2003 Ohio IPM Block Grant Reports

Delivering Weather, Climatological and Environmental Information Pertinent to Tree Fruit Management in Northern Ohio

Effect of Nozzle Type on Glyphosate Efficacy and Spray Particle Drift

Environmental Factors that may affect Sulfentrazone (Spartan) Selectivity and Safety on Newly Strawberry Plantations

Field Evaluation of the Percentage of Overlap for Crop Production Inputs with a Foam Marker System

IPM Demonstation Projects in Ohio Elementary Schools to Increase Awareness of Head Lice

Improving Access to Relevant and Reliable Information About the Practice of IPM in Schools for Ohio School Districts

IPM Programming by the Extension Nursery, Landscape and Turf Team

Monitoring for the Female Codling Moth in Ohio with the Pear Essence Kairomone Lure

Monitoring Network for Beet Armyworm, a Serious Pest New to Ohio

Optimizing Scouting for Weeds of Field Crops

Status of First Year Corn Rootworm in Ohio, 2003

Delivering Weather, Climatological, and Environmental Information Pertinent to Tree Fruit Management in Northern Ohio

FUNDS AWARDED/UTILIZED: $3448/$3448

GROWER PARTICIPATION FEES COLLECTED/UTILIZED: $10, 260/$10, 260

PRINCIPAL INVESTIGATOR: Ted W. Gastier, Huron County Agricultural Agent

**COOPERATING
ORCHARDS:**   Burnham Orchards, Berlin Heights, OH 44814
                 Eshleman Orchards, Clyde, OH 43410

SCOUT TECHNICIANS: Eugene Horner, Extension Program Assistant
                         James Mutchler, Extension Program Assistant

ABSTRACT: Thirty-one apple and peach growers in fourteen Ohio counties, including five of the top ten apple producing counties, plus five Extension Agents and two industry reps received apple disease prediction products by e-mail. These products were supplemented with weekly orchard visits to thirty-five production blocks. The objectives of this project were; 1). To expand a weather-based predictive system for pest management in northern Ohio orchards 2). To initiate practice change by growers in their selection process for for pest management based on lowering orchard Environmental Impact Quotients (EIQs) to reduce non-target impacts.

METHODS: Disease products for apple scab, fire blight, and sooty blotch were purchased from SkyBit, Inc. of Bellefonte, PA for two orchard locations which were representative of ten apple producing counties. The products were received through e-mail by the Huron County Extension office and forwarded to growers and agents twice each week during the growing season. These products were supplemented with National Weather Service wind, temperature, and precipitation forecasts for seven Ohio locations. The NWS Web site is available at no cost to growers and the general public at <http://www.nws.noaa.gov/mdl/forecast/text/state/OH.MRF.htm>

Three temperature/leaf-wetness Spectrum Technologies monitors where positioned at eye-level within the apple tree canopies at three locations. The apple scab computer Specware, based on the Modified Mills Chart (available from Spectrum Technologies of Plainfield, IL) was utilized to indicate expected apple scab infection periods.   In addition, daily temperature and precipitation data from twelve Ohio weather stations were recorded to collaborate wetting periods.

Two scout/technicians made weekly orchard inspections in 24 apple blocks and 12 peach blocks to determine pest pressures through pheromone traps and visual observation of insects, mites, and diseases as well as populations of beneficial insects and predatory mites. In addition, the principal investigator made weekly visits to 4 apple blocks and three peach blocks for this project and mating disruption trials in cooperation with Eshlemans and Dave O'Brien of UAP. Fruit quality was checked for disease-caused blemishes as apples were placed into storage at eighteen locations. Peach fruit quality was assessed on several dates during the harvest season.

RESULTS:

Fruit Quality Harvest Survey – Apples (sample size = 10 growers)
Defects noted and level of incidence:
- 1). Climatological – soft hail damage (3 orchards)
- 2). Physiological - fruit russet (5 orchards)
- 3). Insect – codling moth (9 orchards)
  - San Jose scale (2 orchards)
  - redbanded leafroller (1 orchard)
  - plum curculio (1 orchard)
- 4). Disease – scab insignificant (10 orchards)
  - fire blight significant (2 orchards)
- 5). Other pests – crows (2 orchards)
  - multi-colored Asian ladybird beetles (2 orchards although present in all orchards.)
- 6). Tree leaf injury noted during growing season –
  - spotted tentiform leafminer (two orchards)

In cooperation with Dr. Celeste Welty, approximately 13,700 apples were examined in two non-destructive surveys with the fruit found to 99.6% free of defects.

Fruit Quality Harvest Survey – Peaches (sample size = 4 growers)
Defects noted and level of incidence:
- 1). Disease – bacterial spot (two orchards)
  - brown rot (one orchard)
- 2). Internal fruit feeders – mainly Oriental fruit moth (one orchard)
- 3). External fruit feeding – mainly redbanded leafroller (two orchards)

Non-destructive surveys were conducted during the harvest season with 725 peaches being examined indicating the following:

Clean	Internal feeding	Surface feeding	Mechanical damage	Bacterial spot	Brown rot	Over-ripe	Split pit	Unknown
90.8%	1.8%	1.5%	2.9%	1.1%	1.2%	0.1%	0.1%	0.1%

Late Season Multi-colored Asian Ladybird Beetle (MCALB – *Harmonia*) Survey – Specimens were found in 55 MultiPher III traps set for apple and peach pests. No fruit feeding was observed. The September 26th observation also included 9.6 adults/trap of family Hemerobiidae (brown lacewing) and syrphid flies too numerous to count.

Date	September 5	September 12	September 19	September 26
MCALB/trap	0.02	0.18	1.04	6.31

North Central Ohio Pesticide EIQs, DEs and Costs for 1999 and 2003-12-11 (Averages for 10 apple producers and 5 peach producers.)

	Apple						Peach					
	EIQ		DE		Cost $		EIQ		DE		Cost $	
Year	1999	2003	1999	2003	1999	2003	1999	2003	1999	2003	1999	2003
Average	1733	1610	17	22.5	306.53	610.05	1744	2553	10	18	176.78	356.51

EIQ – Environmental Impact Quotient,   DE – Dosage Equivalent (explanation at: http://www.nysipm.cornell.edu/publications/EIQ.html)

SkyBit and SpecWare Apple Disease Predictions (percent days reported, indicated or predicted)

Month	SpecWare scab infection indicated	SkyBit Scab Rpt	SkyBit 3-day scab Pdt	SkyBit 4-10 day scab Pdt	SkyBit fire blight Rpt	SkyBit 3-day fire blight Pdt	SkyBit 4-10 fire blight scab Pdt	SkyBit sooty blotch Rpt	SkyBit 3-day sooty blotch Pdt	SkyBit 4-10 day sooty blotch Pdt
April	na*	26%	50%	89%	-	-	-	-	-	-
May	23%	71%	65%	100%	35%	76%	77%	-	-	-
June	27%	60%	57%	100%	50%	53%	100%	0	0	67%
July	45%	65%	58%	55%	81%	81%	100%	100%	100%	100%
August	71%	87%	84%	100%	87%	84%	100%	100%	100%	100%

na* equipment failure   Rpt = reported   Pdt = predicted

DISCUSSION:

Codling moth management continues to challenge apple growers and researchers throughout the Midwest. Timing of spray application will become more important as newer, more environmentally friendly materials supplement and/or replace organophosphates. Dependable timing is provided by establishing Biofixes with pheromone traps. Newer materials will help lower the Environmental Impact Quotients. A combination of factors contributed to control failures in two blocks: inadequate coverage in older, standard trees; storage of apple bins in or near orchard perimeter; high resident populations; nearby woods; and inattention to late-season control during the peach harvest. Codling moth mating disruption is not "ready for the big-time" in the Midwest.

Apple scab pressures were heavy this season due to a cooler and wetter than normal growing season. Our growers had good control using a combination of standard and newer, softer materials.   Continued movement away from the standards will lower future EIQs. Fire blight severity was lessened with the wide-spread use of a twig growth inhibitor except where later applications of foliar nutrients were added in cover spray applications.

For the most part, the peach crop was abundant with good quality. However, bacterial spot was diagnosed in two orchards by Dr. Mike Ellis. Oriental fruit moth damage was considered excessive in later varieties in one block due to several factor. The block has a history of damage, we have no way to monitor mated-females with mating disruption, and extremely high populations were present in the early season. Heavy disease pressures lead to heavier usage of control materials compared to 1999.

The SkyBit scab prediction product has been used for several years to assist growers with apple scab. Because of the low predictability (25% accuracy) of precipitation for any given point, the product errors on the safe side as shown for the 4 to 10 day prediction in the table above which could lead to over-application. The SpecWare monitoring and analysis is subject to equipment failure and depends on downloading by growers on a timely basis.

EXTENSION PROGRAM IMPLEMENTATION:
Specific recommendations for the 2004 growing season: 1) Replace SpecWare and SkyBit with direct-reading Weather Tracker Apple Scab Alert devices, 2) Substitute SkyBit weather forecasts with the National Weather Service forecasts available on the Web, 3) Emphasis EIQs for specific products in the Ohio Fruit ICM News, 4) Recommend San Jose scale control in early season, and 5) encourage softer products for codling moth, and apple and peach disease control.

IPM Block Grant Report

Optimizing scouting for weeds of field crops

Principal investigators: John Cardina, Horticulture & Crop Science
                             David Lohnes, Communications & Technology

BACKGROUND:
We have studied weed phenology using cumulative degree-days to generate a phenological calendar from the flowering sequence of 94 indicator plants. A degree-day database is now accessible on the web in real-time. This database is linked on the web directly to the phenological calendar, which can be used with degree-days to predict pest activity (http://www.oardc.ohio-state.edu/gdd/). Over 5 years, the rank order of phenological events was very consistent, even when growing conditions varied greatly. Therefore, we can follow these events to determine the optimum time for scouting

This year we collected data for use in testing the accuracy of our prediction approaches and put the weed data into the biological calendar on the web. Next year we will use these predictions to time the application of control measures. The specific objective for this grant project was to add to the baseline dataset for weed emergence by expanding the species for which emergence data are available and increasing accuracy of emergence counts.

METHODS:
Weed emergence was monitored in eight 0.5-m2 permanent quadrats located about 10 m apart, and at least 10 m from the field edge. Farm managers conducted land preparation and planting operations according to their normal schedule. Emergence counts and indicator plant phenology observations were made 3 times per week. First and full bloom of indicator plants were determined by standard procedures. Various percentages of weed emergence were determined by developing best-fit models describing the progress of emergence with day of year and matching these to degree-days (base temperature = 0).
Data were plotted using Systat and percent emergence at various times were estimated by interpolating between sample points. Air temperature, soil temperature at a depth of 2.5 cm, and rainfall were monitored at each site, and soil samples were obtained to determine initial soil water content, water holding capacity, and water retention curves.

RESULTS:
Seedling emergence curves were generated for 6 additional species: common groundsel, common mallow, dandelion, hairy galinsoga, common purslane, and velvetleaf (see attached figures). For all species except common mallow, we were able to detect the time of initial emergence, an indicator that is frequently absent in emergence data. Since rainfall was abundant in 2003, emergence curves reflect the response of seeds to soil temperature conditions.

