1998 Ohio IPM Block Grant Reports

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Comparing the efficacy of fungicide application technologies for disease control in tomatoes

Principal Investigators:

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Abstract:

Tomato producers rely heavily on fungicides for effective control and management of various diseases. Proper selection, calibration, operation and use of application equipment has a significant influence on pesticide performance and on the quality and quantity of crop produced. Limited data is available on how some of the application variables such as type of spray equipment, type and size of nozzles, travel speed, spray pressure, nozzle spacing and boom height influence efficacy level of a fungicide. Surveys of the application practices of growers are hard pressed to find a consensus on the optimum application practices. Generally, growers will use a combination of spray volume, small droplets, and higher pressures to provide the good effective coverage with little or no guidance available on the chemical labels. These approaches, however, may lead to the increase in spray drift, and the effectiveness of these practices are not necessarily backed up by research data and experiences. Besides a variety of new technologies available to increase coverage such as air-assist, and electrostatic sprayers, growers now have a variety of new "low-drift" nozzles (such as Turbo TeeJet, AI Air Induction) choices available to them. Unfortunately, not much information is available on effectiveness of these new nozzles. such as ceramic tipped flat fan and hollow cone nozzles.

Objective The intent of this project was to evaluate disease protection and measure spray deposition provided by several application techniques that will provide different levels of spray coverage, canopy penetration, and spray drift and that can be easily adapted to existing vegetable sprayers.

Materials and Methods:

Following is a brief description of materials and procedures that were used in this study:

Crop to be treated: Tomato

Diseases to control: Naturally occurring foliar blights (early blight, Septoria) and fruit rot (anthracnose)

Fungicide used and rate: Bravo Ultrex; 2 pints/acre, in 25 gal water/acre

Application interval: Fungicides were applied according to accumulation of Disease Severity Values (DSVs) using the TOMCAST disease forecasting model.

Spray equipment set up:
The six sprayer treatments included application techniques similar to those currently in practice (traditional broadcast applications using hydraulic nozzles mounted 20 inches apart on the boom), and treatments using an air-assist sprayer. The sprayer treatments included in the experiment were:

1) Conventional 80 degree flat fan nozzle (XR8002), broadcast configuration, 43 psi.
2) Conventional 80 degree flat fan nozzle (XR8002), broadcast configuration, 79 psi.
3) Ceramic disc-core hollow cone nozzle (D6-23), broadcast configuration, 37 psi.
4) Ceramic disc-core hollow cone nozzle (D2-23), broadcast configuration, 240 psi.
5) TurboTeeJet 110 degree flat fan drift reduction nozzle (TT110015), broadcast configuration., 71 psi.
6) Myers air-assist row crop sprayer (40 mph air stream), equipped with XR11005 flat fan nozzles in broadcast configuration (12 in. nozzle spacing), 28 psi.

Procedure:

This study was conducted at the Snyder Farm, OARDC in Wooster, in a replicated, randomized complete block design with four replications. In addition to the plots associated with the treatments listed above, there were four check plots receiving no fungicides (total of 28 plots). Each plot consisted of three rows of tomatoes, each 20 ft long, with 1 ft between plants. Rows were placed 5 ft on center, and each set of three treatment rows was alternated with a single untreated border row.

Fungal foliar diseases (early blight, Septoria) and fruit rot (anthracnose) moved into the plot naturally. Approximately mid-season, Bravo Ultrex fungicide was applied on a 7-10 day schedule according to the accumulation of DSVs (Disease Severity Values) in the TOMCAST model. Six spray applications were made between 2 July and 20 August 1998. Check plots did not receive the fungicides or copper treatments.

A fluorescent tracer (Tinopal) was added in the spray mixture to evaluate foliar spray deposits. Each sprayer treated four, 3-row plots. Four leaves at top and four leaves at middle elevations were taken from each of the 3 plants in center row. The spray coverages both on upper and under side surfaces of leaf samples were evaluated using an image analysis system. With a separate set of spraying treatments on the same plots, effectiveness of adding surfactants which improve spreading characteristics of the spray was investigated. For this, X-77 a spreader surfactant, was added to the spray mixture at a concentration of 0.1%.

Tomatoes were evaluated for disease control relative to the untreated check plots three times throughout the growing season based on foliar disease. Foliage was rated for lesions and defoliation according to the Horsfall-Baratt rating scheme (a rating of 1 indicating the least amount of disease observed, while a rating of 12 indicating the highest amount of disease observed). Fruit at ripe stage was harvested from the center 5-feet section of the center row of each plot. Samples were evaluated for anthracnose, and yield was determined. Insects and weeds in the plots were managed by using standard management practices.

Summary of Results:

- It is more difficult to treat undersides of leaves than upper sides of leaves
- The air-assisted sprayer provided significantly better coverage on underside of leaves than other sprayers and nozzles.
- Regardless of the nozzle type used, coverage on leaves lower in the canopy was significantly less with conventional sprayer setup than with the air-assisted sprayer.
- Although there were differences in spray coverage from different treatments, this did not correlate with

the control of all foliar diseases.

- Small differences were observed in disease control provided by different nozzles.
- The experiment summarized in this report will be repeated in 1999.

Extension Program Implementation:

Results of this study was presented to Tomato growers at several county-based meetings and at a field day held in OARDC Vegetable Crops Branch in Freemont, and to OSUE Extension Agents at the 1999 Pesticide Update In service. A handout was prepared and distributed to the agents at this In service. The data will be distributed to interested Extension Specialists in other states via e-mail.

For further information contact Erdal Oskan, Professor, Food, Agriculture and Biological Engineering or the Ohio IPM Office.

Comparison of Disease Control on Fresh Market Tomatoes using TOMCAST and SKYBIT to Time Fungicide Applications

Principal Investigator:

Jim Jasinski, Southwest District IPM, The Ohio State University Extension;
Mac Riedel, Becky Lyon, Plant Pathology;
Brad Bergefurd, Thom Harker, The Enterprise Center
Robert J. Precheur, .Horticulture and Crop Science, The Ohio State University, Columbus, OH 43210

Background:

TOMCAST, a tomato disease forecasting program, has served the Ohio fresh market tomato industry since 1996 by providing assistance in scheduling fungicides. Initially, DSV spray thresholds were adapted from processing operations to meet the quality standards necessary for fresh market product. As preliminary spray thresholds continue to be developed and tested in the field, other concerns such as access to TOMCAST information have emerged. Over the last few years, for profit weather forecasting businesses began offering local sources of Disease Severity Values (DSV) to growers. Monthly weather forecasting contracts during the growing season may have an economical appeal to growers vs. the large up front expense of a local weather station. These alternate sources of agricultural weather require investigation for both the quality and reliability of the information broadcast.

