PROCEEDINGS

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66TH ANNUAL PACIFIC NORTHWEST

INSECT MANAGEMENT CONFERENCE

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Section I.
Surveys of Invasive and Emerging Pests

Exotic Seed-bugs (Lygeoidea: Rhyparochromidae and Oxycarenidae) New to the Pacific Northwest

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Figure 1. ***Rhyparochromis vulgaris***

In recent years a three introduced European seed-bugs have been discovered in the Pacific Northwest, where they are an increasing nuisance pests in homes. Populations of the seed-bugs invade homes and other buildings seeking over-wintering shelter and homeowner complaints of high numbers of the bugs in the spring and fall have increased steadily from many areas since 2002. Crop and garden problems from the seed-bugs have not been reported, and based on the European literature, they are not expected to become significant agricultural pests in the region.

The most prominent species currently in the Puget Sound area is *Rhyparochromis vulgaris* (Schilling) (Figure 1.). It was first reported in late 2001 by a homeowner in Orting (Pierce Co.), which was the first record for the species in North America. Since 2003, large congregations of the species have been reported in locations from greater Seattle south to rural sites south of Chehalis, in Lewis County.

A second European seed-bug reported as a household nuisance problem in the region is *Raglius alboacuminatus* Goeze (Figure 2.), which has also been documented as recently established in areas of California and Utah, where it was first recorded in North America in 1999. In 2006, *R. alboacuminatus* aggregations were reported from the Seattle area and locations near Idaho, in Eastern Washington (Rosalia), and Northeastern Oregon (La Grande).

Figure 2. *Raglius alboacuminatus*

A third, much smaller species is *Metapoplax ditimoides* (Costa) (Figure 3.), first reported from North America in Oregon in 1998, it has now been found in many areas of Western Oregon and in California, as far south as Los Angeles county. In the spring of 2006, a homeowner reported large numbers of the species in her home in Lynden, Washington, near the Canadian border.

Figure 3. *Metapoplax ditomoides*

Native to continental Europe, all three species have been intercepted by USDA APHIS PPQ in recent years, in shipments of various goods from Europe, particularly Italy. A 2004 publication by Dr. Henry (USDA ARS Systematic Entomology Lab), documenting the introduction of the European seed-bug pests into North American, describes the group as a "serious nuisance pests" that "may invade houses and other buildings in large numbers, causing anxiety among homeowners and creating costly control expenses for commercial establishments." They are all now well established and becoming widespread in our region, and have the potential to become significant "invasive" exotic pests for home and business owners due to their serious nuisance potential.

Section I
Forage (Hay) Pests

Control of the armyworm, *Pseudaletia unipuncta* (Haworth), in SW Oregon grass pastures

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August and September of 2005 marked the third year that armyworms defoliated hundreds of acres of grass pasture and field corn in Coos County (and established tall fescue for seed in the mid-Willamette Valley). Populations of over 30 larvae per sq. ft. were recorded (>1,000,000 larvae/A)

Historically, damage in Oregon has been sporadic and localized in grass pastures and seed crops (some silage corn) occurring in the late summer and fall about once every ten to fifteen years. Outbreaks usually followed a mild winter and wet spring. Infestations likely arose from moths migrating north from California in mid-summer. It seems that now AW moths are over-wintering in western OR (or close to it!).

In 2004 and 05 hundreds of acres of grass pastures in Myrtle Point, OR, literally disappeared in about a week! Organic milk production in the area has necessitated an OMRI approved control of this pest. The two replicated field trials we conducted in dairy pastures indicate that spinosad can provide effective control of AW.

A 15 day Crisis Exemption for both Entrust® (for organic milk producers) and Success® biological insecticides from Dow AgroSciences was issued by ODA for use on Myrtle Point Dairy Pastures to control AW.

At the time of application, larval populations were large and uniformly distributed among plots (>30 larvae/sq ft). At site I, application of products was made to predominantly second and third instar larvae; at site II, application of Success® and Javelin® was to third and fourth instar larvae. AW pressure was lighter and of earlier instars at site I compared to site II. In fact, AW populations were sufficiently greater by the time treatments were applied to site II, so all but the plot area in the experiment was harvested.

Treatments were applied on 9 Aug at site I in the late afternoon and were concluded at site II at dark. Plots at both sites were 20 x 20 ft and replicated three times in a RCB design. Treatments were applied in a 6.5 ft swath using a CO_2 backpack sprayer equipped with a 5 nozzle boom (8002 flat fan nozzles with a 50 mesh screen) to deliver 40 gpa at 30 psi.

On 15 Aug (6 DAT), plots in both sites were evaluated by taking ten, 5 ft straight-line sweeps with a standard 15-inch diameter sweep net in the middle area of each plot, leaving 5 ft between sampled area and plot borders. Site I was sampled again on 24 Aug (15 DAT). The numbers of live AW were counted and recorded in each plot. Data were subjected to analysis of variance (ANOVA) and means were separated using the Fisher Protected (LSD). Test at *p-value* = 0.05. All values were transformed using square root transformation to equalize the variance. Original means are presented in tables.

At both sites, Success® at both 3 and 6 oz rates gave significantly better AW control than the other treatments (Table 1 & 2). Also, the low rate of Success® was comparable in performance to the high rate. Neither Javelin® nor carbaryl at the rates tested significantly reduced AW numbers below those of the UTC at site I. And although the Javelin® treatment significantly reduced numbers of AW below those of the UTC at site II, the approximate 50% control observed was inadequate. No foliar symptoms of phytotoxicity were observed with any treatment. Collections of AW larvae from site II in late Aug indicated that nearly 25 were parasitized by Tachinid flies.

Table I. Site I, Avg AW larvae per 10 straight-line sweeps of standard 15" diameter sweep net

Treatment	Rate/A lb	Live Larvae	
		6 DAT	14 DAT
Success	.047 ai	1.7a	1.3a
Success	.094 ai	3.0a	1.3a
Javelin	1.5 form	20 b	18.3 b
Javelin	1.0 form	26.7b	15.7 b
carbaryl	1.0 ai	30.7b	20.7 b
UTC		25.3b	18.7 b

Table 2. Site II Reed Canary Grass, Avg. AW larvae/ 10, 90degree sweeps 6 DAT

Treatment/ Formulation	Rate lb/acre	Mean
Success	.047 ai	20.0 a
Success	.094 ai	19.0 a
Javelin	1.5 form	107.3bc
Javelin	1.0 form	72.3 b
UTC	---	141.3 bc

Means followed by the same letter are not significantly different (P=0.05; Tukey LSD)

POTATO TUBERWORM IN THE COLUMBIA BASIN

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The potato tuberworm (PTW) or potato tuber moth *Phthorimaea operculella* (Zeller) is a cosmopolitan, oligophagous pest of solanaceous crops commonly found in tropical and subtropical regions. Tuberworm has been recorded in California as early as 1856; however, PTW was not a major concern for growers in Oregon and Washington until 2002 when a field with severe tuber damage was documented in northeastern Oregon and southeastern Washington, and was not considered an issue in Idaho until confirmation of the occurrence of this insect in 2005.

The history of PTW in the Pacific Northwest dates back to 1913, when Chittenden reported the presence of PTW in Washington, and British Columbia. Additional reports from the Pacific Northwest are not found until tubers suspected to have been damaged by PTW were found in 2000 and 2001. In 2003, several fields in the Columbia Basin were rejected for market due to PTW infestation resulting in an economic loss. Economic losses increased substantially in 2004 and 2005. Adequate control of PTW is critical because larvae infest tubers, rendering them unmarketable (there is a zero tolerance for the presence of tuberworm larvae in raw processing product because they are classified as foreign material). Since this region stores large quantities of potatoes, additional losses are likely from infested tubers that rot in storage.

Researchers, crop consultants, and growers in Oregon, Washington and Idaho are currently using the Pacific Northwest PTW protocol to determine the presence of the insect. Growers in areas potentially affected are encouraged to monitor insect numbers using pheromone traps. For current information on PTW trapping in Oregon visit:

http://oregonstate.edu/Dept/hermiston/TrapReports.php (OSU, HAREC), in Washington, www.potatoes.com/research.cfm (Washington State Potato Commission), and in Idaho http://www.ag.uidaho.edu/potato/currentissues/index.htm.

POTATO TUBERWORM PESTICIDE SCREENING RESULTS IN OREGON

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The potato tuberworm (PTW) *Phthorimaea operculella* (Zeller) is one of the most important constraints to potato productivity worldwide. PTW larvae mine leaves, stems, petioles, and excavate tunnels throughout the potato tubers. The pest is difficult to control and over the years, many farmers in other parts of the world have relied extensively on the use of insecticides.

Pesticide screening. Many insecticides have been tested for their efficacy for controlling PTW. In 2005 and 2006, insecticides or combinations of insecticides via ground or chemigation were tested in screening trials at the Hermiston Agricultural Research and Extension Center in Oregon. Products that have been found to be effective for control of PTW in Oregon are: Monitor, Rimon, Avaunt, Agri-Mek, Asana, Lannate, Imidan, Success, Furadan, Leverage, Baythroid, Assail, Penncap M, and Dipel.

Pesticide Timing. When to begin application of insecticides to reduce tuber damage is a very important and potentially expensive question. Two basic treatment opportunities exist: (1) use insecticides throughout the season to prevent the build up of high numbers of moths (remembering that feeding on foliage does not reduce yields) or (2), wait until vine-kill and begin treating (similar to the methods reported in California). Trials in 2005 and 2006 in the Columbia Basin suggest that when three insecticides (Asana, Monitor 4, and Lannate LV) were applied at different intervals before vine kill, all insecticide treatments significantly reduced tuber damage. Therefore there was no apparent advantage in beginning control efforts earlier in the season compared to later.

Section I
Surveys of Invasive & Emerging Pests

IDAHO CEREAL LEAF BEETLE (*Oulema melanopus*) BIOCONTROL PROJECT UPDATE

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Cereal Leaf Beetle (CLB) is established in 42 of 44 Idaho counties. The species has spread to a wide variety of environments within the state since the first record of the pest in Franklin County, ID in 1992. Economic impact of the species has varied over the diverse small grain production environments found in Idaho. Generally CLB has the status of an occasional pest problem in most counties were it occurs, with declining crop damage or economic impact being reported in recent years. Shoshone and Clearwater county sweep net surveys remain negative for CLB.

CLB larval parasite (*Tetrastichus julis*) surveys were conducted in grain fields at the University of Idaho, Parma Experiment Station on May 18, June 8, and on June 22. On each date, 30 larvae were collected and dissected. *T. julis* parasite levels were 50% on May 18. 0% on June 8 and 100% on June 22 of the CLB larval dissected. If *T. julis* parasite levels remain above 50% at the Parma site, the fields will be used as a source for collection and distribution of parasitized CLB to introduce larval parasites at other locations in the state during 2007.

A field insectary for the egg parasite, *Anaphes flavipes,* was initiated in the spring of 2004 at the University of Idaho, Southwest Idaho Research and Extension Center in Parma, in cooperation with Dr. Brad Brown. Several parasite releases have been made during the 2004 and 2005 field seasons. *Anaphes flavipes* egg parasite recovery surveys were conducted on May 11, 18, 25, and June 1, 2006. A total of 490 CLB eggs were collected and rear out. No *A. flavipes* were recovered and no evidence of overwintering and establishment of this biological control agent have been observed thus far. ISDA received one shipment of egg parasites from the Colorado Department of Agriculture Insectary in Palisades, CO and released them on June 8. The shipment contained 1,200 CLB eggs at and average of 83% *A. flavipes* parasite levels. Follow up surveys and biocontrol agent releases are planned for 2007.

Section I
Surveys of Invasive & Emerging Pests

ISDA 2006 POTATO TUBERWORM (*Phthorimeae operculella*) (PTW) DETECTION SURVEY

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During the 2006 growing season, ISDA deployed 468 PTW traps in 25 potato producing counties. ISDA used Trece Pherocon VI traps baited with Trece International PTW pheromone lures. Traps were placed on the edge of potato fields at about canopy height. In counties with positive trap records from the 2005 survey, traps were deployed in mid May. These counties include Canyon, Payette, and Elmore counties. In counties that had negative records for PTW catches during the 2005 survey, ISDA deployed traps during the first week of August. This included 22 potato producing counties in south central and eastern Idaho.

The first, single, PTW male was captured in a trap east of Parma Idaho, Canyon County on August 7. Subsequent positive traps were recorded on 9/26, 10/10, 10/12. The last male captured was on October 24. Traps were removed and the survey ended during the week of November 5. A total of six male PTW moths were captured at four trap sites, all located within a 5 mile radius of Parma, Idaho (Canyon County). This was a decline in moth captures from the 2005 season which totaled 19 moths in 14 traps sites located in three counties (Canyon Payette, and Elmore) Traps have also been deployed in a few private and commercial storage facilities in SW Idaho. To date no positive reports or PTW trap catches have been reported from traps located near or in potato storage facilities.

ISDA trained their Fresh Fruit and Vegetable Division (FF&V) inspectors to look for PTW damage as part of the potato grading and quality inspection program. Also, USDA, Idaho Agricultural Statistical Service (IASS) conducts a yield survey covering all potato production areas of the state. Fifteen pound sample of tubers were dug from a statistical sample of all potato fields within the state. The sample size was 285 samples from over 20 potato production counties. IASS staff involved with this yield survey received special training, conducted by ISDA, on recognizing PTW tuber damage signs. To date no live PTW larvae or suspected PTW damaged tubers have been found in Idaho base on FF&V as well IASS tuber samples and observations.

University of Idaho, crop protection entomologists, cooperating with ISDA developed PTW Recommended Management Practices (RMP's) document with a pest management flow chart. The pest management flow chart relating moth trap numbers and situations with specific RMP's. RMP's included insecticide treatments and cultural practices. Since PTW positive trap levels were so low and geographical isolated, the effectiveness of RMP's in reducing infestation levels and spread was not fully tested.

Section II.
Bee Poisoning, Environmental Toxicology, Regulatory Issues

LEAFCUTTING BEE PESTICIDE SAFETY TRIALS ON ALFALFA SEED, 2006

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The alkali bee, *Nomia melanderi*, and the alfalfa leafcutting bee, *Megachile rotundata*, are significant pollinators of the alfalfa seed crop in Washington State. It is imperative that we know whether the pesticides used on alfalfa seed to control Lygus bug, aphids, and mites are toxic to these pollinating bees. Dan Mayer of Washington State University was one of very few entomologists who conducted safety trials on these bees. Since his retirement in 2000, there had been no studies on the newly registered and registration-pending pesticides until 2005, when we developed a protocol to conduct pollinator safety bioassays to enable resumption of this important research.

Preliminary trials were conducted in 2005 with fenpyroximate (Fujimite) and bifenthrin (Capture 2EC) to develop the experimental protocol. Bifenthrin is known to be very toxic to bees. Fenpyroximate along with 13 other compounds were tested in 2006 using the following methods. Products were applied at either the maximum label rate or the maximum recommended rate for control of certain insects or mites on alfalfa seed using a CO_2 pressurized sprayer with a hand-held boom at a rate of 26 gallons per acre over 0.01 acre plots of first- or second-growth alfalfa. Alfalfa samples were collected at 1 hour and 8 hours after treatment for the bee bioassays, with treatment and age of residue replicated four times. For each sample, about 400 cm of alfalfa foliage were placed into a 15-cm Petri dish cage with tops and bottoms separated by a wire screen insert. Approximately 20 leafcutting bees were placed into each cage; they were fed 50% sucrose solution in a wad of cotton. Bees were exposed to the alfalfa samples at 75°F for 24 hours at which time mortality was scored. Scores were corrected for control mortality using Abbott's formula.

All pesticide treatments except bifenthrin resulted in less than 25% mortality, even in the 1-hour residue samples (Table 1). Dan Mayer had concluded from his research that rates of materials that cause less than 25% mortality with 2-hour residues can probably be applied during the early morning with little or no hazard to bees, and those materials that cause less than 25% mortality with 8-hour residues can probably be applied during late evening with little or no hazard to bees.

Table 1. Mortalities of alfalfa leafcutting bees exposed to field-aged residues of pesticides applied to 0.01 acre plots of alfalfa seed, Prosser, WA.

Treatment			% Mortality at 24 hours*	
			Age of Residue	
Formulation	**Active Ingredient**	**Rate/acre**	**1 hour**	**8 hours**
Acramite 4SC	bifenazate	1.5 pt	8.97	10.67
Actara	thiamethoxam	4 oz	0.00	0.00
Agrimek with oil	abamectin	1 pt	12.82	0.00
Assail 70WP	acetamiprid	1.1 oz	0.00	5.00
Beleaf	flonicamid	3 fl oz	1.23	0.00
Calypso	thiacloprid	4 oz	7.83	2.56
Capture 2EC	bifenthrin	6.4 oz	93.75	77.50
Comite	propargite	1.25 pt	16.67	8.97
Dibrom	Naled	1 pt	12.68	6.85
Fujimite	fenpyroximate	3 pt	19.44	11.54
HGW 86 10% SC	proprietary	20.6 fl oz	12.68	8.22
spiromesifen	Oberon	1 pt	0.00	0.00
Provado	imidacloprid	3.8 fl oz	7.56	4.56
Rimon	novaluron	12 fl oz	2.52	3.75
Zeal	etoxazole	3 oz	12.66	2.53

*Corrected for control mortality using Abbott's formula.

Life after the Food Quality Protection Act

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The Food Quality Protection Act scheduled all food tolerances to be reviewed by August 3, 2006. For the most part, EPA met this requirement. It is interesting to note that of the thousands and thousands of tolerances that were evaluated, not a single one was considered to pose an unreasonable risk to human health. Most of the more dire predictions that were made by so called experts, most notably me, did not occur. Defense of the pesticide registrations under FQPA cost registrants hundreds of millions of dollars. Many uses were canceled due to the lack of financial incentives to maintain registrations. IR-4 and commodity groups spent large sums of money to defend products and develop new registrations for replacements for the expected losses of organophosphate and carbamate insecticides. In the end, FQPA canceled very few products due to food safety concerns. However, EPA is forcing significant regulatory changes based on human health and environmental concerns, issues that were not included in the original food safety intent of FQPA.