We identified two general patterns of emergence: for dandelion and hairy galinsoga, peak emergence was reached during a relatively short time interval (~ 30 days). For other species, emergence continued over a large proportion of the growing season so that peak emergence occurred long after initial emergence (160 to 200 days).

Some weeds are considered early emerging species whereas others are considered late emergers. However, we also found that the emergence interval varied among these species. For

example, the earliest emerging species in this group was common mallow, but this species was also one with the longest period during which emergence continued. The latest emerging species was common purslane, which reached its peak emergence about the same time as common mallow.
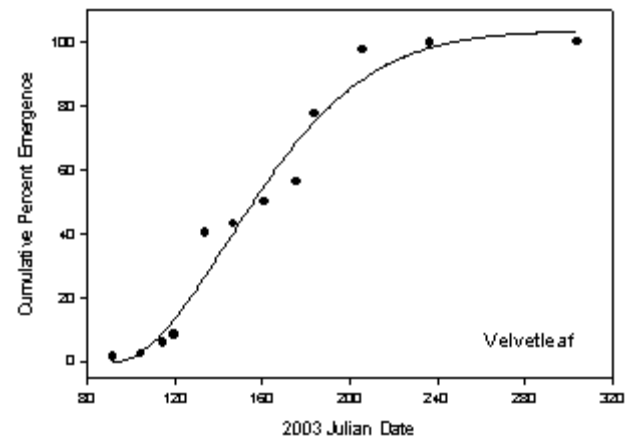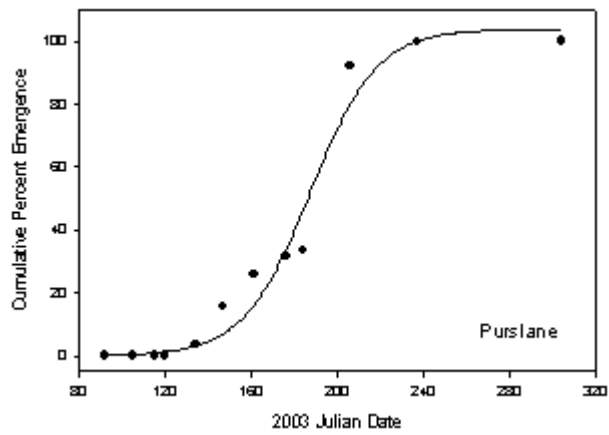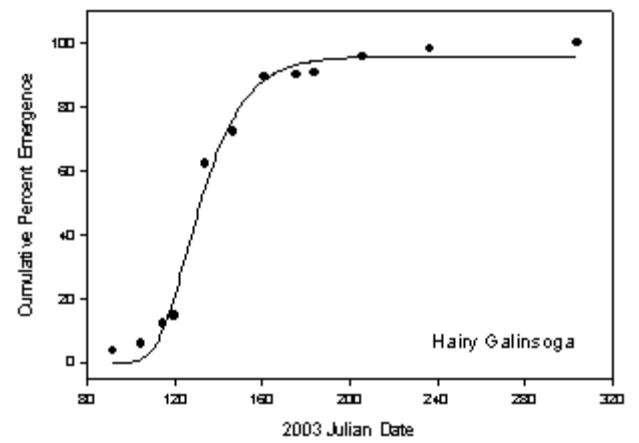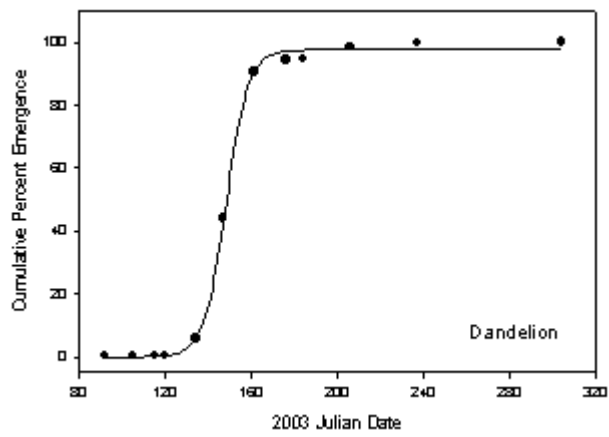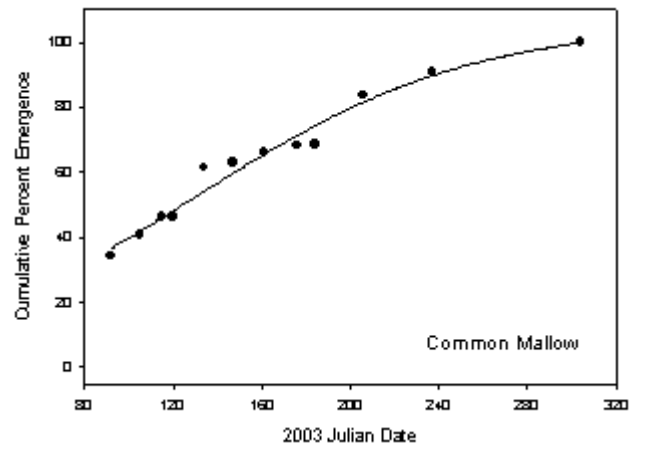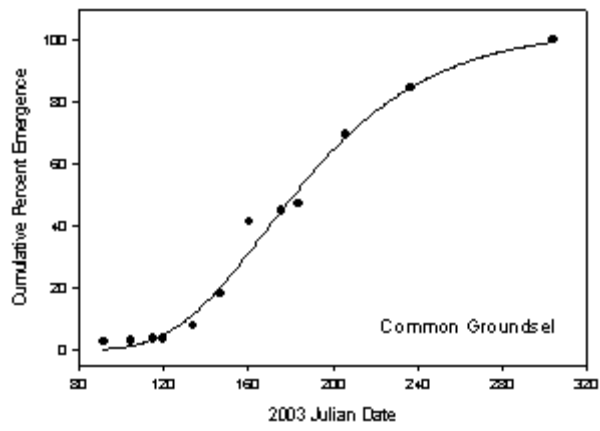
We selected three key emergence percentages (20, 50, and 80%) at which growers would likely make management decisions. The day of year (DOY) at which these events occurred for each species was calculated using a standard interpolation method (Figure 2). These estimated emergence times are shown in Table 1, which can be used to rank the phenological events relative to other weeds and relative to ornamental plants and insect pests.

Table 1. Estimated day of year when weeds reached 25, 50, and 80% emergence in studies at Wooster, OH in 2003.

| Weed Species | Emergence Percentage | | |
	25	50	80
	----------------Day of year 2003--------------------		
common groundsel	152	185	218
common mallow	-	125	208
dandelion	140	152	158
hairy galinsoga	121	135	157
common purslane	158	190	205
velvetleaf	130	162	188

The data in this table will be incorporated into the biological calendar for all recorded pests and ornamental plants. Average rankings using a minimum of 5 years of data will be used to develop the calendar. An updated degree-day calculator is now available on the web (http://www.oardc.ohio-state.edu/gdd/). This will be linked to the biological calendar so that users can enter their zip code and obtain daily information about the progression of degree days as well as the progression of weed emergence and pest development.

Studies in 2004 will focus on application of control measures at different times corresponding to different percentages of weed emergence. This will allow us to determine what emergence percentage to target for different species, which may vary with control measures and cropping system.

Common Groundsel — Cumulative Percent Emergence vs 2003 Julian Date

Common Mallow — Cumulative Percent Emergence vs 2003 Julian Date

Dandelion — Cumulative Percent Emergence vs 2003 Julian Date

Hairy Galinsoga — Cumulative Percent Emergence vs 2003 Julian Date

Purslane — Cumulative Percent Emergence vs 2003 Julian Date

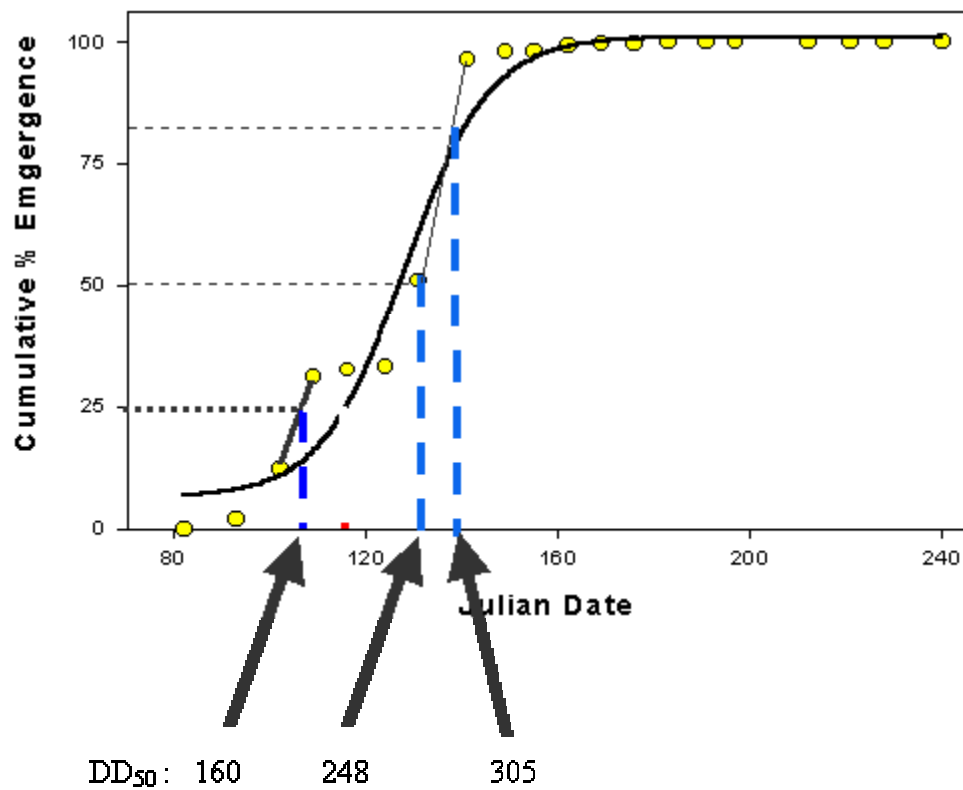Velvetleaf — Cumulative Percent Emergence vs 2003 Julian Date

Figure 2. For each phenological event, we used daily max and min temperatures to calculate degree-days by the Double sine wave method (Allen 1976). The Base temp = 50 F; start date = Jan. 1. Then phenological events were ranked by degree-days for the biological calendar.

Status of First Year Corn Rootworm in Ohio, 2003

Bruce Eisley
IPM Program
The Ohio State University
Columbus, OH 43210

Personnel from Ohio State University Extension sampled for western corn rootworm adults (WCRA) in soybean fields for the sixth year in a row. The sampling was done using Pherocon AM yellow sticky traps placed in 89 fields in 21 counties. Six traps were placed in the soybeans on metal posts at canopy height and located at least 100 feet from the field edge and evenly spaced in the field. The traps were placed in the field at the end of July and changed weekly for six weeks until the early part of September. Each week the old traps were removed from the posts, the WCRA were counted and recorded and new traps placed on the posts. After each trapping week, the number of beetles collected were summed and divided by the number of days the traps were in the field resulting in the average number of beetles collected per trap per day. Research indicates that catches in soybean of **5 or more beetles/trap/day** during any trapping week indicates a potential problem with rootworm in the field the following year.