Objectives:

(1) To compare the accumulation of DSV in Hillsboro, OH using a ground based CR10 datalogger versus Skybit generated values and (2) To compare the fruit quality produced by both systems following a 15, and 20 DSV fungicide schedule.

Materials and Methods:

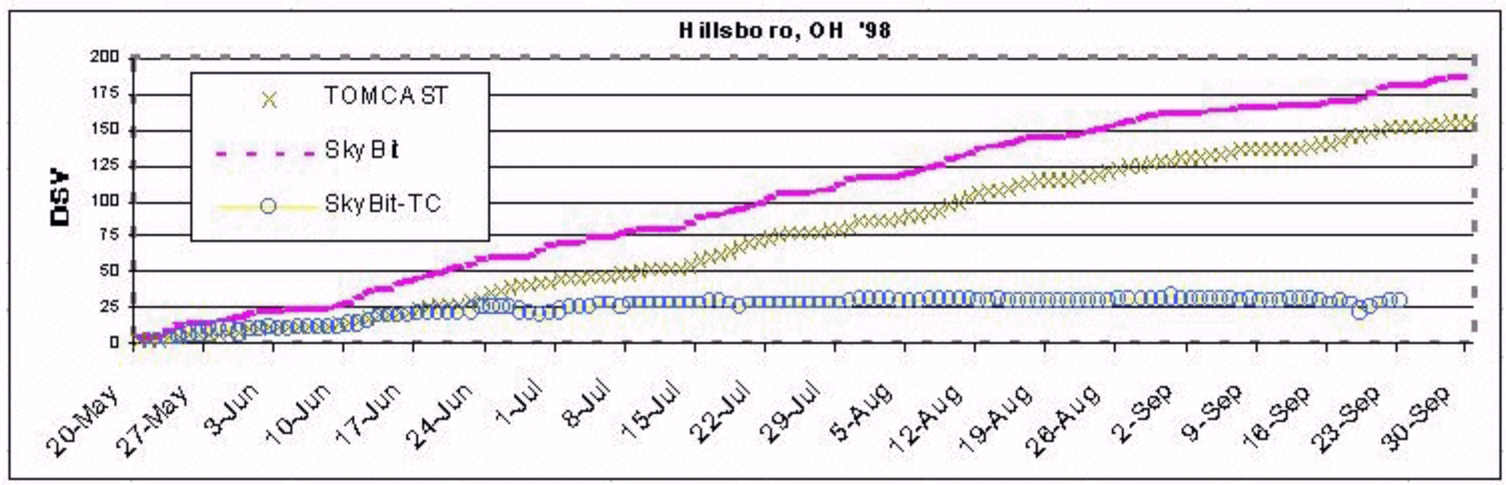
A Campbell Scientific CR10 datalogger was stationed at, Hillsboro to record hourly temperature, leaf wetness, and precipitation. Specific combinations of temperature and leaf wetness are converted to DSV on a daily basis and accumulated from June 1 through harvest, typically mid September. Daily forecasted leaf wetness and temperature data were received electronically from Skybit during the same time frame, also producing a daily DSV.

Fungicide scheduling trials on fresh market tomatoes were conducted in 1998 at Hillsboro, OH. There were six fungicide application treatments on tomato cultivar Mountain Spring: Skybit 15 (DSV), Skybit 20, Tomcast 15 (DSV), Tomcast 20, 7 day calendar, and an untreated check, each replicated four times. Each treatment was applied when the number of DSV accumulated by each system (Skybit or Tomcast/CR10) equaled or exceeded the Action Threshold (15, or 20 DSV), weather permitting. Fruit quality was determined on site by harvesting five feet of row per plot and analyzing the data with a two way ANOVA. Spray schedules for the site are listed in Table 1.

Results & Discussion:

DSV accumulation under both systems are shown in Figure 1 for Hillsboro. The Skybit forecasting system generated a higher number of DSV than the CR10 datalogger physically measured. The maximum difference between the two curves can be seen readily by the end of June or first part of July. From this point on, the difference between the two systems remains constant or even decreases over time. Since there is no consistent pattern of accumulation, it is difficult to determine during the season when the Skybit numbers closely follow ground based observations and when they diverge. With a wide fluctuation in the accuracy of the DSV accumulations compared to ground based readings, the results were similar, especially in the area of a wide DSV gap early in the season between the two systems, followed by unpredictable DSV accumulations later in the season.

Figure 1. Daily Skybit and TOMCAST / CR10 DSV accumulations



The Hillsboro site showed no statistical separation between the treatments in the categories of Red plus Green, and Salad. Cull weight of fruit in the calendar treatment was significantly less than the cull fruit weight of Tomcast 20 DSV. Although statistically no differences were seen, the calendar fungicide program yielded the most Red plus Green fruit and the check the least, with the other treatments with very similar yields (See Table 2).

With quality and yield being statistically no different, growers would not have been penalized for using (following) either TOMCAST or Skybit DSV accumulations to schedule their fungicides, even though the two systems accumulation curves were off by as much as 25 units at different times of the season. Part of the lack of difference may be attributed to the weather not allowing for sprays to be applied as soon as they were recommended, and the second part involves the conservative nature of the DSV calculation itself. Being "off" by a few days or a few DSV doesn't heavily affect fruit quality or yield, according to these experiments anyway.

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

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Controlling Weeds in Vegetable Production Using Spring Sown Cover Crops as Killed Mulch.

Principal Investigator:

Dr. Mark Bennett, and Mary Christine Akemo, Dept. of Horticulture and Crop Science, O.S.U.