Of particular note is EPA has or is attempting to force major cancellations for Guthion (azinphos-methyl), Mocap (ethoprop), Temik (aldicarb) and Furadan (carbofuran). Cancellations for Guthion have been promulgated. Cancellations for Mocap, Temik and Furadan have been proposed but are being opposed by the registrants and the regulatory community.

Human health issues, particularly farmworker and applicator safety, will increasingly be the major driver on EPA actions against pesticide. Environmental issues will be more of a driver than it has in the past. Furadan may become the first major active ingredient that is canceled primarily due to an environmental risk issue (e.g. avian risk). Food safety issues associated with pesticide residues (e.g. tolerances) will not be an issue of concern in the near future.

Section II.
Regulatory Issues

PICOL: PESTICIDE LABEL INFORMATION AT YOUR FINGERTIPS

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WSU's Pest Management Resource Service operates a searchable label database, PICOL, containing information on all pesticides registered in Oregon and Washington (wsprs.wsu.edu). The presentation will cover some background information on the database, use of the two search modes (Simple and Advanced), conducting multi-step searches, and output options for viewing search results. The Pest Management Resource Service also operates the Pesticide Notification Network (www.ext.wsu.edu/pnn). The PNN provides up-to-date information on regulatory issues, new pesticide registration, and label changes, as well as providing links to electronic copies of both Oregon and Washington Section 18s and SLNs.

Section III

Biological & Cultural Control

Cereal leaf Beetle Biological control program in Oregon, 2006

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Introduction

Cereal leaf beetle, *Oulema melanopus* (CLB), was first identified in Michigan in 1962 as an introduced pest from Europe. Oregon first found CLB in 1999 in Malheur County. A statewide survey (Fig. 1) did not detect CLB in any previously uninfested counties in 2006. To date, CLB has been detected in 19 counties: Baker, Benton, Clackamas, Columbia, Crook, Deschutes, Jefferson, Lane, Linn, Malheur, Marion, Multnomah, Polk, Tillamook, Umatilla, Union, Wallowa, Washington, and Yamhill.

The cornerstone of CLB management is biological control which has been effective in the eastern US where CLB first caused serious damage in North America. The cooperative biological control program among ODA, USDA, and OSU for CLB in Oregon began immediately after its detection in 1999. In 2006, the program continued to monitor, release, and redistribute the two parasitoid species, *Anaphes flavipes* and *Tetrastichus julis*, in many CLB infested counties in Oregon.

Egg parasitoid – *Anaphes flavipes*

The two insectaries for the egg parasitoid, *Anaphes flavipes,* in Washington County were monitored for natural population changes. The wasp was established in both insectary fields after two years of releases. Releases were made at the Banks insectary in 2002 and 2003 and the site has been monitored each year since then. Although the parasitism rate peaked in late June to early July at about 30% in 2005, all efforts to recover the wasp failed in 2006. Recovery efforts were also made at the Scholls insectary site where releases of *A. flavipes* had been made during 2004 and 2005 and within-season recovery was achieved in 2005. Monitoring of the Scholls site during 2006 yielded our first overwintering recovery there, but only from one collection in mid-June with a parasitism rate (PR) of approximately 5%. Discussions with colleagues in Montana suggest that populations may not stabilize or even increase until a minimum of 5 years after release. Due to very low CLB levels and lack of other resources, there were no release or monitoring activities at the OSU Agricultural Research Center insectary site in Union County where *A. flavipes* was released in 2005. Hopefully monitoring eggs for parasitoid establishment can begin in 2007. All releases of *A. flavipes* in 2006 were made in a new location in a grower's field in Scio, Linn County. An estimated 16,750 *A. flavipes* were released at the Scio field. Releases were made there so as not to interfere with recovery efforts in the Washington County insectaries and to start moving the egg parasitoid to other CLB infested areas in the state. Figure 2 shows *A. flavipes* activity sites.

The source for the *A. flavipes* releases was the Colorado Department of Agriculture's biocontrol facility in Palisade, Colorado. Oregon sent 18,316 adult CLB to Colorado to help support the lab colony. As in previous years, the *A. flavipes* wasps were released in parasitized CLB eggs on oat leaves and placed with a sponge inside small, modified paper milk cartons mounted on wooden stakes in the field.

Larval parasitoid – *Tetrastichus julis*
The main goals for the *T. julis* program in 2006 were to determine the distribution of *T. julis* in western infested counties, to track the phenology of *T. julis* in western Oregon for accurately timing collections of parasitoids, and to continue to collect and redistribute *T. julis* to more recently infested areas, such as central Oregon.

An unexpected discovery in 2005 of *T. julis* in Linn County, where it had never been released before, suggested that the parasitoid had spread naturally through parts of western Oregon. To determine *T. julis'* current distribution, several grain field sites throughout the Willamette Valley not previously used for *T. julis* releases, in addition to previous release sites, were sampled for CLB larvae. Larvae were collected approximately biweekly and brought to the lab in Salem for dissection and parasitism assessment. Widespread recovery of *T. julis* was found in 2006 with exceptionally high PRs, even in some locations where it had not been previously released. The peak PRs of *T. julis* found in each CLB-positive county were as follows: Benton (100%), Clackamas (84%), Jefferson (2%), Lane (76%), Linn (100%), Multnomah (67%), Union (98%), Washington (100%), Yamhill (100%).

An effort was also made to examine *T. julis* phenology and PRs changes over time. CLB larvae were collected weekly from three sites each in three different counties known to have high PRs for *T. julis*. Larvae were dissected to determine PR. Results generally showed a maximum PR of approximately 50% around mid to late May, a drop to near zero in early June, and a second PR peak of 100% in mid to late June. This data suggests that the first half of June is a poor time to collect CLB larvae for redistribution of *T. julis*, even from known, heavily parasitized fields.

Two of three field insectaries for *T. julis* were active in 2006. OSU's insectary field at the Central Oregon Agricultural Research Center in Madras, Jefferson County, was the only one that received *T. julis* for release. The Madras insectary had CLB numbers too low to release *T. julis* in 2005. Additional adult CLB and larvae with *T. julis* were released in the insectary field. Larvae with *T. julis* were also released in a few local growers' fields. Due to recovery success and an already high parasitism rate, no *T. julis* releases were made at the Hyslop insectary field, although adult CLB were added to the site to boost CLB numbers for the parasitoids. Due to very low CLB levels and lack of other resources, there was no activity at the OSU Agricultural Research Center insectary site in Union County. This insectary will likely be discontinued in 2007 due to the widespread success of *T. julis* in Union and Baker counties.

High PRs in some areas made 2006 the first year that *T. julis* was collected entirely from within Oregon and moved for redistribution. In addition to the releases in Central Oregon and a few small releases into Linn and Union counties, 2006 marked the first year for *T. julis* release into Umatilla County. *T. julis* were released in four counties in 2006. The number of CLB larvae (and estimated number of *T. julis*) released in each county are: Jefferson, 4,750 (20,500); Linn, 1,000 (4,800); Umatilla, 3,500 (16,425); Union, 50 (240). The parasitism rates among CLB release material from all areas, ranged from 28% to 98%. *T. julis* activity sites are shown in Figure 3.

Successful biological control is needed for a healthier farm and landscape environment. A pesticide warehouse survey by USDA in 2005 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, 38,309 acres in 2003, and 64,200 acres in 2004 but had gone down slightly in 2005 to 50,175 acres due to reduced grain acreage. Results are not yet available for 2006.

Figure 1

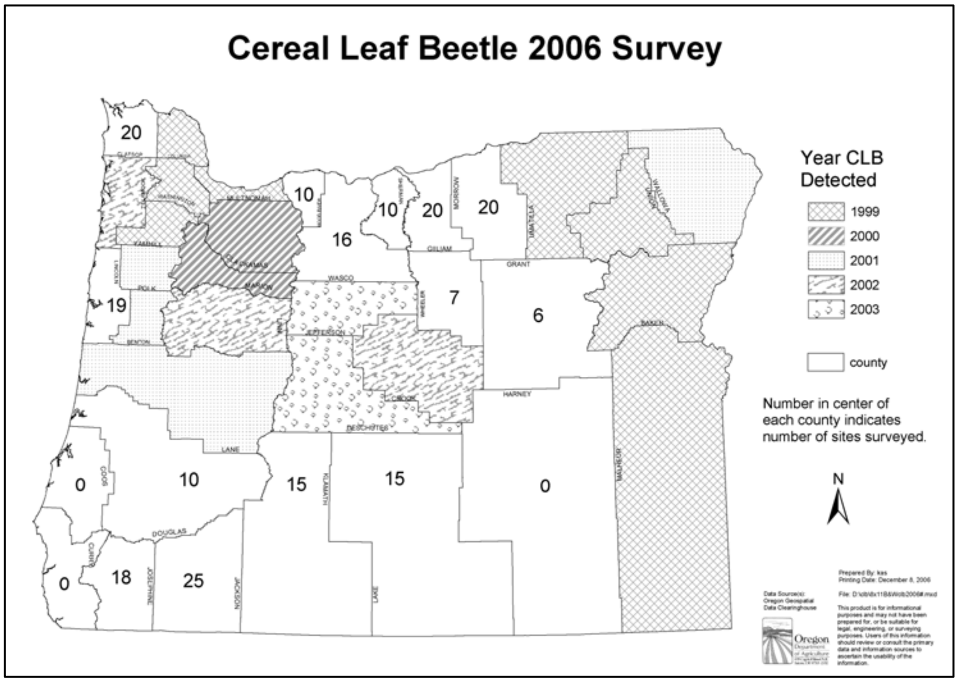


Figure 2

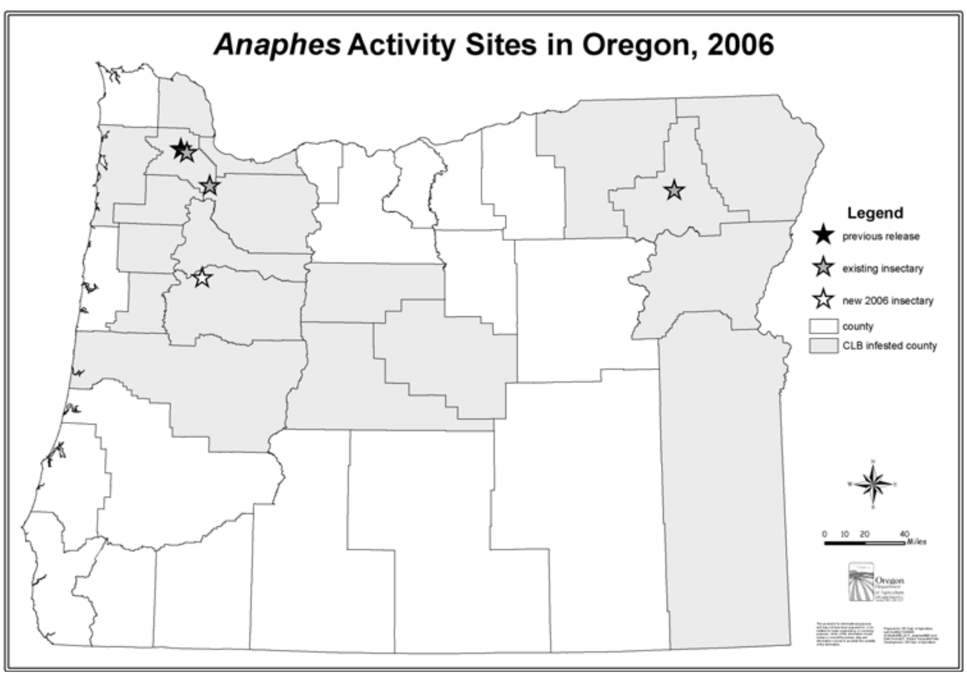
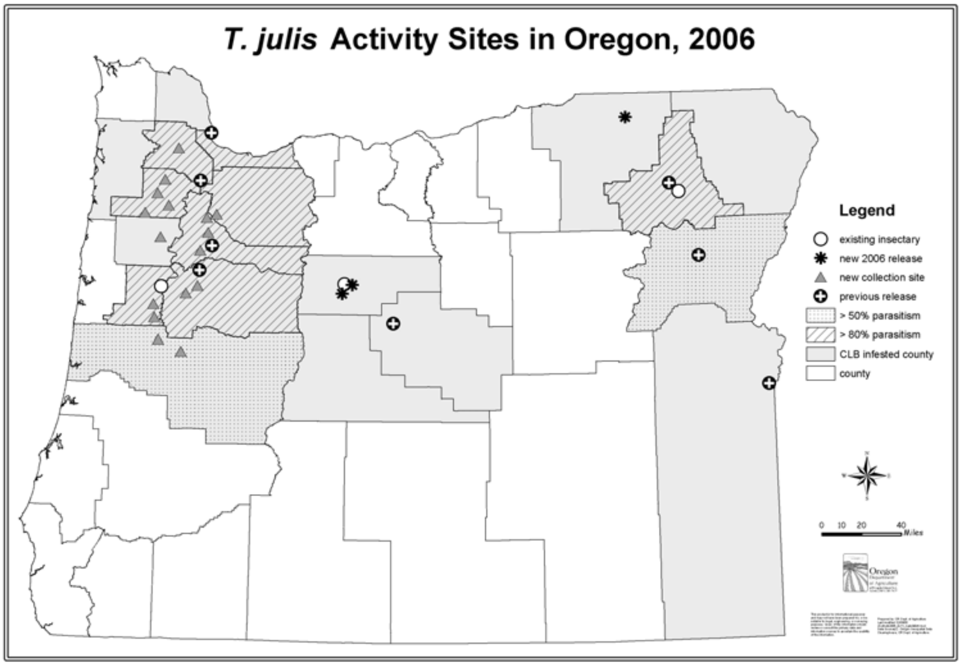


Figure 3


T. julis Activity Sites in Oregon, 2006
Legend
existing insectary
new 2006 release
new collection site
previous release
> 50% parasitism
> 80% parasitism
CLB infested county
county
0 10 20 40
Miles
Oregon

Efficacy of *Metarhizium anisopliae* as a Curative Application for Black Vine Weevil Infesting Container-Grown Nursery Crops

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The black vine weevil (BVW), *Otiorhynchus sulcatus* (F.) (Coleoptera: Curculionidae) is a serious pest of nursery crops. The fungus, *Metarhizium anisopliae* (F52), is registered by the US Environmental Protection Agency for BVW control. The objective of this study was to determine the efficacy of a curative drench application of *M. anisopliae* for BVW larval control in container-grown nursery plants. Trials were performed in the spring of 2004 and 2005 as well as the fall of 2006. Laboratory studies were also performed to quantify the impact of temperature (10, 15, 20, 24 and 28˚C) on fungal growth and speed of kill. *Metarhizium anisopliae* applied in the greenhouse and outdoors in 2004 were 92 and 30% effective, respectively. Fungal drench applications to container-grown plant material maintained outdoors in the spring of 2005 were nearly 100% effective 28 days after application. Fall applications in 2006 provided statistically significant reductions in the number of live BVW larve per pot, but were not as effective as spring applications in 2005. The mean media temperature of containers maintained outdoors in the fall of 2006 dropped considerably (10-12˚C) over the course of the experiment. Laboratory experiments demonstrated that temperatures below 20˚C significantly retarded fungal growth and the speed at which *M. anisopliae* infected BVW larvae. When soil temperatures were adequate (16˚C) topical drench applications of *M. anisopliae* were very effective at eliminating BVW infestations in container-grown nursery plants. The use of *M. anisopliae* curative drench applications have similar limitations as the use of nematodes for BVW control in regards to soil temperature. Therefore, applications will have to be made as early in the fall as possible once egg laying has ended or potentially late in the spring just prior to pupation.

Section III
Biological & Cultural Control

Biology of a Microsporidian Infecting the Black Vine Weevil

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A microsporidian infecting the black vine weevil (BVW) *Otiorhynchus sulcatus* (Coleoptera: Curculionidae) originally isolated from adults collected from a wholesale nursery located in McMinnville, OR was tested as a curative drench application. Microspora are obligate pathogens and can be costly to produce commercially, however, they have been commercialized and one is currently used for grasshopper control (i.e. NoLo Bait, M & R Durango, Inc. Bayfield, CO). As a group, Microspora generally reduce insect fecundity, longevity and overall population growth, however, there are other Microspora such as the microsporidian infecting BVW that cause acute toxicity to their host. One of the main benefits of implementing Microspora in a pest management program is their host specificity. Investigations into the development of a new microbial control agent are necessary in order to provide nursery growers with additional alternatives for managing BVW populations. Laboratory studies have shown that the BVW microsporidian is extremely virulent against 3rd instar BVW (Figure 1). Because of the efficacy of this microbial control agent, applications of 10^7, 10^6 and 10^5 microsporidian spores were made to the surface of 4 inch pots infested with BVW larvae in the greenhouse. Microsporidian have not previously been targeted against soil insects and these preliminary results are encouraging. The experiment was performed initially using all three application rates (Table 1). No infection was observed after 7 days, but infected larvae were recovered from pots drenched with 10^7 and 10^6 spores. No infection was observed in larvae collected from pots receiving 10^5 spores after 7 or 14 days. The experiment was repeated concentrating on the 10^7 and 10^6 spore/pot application rate and an extended recovery period. The recovery period was extended to give the larvae additional time to consume spores while feeding. The extended recovery period did result in higher infection levels (Table 2). An average of 32% of the larvae recovered from pots receiving 10^7 spores were infected. These data are the first to demonstrate that a microsporidian can be effectively applied to treat insects in a soil environment.