A summary of the weekly catches of WCR adults per trap per day from the 2003 season is presented in Table 1. Based on the potential treatment level of 5 beetles/trap/day during any trapping week, the trapping data from 2003 had the following results:

One field had an average > 3 beetles/trap/day
Three fields had an average > 2 beetles/trap/day
Twenty-six fields had an average > 1 beetle/trap/day
Fifty-nine fields had an average < 1 beetle/trap/day
None of the fields went over the threshold of 5 beetles/trap/day.

Based on these data, if any of these fields are planted to corn in 2004, a treatment (either insecticide or plant resistance) should not be needed for rootworm. These data do not mean that other fields in a county, that were not sampled, do not need treatment but it does give good information about the fields that were sampled and about the abundance of the beetles this year.

In addition to sampling with the sticky traps, OSU Entomologists sampled soybeans in 8 counties along the Ohio-Indiana border for WCRA the first week of August. Twenty sweeps in 5 places in 3 fields per county were taken and contents of the nets bagged and later counted in the lab. Sweep net samples do not tell us if a field has a high enough WCRA population to warrant treatment the next year, but they do tell us the relative abundance of the beetle population. The number of WCRA per 100 sweeps ranged from 0 to 25 (Figure 1). This is the first year that we have swept for beetles so we cannot compare data from this year with prior years data but if we compare these sweep counts with data from Indiana and Illinois where they may sweep several hundred beetles in some of their problem counties, it does indicate how low our beetle populations were in soybeans this year.

Multi-colored Asian lady beetles were also counted each time the traps were changed and these counts are included in Table 2.

Thanks to the following county agents for their help in conducting this survey:

County	Agent	County	Agent
Allen	C. Young	Miami	H. Watters
Auglaize	J. Smith	Morrow	S. Ruhl
Butler	S. Bartels	Paulding	J. Lopshire
Champaign	B. Ward	Putnam	G. Arnold
Crawford	S. Prochaska	Sandusky	M. Koenig
Darke	S. Foster	Shelby	R. Bender
Defiance	B. Clevenger	Van Wert	A. Kleinschmidt
Fulton	G. Lebarge	Williams	F. Chirra
Henry	D. Sonnenberg	Wood	A. Sundermeier
Mercer	T. Mangen		

Table 1. – Average Western Corn Rootworm Adults Collected per Trap per Day on Pherocon Yellow Sticky Traps in Soybeans in Ohio in 2003

County	Average WCR/Trap/Day During Weekly Period						
	Approximate Date Traps Changed						
	July 30	Aug 6	Aug 13	Aug 20	Aug 27	Sept 3	Sept 10
Allen	0.31	0.74	0.45	0.31	0.63	0.98	
Allen	0.33	0.83	0.48	0.67	0.70	1.24	
Allen	0.57	1.07	0.38	0.40	0.38	0.44	
Allen	0.05	0.18	0.33	0.57	0.31	1.25	
Allen	0.08	0.19	0.10	0.15	0.77	0.48	
Auglaize	na	3.26	0.94	1.08	0.45	0.76	0.69
Auglaize	0.10	0.31	0.17	0.31	0.28	0.19	
Butler	0.00	0.05	0.10	0.12	0.10	0.00	
Butler	0.07	0.05	0.07	0.05	0.00	0.02	
Butler	0.05	0.02	0.05	0.00	0.00	0.00	
Butler	0.05	0.12	0.09	0.12	0.17	0.07	
Champaign	0.07	0.14	0.21	0.14	0.21	0.69	0.36
Champaign	0.19	0.05	0.05	0.14	0.19	0.64	1.14
Clark	0.02	0.07	0.24	0.12	0.02	0.05	
Crawford	0.42	0.25	0.15	0.19	0.08	0.22	
Crawford	0.37	0.19	0.15	0.47	0.38	0.23	
Crawford	0.03	0.33	0.23	0.33	0.23	0.06	
Crawford	0.03	0.14	0.12	0.14	0.15	0.20	
Darke	0.52	1.33	0.57	0.62	0.69	0.38	
Darke	0.48	1.15	1.06	1.07	0.83	0.55	
Darke	0.38	0.43	0.45	0.45	0.29	0.26	
Darke	0.26	0.63	0.22	0.58	0.43	0.38	
Darke	na	na	0.43	0.10	0.10	0.05	
Defiance	na	0.27	1.23	0.48	0.80	1.83	
Defiance	na	0.21	1.07	0.56	0.39	0.71	
Defiance	na	0.07	0.30		0.14	0.44	
Defiance	na	0.08	0.77	0.88	0.33	1.25	
Fulton	na	0.16	0.25	0.14	0.08	0.00	
Fulton	na	0.13	0.32	0.18	0.08	0.04	
Fulton	0.08	0.71	0.13	0.17	0.07	0.04	
Fulton	0.21	0.78	0.56	0.30	0.14	0.04	
Fulton	na	0.19	0.43	0.25	0.08	0.07	
Henry	0.06	0.28	1.13	0.44	0.43	1.03	
Henry	0.02	0.06	0.21	0.11	0.40	0.52	
Henry	0.00	0.25	0.69	0.53	0.64	1.62	
Henry	0.06	0.39	1.17	0.42	0.48	1.06	
Henry	0.28	0.38	1.83	0.42	0.62	1.17	
Henry	0.10	0.28	1.00	0.47	0.33	1.12	
Madison	0.14	0.07	0.24	0.12	0.02	0.05	
Mercer	0.14	0.52	0.48	0.33	0.21	0.69	
Mercer	0.36	0.19	0.17	0.14	0.07	0.07	
Mercer	0.14	1.30	0.70	0.60	0.26	1.02	
Mercer	0.09	0.50	0.60	0.20	0.20	0.60	
Miami	na	0.52	0.79	0.69	0.63	1.33	2.72

County							
Miami	na	0.14	0.38	0.24	0.04	0.17	0.44
Miami	na	0.38	0.40	0.40	0.22	0.39	0.75
Miami	na	0.55	0.48	0.31	0.37	0.33	0.36
Miami	na	0.29	0.38	0.21	0.24	0.28	1.06
Morrow	na	Na	0.02	0.00	0.02	0.00	
Morrow	na	Na	0.04	0.03	0.02	0.15	
Paulding	na	0.10	0.38	0.31	0.05	0.10	0.22
Paulding	na	0.21	0.79	0.45	0.26	0.23	0.53
Paulding	na	0.05	0.60	0.71	0.33	0.21	0.22
Paulding	na	0.02	0.17	0.31	0.04	0.14	0.07
Putnam	0.57	0.31	0.83	0.31	0.48	0.31	
Putnam	0.52	0.83	0.76	0.71	0.24	0.38	
Putnam	0.19	0.40	1.10	0.67	0.79	0.00	
Putnam	0.29	0.21	0.50	0.50	0.33	0.26	
Putnam	0.81	1.74	1.55	1.10	1.07	1.00	
Sandusky	0.10	0.17	0.31	0.43	0.36	0.43	
Sandusky	0.21	0.62	0.57	0.60	0.45	0.48	
Sandusky	0.02	0.10	0.07	0.05	0.10	0.24	
Sandusky	0.21	0.93	0.64	0.24	0.31	0.31	
Shelby	0.14	0.23	0.48	0.74	1.17	0.81	
Shelby	0.02	0.15	0.58	0.14	0.14	0.31	
Shelby	0.05	0.17	0.43	0.10	0.14	0.12	
Van Wert	0.00	0.00	0.10	0.50	0.40	0.30	
Van Wert	0.00	0.10	0.60	0.90	0.40	0.60	
Van Wert	0.00	0.00	0.20	0.50	0.30	0.30	
Van Wert	0.10	0.20	1.30	1.70	0.80	0.70	
Van Wert	0.00	0.10	0.80	0.70	0.50	0.60	
Van Wert	0.10	0.20	0.50	0.60	0.50	0.70	
Van Wert	0.00	0.10	0.40	0.50	0.10	0.10	
Van Wert	0.10	0.10	0.30	0.70	0.30	0.20	
Van Wert	0.10	0.00	0.80	1.40	0.50	0.40	
Van Wert	0.00	0.10	0.50	0.70	0.50	0.20	
Van Wert	0.00	0.00	0.30	0.50	0.40	0.30	
Van Wert	0.00	0.00	0.30	0.40	0.60	0.30	
Van Wert	0.10	0.10	1.50	1.10	0.80	0.30	
Williams	0.19	0.23	0.27	0.42	1.00	2.61	
Williams	0.03	0.31	0.46	0.56	1.19	2.42	
Williams	0.13	0.06	0.21	0.13	0.13	0.50	
Williams	0.00	0.08	0.19	0.31	0.56	1.08	
Williams	0.22	0.08	0.08	0.15	0.40	0.72	
Williams	0.04	0.25	0.15	0.13	0.25	0.31	
Wood	0.00	0.05	0.03	0.15	0.12	0.12	
Wood	0.02	0.07	0.08	0.10	0.06	0.29	
Wood	0.06	0.19	0.07	0.04	0.14	0.14	
Wood	0.00	0.00	0.08	0.07	0.06	0.14	

na = Traps were not in the fields during this trapping period.

Figure 1.