Abstract:

The use of cover crops in vegetable production in Ohio would reduce application of herbicides for weed suppression, reduce soil and environmental pollution, and improve soil structure and fertility. Most research on cover crops has been on those over-wintered and killed in the spring for mulch. This study was repeated for the third time to determine if cover crops sown in the spring and killed for mulch can control weeds well enough to produce acceptable tomato yields. The unusually dry season and high weed pressure in the experimental plots depressed tomato performance, though plots with higher pea proportions in the cover crop had better yields than those with higher rye proportions. Yields were much lower than in 1997 when soil moisture was adequate.

Materials and Methods:

Raised plots measuring 40ft by 4ft were established at OSU Horticulture Farm on Lane Avenue in Columbus. Cover crops winter rye ' Wheeler' (*Secale cereale* L.) and field peas (*Pisum sativum* L.) were sown on April 23 with ratios and seed rates as shown in Table 1. There were 18 treatments including 3 controls, all replicated 4 times. Percent ground cover by weeds was assessed visually 60 days after sowing cover crops (DAS). Cover crop biomass was harvested 62 DAS from 0.5 m^2 areas of treatments 1 to 15. Pea and rye foliage were dried and weighed separately. Cover crops were undercut 63 DAS, and WT and WFT were rototilled 73 DAS. One-month-old 'Marglobe' tomato (*Lycopersicon esculentum* Mill.) seedlings were hand transplanted July 6 to 7, 50 plants per plot in 2 rows, 60 cm between rows, 45 cm between plants. Disease control was carried out following recommendations for the State of Ohio, and pests were controlled based on scouting. Tomato plants were destructively harvested from all treatments 50 days after transplanting. Data was collected on soil temperatures, flowering, and fruiting of tomato plants. WFT was hand weeded as required. Ten plants from each plot were tagged for harvesting, and fruit was picked as it ripened. Weed dry weight was taken at undercutting and 45 days after undercutting cover crops. Soil was sampled before sowing cover crops, at cover crop cutting, and end-of-season.

Results and Discussion:

May was cold and dry, and the cover crops accumulated foliage mainly in June. rpH and rPH had the highest cover crop dry weight, while PPL had the least (Table 1). Before undercutting, grass weeds were very few or non-existent. Broad leaf weeds were stunted by pure rye treatments but higher in numbers (data not shown). Weed dry weights were higher 45 days after undercutting cover crop that at undercutting (Table 2). Soil temperatures did not vary much, ranging between 20 and 25 C the whole season.

This year dry weather and high weed pressure after transplanting suppressed tomato growth in all cover cropped treatments compared to WFT and WT (Table 3). Fifty days after transplanting tomato plants from WFT and WT had highest leaf areas, followed by PPM, PPH, and rPH. This was probably due to the nitrogen supplied by the field peas in these treatments. Dry weight of tomato plants in cover cropped treatments was more comparable to that obtained in the weedy check (WNT) than in WT and WFT. Tomato plants flowered and fruited 2 weeks earlier in WT and WFT than in the cover cropped treatments and WNT (data not shown). rPH and rpH had next fastest rate of tomato plant flowering and fruiting. WFT and WT out-yielded WNT and the cover cropped treatments, except rPH (Table 3).

N, P, and K soil levels were higher in most treatments at undercutting than before sowing cover crops, while N and P levels were lower at the end of the season (Table 4). Ca, Mg, and CEC levels were also higher at undercutting cover crops and had fallen by the end of the season (data not shown).

Weeds and cover crops have to be killed completely at mowing or undercutting otherwise they re-establish and suppress vegetable growth. This year rain the same evening the cover crops were undercut especially favored re-establishment of the broad leaf weed species. Undercutting must be timed to allow cover crops and weeds enough time to dry out before the soil receives any moisture. At least three days are required for cover crop and weed kill after undercutting. Adequate soil moisture is also essential after establishment of the primary crop for acceptable yields. These results showed that in a dry year cover crops may not adequately offset the effect of deficient soil moisture on crop growth and yield.

Extension Program Implementation:

These results will be presented in seminars in the Department of Horticulture and Crop Science, at 1998 horticulture meetings such as the Ohio Fruit and Vegetable Growers Congress, and the American Society of Horticultural Science.

For further information contact Mark Bennett, Associate Professor, Horticulture & Crop Science or the Ohio IPM Office.

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Define production losses in Pumpkins due to unknown insects or pathogens.

Principal Investigator:

Craig Everett, Wood County Extension

Abstract:

Ohio produces more than 3000 acres of pumpkins as a high value crop for which yield and quality of the crop is extremely important. Quality and yields were reduced by as much as 20% in 1997 in certain areas of the state by mysterious holes, caused by an unknown factor. Lost revenues were as high as $195.00 per acre in certain areas of Ohio. Yield reductions based on samples and inquiries received at Ohio State University's Extension, Pest Diagnostic Clinic, and the Wood County Extension office. The purpose of this study is to determine the cause and to prevent the problem hole findings in pumpkins late in their production cycle. The first objective of this study is to determine the identity of these problem holes through thorough monitoring of pathogens and insects. Some hypotheses to be looked at include pickle worm a common insect of pumpkins in the Carolinas, not known to occur in Ohio. Another theory is the increased moisture during the 1997 growing season aggravated a known pumpkin pathogen or a new pathogen occurred. Some methods to be used to determine these unknown pests include pheromone traps, and the Pest Diagnostic Clinic.

The second objective is to prevent the problematic holes from occurring. Several varieties of pumpkins will be raised to evaluate variety sensitivity. Rotation of chemical classes of insecticides and fungicides for control of pests on pumpkins for comparison purposes will also be looked at.

Implementation:

The acre test plot was established in late June of 1998 at Rick and Carl's Trees in Bowling Green, Ohio. The acre plot was divided into four .25 acre plots. Each plot had eight rows of separate varieties of Pumpkins, eight feet apart, and a fifteen-foot walkway between rows four and five. There was fifteen foot pathways between the plots, and rows ran North and South.