Figure 1

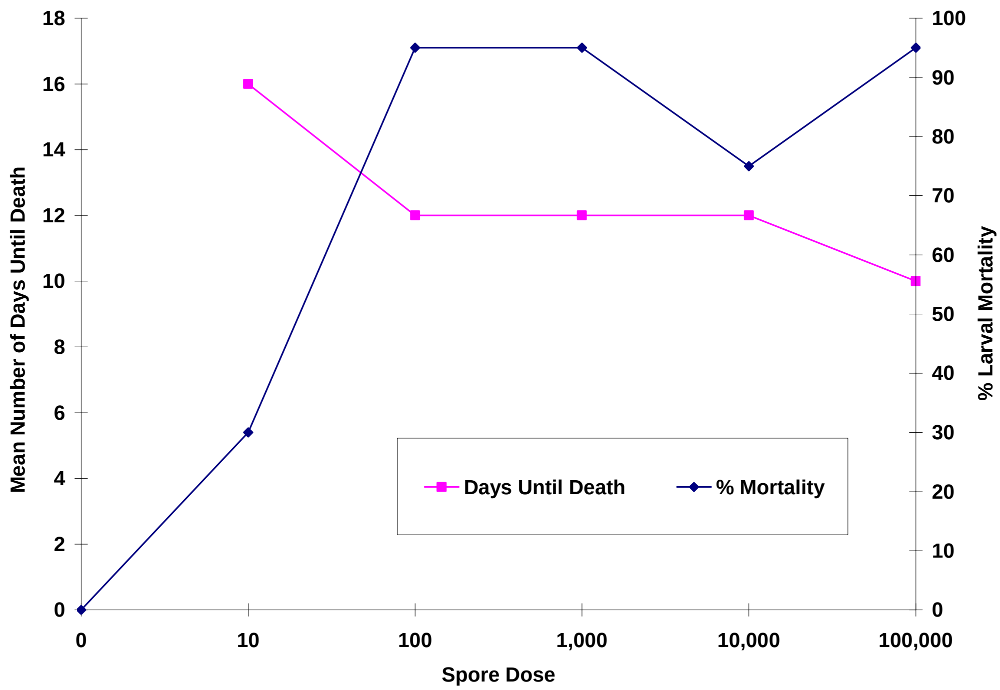

Table 1. Percentage of black vine weevil larvae infected 7 and 14 days after a topical application of microsporidian.

	Days after Microsporidian Application	
Treatment	7 days	14 days
Control	0%	0%
10^7	0%	18%
10^6	0%	2%
10^5	0%	0%

Table 2. Percentage of black vine weevil larvae infected 14 and 21 days after a topical application of microsporidian.

	Days after Microsporidian Application	
Treatment	14 days	21 days
Control	0%	0%
10^7	11%	32%
10^6	0%	0%

INTEGRATED CONTROL OF BROCCOLI AND AVOCADO PESTS IN NORTHERN ECUADOR AND THE IMPACT OF ECONOMIC AND CULTURAL FACTORS ON MANAGEMENT DECISIONS

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The concept of Integrated Pest Management is well understood by agronomists in Central and South America, however many small scale producers lack the education and motivation to implement the scouting necessary for IPM. . Those producers that have the skills to use IPM are often unwilling to take the risks involved with acting on economic thresholds. After experiencing numerous crop losses and economic shortfalls, most field agronomists working with small scale producers recommend a calendar spray program. Visits to the field on a weekly basis by technical staff are used to reinforce the need for crop protection and fertilization practices in sensitive, export quality row crops. See the following table for an example of a typical program for broccoli producers.

IPM is more practical in tree fruits such as avocados, due in part to the higher education levels of landowners and the relative lack of potential insect and disease pests that threaten the crop. Most of the technical efforts in USAID sponsored ProNorte project, were directed at obtaining proper irrigation techniques to prevent development of avocado root rot in virgin soils. Proper fertilization and handling of fruit during and after harvest are the second and third important factors in successful avocado production. The presence of a year round high-value market in nearby Columbia for the Hass avocado will ultimately lead to a substantial increase in the income level of many Ecuadorian avocado growers. The primary limitation on planting of new ground to Hass avocados is the lack of investment capital available to landowners and the reluctance of many producers to sell in international markets.

Aplicaciones en Brócoli - IMANTAG

Para: 10000 metros de Terreno | Sr(a): ____________

Dìas	Fecha	Actividad	Insumo	Cantidad	Unidades	Objetivo
15 días Antes		Preparar el suelo:	Rastra Cruzada	2	Rastras	Suelo flojo y fértil sin yerbas.
			Poner Gallinaza	120	Sacos	
			Poner Cal Agrícola	10	Sacos	
2 dias antes		Abonar para siembra:	Guachar / Surcar	1	Surcada	Para Riego
			18 - 46 - 0	100	Kilos	Abonar
			Nitrato de Amonio	100	Kilos	Abonar
			Borax	10	Kilos	Abonar
			Sulpomag	100	Kilos	Abonar
0 dias		Transplantar	Plantas de Brócoli	60	Gavetas	
		Transporte	Transporte Planta			
0 dias		Aplicar a chorro en la raíz:	Captan 80	50 gr	por Bomba	Pudrición de Tallo
			Raizal	40 gr	por Bomba	Enraizador
			Eco Hum (Ac.Húmicos)	40 cc	por Bomba	Materia Orgánica
			Cipermetrina	20 cc	por Bomba	Trozador
7 dias		Fumigar:	Captan 80	50 gr	por Bomba	Pudrición Tallo
			Diazol	20 cc	por Bomba	Mariposa-Pulgòn
			Merit Azul	50 cc	Por Bomba	Foliar
			Agrotín	10 cc	Por Bomba	Fijador
21 dias		Abonar:	Nitrato de Amonio	200	Kilos	Abonar
			Borax	10	Kilos	Abonar
			Sulpomag		Kilos	Abonar
			0 - 0 - 60 (Potasa)	100	Kilos	Abonar
21 dias		Fumigar:	Nitrofoska 30 10 10	50 gr	por Bomba	Foliar
			Kelatex Boro	20 gr	por Bomba	Foliar
			Agrotín	10 cc	por Bomba	Fijador
35 dias		Fumigar:	Nitrofoska 20-19-19	50 gr	por Bomba	Foliar
			Diazol	20 cc	por Bomba	Mariposa-Pulgòn
			Kelatex Boro	20 gr	por Bomba	Foliar
			Agrotín	10 cc	por Bomba	Fijador
45 dias		Abonar:	Nitrato de Amonio	300	Kilos	Abonar
			Borax	10	Kilos	Abonar
			Sulpomag		Kilos	Abonar
			0 - 0 - 60 (Potasa)	150	Kilos	Abonar
45 dias		Fumigación:	Diabolo	20 cc	por Bomba	Pulgon
			Endosulfán	20 cc	por Bomba	Plutella
			Nitrofoska 20-19-19	50 gr	por Bomba	Foliar
			Agrotín	10 cc	por Bomba	Fijador
55 dias		Fumigación:	Cipermetrina	10 cc	por Bomba	Pulgon-Plutella
			Nitrofoska 8-12-24	50 gr	por Bomba	Foliar
			Bioenergia	50 cc	por Bomba	Foliar
			Agrotín	10 cc	por Bomba	Fijador
57 días		Abono de corrección:	Nitrato de Amonio	100	Kilos	Fertilizar
70 dias		Transportar Cosecha:	Gavetas necesarias:	1150	Gavetas	

1 Cuchara sopera =	10 gr.	gramos
1 Cuchara sopera =	5 cc.	centimetros

Section III
Biological & Cultural Control

INVESTIGATION OF MATING DISRUPTION OF PEACH TREE BORER, *SYNANTHEDON EXITIOS,* IN LAUREL,*PRUNUS LAUROCERASUS*

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Objectives:
Investigate the efficacy of mating disruption for peach tree borer (PTB) in laurel production.

Methods and Materials:
On May 26, 2006 diamond traps (Pherotech International) with peach tree borer pheromone lures (Pherotech International) were placed in a commercial nursery site in Gresham producing several varieties of *Prunus laurocerasus* with a history of PTB. We set three traps per plot with four sampled plots in the mating disruption area and two in the untreated area on the other side of the farm, separated by a distance of 1633 feet (plots ranged in size from 10,452 ft^2 to 37,024 ft^2). Several additional traps were set outside but near the area of the untreated plots. On June 27th Isomate®-P pheromone dispensers (Pacific Biocontrol Corporation) were placed in the upper canopy of the laurel plants in treated plots at the recommended rate of 100 dispensers per acre. The entire area treated was approximately 5.08 acres. Traps were monitored weekly from June 2, 2006 and monitoring continued until the end of the flight period (through September 2006). PTB pheromone lures were changed in the traps on August 15, 2006. Additionally, a sample of off-size, off-colored shrubs were evaluated and quantified for PTB presence and damage

Results:
Two male PTB moths were observed in plots on 6/2/06 but no trap catches were positive until four moths were found in three separate traps in one of the plots in the untreated area on 8/8/06 (Figure 1.). The action threshold for PTB in mature orchards is 2 moths/trap and Pacific Biocontrol recommends treatment at this level. On August 10, 2006, the grower made applications of chlorpyrifos to both the treated and untreated areas (per the Pacific Biocontrol protocol). Two additional moths were caught in an untreated plot on 8/22/2006. The grower made an application of chlorpyrifos to all plots on 8/23/06. A final application occurred on 9/11/06 and 9/12/06 upon the advice of an agrichemical crop consultant. No additional moth captures occurred through the end of the sampling in late September.

Ten plants with low vigor were removed from plots throughout the farm and evaluated for damage and presence of PTB. All ten plants exhibited tunneling damage with frass and decay. Six of the 10 plants had live larvae (including one pupa). Most of the larvae were found below or at the soil line.

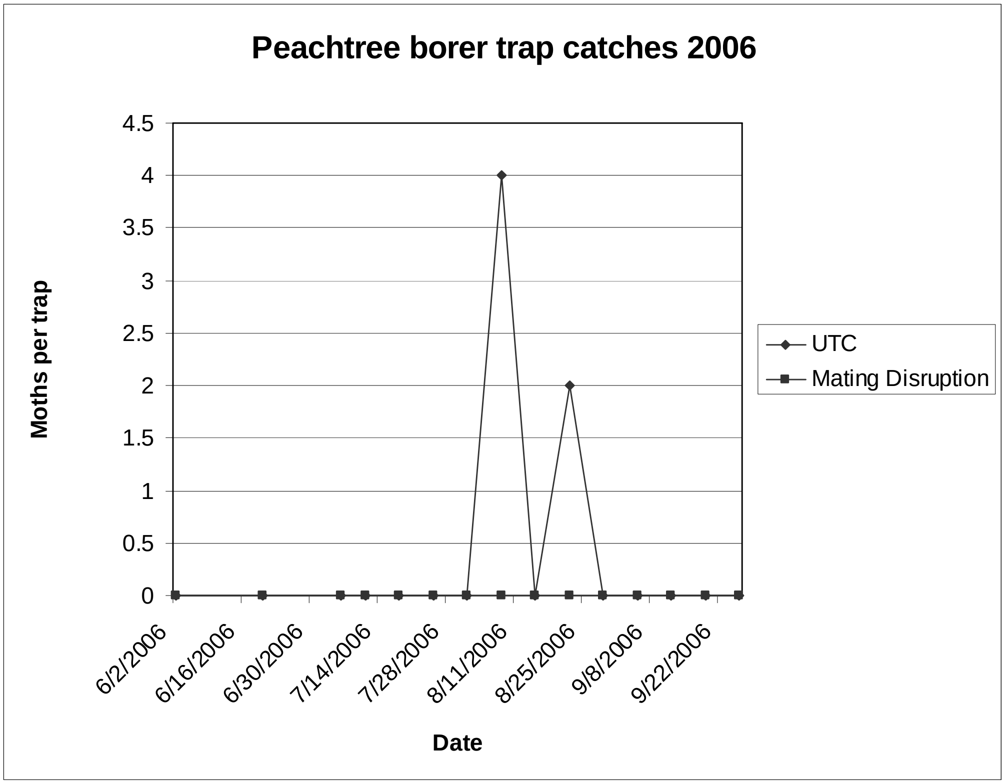

Figure 1. Peachtree borer trap catches in laurel, *Prunus laurocerasus*.

Section IV
Cereal Crop Pests

WIREWORM MANAGEMENT IN SPRING WHEAT 2006A VALENT INSECTICIDE TRIAL

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Protocol
Treatments = 4 reps in RCBD of 7 rows x 20 feet.
Seeding date 4-11-2006 using Hegi Cone Seed Drill – Variety **Wawawai** SWSW. 2 contract confidential Valent products included in trial compared to UTC and Gaucho 480 standards. Emergence 4-19-2006. Plant stand was counted on 10 DPE (4-28-2006). Pre-harvest plant stand was counted on July 21. Grain yields were sampled on July 24,25, & 26**,** 2006 by hand threshing through a stationary machine. Grain yield are reported under CLB trials

Abstract
The tabular data for plant stand at 10 DPE show very similar data for the experimental products due to **wireworm *(Limonius canus)*** stand reduction at 10 DAE. The UTC is SD all other treatments.
at higher rates, Gaucho 480 at 31 grams, and V10170 at 10 grams ai/kg/ha. Gaucho 480 at 5 grams, V10170 at 5 grams, a lower stand pair, with the UTC being SD all other treatments. The plant stand data at Pre –Harvest 07/21/06 show all treatments were SD the UTC. Extensive tillering w/o heading including "T0 tillers" resulted in overall lower stands except where blank TO tiller separated from initial seedlings at 10 DPE. This phenomenon is often reported from the Variety Wawawai. Cereal Leaf Beetle attack at boot/early flag leaf stage reduced yield overall. The wireworm data for this trial are well reflected in the tests for plant stand counts at 10 DAE and also at Pre-Harvest. Seed treatment insecticides in the trial did give good wireworm control over the UTC.

Table 1. LSD All-Pairwise Comparisons Test Plant Stand 10 DPE

Treatment	Rate grams/ha ai	Mean plant stand	
V10112	50 grms/Ha	19.000	A
V10170	30	18.000	A
V10170	50	17.750	B
V10112	10	17.500	B
V10112	30	17.500	B
GAUCHO 480	31	17.000	B
V10170	10	16.500	B
GAUCHO 480	5	14.750	C
V10170	5	14.500	C
UTC	---	11.500	D

Alpha 0.01 Standard Error for Comparison 1.1583
Critical T Value 2.750 Critical Value for Comparison 3.1853
.

Table 2. LSD All-Pairwise Comparisons Test for plant stand at pre-harvest July 21.

Treatment	Rate ai grams/ha	Mean plant stand	
V10170	30	18.250	A
GAUCHO 480	5	18.000	A
V10170	10	18.000	A
V10112	10	17.500	B
V10170	10	17.250	B
V10112	30	17.250	B
V10112	50	17.250	B
GAUCHO 480	31	16.500	B
V10170	50	15.500	B
UTC	---	13.750	C

Alpha 0.01 Standard Error for Comparison 1.3525
Critical T Value 2.750 Critical Value for Comparison 3.7193

Section IV
Cereal Crop Pests

WIREWORM MANAGEMENT IN SPRING WHEAT 2006B BAYER INSECTICIDE TRIAL

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Protocol
Treatments plus rates per cwt = 4 reps in RCBD of 7 rows x 20 feet.
Seeding date 4-11-2006 using Hegi Cone Seed Drill – Variety Wawawai SWSW.
Emergence 4-19-2006. Plant stand was counted on 10 DPE on 4-28-2006. Plant stand was also counted at harvest on July 21, 2006.

Abstract
Plant stand counts at 10 DPE show most of the treatments providing similar stand protection from wireworm feeding. A mean of 4 plants per ¼ M2 were present at this stand count date in the treatments in the AB group. Lindane, Cruiser at 0.19, and Gaucho at 0.128, in group C provided medium plant stand protection at a level that would likely not be noticed in a commercial setting. The fungicide treatments were SD from and lower than other comparisons, with the UTC more than 5 plants ¼ M2 lower than the best treatment. Pre-Harvest stand counts show slight variation from 10 DPE counts due to randomized sampling and field variation but are similar. More than 4 plants ¼ M2 occur between the AB treatments and the check. The group followed by C has moderate plant stand protection compared to AB. The fungicide only group D is SD the UTC alone in E. This being a rate study trial with combinations of Poncho and Gaucho, and Spinosad and Gaucho, plus higher and lower rates of available of products, one can conclude that a wide range of treatments and rates will provide good and very good wireworm protection through harvest in spring wheat allowing selection by rate/price.

Table 1. LSD All-Pairwise Comparisons Test for plant stand at 10 DPE

Treatment	Rate ai floz/cwt	Mean Plant Stand	
PONCHO 600 FS	0.510	18.250	A
GAUCHO 600 FS	0.256	17.500	B
PONCHO 600 FS	0.256	17.500	B
GAUCHO 600 FS + PONCHO 600 FS	0.128/0.128	17.250	B
CRUISER 5 FS	0.383	17.000	B
GAUCHO 600 FS	0.800	17.000	B
PONCHO 600 FS	0.128	17.000	B
SPINOSAD 480 + GAUCHO 600 FS	0.160/0.128	16.750	B
LINDANE	1.00	16.000	C
CRUISER 5 FS	0.190	15.500	C
GAUCHO 600 FS	0.128	15.500	C
DIVIDEN Ext.	2.00	14.500	D
RAXIL XT	0.160	13.500	D
UTC	-----	12.500	E

Alpha 0.01 Standard Error for Comparison 0.8256
Critical T Value 2.698 Critical Value for Comparison 2.2274

Table 2. LSD All-Pairwise Comparisons Test –plant stand at harvest

Treatment	Rate ai floz/cwt	Mean Plant Stand	
GAUCHO 600 FS	0.800	17.750	A
GAUCHO 600 FS	0.256	17.250	A
PONCHO 600 FS	0.510	17.250	A
GAUCHO 600 FS	0.128	16.750	B
PONCHO 600 FS	0.128	16.750	B
PONCHO 600 FS	0.256	16.750	B
SPINOSAD 480 + GAUCHO 600 FS	0.128/0.128	16.750	B
CRUISER 5 FS	0.190	16.500	B
GAUCHO 600 FS + PONCHO 600 FS	0.128/0.128	16.000	B
CRUISER 5 FS	0.383	15.750	B
DIVIDEND Ext	2.000	14.750	C
LINDANE	1.000	14.750	C
RAXIL XT	1.600	14.750	C
UTC	------	13.000	C

Alpha 0.01 Standard Error for Comparison 0.8814
Critical T Value 2.698 Critical Value for Comparison 2.3780

Section IV
Cereal Crop Pests

WIREWORM MANAGEMENT IN FALL SEEDED WHEAT 2005-2006

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Protocol:
Trial Seeded September 9, 2005 with a Hegi Cone Seeder Drill set at 60 lbs acre seed rate & 7 inch row spacings with 7 rows per 48 inches. Replicates were 4 in RCBD 8 feet x 20 feet. Seeding depth was ca.1.5 inch into moisture. Variety mix Rod/Madsen SWWW. Crop emerged September 19. Trial was rated for plant stand on October 13 (24 DPE). Trial was rated for BCOA/Barley Yellow Dwarf Virus on April 25, 2006 and BYDV numbers were too high for AOV/LSD tests.

