1995 Ohio IPM Block Grant Reports

1995 North Central Ohio Tree Fruit IPM Program

Principal Investigator:

Ted W. Gastier, Huron County

Abstract:

Eighteen apple and five peach growers, located in the counties of Erie, Huron, Lorain, Ottawa, and Sandusky, enrolled 29 blocks of commercial production. Insect pests monitored with pheromone traps included spotted tentiform leafminer (STLM), codling moth (CM), apple maggot (AM), San Jose scale (SJS), peach tree borer (PTB), redbanded leafroller (RBLR), Oriental fruit moth (OFM), tamished plant bug (TPB), and lesser peach tree borer. Other fruit tree pests monitored by scouting were various aphids, leafhoppers, and European red mites.

Additional orchard monitoring verified the presence of the following: *Stethorus punctum*, syrphid fly larvae, lacewing, Cecidomyiid larvae, phytoseiid mite ('fallacis'), and various ladybeetles. Of particular interest were the populations of Stethorus as a biological agent for the control of European red mite. The following project objectives were followed as reporting guidelines for this Mini-grant:

1 . To test the Penn State guidelines for Altemate Row Middle spray system.
2. To identify beneficial arthropods and monitor populations.
3. To study the effect of pest control measures on beneficial arthropod populations.
4. To evaluate the economic benefit of biological control made possible by protecting beneficials.

Based on orchard observations made in the early to mid-Seventies in SE Pennsylvania, the alternate middle spraying has been encouraged by Penn State as a means of protecting *Stethorus punctum* and predacious mites in apple orchards. Applications of insecticides and miticides are made to 27 alternate tree rows with a follow-up to unsprayed rows three or four days later. This spray application method should allow a protective refuge in the unsprayed trees while the pesticides degrade in the sprayed rows.

Three growers utilized the alternate row middle (ARM) method in a portion of their orchards. Grower #1 tried ARM in a block of young Red Delicious in their second year of production. Grower #2 utilized ARM in an older block of Red Delicious where heavy pressure from European red mite has been a historic fact. Grower #3 normally uses ARM throughout his blocks when applying insecticides and/or miticides but not for disease control.

Results of observations of *Stethorus punctum* neither support nor discourage ARM. Stethorus punctum were present in 24 of the 25 monitored apple blocks with populations apparently dependent upon European red mite (ERM) pressures. *Stethorus punctum* mobility was evident in ARM blocks as well as other blocks. This

mobility was displayed by their ability to move into areas with sufficient ERM populations to encourage female Stethorus to lay eggs, and when ERM numbers were controlled to move to other areas or blocks.

A review of the early Pennsylvania work with ARM indicated a concern over the use of the acaricide Plictran (cyhexatin). This material, though rate dependent, was considered harmful to beneficials and of limited value in IPM programs. Fortunately, newer materials including both miticides and insecticides have found widespread usefulness by protecting apple crops without more than low to moderate effects on beneficials including *Stethorus punctum*. In other words, an IPM program can be designed around chemical as well as biological control of ERM while reducing the need for refuge said to be afforded with ARM.

The percentage of blocks where beneficial insects and/or predator mites were found increased from 59% in the late spring to 100% by mid-August. Some beneficials were found during orchard scouting during each of the 17 weeks from May through August.

One orchard block, owned by a grower more interested in 100% pest control rather than protecting beneficials, inadvertently become the "worst case" example for comparison with all other blocks. Beneficials were found during only 4 weeks with no populations of *Stethorus punctum* ever found. The savings from one spray application deleted in the IPM program would approximately equal the grower cost in the program. Producers saved from one to five applications when comparing their records with a standard spray calendar based on a 7- to 10-interval. A harvest survey showed negligible fruit damage caused by direct feeders though some disease damage from sooty blotch and fly speck was found.

Extension Program Implementations:

Grower's continue to financially support and participate in a program that make sense economically, allows for the production of high quality fruit, and combines biological pest control with judicious use of pesticides. An evaluation instrument completed by 90% of the growers indicated a high level of satisfaction with programming targeting a specific need. One other small measure of success - growers indicated that they are more likely to use the advice available from Extension sources, including scouts and the weekly newsletter, than the advice traditionally available from sales representatives of chemical companies.

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

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Alternatives to Chemical Controls of Insect Pests in the Home Garden.

Principal Investigators:

Richard C. Funt, Horticulture and Crop Science
Mike McCullough, Horticulture and Crop Science
Celeste Welty, Entomology
Mark Bennett, Horticulture and Crop Science

Abstract:

The traditional recommendation for controlling pests that kill or injure plants in home gardens is to protect plants by treating with insecticide. Gardeners and extension agents are often frustrated by the lack of reliable information about efficacy of non-chemical alternatives for pest management. Several pest management strategies are likely to be effective for these pests, but these strategies have not been tested in controlled experiments. This project focused on cultural control of common pests of green beans. We are evaluating the effects of repellents, made from garlic and from hot peppers, on feeding by bean leaf beetle and Mexican bean beetle. This is the second year for this experiment. We used the concentrations of garlic spray and pepper spray that appeared to be effective from last years data. These treatments are being compared to a control with no treatments and a control with insecticide dust. The experiment was performed at the Lane Avenue Horticulture Farm. Statistical analysis of the 1995 data is still being performed.

Introduction:

Interest in gardening has grown in recent years and is one of the most widely practiced hobbies of Americans. Two attitudes commonly encountered by extension agents are that gardeners prefer their produce to be free of pest damage and that they prefer not to use conventional pesticides in order to keep the produce clean. When it comes to specific recommendations for alternative management strategies, there is a lack of reliable information available to gardeners and extension agents.

Within the field of vegetable pest research, strategies for non-chemical control are understudied compared to chemical control, and strategies appropriate to home gardens have been understudied compared with strategies for use on commercial vegetable farms. Gardening publications often make general recommendations about mechanical and cultural controls, but without data from controlled experiments to document efficacy of such controls.

We tried to find strategies that would be useful for managing pests on green beans. The target pests, based on observations of last years plots, were bean leaf beetle and Mexican bean beetle. These were the most frequently observed, and did the most damage, on last years plots.

There are two products currently on the market made from garlic and hot peppers. It is important to find out if they really are effective in preventing feeding. There seems to be great interest among gardeners about the efficacy of homemade repellents such as sprays of garlic or ground chili peppers.

The objective of this project was to evaluate the effectiveness of repellents on pests that attack green beans.

Plan of Action:

A. Experimental treatments:

1) main plot
a) crop: green beans
b) pests: bean leaf beetle, Mexican bean beetle
c) planting dates: June 1

2) treatments:
a) no treatment
b) standard insecticide dust
c) tap water spray
d) garlic repellent spray
e) chili pepper repellent spray
f) row covers

B. Experimental design:
1) Each plot contained four replications. Each replication contained thirteen treatment areas. Replications consisted of four rows of beans, with three feet between treatments and ten feet between replications. Samples were drawn from the middle rows of each treatment area.

C. Results:
1) Produce was harvested at appropriate times with a record of number, weight and quality of beans. Foliage was evaluated for degree of damage, and dry weight for each treatment was measured.