A dismal start delayed production due to dry spring conditions. In April soil tests were sent to REAL. Roundup Ultra (qt/acre) and 2-4D (pt./acre) was also applied. Mid may was the first planting (2 lbs./acre) and consist of the varieties Howden, Pro-Gold, Howden Biggy, Ichabod, Aspen, Tallman, Baby Bear, and Jumpin Jack. At planting 50 lbs. of 16-16-16 was banded in the seed row, and Prefar (qt/acre) was incorporated. Plots did not receive supplemental irrigation. Late June the plots were reseeded, due to dry conditions (2 lbs./acre) using same varieties. Germination started around June 30,1998. Due to the dry conditions Prefar did not take hold and cultivation was employed in early July to help combat weeds. Additional fertilizer was applied as a spray , 20- 20 -20(5 lbs/acre), in early July. All four plots were adversely affected by the weather again, between August 5 and the 15 when the plots received 6.5 inches of rain. Scouting of the plots utilizing pheromone traps for pickle worm, started the second week of August. Traps were checked twice a week and the pheromone lures replaced every two weeks.

To look at possible pesticide interactions, each plot had a separate insecticide and fungicide program. Plot number one tried to duplicate the same growing practice used by Rick and Carl's Trees in 1997. Plot number two looked at not using any insecticides or fungicides. Plot number three evaluated the rotation of insecticides and fungicides, and plot number four evaluated the rotation of insecticides and fungicides based on the 1998 Ohio Vegetable Production Guide. For comparison purposes total yield data was also collected.

	Plot Number One
July 7, 1998	Sevin XLR qt/acre
July 29, 1998	Sevin XLR qt/acre
September 13, 1998	Sevin XLR qt/acre ; Bayleton 50 4oz/acre ; Bravo 500 qt/acre
September 25, 1998	Malathion 57EC 3pt/acre; Bayleton 50 4oz/acre ; Bravo 500 qt/acre
August 11, 1998	Monitored pickle worm traps, twice week - none found Monitored major insect and disease pressure - none found
October 26, 1998	Total yield 10 ton/acre
	Plot Number Two
August 11, 1998	Monitored pickle worm traps, twice week - none found Monitored major insect and disease pressure - none found
October 26, 1998	Total yield 15 ton/acre
	Plot Number Three
July 7, 1998	Sevin XLR qt/acre
July 29, 1998	Sevin XLR qt/acre
September 13, 1998	Thiodan 50WP 1.5lbs/acre ; Bayleton 50 4oz/acre ; Bravo 500 qt/acre
September 25, 1998	Asana 8oz/acre; Bayleton 50 4oz/acre ; Bravo 500 qt/acre
August 11, 1998	Monitored pickle worm traps, twice week - none found Monitored major insect and disease pressure - none found
October 26, 1998	Total yield 10 ton/acre
	Plot Number Four
May 18, 1998	Furadan 4F 2.4oz/1000ft
July 29, 1998	Sevin XLR qt/acre
September 13, 1998	Asana 8oz/acre ; Bayleton 50 4oz/acre ; Bravo 500 qt/acre
September 25, 1998	Thiodan 50WP 1.5lbs/acre; Bayleton 50 4oz/acre ; Bravo 500 qt/acre
August 11, 1998	Monitored pickle worm traps, twice week - none found Monitored major insect and disease pressure - none found
October 26, 1998	Total yield 10 ton/acre

Results:

Data collected from the four plots was inconclusive about what may have happened to part of Ohio's 1997 pumpkin crop. All four research plots were unremarkable, as the mysterious hole findings did not appear. The pheromone traps collected no male pickle worm moths. Though we had an unusual wet August, disease pressure was light to none. An interesting anecdote is plot number two without the additional insecticides or fungicides had an increased yield of five tons to the acre. Reports from Ohio States University Extension Entomology Department also note no significant reports of damage to Ohio's 1998 pumpkin crop.

Based on one year research, the theory that pickle worm may appear on a cyclic time table, or be brought into Ohio on southerly winds, needs to be monitored more closely. Another hypothesis is climatic weather conditions still may play a role in production years where these mysterious holes appear.

Extension Program Implementation:

Results of this study will be made available to the Ohio State University Vegetable Team, and with pumpkin producers. Reports will also be distributed for use in Extension bulletins on pumpkin production.

For further information contact Craig Everett Ohio State University Extension, Wood County or the Ohio IPM Office.

Documentation of Pest Activity and Pesticide Applications Using GPS with a Crop Scouting Program.

Principal Investigators

John Barker, County Extension Agent - Knox County

Abstract:

New technology currently exists allowing farmers to vary the application rates of crop inputs throughout an individual field. These practices are creating vast and sweeping changes throughout grain farms in the Western Cornbelt States. This new technology allows such inputs as herbicide, insecticide, fertilizer, manure, seeding rates, etc. to be altered at any particular point in a field, thereby reducing the potential for over application of these inputs. Combining a regular, systematic crop scouting program with the ability to vary pesticide applications according to exact location within a field should reduce pesticide usage. This not only improves the profit margin on any given farm, but also allows for more environmentally sound practices to be adopted. The objective of this study is to evaluate the use of Global Positioning Systems (GPS) in conjunction with a regular crop scouting program to pinpoint exact pest locations in these fields. Once documented, this data will then be used to make pesticide applications if needed. Fields will be divided into two parts. On one side the field will be farmed according to the producers normal production practices. On the other side GPS will be used to document exact pest location. With this data we will treat only portions of the field needing applications rather than the entire field. Many farmers believe that SSM is to costly and thus have not added it to their operation. The results of this research will be used to develop an economic and environmental analysis comparing SSM vs. normal production practices in an actual farm setting.

Methods:

Four full field test plots were established in April 1998. These fields varied in size from 69 to 182 acres. Each field received Canopy herbicide (1/2 rate) applied in early April, prior to planting. Each field was planted with Roundup-Ready soybeans. Therefore, postemergence applications of Roundup will be applied if warranted. Each field was systemately scouted on two week intervals from May through September, 1998. The field scout was equipped with a Fijitsu handheld PDA and a Satlock differentially corrected global positioning satellite receiver. This equipment allowed the scout to record detailed field data showing weed species and exact weed location within the field. Weed data was recorded in areas where groupings of three or more species were observed in a radius of five feet or less.