2003 Western Corn Rootworm Sweep Net Survey in Soybean
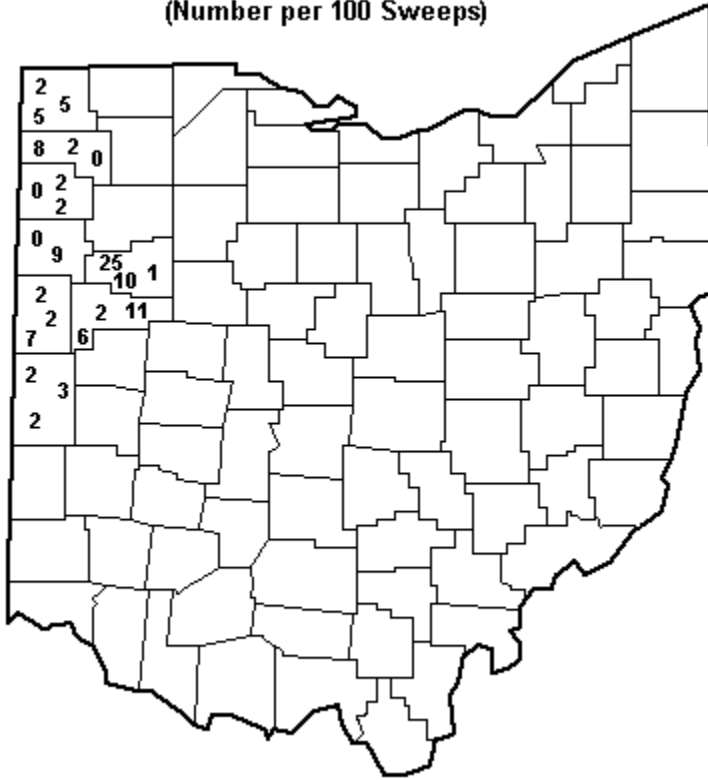(Number per 100 Sweeps)

Table 2. - Multi-colored Asian Lady Beetles – Average/Trap/Day

County	July 30	Aug 6	Aug 13	Aug 20	Aug 27	Sept 3	Sept 10
Auglaize	0.21	0.07	0.23	0.23	0.31	**0.81**	
Auglaize		0.31	0.33	0.42	0.64	1.29	2.89
Allen	0.05	0.10	0.12	0.24	0.13	**0.52**	
Allen	0.07	0.24	0.33	0.21	0.19	**0.40**	
Allen	0.07	0.33	0.26	0.14	0.15	**1.31**	
Allen	0.05	0.07	0.50	0.29	0.27	**0.90**	
Allen	0.21	0.26	0.24	0.25	1.08	**3.40**	
Butler	0.29	0.05	0.07	0.10	0.17	**0.24**	
Butler	1.29	**2.45**	0.79	0.31	0.33	0.31	
Butler	0.07	0.17	0.17	0.12	0.15	**0.31**	
Butler	0.12	0.31	0.07	0.31	0.29	**1.40**	
Champaign	0	0.07	0.07	0.19	0.21	0.43	**2.09**
Champaign	0	0.09	0.12	0.17	0.19	0.43	**2.88**
Crawford	0.05	0.19	0.23	**0.75**	0.25	0.15	
Crawford	0.07	0.11	0.33	**0.50**	0.17	0.15	
Crawford	0.10	0.19	0.50	**0.64**	0.22	0.35	
Crawford	0.03	0.14	**0.65**	0.50	0.17	0.50	
Darke			**0.14**	0.00	0.07	0.10	
Darke	0.40	**0.45**	0.24	0.08	0.21	0.35	
Darke	0.17	0.21	0.31	0.29	0.10	**0.33**	
Darke	0.07	0.05	0.19	0.12	0.28	**0.45**	
Darke	0.19	0.07	0.36	0.38	0.38	**0.62**	
Defiance	0.09	0.10	0.09	0.17		**0.17**	
Defiance	0.05	0.13	0.30	0.39		**0.77**	
Defiance	0.09	0.07	0.07	0.24		**0.60**	
Defiance	0.06	**0.27**	0.08			0.25	
Henry	0.17	0.12	**0.83**	0.63	0.33	0.58	
Henry	0.21	0.21	0.44	**1.08**	0.36	0.62	
Henry	0.10	0.10	**0.50**	0.25	0.29	0.36	
Henry	0.03	0.13	**0.50**	0.16	0.07	0.14	
Henry	0.17	0.05	**0.53**	0.46	0.38	**0.53**	
Henry	0.02	0.07	0.21	0.56	0.45	0.43	
Mercer	0.12	0.21	0.33	0.14	0.07	**0.67**	
Mercer	0.17	0.21	0.24	0.12	0.12	**0.98**	
Mercer	0.26	0.07	0.17	0.36	0.26	**0.48**	
Mercer	0.21	0.09	0.12	0.12	0.14	**0.36**	
Miami		0.33	0.33	0.21	0.22	0.61	**1.86**
Miami		0.29	0.45	0.10	0.14	0.74	**0.86**
Miami		0.12	0.40	0.17	0.24	0.63	**2.11**
Miami		0.07	0.12	0.26	0.43	0.57	**2.44**
Miami		0.02	0.05	0.10	0.14	0.57	**0.58**
Morrow			0.25	0.35	0.50	**0.81**	
Morrow			0.31	0.39	**0.98**	0.19	
Paulding	0.07	0.24	0.21	0.17	0.25	**0.94**	
Paulding	0.29	0.50	**0.55**	0.26	0.27	0.50	
Paulding	0.14	0.19	0.12	0.19	0.27	**0.42**	
Paulding	0.21	0.26	0.12	0.19	0.08	**0.53**	
Putnam	0.09	0.05	**0.14**	**0.14**	0.05	0.07	

Putnam	0.19	0.12	0.10	0.05	0.14	**0.21**
Putnam	0.10	0.12	0.12	**0.14**	0.12	0.00
Putnam	0.05	0.10	0.02	0.07	**0.12**	0.02
Putnam	0.02	0.17	0.14	**0.26**	0.21	0.24
Shelby	0.00	0.19	**0.36**	**0.36**	0.26	0.05
Shelby	0.12	0.42	0.47	**0.60**	0.17	0.55
Shelby	0.12	0.17	0.21	0.69	0.40	**0.87**
Sandusky	0.00	0.24	0.24	0.21	0.43	**0.69**
Sandusky	0.02	0.38	0.60	0.45	0.19	**0.69**
Sandusky	0.00	0.17	**0.50**	0	0	0.07
Sandusky	0.02	0.00	0.21	0.09	**0.31**	0.17
Van Wert	0.05	0.14	0.02	**0.24**	**0.24**	0.14
Van Wert	0.12	0.02	0.02	0.10	**0.17**	0.02
Van Wert	0.00	0.12	0.12	0.02	0.07	**0.19**
Van Wert	0.14	0.07	0.10	0.10	**0.36**	0.14
Van Wert	0.26	**0.36**	0.24	0.19	0.31	0.02
Van Wert	0.02	0.07	0.19	**0.21**	0.12	**0.21**
Van Wert	0.07	0.00	0.29	**0.50**	0.29	0.36
Van Wert	0.10	0.05	0.21	0.14	0.12	**0.33**
Van Wert	0.02	0.02	0.00	0.10	**0.19**	0.12
Van Wert	0.05	0.07	0.02	0.10	0.02	**0.14**
Van Wert	0.02	0.02	0.07	0.05	0.05	**0.24**
Van Wert	0.07	0.02	0.02	0.19	**0.36**	0.24
Van Wert	0.00	0.00	0.02	0.17	**0.26**	0.21
Wood	0.06	0.43	**0.51**	0.40	0.36	0.29
Wood	0.13	0.24	0.14	0.15	0.12	**0.33**
Wood	0.07	0.14	0.10	0.26	0.42	**0.55**
Wood	0.40	0.36	0.31	0.12	0.35	**0.74**
Williams	0.09	0.17	0.08	0.10	0.25	**0.42**
Williams	0.13	0.13	0.10	0.19	0.17	**0.69**
Williams	0.02	0.06	0.13	0.19	0.19	**0.31**
Williams	0.11	0.19	0.17	0.23	**0.33**	0.14
Williams	0.15	0.08	0.19	0.19	**0.23**	0.11
Williams	0.06	0.25	0.31	0.46	0.44	**0.53**

Effect of nozzle type on glyphosate efficacy and spray particle drift

Jeff M. Stachler, Mark M. Loux, Erdal Ozkan, Clark S. Hutson, and Steve D. Ruhl

BACKGROUND:

Recent innovations in spray nozzle technology may help applicators achieve effective weed control while reducing spray particle movement. Laboratory and field tests have shown the effectiveness of new nozzle types for reduction of spray drift. However, pesticide applicators are reluctant to switch to new nozzles because limited information is available on the effectiveness of these nozzle types for controlling weeds. Chemical labels provide little or no guidance on the use of using new nozzles. The major objective of this study was to evaluate the effectiveness of low-drift nozzles in weed control. We also investigated the drift and spray coverage from conventional and low-drift nozzles.

METHODS:

Field studies were conducted at three locations in 2003 to determine the effect of nozzle type and drift control adjuvant on herbicide effectiveness and spray particle drift. A field-size study was conducted near Tiffin, OH, and small-plot studies were conducted near South Charleston and Chesterville, OH, respectively, in 2003. At Tiffin and Chesterville, glyphosate was applied postemergence in glyphosate-resistant soybeans. The factors at these sites included nozzle type (XR Teejet at 40 psi, Turbo Teejet at 40 psi, AI Teejet at 40 and 60 psi) and drift control adjuvant (0 and 2.5 gal/100 gal spray mixture of Corral AMS Liquid, a liquid ammonium sulfate plus a polyacrylamide drift control adjuvant). At Tiffin, treatments were applied in a spray volume of 15 gallons per acre (gpa) with a commercial-sized Patriot sprayer using 0.3 gal/min nozzles. Plot size was 60 ft wide by 711 to 1212 ft long (length of field). Spray coverage at the canopy level and in the canopy (~ 2 inches above soil) was measured using 26 by 76 mm water-sensitive paper. GPS coordinates were used to mark at least two patches of each weed species evaluated per plot. Weed control was evaluated 28 DAT. At Chesterville, treatments were applied with a hand-held carbon dioxide-pressurized sprayer using 0.2 gal/min nozzles and a spray volume of 15 gpa. Plot size was 10 feet wide by 40 feet long. Weed control was evaluated 14 DAT.

In the study at South Charleston (at the OARDC Western Branch), treatment factors included nozzle type (XR Teejet at 40 psi, Turbo Teejet at 40 psi, AI Teejet at 60 psi), herbicide (glyphosate or a combination of fomesafen plus fenoxaprop plus fluazifop), and herbicide rate (recommended and 67% of recommended). An additional two treatments consisted of the drift control adjuvant with recommended rates of both herbicide treatments applied with the AI nozzle at 60 psi. Herbicides were applied postemergence to glyphosate-resistant soybeans with a tractor-mounted, carbon dioxide-pressurized sprayer using 0.2 gal/min nozzles and a spray volume of 15 gpa. Plot size was 10 feet wide by 65 feet long. Weed control was evaluated 26 DAT.

RESULTS:

In the small-plot study at Chesterville, all treatments controlled at least 98% of the giant foxtail, giant ragweed, and common lambsquarters, and control was not affected by nozzle type or drift control adjuvant. In the field-size study at Tiffin, there was no significant interaction between nozzle type and drift control adjuvant, allowing comparison of main effects only. There was no difference in nozzle type or drift control adjuvant for control of Canada thistle and seedling dandelion. Nozzle type affected control of yellow nutsedge, common ragweed, and Venice mallow at an alpha level of 0.05,

and control of common lambsquarters and velvetleaf at an alpha level of 0.1. Results were as follows for control of these weeds (where a nozzle type is not listed, that nozzle was not different than any of the other nozzles): yellow nutsedge – XR=AI (40 psi)>AI (60 psi); Venice mallow and velvetleaf – XR>AI (40 and 60 psi); common ragweed – XR=Turbo Teejet>AI (60 psi); common lambsquarters - AI (40 psi)=Turbo Teejet>XR. The addition of the drift control adjuvant did not affect common lambsquarters control, but reduced control of velvetleaf, Venice mallow, and yellow nutsedge at an alpha level of 0.05, and common ragweed at an alpha level of 0.1. The greatest reduction in control occurred for velvetleaf and Venice mallow, for which the addition of the drift control adjuvant reduced control from 85% to 59 and 64%, respectively. Wind speed and direction were extremely variable during herbicide application at Tiffin, and no differences were observed among treatments with regard to spray particle drift.

