipping container yards, and importers of tile, granite, and marble from high-risk countries of origin. Survey methods were mainly visual observations and hand-collection; baited pitfall trapping was also attempted on a trial basis. Standardization of survey methods was attempted through identifying key habitat types, environmental conditions (precipitation, temperature) and allocating a minimum sampling time of 1.0 survey-hour/site. Field samples were also submitted by PPQ officers, Oregon Dept. of Agriculture horticulturalists and entomologists, OSU extension agents, and private homeowners.

From October 2003 though December 2004, nineteen sites, from eight Oregon counties were surveyed (Table 1). Specimens collected and identified include both native species and naturalized exotic species. Many collections included well-established exotic slugs such as *Derocerus reticulatum*, *Limax maximus*, and the *Arion rufus* species complex. The established exotic snail *Cryptomphalus asperses (Helix aspersa),* while sporadically reported in western Oregon, was intercepted from a residential site in eastern Oregon (Umatilla County). One significant report confirms the established status of the japanese mystery snail, *Cipangopaludina japonica* at a lake in Polk County (Table 2).

Table 1: Oregon counties and number of sites surveyed or sampled

Multnomah	7
Washington	3
Marion	3
Clackamas	2
Benton	1
Columbia	1
Polk	1
Umatilla	1

Table 2: List of species collected and submitted as of 12/30/04.

Genus	Species	common name	Family	collected
Ancotrema	*sportella*	beaded lancetooth	Haplotrematidae	5
Ariolimax	*columbianus*	Pacific banana slug	Arionidae	2
Arion	sp. *	arion slug	Arionidae	38
Arion	***rufus*** **	chocolate arion	Arionidae	3
Cipangopaludina	***japonica***	Japanese mystery snail	Viviparidae	14+
Cryptomphalus	***aspersus***	brown garden snail	Helicidae	1
Deroceras	***reticulatum***	grey garden slug	Agriolimacidae	67
Limax	***maximus***	leopard slug	Limacidae	3
Monadenia	*fidelis*	banded wood snail	Bradybaenidae	1
Prophysaon	*sp.* *	taildropper	Arionidae	1
Succinea	*sp.* *	ambersnails	Succineidae	4
unknown snail	sp. 1		Hygromiidae	2
unknown slug	sp. 2		Arionidae	16
Vespericola	*columbianus* *	northwest hesparian	Polygyridae	2

* tentative identification, awaiting confirmation

** species complex

Section III
Biological & Cultural Controls

BIOLOGICAL CONTROL PROJECT FOR CEREAL LEAF BEETLE, *OULEMA MELANOPUS* LINNAEUS, SUPPRESSION IN IDAHO

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CLB was detected in Lewis, Nez Perce and Latah counties for the first time in 2004. Five fields were survey in Benewah County but no CLB was detected. Surveys in Shoshone and Clearwater counties were also negative for CLB establishment. Biocontrol agent releases were made of the larval parasite, *Tetrastichus julis*, at new site in Kootenai County outside of Post Falls ID. A new establishment record for this biological control agent was recorded in Boundary County in 2004. A survey conducted on June 23 found a *T. julis* parasite level of 8% in the CLB larval sample from that county. A larval sample collected June 24, from a wheat field in Canyon County, near Kuna, ID had a *T.julis* parasite level of 56%. A field insectary for the egg parasite *Anaphes flavipes* was initiated this spring at the University of Idaho, Parma Research and Extension Center, Parma, Idaho with cooperation from the University of Idaho and USDA, PPQ. Four releases of egg parasites shipped in from the USDA, Niles Lab, Niles, Michigan, were made during the peak CLB egg-laying period (April 27, May 11, May 19, and May 26). Follow up surveys will be conducted spring of 2005 to determine if the egg parasite successfully established in the insectary field. Maps showing Idaho counties positive for CLB and *T. julis* larval parasite establishment are attached.