Results:

Scouting data from each field was used to make pesticide recommendations. Field 1 (Figure 1) consists of approximately 173 acres. This line in this field served as the boundary between the two plots. Plot A was treated with the farmers normal production practices. Plot B was treated with recommendations from the scouting and GPS data. Figure 1 shows field data including weed species and location one day prior to pesticide application. In Plot A the farmer sprayed the entire field based upon weed pressure and recommendations from his chemical supplier. Roundup herbicide was applied at a rate of 2 Qt./A In Plot B the entire field was sprayed with a reduced rate (1 Qt./A.) of Roundup. Figure 2 indicates weed pressures three weeks after application. Yield data was collected for each of these plots. The average yield in Plot A and Plot B were 45.3 Bu./A. and 46.1, respectively. The lower herbicide application in Plot B provided adequate weed control, had no adverse affect on yield and resulted in a savings of $12/A. Similar results were found in fields 2 and 3. Figure 3 represents the weed pressure one day prior to herbicide application in field 2. The line in the middle of the field represents the division between the two plots. In Plot A the farmer sprayed the entire field based upon weed pressure and recommendations from his chemical supplier. Roundup herbicide was applied at a rate of 2 Qt./A In Plot B the entire field was sprayed with a reduced rate (1 Qt./A.) of Roundup. Figure 4 indicates weed pressures three weeks after application. Yield data was collected for each of these plots. The average yield in Plot A and Plot B were 46.2 Bu./A. and 44.9, respectively. The lower herbicide application in Plot B provided adequate weed control and resulted in a savings of $12/A. Field 4 (Figure 5) consists of approximately 87 acres. In this field Plot A is represented by the shaded areas of the field. This portion of the field received one application of Roundup herbicide at 2 Qt./A. The farmer made this decision based upon weed pressure and recommendations from his chemical supplier. Plot B is represented by the unshaded portion of the field. This plot was approximately 31 acres in size. With regular scouting and documentation of weed location we determined that the existing weed pressure did not justify a herbicide application. Figure 6 displays weed pressures three weeks after application. The yield in Plot A and Plot B were 47.8 Bu./A and 47.9 Bu./A, respectively. Heavier weed pressures are observed in Plot B however, this increased weed pressure appears to have no impact on yield. The combination of regular, systematic scouting and the ability to document exact weed location in this field resulted in herbicide applications being reduced by approximately 35.6 percent. This reduction resulted in savings in chemical and application charges of $29/A. Which translates to a savings of $899 for the entire field.

Extension Program Implementation:

Results of this study will be reported at winter meetings and at various field days throughout the year. These results will be published in our annual county research report and shared with various industry personnel throughout Ohio. Figure 1.

For further information contact John Barker Extension Agent, Ohio State University Extension, Knox County or the Ohio IPM Office.

Evaluating Effects of Insect and Disease Damage on TopCross High Oil Corn Production

Principal Investigators

Peter Thomison, Horticulture and crop Science
Pat Lipps, Plant Pathology
Bob Buxton, Riverview High School

Abstract:

High oil corn acreage in the U.S. has increased from less than 50,000 acres in 1992 to over one million acres in 1998. High oil corn is attractive as a livestock feed because it has greater energy value than normal yellow dent corn and can replace more expensive dietary sources of fats and proteins. The **TopCross**® grain production system is rapidly gaining popularity as the preferred method of producing high oil corn and involves planting a blend (a **TC-Blend**®) of two different types of seed corn mixed together in the same bag. TopCross corn production may be more vulnerable to certain pest problems, including those that result in defoliation and silk clipping, than normal corn. Widely publicized yield losses in TopCross corn fields near West Liberty, Ohio in 1997, associated with insect injury and unfavorable growing conditions, have slowed adoption of this new seed technology. The objectives of this research include the following: 1) to evaluate defoliation effects on the nutrient composition of **TopCross** and normal corn grain and 2) to compare the effects of varying levels of defoliation at different stages of corn development on the agronomic performance of pollinator and male sterile grain parent plants, as well as their normal (and fertile) grain parent checks. Results of this project will serve as a basis for predicting grain quality and yield losses associated with leaf destruction of TopCross corn by insect feeding, and/or foliar diseases.

Two field experiments were performed to determine the impact of defoliation injury on TopCross high oil corn production. In Experiment 1 effects of early season plant injury on TopCross grain production were determined. In Experiment 2 effects of defoliation during grain fill were evaluated. The two experiments were established at the OSU/OARDC Western Branch research farm near South Charleston and at the OSU Waterman Research Farm in Columbus.

Experiment 1 A high oil TC Blend (Pfister SuperKernoil 2852-19) and its normal grain parent check (Pfister 2652) were evaluated. Early season plant injury was created using different levels of defoliation. Defoliation treatments were as follow: no defoliation, 100% leaf removal at V4 (or the 4- collar leaf stage), and 50 and 100% leaf blade removal at the V13 stage of development. The distal half of all leaves at the collar was removed to accomplish the 50% defoliation treatment. The 100% defoliation treatment entailed cutting at the collar all fully developed leaves on the plant.

Experiment 2 This experiment used the same high oil TC Blend and normal grain parent evaluated in Experiment 1. Defoliation treatments were as follows: no defoliation, and 50 and 100% leaf blade removal at the tassel emergence (VT), milk (R3), and full dent (R5) stage of development. The leaf removal protocol was the same as that described for Experiment 1.

In each experiment, treatments were replicated three times in a randomized complete block field design with treatments in a split plot layout. The TC Blend and grain parent check were assigned to main plots and the defoliation treatments to subplots, four rows 30 inches apart and 17.5 feet in length. Plots were planted at seeding rates of 30,800 seeds/A.

Final plant stand, numbers of plants stalk lodged (stalk breakage below the ear), and barren or with nubbin ears were recorded at maturity prior to harvest. At harvest, the center two rows of each plot were hand harvested to determine grain yield, ear moisture, and kernel weight. Ears of the TC Blend pollinator plants (SK2652 pollinator 19) and TC Blend male sterile grain parent plants were separated to distinguish effects of defoliation on these different plant types. Additional pollinator ears were collected from the mini-plots. Sampled ears were shelled and a sub sample of grain from each plot was analyzed for grain quality composition.

To minimize possible pollen contamination from the neighboring male fertile grain parent check as well as any nearby normal corn, the TC Blend plots were planted in isolation at least 100 feet from normal corn hybrids. This 100-foot buffer was planted with male sterile seed to minimize foreign pollen contamination. Plots were also planted with this TC Blend seed as border (20-50 feet) on all sides of the isolation field.

