2002 Ohio IPM Block Grant Reports

North-central Ohio Apple and Peach IPM Programming

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Abstract:

Sixteen apple growers and nine peach growers enrolled 25 apple blocks and nine peach blocks in the 2002 North-central Ohio Tree Fruit IPM Program. This program, now completing its 12th year, provided weekly orchard visits during the growing season for the purpose of monitoring arthropod pest populations as well as beneficials. The reports generated by these visits were intended to provide growers with a tool for making judicious orchard management decisions for environmentally and socially acceptable fruit production while providing sustainable income for the grower families. Tree fruit production in five counties, representing approximately 700 acres, was included in this program.

Methods:

Apple pests, including codling moth, lesser appleworm, obliquebanded leafroller, Oriental fruit moth**,** redbanded leafroller, and spotted tentiform leafminer populations were monitored with "Multipher 3" pheromone traps. San Jose scale populations were monitored with tent pheromone traps. Apple maggot flies were trapped with essence-baited red spheres. Other pests, including apple rust mite, European red mite, green apple aphid, potato leafhopper, rosy apple aphid, white apple leafhopper, and wooly apple aphid were monitored by visual observation of five trees in each block. Populations of beneficials, including brown lacewings, cecidomyid and syrphid fly larva, green lacewings, Multicolored Asian lady beetle, native lady beetles, predatory mites, *and Stethorus punctum* were noted during the same visual observations. Peach pests, including lesser peachtree borer, Oriental fruit moth, peachtree borer, and redbanded leafroller were monitored with "Multipher 3" pheromone traps. Other pests, including European red mite, green peach aphid, and two-spotted spider mite were monitored by visual observation of five trees in each block. Populations of beneficial arthropods were visually monitored.

Weekly orchard reports were compiled and included in the Ohio Fruit ICM News published weekly (in season) and distributed by surface and e-mail. The Fruit ICM News was also posted to the Internet by Bruce Eisley at this site: http://ipm.osu.edu/fruit/index.html IPM funding helped support a part-time secretary, Cathy Weilnau, who prepared the newsletter for distribution.

Results & Discussion:

The 2002 growing season was successful in spite of hot, dry weather during late June through August. However, the apple harvest yielded an unusual amount of fruit damage attributed to codling moth. The CM management regimen, based on the Michigan degree-day model, is now being challenged in Ohio as well as other mid-west apple producing states. The possibility of lesser appleworm or Oriental fruit moth damage has been discounted by careful identification of trapped adults. Enrolled growers have been saving an average of two cover sprays each year through this program. In the past, some growers have suggested a

2500% return on their investment of program fees through cost reduction of materials, grower application time, and machine costs. We will need to more thoroughly examine optional management materials and application scheduling in light of this year's codling moth damage and resultant fruit losses.
Particular attention was paid to lady beetle populations after the 2001 invasion of Multicolored Asian Lady beetle (MCALB) into ripening peach fruit. Soy bean fields near or adjacent to orchard blocks were noted early in the season and observed for soybean aphid populations as a pre-cursor to MCALB. Interestingly, few if any soybean aphids ever appeared and populations of MCALB were greatly reduced in the monitored orchards (as well as other locales). Native lady beetle populations had also decreased, but not to the extent that MCALB had. We are hopeful that the natives can remain established and return to populations observed during the first ten years of this program. Populations of *Stethorus punctum* were smaller than usual probably due to low European red mite pressures.

For further information contact Ted Gastier Ohio State University Extension, Huron County or the Ohio IPM Office.

Calibrating a Biological Calendar for Timing IPM Decisions for Ornamental Plants Across Ohio

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Monitoring is a key component of IPM programs, but is complicated in ornamental landscapes and nurseries by the tremendous diversity of plants and pests. Because the development of both plants and insects is temperature-dependent, the blooming sequence of ornamental plants accurately tracks degree-day accumulation, and thus can be used to predict pest activity.

A Biological Calendar had been established for Wooster, Ohio from 1997-2001 consisting of phenological events for a 43 key arthropod pests of nurseries and landscapes, and the blooming sequence of 94 ornamental plants. Despite substantial year-to-year variation in weather, the order in which phenological events occurred remained highly consistent. This demonstrated that the easily-monitored sequence of flowering plants can be used accurately as a Biological Calendar to track degree-days and predict the emergence of insect pests, and that phenological indicators for a particular site can be based on just one year of data.

However, there is substantial variation in degree-day accumulation across Ohio, and degree to which the Biological Calendar developed in Wooster can be applied accurately elsewhere has previously been an open question. Documenting the phenological wave across Ohio would dramatically improve the ability to predict the development of key pests, time pest management decisions, and facilitate extension recommendations on a state-wide basis. Therefore, our objective in this project was to evaluate the state-wide significance of the Biological Calendar by monitoring plant and pest phenology at key locations across Ohio (including northeast in Lake and Geauga Counties, central in Franklin and Clark Counties, southwest in Hamilton County, and in northwest Ohio)..

In 2002, the phenology of the 43 pests and 94 plants were monitored in Secrest Arboretum, and the 32 pests and 74 plants were monitored in nurseries in Lake County, Ohio. Daily maximum and minimum temperatures were used to calculate growing degree-days for each phenological event at both sites. Despite unusually warm winter, there was an extremely high degree of correspondence in the sequence of phenological events as they occurred in Secrest Arboretum in 2002, and the previous five years (Spearman's r

= 0.99). This confirms that at a particular location, the phenological sequence remains quite constant from year-to-year, despite unusual fluctuations in weather patterns.

Furthermore, the sequence of plant and insect events in Lake County, Ohio corresponded almost exactly with the sequence of the same events as they occurred in Secrest Arboretum (Spearman's r = 0.98), providing support for the hypothesis that the Biological Calendar has state-wide significance. This hypothesis is being evaluated further as an ongoing project by comparing the Wooster sequence with phenological events monitored in other regions of Ohio. Calibrating with these other locations is continuing as a multi-year project which will continue in the 2004 growing season and beyond.

The state-wide significance of the Biological Calendar has been enhanced by the development of a phenology web site by Dave Lohnes (OARDC Communications and Technology), where degree-day data for the state of Ohio is accessible in real-time, and is linked directly to this Biological Calendar (http://www.oardc.ohio-state.edu/gdd). Daily temperature data from the 12 OARDC stations around Ohio are used to calculate current degree-day values for any location in the state. Upon entering any Ohio zip code, current degree-day accumulation for that location is calculated, and the user is directed to the appropriate spot on the BioCalendar. Users can scroll up or down to see what pest events have already occurred, as well as what has yet to occur. In this way, the BioCalendar can be used to predict accurately the emergence of insect pests and time pest management activities for any location in Ohio. Accurately timed management tactics result in more effective pest management and increased crop quality, while decreasing pesticide use and production costs.

In summary, this research demonstrates that the BioCalendar can be used accurately to track degree-day accumulation and predict pest activity, because the phenological sequence of insect emergence and plant flowering remains remarkably consistent from year-to-year, even in different locations where weather varies considerably. Using the BioCalendar to accurately predict pest emergence and timing management activities will result in more effective pest management and increased crop quality, while decreasing pesticide use and production costs in Ohio nurseries.