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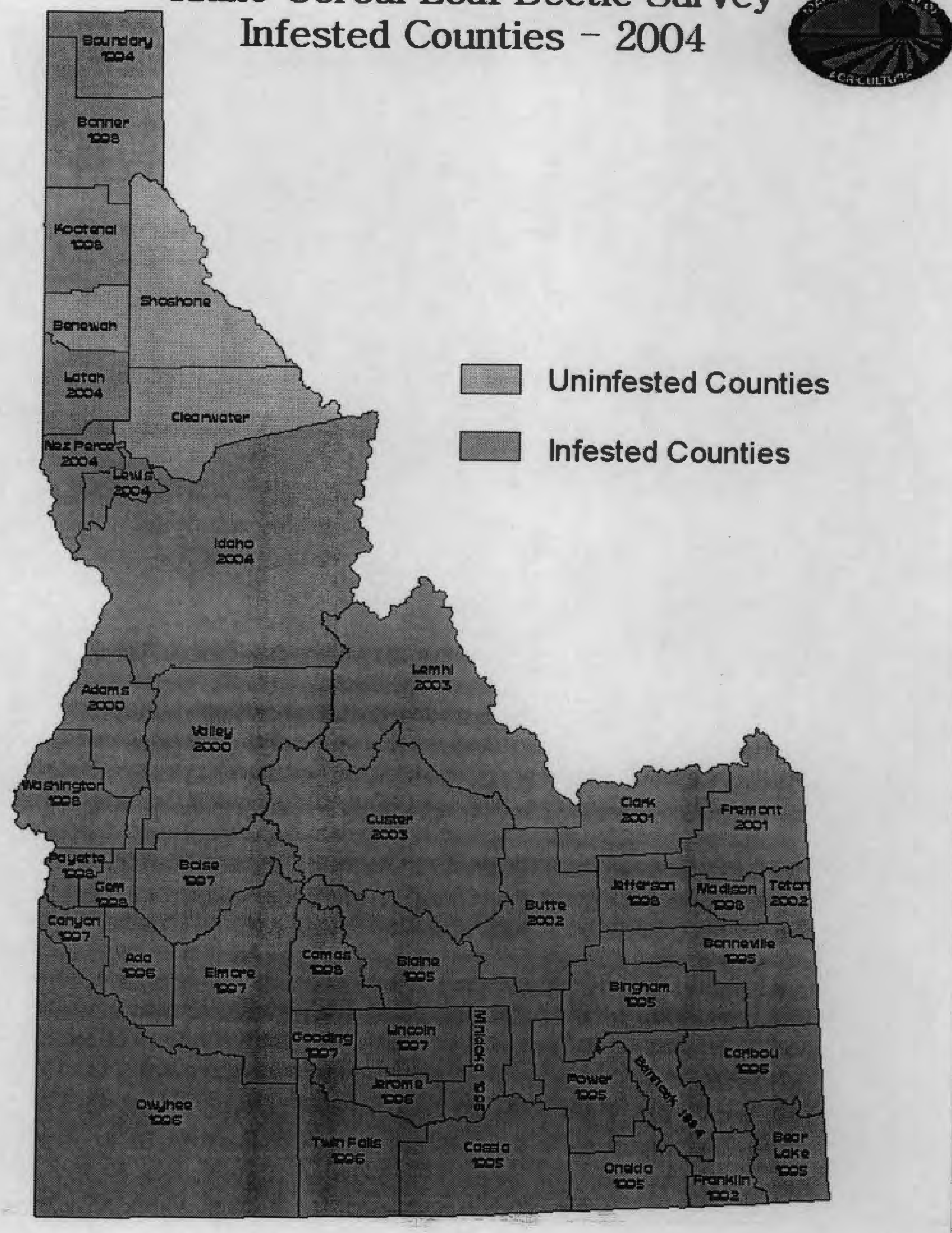