In the small-plot study at South Charleston, control of redroot pigweed was not affected by nozzle type, herbicide type, or herbicide rate. Glyphosate controlled giant foxtail and common lambsquarters more effectively than fomesafen plus fenoxaprop plus fluazifop regardless of nozzle type or herbicide rate. At recommended rates, there was no difference in the control of giant foxtail or common lambsquarters among nozzles within herbicide treatment. At 67% of the recommended rate, the AI nozzle was more effective than the Turbo Teejet nozzle on these weeds. At recommended rates, there was no difference in giant ragweed control between glyphosate and the fomesafen mixture with the Turbo Teejet and AI nozzles and with the glyphosate and XR nozzle treatment, however reduced control was observed for the fomesafen mixture and XR nozzle treatment.

SUMMARY:

Nozzle type and drift control adjuvant affected weed control with a large commercial sprayer, but not with small plot sprayers. In the commercial sprayer, glyphosate was generally more effective when applied with XR Teejet or Turbo Teejet nozzles, compared to AI nozzles. The addition of a polyacrylamide drift control adjuvant reduced the effectiveness of glyphosate on most weed species when applied with a commercial sprayer. These results indicate that adjustment of spray equipment or adjuvants to reduce drift can reduce herbicide effectiveness. However, some reduction in drift can be achived without sacrificing herbicide effectiveness (e.g use of Turbo Teejet nozzles).

"Environmental factors that may affect sulfentrazone (Spartan) selectivity and safety on newly strawberry plantations"

(Second year of funding to complete the study)

Principle Investigator(s):   Dr. Douglas Doohan and Dr. Rodrigo Figueroa
Phone Number: (330) 263-3820
Fax: (330) 263-3887
E-mail: doohan.1@osu and figueroa.21@osu.edu
Cooperating Institution: Ohio State University
Mailing Address: 1680 Madison Ave, Wooster OH 44691
Other Key Personnel: Dr. Dick Funt

Objectives(s) of research proposal:
Our goal is to investigate environmental, biological and cultural factors that may influence the safety of using Spartan (sulfentrazone) on strawberry plantations.

To achieve our goal it will be necessary to do the following:
1. Determine the crop sensitivity under different soil conditions, specifically pH and texture.
2. Determine the lethal dose required for a series of common weed species present in strawberry crops.
3. Determine sulfentrazone activity at different stages of weed development (ie PRE, Early POST, and Late POST)
4. Determine sulfentrazone selectivity on different strawberry cultivars used by farmers in Ohio.

Objectives 1 & 4: Field studies were established at Wooster, Ohio (81°58' W longitude, 40°45' N latitude, elevation 310 m) during 2002. 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. The crop was protected from pests in 2003 following OSUE recommendations and ripe berries were harvested approximately every 3 days over 3 weeks. Data were analyzed using general lineal models procedures. When significant differences occurred orthogonal contrasts were used for mean separation at the 5% significance level.

Strawberry tolerance to sulfentrazone applied immediately after planting was affected by soil pH. Strawberry plants were stunted more at soil pH 7 than at pH 5. 'Jewel' was relatively insensitive to sulfentrazone. Plant stunting at soil pH 5 was only detected at the highest rate (0.4 kg/ha) 6 WAA. Visual estimates of stunting indicated that 'Jewel' tolerance 3 WAA was reduced at soil pH 7; however, the cultivar had recovered 6 WAA except for those plots treated with sulfentrazone at 0.4 kg/ha. 'Allstar' was more sensitive to sulfentrazone than was 'Jewel' and recovered more slowly. At soil pH 5, 8% stunting was observed 3 WAA with 0.4 kg/ha, and by 6 WAA stunting was obvious at each rate of the herbicide. 'Allstar' was severely stunted by sulfentrazone at soil pH 7, 3 WAA. Six WAA some recovery had occurred but stunting was still apparent at 0.2 and 0.4 kg/ha. Measures of strawberry plant diameter were not sensitive to differential stunting caused by sulfentrazone rate and soil pH. Plant diameter did not vary within a cultivar across rates of sulfentrazone at 3 or 6 WAA. However, measurement of this variable at 6 WAA illustrated the greater plant size achieved by 'Jewel' compared to 'Allstar' and the enhanced growth of both cultivars at pH 5 compared to pH 7. These data suggest that visual estimates provide a superior integration of the variables involved in the strawberry plant's phytotoxic response to sulfentrazone than do the quantitative measures of plant growth used in this study. Fruit yield was not affected (p= 0.2194) by sulfentrazone at the rates evaluated (0 to 400 g/ha). These results are consistent with those of Wehtje et al. (1997) who reported improved control of *Cyperus* spp. with sulfentrazone when soil pH was greater than 6.6. Improvements in weed control and greater crop sensitivity may both be attributed to increased sulfentrazone availability in solution for absorption by plants at soil pH > 6.6 (Grey et al. 1997).

Objectives 2 & 3: A greenhouse experiment was performed to determine the response of common groundsel, common mallow, common chickweed, common purslane, redroot pigweed, and yellow wood sorrel at various growth stages to a range of sulfentrazone rates. On April 17, 2003 individual species were seeded in 110 mm plastic pots containing a Promix BX[1] that consisted of: Canadian sphagnum peat moss (75-85% volume), perlite, vermiculite, dolomitic and calcitic limestone and a wetting agent. Seeded pots were placed in a greenhouse mist room (25 ± 1 °C) set to mist every 10 min for 10 s intervals. Plants were watered as needed and fertilized once a week with 200 ppm of a 20:20:20 (N:P:K) solution. To produce four seedling stages: PRE (preemergence), COT (cotyledon stage), EPOST (early post seedlings with 4 fully expanded leaves) and LPOST (late post seedlings with 10 fully expanded leaves), seeding was done four times 10 days apart. To promote plant hardening and leaf cuticle development, after one week in the mist room seedlings were moved outdoors to benches under direct sun light. The shortest interval between moving seedlings outside and herbicide application was 1 week for plants at COT. A split plot design was used, with weed seedling stages as the main plot and sulfentrazone rate (0, 0.25, 0.50, 0.1, 0.2 and 0.4 kg/ha) as the subplot. Four replications were used. All weed seedling stages were sprayed at the same time. A compressed-air laboratory sprayer equipped with TJ-8003VS flat fan nozzles calibrated to deliver 187 L/ha at a pressure of 276 kPa was used. Weed response to sulfentrazone was estimated by measuring plant height 3 WAA. The experiment was repeated. ANOVA was conducted using SAS GLM procedure, including analysis of interactions between main factors (weed seedling stages, sulfentrazone rates and experiment replication). Seedling height 3 WAA of all sulfentrazone treated weeds was converted to percent of the untreated control. Each weed seedling stage was regressed on sulfentrazone rate using the SAS NLIN procedure. This procedure produced the parameters needed to fit a log-logistic function (Seedfeldt et al. 1995) and obtain the rate-response curves defined by the equation:

$$\text{\% of control height} = C + (D - C) / (1 + (x/GR_{50})^{b}) \qquad [1]$$

Where C = the mean response of the highest dose; D = mean response of the untreated; b = slope; x= sulfentrazone rate; and GR_{50} = 50% growth reduction.

Weed seedling growth stage at the time of sulfentrazone application influenced subsequent plant growth. Common chickweed was the only species inadequately controlled by sulfrentrazone, regardless of application rate or stage of growth. Amongst the other, sensitive species, control with applications at PRE and COT were equivalent with essentially complete control achieved when the herbicide was applied at 50 – 100 g *ai*/ ha; however, yellow wood sorrel was only controlled when the herbicide was applied PRE. Later applications at EPOST and LPOST were progressively less effective. In the e case of common mallow, redroot pigweed and common purlsane LPOST treatments did not provide adequate control.   Common groundsel was slightly more sensitive LPOST than EPOST. Groundsel was completely controlled when sulfentrazone was applied PRE at 0.025 kg/ha, and at 0.05 kg/ha to seedlings at the COT stage. These data indicate that sulfentrazone applications should be timed PRE or to coincide with seedling emergence to achieve optimum control.

Literature Cited

Grey, T. L., R. H. Walker, G. R. Wehtje and H. G. Hancock. 1997. Sulfentrazone adsorption and mobility as affected by soil and pH. Weed Science 45: 733-738.

Seedfeldt, S., J. Jensen and P. Fuerst. 1995. Log-logistic analysis of herbicide dose-response relationships. Weed Technology 9: 218-227.

Wehtje, G. R., R. H. Walker, T. L. Grey and H. G. Hancock. 1997. Response of purple (*Cyperus rotundus*) and yellow nutsedges (*C. esculentus*) to selective placement of sulfentrazone. Weed Science 45: 382-387.

---

[1] Premier Horticulture Inc., Red Hill, PA, 18076.

Field Evaluation of the Percentage of Overlap for Crop Protection Inputs with a Foam Marker System

M. Reza Ehsani[1], Matthew Sullivan[1], and Tom Zimmerman[2]
[1]Department of Food, Agricultural, and Biological Engineering, OSU, Columbus, OH
[2]Agricultural Technical Institute, OSU, Wooster, OH

Introduction

As farm size increases in acres and locations, the need to have crop inputs applied by a custom application company increases as well. Crop inputs such as chemicals and fertilizers are applied with large application equipment with boom widths of 18.2 to 27.4 meters (60-90 ft). In order to maintain a quality application with no gaps in coverage, the operator overlaps the inputs applied to the field. These overlaps increase the amount of inputs in the field, decrease the efficiency of the custom application process, and increase costs and possible environmental effects.

GPS-based guidance technology enables applicators to drive in a straight line and apply agriculture inputs more accurately. Most field operations entail driving machinery in a series of parallel passes over a field. Operators must concentrate on driving accurately on parallel passes to avoid overlap as well as leaving gaps in the field which is very exhausting; especially with some of the new wider and faster field equipment. GPS-based guidance can reduce not only the overlap of chemical inputs, but can be used at all hours of the day and times of the year. This flexibility enables the applicator to choose the correct time to apply chemical inputs to minimize over usage or off-target application. These systems also reduce the applicator's fatigue level during critical application times. Even though this technology is popular, there are a large percentage of applicators still using foam to determine the placement of inputs. Knowing the accuracy of a foam marker system is important from the standpoint of knowing how much overlap is occurring, which ultimately affects the number of application acres and the amount of chemical inputs used. If this error can be quantified, then the amount of savings in time and inputs can be calculated and changes can be made to application practices.

There has always been some type of error and limitations associated with using a foam marker system. The foam may drop below the canopy, there may also be uneven distribution on a windy day; it freezes during the winter months and is hard to see with reduced visibility and evaluate from pass to pass as the spray booms have become wider with more boom bounce. There are several factors that influence the overall accuracy of a foam marker system namely, speed of machine, elevation of the ground, width of the machine, type of equipment, experience of the driver and type of field. Under an optimal simulated spraying condition, a 2-3% efficiency was observed using a guidance system compared to a foam marker with an experienced applicator (Ehsani et. al., 2002, Buick and White, 1999). Much higher error (up to 10%) has been observed using a foam marker compared to a guidance system (Medlin and De-Boer, 2000). Simulated and observed error can not fully explain all the error associated with a foam marker system

during the real application of chemical inputs. All of these factors can influence the performance and overall accuracy of a foam marker. Measuring the error due to each of the aforementioned factors may be possible, but is a very time consuming and difficult task. Moreover, the end users are mainly interested in knowing the overall error of the foam marker system in the field. Thus, the objective of the project is to evaluate the error associated with a foam marker applicator using an RTK-GPS under real field conditions.