2) Results will be shared with extension agents via the Consumer Hort Newsletter, and with Master Gardeners via the Master Gardener Newsletter.

3) Information will be incorporated into new versions of Extension Factsheets.

Click here for harvest results.Harvest Results

For further information contact Richard C. Funt , Professor, Dept. of Horticulture & Crop Science, The Ohio State University or the Ohio IPM Office.

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Combining Bioprimed Seed and Clear Plastic Mulch for Earliest Sweet Corn Production

Principal Investigator:

Mark Bennett; Associate Professor; Dept. Of Horticulture & Crop Science

Abstract:

Seeding establishment continues to be a key factor in profitable production of early fresh market sweet corn in Ohio. The use of clear plastic mulch over a trench of sweet corn can lead to a 10-14 day advantage in earlier harvest. This research tested untreated control and bioprimed sweet corn seed, alone and in combination with clear plastic mulch to determine if these treatments provide early, successful production of sweet corn for the Ohio market. Biopriming is a combination of seed hydration and inoculation of seed with a beneficial bacteria (*Pseudomonas aureofaciens*, strain AB254), which was originally developed for protection of sh2 sweet corn from *Pythium ultimum* seed decay (Callan and Mathre, 1995).

Two sweet corn varieties 'Seneca Daybreak' (se; yellow) and 'Double Gem' (se; bicolor) were planted in Columbus on April 27, 1995. Untreated seed and bioprimed seed were planted on bareground and in trenches covered with clear plastic mulch. When seed began to germinate, the plastic was cut open to expose the plants. Stand counts were taken 14 days after planting and continued to 36 days after planting. Plant heights and plant dry weights were measured on treatments 47 days after seeding. Each cultivar/treatment was harvested twice; the first harvest occurred when ears reached optimum maturity for fresh market sales. The second harvest removed the second or smaller ear from the plants. Plant height, ear height, ear length and diameter and percent kernel moisture were measured and recorded from each treatment at the time of the first harvest (see Table 1).

Plant heights and dry weight measurements (for both varieties) taken 47 days after seeding showed larger plants for those treatments planted in trenches with clear plastic vs. planting the seed into bareground. However, during the 1995 growing season, heat units and degree growing days increased rapidly due to the warm temperatures. Harvest dates for 'Seneca Daybreak' were July 10 and July 19 for all treatments except those planted on bareground with bioprimed seed which were harvested on July 19 and July 25. 'Double Gem' trench/mulch treatments were harvested 5 to 9 days earlier than treatments planted in bareground. Ear measurements of length and diameter along with percent kernel moisture showed no significant differences between treatments for both cultivars. Both cultivars were harvested earlier when seed was planted in trenches and covered with clear plastic mulch without any decrease in ear size or quality.

Extension Program Implementation:

Preliminary results from 1995 shows these practices may be feasible for Ohio growers to produce earlier, better quality sweet corn. This study will be repeated in 1996 to test if these results are consistent under different growing conditions. Results from 1995 will be reported at upcoming grower meetings, field days, and extension/research conferences.

Table 1. Combining Bioprimed Seed and Clear Plastic Mulch for Earliest Sweet Corn Production - 1995.

Cultivar: "SENECA DAYBREAK"								Cultivar: "DOUBLE GEM"						
	Days after Planting							Days after Planting						
Treatment	14	15	18	19	22	25	36	14	15	18	19	22	25	36

	PERCENT GERMINATION							PERCENT GERMINATION						
Bareground Control	41	61	77	78	79	80	80	28	55	72	79	83	84	84
Bareground/Bioprimed	25	37	60	64	65	65	64	23	42	65	69	76	76	74
Trench/mulch/control	87	91	91	91	91	91	90	93	93	93	93	93	93	93
Trench/mulch bioprimed	87	89	89	89	89	89	89	93	95	95	95	95	95	93
Trench/mulch hydrated	87	88	90	90	90	88	88	93	94	94	95	95	95	95
LSD (0.05)	10.8	8.6	10.5	10.8	10.9	11.7	11.9	10.7	10.2	12.1	9.5	9.1	9.3	9.7

Table 1. Combining Bioprimed Seed and Clear Plastic Mulch for Earliest Sweet Corn Production - 1995. (cont)

	Cultivar: "SENECA DAYBREAK"		Cultivar: "DOUBLE GEM"	
	Measurements on 3 Plants		Measurements on 3 Plants	
	47 Days after Seeding		47 Days after Seeding	
Treatment	**Plant Ht.(in)**	**Dry Wt.(g)**	**Plant Ht.(in)**	**Dry Wt.(g)**
Bareground Control	20.0	46.8	16.7	40.2
Bareground/Bioprimed	16.0	40.8	15.5	35.1
Trench/mulch control	29.1	76.9	26.8	65.8
Trench/mulch bioprimed	28.2	78.7	25.8	58.9
Trench/mulch hydrated	25.0	78.1	27.5	61.0
LSD (0.05)	4.76	15.65	3.85	9.79

Table 1. Combining Bioprimed Seed and Clear Plastic Mulch for Earliest Sweet Corn Production - 1995. (cont)

	Cultivar: "SENECA DAYBREAK"				Cultivar: "DOUBLE GEM"			
	Harvest	Marketable crates/A*			Harvest	Marketable crates/A*		
Treatment	**Dates**	**Harvest 1**	**Harvest 2**	**Total**	**Dates**	**Harvest 1**	**Harvest 2**	**Total**
Bareground Control	7/10,7/19	119	45	164	7/19,7/25	116	30	146
Bareground/Bioprimed	7/19,7/25	115	22	137	7/19,7/25	91	18	109
Trench/mulch control	7/10,7/19	164	42	206	7/10,7/19	130	73	203
Trench/mulch bioprimed	7/10,7/19	150	59	209	7/14,7/25	142	59	201
Trench/mulch hydrated	7/10,7/19	144	51	195	7/10,7/19	122	73	195
LSD (0.05)		NS	NS	NS		NS	46.7	32.7
p value		0.369	0.353	0.095		0.162		
CV		34.8	71.3	29.8		30.3		

* crate = 56 ears

Table 1. Combining Bioprimed Seed and Clear Plastic Mulch for Earliest Sweet Corn Production - 1995. (cont)

	Cultivar: "SENECA DAYBREAK"						Cultivar: "DOUBLE GEM"					
		Harvest Measurements						Harvest Measurements				
		Plant	Ear	Ear	Ear			Plant	Ear	Ear	Ear	
	Harvest	Ht.	Ht.	Length	Diam.	% Kernel	Harvest	Ht.	Ht.	Length	Diam.	% Kernel
Treatment	**Dates**	**(in)**	**(in)**	**(in)**	**(in)**	**Moisture**	**Dates**	**(in)**	**(in)**	**(in)**	**(in)**	**Moisture**
Bareground Control	7/10,7/19	46.5	9.7	7.6	1.5	76	7/19,7/25	51.0	11.1	7.6	1.8	76

Bareground/Bioprimed	7/19,7/25	46.2	8.8	7.6	1.6	77		7/19,7/25	52.7	11.8	7.5	1.8	77
Trench/mulch control	7/10,7/19	47.7	12.8	7.5	1.6	75		7/10,7/19	52.3	12.5	7.6	1.6	78
Trench/mulch bioprimed	7/10,7/19	48.9	13.7	7.5	1.6	75		7/14,7/25	52.7	13.0	7.5	1.6	77
Trench/mulch hydrated	7/10,7/19	48.2	11.5	7.4	1.5	75		7/10,7/19	54.3	14.2	7.4	1.6	79
LSD (0.05		NS	2.77	NS	NS	NS			NS	NS	NS	NS	NS
p value		0.574		0.814	0.836	0.160			0.808	0.168	0.628	0.445	0.070
CV		6.7		4.4	9.7	3.3			8.4	17.5	4.0	11.5	2.4

For further information contact Mark Bennett Associate Professor, Dept. of Horticulture & Crop Science, The Ohio State University or the Ohio IPM Office.