Funding of this project in 2002 with this special IPM grant, including the purchase of traps and equipment for pest monitoring and travel reimbursements has helped develop a core of cooperators covering the regions of Ohio (except southeast) that will solidify the Biological Calendar with observations made of the phenological wave statewide in subsequent years.

For further information contact Jim Chatfield OSU Extension, Northeast District or the Ohio IPM Office.

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Environmental factors that may affect sulfentrazone (Spartan™) selectivity on newly planted strawberries

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Introduction

Sulfentrazone has joined the strawberry farming toolbox during this season. Its tolerance as well as activity on groundsel and other broadleaf weeds has triggered a Section 18 in Ohio. Sulfentrazone is a suitable alternative to Goal, which was used during the past three seasons, but has not received a federal label. Despite sulfentrazone positive features there is a need for research focused on environmental factors affecting strawberry tolerance. Several authors have reported that soil pH had the greatest effect on sulfentrazone adsorption. Soil adsorption generally decreased in response to increasing pH resulting in greater availability of the herbicide to plants (Grey et al, 1997 and 2000). The objectives of the present research were to determine crop sensitivity to sulfentrazone under varying soil pH values and to delineate the relative sensitivity of weed species common in strawberries in Ohio.

Materials and Methods

Field studies were conducted at Wooster, Ohio (81^{o} 58' W longitude, 40^{o} 45' N latitude, elevation 310 m) during 2002-03 seasons. Four rates of sulfentrazone were applied one week after planting to strawberries cultivars 'Jewel' and 'Allstar' grown in soil pH levels of 5.0 and 7.0. A three factorial experimental design (2 pH levels x 2 cultivars x 4 sulfentrazone rates) was used with four replications per treatment. Plots consisted of two rows with 10 plants each. Fertilization was applied after planting (40 lb N/A) and early fall (September) as potassium nitrate. Plant growth evaluations (percent stunting, chlorosis, leaf deformation, number of stolons, plant height and diameter) were carried out 1, 3 and 6 weeks after treatment (WAT). Plots were hand weeded every other week and irrigation was provided through central pivots as needed during the summer. Data were analyzed using general lineal models procedures (SAS, 2002). When significant differences occurred orthogonal contrasts were used for mean separation at the 5% significance level.

Results and discussion

Plant growth evaluations at 1, 3 and 6 WAT showed reduced crop tolerance to sulfentrazone at soil pH of 7, relative to strawberries grown in plots with soil pH of 5.. Among the two cultivars evaluated Allstar showed higher sensitivity to sulfentrazone. Factorial analysis indicated that for all the parameters of strawberry growth, pH and herbicide significantly affected growth. Interactions between pH and cultivars were also highly significant for some of the parameters evaluated. Contingent upon further research, it may be necessary to restrict sulfentrazone use when soil pH is close to 7.

Literature cited

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Moving Predatory Mites Into Apple Orchards For Biological Control

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Summary:

Field trials were conducted to test whether two species of predatory mites could be successfully transferred into commercial apple orchards for biological control of European red mite. One experiment tested the transfer of *Typhlodromus pyri* at late bloom using burlap-lined paper bands that had been wrapped around trunks in the source orchard. Another experiment tested the transfer of *Zetzellia mali* in mid-summer using terminal shoots cut from the source orchard. Both experiments were conducted in separate blocks at each of 3 commercial orchards. The mite populations were evaluated at 3-week intervals. Transfer of *T. pyri* was successful at all three sites. Transfer of *Z. mali* was successful at all three sites although at very low density. Another field trial tested the pesticide tolerance of *Z. mali*. *Z. mali* was unaffected by bifenazate (Acramite) and indoxacarb (Avaunt) but was suppressed by Danitol and Agri-Mek.

Background:

Two species of predatory mites have been under study in a research orchard at Columbus for the past few years. Either species can provide biological control of European red mite as long as certain pesticides are not used. One species is a slow-moving yellow mite, *Zetzellia mali* (family Stigmatidae), that is found naturally in Ohio; the other species is a fast-moving white mite, *Typhlodromus pyri* (family Phytoseiidae), that is not known to occur naturally in Ohio. Both species have the attribute that they are present earlier in the season than Ohio's most common local predator, the phytoseiid *Neoseiulus fallacis*. Specific orchard pesticides that *Z. mali* can or cannot tolerate have been recently documented. *Z. mali* does not tolerate endosulfan (Thiodan) or pyridaben (Pyramite). Of particular interst is the finding that *Z. mali* tolerates pyrethroids at low rates, which is in contrast to the well known susceptibility of phytoseiid mites to pyrethroids. The *T. pyri* population used in this project was brought to Ohio from western New York in 1999 and is a strain that has some pyrethroid tolerance. Work is now needed on whether these mites can be distributed to commercial orchards where biological control is desired but is not occurring naturally. A trial move of *Z. mali* into one commercial orchard in 2001 was somewhat successful, with mid-summer transfer of terminal shoots more effective than trunk band transfer at bloom. The project done in 2002 was designed to document transfers of both species at multiple locations. Better success was anticipated in 2002 because both species were available, trunk bands were placed in the source orchard 3 weeks earlier than in the previous year, bands were removed earlier before bouts of warm weather occurred, and the number of bands was greater.

Objectives:

1) To evaluate how well two different species of predatory mites (*Z. mali* and *T. pyri*) become established in commercial orchards for biological control of European red mite. 2) To compare two methods of moving *Z. mali* into an orchard: trunk bands at bloom versus transfer of terminal shoots in mid-summer. 3) To refine the pesticide tolerance guidelines for *Z. mali* by conducting a field trial to compare a standard organophosphate program with an organophosphate plus early pyrethroid program, as well as to evaluate the tolerance to new pesticides bifenazate (Acramite) and indoxacarb (Avaunt).

Methods:

The experiment on *T. pyri* transfer used a randomized complete block design with four or five replicates of two treatments: trees seeded with *T. pyri* in bands at bloom, and trees not seeded. There was one tree per treatment replicate. Plots were as widely spaced as possible within each orchard block.

The source orchard for *T. pyri* was a research block of 8-year old Jonafree and Liberty apple trees at OSU's Waterman Laboratory in Columbus. To collect *T. pyri*, a band was stapled to the trunk of each of 110 trees on 1 October 2001 and removed on 21 January 2002. Harvested bands were rolled up and stored in zip-top plastic bags at 4.5 degrees C. The bands were 4 inches wide and made of an outer layer of paper tree wrap that was lightly glued to an inner layer of burlap. Four bands were randomly chosen from cold storage to determine the number of predatory mites per band; the mean $\pm$ SD was 49 $\pm$ 31 phytoseiid mites per band.

T. pyri was seeded at late bloom to early petal-fall at three commercial orchards. In each seeded tree, six bands were loosely wrapped around the base of scaffold branches and stapled. In Licking County (central Ohio), a 5-year old Suncrisp block was seeded on 3 May in five replicates. In Columbiana County (northeast Ohio), a 14-year old Red Delicious block was seeded on 9 May in four replicates. In Ottawa County (northwest Ohio), a 17-year old Red Delicious block was seeded on 13 May in five replicates. Mite populations on 25 randomly selected leaves per plot were evaluated at 3-week intervals from late June until early September 2002. Pesticide records for the three orchards are listed in Table 1.