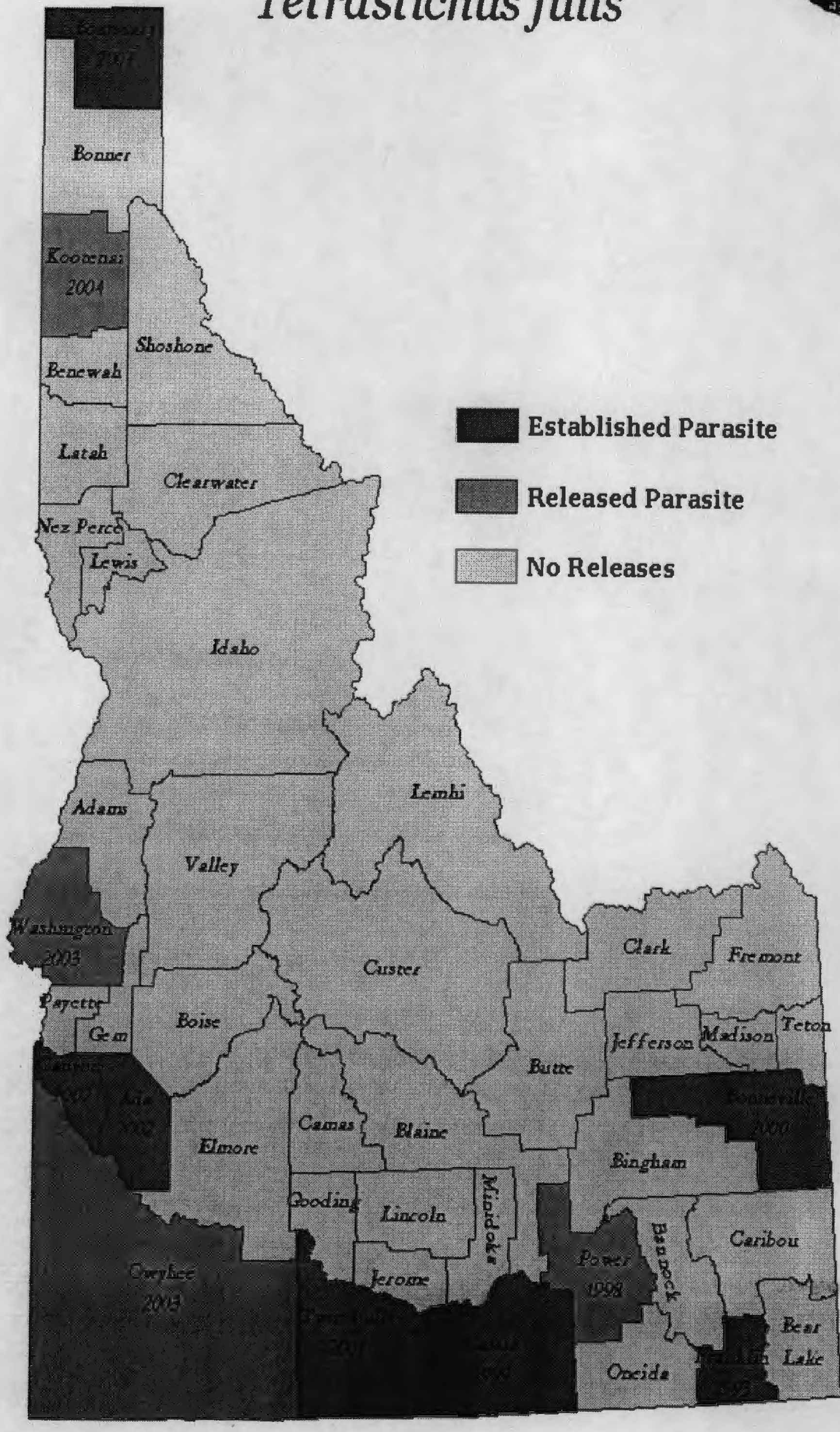
Idaho Cereal Leaf Beetle Survey
Infested Counties - 2004