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Comparing Economic Thresholds of Potato Leafhopper on Alfalfa

Principal Investigator:

Gary W. Wilson, Hancock Co Extension Agent

Abstract:

The potato leafhopper continues to be the most serious insect affecting alfalfa production in Ohio. We conducted a special study with established alfalfa at The University of Findlay Equestrian & Pre-Vet Center to emphasize the importance of the economic threshold of the potato leafhopper and determine the amount of reduced alfalfa yield and quality that actually happens as a result of the crop damage. We designed a 4x replicated research plot which involved collecting quality and yield data for each hay cutting. Potato leafhopper insecticide treatments was varied in the following ways:

* No spraying
* Spraying every two weeks
* Spraying at established economic threshold
* Spraying 1 1/2 times over established economic threshold.

Potato leafhopper scouting was completed on a weekly basis, along with 15 one acre adjoining alfalfa variety plots. Potato leaf hopper populations seemed to get a very early start and continued very intensely throughout the 1995 growing season. Table 1 shows data recorded for potato leafhopper populations starting on June 22, 1995 (one week after lst cutting). At this early point, PLH populations were already over threshold and spray treatments were applied on plots to be sprayed every two weeks, at threshold and at 1 1/2 times over threshold. Because of the high intensity of PLH populations the plots to be sprayed at and over threshold were being sprayed the same time as those being sprayed every two weeks. This occurrence happened three out of the four spray treatments which is unusual for normal PLH infestations.

On the fifth week into the second cutting growth, the plots not sprayed were 5.5 inches shorter than those sprayed. There was also a very great visual difference comparing the sprayed plots (very green) with the non sprayed (very yellow). The PLH populations also had a tendency to still remain higher than normal after the second cutting was removed as high nymph populations were noted.

Yield results are indicated in Table 2. As expected before PLH arrived the first cutting yields show no significant difference with p=.98. The second cutting yields are approaching more difference but still not significant with p=.58. The third cutting yields did show significant difference with p=.10.

Forage Quality comparisons are recorded in Table 3. Very little difference in quality was noted throughout the project except for protein data from the second cutting. The plots not sprayed had significantly lower

protein with p=.05 but this did not follow through in the third cutting.

Conclusions:

1. High Potato Leafhopper populations in alfalfa can significantly reduce yields but its effect on quality is less. This phenomena probably happens because even though the plant becomes shorter, the leaf to stem ratio remains the same.

2. In years of high PLH intensity, a minimum of scouting every two weeks is needed to keep up with the growing population.

3. Cutting the alfalfa can reduce PLH populations but PLH thresholds can be reached in ten days or less.

4. PLH nymphs can be very significant since they cannot travel making high PLH populations in stubble during the first week after a cutting.

5. This research needs to be continued in 1996 using the same plots with the same treatments. It is highly probable that due to stress, the plots not sprayed could have a thinner stand.

Extension Program Implementation:

A special Northwest Ohio Alfalfa Field Day was held at the research plots on August 16, 1995. Speakers included Dr. Curtis Young, Dr. Mark Sulc, and Gary Wilson. Topics included Alfalfa Establishment, IPM Techniques, and the Potato Leafhopper research. 30 people attended.

For further information contact Gary Wilson , Extension Agent, Ohio State University Extension, Hancock County or the Ohio IPM Office.

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Disease Enhancing the TOM-CAST Monitoring System via the Addition of Late Blight Disease Prediction

Principal Investigators:

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Mac Riedel, Dept. of Plant Pathology
Mark Bennett, Dept. of Horticulture and Crop Science
Celeste Welty, Dept. of Entomology

Abstract:

TOMCAST is a disease forecasting program used in thirteen processing and fresh market tomato field sites throughout southern Michigan, Indiana, and Ohio. TOMCAST has existed at one level or another in the tri-state area since 1988. The development of warm, wet weather diseases such as early blight, Septoria leaf spot, and anthracnose are monitored at each site using environmental recording instruments such as Campbell Scientific CR10 or Omnidata Datapod units. The original issue data loggers were Omnidata Datapods, which recorded leaf wetness and air temperature hourly but required manual downloading. The CR10 performs all Datapod functions and has the advantage of greater electronic sophistication, expansion for additional sensors, and the ability to download collected data over a phone line to an office personal computer. The CR10 units are designed with a high degree of automation and a low degree of maintenance, conserving valuable man hours for other field tasks. Clearly defined durations of leaf wetness and temperature result in the accumulation of Disease Severity Values (DSV). When specific DSV thresholds are exceeded, growers are advised to initiate spray treatments to protect the crop from fungal disease. This is how TOMCAST operates in the Midwest; as a mechanism for growers to consistently manage disease pressure.

Until mid-season 1995, late blight was the only major fungal disease of processing tomatoes TOMCAST was not designed to predict. This capability was gained by adding electronic tipping rain buckets to existing CR10 units and acquiring late blight software (BLITECAST module of WISDOM). There are currently nine CR10 units providing late blight prediction information within the tri-state TOMCAST network, in addition to disease prediction for early blight, Septoria leaf spot, and anthracnose.

There were six main objectives for TOMCAST in 1996:
1. To obtain needed late blight hardware and software
2. Initiate late blight prediction network
3. Integrate TOMCAST and BLITECAST into one comprehensive disease management system
4. To determine if TOMCAST can be adapted as a reliable disease management system for control of early blight, Septoria leaf spot, and anthracnose in fresh market tomatoes.

5. To compare calendar spray program with TOMCAST spray program at Hillsboro, OH
6. To compare TOMCAST DSV accumulation at 5 network sites with those generated by Skybit, Inc.

Introduction:

The distribution and operational set up of each CR10 and Datapod unit to their field location was completed the last week in May. June 1, all sites in the TOMCAST network began recording and reporting daily DSV for early blight, Septoria leaf spot, and anthracnose. Three fresh market sites were added to the network in 1995.

Late blight prediction was also scheduled to start June 1, but was delayed until late June due to equipment shortage. Although late blight was not detected in Ohio this year, the BLITECAST model eventually issued warnings at all stations from June 30 to July 21, based on weather data. Several states around Ohio did experience late blight this year (Table 1), including a small pocket confirmed on potatoes in southwest Michigan in late summer. Some of the temporal variability between the initial warnings among sites may be explained due to the wide geographic area covered by the network. Another factor is the non-uniform BLITECAST start date throughout the network, ranging from May 30 to June 27. It took 25 days on average to develop the first late blight warning, with the range for all sites between 7 and 59 days.