There have been several estimations of the degree of overlap (from 0 to 10%) from custom applicators, but none have been able to quantify the actual overlap of inputs with a foam marker application system using a global positioning system (GPS).

Objectives

The goal of this study was to quantify the application accuracy on custom application equipment that are using a foam marker system under field conditions.

Methods

Drivers from two custom applicators who use foam marker application equipment were selected to participate in the study. The drivers varied in age and experience of using foam application equipment. The sprayers used in the study were an Ag-Chem Terragator 1803 with a 25.9 m (85 ft) spray width and an Ag-Chem RoGator 1254 with a 27.4 m (90 ft) boom width. Soil and weather conditions were suitable for spraying. The wind speed varied from 6.44 to 12.88 km/h. The soil was moist to dry. The custom application equipment drove through corn stalk residue with a 2 to 6% ground slope. White foam was distributed from the end of the boom in a 3.81 cm diameter hose. The speed of the application equipment ranged from 20.8 km/h to 27.2 km/h.

The exact location of the vehicle in the field was determined by a Real Time Kinematic (RTK) GPS (Trimble 4800 rover unit and Trimble 4700 base station). Data from the RTK GPS rover unit were collected every second using a Trimble TSC1 data collector and survey controller unit. The RTK GPS rover unit was placed in the center of the vehicle for the Terragator and RoGator (figure 1). The RTK base station was located near (less than 5 km) the research fields (figure 2).

Figure 1. Location of RTK rover unit on Terragator roof

Figure 2. View of RTK base station and Terragator

The total length of the field was divided into separate segments. Those segments were evaluated for pass-to-pass and overall accuracy. A computer program was written to analyze the raw data and display the results. From the initial A-B line, the program first identified the swath line. Knowing the swath number and swath width, the program was able to determine the desired distance of each swath to line A-B, i.e. 27.4 meters (90 ft) for swath line #1 and 54.7 meters (180 ft) for swath line #2 and so on. Using the vehicle's actual position, which was recorded by the RTK GPS in the data logger, the perpendicular distance of each RTK point position for each swath line was calculated from the line A-B. At the end, the actual error from desired position was calculated. For each line, mean error and standard deviation of error were calculated using the following equations:

$$(1) \qquad m_j = \frac{1}{N} \sum_{i=1}^{N} e_{ij}$$

$$(2) \qquad rms_j = \sqrt{\frac{1}{N} \sum_{i=1}^{N} e_{ij}^2}$$

$$(3) \qquad std_j = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} \left(e_{ij} - m_j \right)^2}$$

Where:

N   th e number of data obtained from line j

e_{ij} the distance from point i to its desired line j

m_j the mean error of line j

rms_j the rms value of line j

std_j the standard deviation of error for line j

Results

       The pass-to-pass and all-field overlap from driver one is shown in table 1. Pass-to-pass is the measure of percent of overlap for each pass when the actual position of vehicle and desired position compared to the previous pass. The all-field overlap is the measure of percent of overlap when the actual position of vehicle and desired position of vehicle in last pass compared to the first pass. The all-field average of 6.3% for driver one indicate that the overall overlap is for the whole field is less than the 10% error reported by Medlin and De-Boer (2000) but it is slightly more than 5% that is reported by some custom applicators. The minimum and maximum pass-to-pass accuracy varied from 1.0% to 26.9%. The average of pass-to-pass error for driver one was 4.9 % with a standard deviation of 5.4 % which indicate a large variability of percent of error from pass-to-pass. Driver one tended to overlap, which is more desirable to the farmer than having skips.

	Driver 1	Field A	Field B	Field C	Overall
	Number of tested sections	32	13	25	70
All Field Overlap (%)	Average	8.4	6.3	4.2	6.3
Pass-to-Pass Overlap (%)	Max	5.2	26.9	23.2	26.9
	Average	3.2	5.5	5.9	4.9
	Min	1.0	0.6	0.8	0.8
	Standard deviation	1.4	8.1	6.8	5.4

Table 1. Pass-to-pass and all-field overlap for driver 1.

	Driver 2	Field A	Field B	Overall
	Number of tested sections	70	32	102
All Field Overlap (%)	Average	3.0	0.6	1.8
Pass-to-Pass Overlap (%)	Max	3.7	2.8	3.7
	Average	3.9	1.2	2.6
	Min	0.0	0.3	0.2
	Standard deviation	6.0	1.0	3.5
	Pass-to-Pass miss (Number of sections)	33	19	52
	Pass-to-Pass miss (%)	-0.8	-1.36	-1.1

Table 2. Pass-to-pass, all-field overlap and misses for driver 2.

The pass-to-pass and all-field overlap from driver two is shown in table 2. For the three fields, driver two had an average pass-to-pass overlap of 2.6% with an average standard deviation of 3.5%. The minimum and maximum pass-to-pass accuracy varied from 0% to 3.7%. Generally, custom applicators tend to overlap with no skips (non-applied areas), but driver two had areas where the skips averaged from -0.8 to -1.36%. In field A, driver two had 33 sections out of 70 where skips were observed. Similar results were observed in field B with 19 out of 32 sections with skips. The overall pass-to-pass misses were 52 out of 102 sections. Driver two may have a lower all-field overlap percentage and actually be more cost effective, but the percentage of skips in the fields may provide a problem from not reducing the pest population to the desired threshold. It is believed that since driver two knew about the objective of this research and perhaps was trying to reduce the percent of overlap error, resulting in more under application area, atypical for most custom applicators.

Conclusions

Important results and issues related to the overlap of custom application equipment were quantified. The procedure used in this study was very effective in measuring not only the overall percent of overlap but also the pass-to-pass percent of overlap. The installation and use of measurement equipment on the custom applicator was relatively easy and fast and had the minimum amount of interference with their job. Both field experiments provided valuable information on how to approach the dynamics of custom application operations. There was a difference between drivers on the percentage of overlap. More tests with different drivers are needed to quantify the effect of the driver and parameters related to driver such as age, experiences, time of day.

The results of this study can be used for cost-benefit analysis and justification of buying a guidance aid to replace or compliment the current foam marker system. On average, a custom applicator will spray 10,000 acres during a spraying season. From the data obtained in this study, the average overlap for driver 1 was 6.3%. With this amount of overlap, the applicator would apply 630 extra acres over the spraying season. The excess cost for crop protection products and per acre charge could be over $8000 per year if no overlap is occurring. Monitoring custom applicator overlap and providing solutions such as GPS guidance aids to reduce the overlap and skips are the next steps in improving the crop protection application process. If the overlap can be reduced by 3 to 4%, while eliminating skips, the cost savings in chemical application will offset the cost of guidance steering aids.

References

Buick, R. and E. White. 1999. Comparing GPS guidance with foam marker guidance. In: Proc. Of the 4th Int'l Conf. on Precision Agriculture, editors: R.H. Rust and W.E. Larson, ASA/CSSA/SSSA, Madison, WI.

Ehsani, M. R., Matthew Sullivan, Dr. Joel T. Walker, T. L. Zimmerman. 2002. A Method of Evaluating Different Guidance Systems. 2002 ASAE Annual Meeting. Paper number 021155.

Medlin, C. and J. Lowenberg-DeBoer. 2000. Increasing cost effectiveness of weed control. In: Precision Farming Profitability, SSM-3, editor: K. Erickson. Purdue University, West Lafayette, IN pp 44-51.

Final Report For IPM Block Grants, Urban Entomology

Title: **IPM Demonstration Projects in Ohio Elementary Schools to Increase Awareness of Head Lice**

Principal Investigator: Susan C. Jones, Ph.D.
Urban Entomologist
The Ohio State University
Department of Entomology
Extension Entomology Building
1991 Kenny Road
Columbus, OH 43210-1000

Head lice (*Pediculus humanus capitis* De Geer) are tiny parasitic insects that can infest humans of any age, but they most commonly occur among children who have close contact with each other at school and at play. Approximately 5 to 10% of all school-age children contract head lice at one time or another (Chunge et al., 1991). Each year in the United States, head lice infect approximately 6 to 12 million persons (Atkinson et al., 1986). Head lice have afflicted humans for millennia (reviewed by Mumcuoglu, 1996).

Head lice are an important community issue, causing disruptions to families, schools, and the workplace. Many school systems in the U.S. advocate a "no-nit" policy, which requires the removal of all head lice and nits (eggs) before a child can return to class. The associated costs to families and to society include: school absenteeism, lost wages, workplace disruptions, and unwarranted ridicule, embarrassment, or blame. The monetary cost to treat head lice infestations is conservatively estimated at $100 million annually (Carson, 1997).

The social stigma that surrounds head lice outbreaks can result in embarrassment and a secretive "home remedy" approach to treatment. Instead of asking for assistance from reliable sources, people who need to know how to control head lice often resort to seeking anecdotal advice from friends and family. Unfortunately, most "home remedies" used by well-meaning parents and caregivers are ineffective; many also are unsafe and directly cause other health problems.

Historically, and even today, chemical treatments have been the preferred method of head lice control. However, there is increasing evidence that head lice have developed resistance to many insecticides (Carson, 1997). Sadly, uninformed consumers risk unnecessary chemical

exposure as they misuse over-the-counter insecticidal products or repeatedly use ineffective "home remedies."

Outreach Efforts

During March 2002, the Ohio School IPM Program in conjunction with an EPA grant allowed for distribution of head lice prevention materials to approximately 2,700 elementary schools throughout Ohio. The head lice information packet contained a sheet of four awareness stickers conveying the message, "Be Aware, Please Don't Share" head lice, a cover letter to the school nurse to gauge interest in distributing awareness stickers to students, a quiz to assess children's awareness of head lice, and a public information sheet regarding the safe use of pesticides. The packet also included a complimentary copy of Ohio State University's Extension Bulletin 893 (Head Lice) that described how to safely deal with head lice.

Based on this initial mailing, 95 schools requested sufficient numbers of awareness stickers for approximately 15,000 students. These schools were located in 40 of Ohio's 88 counties. The purpose of the awareness stickers was to increase children's knowledge of head lice, how these parasites are spread, and how to avoid becoming infected. The results of the quiz given to children pre- and post-receipt of the awareness stickers indicated that these stickers are an effective method to increase children's awareness of head lice. The children's awareness stickers are large, colorful stickers that are designed to teach children, in a fun way, some things that they can do to help stop the spread of head lice.

2003 IPM Block Grant

An IPM Block Grant of $3,500 was awarded in March 2003 to sponsor age-appropriate demonstration projects for students and staff at elementary schools in Ohio. The project was implemented with the assistance of an independent contractor, Judy Bozick, who is an R.N. with considerable knowledge of head lice and "nitpicking".

In late April 2003, a letter was sent to school nurses announcing the availability of IPM demonstration projects for students and staff at elementary schools in Ohio. An announcement also was sent to the Ohio Department of Education for inclusion in their May newsletter. In addition, the 95 schools that participated in the awareness sticker program during FY 2002 were contacted to provide follow-up data on the number of children contracting head lice and the total number of days that children were absent due to the presence of nits or lice. These school nurses

also were queried as to their general impressions or comments regarding the usefulness of the awareness stickers.