The experiment on *Z. mali* transfer used a randomized complete block design with three or five replicates of three treatments: trees seeded with bands at petal-fall, trees seeded with branches in mid-summer, and trees not seeded. The source orchard for *Z. mali* was a research block of 18-year old Red Delicious and Melrose apple trees at OSU's Waterman Laboratory in Columbus.

Trunk bands were stapled on 50 Delicious trees; band construction and dates that bands were set up and removed were identical to those described above for *T. pyri*. Examination of bands in the lab showed that only 3 of 50 bands harbored any stigmaeid mites and these bands had only 1 to 3 stigmaeids per band. The experimental design was thus modified so that the seeding with *Z. mali* with bands was done at just one orchard and with just 3 replicates.

Transfers of terminal shoots were made in late July once density of *Z. mali* built to high levels at the source orchard. Ten Melrose trees were chosen as the *Z. mali* source based on preliminary sampling; there was a mean of 2.1 *Z. mali* per leaf in these trees on 22 July. A species determination in the Melrose trees on 22 July showed that *Z. mali* was the only stigmaeid species present; there was absence of another occasional stigmaeid species, *Agistemus fleschneri*. Terminal shoots 50-75 cm long were cut and held in large plastic bags in coolers for 2 to 20 hours before seeding in the commercial orchards. In each tree seeded with shoots, ten cut terminal shoots were placed on scaffold branches and held by wire twist-ties.

In Licking County, a Fuji block was seeded with *Z. mali* in bands on 17 May in three replicates and with *Z. mali* on shoots on 23 July in three replicates. In Columbiana County, a Red Delicious block was seeded with shoots on 24 July in five replicates. In Ottawa County, a Starkrimson Red Delicious block was seeded with shoots on 25 July in five replicates. Mite populations on 25 randomly selected leaves per plot were evaluated at 3-week intervals from late July until early September 2002. Pesticide records for the three orchards are listed in Table 1.

A field trial on insecticide tolerance of *Z. mali* was conducted at a 18-year old block of Scarlet Spur Delicious apples at OSU's Waterman Laboratory in Columbus. The experimental design was randomized complete block with four replicates of six treatments as detailed in Table 2. Plot size was three adjacent trees. All data were taken from one central tree per plot. Treatment sprays were applied by hand-gun sprayer. All plots including the checks were treated with Esteem 35WP at half-inch green for control of San José scale, which had been a significant problem the previous year. Action thresholds for mite control were 2.5 mites per leaf in early summer, 5 mites per leaf in mid-summer, and 7.5 mites per leaf in late summer. Due to above threshold levels, rescue treatment with Savey was needed in July in some treatments. Mite populations on 25 randomly selected leaves per tree were evaluated every 1 to 3 weeks from late April through late August. Leafhopper leaf damage ratings were taken and fruit were rated at harvest for insect damage, but these data are not included in this report.

All plots including the checks were treated with fungicides applied by an airblast sprayer. Fungicides used were Captan at quarter-inch green (4/11/02); Captan plus Nova at pink (4/17/02) and at bloom (4/24/02); Captan at petalfall (4/30/02); Captan plus Topsin-M at first cover (5/15/02), second cover (5/31/02), and third cover (6/14/02); Captan at fourth cover (6/28/02) and fifth cover (7/12/02); Captan plus Topsin-M at sixth cover (7/24/02) and seventh cover (8/16/02); and Captan at eighth cover (9/9/02).

Leaf samples from all trials were processed with a leaf-brushing machine to determine the number of European red mite motiles and eggs, and phytoseiid and stigmaeid motiles per leaf, as well as a rating of relative density of apple rust mite. Predatory mites were preserved and later mounted on microscope slides to determine species identification.

Data were subjected to analysis of variance and mean comparisons by least significant difference (LSD) tests in the ANOVA procedure of the SAS statistics program.

Results & Discussion:

In the experiment on *T. pyri* transfer, phytoseiid mites were detected in seeded plots but not in check plots on the first sampling dates at the CO and LI sites, and in both treatments at the OT site (Table 3). The density of European red mite and phytoseiid mites was not significantly different ($P > 0.05$) in unseeded check trees than in seeded trees at any of the three sites on any of the four sampling dates (Table 3). Mite species identifications showed that *T. pyri* was found in all three orchards only in seeded trees, never in check trees (Table 4). In check plots, *Neoseiulus fallacis* was found at all three sites and an undetermined species was found at two of the three sites. Presence of phytoseiids at all three sites was somewhat surprising because the growers had been doubtful of their presence before this project was initiated.

In the experiment on *Z. mali* transfer, there were differences in the presence or absence of stigmaeids at all three sites (Table 5). There were no stigmaeids detected in unseeded check trees, but some stigmaeids were found at all three sites in plots seeded via shoots and at the one site that had plots seeded via bands. The density of European red mite and stigmaeids did not differ significantly among treatments ($P > 0.05$) at any site on any date (Table 5). Although the density of stigmaeids was extremely low, it indicates that the species achieved initial establishment. Although trunk bands were placed and removed in the source orchard at better times than in the previous year, the results in 2002 were similar to 2001 in that stigmaeids did not inhabit the bands, even in trees that had high density of stigmaeids in late summer. Stigmaeids consistently reach maximum density in mid- to late summer. At present, transfer of shoots in mid-summer is a useable method of transfer that is better than banding.

In the experiment on pesticide tolerance, periodic leaf sampling showed that European red mite reached density above threshold by mid-June in some treatments (Table 6); densities by mid-July were the highest seen in this orchard in several years. *Z. mali* was unaffected by Acramite or Avaunt (Table 7). *Z. mali* was suppressed by Danitol used at pink and petalfall but recovered to moderate levels by late summer. Unlike previous years, *Z. mali* was also suppressed in the standard treatment, probably due to use of Agri-Mek for the first time in several years. Some phytoseiids were also found in this orchard (Table 8) and surprisingly they rebounded to higher density in the Danitol treatment than in the standard treatment; inclusion of Agri-Mek in the standard program could have caused this suppression. Rescue treatment with Savey in mid-July had no negative effect on *Z. mali* (Table 7) but was associated with a sharp drop in phytoseiid density, possibly due to prey depletion (Table 8).

Table 1. Pesticides applied in three apple orchards where predatory mites transfered, 2002.