Abstract
Trial data show the higher rates of Gaucho 600 FS and Poncho 600 FS to be equal in protection of plant stand from **Basin wireworm** (*Limonius cana*) in the fall. Lindane, Gaucho 600 FS at 0.16 oz/cwt, and Cruiser 5 FS at 0.19 oz/cwt are NSD from the other insecticide treatments but provided lower plant stands. The UTC is SD all other treatments.
Dividend Extreme shows some biological effect on plant stand just below the insecticides but better that the UTC and Raxil XT treatments at 24 DPE. Why??? What could make DE effective for ca. 30 days then break down as tillering begins, during which time it pairs out with the other fungicide and UTC treatments?

The decision was made to not harvest this trial due to extreme **Bird Cherry-Oat Aphid** activity all through the normally dormant season followed by spring rains that allowed heavy Bird Cherry –Oat Aphid *(Rhopalosiphum padi)* (BCOA) damage from feeding and from Barley Yellow Dwarf Virus variability. At 218 DPE no product was effective against these aphids. A lesson learned is an early seeding followed by a mild winter and wet, cold spring favor (BCOA). The BCOA usually leave for their *Prunus* host in late February. In 2006 river bluff *Prunus sp.* (Choke Cherry) bloomed in late May. BCOA have few natural enemies other than *Aphidius* and *Diaeretiella* spp (Braconidae) and cold, wet weather disfavors the parasitoids.

Table 1. LSD All-Pairwise Comparisons Test Plant Stand 24 DPE

Treatment	Rates oz ai/cwt.	Mean Plant Stand	
PONCHO 600 FS	0.79	22.250	A
PONCHO 600 FS	0.26	22.000	A
GAUCHO 600 FS	1.44	21.750	A
PONCHO 600 FS	0.13	21.750	A
PONCHO 600 FS	0.51	21.750	A
GAUCHO 600 FS	0.99	21.500	A
GAUCHO 600 FS	0.32	19.250	B
LINDANE	1.00	16.000	C
CRUISER 5 FS	0.19	15.000	CD
GAUCHO 600 FS	0.16	14.000	CD
DIVIDEND EXT	2.00	12.250	D
RAXIL XT	0.16	10.250	E
UTC	----	9.5000	E

Alpha 0.01 Standard Error for Comparison 1.0576
Critical T Value 2.708 Critical Value for Comparison 2.8640

Section V
Soil Arthropods

Wireworm Control in Potatoes.

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Abstract

Wireworms (Coleoptera: Elateridae) are the most important soil-dwelling pest of potatoes in the U.S. Growers in the U.S. rely on preventative soil insecticide treatments for wireworm control. The few registered insecticides are all organophosphates or carbamates, and are only moderately-effective often resulting in sporadic control of wireworms. The Environmental Protection Agency (EPA) is in the process of re-registering pesticides under the requirements of the Food Quality Protection Act and could eventually cancel some or all organophosphate and carbamate pesticides on potatoes. Therefore, during the last four years we conducted a set of efficacy trials with the overall goal of anticipating the possible cancellation of broad-spectrum pesticides by determining potential chemistries that would reduce wireworm damage. In furrow treatments in general presented a lower average number of holes / tuber than seed treatments. Fipronil (phenylpyrazole) insecticide has consistently been the most efficient insecticide in the last three years. Most damage to tubers occurred after mid-June. This indicates that all the wireworm insecticides may be applied prematurely (at planting) because the wireworm damage is occurring mostly at the end of the season when the effectiveness of these insecticides has probably been reduced. Therefore, this could be the reason why insecticides against wireworms are only partially effective at reducing wireworm damage.

Efficacy Trials in Idaho

We have conducted efficacy trials in potatoes for the last four years for wireworm control in Idaho. Because of the patchy distribution of wireworm damage found in previous years, we redesign the experimental plots for efficacy trial and instead of having a single check plot for each experimental block, each individual treatment had an untreated check consisting of one untreated row 25 ft long on each side. Therefore, the complete individual treatment plot consisted of four 25 ft long rows (36 inch row spacing), with the two central rows treated with the insecticide and the two bordering rows left as checks. All the current registered insecticides represented the broad-spectrum insecticides including the insecticide standard, phorate (Thimet 15G). Newer more selective insecticides included the following: the neonicotinoids, imidacloprid and thiamethoxam; the phenylpyrazole, fipronil; the pyrethroid, bifenthrin; as well as several other promising experimental materials. Different application methods were included (seed treatments, in furrow at planting, granular treatments applied utilizing a belt applicator on the planter, and liquid treatments applied with a modified CO_2 backpack sprayer).

The center two rows and the bordering rows of each plot were harvested the first week of October for wireworm damage evaluations. Fifty tubers per each 25 ft row, for a total of 100 tubers per plot and 400 tubers per treatment, were examined for feeding damage. Fifty tubers per each check row were also examined. Weight and number of external feeding sites were recorded for each tuber. For percentage of affected tubers, a tuber with one or more wireworm holes was considered an affected tuber. More than 28,000 tubers/ year were examined for this experiment. Data were analyzed using an analysis of variance. A mean separation test (LSD, p=0.05) was used to determine significant differences between treatments.

The mean number of holes per tuber, percentage of affected tubers, weight per tuber, and USDA number one tubers (tubers weighing more than 114 grams and with no defects were considered number 1) were evaluated. We also determined the timing of wireworm peak activity (represented by the number of affected tubers and also the percentage of affected tubers during the whole season) to optimize efficacy of insecticide application methods.

Conclusions:

1. Limited availability of completely effective chemicals
2. Lack of efficient and labor-friendly monitoring tools which would allow growers to predict likelihood of damage or to assist in decisions about the necessity of insecticide treatment
3. In furrow treatments in general presented a lower average number of holes / tuber than seed treatments
4. Fipronil (phenylpyrazole) insecticide has consistently been the most efficient insecticide
5. Most damage to tubers occurred after mid-June. This indicates that all the wireworm insecticides may be applied prematurely (at planting) because the wireworm damage is occurring mostly at the end of the season when the effectiveness of these insecticides has probably been reduced. Therefore, this could be the reason why insecticides against wireworms are only partially effective at reducing wireworm damage.

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Section V
Soil Arthropods

MANAGEMENT OF THE CABBAGE MAGGOT, *DELIA RADICUM* L., IN BRASSICA ROOT CROP PRODUCTION IN WESTERN OREGON

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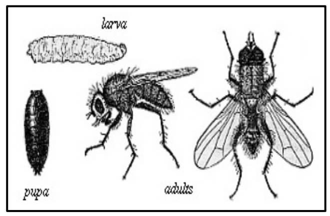
Brassica growers are highly dependent on the use of chlorpyrifos (organophosphate; Lorsban) as the single control method for managing cabbage maggots (*Delia radicum* (L.); Diptera: Anthomyiidae). The threat of chlorpyrifos loss, resistance build-up, and environmental scrutiny has increased grower willingness to test and adopt new management strategies. An integrated pest management plan is being developed from data collected over years 2001 through 2005, which includes: predicting spring fly emergence and seasonal flight (degree-day modeling); monitoring for egg-laying and crop damage; altering planting and harvesting dates; reducing overwintering pupae by spring and fall cultivation; using row covers, exclusion fences, and trap crops; and testing of alternative chemistries and application methods.

Some Conclusions:

- Bimodal emergence pattern in the spring: 70% early-emergers (249 DD – Mar 23) and 30% late-emergers (715 DD - May 24); 2 months between early- and late- emerging flies.
- Emergence was initiated at ~200 DD (Mar 8).
- Flight started at ~300 DD (March 31); Spring flight ends ~900 DD (Jun 15).
- Flight increased again in the Fall at ~2138 DD (Aug 28).
- Flight lagged behind emergence by 5 days to 3 weeks.
- Lowest damage occurred when crop was seeded after spring flight (>900 DD), but harvested before fall flight (< 2100 DD).
- Low fly catch numbers (<100 flies / 6 weekly totals) ≈ < 20% CM damage.
- Oviposition incidence was highest at older plant growth stages (> 7- 9 leaves, ¼ inch root; growth stage #2) than at young plants.
- Plants were most vulnerable to fly oviposition at 4 weeks after planting.
- Low fly catch numbers (< 100 flies / 6 weekly totals) ≈ < 20% CM damage.
- Oviposition incidence was highest at older plant growth stages (> 7-9 leaves, ¼ inch root) than young plants.
- Plants were most vulnerable to fly oviposition at 4 weeks after planting, however a delay in egg-laying occurred in some fields.
- Fall and spring cultivation reduced overwintering pupae in harvested fields.
- Exclusion fences and trap crops proved to decrease the maggot load in fields.
- In-furrow application and seed-treatments have shown promise. Spinosad and Fipronil treatments were efficacious.

High levels of slug mortality were observed within 1-3 days in plots treated with the standard treatments including Metarex 4%. Mortality of slugs in containers treated with iron-phosphate pellet formulations did not occur until 5 DAT, however feeding on pellets and carrot pieces greatly declined after day 1. Greater than 80% slug mortality was reported within 7-10 days of application in all treatments. Factors such as earthworms, collembolans, temperature, rain, and wind could affect bait performance.



EVALUATION OF BAITS FOR CONTROL OF GRAY GARDEN SLUG

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Commercial formulations of pelleted metaldehyde and of iron phosphate-based slug baits were evaluated for control of grey garden slugs *(Deroceras reticulatum* (Mueller) in grasses grown for seed in Oregon. Field and greenhouse trials were conducted to understand bait efficacy, placement, rates, and the effects of weathering on baits. What is the best way to evaluate bait effectiveness and what factors affect the performance of baits?

In the controlled environment greenhouse studies, treatment replications consisted of vented, clear, round plastic containers (10.75 inches in diameter, 4 inch height), a hiding place, a carrot piece or lettuce placed in each container along with 14 slugs of fairly uniform size. Pellets (1.25mg) were evenly-distributed on the paper toweling covering the floors of the containers. Untreated containers received only carrot pieces. Containers were inspected for dead and dying slugs at 1, 3, 5, 7, 10, 14 days after treatment (DAT). Dead slugs were counted, recorded and removed from containers at evaluation. Treatment efficacy was determined by comparing mean mortalities of slugs through time as well as amount of feeding on carrot pieces as measured by a visual scale of 0-10 (0= no obvious feeding; 10=100% eaten) at each evaluation date.

In field studies, plots were replicated four times in a RCB design with plots measuring 50 x 50 ft. Treatments were applied to all plots using a rotary, hand held bait spreader for higher treatment rates and a shaker jar for lower rates to achieve uniform coverage. Relative slug populations within plots were determined with bait stations prior to and after application of treatments (0, 7, 14, 21, 29, and 35 DAT). Treatment efficacy was determined by comparing reduction of mean number of slugs recorded at bait stations at different intervals pre- and post-treatment through time. Other field studies were replicated six times in a RCB design with grass plots measuring 15 x 15 feet. Slugs were exposed to weathered baits (0, 3, 5 and 7 day exposure). A 12 by 12 inch area of soil scraped free of vegetation was prepared in each plot, and the station was equipped with weathered pellets of each treatment. Total number of slugs visiting each station was recorded.

High levels of slug mortality were observed in the standard treatments such as Metarex before 3 days of treatment. Mortality of slugs in containers treated with iron-phosphate pellet formulations did not occur until 5 DAT, however feeding on pellets and carrot pieces greatly declined after day 1. Greater than 80% slug mortality was reported within 7-10 days of application in all treatments. Factors such as earthworms, collembolans, temperature, rain, wind could affect bait performance.

Section V
Soil Arthropods

Western Orchardgrass Billbug, *Sphenophorous venatus confluens* Chittenden, Biology & Control in Commercial Seed Fields

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Jon Umble (Fall Creek nursery)

The biology and control of this pest were studied over the past 5 years in unirrigated commercial orchardgrass (OG) seed fields in the Willamette Valley. We found the biology of this univoltine pest to be quite similar to that reported by Kamm in the late 1960's: Adults overwinter, breaking diapause from late MAR through APR. At this time adults feed on grass blades, mate and migrate among crowns. Females deposit eggs in crowns and developing stems through June. Eggs hatch and larvae develop through the summer and early fall. Pupation occurs in AUG and adults can be found from SEP through NOV. Kamm suggested controlling this pest in the spring, applying Lorsban 4E ® in the rain to wash the insecticide down the leaves to the crowns and soil where the billbugs are active. This has not been satisfactory because (1) Lorsban is ineffective as an adulticide, (2) grass regrowth is often too tall for the insecticide to evenly penetrate the canopy, (3) rain seldom falls when needed and in sufficient quantity for effective control.

Fieldmen and growers were interested in finding an alternative to chlorpyrifos as well as determining if a fall spray would be more effective for controlling this pest. Why? The grass regrowth is very short, rainfall would not be needed for insecticide to reach target sites.

We revisited the field biology of this billbug and evaluated different products for controlling it. in the fall of the year.

We took sampled OG crowns, roots and soil through the year to monitor occurrence of larval, pupal and adult stages in the roots and crowns of the OG.

We used presence of adult feeding scars on grass blades both in the spring as well as in the fall (2005 and 2006). to determine when adults broke diapause in the spring and aestivation in the fall. We use an economic threshold of 8% of the crowns with adult feeding damage to initiate control in both spring and fall periods. Pitfall traps monitored spring and fall adult dispersal which begins shortly after the first feeding scars are noticed in spring as well as fall. Dispersal lasts for about three weeks.

As a result of these studies and trials with various insecticides, we now recommend bifenthrin at 0.1 lb ai/A (section 18 registrations) applied as a broadcast spray with either the spring or fall (after OCT 20th and before NOV 10th) timing to control the adults of this pest.

Bifenthrin applied in the fall provides in excess of 90% control of adult billbugs present. Other pyrethroids evaluated at suggested label rates have not provided satisfactory control. We think fall applications have provided excellent control because (1) sprays occur when vegetative regrowth is minimal (compared to spring applications made to knee-high orchard grass), (2) adults are actively dispersing on soil surface and come into contact with insecticides, rain is NOT needed for product to hit the soil surface target site and (3) since field burning has been reduced or eliminated by many growers, little charcoal residues remain to adsorb insecticides.

Section V
Soil Arthropods

EFFICACY OF DIFFERENT METHODS OF APPLYING ALTACOR® 35 WDG, (chlorantraniliprole) FOR CONTROL OF MINT ROOT BORER LARVAE IN FURROW AND SPRINKLE IRRIGATED PEPPERMINT LOCATED IN IDAHO, 2006

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ABSTRACT

Altacor® 35 WDG (chlorantraniliprole) provided control of mint root borer (MRB) larvae in furrow irrigated mint, when it was broadcast applied and incorporated with approximately 0.5 inch of rain, thirteen days after application. No significant control of the MRB was observed when Altacor® was applied in the furrows only, of furrow irrigated mint before furrow irrigating. Altacor successfully controlled MRB larvae when applied by chemigation or broadcast applied and then incorporated with overhead watering up to four days later. Altacor® successfully controlled the MRB larvae at both the maximum rate of 4 oz/a (0.087 lb ai/a) and at the lower rate of 3 oz/ac (0.065 lb ai/a) when chemigated.

OBJECTIVE 1:
Control of mint root borer larvae in furrow irrigated mint with Altacor® 35WDG

INTRODUCTION

Mint root borer control can be obtained by chemigating Lorsban (chlorpyrifos), however, MRB control is sometimes poor when chemigating Lorsban. This is likely due to the complications of applying an insecticide through irrigation water and having it move though the soil, and contact the larvae. Lorsban is the only chemical insecticide registered for the control of mint root borer. In addition, MRB control becomes problematic in furrow irrigated mint where applying Lorsban by chemigation is not possible. Tilling of mint fields is the only non chemical method to control MRB, but is not always an option with fields infested with verticillium wilt.
Studies done in 2004 and 2005 in the La Grande Oregon area, found that the new DuPont Crop Protection insecticide, registered with the name of Altacor® 35 WDG (chlorantraniliprole), formerly known as DPX-E2Y45, controlled MRB as well as Lorsban when applied by chemigation.

MATERIALS AND METHODS

These experiments were located in two production, peppermint fields located in the Dry Lake, Idaho area, West of Caldwell. Experiments one and three were located in a field with a Scism silt loam soil. The fields with experiments two and four were located in a Bahem silt loam soil. Both soils have an approximate pH of 8.3 and both have an approximate organic matter level of 1.5%. Both fields were Black Mitchem peppermint; furrow irrigated, and had just been harvested for the second year in 2006. Both fields had been power corrugated before the applications were made. The field containing experiments one and three was swathed approximately August 21st and the field containing experiments two and four was swathed approximately August 22nd. Neither field had been irrigated before the insecticide applications were made, nor was there any mint regrowth at the application date.

Experiments 1 and 2

Experimental plots were 12'x 40'sections of the peppermint field which contained a natural infestation of MRB larvae. A randomized block design was used with five replications. Treatments were applied post-harvest on September 2nd for both experiments, with a CO_2 backpack sprayer (20 GPA at 15 psi.). No surfactant or adjuvant was added to the spray solution. The field with experiment one was furrow irrigated approximately three days after the insecticides were applied. Experiment number two had water starting down the furrows in the plot area within four hours of the applications.