In experiment 1, defoliation did not change the timing of pollen shed of the pollinator and silk emergence of the male sterile grain parents. Complete defoliation at V4 delayed pollen shed and silk emergence by 7 to 10 days. Defoliation at V13 had little effect of the timing of silk emegence and pollen shed compared to nondefoliated check. Defoliation resulted in more nubbin ears and greater stalk lodging in the TC Blend pollinator than in the TC Blend grain parent. Grain yields of the non defoliated grain parent check were not significantly different from the TC Blend (157 vs. 148 Bu/A). However defoliation treatments reduced yields of the check more than the TC Blend. Complete leaf removal at V4 reduced yields of the TC Blend and grain parent check 17% and 30%, respectively. At V13, yields of the TC Blend were reduced 11% and 25%, respectively by the 50 and 100 percent defoliation treatments, whereas yields of the grain parent check were decreased by 16% and 35% by the 50 and 100 percent defoliation treatments. Grain oil content and metabolizable energy were significantly higher in grain from the TC Blend than the grain parent check but grain nutrient composition was not affected by defoliation.

In experiment 2, agronomic performance of the grain parent check and TC Blend were similarly affected by defoliation treatments. Yields of the nondefoliated grain parent check and TC Blend did not differ significantly. Defoliation (50 and 100 %) reduced yields in all treatments but 100% defoliation treatment at VT resulted in the greatest yield reduction whereas 50% defoliation at R5 resulted in the least yield loss. Effects of 50% defoliation on yield at VT and R3 were comparable. Yield losses from defoliation were greatest at anthesis and during early kernel development.

Defoliated pollinators were characterized by a much higher percentage of barrenness and nubbin ears than the male sterile grain parents. For those pollinator plants that did produce normal ears, grain/plant, and ear weight appeared less affected by defoliation than the grain parent plants. Grain yield of pollinator plants was reduced by 50% and 100% defoliation at VT and 100% defoliation at R3, whereas all the defoliation treatments reduced yields of TC Blend grain parent plants. However kernel size of pollinators was reduced by all defoliation treatments except the 50% defoliation at VT, a response similar to the grain parent.

The average oil content of grain from the TC Blend grain parent was 3.6 and 1.8 percentage points greater than that of the fertile grain parent. Grain oil content was generally reduced by defoliation treatments whereas protein content was increased. The reduction in oil content was more severe with greater defoliation at the earlier kernel development stage The oil content of the grain parent check was reduced by three of the defoliation treatments (50% and 100% at R3 and 100% at R5) with oil levels lowered by 14 to 31%. The grain oil content of the TC Blend grain parent was reduced by all defoliation treatments except the 50% defoliation at VT. Decreases in oil content ranged from 9 % for 50% defoliation at R5 to 29%for complete defoliation at R3. Complete defoliation of the TC Blend grain parent at R3 and R5 reduced oil levels by 29% and 19% respectively; whereas 50% defoliation reduced grain oil levels at VT, R3, and R5 by 6%, 11%, and 8%, respectively. Since premiums for contract production of high oil corn are based on grain oil content, the lower grain oil levels associated with defoliation would result in reduced premiums. Moreover, with grain yield reduced by defoliation, oil yield/A would be reduced.

Extension Program Implementation:

Results from these experiments will be summarized in an Ohio State University Extension Fact sheet as well as in the OSU C.O.R.N. (Crop Observation and Recommendation Network) Newsletter. Results will also be presented at grower and ag industry meetings, including field days and plot tours. Data collected will be used in developing guidelines for assessing yield and grain quality losses associated with leaf blade destruction by insect feeding and foliar diseases in TopCross corn fields. **TC-Blend**® , **TopCross**® , and **Optimum**® are registered trademarks of Optimum Quality Grains L.L.C.

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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Evaluating the pest status of squash bug and bacterial diseases on gourds

Principal Investigators:

Celeste Welty, Associate Professor, Dept. of Entomology
Richard M. Riedel, Professor, Dept. of Plant Pathology

Abstract:

Gourds have become a profitable crop on Ohio vegetable farms in recent years, but growers have been having problems with gourd fruit being unmarketable due to bacterial diseases: bacterial leaf spot (*Xanthomonas campestris* pv *cucurbitae*) and angular leaf spot (*Pseudomonas lacrymans*). These two diseases are known to be seed borne. Some growers have intensified their insecticide program for squash bug control because they speculate that bacteria gain entry into fruit through feeding punctures of squash bug. It is possible that soft rot bacteria (*Erwinia* spp.) could invade wounds made by insects. The role of squash bug in entry of bacteria must be determined so that the need for squash bug control can be evaluated. Squash bug is a serious yet sporadic pest in Ohio; the occurrence of parasitoids needs to be evaluated to determine if biological control is keeping squash bug populations suppressed in some years. The objectives of this project were: 1) to verify which bacterial diseases are present; 2) to determine whether bacterial disease incidence is associated with squash bug infestation; 3) to determine whether squash bug eggs are being parasitized, and if so, to what extent and by what species. Three activities were undertaken in the summer of 1998: two large commercial gourd fields were scouted for diseases and insects, a cage field trial was conducted a research farm in Columbus, and squash bug eggs were surveyed for parasitism.

In Sandusky County, two large commercial gourd fields 15 miles apart were scouted weekly from mid-June until early September. The sample unit was one whole plant until vines ran; and one older leaf, one stem, one flower, and one fruit after vines ran. The number of samples examined was 50 in the seedling stage, 25 from seedling until vines ran, and 50 after vines ran. Both fields had poor plant quality by harvest due to frequent flooding rains in July and August.

In the 26-acre field, bacterial lesions on leaves were detected on 32% of plants randomly sampled on 18 June when plants had 6-8 leaves; the disease was diagnosed clinically as angular leaf spot, *Pseudomonas syringae* in two samples and *Pseudomonas chichorii*/*P. syringae* in another sample. In the same field, lesions were detected on only 8% of plants the following week (25 June), then no symptoms were detected until spots were found on fruit on 8% of plants on 13 August. Spots were not seen on random samples during the following two weeks. For bacterial control, the field was treated four times with copper, on 5 and 17 July and 1 and 11 August. No squash bug adults, nymphs, or eggs were ever detected in the 26-acre field, although some cucumber beetles and aphids were present throughout the season. The field was sprayed twice with

insecticide: endosulfan on 21 June and Warrior on 5 July.