Once the late blight program was up and running, its Severity Values (SV) were reported daily along with the DSV data. DSV and SV information is summarized by site and year (Table 2). Ten TOMCAST sites did not change from 1994 to 1995, of which nine had mean accumulations 38 DSV higher in 1995 than the previous year, which translates roughly into two additional sprays in 1995 over the previous year. The variability between sites ranged from 20 to 59 DSV higher at the same location over the two seasons. Only Lacrosse, IN had 17 fewer DSV in 1995 compared to 1994.

TOMCAST and Skybit, Inc.

A research agreement between OSU and Skybit, Inc. was initiated June 1 to determine if DSV could be accurately generated at a specific field site using remote sensing technology and National Weather Service data, as an alternative to use of a CR10 or Datapod stations. Skybit, Inc. is a commercial ag-weather service, who offer custom weather products and variables for crop consultants, growers, etc.

Skybit did not generate a true DSV variable for the study, instead they supply the weather variables needed (hourly leaf wetness and air temperature) to construct daily DSV. Delivery of this information is daily, either through electronic mail or FAX. TOMCAST generated DSV were used as a benchmark to compare Skybit generated DSV on a daily basis at each of five locations to see if a difference in accumulation existed. If a difference does not exist, growers located outside the predictive range of the nearest TOMCAST site may choose to subscribe to Skybit to obtain data similar to an in-field located CR10 station.

Using a t-Test (alpha 0.05) to compare daily DSV accumulations between Skybit and TOMCAST (Table 3), found four out of five sites significantly different in their seasonal total of DSV, with Skybit predictions consistently lower. Lacrosse, IN was the only site where no significant difference was found. The lack of accumulation of nearly 60 DSV (3-4 sprays) at some sites could allow significant disease pressure to develop unchecked, resulting in yield reduction. Use of remote weather forecasting for disease prediction has potential applications for models such as TOMCAST, but needs greater development and accuracy to be adopted widely.

Fresh Market Tomatoes

Traditionally TOMCAST has been utilized by tomato processors, but this year three fresh market sites tested various aspects of TOMCAST. Previously, results from experimental plot work at Celeryville (1993) and a split field trial at two grower locations in Meigs county in 1994 indicated TOMCAST could be adapted for use in fresh market tomatoes. To further evaluate TOMCAST usefulness in a fresh market situation, a comparison of a calendar versus TOMCAST spray program was made in Hillsboro, OH. The experiment used the variety Mountain Fresh in a split field design with 10 replications. Five plants were harvested per replication. Results for early harvest (first) and total harvest are presented in Table 4 and 5. There were 6 sprays with TOMCAST versus 9 sprays under the calendar program. Sprays began June 15 and ended September 12. There was no significant difference in the number or weight of US#1 fruit and culls for either early or total harvest. This agrees with the previous year's findings which indicate that the TOMCAST spray program has not had a deleterious effect on marketable yield.

In Geauga County, growers found TOMCAST helped them time their sprays much better than in previous years. With the weather switching from wet and cool to very dry, there was much confusion on proper timing, which TOMCAST helped to eliminate. Disease pressure was low as indicated by a comparison of fruit harvested from sprayed and unsprayed plots (Table 6). Visual ratings for incidence of disease showed little difference between treatments.

Table 6. Total Harvest (Mean of 10 feet of row).

Treatment	#1 Fruit (lbs)	Visual Disease Rating*
Sprayed	26.5	4.2
No Spray	24.5	4.7

*Average of 4 dates using Horsiall-Barratt Disease Rating Scale.

Cooperator Survey Results

A nine question survey was sent to ten growers in the network to determine how important TOMCAST was to their business. The seven respondents indicated they used the TOMCAST DSV Hotline at least once a week, made most of their calls in August and July respectively, would be willing to pay $15-50 per month if TOMCAST were a commercially owned service, and rated TOMCAST 7.4 on a scale from 1 to 10 on importance to overall disease management. The cooperators also indicated they would like daily or weekly rainfall and Colorado Potato Beetle emergence data added to their site if possible.

Fresh market growers in Meigs county, not part of the above mentioned survey, are following TOMCAST and seem to be comfortable with it especially in the early part of the season. As is processing tomatoes, the early season seems to be the best time of the year to save sprays. In this region, during mid and late season, DSV accumulation on a weekly basis was the maximum that could be accumulated on several occasions.

Conclusion

TOMCAST is ultimately a successful IPM program with respect to disease management. Since 1988, the network has expanded both the number of sites and its degree of sophistication. Data collection is now almost fully automated, streamlining the information flow from the field to a central location where it can be accessed 24 hours a day via a phone by any individual. In addition to disease forecasting, the research focus will be to expand the insect component and be able to provide a total IPM approach to growing tomatoes. The use of remotely sensed weather data to generate and predict DSV and SV also holds exciting promise. Based on survey results, clientele who use TOMCAST seem very pleased with the way the system operates, and view it as a valuable service to their business. New educational materials are being developed to familiarize growers with the improved and expanded services, such as the addition of late blight forecasting via BLITECAST. These new materials will explain the combined forecasting of early blight, Septoria leaf spot, anthracnose and late blight. A very thorough explanation can be found in the 1996 Ohio Vegetable Production Guide. To keep growers abreast of any fungal disease developments, a weekly summation of DSV and SV accumulation at all TOMCAST sites will be posted in the 1996 VegNet newsletter/FAX.

Acknowledgements

Without the support and enthusiasm of a handful of county extension agents and station managers, TOMCAST would not be as diverse or encompassing as it currently is. Special thanks to Brad Bergefurd, Mardy Townsend, Hal Kneen, and Ken Scaife for all their efforts.

For further information contact Jim Jasinski , Extension Agent, Ohio State University Extension, Southwest District or the Ohio IPM Office.

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Evaluation of Corn Hybrids for Resistance to Gray Leaf Spot

Principal Investigators:

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Abstract:

Gray leaf spot (GLS) is a foliar disease of corn caused by the residue-borne fungus, Cercospora zeae-maydis. This disease has become a widespread problem affecting corn production in the United States over the past two decades. The increase in GLS prevalence has accompanied an increase in the use conservation tillage for corn production, especially in areas that grow continuous corn. By 1993, nearly 70% of the cropland in the Midwest was farmed using some form of conservation tillage that left greater than 30% of the crop residue on the soil surface. This positive response of farmers to the conservation compliance program and the lack of crop rotation in many areas has increased the potential for GLS such that it has become a major yield limiting factor in Ohio and other Corn Belt states.

Although hybrid resistance has been a very effective means for control of a number of corn diseases, the level of resistance to GLS currently available in commercial hybrids is limited. All hybrids currently on the market will develop high levels of GLS when the fungus is present on corn residue within the field and the environmental conditions are highly favorable for disease development. The resistant hybrids suitable for production in Ohio are considered to be moderately resistant at best. Since GLS may not be a problem every year it is important to consider how resistant hybrids will perform in the absence of disease pressure. Will resistant hybrids be competitive with more susceptible hybrids when GLS is not a major limiting factor? In the past some hybrids characterized as GLS resistant, especially those of early to mid maturity, were not used because of their relatively low yield potential. Growers were often willing to risk some degree of GLS damage in order to use a higher yielding but more susceptible hybrid.