Evaluations were made by taking seven, 0.75-ft^2 soil / rhizome samples in each plot. The samples were taken to the depth of the rhizomes which averaged four inches deep.

The soil was shaken off the mint rhizomes and sifted though a 0.25" 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 1 was evaluated 40 days after treating (DAT) while experiment 2 was evaluated 41 DAT.

RESULTS AND DISCUSSION

Results from experiments one and two were relatively similar to each other (table 1). The band application did not provide statistically different results in both experiments compared to the untreated check. It was theorized that the water that seeped by capillary action, laterally across the rows, would carry the banded Altacor, into the row and to the roots of the mint plants. It may be that the Altacor was moved somewhat laterally, but that it was concentrated on the soil surface and was not taken up by the mint roots.

The broadcast application did significantly lower the MRB levels compared to the UTC and reduced the MRB levels below the treatment threshold. Approximately thirteen days after the treatments were applied; there was a significant amount of rain in the area of these two experiments. No precipitation was expected in the month of September so no rain gages were put in the test plot areas. The nearest Agrimet station did not report any significant precipitation during this period but this station was apparently not functioning at that time of the rain. It is impossible to know the exact amount that each of these experiments received but it is estimated that both experiments received between 0.25 to 0.5 inch of precipitation in one day and lesser amounts within the following seven days. It is assumed that each experiment received the same amount of rain due to both being approximately one mile apart. It is not clear if the Altacor would have controlled the MRB if it had not rained, but the rain most likely moved the Altacor into the soil. It is encouraging that this product appears to be able to be washed into the soil after thirteen days and still be mostly effective.

Table 1
Results of field efficacy trials for mint root borer larvae control in furrow irrigated mint with Altacor® 35 WDG.

		Experiment 1 40 DAT	Experiment 2 41 DAT
Treatment	Rate(lb ai/a)	Mean number live mint root borers per ft^2.*	Mean number live mint root borers per ft^2.*
UTC		4.76 a	2.59 a
Broadcast application of Altacor® 35 WDG	0.087	0.76 b	0.72 b
Band application of Altacor® 35 WDG in furrow	0.087	3.96 a	3.73 a

Sample means were compared with Fisher's Protected LSD (p=0.05). Means with the same letter are not significantly different (Petersen 1985).
Experiment 1: LSD = 1.85, p<0.05
Experiment 2: LSD = 1.46, p<0.05
* Includes live mint root borer larvae found in the rhizomes, soil and hibernaculum.

CONCLUSION
Although band application of Altacor to the furrow was ineffective, broadcast applying and then a significant amount of rain occurring within thirteen days, did provide acceptable control. It appears that mint root borer control in furrow irrigated mint could be obtained if Altacor is applied before an expected rain storm, between the times of harvest and the MRB entering their hibernacula. Further testing is needed to determine the amount of MRB control with broadcast applications of Altacor® on furrow irrigated mint with out rain.

OBJECTIVE 2:
Comparison of mint root borer larvae control with Altacor® 35 WDG when applied by chemigation and when sprayed on and incorporated later with sprinkle irrigation, compared to the standard chemigation of Lorsban.

MATERIALS AND METHODS

Experiments 3 and 4

These experiments were located in two production peppermint fields in the Dry Lake, Idaho area as mentioned previously. Experimental plots were 12'x 15'sections of a peppermint field with a natural infestation of MRB larvae. Experiment three was located in a peppermint field with solid set, sprinkler irrigation. Experiment four was in a furrow irrigated field. In both experiments treatments were in a randomized block design, replicated four times.

Chemigated treatments were applied with a CO_2 backpack sprayer (20 GPA at 15 psi) to pre-irrigated plots. The insecticide in the chemigated treatments was immediately washed into the soil with overhead sprinklers. A total of approximately 0.75 inch of water was applied. Garden sprinklers, attached to a pump and water tank, were used for applying water for all the chemigated treatments.

In experiment number three, one of the non-chemigated Altacor treatments was applied on September 1 while and other non-chemigated Altacor treatment was applied on September 2. Both were applied with a CO_2 backpack sprayer (20 GPA at 15 psi) to dry soil. The solid set sprinkle irrigation occurred on September 5. The solid sprinkler irrigation set ran for approximately 12 hours and thoroughly saturated the soil.

Experiment four was in a furrow irrigated field so only the chemigation treatments were applied. This experiment was also furrow irrigated approximately two days after the treatments were applied. These two experiments were also in the same area as experiments one and two so they also received rain approximately thirteen days after being applied.

Evaluations of all treatments were made by taking seven, 0.75-ft^2 soil / rhizome samples in each plot and processed as described before. Experiment three was evaluated 40 DAT while experiment four was evaluated 41 DAT.

RESULTS AND DISCUSSION

The results from the same treatments of each experiment were similar to each other (table 2). All the treatments provided control similar to the standard Lorsban treatment and significantly more control than the UTC. There was little difference in the level of MRB control between the two rates of Altacor when chemigated. The Altacor that was applied to dry soil and incorporated with sprinkle irrigation provided similar results compared to chemigation.

Table 2

Results of field efficacy trials for mint root borer larvae control in sprinkle irrigated mint using Altacor 35 WDG.

		Experiment 3 40 DAT	Experiment 4 41 DAT
Treatment	Rate (lb ai/a)	Mean number live mint root borers per ft^2.*	Mean number live mint root borers per ft^2.*
UTC		5.8 a	2.1 a
Altacor chemigated (3 oz/a)	0.065	0.05 b	0.3 b
Altacor chemigated (4 oz/a)	0.087	0.0 b	0.1 b
Altacor watered in 96 hr later	0.087	0.2 b	---
Altacor watered in 72 hr later	0.087	0.1 b	---
Lorsban 4E chemigated	2.0	0.2 b	0.02 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 1: LSD = 1.6, $p<0.05$, Experiment 2: LSD = 1.2, $p<0.05$
* Includes live mint root borer larvae found in the rhizomes, soil and hibernaculum.

CONCLUSION

The Altacor 35WDG treatments were all successful in providing MRB control similar to chemigated Lorsban. The Altacor is more flexible than Lorsban because it can be sprayed on and watered in later, or chemigated. Lorsban is only effective when chemigated. Applying Altacor with a ground sprayer allows it to be evenly applied to the field, unlike chemigation which can unevenly apply a product due to the uneven distribution of water by some sprinkler systems. This data also shows that the three and four oz/a rate of Altacor provided nearly equal MRB control when chemigated. It should be further investigated to determine if Altacor could control the MRB at rates even lower rates lower than 3 oz/ac.

REVISITING MONITORING STRATEGIES FORROOT WEEVIL MANAGEMENT IMPROVEMENT IN NURSERIES

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Root weevil (Coleoptera: Curculionidae genus *Otiorhynchus*) damage to nursery crops is a persistent problem, physically and financially. Degree-day modeling and trapping are tools to supplement scouting to monitor development and presence of weevils in the field. A multi-year research study was conducted since 2005 at different locations in the north to mid-Willamette Valley.

Weekly visits to various nurseries were undertaken in the spring and summer seasons to trap and collect adults, monitor development (by digging), maintain traps, and download soil and air temperatures from data loggers. Relative stages and abundance were relayed to managers or owners to optimally assist in timing their spray regimens. Examination of potting media and soil in containers and in-ground plantings, respectively, was necessary to generate developmental curves.

Two types of traps were implemented for relative comparison.. One trap, called the Exotior™ Black Vine Weevil Trap, by Exosect (UK), had been used in previous seasons with some success. The second trap, tested for the first time, was an inverted cone suspended over a circular ramp (8 inch base diameter) with a sticky plastic circle placed under the cone (Figure 1). Both traps encased sticky plastic substrates, to detain the adults, and bait consisting of small dried apple chips. Seventy traps of each type were set among containers or susceptible in-ground plants at 7 separate locations (10 each per site in 4 nurseries and 2 strawberry blocks). Two of the sites were repeated from the previous year, which allowed for comparison. Developmental graphs were compared for a yew field, where the site was monitored in 2003, and a nearby site was monitored in 2005 (Figure 2).

Two HOBO™ data loggers at each site were used, each with three probes, two for soil temperatures (3 cm deep) and one for air (1 meter height). Transformation of data was employed, using a 10^{o} C baseline to obtain cumulative degree days, both hourly and daily from a high-low averaging. Developmental graphs were compared for a yew field, where the site was monitored in 2003, and a nearby site was monitored in 2005.

Results of trapping showed a relative advantage of the Exotior™ traps at most sites, except the total capture was higher with the cone traps in the more populated yew field (Figure 3), the totals for the site accounting for over 72% of the total weevils captured and 87% of the total cone capture.

Figure 1

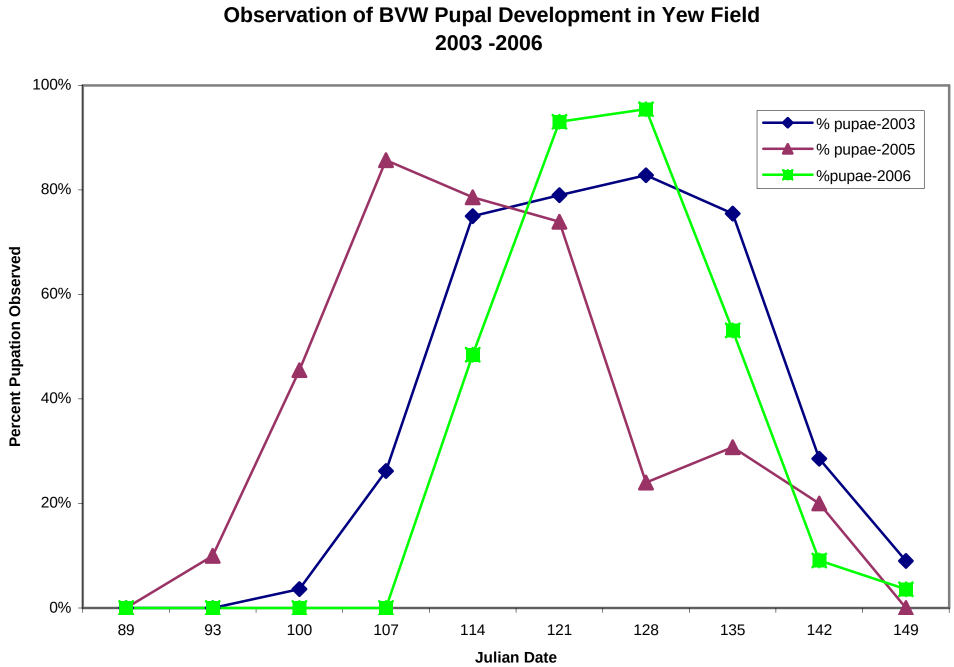

Figure 2

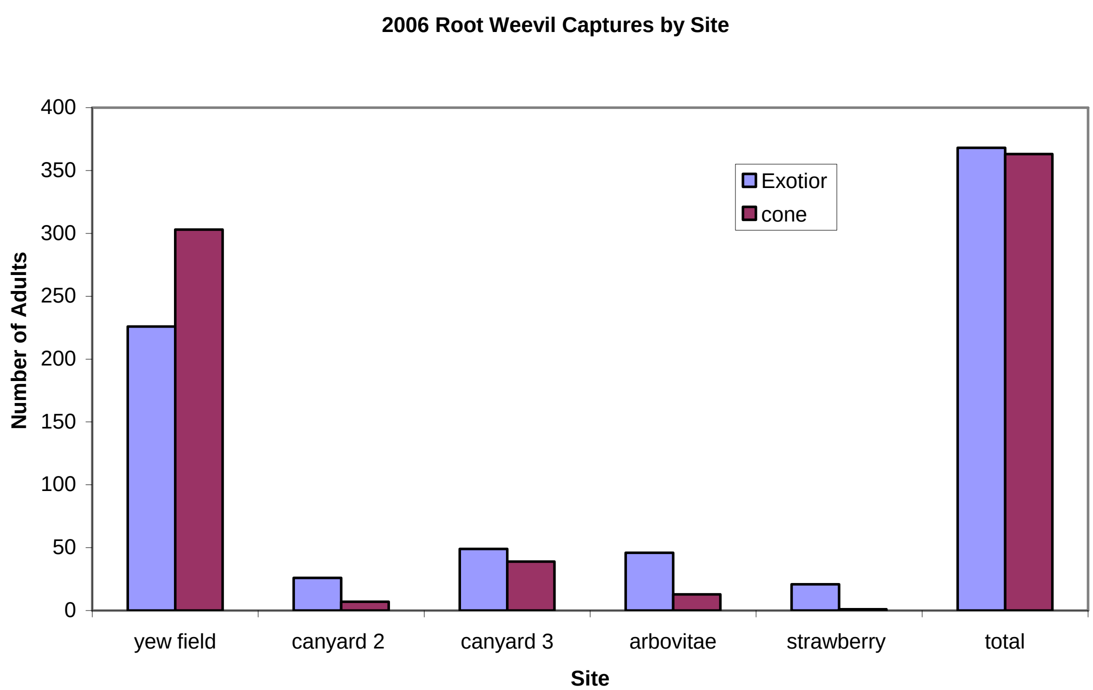

Figure 3

Section VI
Vectors of Plant Pathogens

Management of Potato Viruses and Vectors

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We have recently dicovered that mixed-viral infections of heterologous viruses such as *Potato virus Y* (Potyviridae: *Potyvirus*) (PVY) and *Potato leafroll virus* (Luteoviridae: *Polerovirus*) (PLRV) are a regular occurrence in Idaho's potato cropping systems. These two viruses are the most important virus pathogens of potato and are transmitted most efficiently by the green peach aphid (*Myzus persicae* Sulzer) (GPA) and the potato aphid, *Macrosiphum euphorbiae* (Thomas). An increased number of plant samples from Idaho's potato fields over the last two years has serologically tested positive for both PVY and PLRV via double antibody sandwich enzyme linked immunosorbent assay (DAS-ELISA) and exhibited more severe symptoms than singly-infected plants (PVY or PLRV).

Several authors have extensively studied the mixed infection phenomenon but to the best of my knowledge none has examined the effect of such infections on vector biology and preference. We used a set of laboratory studies to assess the effect of mixed-viral (PVY-PLRV) infection on the fecundity and preference of the two most efficient PVY and PLRV vectors, the green peach aphid and the potato aphid. Adult aphids were clip-caged (1 adult per cage) to leaflets of PVY, PLRV, PVY-PLRV-infected and non-infected potato plants. The number of nymphs produced in all four treatments was recorded after 96 h. Preference of winged and wingless green peach aphid and potato aphid was determined with the use of settling bioassays. Our recent studies have demonstrated the green peach aphid and the potato aphid fecundity was significantly higher on mixed-infected plants than on singly-infected plants or non-infected plants. Both winged and wingless green peach aphid and potato aphid preferentially settled on PVY-PLRV infected plants than on singly-infected plants (PVY or PLRV) or non-infected plants. These results suggest that mixed viral infections could influence the epidemiology of potato viruses in the crop, with implications for disease management. Increased detection of mixed-infected plants in Idaho's potato systems indicates that the current management plants are inadequate and requires changes in management approaches. Increased sampling and identification of viruses should be advocated before choosing an appropriate aphicide; this could be more useful and economical. This research will allow a more complete understanding of the interaction between viruses, and vectors, and aid in development of much needed and improved virus management plan.

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SECTION VI
Foliage and Seed Feeding Pests

FIRST EFFICACY DATA AGAINST BEET LEAFHOPPER IN POTATO

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A serious epidemic of a “potato yellows” disease occurred in many potato fields throughout the Columbia Basin in 2002. The beet leafhopper-transmitted virescence agent (BLTVA), a bacteria-like organism called a phytoplasma, has been shown to be a primary, if not the only, cause of this disease. The only known vector for this disease is the beet leafhopper (BLH), but leafhoppers in one other genus have tested positive for BLTVA. Even though we know little about this disease and its vector(s), potato growers are still faced with the prospect of protecting their crops from this disease.

We conducted efficacy trials in 2003, 2004 and 2005 to generate efficacy data against beet leafhopper. In all cases we failed to generate useful data. These failures were largely due to the lack of understanding of basic pest biology. As a result of the biggest string of failures to generate data against an insect pest, virtually no one was willing to fund additional efficacy trials against beet leafhopper. Roger Willemsem, Cerexagri, had some original ideas on how to build on our increasing knowledge of beet leafhopper biology. Cerexagri funded a small trial using some different techniques, including drip irrigated potatoes, to generate data against leafhopper.

The most striking result from this trial was the clear result that Assail and Penncap M, as did Actara and Asana, provided significant level of control of BLH. To our knowledge no other trial has data to support this conclusively. All four Assail treatments as well as the Penncap M, Actara and Asana treatments significantly reduced the level of BLH in the trial. Penncap M provided perfect control of BLH with no BLH detected in the trial. There was no difference in level of BLH between any of the insecticidal treatments.

At 21, 28 and 35 days after the last application (July 11) incidence of beet leafhopper transmitted virescens agent (BLTVA) was collected. At 21 days (August 1) the incidence of BLTVA was low across the trial; however the highest level was in the untreated check. Seven days later, the incidence had risen, particularly in the untreated check. The incidence of BLTVA in the check was statistically higher than in all of the insecticidal treatments except for Assail applied at a 7 day interval which was not different from the check, but also was not different from the other insecticidal treatments. On August 15, the incidence of BLTVA expression in the untreated check was statistically significantly higher than in all of the insecticidal treatments. There was no difference in level of BLTVA expression between the insecticidal treatments.

Efficacy data for four active ingredients against beet leafhopper in potatoes.