In the 61-acre field, lesions were also found on 18 June but on only 2% of plants sampled; lesions were not detected again on randomly sampled plants, but angular leaf spot symptoms were noticed by the scout as she walked through the field on 16 July and 4 September. For bacterial control, the field was treated four times with copper, on 3 and 17 July and 1 and 11 August. The field was sprayed once with insecticide: endosulfan on 3 July. Squash bug was detected at low densities starting in late July. On 28 July and 11 and 18 August, only one infested sample was found per 50 samples; the infested sample on 28 July had 23 eggs and 23 nymphs on a leaf; the infested sample on 11 August had 1 adult on a stem, and the infested sample on 19 August had 6 nymphs on a stem. On 27 August, 3 of 50 samples were infested; two samples each had one nymph on a stem and one sample had one adult on a fruit; this is the only time that a squash bug was found on a fruit.

Squash bug egg masses were surveyed at the Waterman Farm at OSU/Columbus from 6 July until 20 August, mostly from pumpkins and some from gourds. On each sampling date, half of egg masses found were collected and brought to the lab to be held until hatch, and half were left in the field but flagged to collect after one week, to allow maximum exposure to parasitoids before collection. A total of 44 masses were collected. None were parasitized.

A cage experiment was conducted at the Waterman Farm at OSU/Columbus. There were four treatments each with four replicates, with one caged plant per replicate. Treatments were: 1) no bacteria, no squash bug, 2) with bacteria and with squash bug, 3) no bacteria but with squash bug, and 4) with bacteria but no squash bug. A metal fence post was put in the soil at the center of each cage location. A 20-cm length of PVC pipe was pushed halfway into the soil next to the fence post. Seeds were placed in soil within the PVC pipe. Plants were caged individually after seeding on 8 June. Cages were cylindrical, 2 m tall, made of fine mesh fabric, stretched over loops of thin plastic pipe. Cages were supported by the central fence post that served as a plant trellis, and closed at the bottom by an elastic band stretched tightly around the fence post and PVC pipe. Clorox-treated seeds were used to produce plants free of bacteria. Two leaves on each of 8 plants were artificially inoculated with angular leaf spot from a lab culture on 15 July. Ten squash bug small nymphs were artificially infested on each of 8 plants on 18 July and reinfested with 10 small nymphs per plant on 31 July. Flowers of caged plants were pollinated by hand twice per week. Cages were removed briefly for fungicide application for powdery mildew control on 31 July and 12 August. Cages were removed on 26 August after they were severely damaged by a storm. At harvest on 29 September, only one fruit on one plant had bacterial symptoms, from the treatment with bacteria and with squash bug. We felt that this experiment was inadequate to answer our question due to many logistic problems of keeping squash bugs on plants, so we are planning a greenhouse test to be conducted in January and February 1999 with squash bugs that are currently in culture in our lab; individual fruit will be caged rather than whole plants.

Extension Program Implementation:

We discussed this project with cucurbit growers at two field tours in 1998, at Columbus and Hillsboro. We are scheduled to make a presentation on this topic at the Vegetable Growers Congress in February 1999. The point that is being made to growers immediately is that Clorox treatment is important in preventing bacterial seed-borne diseases. Further applied research is needed before conclusions can be made about the role of squash bug in disease development and whether parasitoids are a contributing factor to management of this pest.

For further information contact Celeste Welty Assistant Professor, Entomology or the Ohio IPM Office.

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Evaluation and On-Farm Demonstration of Glandular-haired Alfalfa as an IPM Strategy

Principal Investigator:

R. M. Sulc, Horticulture & Crop Science

Abstract:

The potato leafhopper (Empoasca fabae) is the most serious insect pest affecting alfalfa production in the midwestern United States. Host plant resistance achieved through the use of glandular-haired (GH) germplasm promises to be an effective and environmentally desirable IPM strategy for controlling this pest in alfalfa. Field evaluations of GH alfalfa varieties began in 1996. Our objectives this year were to: 1) continue the evaluation of GH alfalfa varieties for resistance to potato leafhopper (PLH) and agronomic performance, 2) establish new on-farm demonstration trials comparing GH varieties and standard alfalfa varieties, 3) determine what level of PLH resistance is needed to eliminate economic losses in forage yield and quality of alfalfa, and 4) determine whether strategic use of insecticides in the seeding year can reduce or eliminate pesticide usage on resistant varieties in subsequent years. The results demonstrate that glandular-haired varieties with high levels of potato leafhopper resistance show tremendous promise as an effective and environmentally benign IPM tactic to control this most serious insect pest in alfalfa.

More insecticides are applied to control PLH than for any other pest in alfalfa. Economic thresholds for this pest are commonly exceeded at least once and often twice each year in Ohio. Varieties with resistance to PLH became available in 1997. These varieties were developed by several industry breeding programs from wild glandular-haired Medicago germplasm. Evaluations of the first commercial GH varieties began in Ohio in 1996. Our results in 1996 and 1997 demonstrated that the GH varieties performed dramatically better than standard varieties in the presence of high PLH populations; however, the GH varieties still suffered economic damage, and the initial varietal releases did not meet growers' expectations in the first year of commercial production (1997). In 1998 we continued to evaluate GH alfalfa varieties and new experimental strains in small research plots and in large on-farm demonstration plots at several locations across the state. We also established a new experiment to determine what level of resistance (% resistance plants) in alfalfa is needed to eliminate economic losses to PLH, and whether strategic use of insecticides in the seeding year will be needed to achieve this goal in subsequent years.

A trial established in 1996 at South Charleston was completed in 1998. Table 1 summarizes the net return from insecticide treatment for the GH (resistant) and standard (susceptible) varieties. These data demonstrate that at several harvests insecticide treatment was not economical for the resistant varieties but was for the standard susceptible varieties. It also shows that the greatest benefit of insecticide treatment occurred in the seeding year (1996), and that a significant carryover benefit of insecticide treatment in the seeding year was observed in the first harvest the next year (1997). Leafhopper damage to unprotected plants during the establishment year resulted in lower yields at the first harvest the next year. Thus, it is reasonable to hypothesize that strategic use of insecticides to protect resistant varieties during establishment may lead to a decrease in insecticide usage in subsequent years.