In 1995 we conducted field tests to evaluate the performance of a limited number of corn hybrids known to have some degree of resistance to GLS with maturities acceptable for production in Ohio. The goal of our study was to help corn growers identify profitable corn hybrids for use in regions of the state where GLS can be a major yield limiting factor.

Commercial seed corn companies were requested to submit only those hybrids known to have some level of resistance to GLS and to be of a maturity acceptable for production in Ohio. Pioneer brand 3394 was chosen as the check hybrid because of its high yield potential, adaptability, popularity and GLS susceptibility. In several on-farm strip tests additional hybrids were included by the cooperator.

Field plots were established at six on-farm sites in Coshocton, Knox, Fairfield and Richland Counties that have a history of heavy gray leaf spot pressure. Plots were located in fields which have been continuously cropped to corn. Hybrids were planted in strip plots at least four rows wide (in 30-inch or 38-inch row spacings) and 300 feet in length.

A set of ten hybrids compared in the on-farm strip tests (described above) was also planted at the Ohio Corn Performance Test site at West Lafayette in Coshocton county, a site previously cropped to corn with a history of gray leaf spot. The experimental design was a randomized block with four replicate plots. Each plot consisted of four 30-inch rows 25-feet in length.

Disease assessments were made in each plot location two to three times at approximately two week intervals. Assessments were made on 24 August, 31 August, 7 September, 14 September and 21 September, but each plot was not assessed on each date. Hybrids were assessed for GLS by estimating the percentage of the ear leaf covered by lesions on six plants per plot. Disease assessment scales were used to estimate severity percentages. The average severity was calculated for the six plants per plot and plot means were used for statistical analysis. The incidence of stalk rot was determined using the "squeeze" method, i.e. squeezing the stalk above the brace roots and recording the number of stalks that crushed easily. At least 10 plants in each plot were checked for stalk rot. Stalk lodging (stalk breakage below the ear), test weight, and grain moisture were recorded at harvest and yields were adjusted to 15.5% moisture.

None of the hybrids were highly resistant to GLS. Hybrids with resistance delayed onset of the disease and this allowed plants to retain more green leaf tissue during grainfill.

However, under heavy disease pressure even GLS resistant types succumb to extensive leaf blight injury.

In each of the strip plot evaluations, the susceptible check exhibited higher GLS disease ratings, as much as 2 to 3 times more leaf tissue affected, than hybrids characterized as having some resistance. Several hybrids which exhibited relatively low disease ratings produced higher yields than the susceptible check and other susceptible hybrids included by cooperators. However, lower GLS ratings were not always associated with grain yields superior to those of the susceptible check. To determine if differences in hybrid strip plot performance were significant, data from four of the strip test locations with 13 hybrids in common was combined and evaluated as a randomized complete block design with four replicate blocks. A comparison of agronomic performance and disease reaction for these hybrids is indicated in Table 1. Six hybrids (Asgrow RX770, Pioneer 3335, Great Lakes GL581, DeKalb 634, ICI 8541, and ICI 8321) produced grain yields significantly greater than the susceptible check. One of these hybrids, Pioneer 3335, had disease ratings that were not significantly lower than that of the check. Moreover, there were hybrids that had GLS levels significantly lower than the check but did not differ in yield significantly from the susceptible check.

The agronomic performance and disease reactions of nine resistant hybrids (which were evaluated in the strip plot studies) and the susceptible check are indicated in Table 2. Relatively dry conditions slowed progress of GLS at W. Lafayette and thus reduced disease severity. Although the check consistently exhibited significantly greater disease levels on each rating date during grain fill than the other hybrids, it produced yields that were not significantly different from the top yielding resistant hybrids. The check exhibited significantly higher stalk rot than most of the other high yielding hybrids (but actual stalk lodging was minimal).

Results of the strip tests indicate that there are commercial moderately resistant hybrids available that have higher yield potential than the susceptible check when GLS pressure is severe (Table 1). However the results of the replicated plot test at West Lafayette (Table 2) suggest that when GLS development is less severe, resulting in less leaf blight or developing late in the season after grain filling is complete, then certain resistant hybrids may offer little or no yield advantage over susceptible types. Nevertheless some of the hybrids with low disease levels exhibited yields that were not significantly different from the susceptible check hybrid suggesting that there are resistant hybrids available now that have yields comparable to popular but susceptible hybrids such as Pioneer 3394. There were several hybrids (Asgrow RX770, DeKalb DK634, and ICl 8541) common to both the strip tests and the replicated plot tests with low disease ratings that performed above average under varying levels of GLS injury.

Extension Program Implementation:

Results of this study will be reported at 1996 winter meetings for county ag agents, crop producers and agricultural industry personnel. Data collected has been summarized in an Agronomy Fact Sheet (AGF-130) and a Plant Pathology Circular. Information from the study will also be utilized in ICM newsletter articles and shared with trade magazines for wider distribution.

For further information contact Peter R. Thomison , Assistant Professor, Dept. of Horticulture & Crop Science, The Ohio State University or the Ohio IPM Office.

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Framed Insect Cages with Synthetic Covering for Diagnostic Training Program

Principal Investigators:

Larry Lotz, Fayette Co.
Troy Putnam, Highland Co.

Abstract:

The purpose of this project was to provide a contained environment in which the feeding habits and resulting effects of various insects could be observed and evaluated including damage variations between plant hybrids/varieties, tillage practices, insecticides, and other factors. In the spring of 1995, a tan toot high 20 foot times 30 foot netted cage was purchased from Synthetic Industries of Ganesville, Georgia. A wood frame was constructed with adjustable height to support the netted material. Two three foot times six foot zipper doors were located in each end of the cage. The netting caused a 20% reduction in sunlight.

The project selected for 1995 utilizing this netted insect cage was one involving European Corn Borer resistant corn varieties. Eight rows of an alternating resistant and nonresistant CIBA corn variety were planted on May 1 at the Fayette County Farm. The cage was erected over the corn plot on June 19 and all corn plants were inoculated with European Corn Borer eggs on June 20 secured from Dekalb Research. Corn borer feeding differences between the resistant and non-resistant varieties were evident within a few days with the resistant variety exhibiting very little if any damage while the non-resistant variety showed a moderate amount of feeding damage and larvae present. This demonstration was used for discussion and insect educational purposes during four diagnostic field days conducted during the week of June 19 at the Fayette County Farm. In addition, this demonstration was featured during the wagon tours at the August 16 Southwest Ohio Corn Growers Field Day. For this field day the stalks of each variety were split in half vertically to show the difference in borer infestation and it created considerable interest. The resistant variety showed no borer infestation in the stalks. Yield checks were not taken because of damage to the plots caused by field day participants and the destruction of some plants for demonstrational purposes.

Possible future projects will include the use of soybean leaf and pod feeding insects, potato leaf hopper in alfalfa, disease transmitting insects, or the simple shading effect of the netting on crops.

For further information contact Larry Lotz Extension Agent, Ohio State University Extension, Fayette County or the Ohio IPM Office.