School nurses indicated that they were interested in this IPM demonstration project, but they were unable to participate because of the timing of the grant. When this grant was announced in late April and early May, school activities already had been scheduled until the end of the school year (typically early June) and classes were not in session during the summer. Furthermore, the grant monies had to be spent by 30 September, but schools had difficulty implementing training sessions at the beginning of the school year (late August into September). The demonstration project was conducted in one school, Hilliard Elementary, in September 2003. In the future, increased participation is anticipated with outreach efforts that can be announced at the beginning of the school year and that are available from fall through spring.

In order to facilitate demonstration projects in schools, several pieces of educational artwork were created and a detailed notebook was prepared describing IPM procedures for managing head lice. These materials are available on loan from OSU Extension Entomology for teaching efforts pertaining to head lice. Thus, demonstration projects can be readily conducted in schools in the future.

Of the 95 schools that participated in the awareness sticker program during FY 2002, 25 (26.3%) responded to the request for follow-up information. Comments regarding the usefulness of the awareness stickers included such positive responses as: "Great."; "Kids loved them!"; "The children liked them, and they were useful to teach the basic facts they need to know."; "Easy to understand message due to picture format."; "Reinforces information regarding transmission."; "Were well received and good reminders."; "Stickers and parent sheets used as a follow-up and parent education. Thanks."; "The kids liked them."; "The stickers were received gladly by the students—it gave me a prompt to do the 'lice' lesson and hopefully was a reminder to parents."; "The younger students enjoyed the stickers and felt rewarded for knowing about head lice.". There were only two negative responses: "Don't think stickers are of value. I think a book or a story about lice would be more appropriate."; "Do not seem to be effective; however, effective to some individuals." Overall, positive feedback was received regarding the children's awareness stickers. Additional stickers were mailed to three schools per their request.

Some schools provided detailed data regarding the numbers of children contracting head lice and days absent due to the presence of nits or lice. However, most did not provide necessary information on the timing of educational efforts. Too few data are available to interpret time trends.

Continuing efforts are needed to reinforce IPM approaches to head lice control. It is particularly important to further educate children and families as to the basics of head lice transmission and prevention. Prevention of head lice is the foundation for management efforts. Children that know the basic facts about head lice can become the first line of defense in the on-going battle to prevent head lice infestations. Successful prevention efforts also are expected to decrease the use of pesticides for head lice control. Head lice awareness and the concomitant decrease in insecticides and their misuse will benefit society's children, families, and communities.

2003 IPM Mini Grant Program
Final Report

Title: Improving Access to Relevant and Reliable Information About the Practice of IPM in Schools for Ohio School Districts

Principal Investigator: Margaret Huelsman, Ohio School IPM Program Coordinator

The Ohio School IPM Program received $2382 to mail the manual <u>IPM in Ohio Schools</u> to all public school districts. The manual was adapted from a school IPM manual written for Pennsylvania schools. The original intent was to mail the manuals in the fall of 2003. However the manuals were not available to mail until November due to printing delays. In the mean time it was learned that the Ohio Pesticide Education Program was planning a series of trainings targeting school personnel. The new Ohio pesticide law will require after July 2004 that anyone who applies pesticides on school property must be licensed to do so. The tightening of the pesticide law as it applies to schools provides an excellent opportunity for the promotion of IPM in schools. Therefore it was determined to be mutually beneficial for both programs to mail the flyer announcing the pesticide certification trainings with the manual. This will allow us to use the new pesticide education law to emphasize the need for an IPM in School and give the schools options for dealing with change (e.g. get someone licensed and/or implement IPM). Furthermore the Pesticide Education Program has only received a small grant to conduct these training programs for school personnel. By eliminating the cost for postage more money can be spent on programming. The flyer for the pesticide certification training program will not be finished until January 2004 as they are still working out the details for each training site. Consequently the <u>IPM in Ohio Schools</u> manual will be mailed with the Pesticide Education Program flyer to Ohio schools in February 2004 at a cost of $1985. The book <u>Exploring Urban Integrated Pest Management</u> will not be mailed with any of the <u>IPM in Ohio Schools</u> manuals as originally proposed. These books will be given to the elementary schools in our new pilot program with the Westerville City Schools as a reward for participation in the program.

IPM programming by the Extension Nursery, Landscape, and Turf Team

Key Cooperators

Dan Herms
Randy Zondag
Charles Krause
Nancy Taylor
Dave Shetlar
Enrico Bonello
Denise Ellsworth
Pam Bennett
Joe Boggs
Erik Draper
Dave Dyke
Curtis Young
Amy Stone
Jim Chatfield

A. **Phenology Project.**

1. This project, led by Dan Herms, continues to develop with another year of data from Wooster and the Lake County nursery area, and the extrapolation of the phenology information to the rest of Ohio for the timing of insect and mite management practices.

2. Check out the latest phenology calendar information on the following website:
http://www.oardc.ohio-state.edu/gdd/

3. The newest component of this project, coordinated by Denise Ellsworth and Dan Herms, is the planning for Phenology Gardens throughout Ohio, from Lake County nurseries to OSU Extension Piketon Center, from the OSU Extension Clark County trial gardens to the OARDC's Secrest Arboretum in Wooster.

4. Phenology and growing degree day information was included as a regular portion of the Buckeye Yard and Garden Line (BYGL) weekly electronic newsletter during the growing season of 2003.

B. **Herbaceous IPM Project.**

1. Images of herbaceous landscape annual and perennial diseases, insects, and mites were taken by ENLTTers throughout the 2003 season as part of their survey for these diseases and pests. Nodes of this project were in northeast Ohio, central Ohio, southwest Ohio, and west central Ohio.

2. These images are now being catalogued and with one more year's work will be used for a publication of Diseases and Insects of Herbaceous Annuals and Perennials to be published by the

Ohio Nursery and Landscape Association (ONLA) as part of the ENLTT's partnership with ONLA. A CD will also be developed with this information. Publication with nationwide distribution is anticipated by the end of 2004.

3. This project has already yielded raw materials (slides and Power Point presentations) for several perennial disease programs for the green industry and general public around Ohio, including several in Geauga County, in Lucas County, and in Clark County.

C. **Lake County IPM Project.**

1. Biweekly Nursery/Landscape IPM programs are conducted by Randy Zondag and Dan Herms with growers and other green industry professionals, discussing phenology, pest management, monitoring, pesticide application technology, and diagnostic topics.

2. This project is linked to the United States Department of Agriculture and Charles Krause's USDA-ARS pesticide Application Technology Research Unit which is involved in finding the most efficient ways to apply pesticides by improving coverage and reducing non-target application. This project also involves linking IPM strategies to improved environmental monitoring. See the following websites developed for such monitoring.

http://lake.osu.edu/hort/pg1.htm

http://www.oardc.ohio-state.edu/usdaweather/

3. For more on the USDA connections to the ENLTT project, see articles in the OARDC/OSUE *Ornamental Circular* for 2003, to be published in January, 2004.

D. **Other IPM Projects.**

1. Emerald Ash Borer (EAB). IPM perspectives on EAB are included in articles in the 2003 *Ornamental Circular*, throughout the season in the BYGL, in the special December 2003 Emerald Ash Borer special edition of the BYGL, and numerous programs including EAB information for arborists, landscapers, diagnosticians, and the general public. Dan Herms also led several ENLTT-sponsored EAB tours for team members, for the green industry and for public officials and is heavily involved in statewide, regional, and national EAB research and management initiatives.

2. Disease surveys of *Phytophthora ramorum* (none found) and pathogenicity studies of honeylocust knot disease were conducted in 2003 by Enrico Bonello.

3. A Riker mount project for insects and diseases of ornamental plants for Extension programming was started in 2003 by the OSU C.Wayne Ellett Plant and Pest Diagnostic Clinic as part of ENLTT's 2003 IPM Project.

MONITORING FOR THE FEMALE CODLING MOTH IN OHIO WITH THE PEAR
ESSENCE KAIROMONE LURE
Ron Becker
Program Assistant, OSU Extension, Wayne County, Ohio

The use of the Michigan spray model for codling moth control has been in use for several years by apple growers attempting to incorporate Integrated Pest Management (IPM) practices into their pest control program. To prevent codling moth damage, this model calls for a pesticide application to be made 250-degree days (base 50) after the biofix. Follow up applications are then made, if needed, after an additional two to three weeks. After several years of using this model, one orchard in Wayne County, Ohio began developing significantly higher moth counts in the pheromone traps used to monitor the male codling moths within the orchard. For the first three years of this phenomenon (1999 to 2001), no additional fruit damage was associated with the increase in moth count. However, in 2002 the orchard experienced a greater than 60% loss due to codling moth damage despite intensive spray efforts according to the Michigan model. This has called into question the value of the model as it relates to Ohio conditions as well as the gender ratio in these large numbers of codling moths. The use of passive interceptor traps as well as Multipher traps baited with a vinegar/molasses-based feeding attractant failed in two previous studies to catch enough moths to determine the gender ratio. The development of the pear essence kairomone lure with the attractant *ethyl(2E,4Z)-2,4-decadienoate* (DA) has given one more option to use to determine this ratio as it is based on a feeding attractant that is attractive to both the male and the female moths.

Methods:
Monitoring was carried out in two separate orchards in Wayne County. Orchard #1 had three blocks of mixed apples, each having had abnormally high pheromone trap counts since 1999. Orchard #2 also had three blocks of mixed apples, but has not experienced the high numbers of codling moths in its traps. Neither orchard had pear trees within 200 yards of the DA baited traps. Orchard #1 has been monitored for codling moths by the county-based IPM program since 1992, and orchard # 2 since 1995.   Each block of apples had three Multipher-3 traps baited with standard Scentry CM lures and one Pherocon-VI delta trap baited with the DA lure. The Pherocon-VI delta trap was used for the DA -baited trap rather than the Multipher-3 trap as it was the type of trap suggested by the supplier (Great Lakes IPM). In addition, each orchard had a Universal Black Light trap (BioQuip Products, Inc.) positioned against a light colored building adjacent to a block of apples. Each black light trap was operated with a timer to turn the trap on at 8pm and off at 2am. The black light traps and Multipher traps used DDVP vapor strips as killing agents. Traps were monitored 2-3 times per week until first catch and weekly thereafter. Traps were set out on April 23. Neither orchard uses mating disruption.

Results:
In orchard #1, which has had the history of high trap counts, the first moths were caught in the pheromone traps on May 5th, with an average of 1.55 moths per trap per week. The first catch for the DA lures was on May 12th when one of the three traps within the orchard had captured one male and one female moth. The average trap catch of the pheromone baited traps for this date was 28.2 per trap per week. Table 1 shows the total number of moths caught in the three DA traps each week through August 11th as compared to the average number of moths caught in the nine pheromone traps. No moths were caught in the DA traps after August 11th.

Harvest evaluations (1000 fruit per block on 10/4) showed a range of 0.1% to 9.7% damage to the fruit by codling moths among the three blocks.