Stage	County; Date, product, and rate applied		
	Licking	Columbiana	Ottawa
1/2" green	4/10/02 oil 5.4 gal/A chlorpyrifos 1 qt/A Topsin 1 lb/A Dithane 6 lb/A	4/15/02 Pounce 6 oz/A Polyram 6 lb/A	4/15/02 oil 5 gal/A Polyram 6 lb/A Rubigan 8 oz/A
pink	4/16/02 Nova 6 oz/A Dithane 6 lb/A	4/24/02 Polyram 3 lb/A Nova 4 oz/A	4/29/02 Polyram 6 lb/A Rubigan 8 oz/A
bloom	5/1/02 Nova 6 oz/A Dithane 6 lb/A	-	-
petal-fall	5/10/02 Avaunt 5 oz/A Flint 2.5 oz/A	5/8/02 & 5/11/02 Guthion 1.5 lb/A Nova 4 oz/A Polyram 3 lb/A	5/10/02 Guthion 2 lb/A Provado 6 oz/A Nova 5 oz/A Captan 5 lb/A
1st cover	5/20/02 Provado 6 oz/A Imidan 2.2 lb/A Apollo 4 oz/A[S] Flint 2 oz/A	5/23/02 Imidan 2 lb/A Pyramite 4.4 oz/A[S] Agri-Mek 10 oz/A[P] Flint 2 oz/A Polyram 3 lb/A	5/28/02 Imidan 3 lb/A Captan 5 lb/A Flint 2.5 oz/A
thin	5/23/02 Sevin 1 qt/A NAA 10 ppm[P] Accel 100 ppm[S]	5/17/02 Sevin XLR 1 qt/A[P]	5/30/02 Sevin XLR 1 qt/A NAA 10 ppm
2nd cover	5/30/02 Imidan 2.2 lb/A Captan 4.5 lb/A	6/7/02 Asana 6 oz/A[S] (cicada) Imidan 2 lb/A[P] Flint 2 oz/A	6/14/02 Imidan 3 lb/A Apollo 4 oz/A Ziram 5 lb/A

		Polyram 3 lb/A[P]	
3rd cover	6/17/02 Imidan 2.2 lb/A Captan 3 lb/A Ziram 2 lb/A	6/20/02 & 6/21/02 Asana 6 oz/A Captan 2 lb/A Ziram 2 lb/A	7/8/02 Imidan 3 lb/A Ziram 5 lb/A
4th cover	7/8/02 Imidan 2.2 lb/A Captan 3 lb/A Ziram 2 lb/A	6/25/02 Asana 6 oz/A Captan 2 lb/A Ziram 2 lb/A	7/29/02 Imidan 3 lb/A Ziram 5 lb/A
5th cover	8/1/02 Imidan 2.2 lb/A Captan 3 lb/A Ziram 2 lb/A	7/5/02 Imidan 2 lb/A Captan 2 lb/A Ziram 2 lb/A	9/6/02 Imidan 3 lb/A Ziram 5 lb/A
special	-	7/20/02: Acramite 1 lb/A[P]	-
6th cover	8/21/02 Imidan 2.2 lb/A Captan 3 lb/A Ziram 2 lb/A	8/22/02 Imidan 2 lb/A Topsin-M 12 oz/A	-

[P] used in pyri-release block only [S] used in stigmaeid-release block only

Table 2: Timing and rates of mite and insect treatments on Delicious apples, Columbus, Ohio.

Timing >> *Treatment*	1/2" green (4/11)	Tight cluster (4/15)	Pink (4/18)	Petal-fall (5/1)	1C (5/16)	2C (5/31) 3C (6/14) 4C (6/28) 6C (7/24) 7C (8/16) 8C (9/9)	Extra sprays for mites
Check	Esteem 35WP, 4 oz/A	none	none	none	none	none	none
Standard	Esteem 35WP, 4 oz/A	none	Lorsban 50WP, 2 lb/A	Imidan 70WP, 3 lb/A	Imidan 70WP, 3 lb/A + AgriMek 0.15EC, 10.7 oz/A + SunSpray UF oil, 0.25%	Imidan 70WP 2.1 lb/A	7/16: Savey, 3 oz/A
Danitol	Esteem 35WP, 4 oz/A	oil 1%	Danitol 2.4EC, 10.7 oz/A	Danitol 2.4EC, 16 oz/A	Imidan 70WP, 3 lb/A	Imidan 70WP 2.1 lb/A	7/16: Savey, 3 oz/A
Avaunt	Esteem 35WP,	oil 1%	Avaunt 30DG, 6	Avaunt 30DG, 6	Avaunt 30DG, 6 oz/A	Imidan 70WP 2.1	7/16: Savey, 3 oz/A

	4 oz/A		oz/A	oz/A		lb/A	
Acramite early	Esteem 35WP, 4 oz/A	none	Lorsban 50WP, 2 lb/A	Imidan 70WP, 3 lb/A + Acramite 50W, 1 lb/A	Imidan 70WP, 3 lb/A	Imidan 70WP 2.1 lb/A	7/3: Acramite 50W, 1 lb/A + LI700 + Latron
Acramite late	Esteem 35WP, 4 oz/A	none	Lorsban 50WP, 2 lb/A	Imidan 70WP, 3 lb/A	Imidan 70WP, 3 lb/A	Imidan 70WP 2.1 lb/A	6/7: Acramite 50W, 1 lb/A at threshold 7/3: Acramite 50W, 1 lb/A + LI700 + Latron + Choice

Table 3. Mite density in experiment on transfer of *T. pyri* via bands at late bloom, 2002.

Site[a]	Date	Mean number per leaf					
		European red mite			Phytoseiid mites		
		Check trees	Seeded trees	P^b	Check trees	Seeded trees	P^b
LI	*6/24*	*0.0*	*0.0*	-	*0.00*	*0.11*	*0.11*
	7/23	*1.8*	*0.4*	*0.16*	*0.13*	*0.16*	*0.69*
	8/13	*6.0*	*2.7*	*0.18*	*0.96*	*1.04*	*0.79*
	9/4	*0.1*	*0.1*	*0.88*	*0.72*	*0.44*	*0.10*
CO	*7/8*	*3.7*	*3.1*	*0.50*	*0.00*	*0.10*	*0.28*
	7/24	*15.9*	*7.5*	*0.30*	*0.76*	*0.55*	*0.70*
	8/14	*0.0*	*1.5*	*0.32*	*0.26*	*0.26*	*1.0*
	9/10	*0.02*	*0.3*	*0.10*	*0.16*	*0.14*	*0.82*
OT	*7/2*	*1.8*	*3.2*	*0.50*	*0.10*	*0.11*	*0.75*
	7/25	*5.6*	*8.0*	*0.53*	*0.11*	*0.08*	*0.18*
	8/15	*6.8*	*8.6*	*0.58*	*0.45*	*0.26*	*0.31*
	9/9	*2.9*	*0.5*	*0.09*	*0.24*	*0.35*	*0.21*

[a] Sites: LI = Licking County; CO = Columbiana County; OT = Ottawa County.
[b] P = probability value for statistical test of ANOVA treatment effect.

Table 4. Species identification of phytoseiid mites found in random leaf samples in orchards seeded with *T. pyri* by bands in May 2002.