Holmes County Vegetable I.P.M. Program

Principal Investigator:

John Dean Slates, Holmes Co.

Abstract:

In 1995 approximately 300 growers began producing fresh vegetables for commercial wholesale markets in the greater Holmes County area. The majority of the products were marketed at a wholesale produce auction held three times weekly in the Mt. Hope area. It was assumed at the start of the program that a majority of new growers would have small acreages and the growers would be unwilling to pay the cost for traditional IPM services.

In 1995, the Holmes County Officer of OSU Extension developed and conducted two IPM programs. One was the traditional "weekly scout" program; the other was a "scout your own with assistance." Twelve growers enrolled in the "scout your own" program comprising 21 acres of produce. To support the growers, six biweekly seminars were held and each enrollee received a notebook of fact sheets and record sheets to facilitate their efforts. Sixteen growers enrolled in the traditional scouting program with 37 acres of produce enrolled.

The scouting program was augmented by a network of insect traps (see table) from which weekly counts of key pest activity were collected, recorded and disseminated to growers to facilitate pest management decisions.

Pest Monitored	Trap Employed	Crop Station Habitat	No. Stations
European corn borer	Heliothis trap	Sweet corn & peppers	10
Corn earworm	Heliothis trap	Sweet corn plantings	6
Variegated cutworm	Sticky wing trap	Tomato plantings	6
Misc. flying pests	Yellow sticky traps	Vegetable crop habitats	120
Note: Heliothis and wing traps were baited with specific pheromone lures.			

Program Implementation and Conclusions:

Three facts became apparent; first, growers are reluctant to pay for scouting (regardless of how cheaply the service is provided). Second, growers would rather rely on a scout rather than conduct the scouting for themselves. Trapping is a valuable tool to help make pest management decisions, especially for corn borer and corn earthworm. Growers who used heliothis catch data to time European corn borer sprays were able to drop at least two sprays from their program (as compared to growers who sprayed by a calendar method). There were no reports (in 1995) where growers had poor results from using trap counts to schedule spray applications for control of European Corn Borer on peppers. Continued use of traps and making greater effort to publicize trap data seems to be a viable program option.

For further information contact John Dean Slates , Extension Agent, Ohio State University Extension, Holmes County or the Ohio IPM Office.

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Ohio Integrated Pest Management

THE OHIO STATE UNIVERSITY EXTENSION

Integrating Biological and Chemical Control of Sweet Corn Pests

Principal Investigators:

Celeste Welty, Assistant Professor of Entomology
Sandra Alcaraz, Graduate Student in Entomology

Summary:

Experiments on the role of insect predators in sweet corn fields were conducted for a third and final year in 1995. This project was initiated because information was lacking on whether the conservation of generalist predators combined with other control measures can provide acceptable control of European corn borer and other key pests of sweet corn. Data obtained is allowing us to evaluate whether a reduction in conventional insecticide use and an increase in biological control is a viable option in commercial sweet corn production. In order to better understand the results of the field experiments, we conducted a field-cage study and a laboratory study in 1995 to quantify predator response to European corn borer eggs and young larvae. The two indigenous generalist predators studied were a lady beetle, *Coleomegilla maculata*, and a minute pirate bug, *Orius insidiosus*.

A field experiment was conducted to compare sweet corn pest management by conventional insecticides with the biological control strategies of predator conservation and predator enhancement. We are attempting to conserve predators by applying microbial insecticide (B.t.), and to enhance predators by a sprayable sugar-protein product (Pred-Feed). In an early planting of 'Seneca Horizon' at both Fremont and Columbus, a split-plot experimental design was used. Main plot treatments were Pred-Feed applied weekly vs. no Pred-Feed. Sub-plot treatments, replicated four times, were 1) B.t. granules in whorls, 2) permethrin granules in whorls, 3) B.t. sprays to silks, 4) thiodicarb sprays to silks, 5) B.t. granules in whorls plus B.t. sprays to silks, 6) permethrin granules in whorls plus thiodicarb sprays to silks, 7) untreated check. A similar trial was conducted in late plantings of 'Lancelot' at both locations but with only sub-plot treatments 3, 4, and 7. Plots were monitored in the whorl and tassel stages for pests and predators, and ear quality was evaluated at harvest. Results of harvest (Table 1) and scouting were subjected to analysis of variance. Results were similar to trials conducted in 1993 and 1994; there was no significant effect of the Pred-Feed attractant; conventional insecticides provided the best control, and B.t. provided control intermediate between conventional and untreated.

To determine the efficiency of *O. insidiosus* and *C. maculata* in searching and destroying egg masses of European corn borer, a field cage study was conducted at the OSU Horticulture Farm in Columbus on 3-4 September 1995. Cages were placed over individual corn plants in the pollen shedding stage. The day before the experiment was conducted, caged plants were sprayed with pyrethrin to remove any predator or prey insects. Adult *O. insidiosus* and *C. maculata* were collected in the field and starved for 24 hours before release. Egg masses of European corn borer were obtained from a laboratory colony. Three egg masses per plant were pinned on the ear husk, and on the bottom surface of the leaf immediately above and immediately below the ear. Twelve treatments in a three by four factorial design were: *O. insidiosus* at densities of 0, 4, 8, and 12 per plant, *C. maculata* at densities of 0, 1, 3, 5 per plant, and combined *O. insidiosus* and *C. maculata* at the same densities. There were four replicates per treatment. Egg masses were retrieved 24 hours after release, and examined under a microscope to determine egg mortality. Statistical analysis will determine effects of egg mass placement on the plant, egg mortality at different predator densities, and interactions between predators as related to egg mortality. Data have not yet been analyzed, but we observed that *C. maculata* was generally better than *O. insidiosus* at finding and consuming eggs, and eggs on the leaf above the ear were more frequently consumed than eggs at other locations.

The effect of prey density on predator feeding was studied in a growth chamber in September and again in December 1995. Adult *O. insidiosus*, adult *C. maculata*, and the first instar of the lacewing *Chrysoperla carnea* were kept in containers with cotton wicks saturated with water, and starved for 24 hours before testing. Individual adult *O. insidiosus* were placed in containers with 0, 10, 20, 30, and 40 corn borer eggs and 0, 10, 20, 30, and 40 corn borer first-instar larvae. Consumption was measured and prey replaced every 2 hours for 12 hours. The procedure was the same for *C. carnea* and for *C. maculata* except that for the *C. maculata* tests, prey density was 0, 50, 75, 100, and 125 per container. There were six replicates each for male *O. insidiosus*, female *O. insidiosus*, unsexed *C. maculata*, and unsexed *C. carnea*. Analysis of variance and regression analysis were done to determine the functional response curves. Preliminary results show that *C. maculata* exhibits a type II functional response to corn borer larvae, *O. insidiosus* females exhibit a type II functional response to larvae while males exhibit a type I response to larvae, and *C. carnea* exhibits a type II functional response to larvae. Maximum prey consumed in 24 hours was 80 eggs or 123 larvae by *C. maculata*, and 8 eggs or 40 larvae by *O. insidiosus*.

Extension Program Implementation:

Weekly trap counts and observations from periodic field scouting were included in newsletter articles about current pest developments. The field experiment at Fremont was included in a tour for the Vegetable Crops Field Day on 9 August. Results will be included in talks on sweet corn pest management at grower meetings during the next year.