2004 Cereal Leaf Beetle Parasite

Tetrastichus julis



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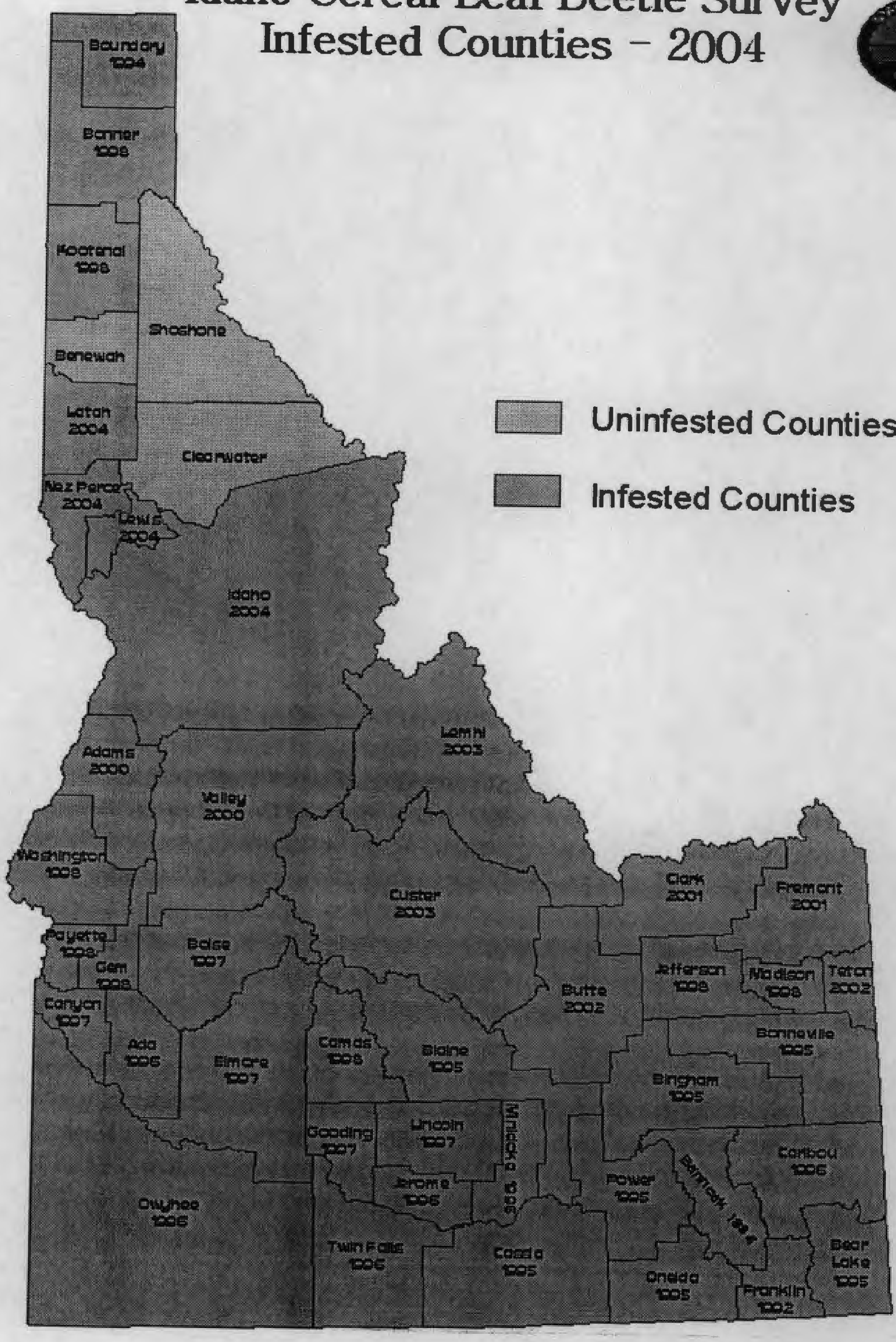

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