Trt No.	Treatment Name	Rate	Rate Unit	Product Rate	Product Rate Unit	Appl Code	Cumulative Leafhoppers	Incidence BLTVA
1	UNTREATED CHECK						9.50 a	2.75 a
2	ASSAIL	0.047	LB A/A	2.5	OZ/A	ABCDEFGH	2.25 b	1.00 a
3	ASSAIL	0.047	LB A/A	2.5	OZ/A	ACEG	2.00 b	0.75 a
4	ASSAIL	0.047	LB A/A	2.5	OZ/A	AD	0.75 b	0.75 a
5	ASSAIL	0.075	LB A/A	4	OZ/A	ACEG	1.25 b	1.50 a
6	PENNCAP-M	1	LB A/A	4	PT/A	ACEG	0.00 b	0.25 a
7	ACTARA	0.047	LB A/A	3	OZ/A	ACEG	2.00 b	0.00 a
8	ASANA	0.0206	LB A/A	4	FL OZ/A	ACEG	0.75 b	0.00 a
LSD (P=.05)							2.721	1.721
Standard Deviation							1.850	1.170
CV							80.0	133.72
Grand Mean							2.31	0.88
Bartlett's X2							11.709	8.38
P(Bartlett's X2)							0.069	0.136
Friedman's X2							18.104	7.479
P(Friedman's X2)							0.012	0.381

SECTION VI
Foliage and Seed Feeding Pests

ADVANCES IN MITE MANAGEMENT IN COLUMBIA BASIN POTATOES

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Potatoes are one of the most widely grown crops in the United States and world. In all locations, control of arthropod pests are considered either production limiting or a major concern, however, mites are considered a pest of potatoes only in the Pacific Northwest. In excess of 95% of miticide applications in the PNW are made in the Columbia Basin. With the recognition of beet leafhopper as an important pest of potatoes and the introduction of potato tuberworm and the increase in problems associated with cabbage looper and thrips has resulted in a dramatic shift in insecticide use patterns and overall use of insecticides on potatoes in the region. Growers are increasingly shifting away from planting time treatments to foliar applications and significantly increasing the number of foliar applications of insecticides. In the Columbia Basin of Oregon and the lower Columbia Basin of Washington, growers commonly applied 5 or more insecticides during the growing season. This change in use practices greatly increases the likelihood that mite outbreaks will occur. Mite outbreaks in 2006 were worse than anytime in recent memory with acres treated with miticides reaching historic highs. Data will be presented showing which commonly used potato insecticides are closely associated with mite outbreaks.

Historically, propargite (Comite) was the product of choice. In 2005, spiromesifin (Oberon) was registered for use on potatoes. In its second year on market, Oberon capture most of the potato mite marketshare. Bifenazate (Acramite) is expected to be registered for use on potatoes in 2007. Hexythiazox (Onager) is expected to registered on potatoes by 2007 or 2008. Use restrictions on Agri-Mek (abamectin) are expected to be modified allowing the product to be more easily used on potatoes. Additionally, generic abamectin is expected to become available soon, reducing the cost of the product, making its use more attractive to growers. Soon growers will have access to four miticides for use on potatoes.

These products different in modes of action, efficacy, price, method of application, spectrum of control and activity against life stages. A series of trials involving the products was conducted over the past three years. Data on efficacy, period of residual control and method of application have been generated for Comite, Oberon and Acramite. Information will be presented on how best to develop a mite management program on potatoes.

SECTION VI
Foliage and Seed Feeding Pests

FIRST EFFICACY DATA AGAINST THRIPS ON POTATO

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Historically, thrips have not been considered an insect pest of potatoes, for example, the PNW Insect Management Handbook includes no mention of thrips of potatoes. Increasingly, growers in the Columbia Basin are making applications of insecticides for control of western flower thrips. Thrips populations have been targeted in potatoes from the Oregon border of Washington to north of Moses Lake. While it has not been documented that thrips actually cause economic damage to potatoes, growers are insistent that management of the pest is required.

No efficacy data are available for control of thrips on potatoes as no research efforts have been directed toward the pest on that crop. In 2006, we conducted the first trial to generate efficacy data on thrips occurring on potatoes. The first attempt to conduct the trial in a commercial field was over sprayed by an aerial application of Monitor. The trial was repeated on our research station on "research" potatoes. Unfortunately, pest pressure was substantially lower than that in the commercial field.

In this trial every product tested with the exception of a highly experimental insecticide resulted in a significant reduction in thrips numbers. Tank mixes of imidacloprid and lambda cyhalothrin were extremely effective against thrips. Other products that were effective against thrips included Monitor; lamba cyhalothrin (Warrior) applied alone, Clutch (clothanidin), Leverage (imidacloprid and cyfluthrin) and Assail.

These data suggests that thrips on potatoes are relatively easy to manage when populations are low. Some of the products that demonstrated efficacy are registered including Monitor and Leverage. Other products such as Clutch and Lambda are expected to be registered on potatoes in the next one to two years. The results suggest that existing or near future will provide a significant level of control of thrips.

Efficacy of 17 Treatments for Control of Thrips							
Trt No.	Treatment Name	Rate	Rate Unit	Other Rate	Other Rate Unit	Appl Code	Cumulative number of thrips
1	UNTREATED CHECK						11.00 a
2	WARRIOR	0.0234	LB A/A	3	FL Z/A	A	4.25 cde
3	ASANA	0.031	LB A/A	6	FL Z/A	A	6.00 bcd
4	MONITOR	1	LB A/A	2	PT/A	A	3.75 cde
5	ASSAIL	0.0744	LB A/A	1.7	OZ/A	A	4.00 cde
6	SUCCESS	0.07	LB A/A	4.5	FL OZ/A	A	5.75 bcd
7	PENNCAP-M	1	LB A/A	4	PT/A	A	6.00 bcd
8	Experimental	9.4	LB A/A	8	OZ/A	A	9.50 ab
	ORGANO SILICONE SURFACTAN	0.1	% V/V	0.1	% V/V	A	
9	Experimental	14	LB A/A	12	OZ/A	A	9.50 ab
	ORGANO SILICONE SURFACTAN	0.1	% V/V	0.1	% V/V	A	
10	BUG OIL	1	% V/V	1	% V/V	A	7.75 abc
11	BUG OIL	2	% V/V	2	% V/V	A	7.50 abc
12	LEVERAGE	0.08	LB A/A	3.8	FL OZ/A	A	3.50 cde
13	IMIDACLOPRID			3.8	FL OZ/A	A	2.75 de
	LAMBDA			2.56	FL OZ/A	A	
14	IMIDACLOPRID			3.8	FL OZ/A	A	1.00 e
	LAMBDA			3.2	FL OZ/A	A	
15	IMIDACLOPRID			5	FL OZ/A	A	3.50 cde
	LAMBDA			2.56	FL OZ/A	A	
16	CLUTCH			4	OZ/A	A	2.25 de
17	BATTALION			12	FL OZ/A	A	3.50 cde

CEREAL LEAF BEETLE MANAGEMENT WITH SEED TREATMENT INSECTICIDES – NEW AND CURRENTLY AVAILABLE PRODUCTS SPRING WHEAT 2006 TRIALS

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Protocol

Treatments plus rates per cwt = 4 reps in RCBD of 7 rows x 20 feet.
Seeding date 4-11-2006 using Hegi Cone Seed Drill – Variety Wawawai SWSW.
Emergence 4-19-2006. Both trials were rated for CLB larvae per cent per M2 at boot stage on June 15, 2006.

Abstract

Yield results for CLB in grain grams/M2 have high CV's for entomology trials due to the very **Poisson** distribution of Cereal Leaf Beetle larvae. Yet obvious SD's show in the tables for CLB percent per flag leaf in both trials. Products in the C and D groups have SD CLB reduction at boot/early flag stage compared to groups A and B groups in the Bayer Trial. The Valent trial data show more of a gradient in CLB larval management with group C SD from A and B. One observation is that Gaucho 600 FS and 480 seem more variable on CLB than Cruiser and Poncho. The Gaucho/Spinosad treatment doe provide better control of CLB larvae per flag leaf than Gaucho alone. After 2 trials in one spring wheat season CLB larvae seem to be reduced in number by already labeled products for wireworm and aphid in spring wheat. More research is needed to study CLB flag leaf damage related to yield.

Table 1. LSD All-Pairwise Comparisons Test for CLB% infested flag leaves at boot stage in the Bayer Trial

Treatment	Rate ai floz/cwt	Mean	Homogeneous Groups
DIVIDEND EXT	2.00	35.000	A
LINDANE	1.00	31.250	A
UTC	----	28.750	A
GAUCHO 600 FS	0.128	23.750	B
RAXIL XT	0.160	21.250	B
PONCHO 600 FS	0.128	20.000	C
GAUCHO 600 FS	0.800	18.750	C
GAUCHO 600 FS + PONCHO 600FS	0.128/0.128	16.250	C
PONCHO 600 FS	0.256	15.000	C
PONCHO 600 FS	0.510	15.000	C
CRUISER 5 FS	0.190	8.7500	D
CRUISER 5 FS	0.383	8.7500	D
GAUCHO 600 FS + SPINOSAD	0.128/0.160	8.7500	D
GAUCHO 600 FS	0.256	6.7500	E

Alpha 0.01 Standard Error for Comparison 5.7066
Critical T Value 2.698 Critical Value for Comparison 15.397

Table 2. LSD All-Pairwise Comparisons Test for CLB % Flag leaf infestation at boot stage in the Valent Trial

Treatment	Rate ai grams/Kg/Ha	Mean	Homogeneous Groups
UTC	----	30.000	A
GAUCHO 480	5	25.000	B
GAUCHO 480	31	23.750	B
V10170	5	20.000	B
V10170	10	18.750	B
V10170	30	17.500	B
V10112	10	16.250	B
V10112	30	10.250	C
V10170	50	7.5000	C
V10112	50	7.5000	C

Alpha 0.05 Standard Error for Comparison 7.4855
Critical T Value 2.042 Critical Value for Comparison 15.288

Table 3. LSD All-Pairwise Comparisons Test for Gms/M2 Grain Bayer Trial

Treatment	Rate ai floz/cwt	Mean	Homogeneous Groups
GAUCHO 600 FS	0.256	378.00	A
CRUISER 5 FS	0.383	377.00	A
GAUCHO 600 FS + SPINOSAD	0.128/0.160	335.00	B
PONCHO 600 FS	0.510	317.00	B
GAUCHO 600 FS + PONCHO 600 FS	0.128/0.128	312.00	B
CRUISER 5 FS	0.190	306.00	C
GAUCHO 600 FS	0.800	303.00	C
PONCHO 600 FS	0.128	295.75	C
GAUCHO 600 FS	0.128	295.00	C
RAXIL XT	0.160	275.00	D
PONCHO 600 FS	0.256	270.00	D
LINDANE	1.000	266.50	D
UTC	-----	241.00	D
DIVIDEND Ext	2.00	172.00	E

Alpha 0.01 Standard Error for Comparison 22.995
Critical T Value 2.698 Critical Value for Comparison 62.041

Table 4. LSD all-Pairwise Comparisons Test for grain grams/m2 Valent CLB Trial

Treatment	Rate grams/Kg/Ha	Mean	Homogeneous Groups
V10170	50	338.50	A
V10112	10	235.00	B
V10170	5	234.00	B
V10112	50	229.50	B
V10112	30	228.00	B
UTC	---	214.50	C
V10170	10	214.00	C
V10170	30	212.00	C
GAUCHO 480	10	206.00	C
GAUCHO 480	5	188.00	C

Alpha 0.05 Standard Error for Comparison 18.445
Critical T Value 2.042 Critical Value for Comparison 37.670

Section VII
Foliage & Seed Feeding Pests

PRELIMINARY RESEARCH ON CEREAL LEAF BEETLE ECONOMIC THRESHOLDS IN MATURING SPRING WHEAT

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Protocol
Treatments plus rates per cwt = 4 reps in RCBD of 7 rows x 20 feet in each of 2 trials. Seeding date 4-11-2006 using Hegi Cone Seed Drill – Variety Wawawai SWSW. Emergence 4-19-2006. Treatments consisted of experimental seed treatment insecticides plus a UTC.

Abstract
Cereal Leaf Beetle larvae (*Oulema melanoplus* (L)) appeared in leaf damaging numbers by June 1, 2006 in each of 2 spring wheat trials. Both trials were rated for CLB larvae per cent per M2 at boot stage on June 15, 2006. Flag leaf loss was calculated in terms of per cent destruction of leaf surface on July 1. In an effort to estimate wheat flag leaf per cent surface lost by cereal leaf beetle larval feeding, flag leaves were sampled from a ¼ meter square area in each of 4 replicates per treatment. Length of flag leaf was measured in centimeters for each replicate and means were produced statistically by AOV. Levels of flag leaf per cent losses were broken out for each treatment, with percentages in 5 % differences. The tables show increased length in flag leaf and reduced flag leaf damage above 15% by some of the insecticide seed treatment. Effect on flag leaf reduction by mechanical means could relate to flag leaf damage and wheat yield from CLB feeding. The need for a mechanical damage experiment is obvious. From the data tables seed treatment insecticide treatments do affect flag leaf damage and flag leaf length. As a bi-product of the research, a field insectary was established on the trial site to protect the *T. julius* parasitoid wasp present in ca. 50% of the larvae collected by Terry Miller, WSU Insectary Manager.

Valent Products under test

1	UTC	
2	Gaucho 480	5 ai grams/kg/ha
3	Gaucho 480	31 “
4	V10170	5
5	V10170	10
6	V10170	30
7	V10170	50
8	V10112	10
9	V10112	30
10	V10112	50

Bayer Crop Science Products under test

1 UTC -----
2 Raxil XT 0.160 floz/cwt
3 Gaucho 600 FS 0.128
4 Gaucho 600 FS 0.256
5 Gaucho 600 FS 0.800
6 Poncho 600 FS 0.128
7 Poncho 600 FS 0.256
8 Poncho 600 FS 0.510
9 Ga + Poncho 0.128/0.128
10 Ga + Spinosad 0.128/0.160
11 Cruiser 5 FS 0.190
12 Cruiser 5 FS 0.383
13 Lindane 1.000
14 Dividend Ext 2.000

Table 1. Valent Trial cereal leaf beetle larval damage, length of flag leaf, and leaves displaying 20 or more per cent flag leaf surface loss.

Trt	CM	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70+	Leaves	L20%>
1	11.5	11	9	2	1	1	-	-	-	2	1	3	1	-	1	1	33	30
2	11.5	15	12	5	5	2	3	1	1	1	1	1	-	1	2	-	50	26
3	13.5	15	5	2	-	-	-	-	1	-	-	1	2	3	1	-	30	27
4	14.0	21	8	10	1	1	-	1	-	1	-	1	-	1	1	1	53	11
5	12.5	25	11	5	1	1	-	-	-	-	2	-	-	1	-	-	46	13
6	14.0	15	5	4	2	2	3	-	2	-	1	4	-	-	1	-	41	36
7	15.0	37	9	5	-	-	-	-	-	-	-	-	-	1	1	-	53	4
8	14.0	35	7	1	5	1	-	-	-	1	2	-	-	-	-	-	52	8
9	15.0	24	11	1	2	-	-	-	-	1	-	-	-	-	2	-	41	7
10	15.0	14	8	7	1	2	-	3	-	4	-	-	-	-	-	-	36	25

Table 2. Bayer CS Trial cereal leaf beetle larval damage, length of flag leaf , and leaves displaying 20 or more per cent surface loss.

Trt	CM	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70+	Leaves	L20%>
1	11.5	17	6	5	5	-	-	2	-	2	1	2	-	-	1	-	41	20
2	11.5	9	13	6	4	3	1	1	5	-	-	1	1	-	-	-	44	27
3	11.5	16	7	4	3	-	2	3	2	-	-	-	2	1	1		41	27
4	14.0	25	10	6	5	-	-	-	3	-	-	-	1	-	1	-	51	10
5	14.5	4	10	6	3	-	7	-	3	3	-	2	2	2	-	-	42	45
6	15.5	12	8	5	4	3	1	-	4	-	1	-	-	-	-	-	38	24
7	15.0	8	7	6	6	-	1	3	-	2	2	2	-	1	2	-	40	33
8	16.0	4	9	7	2	-	2	-	2	-	4	1	-	1	1	-	33	33
9	17.0	16	12	8	3	2	-	5	2	-	3	1	3	-	3	-	57	33
10	16.0	15	9	8	4	-	3	-	1	-	-	-	-	-	-	-	40	10
11	14.0	14	11	4	2	1	-	2	2	-	-	-	1	1	1	-	46	17
12	15.0	21	7	5	5	1	1	3	-	-	2	-	-	-	-	-	46	15
13	11.0	17	4	3	1	-	2	1	-	-	2	-	2	1	2	2	35	34
14	10.5	9	14	2	2	2	-	3	1	-	-	-	1	-	-	1	35	23

INVESTIGATION OF A "PRE-EMERGENCE' APPLICATION OF GRANULAR IMIDACLOPRID TO MANAGE ROSE MIDGE, *DASINUERA RHODOPHAGA* [DIPTERA: CECIDOMYIIDAE].

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PROJECT OBJECTIVES:

The objective of this project is to evaluate the use of a "pre-emergent" application timing to reduce overwintering populations of the rose midge.

METHODS AND MATERIALS:

A field trial was conducted at the International Rose Test Garden (IRTG) in Portland, Oregon in 2006 to evaluate management of rose midge. Three treatments were applied to plots. The treatments were: untreated control; imidacloprid granular insecticide (Merit) applied at 1.8 lbs/1000 ft^2 (80 lbs/acre) prior to midge emergence on Feb. 24 and Feb. 27 (two separate days were required to complete application across entire Merit plots); and foliar cyfluthrin (Tempo 2) at a rate of 45 ml/100 gal applied April 8 and every two weeks throughout the growing season (4/28; 5/15; 5/29; 6/16; 7/14; 8/14). Miticides were also applied to the entire garden on 8/14 (Avid) and 8/25 (Floramite/Hexygon tank mix). Plots were sampled every week by evaluating rose branches from treated and non-treated plots from beginning June 1 and continued through the mid-October (10/16). A quantitative assessment of percentage tip damage was obtained by counting new growing tips and noting the percentage of those tips damaged. All damaged tips were examined under a microscope to further determine cause of damage.