Table 1. Insect damage on harvested sweet corn, 1995.

	Mean percentage of ears unmarketable	
	Early planting	**Late planting**
Location effect:		
Columbus	**13.3 a**	**60.5 a**
Fremont	**1.3 b**	**23.0 b**
Main plot effect:		
With attractant	**6.8 a**	**43.2 a**
No attractant	**4.8 a**	**39.0 a**
Sub-plot effects:		
Untreated control	**15.3 a**	**73.5 a**
Microbial insecticides		

B.t. granules	**5.8 ab**	**--**
B.t. sprays	**7.0 ab**	**38.8 b**
B.t. granules + sprays	**4.7 ab**	**--**
Conventional insecticides		
Permethrin granules	**2.9 b**	**--**
Thiodicarb sprays	**7.7 ab**	**14.0 c**
Permethrin + thiodicarb	**1.3 b**	**--**

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

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Planting Date Effects on Severity of Sclerotinia Crown and Stem Rot in Alfalfa

Principal Investigator:

Mark Sulc, Dept. of Horticulture and Crop Science

Abstract:

Sclerotinia crown and stem rot (SCSR) is one of the most destructive diseases of alfalfa (*Medicago sativa* L.) and other perennial forage legumes in the eastern USA. *Sclerotinia* is most severe in alfalfa seeded in late summer or early fall, especially when minimum tillage practices are used to establish the crop. This presents a production dilemma for producers, because both of these practices allow reduced pesticide and fuel use and promote soil conservation. Late summer is an excellent time to establish alfalfa in the eastern USA. Adequate controls are currently unavailable to producers, and this disease is one of the most significant impediments to no-till summer seedings of alfalfa in this region. No commercially available alfalfa varieties are listed as resistant to this disease, although progress is being made in selection of germplasm with disease resistance. The fungicide vinclozolin (Ronilan) is an effective control, but is not registered for use in alfalfa. Based on studies in controlled environments, late summer planting date may influence the relative severity of Sclerotinia crown and stem rot in alfalfa. The objectives of this project were to evaluate under field conditions the effect of planting date on the severity of Sclerotinia crown and stem rot in alfalfa, and to develop guidelines for an integrated approach to controlling Sclerotinia crown and stem rot in alfalfa.

Field experiments were established in 1993 and 1994 at the OSU Horticulture Farm in Columbus. Two alfalfa cultivars differing in field resistance to SCSR were no-till seeded mid-May, August 1, August 16, and August 30 in a grass-legume sod uniformly infested with sclerotia of *S. trifoliorum*. Plots were irrigated immediately after seeding to ensure rapid and uniform establishment. Armor alfalfa is the susceptible check cultivar for *Sclerotinia*, and A9109 is an experimental line selected for improved resistance to *Sclerotinia*. Each planting date-cultivar combination was subdivided into fungicide-treated (vinclozolin) and untreated plots so that data from each treatment combination could be compared with a disease-free control. Treatments were replicated four times in a split-strip-plot randomization of a randomized complete block design. Planting dates were whole plots, cultivars subplots, and fungicide treatments were stripped across the cultivar sub-plots.

Weather conditions were favorable for sclerotia germination during the Fall of 1993 and 1994, and inoculum loads were sufficient to cause heavy damage by *Sclerotinia* both years. *Sclerotinia* disease severity ratings in the spring the year after seeding demonstrated that the four applications of vinclozolin effectively controlled the disease (Table 1). Without the fungicide, A9109 suffered less SCSR damage than Armor in the 1993 seeding, especially when seeded in late August. The cultivars did not differ in disease severity ratings in the

1994 seeding. Planting date significantly affected disease severity (% of stand affected) in the absence of the fungicide treatment (Table 1). Total season forage yield as a percent of the disease-free control was 98, 94, 85, and 73% for the mid-May, August 1, August 16, and August 30 planting dates, respectively. These data demonstrate that the risk of SCSR is minimal when seeding in the spring. When alfalfa is no-till seeded in late summer, the risk of SCSR damage can be dramatically reduced by seeding in early to mid-August, assuming timely rainfall to promote rapid emergence. These field data confirm results from controlled environments demonstrating that alfalfa seedlings should be at least 8 to 10 weeks of age at the time of apothecium emergence in order to reduce the risk of serious stand loss. In Ohio, this means that alfalfa should be planted in early August, because apothecium emergence normally occurs in mid-October. These data also demonstrate the potential for effectively reducing the impact of *Sclerotinia* in no-till establishment of alfalfa through the combined effect of earlier planting and improved cultivar resistance to SCSR.

Extension Program Implementation:

A field day was held for OSU Extension Agents in early spring 1995 when SCSR injury was very apparent in the plots. The plots were part of a tour organized by Dr. Landon Rhodes in September 1993 and 1994 for representatives of the alfalfa seed industry. Results were presented at the North American Alfalfa Improvement Conference in July 1994, and at the American Society of Agronomy Meetings in October 1995. The data will be presented at an OSU Extension Forage conference for producers at the South District office at Jackson, OH December 13,1995. The data will be reported in an Ohio State University Extension Fact Sheet, the Ohio ICM Newsletter, and at winter meetings and field days. A manuscript is in preparation for publication in the Plant Disease journal.

Table 1. Effects of planting date and fungicide treatment on severity of Sclerotinia crown and stem rot in no-till seeded alfalfa.

Planting	Disease severity (%) *		Total DM yield (T/A)		Final stand density (%)	
date	No fungicide	Fungicide	No fungicide	Fungicide	No fungicide	Fungicide
Mid-May	4	0	7.00	7.13	90	88
August 1	12	0	6.23	6.65	80	81
August 16	23	0	5.57	6.59	78	83
August 30	41	0	4.46	6.14	68	84
LSD (0.05)	6	NS	1.45	0.39	6	NS
* % of stand affected in May the year after seeding.						
NS = treatment differences were not significant at the 0.05 probability level.						

For further information contact Mark Sulc , Assistant Professor, Dept. of Horticulture & Crop Science, The Ohio State University or the Ohio IPM Office.

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Ohio Integrated Pest Management

The Ohio State University Extension

Slug Life Cycle and Damage Potential Studies in Ohio

Principal Investigators:

Ronald B. Hammond, Entomology
Roger Amos, Ashland County Extension Agent
John Barker, Knox County Extension Agent
Terry Beck, Wayne County Extension Agent
Robert Moore, Fairfield County Extension Agent
Howard Siegrist, Licking County Extension Agent
Dean Slates, Holmes County Extension Agent
Barry Ward, Richland County Extension Agent

Summary and Conclusions:

Each county agent contacted growers in their areas prior to the beginning of the growing season to locate at least two fields for conduction of the research (Knox County had three fields, Wayne County four fields). The only requirements for the fields were that they fit the definition of conservation tillage and were being planted to either corn or soybeans.