Table 1. Weekly codling moth catches in DA and pheromone traps 5/05-7/14/2003 in orchard #1

Date	DA lure (total of three traps)		Pheromone (average of nine traps)
	Female	Male	
5/05	0	0	1.5
5/12	1	1	28.2
5/19	3	4	48.1
5/26	3	5	32.6
6/02	2	2	33.4
6/09	1	0	21.8
6/16	0	1	41.9
6/23	0	0	27.0
6/30	0	0	25.6
7/07	0	0	21.0
7/14	1	2	9.7
7/21	0	0	1.2
7/28	0	0	10.1
8/04	0	0	10.4
8/11	1	0	13.6
Total	12	15	
Gender percentage	44.4%	55.6%	

Orchard #2 had no moths caught in the DA traps throughout the season. The date for the first moth catch in the pheromone traps was May 20th at 1.8 moths per trap. This also happened to be the highest average number of moths caught for the first flight. For the second flight, the highest average for the pheromone traps was 3.7 moths per trap on August 5th. Due to heavy hail damage sustained by this orchard in late June, no harvest evaluation was done.

In neither orchard did the use of black light traps result in any useful information. Continuous rainy conditions for much of the season may have been part of the reason for this as what was caught in the traps was difficult to identify due to rain getting into the collecting bucket. These wet conditions may also have been part of the reason for the low incidence of codling moth damage in comparison to 2002, which was a very dry year. The Codling Moth Information Support System web site <http://ippc.orst.edu/codlingmoth/bionomics/humidity.html> mentions *"Hagley (1972) found that rainfall was the most important cause of mortality of the first instar larvae when they were just beneath the epidermis of the fruits. Gier (1963) suggested that mortality of first larval instar occurred because of increasing water contents of the fruits and consequent flooding of tunnels. The second and third instar larvae in the fruits are also affected by the rainfall."* This may also offer an explanation to the fact that throughout the season as well as while doing the harvest evaluations in orchard #1 that most of the fruit damage found was a superficial sting rather than actual tunneling.

Conclusions:

1) Though the pear essence kairomone DA lure is capable of attracting both sexes of the codling moth, it appears that it is only effective in our region when moth numbers are high (10+ per trap) as indicated by pheromone traps. This would make the use of the DA lure unacceptable for the purpose of determining an initial spray date. The ripening of fruit during the second flight may also be a factor that may interfere with the attractiveness of the lure to the moths at that time.

2) Though the number of moths caught in the DA traps was low as compared to pheromone traps, the ratio of male to females caught did indicate a fairly even balance between the two genders.

Pheromone vs DA Trap Reports
Orchard #1, 2003
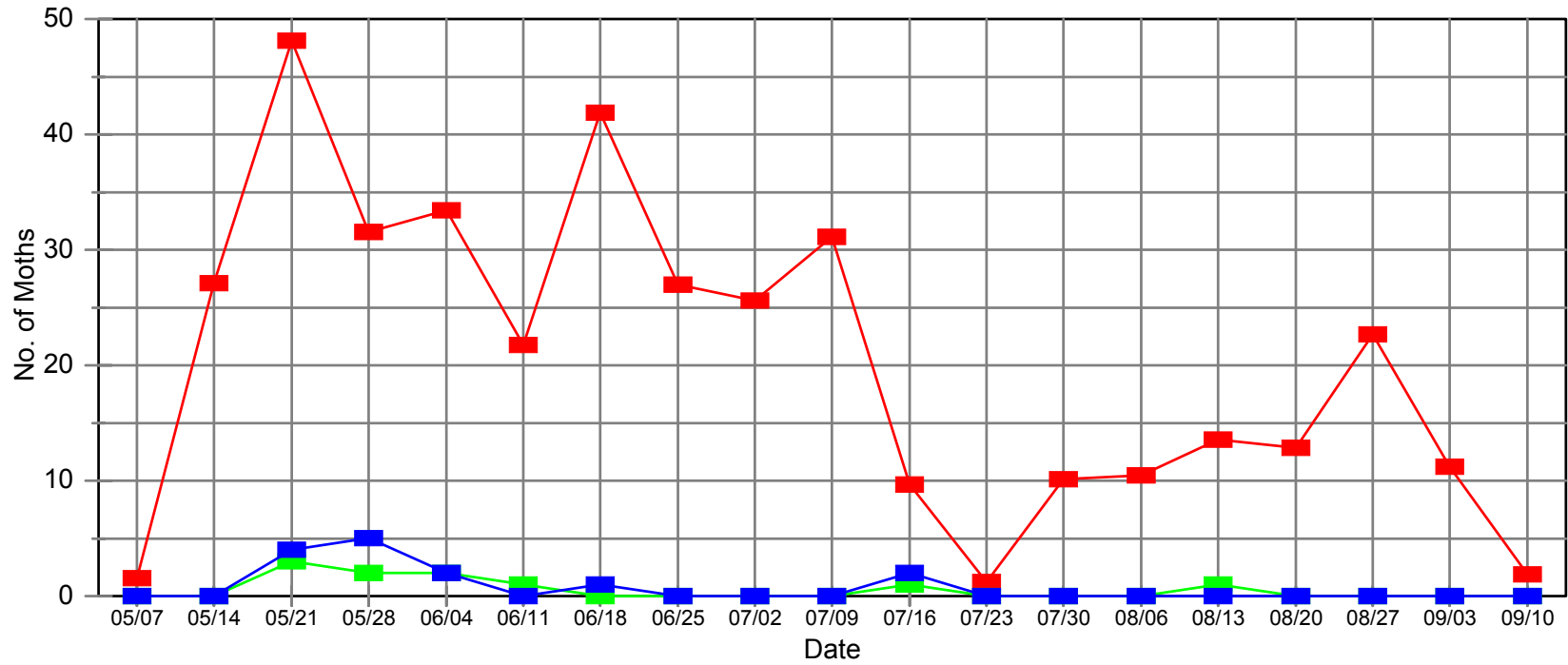
Monitoring network for beet armyworm, a serious pest new to Ohio

A vegetable team mini-grant project funded by the Ohio IPM Program
Final report, 24 November 2003

Celeste Welty, Associate Professor of Entomology, The Ohio State University

Background: Beet armyworm is one of the most important vegetable pests in the southern USA but it is not usually found as far north as Ohio. Serious infestations of beet armyworm were found in southern and northern Ohio in September 2002 in peppers and tomatoes. Although this pest had not been previously reported in Ohio, it has been a consistent problem in Kentucky for the past few years. Beet armyworm larvae are difficult to control with insecticides once an infestation is well established, but can be controlled if detected early and diagnosed correctly. Pheromone traps are available for this pest and are useful in detecting arrival of migratory moths so that scouting can be initiated for larvae on leaves. We have had a network of vegetable pest trap cooperators in Ohio for the past 15 years but have never included beet armyworm as a target species for trapping. To address the need for trap data on this pest, this project was done to expand our network to include this species. The objectives were to determine if beet armyworm moths were detected in Ohio in 2003, and to educate trap cooperators on beet armyworm identification and seasonal activity patterns.

Methods: The trap type selected was the standard tri-color universal moth trap, baited with pheromone lures made by Trécé Inc., with DDVP strips as the fumigant to kill trapped insects. Twenty-four traps were purchased and twelve cooperators were identified who agreed to set up and monitor one to three traps each, in pepper or tomato fields. Cooperators were crop consultants (3), county agents (2), extension program assistants (1), research farm managers (2), and research assistants (4). Trap locations were: Racine in Meigs County; Devola, Lowell, and Beverly in Washington County; Hamilton in Butler County; Hillsboro in Highland County; Port William in Clinton County; Springfield in Clark County; Columbus in Franklin County; Wooster, Moreland, and West Salem in Wayne County; Copley in Summit County; Celeryville in Huron County; Old Fort in Seneca County; Ballville, Riley, Fremont, and Gibsonburg in Sandusky County; Genoa in Ottawa County; and Hoytville in Wood County. Traps, lures, fumigant, instructions, photographs of beet armyworm moths and larvae, and trap record forms were shipped to cooperators in mid-May 2003. Cooperators were requested to send a trap report via e-mail once per week. Reports were posted at OSU's IPM web site and in weekly VegNet newsletters. Traps were monitored until the host crop was harvested.

Results: Beet armyworm moths were reported from traps in Meigs, Washington, and Clinton Counties in southern Ohio, Clark and Franklin Counties in central Ohio, and Huron, Sandusky, Ottawa, and Wood Counties in northern Ohio (Table 1). No beet armyworm moths were caught in traps at the remaining locations. Most beet armyworm moths were trapped starting in late July at southern sites and in late August at northern sites. The largest weekly catch was 13 moths at Meigs County in mid-September. Cooperators had been alerted that trap catch of less than 25 moths per week usually indicates a negligible population, but crops should be scouted for larvae if any target moths were trapped. There were no reports of infestations of

beet armyworm larvae at sites where moths were caught, although insecticide programs were modified at some sites so that beet armyworm larvae would have been controlled by preventive sprays. A problem at many sites in many weeks was that a moth was trapped but positive identification was impossible due to poor condition of the specimen. Because of poor condition, identification was often based on moth size and shape rather than wing markings. In late summer when corn earworm moths were abundant, this species was occasionally caught as a non-target in beet armyworm traps. Despite the frustration of uncertain identification, most cooperators found the traps to be a valuable addition to their monitoring program and most will continue to use traps in the future.

Table 1. Summary of weekly catch of beet armyworm moths in pheromone traps at nine Ohio sites where positive captures were made, 2003.

Date	Number of beet armyworm moths in one trap in one week											
	Meigs Co. (Racine)			Washington Co. (Marietta)	Clinton Co. (Port William)	Clark Co. (Spring field)	Franklin Co. (Colum bus)	Huron Co. (Celery- ville)	Sandus- ky Co. (Fre- mont)	Ottawa Co. (Genoa)	Wood Co. (Hoyt- ville)
5/27	0	0	0	-	-	-	-	-	-	-	-
6/3	0	0	0	-	-	-	-	-	-	-	-
6/10	0	0	0	-	-	1	0	-	-	-	-
6/17	0	0	0	-	-	0	0	-	-	-	-
6/24	0	0	0	-	-	1	0	-	0	-	-
7/1	0	0	0	-	-	0	1	0	0	-	0
7/8	0	0	0	-	-	2	0	-	0	-	1
7/15	0	0	0	-	-	-	0	0	0	-	0
7/22	0	0	0	0	-	0	0	0	0	0	0
7/29	3	4	6	-	-	1	0	0	0	0	0
8/5	4	0	0	1	0	0	0	0	0	0	0
8/12	2	0	0	1	1	2	0	0	0	0	0
8/19	0	0	1	0	0	1	0	0	0	0	0
8/26	0	6	0	1	1	0	2	4	1	0	0
9/2	0	3	0	-	-	3	1	6	0	-	0
9/9	0	7	0	-	2	5	0	0	0	2	0
9/16	1	13	0	-	-	-	0	0	0	-	0
9/23	12	7	5	-	-	-	0	4	-	-	-
9/30	-	-	-	-	-	-	1	1	-	-	-
10/7	-	-	-	-	-	-	-	-	-	-	-