Site[a]	*Date (2002)*	*Treatment*	*Number of specimens identified (% of total)[b]*		
			T. pyri	*N. fallacis*	Undetermined

					species
LI	6/24	check	0	0	0
		seeded	5 (83%)	1 (17%)	0
	7/23	check	0	4 (50%)	4 (50%)
		seeded	8 (100%)	0	0
	8/13	check	0	29 (69%)	13 (31%)
		seeded	54 (86%)	9 (14%)	0
	9/4	check	0	2 (25%)	6 (75%)
		seeded	23 (92%)	2 (8%)	0
CO	7/8	check	0	0	0
		seeded	4 (100%)	0	0
	7/24	check	0	36 (100%)	0
		seeded	20 (74%)	7 (26%)	0
	8/14	check	0	18 (100%)	0
		seeded	7 (58%)	5 (42%)	0
	9/10	check	0	9 (100%)	0
		seeded	7 (100%)	0	0
OT	7/2	check	0	0	5 (100%)
		seeded	5 (71%)	1 (14%)	1 (14%)
	7/25	check	0	2 (40%)	3 (60%)
		seeded	4 (80%)	1 (20%)	0
	8/15	check	0	27 (96%)	1 (4%)
		seeded	5 (36%)	8 (57%)	1 (7%)
	9/9	check	0	13 (93%)	1 (7%)
		seeded	2 (9%)	20 (91%)	0

[a] S4ites: LI = Licking County; CO = Columbiana County; OT = Ottawa County.
[b] NA = not available yet (identifications in progress).

Table 5. Mite density in experiment on transfer of *Z. mali*, 2002.

Site[a]	Date	Mean number per leaf							
		European red mite				Stigmaeid mites			
		Check trees	Seeded trees		P^b	*Check trees*	Seeded trees		P^b
			shoots	bands			shoots	bands	
LI	*7/23*[c]	*0.03*	*0.43*	*0.05*	*0.48*	*0.00*	*0.00*	*0.00*	-
	8/13	*0.3*	*0.3*	*0.3*	*0.99*	*0.00*	*0.05*	*0.00*	*0.44*
	9/4	*0.7*	*0.8*	*0.2*	*0.42*	*0.00*	*0.00*	*0.03*	*0.44*
CO	*7/24*[c]	*0.1*	*0.8*	-	*0.41*	*0.00*	*0.00*	-	-
	8/14	*0.3*	*5.1*	-	*0.19*	*0.00*	*0.06*	-	*0.24*
	9/10	*6.4*	*12.4*	-	*0.32*	*0.00*	*0.22*	-	*0.16*
OT	7/25[c]	0.03	0.4	-	*0.38*	0.00	0.00	-	-
	8/15	1.5	1.7	-	*0.61*	0.00	0.03	-	*0.37*
	9/9	6.0	1.6	-	*0.27*	0.00	0.02	-	*0.37*

[a] Sites: LI = Licking County; CO = Columbiana County; OT = Ottawa County.
[b] P = probability value for statistical test of ANOVA treatment effect.
[c] Mite density on 7/23 to 7/25 was immediately before predators were seeded.

Table 6: European red mite density on Red Delicious apple leaves, Columbus, Ohio, 2002; mean of 4 replicates.

Treatment[a]	Number of motile European red mite per leaf on each of 10 dates									
	4/26	*5/14*	*5/29*	*6/4*	*6/12*	*6/19*	*7/1*	*7/15*	*7/31*	*8/26*
Check	0.7	0.9	1.7	4.6 AB	3.3 A	7.2	46	74 BC	6.8	0.18
Standard	0.1	0.6	0.2	0.3 B	0.1 B	1.1	4	40 CD	0.8	0.04
Danitol	0.3	0.1	0.04	0.1 B	0.7 B	1.0	13	126 A	1.0	0.08
Avaunt	0.1	0.7	0.5	1.9 B	4.0 A	9.5	48	96 AB	0.6	0.00
Acramite early	0.1	0.2	0.1	0.7 B	1.0 B	3.1	35	21 D	2.1	0.06
Acramite late	0.4	0.9	1.7	8.1 A	4.2 A	7.8	61	13 D	2.6	0.00
P (trt effect)	*0.35*	*0.10*	*0.12*	***0.04***	***0.001***	*0.28*	*0.45*	***0.0001***	*0.08*	*0.66*

[A] See Table 2 for pesticides included in each treatment.

Table 7: Stigmaeid density on Red Delicious apple leaves, Columbus, Ohio, 2002; mean of 4 replicates.

Treatment[a]	Number of predatory stigmaeid mite motiles per leaf on each of 10 dates									
	4/26	*5/14*	*5/29*	*6/4*	*6/12*	*6/19*	*7/1*	*7/15*	*7/31*	*8/26*
Check	0.04	0.06	0	0.02	0	0.06	0.04	0.62	2.70 A	0.70 AB

Standard	0.02	0	0	0	0.02	0	0	0.06	0.49 B	0.14 C
Danitol	0.02	0	0	0	0	0	0.02	0.02	0.25 B	0.16 C
Avaunt	0.08	0.06	0	0.08	0.10	0.20	0.14	1.77	1.43 B	0.16 C
Acramite early	0.10	0	0.06	0	0.06	0.12	0.52	1.56	2.80 A	1.00 A
Acramite late	0.04	0.02	0.02	0.08	0.04	0.10	0.20	1.10	1.39 B	0.45 BC
P (trt effect)	*0.59*	*0.10*	*0.15*	*0.20*	*0.09*	*0.13*	*0.17*	*0.15*	***0.001***	***0.005***

[A] See Table 2 for pesticides included in each treatment.

Table 8: Phytoseiid density on Red Delicious apple leaves, Columbus, Ohio, 2002; mean of 4 replicates.

Treatment[a]	Number of predatory phytoseiid mite motiles per leaf on each of 10 dates									
	4/26	*5/14*	*5/29*	*6/4*	*6/12*	*6/19*	*7/1*	*7/15*	*7/31*	*8/26*
Check	0	0	0	0.02	0.06 A	0.14 A	0.16	0.84	0.30	0.16
Standard	0	0	0	0	0.00 B	0.00 B	0.02	0.44	0.12	0.04
Danitol	0	0	0	0	0.02 AB	0.04 B	0.06	1.06	0.12	0.12
Avaunt	0	0	0	0	0.00 B	0.06 AB	0.20	1.03	0.20	0.12
Acramite early	0	0	0	0	0.02 AB	0.00 B	0.04	0.18	0.30	0.06
Acramite late	0	0	0	0	0.00 B	0.00 B	0.04	0.44	0.38	0.16
P (trt effect)	-	-	-	*0.45*	***0.05***	***0.05***	*0.24*	*0.19*	*0.91*	*0.79*

[A] See Table 2 for pesticides included in each treatment.

For further information contact Celeste Welty Associate Professor, Dept. of Entomology, The Ohio State University or the Ohio IPM Office.

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Reducing Weeds in Black or White Plastic in Eastern Strawberry Production - 2002 Report

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Introduction

Weeds are the number one pest of the Ohio strawberry industry. Growers who us the matted row system can spend in excess of two thousand dollars per acre for fumigation, hand weed control and/or chemical herbicides over two to three years to reduce the many different species of weeds (Funt et al., 1997). On Ohio farms the matted row system is used and the soil is not fumigated as a standard practice. However the combination of matted row culture and un-fumigated soil presents the greatest problem in weed control (Himelrick, 1991).
New systems of strawberry culture are being tested. One system is the use of plastic which can reduce weeds. It may also be beneficial in early ripening of fruit and rapid establishment of strawberry plants in a late summer planting. Himelrick, in Virginia, found mulch surface temperatures of clear, black and white plastic were 17E, 19E, and 15EC higher than for bare soil, respectively (Himelrick, 1981). He also found that black plastic increased total fruit weight. New systems need to be compared to current matted row systems for costs/benefits to the grower and to the environment. For example, plastic needs to be removed from the field and disposed of in an appropriate manner. In this study, an irrigated raised bed was tested without plastic (control) and with black and white plastic installed in an August plug planting (2001) and harvested the following two years (2002-2003).