RESULTS;

The onset of midge activity was delayed due to a late spring frost occurring during adult emergence which reduced midge survival. Most of the damage to shoots in early sampling was an abiotic disorder called blind shoots. The first signs of rose midge damage were detected June 20, 2006 (Figure 1.) and larvae were found shortly thereafter on June 27, 2006**.** By July 18, blind shoots were only a minor factor in the percent of damaged shoots, replaced by midge damage. Midge pressure was significantly less in the untreated control in 2006 (peak damage of 16%) compared to the untreated control in 2005 where rose midge damage peaked at 54%. Percent damaged shoots was greater in 2006 than 2005, for Merit a peak of 2% in 2005, 9% in 2006; for Tempo, a peak of 3.5% in 2005, 13% in 2006). Even so, the two chemical management programs kept percent damage below the untreated control. Further analysis of data to separate blind shoot damage from midge damage is planned.

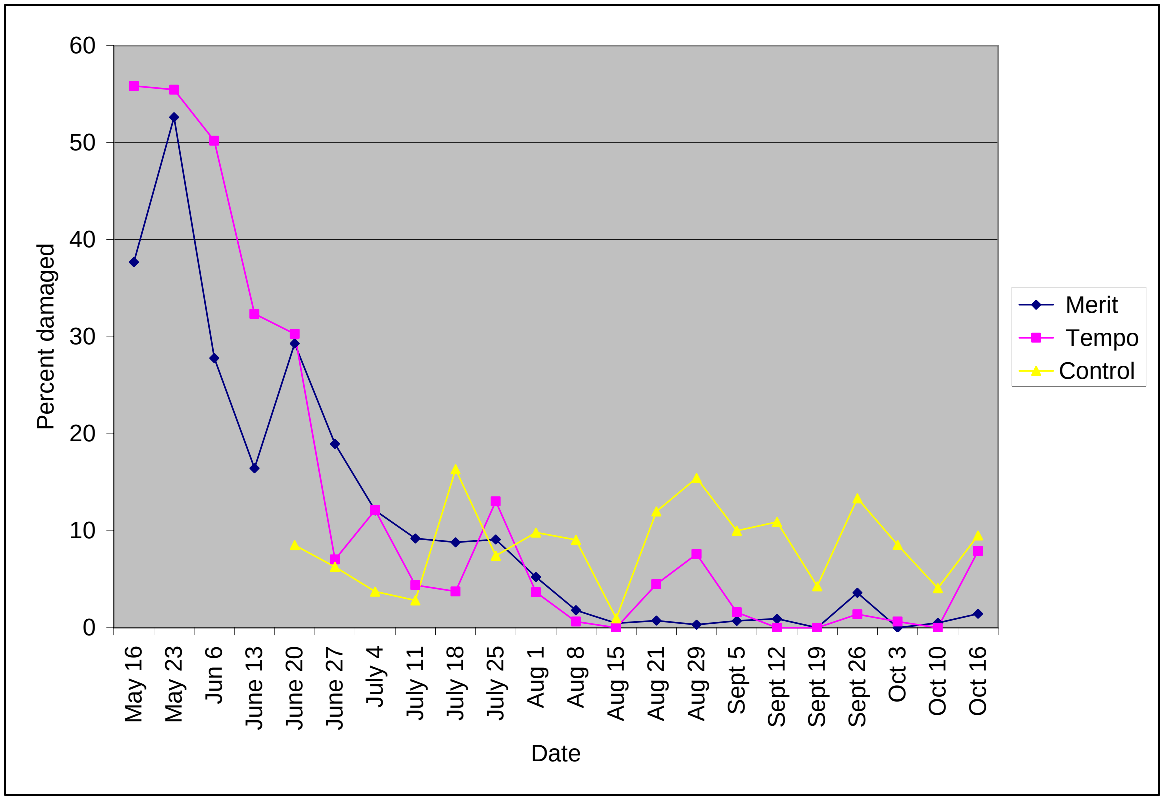

Figure 1. Percent of damaged rose shoots at the International Rose Test Garden in 2006 following applicatons of imidacloprid, cyfluthrin, and or a nontreated control.

BLUEBERRY GALL MIDGE, *Dasineura oxycoccana*, (Diptera: Cecidomyiidae) CONTROL TRIALS 2006

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Three trials were conducted in the spring and summer of 2006 in rabbiteye blueberries (*Vaccinium ashei* Reade) at Fall Creek Farm and Nursery. Trials were targeted at egg-laying blueberry gall midge, *Dasineura oxycoccana* Johnson, (BGM) adults and/or larvae present in buds. The first trial focused on first generation adults and resultant larvae (mid-April when first adults were found) using foliar sprays. Larval populations in buds were very low in the 2 months following this application (including the control plots), therefore it was difficult to accurately assess the effect of these treatments following treatment. Plots were assessed in late June (Table. 1) at which time populations in the treatments were not statistically different ($P > 0.05$ using Tukey multiple comparison procedure). Although it is possible that midge migrated into our plots and obscured the treatment effects, we interpreted our data (Table 1) to indicate the treatments were not successful in controlling the midge. Plots were re-treated in early July with the same products and rates (Table 2).

Table 1: Trial 1, Plot Size = 30 x 30', GPA = 45, Treatment date = 17 APR 2006, Evaluation date = 30 June 2006

Product	Percent AI	Rate/A	Larvae/Bud
Provado 1.6	17% Imidacloprid	4 Fl. Oz	0.21 a
Success	22.8% Spinosad	6 Fl. Oz	0.18 a
Actara	25% Thiomethoxam	4 Fl. Oz	0.40 a
Asana XL	8.4% Benzeneacetate	9.6 Fl. Oz	0.21 a
Imidan	70% Phosmet	1.33 lb/A	0.34 a
Diazinon AG 500	48% Diazinon	8 Fl. Oz.	0.32 a
UTC			0.22 a

Table 2: Trial 2, Plot Size = 30 x 30', GPA = 45, Treatment date = 27 JUN 2006, Evaluation date = 6 JUL 2006

Product	Percent AI	Rate/A	Larvae/Bud
Provado 1.6	17% Imidacloprid	4 Fl. Oz	0.78 ab
Success	22.8% Spinosad	6 Fl. Oz	1.2 b
Actara	25% Thiomethoxam	4 Fl. Oz	0.87 ab
Asana XL	8.4% Benzeneacetate	9.6 Fl. Oz	0.60 ab
Imidan	70% Phosmet	1.33 lb/A	0.22 a
Diazinon AG 500	48% Diazinon	8 Fl. Oz.	0.56 ab
UTC			0.87 ab

Populations were statistically lower ($P > 0.05$ using Tukey multiple comparison procedure) in the Imidan treatment, compared to the Success treatment. However, overall control was not considered acceptable. The poor control noted may have been due to any of a number of factors including inappropriate timing, GPA, surfactant, rate and product selection. For the third trial we tried to improve on methods of application including: i) increasing GPA, ii) decreasing droplet size, iii) using a surfactant, and iv) increasing insecticidal rates. For this trial we focused on systemic products, and added soil treatments (Table. 3). Populations were statistically lower ($P <$

Table 3: Trial 3, Plot Size = 30 x 10', Treatment date = 20 JUL 2006, Evaluation date = 27 JUL, Foliar = 100 GPA, Soil = 350 GPA, Surfactant Added.

Product	Percent AI	Rate/A	Larvae/Bud
Provado 1.6	17% Imidacloprid	8 Fl. Oz	0.50 a
Imidan	22.8% Spinosad	1.33 lb/A	0.73 ab
Actara	25% Thiomethoxam	4 Fl. Oz	0.78 ab
Alias (Soil)	21% Imidacloprid	32 Fl. Oz	1 ab
Platinum (Soil)	21.6% Thiomethoxam	8 Fl. Oz	0.75 ab
UTC			1.35 b

0.05 using Tukey multiple comparison procedure) in the Provado treatment, compared to the UTC. However again, control was not considered acceptable. Based on these trials we feel that acceptable control of larvae in buds during mid-season is not likely with the registered products, rates and timing that we screened. However, we feel that several alternative approaches and properly-timed and placed treatments may offer control, including treating for the pupae in the soil, and applying systemic insecticides in the early spring. Probably the greatest success of these trials was the development of a salt extraction method that allows for quick in-field assessment of larvae in buds (70% extraction efficiency), and provides a tool for studying numerous other facets of midge biology/occurrence.

Section VII
Foliage & Seed Feeding Pests

INSECTICIDE EFFICACY AGAINST LYGUS ON ALFALFA GROWN FOR SEED IN WASHINGTON STATE

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Insecticides were screened for their ability to control Lygus nymphs *Lygus hesperus* Knight (Heteroptera: Miridae) in alfalfa seed fields. In early spring, field plots were established at Prosser and Othello Washington State. At each location, plots were 18 ft. wide and 20 ft. in length and treatments were replicated 4 times in a complete random block design. Insecticides were applied to mimic grower timing at a pre-bloom and bloom period of the alfalfa. Treatments were applied using a CO_2 powered back pack sprayer equipped with a four nozzle boom using 25 gallons of water per acre as carrier. Five 180° sweeps per plot were used as a means to sample Lygus nymph abundance and efficacy of the insecticides post application.

At the Prosser location during the pre-bloom period, the Baythroid and Capture treatments provided significantly better Lygus control than did the untreated check. Moderate levels of control were achieved with the Rimon, Beleaf, and Venom treatments. At the Othello location during the pre-bloom period, Rimon, Assail, Baythroid, Dimethoate, Capture, Beleaf, and Venom treatments provided significantly better Lygus control than did the untreated check.

During the bloom period at the Prosser location, the Rimon and Assail treatments provided better control than the untreated check. The Beleaf and Dibrom treatments were also effective, but the variability in the untreated check made the treatments not significantly different from the untreated check. At the Othello location during the bloom period, the Rimon and Beleaf treatments controlled Lygus nymphs significantly better than the untreated check.

Pre-Bloom Treatments:

Mean Lygus Nymphs/5 Sweeps ± Std. Error

Product	**Rate/Acre**	**Prosser, WA**	**Othello, WA**
Rimon 0.83 EC	12 oz.	4.75±1.18	2.00±0.70*
Assail 70 WP	0.05 lb	7.50±0.87	2.25±0.48*
Baythroid	2.8 oz.	1.00±0.71*	1.50±1.19*
Dimethoate 4 EC	1 pt	6.00±0.24	2.75±0.63*
Capture 2 EC	6.4 oz.	0.25±0.25*	0.25±0.25*
Beleaf	3 oz.	3.25±1.88	4.75±2.25*
Venom	3 oz.	4.75±1.37	2.50±0.50*
Untreated check	NA	8.25±1.62	21.75±6.93

Means followed by a * are significantly different than the untreated check.

Bloom Treatments:

Mean Lygus Nymphs/5 Sweeps ± Std. Error

Product	**Rate/Acre**	**Prosser, WA**	**Othello, WA**
Rimon 0.83 EC	12 oz.	0.25±0.25*	6.00±0.91*
Assail 70 WP	0.05 lb	0.25±0.25*	9.00±3.03
Beleaf	3 oz.	0.75±0.75	5.00±2.20*
Dibrom	1 pint	1.00±0.57	13.00±4.06
Untreated check	NA	5.00±4.36	11.25±3.06

Means followed by a * are significantly different than the untreated check.

THRIPS CONTROL ON DRY BULB ONIONS

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Onion thrips *Thrips tabaci* Lindeman are the key pest for dry bulb onion production in Washington State. Trials were conducted at three different locations during the 2006 growing season each implementing a complete random block design with four replicates. Plots were two double rows wide and fifteen feet long. Applications were made with a $C0_2$ backpack sprayer applying 25 gallons per acre water at 35 psi. Plots were evaluated for efficacy by counting the number of adult and immature thrips on the central onion leaf.

The first trail was conducted on 16 June 2006 in Pasco, Washington State in a yellow onion field under rill irrigation. None of the chemistries tested provided thrips control that was significantly different from the untreated check. Thrips abundance was reduced the greatest in the Lannate treatment.

The second trial was conducted on 3 July 2006 in Moses Lake, Washington State in a white onion field under rill irrigation. Due to the extremely high standard error associated with the mean thrips counts in the untreated check, none of the results obtained from this particular trial were significant. Trends in the data will be discussed during the oral presentation.

The third thrips control trial was conducted in a yellow dry bulb onion field near Othello, Washington State under drip irrigation on 27 July 2006. This trial differed from the aforementioned trials in that the plots were larger, 2 double rows by 185 feet, and that only one chemical was compared to the untreated check. The chemical was applied both over the top with a CO^2 powered backpack sprayer like in the treatments above, and chemigated through the drip system with a piston injection pump. Plots were evaluated one and two weeks post treatment to evaluate efficacy of the product. One week post treatment, both the over the top and chemigated treatments of Venom provided significantly better thrips control than did the untreated check. Two weeks post application, none of the treatments varied statistically from the untreated check.

Treatment	Rate/A	Mean Thrips/Onion Plant ± Std. Error	
		One week post treatment	Two weeks post treatment
Lannate SP	0.91 lb. ai	7.0±2.6	13.0±4.2
Mustang Max	4 oz. F	20.75±8.8	29.25±23.8
Pencap M	2 pt F	14.75±2.1	21.75±8.3
Pencap M + Warrior	2 pt F + 0.03 lb. ai	17.5±3.0	17.75±9.1
Success	8 oz. F	19.5±11.7	35.0±18.5
Warrior	0.03 lb. ai	12.75±7.0	20.75±14.6
Untreated Check	NA	15.75±2.2	30.0±14.9

Results from trial at Pasco, WA location. Means followed by * are significantly different from the untreated check (pairwise t-test, P< 0.05)

Treatment	Rate/A	Mean Thrips/Onion Plant ± Std. Error
Assail 30 G	5 oz F + 0.2% NIS	35.33±10.8
Assail 30 G	8 oz F + 0.2% NIS	31.0±10.5
Carzol SP	0.75 lb. ai+0.2% NIS (pH 5)	33.5±27.6
Carzol SP	1.0 lb. ai+0.2% NIS (pH 5)	38.75±18.2
Carzol SP	1.0 lb. ai+0.2% NIS (pH 7)	34.25±17.6
Carzol SP	1.25 lb. ai+0.2% NIS (pH 7)	40.75±24.1
Ecotrol	1.5 pints F	58.0±44.4
Movento 150 OD	8 oz F + 0.1% OSS	50.3±32.75
Movento 150 OD	12 oz F + 0.1% OSS	37.3±19.0
Movento 240 SC	5 oz F + 0.25% MSO	66.0±67.0
Movento 240 SC	5 oz F + 0.2% NIS	71.5±29.0
Movento 240 SC	5 oz F + 0.1% OSS	53.0±28.3
Pencap M	2 pints F	62.5±21.1
Pencap M + Warrior	2 pints F + 0.03 lb. ai	64.5±67.1
Success	8 oz. F	68±61.5
Warrior	0.03 lb. ai	47.5±26.4
Untreated Check	NA	70.75±74.0

Results from trial at Moses Lake, WA. Means followed by * are significantly different from the untreated check (pairwise t-test, P< 0.05)

Treatment	Rate/A	Mean Thrips/Onion Plant ± Std. Error	
		1 week post treatment	2 weeks post treatment
Venom (over the top)	4 oz. F + 0.25% NIS	52.25±16.5*	24.25±8.1
Venom (chemigated)	7.5 oz. F	65.25±16.1*	54.5±25.1
Untreated Check	NA	94.5±25.4	39.5±9.7

Results from trial at Othello, WA. Means followed by * are significantly different from the untreated check (pairwise t-test, P< 0.05)

Section VIII
Mites & Sap-Sucking Pests

2006 RESULTS FROM GREEN PEACH APHID TRIALS ON POTATOES IN WASHINGTON

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This trial was established at ADG research station in Eltopia, WA in order to evaluate the efficacy of various insecticides on green peach aphid populations in potatoes. The variety of potato was russet Burbank with plot sizes of 4 (34" centers) rows by 20 feet and four replications for each treatment.

All treatments were applied using CO2 on a spider sprayer with 24 ft booms. Applications were made with 8003VS nozzles at 40 psi and 20 gallons/acre. Equipment speed was 3.2 mph. Two applications were made for each treatment. The first application was made on July 3 with an aphid population at 1 aphid per 2 plants. The second application was made on August 4 with an aphid population at just under 1 aphid per 2 plants.

Aphid evaluations were made by sampling 2 plants per plot, twice a week during the course of the trial. A 17" X 17" beat sheet was used for each evaluation date and the number of winged and wingless aphid were counted.