Most of the supplies for the study were purchased by Hammond, including the beer, molluscicide applicators, hole cutters, plastic cups, flags, roofing shingles, etc. Deadline Granules were supplied by Bill Haddad, Valent Corp. Visits were made to each county during May to 1) deliver the supplies and 2) to visit each of the fields in the study. *In situ* samples were taken during the field visits to determine the slug population and stages that were present. Ten areas approximately 1 ft^2 in each field were searched for the presence of slugs.

In situ sampling suggested that few adult slugs were present in any of the counties in May unlike the previous year when numerous adult slugs could be found. Less than one slug per sampled area was collected in most fields. However, numerous slug eggs were usually found in all fields, suggesting a slug population was present. Eggs were either of the gray garden or dusky slug. Although few adults were seen, the predominant slug was the gray garden slug with fewer dusky and marsh slugs observed.

Slug Species and Life Cycle

Each agent began weekly sampling after all supplies were delivered. Attractant samples were taken using beer traps. A hole was cut into the ground using a hole cutter, and then a 16-oz plastic food cup was placed in the hole. The cup was filled 1/5 full with beer and then an aluminum foil-covered roofing shingle, 1 ft^2, was placed over the cup. These traps were sampled the following day when the slug species and numbers were recorded. The beer and cups were removed and the shingle placed back over the hole. The holes and areas underneath the shingles were again sampled the following week which constituted passive samples. Afterwards new holes were dug, cups and beer placed into the holes, and the entire process repeated. This sampling procedure continued through June, after which samples were taken on a monthly basis.

Populations of slugs in the fields varied greatly, in both the predominant species and the size of the populations. Overall, the gray garden slug was the most predominant species. The gray garden slug was found in all fields that were sampled, being the most dominant in 11 of 17 fields. Usually they were at least equal to other species in population size in the other fields; they were relatively low in numbers only in two fields. The next most common slug was the marsh slug, found in many fields. However, they were usually not found in high numbers compared with the gray garden slug. The next most sampled were dusky slugs, found in seven fields. However, numbers reached >60 dusky slugs per trap in one field in Knox county, while in a field in Richland county populations were >24 per trap. Although the dusky was not as common as the gray garden and marsh slugs, they had the ability to reach large populations. Banded slugs were rare, only being found in any numbers in a single field in Wayne County. (That field in Wayne county is separated by a distance of 2-3 miles from the other three fields). Few slugs were collected during the summer and fall months.

A special note should be made about that field in Knox County. We took observations on the extent of crop injury that was occurring. Soybean plant stand was reduced, although it was still considered acceptable according to Agronomic guidelines. However, little additional injury was being done to the soybeans that had emerged and had 2-3 trifoliates. This was interesting considering the very large numbers of dusky slugs that were present. At that time, few of the other slug species were being collected.

Slug Injury/Crop Damage Studies

Plots were established in another area of the field to study the slug injury/crop damage relationship. Individual plots measured 50 x 50 ft, with two treatments: an area with molluscicide applied at 20-40 lb/acre and a nontreated area. Experimental design was a randomized block, two treatments with eight replications, for a total of 16 plots. A heavy rate of Deadline granules was used to ensure complete mortality of the endemic slug population. These traps were established and treated prior to knowing if a significant slug population existed. Beer traps were taken within these plots. Our plan was to collect various data on slug populations and crop damage during the season.

Slug injury did not occur at levels sufficient to continue this portion of the experiment in most locations. The only exception was a soybean field in Wayne county, where there was a reduced plant stand in the nontreated plots. Plant stand in the treated plots was calculated to be 171,734 plants/acre, while in the nontreated plots, the stand was 120,214, a 30% reduction. Analysis indicated that this difference was significant. Little additional damage occurred to these soybeans. Sampling indicated a population of dusky slugs (although much less than that field in Knox County mentioned earlier), with fewer gray garden and marsh slugs. Although plant stand was reduced, harvest data indicated no difference in yield between the two treatments: 40.5 bu/acre in the treated and 39.6 bu/acre in the nontreated. It should be noted that Agronomic guidelines state that there should not be any difference in yield between these plant populations. A population of 170,000 per acre is considered quite large; agronomic recommendations call for populations of 100,000 to 140,000 plants at harvest.

Summary

DUSKY SLUGS appear to be able to cause significant stand reductions in soybeans, especially later planted fields. Soybeans had been completely destroyed two years ago in the one Knox field referred to earlier (recollection was that the plants never emerged). This year, the same field had a stand loss; however, the plants that did emerge did not have significant feeding injury. We also saw numerous soybean fields in Wayne county with poor stands but not a lot of feeding injury. When feeding was observed, we always saw a lot of grays and/or marsh slugs.

We need to ask ourselves: are dusky slugs a big stand reducer in soybeans, where the plants are being damage prior to emerging from seed furrows and underneath residues? Are dusky slugs NOT causing that much damage after the plants have expanded leaves? In some of the fields we visit, we often think its poor emergence causing a poor stand; we assume we will have better stands within a day or two. Could poor stands we thought due to "no-till" be from dusky slugs? Is there a problem in corn knowing that it is usually planted earlier? Can dusky slugs reduce corn stands like in soybeans? Can they cause that much defoliation? All corn fields with noticeable defoliation always seem to have gray garden slugs. If the problem is prior to emergence, will it require treatment at planting or immediately afterwards? Obviously it would not be worth it to treat after plant emergence because the damage is already done.

GRAY GARDEN SLUGS can significantly defoliate both corn and soybeans. These slugs can defoliate either crop completely down to the ground. We saw a soybean field in Dalton, OH, where the soybeans had emerged, but then were eaten down to stubs. A corn field near Wooster, OH, which had reached the 4-6 leaf stage, had plants destroyed with other plants greatly stunted. Are gray garden slugs mostly leaf feeders, unless they are so numerous they take stem and all? Do they do most of there feeding after plants emerge, or can they also cause significant injury prior to emergence as seen with dusky slugs?

MARSH SLUGS were not seen in as many fields as gray garden slugs. During the spring, they seem to be relatively larger in size than grays, that is, larger juveniles and adults compared with smaller juveniles of gray garden slugs. Are they causing that much damage, or are they just there? We need to find more fields with marsh slug problems to determine this.

BANDED SLUGS are not in many fields; they were only numerous in one location in Wayne County. These slugs always seemed more sluggish compared with other slugs. Are they doing much damage? Are they elsewhere in the state?

Recommendations:

We have started to gain a better understanding of slug populations in Ohio. Of importance, we now realize, and need to educate growers, that these slug species are quite different, not only in appearance, but also in their life history and damage potential.

We need to continue this sampling program for another year in the same locations to compare this year's findings with another year under differing environmental conditions. We especially need to examine overwintering; so far we have seen one year where mostly adults have overwintered and one year where its been mostly eggs.

The plant/damage studies should only be done in fields where slug injury is occurring. The suggestion will be to wait until slugs begin feeding, and then establish the plots. In this way, only fields with a good chance of providing useable information will be tested. The exception will be for late planted soybean fields with a known history of dusky slugs. The suggestion in these fields will be to establish the nontreated vs. treated immediately after planting only in fields being planted late and where dusky slugs have been collected.

Lastly, we need to continue in our attempts to document the slug problem in Ohio. We will be discussing how to do this at an upcoming Task Force meeting. Also, Hammond will be making a case for this information at various state-wide meetings during the winter.

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

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