Objectives

The objective of this experiment was to determine the amount of weed control between no plastic and plastic covered raised beds, yield, and a comparison of costs among the treatments.

Methods

Strawberry plug plants, Allstar cultivar, were planted in a staggered two row system, 12 inches apart in the row and between rows on August 8, 2001. The control was a raised bed with trickle irrigation. The treatments had black plastic (embossed - 1.0 mil., 5 ft. width) or white plastic (1.3 mil., 5 ft. width). The raised bed with trickle tubes, and plastic covering was constructed with a bedder after the field was plowed and rototilled (twice). A water wheel planter was used to create a hole in the plastic to apply a small amount of water. All plants were planted by hand. No herbicides were applied to the plastic treatments. Grass was planted between rows to reduce weeds and erosion. Straw was applied as a winter cover and removed on May 3, 2002.
Select 2 EC was applied for spring grass control where grass seed had entered the plastic near the plant. In the control, hand weeding was completed once in May, July and October, 2002. Herbicides 2,4-D, Dacthal, and Devrinol plus Sinbar were used after harvest in July, August and October, respectively. A cost comparison (partial budget) between the control and plastic treatments was developed to reflect the labor and products used in this study for determining a cost/benefit analysis.
Berries were harvested and total yield, percent ripe/harvest date and weight per berry (berry size) were determined. There were three treatments and three replications in a completely randomized block design. A statistical analysis appropriate for this field study was used (SAS, 1990). All berries received a herbicide spray of Gramoxone at renovation to narrow the row width (burn runners), and manage weed control for harvest in 2003.

Results

There were very few weeds in the plastic treatments. These consisted, if any, of grasses and bind weed. In the control, several grass species and broadleaf weeds as bind weed, Canadian thistle, and plantain were recorded before harvest, at renovation, and in late summer. Hand weeding was sufficient for maintaining a weed free planting (80 to 90% of area having no weeds). Chemical weed control was only temporary or unable to control weeds.

There were no significant yield differences among treatments at any harvest or for all harvests (Table 1). Treatments achieved about 40% of a normal expected harvest. Plastic did not statistically increase the number of berries to ripen early (June 13) when compared to the control (Table 2). There were no differences between black or white plastic for yield, percent ripe or berry size. Plastic appeared to reduce berry size in the June 21st harvest as compared to the control (Table 3).

The cost to control weeds among the treatments is shown in Table 4. Specific costs per item are shown in Table 5. These costs are based on early 2002 prices for each item as used by the grower-cooperator. Black and white plastic costs were 54% and 71%, respectively, of the no plastic system. Hand labor, as estimated per acre to that used in this study, was 68% of the total cost in the no plastic treatment.

Discussion

Plasticulture has been tested by Ohio growers to reduce weed control costs, to increase yields over matted row systems, and to have earlier ripening of berries. In this study, weed control was considered to be good to excellent with plastic and poor in the no plastic control. There were no differences among treatments for yield or for earlier ripening. However, Himelrick in 1991 reports yields for black plastic.

Yields for this cultivar at this location were disappointing for a double row system. An early October drop in temperature, deer damage, and a low bed could have been the reason for this. It is believed that the planting date was ideal and plant size was good. Weeds did not appear to influence yields in the control. There may be an influence on yield by weeds in the 2003 results.

The white plastic was disappointing and started to break up after 4 to 6 months and is not recommended based on performance and cost. The real influence of white plastic could not be demonstrated in this test.

If growers have similar costs as estimated in this report, then plastic has one distinct advantage for weed control. However, removal and disposal are to be considered in the total expense of the system and this could increase the cost.

Conclusions

Black or white plastic yields were not different from the no plastic control. Few weeds developed in the plastic treatments. Estimated costs for black or white plastic were 54% and 71%, respectively, of the no plastic system. Hand weeding labor was the highest cost for the no plastic system.

Differences in weed control may occur in the second harvest year of 2003 among treatments. The second harvest year may provide different yield response than the first year.

We gratefully acknowledge the financial support of the Ohio IPM program headed by Dr. Joe Kovach. Where trade names are used, no discrimination toward similar products is intended or implied.

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Statewide Survey of Western Corn Rootworm Activity on Soybeans, 2002

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Ohio State University Extension personnel in 2002 continued to monitor for first year corn rootworm (FYCR) which is a biotype of the western corn rootworm (WCR) that deposits eggs in soybean fields that can damage corn planted in that field the next year. This is the fifth year that monitoring has occurred. The program used Pherocon AM yellow sticky traps which are placed in soybean fields (at least 4 traps per field) on a biweekly schedule from mid-July through August to monitor adult rootworm activity. Sixty-four fields in 20 counties were trapped with Pheroncon AM traps in 2002. All of the counties changed traps on a biweekly schedule except Van Wert which changed their traps on a weekly schedule.

A summary of the average catches of WCR adults per trap per day from the 2002 growing season is presented in Table 1. The catch for a given field represents the average catch of adult WCR from traps over a six week period. The average catch for a county represents the total number of fields monitored in a given county. Even though the number of fields sampled is small, it gives an indication of the WCR populations in soybeans in 2002 as compared with previous years.