Rating Date					7/31/2006	7/31/2006	7/31/2006
Sample Size					2	2	2
Sample Size Unit					PLANT	PLANT	PLANT
Pest Stage					wingless	winged	both
Trt-Eval Interval					28 DA-A	28 DA-A	28 DA-A
Trt No.	Treatment Name	Other Rate	Other Rate Unit	Appl Code			
1	UNTREATED CHECK				2.25 bcd	0.25 a	2.5 a-d
2	FULFILL (chem.)	2.75	OZ/A	BE	1.75 b-e	0.75 a	2.5 a-d
3	FULFILL (chem.)	5.5	OZ/A	BE	1.25 b-e	0.25 a	1.5 cd
4	BELEAF (ground)	2.82	OZ/A	AD	1.75 b-e	0 a	1.75 bcd
5	BELEAF (chem.)	2.82	OZ/A	BE	0.25 e	0 a	0.25 d
6	PENNCAP-M (ground)	4	PT/A	AD	2.5 abc	1.5 a	4 ab
7	PENNCAP-M (chem.)	4	PT/A	BE	2.75 ab	1.25 a	4 ab
8	ASSAIL (ground)	1.1	OZ/A	AD	2.75 ab	0 a	2.75 abc
9	ASSAIL (chem.)	1.1	OZ/A	BE	1.5 b-e	1.25 a	2.75 abc
10	ASSAIL (ground)	1.7	OZ/A	AD	0.75 cde	0.5 a	1.25 cd
11	ASSAIL (chem.)	1.7	OZ/A	BE	0.75 cde	0.5 a	1.25 cd

12	ACTARA (ground)	3	OZ/A	AD	0.5	de	0.25	a	0.75	cd
13	BATTALION (ground)	8	FL OZ/A	AD	0.75	cde	0.25	a	1	cd
14	BATTALION (ground)	12	FL OZ/A	AD	4.25	a	0.5	a	4.75	a
15	CLUTCH (ground)	3	OZ/A	AD	1	b-e	0	a	1	cd
16	CLUTCH (ground)	4	OZ/A	AD	0.5	de	0	a	0.5	cd
17	BATTALION (ground)	8	FL OZ/A	AD	0.5	de	0.5	a	1	cd
	CLUTCH (ground)	3	OZ/A	AD						
18	BATTALION (chem.)	12	FL OZ/A	BE	1.75	b-e	0.25	a	2	bcd
19	BATTALION (chem.)	8	FL OZ/A	BE	0.75	cde	0.25	a	1	cd
	CLUTCH (chem.)	3	OZ/A	BE						
20	EXPERIMENTAL (ground)	1	% V/V	ADF	1.25	b-e	0.25	a	1.5	cd
21	IMIDACLOPRID (ground)	3.8	FL OZ/A	AD	0.5	de	0.25	a	0.75	cd
	LAMBDA (ground)	2.56	FL OZ/A	AD						
22	IMIDACLOPRID (ground)	3.8	FL OZ/A	AD	1.5	b-e	0.25	a	1.75	bcd
	LAMBDA (ground)	3.2	FL OZ/A	AD						
23	IMIDACLOPRID (ground)	5	FL OZ/A	AD	1	b-e	0.75	a	1.75	bcd
	LAMBDA (ground)	2.56	FL OZ/A	AD						
24	LEVERAGE (ground)	3.75	FL OZ/A	AD	1.5	b-e	1	a	2.5	a-d
25	IMIDACLOPRID (ground)	3.7	FL OZ/A	AD	0.25	e	0.5	a	0.75	cd
27	LAMBDA (ground)	3.2	FL OZ/A	AD	2.75	ab	1.25	a	4	ab

'Means followed by same letter do not significantly differ (P=.10, Duncan's New MRT)

Despite what appeared to be optimal conditions-applications going out just as aphid numbers started to build, aphids did not continue to climb. Efficacy data were collected for 28 days following the applications. The cumulative number of wingless aphids in the untreated check over a 28 day period was only 2.25 per plant.

Rating Date					8/24/2006		8/24/2006		8/24/2006	
Sample Size					2		2		2	
Sample Size Unit					PLANT		PLANT		PLANT	
Pest Stage					wingless		winged		both	
Trt-Eval Interval					20 DA-D		20 DA-D		20 DA-D	
Trt No.	Treatment Name	Other Rate	Other Rate Unit	Appl Code						
1	UNTREATED CHECK				187.75	a-d	2.5	a	190.25	a-d
2	FULFILL	2.75	OZ/A	BE	6.5	e	1.75	a	8.25	de
3	FULFILL	5.5	OZ/A	BE	4	e	1.75	a	5.75	e
4	BELEAF	2.82	OZ/A	AD	1	e	0.5	a	1.5	e
5	BELEAF	2.82	OZ/A	BE	3	e	1	a	4	e
6	PENNCAP-M	4	PT/A	AD	288.75	ab	1	a	289.75	ab
7	PENNCAP-M	4	PT/A	BE	157.5	b-e	1.5	a	159	b-e
8	ASSAIL	1.1	OZ/A	AD	58	de	0.5	a	58.5	de
9	ASSAIL	1.1	OZ/A	BE	59.5	de	0	a	59.5	de
10	ASSAIL	1.7	OZ/A	AD	141.25	b-e	4.5	a	145.75	b-e
11	ASSAIL	1.7	OZ/A	BE	7.5	de	0.5	a	8	de
12	ACTARA	3	OZ/A	AD	2.25	e	0.25	a	2.5	e

13	BATTALION	8	FL OZ/A	AD	179.5 b-e		2.5 a		182 a-e
14	BATTALION	12	FL OZ/A	AD	346.75 a		2 a		348.75 a
15	CLUTCH	3	OZ/A	AD	3.25 e		0 a		3.25 e
16	CLUTCH	4	OZ/A	AD	28.75 de		0 a		28.75 de
17	BATTALION	8	FL OZ/A	AD	23 de		0.75 a		23.75 de
	CLUTCH	3	OZ/A	AD					
18	BATTALION	12	FL OZ/A	BE	268.5 abc		5.5 a		274 abc
19	BATTALION	8	FL OZ/A	BE	2 e		0.75 a		2.75 e
	CLUTCH	3	OZ/A	BE					
20	BUG OIL	1	% V/V	ADF	104.75 cde		1.5 a		106.25 cde
21	IMIDACLOPRID	3.8	FL OZ/A	AD	29.25 de		7.5 a		36.75 de
	LAMBDA	2.56	FL OZ/A	AD					
22	IMIDACLOPRID	3.8	FL OZ/A	AD	18.75 de		5.75 a		24.5 de
	LAMBDA	3.2	FL OZ/A	AD					
23	IMIDACLOPRID	5	FL OZ/A	AD	7.75 de		2 a		9.75 de
	LAMBDA	2.56	FL OZ/A	AD					
24	LEVERAGE	3.75	FL OZ/A	AD	9.75 de		1.5 a		11.25 de
25	IMIDACLOPRID	3.7	FL OZ/A	AD	9.5 de		3 a		12.5 de
27	LAMBDA	3.2	FL OZ/A	AD	37.75 de		1.75 a		39.5 de

'Means followed by same letter do not significantly differ (P=.10, Duncan's New MRT)

The cumulative number of wingless aphids over the 20 day period, represented by the second set of applications, in the untreated check was 187 per 2 plants-this is among the highest aphid populations we have ever encountered. The Fulfill treatments, at 2.75 and 5.5 ounces per acre applied by chemigation provided excellent control of aphids. The Beleaf treatments, 2.82 ounces per acre applied by ground and by chemigation provided almost perfect control of aphids. Penncap-M had either substantially more or an equalivalent number of aphids as the untreated check. Penncap-M applied by ground had 289 aphids per plant and Penncap-M applied at the same rate by chemigation had 157 aphids. Assail applied by ground at the low rate (not recommended for aphids) did not provide commercially acceptable levels of control Assail applied at the high (aphid) rate by ground did not provide adequate control of aphids. Only Assail applied at the high rate by chemigation provided acceptable levels of control. Actara applied at the full (aphid) rate provided an excellent level of control. Battalion at the low rate had a cumulative number of wingless aphid that was virtually identical to the untreated check. Battalion at the high rate was nearly twice the level of aphids as the untreated check. The level of aphids in the Battalion at the high rate applied by chemigation were among the highest aphid numbers we have ever seen at 348 aphids per two plants. Clutch at the low rate provided an extremely high level of aphid control. Clutch at a slightly higher rate had a higher, but not significantly different, number of aphids than the lower rate. Battalion plus Clutch at 3 ounces had a very similar number of aphids as did Clutch alone at 4 ounces. Battalion plus Clutch at 3 ounces was also applied by chemigation; this treatment provided among the best control of any treatment in the trial. Bug Oil had a cumulative count of 104 aphids per two plants. Imidacloprid applied alone at 3.75 ounces by ground was effective at controlling green peach aphid. There was a very obvious dose response for the combination of imidacloprid and lamba cyahalothrin, with the higher the rate of lamba, the lower the number of aphids. It appears that increasing the rate of lambda in combination with imidacloprid improves efficacy, however the differences were not statistically different.

Section VIII
Mites and Sap-Sucking Insects

Control of Rust Mites in Organically Grown Pears

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Abstract

Rust mites are small and difficult to control, especially in organic crops due to the limited availability of organically approved insecticides and miticides. Azadractin and Ecotrol, registered for organic agriculture, were applied to an organically grown pear orchard in July 2006 to evaluate their efficacy in controlling rust mites. While mite populations decreased over time in both treated and untreated plots, the decrease in the treated plots was greater than in the control. Further studies are needed to determine the effect of organically registered products to control rust mite populations.

Introduction

Rust mites feed on the exposed surfaces of fruit, destroying the rind cells, leading to the characteristic russeting of fruit. This damage may result in reduced grade and size, thereby drastically reducing the marketability and value of the crop.

Control of rust mites is difficult compared to other spider mites and could be more problematic in organic pear production due to the limited availability of organically registered insecticides and miticides. Therefore in this study we evaluated the efficacy of tow products for control of rust mites in an organic pear orchard.

Materials and Methods

Two applications of insecticide/miticide, approved for organic agriculture were applied to pear trees at one week intervals in Irrigon, OR. Azadractin and Ecotrol were applied at 24 fl oz/a and 4 pts/a respectively. All sprays were applied at rate of 200 gallon/a of total solution. One day before and one day after pesticide applications 20 leaves per tree were taken and the samples were transferred to a laboratory. All leaves and fruits were brushed using a mite brushing machine (Bio-Quip) and mites were counted. All mites (live/dead) were counted for the first pesticide application while for the second pesticide application one week later only live mites were counted one day before and after application.

Results and Discussion

Preliminary results indicated that Azadractin and Ecotrol, registered for organic agricultural production, may reduce rust mite populations in organic pears. When all mites were counted one day before and one day after pesticide application, no difference between mites populations was detected (Fig. 1). Perhaps due to combined (dead and alive) numbers of mites effect of the pesticides on mite control was not obvious. Therefore during the consecutive samplings only alive mites were counted. However when mite counts one day pre and one week post application were compared mite numbers were reduced significantly on both treated and non-treated pears. Reduction on non-treated pears was 6% lower as compared to treated pears (Table 1.).

When only live rust mites sampled one day before and one day after the second applications were counted, mite populations decreased for both treated and non-treated pears (Fig.2). These results are in agreement with a study of mite control in apples by Weinzierl et al (2000).They also found reduction of mite populations on untreated check plants. Further studies are needed to determine management of rust mites by pesticides registered for organic agricultural production.

Table 1. Number of rust mites one day before and one week after chemical application. Before chemical application total rust mites were counted while at one week after chemical application only live mites were counted.

Treatment	Mean number of mites 1 day pre-application	Mean number of mites 1 week post-application	MSE (1 day pre-application	MSE (1 week after application)	% mite reduction (1 week after application)
Azadractin	99.23	20.77	2145	6.41	79
Ecotrol	181.16	37.87	20.97	5.81	79
Untreated	233.20	63.50	37.91	9.23	73

Figure 1. First application of chemical control of pear rust mite in an organic pear production farm, Irrigon, OR 2006. Total number of mites before and after treatment is compared.

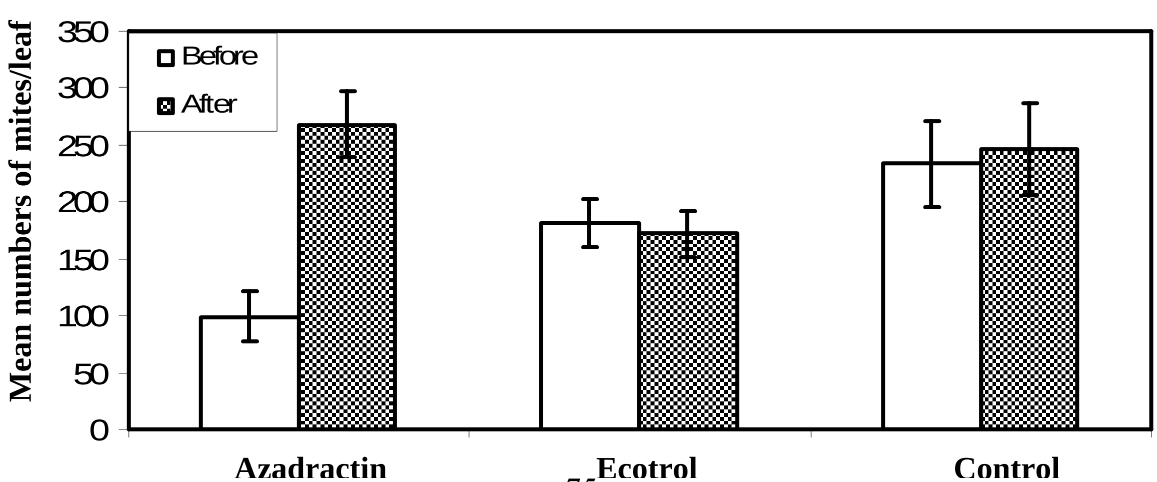
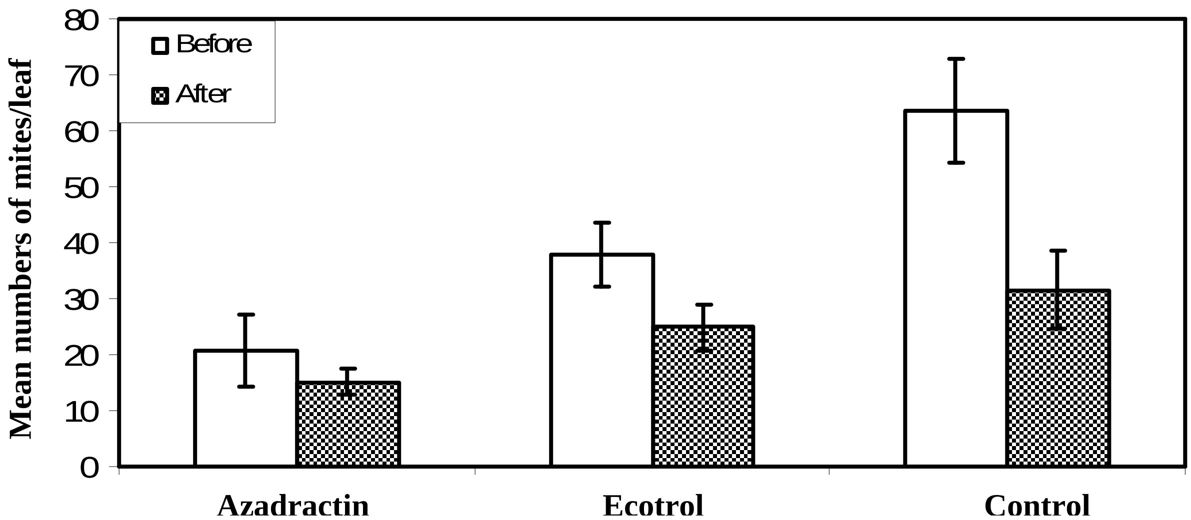


Figure 2. Second application of chemical control of pear rust mite in an organic pear production farm, Irrigon, OR 2006. Number of live mites before and after treatment is compared.



Section VIII
Mites & Sap-Sucking Pests

Winter Grain Mite Control in Grass Pasture, Central Oregon

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OSU Dept of Crop and Soil Science

Crop: Timothy, "*Aurora*"
Pest: Winter Grain Mite, *Penthaleus major* (Duges)
Location & Grower: Culver, Jefferson Co., OR. Mike & Joe Ally **Stand Age**: at least 3 years
Field Condition: Breaking winter dormancy**,** beginning spring re-growth
Plot Design: RCB 4 reps; 21'x21' (.01acre plots)
Application Eqpt.: CO2 powered backpack sprayer, 4 nozzle boom, 8002 flat fan nozzles, 61/2 ft swath 40psi, **gallonage**: 30GPA;
Spray date: 2/24/04, **Weather:** 40F, windy

Data Collected:

On post treatment sampling dates 3, 2 ¼" diameter plugs were cored from each plot. About 1 inch of sod below crown was taken. Cores were placed in zip-lock bags and taken to Round Butte Seed office to count mites under magnification. Total number of live mites/3 plugs was recorded. At 17, 30, 45 & 58 DAT samples were removed from plots with 2inch "plunger" to ease core extraction.

Summary: Populations of mites generally increased in the UTC through 30 DAT. Mustang® and dimethoate were comparable in control, providing the best suppression of WGM in this trial. Other products did not give appreciable mortality/ control of winter grain mite.

Populations began to decline in this trial at 45 DAT, continuing through 58 DAT at which time trial was terminated.

Results:

TABLE I. Total Live WGM in 3, 2 inch diameter core samples removed from crowns of Timothy within Interior of each Plot, MAR 4, 12, 25, APR 9 & 22 2004.

Treatment	**Rep**					
	I	II	III	IV	T	
1) Mustang MAX 2oz/A						
9 DAT	0	1	0	0	1	
17 DAT	0	1	1	1	3	
30 DAT	0	1	0	0	1	
45 DAT	0	0	0	0	0	
58 DAT	0	1	0	2	3	8

2) “ 4oz/A	2	3	2	0	7	
	1	2	3	0	6	
	0	0	0	0	0	
	0	0	0	0	0	
	7	8	0	4	19	32
3) Kumulus DF						
80% Sulfur 20lbs/A	20	0	1	8	29	
	61	4	2	10	77	
	22	18	4	0	44	
	17	1	63	0	81	
	2	0	0	0	2	233
4) “ 30lbs/A	0	1	7	7	15	
	58	9	8	25	100	
	17	24	38	11	90	
	3	0	37	1	41	
	0	0	3	0	3	249
5) Acaritouch 12 oz/A3	12	14	18	47		
	6	46	105	0	157	
	4	40	57	13	114	
	2	0	27	2	31	
	4	4	7	0	15	364
6) “ 25 oz/A	0	6	16	5	27	
	8	24	42	27	101	
	1	10	21	8	40	
	11	4	1	4	20	
	5	1	3	0	9	197
7) dimethoate 2/3 pt/A	0	1	0	0	1	
	3	0	1	0	4	
	2	0	2	0	4	
	0	0	1	0	1	
	0	1	1	0	2	12
8) Vendex 50 WP 2 lbs/A	4	2	7	9	22	
	13	6	65	18	102	
	6	2	31	24	63	
	4	2	48	17	71	
	6	1	1	0	8	266
9) Acramite 4F 24 oz/A	6	3	1	2	12	
	11	27	44	1	83	
	12	34	5	4	55	

	3	7	39	4	53	
	6	6	2	1	15	218
10) UTC	11	6	5	5	27	
	22	18	13	31	84	
	30	26	4	31	91	
	15	0	27	2	44	
	5	2	0	1	8	254

Section IX
New Crop Development

No reports submitted for this section.