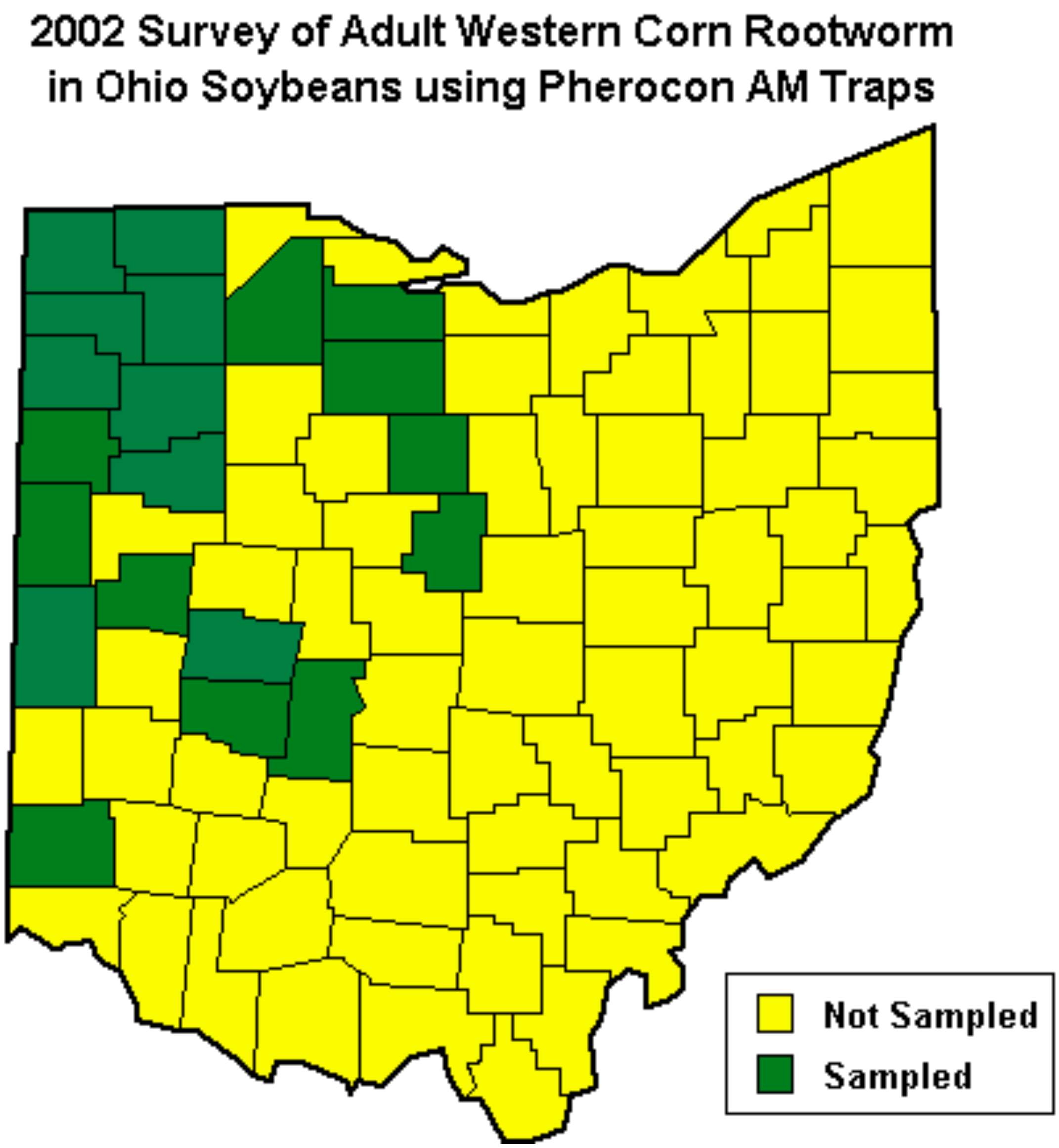
Beetle numbers on traps were higher in all counties in 2002 as compared with previous years. Collection of 2 or more WCR beetles per trap per day in a soybean field is presumed to indicate a potential for economic injury at a root rating of 3 if corn is planted the following year. Based on this fact, only 1 field in Van Wert County exceeded the 2 beetles per trap per day. There were several fields in Van Wert, Allen, Mercer and Defiance Counties that had greater than 1 beetle per trap per day. Fields in the other counties had less than 1 beetle per trap per day.

A soil insecticide treatment for FYCR may be warranted if WCR beetle numbers per trap per day are greater than 2 or more beetles over a six week period. If a field was not trapped in 2002 but observations in July and August found a large number of WCR beetles in the fields at that time, then a soil insecticide might be justified. Conversely, if WCR were not observed in soybeans in high numbers in July and August then a soil insecticide treatment in 2003 probably cannot be justified.

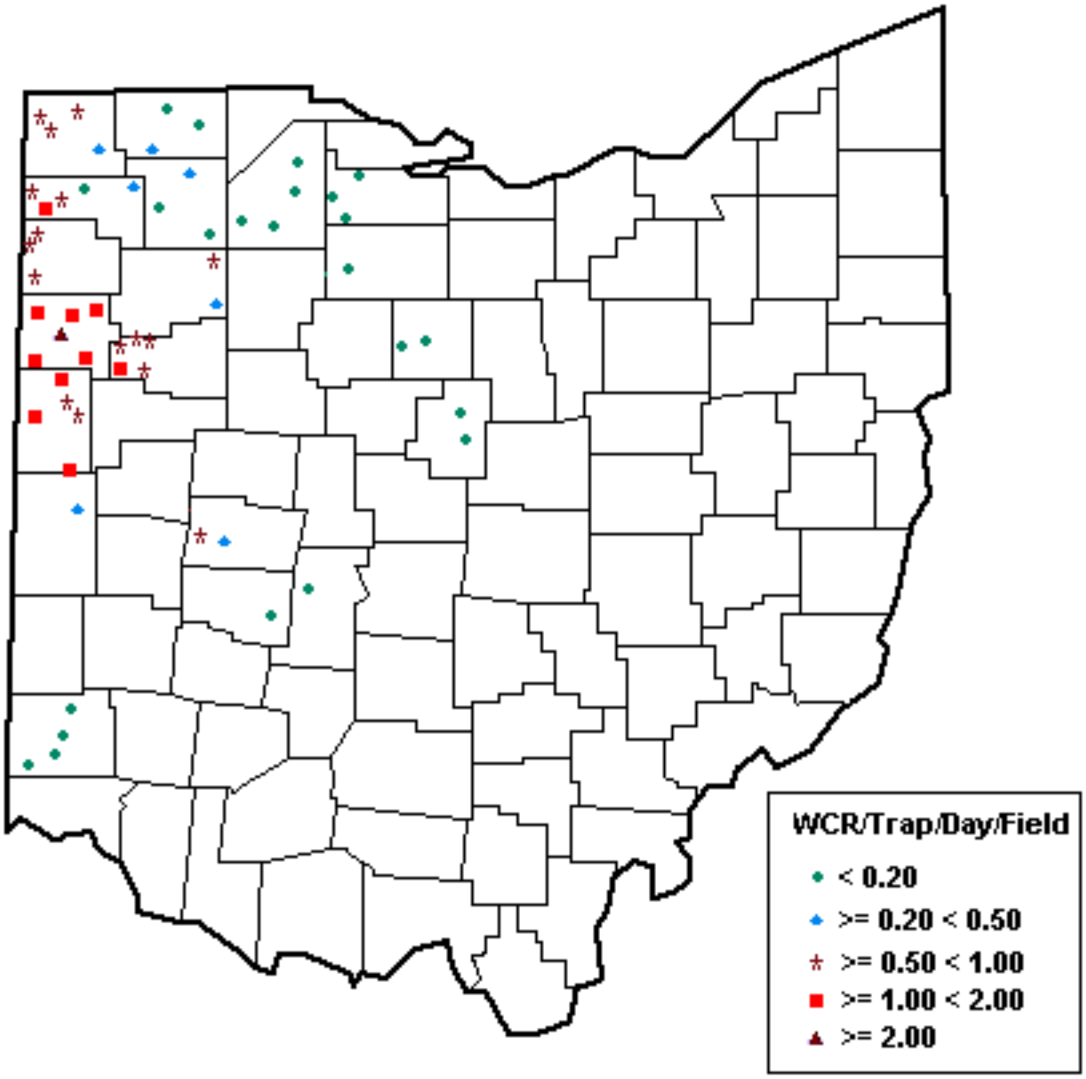
If soil insecticides are applied for rootworm, then check strips should be left to determine if the treatment was warranted or not.

Map showing counties sampled in 2002

Map showing fields sampled in 2002



Location of Soybean Fields Surveyed for Western Corn Rootworm in 2002



For further information contact Bruce Eisley IPM Program, The Ohio State University or the Ohio IPM Office.

Using Feeding Attractant Based Traps to Determine the Effect of Gender Ratio on the Use of Michigan State Codling Moth Control Model

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Background:

Codling moth is one of the more destructive pests in Ohio apple orchards. For this reason, monitoring for codling moth is an important practice for any apple grower striving to use an Integrated Pest Management (IPM) based pest control program. In carrying out this monitoring, pheromone traps have been used to track the presence and relative size of the moth flight. Along with a degree day model developed at Michigan State University, the weekly catches of the male moths provided by pheromone traps have been used to determine an "as needed" spray program to keep direct fruit damage from codling moth larvae to a minimum.

Beginning in the summer of 1999, an orchard in the Wayne County Extension IPM program started having higher numbers of moths in its traps when compared to other orchards in the county as well as to its own history. Before 1999, the use of these traps along with the Michigan spray model indicated a need to spray for codling moth only once or twice per season. In 2001, this had increased to seven sprays per season due to average trap catches being over 10 per trap for 13 of the 21 weeks that counts were taken. The average of three traps per block was as high as 78 per trap in 2000 and 48 in 2001. In all three years, however, minimal fruit damage was observed, even in areas of the orchard where spraying was not as intensive as indicated by the Michigan model. This brought into question the spray threshold indicated by the Michigan Model. Specifically it called into question whether the catch of male moths in the pheromone traps could be directly correlated to the relative

abundance of female moths and the resulting damage of the larvae. Similar concerns about the validity of the Michigan threshold have been expressed recently by other midwestern entomologists
Though recent work in Washington State orchards had shown that the number of female moths caught in passive interceptor traps could be correlated with fruit damage, an attempt to duplicate this study in Wayne County, Ohio in 2001 produced poor results. The current study, conducted in 2002, instead made use of a feeding attractant to attract both male and female moths to help determine the ratio of male and female moths present. The mixture, using molasses, vinegar and ammonia, has been time tested (as mentioned in the 1952 Agricultural Year Book "Insects"). By using these traps, it was hoped to increase information on the ratio and distribution of male and female moths in individual orchards, which in turn would result in better-timed spray applications for controlling the codling moth larvae.

Objective

To evaluate the use of feeding attractant based traps compared to pheromone traps and how the number of female codling moths caught in them related to the Michigan Codling Moth Control model.

Method:

This study was conducted in a single block of mixed apples on the Moreland Fruit Farm near Wooster in Wayne County, Ohio. This is one of three blocks of apples within the orchard. The orchard also contains peaches, cherries, grapes, blueberries, raspberries and a variety of vegetables. The orchard is bordered on the south and west by a state wildlife area, on the east by a dairy farm and on the north by a mix of woods and fields of row crops. On 5/1, twenty Multipher traps baited with long life codling moth lures and containing toxicant strips were distributed in a grid pattern within the block. The traps were placed in every 6th row with four traps in each row. The first and fourth traps in

each row were placed in the trees on the ends of rows. The traps were placed at chest height with approximately 80 feet between traps within the row. Multipher traps that had never had pheromone lures in them were placed in the 9th and 20th rows in a similar pattern on 7/8, just prior to the emergence of the second moth flight. The 20th row had only three traps with one on each end and one in the middle. The bait used in these traps consisted of 1-cup cider vinegar, 1/3-cup dark molasses, 1/8-teaspoon ammonia, and enough water to make 1-1/2 quarts of liquid. 1/8 cup of this bait was placed into the bottom of each trap in a small plastic cup. Baskets made from wire screening were then made to fit inside the trap to assist in removal of the moths and keep the moths out of the bait. Toxicant strips were then placed in the bottom of the baskets.
Trap counts were taken weekly and weather was monitored with a Watchdog 450 weather monitor to help track degree-days from biofix and previous spray dates.

Observations:

In the traps containing the molasses/vinegar bait codling moths were found on only three occasions and only in one of the seven traps. Two moths were found in the trap on 8/5, two were found in the trap on 8/12 and three moths were in the trap on 8/19. Due to the low results in these traps, sexing of the moths was not carried out.
In the grid of pheromone traps, as in the past several years, numbers were high. Traps with the highest numbers were on the border of the block. Chart A shows the average daily catch of all traps each week. The total number of moths caught in a single trap in a single week was as high as 85 (6/04/02). Chart B shows the average daily catch for the traps located on the border of the block verses that for the traps in the inner portion of the block. It can be seen that there was a significant difference between the border vs. the inner traps during the first generation. This could indicate that the majority of the over-wintering population had migrated into the block rather than being a resident population. Chart C goes further to show a comparison of the three borders of the block

where traps were located for the first flight. This would tend to indicate that this migration came primarily from the south. Moth numbers in these same traps for the second flight were not consistently higher for any one border over another.

A significant difference this year over the past three years was that there was very heavy damage to the crop in 2002. In 1999-2001, despite high numbers of moths in the pheromone traps, less than 5% of the fruit showed damage from codling moths. However, in 2002 the damage on a tree-to-tree basis was estimated to be 50-90% of the fruit showing damage, with an overall crop loss estimated to be 60-70%. The damage varied more according to cultivar rather than location within the orchard (inner vs. border area). The cultivars showing the most damage were Thew Gold, Jonathan and Ida Red. This damage occurred despite an intensive spray program for control of the codling moth.

The date used for the biofix was 5/13/02. The table below shows the insecticides applied, rates and degree-days since the previous application (or biofix for the first application) as well as cumulative degree-days since the biofix. The targets for spray intervals were 250 DD following biofix for the first application and 200 DD between applications after that as long as trap counts remained high. Suitability of the weather for spraying often prevented spray applications at the prime time according to degree-day accumulations.

Table 1. Chemical controls applied to control codling moth in 2002

Date	Insecticide(Active Ingredient)	Rate of application (A.I.)
6/1	Phosmet	2.1 lbs/A
6/19	Phosmet	2.1 lbs/A
6/28	Phosmet	2.1 lbs/A
7/31	Tebufenozide	.28lbs/A
8/10	Phosmet	2.1 lb/A
8/20	Azinphosmethyl	1 lb/A
8/31	Methomyl	.6 lbs/A
9/10	Methomyl	.6lbs/A

*Degree days were calculated on a high-low average base 50 degrees

F. **The longer interval between applications was due to low trap counts during the weeks of 7/01-7/15.

Summary:

This study was unable to demonstrate any reliability in the use of Multipher traps baited with a molasses based feeding attractant to measure the relative density of female moths to male moths within the monitored orchard. However, the data collected from the grid of pheromone traps was useful in indicating the probability that the population of codling moths present during the first flight was due to migration rather than from an over-wintering resident population. It was found that the wildlife area to the south contained a grove of walnut trees, also known to be a host to codling moths. The phenomenon of several years of high codling moth counts with little resulting damage followed by a year with heavy pressure was not entirely unexpected. Dr. Bruce Barrett of Missouri State University indicated similar occurrences in the Missouri area. This does not explain, however, the failure of the spray program used in 2002 in this orchard. Also, still in question is the validity of the Michigan spray model, especially in circumstances where moth counts are historically high throughout the season. Further studies are warranted for both of these questions, especially since the incidence of high moth counts and failure to control codling moths in apples is increasing throughout the eastern part of the country.

For further information contact Ron Becker OSU Extension, Wayne County or the Ohio IPM Office.