The GH varieties used in the 1996 seeded trial were rated as having 18 to 35% PLH resistant plants. Data from a trial seeded in 1997 demonstrates that resistance is being increased in newer releases (Table 2). The two highest yielding varieties in the 1997 seeding were rated as having ~50% PLH resistant plants.

As resistance is improved through breeding, dramatic reductions in use of insecticides may be possible in established stands, provided plants are protected from excessive PLH damage in the seeding year. To test this hypothesis, a trial was established in 1998 using varieties differing in resistance: 3A14B (~60% resistance), 54H69 (~50%), Cleansweep (~35%), and WL324 (0%). High PLH populations were present in the plots. Forage yield was not significantly different among varieties in insecticide treated plots, but significant yield differences were observed among varieties in untreated plots (Table 3). Dramatic differences among varieties were observed in adult and especially in nymphal leafhopper populations in untreated plots. Similar results have been observed in the large, on-farm plots across the state. But even the most resistant variety (3A14B) suffered economic yield loss during the seeding year (Table 3). Thus, resistance levels will have to be even higher to eliminate economic losses to PLH in the seeding year when populations are very high, as occurred in this trial. Next year we will be able evaluate whether insecticide treatment during the seeding year can help reduce the need to apply insecticides on the most highly resistant varieties in an established stand.

PLH resistant varieties represent a significant new tool in alfalfa pest management. Although PLH is recognized as an important pest of alfalfa in Ohio and other midwestern states, growers often fail to regularly scout alfalfa and apply insecticides in a timely manner when PLH activity warrants treatment. These data confirm previous findings demonstrating that glandular-haired varieties are superior to standard alfalfa under heavy PLH pressure. Our results demonstrate that plant breeders are still making significant improvements in PLH resistance. The PLH-resistant varieties and associated management practices in an integrated control program will provide growers with significant economic benefits, not to mention the environmental benefits of reduced pesticide use. This research will be continued and expanded, through funding obtained from the USDA CSREES IPM grants program.

Extension Program Implementation:

Field days held at the on-farm trials at several sites around the state provided growers the opportunity to view the new PLH resistant varieties first hand. Leafhopper resistance was demonstrated and results shared with producers, extension agents, and industry professionals at field days, informal plot tours, and regional extension meetings in 1998. Data were presented in February at the National Alfalfa Symposium in Bowling Green, KY. Data from the trials was distributed through the Ohio Forage Performance Trials report, which is available at county Extension Offices, and on the OSU Extension Ohioline internet site (www.ag.ohio-state.edu/~ohioline/). The data were also published in the December issue of Ohio's Country Journal. Data were distributed to interested Extension and industry agronomists in other states via e-mail. Results of the study will continue to be presented at training meetings for extension agents and industry personnel, and at extension meetings for producers. In summary, the results are being widely publicized, and are providing growers with valuable information as they consider adoption of leafhopper resistant varieties.

For further information contact R. M. Sulc , Horticulture & Crop Science, Ohio State University Extension or the Ohio IPM Office.

Improving Chemical Drift Control Through the Utilization and Testing of New Anti-drift Technologies

Principal Investigators

Larry Lotz, Fayette Co. ANR Agent

Abstract:

The use of Roundup, Liberty and other nonselective herbicides on genetically modified crops (corn and soybeans in particular) increased considerably in 1997 and 1998 with an even more dramatic increase expected in the near future. Farmers are excited about effective weed control and clean fields utilizing this new technology. Roundup Ready, and Liberty Link corn and soybean varieties are revolutionizing the seed sale business and paving the way for many more genetically engineered seed products.

However, the use of such nonselective herbicides produces devastating consequences when the product moves off target or is sprayed on the wrong field. Ideal spraying conditions are very critical when using these herbicides near traditional crops to avoid drift and resulting crop injury.

According to cases brought to the attention of the Farmland Insurance Company, many of the misapplication errors were related to equipment - 24%; drift - 33%; and tank mixing errors made by sprayer operators - 33%. Surprisingly, 8% of the applicators sprayed chemicals on the wrong field.

The objectives of this proposal were to:

1. To test the effectiveness of a number of anti-drift technologies in terms of their drift reduction response to various wind speeds and spray pressures.

2. To educate producers and spray applicators in terms of the importance of reducing drift and the selection and use of those technologies that are most effective in drift reduction.

3. To further develop and test the diagnostic capabilities of infrared photography as a tool to measure drift injury.

To achieve these objectives, six 30" rows of the following treatments were planted in side-by-side strip plots approximately 400 ft. long: 1. A Roundup corn variety, 2. A non Roundup Ready corn variety, 3. A Roundup Ready soybean variety, and 4. A non Roundup Ready soybean variety.

A sprayer was built with a variable rate fan located at one end of a six nozzle, 10 ft. spray boom. The boom

was equipped with nozzle bodies capable of holding five different nozzles. Winds up to 20 m.p.h. could be produced depending on where along the boom the measurement was taken. Boom, fan, fan power supply (DC), spray tank, and other spray hardware were all mounted on a small flat trailer and pulled as one unit at a constant speed perpendicular across the four strip plots described. The following drift variables were tested as the sprayer was pulled across the plots using Roundup herbicide.

1. Anti-drift nozzle designs compared to flat fan including: drift guard nozzle tip, Turbo Teejet, Turbo Flood, turbo Drop nozzles.

2. Two different spray pressures - 25 and 40 p.s.i.

3. Normal wind speed (calm) versus a 10 m.p.h. wind speed created by the fan.

Aerial infrared photographs were taken of the plots seven days after they were sprayed.

Results:

Spray drift discussion utilizing these plots was a major educational topic at a Notill and Sprayer Technology Field Day held July 21 at the Fayette Co. Farm. The spray drift sessions were taught by Dr. Erdal Ozkan with approximately 85 producers attending. The topic, demonstrational plots, and introduction of new technologies were well received by participants. Infrared pictures of the plot area will be used at winter meetings to discuss spray drift problems and solutions. In general, the infrared photos do indicate visually that higher wind speeds and tank pressures increase chemical drift as we would expect and that the new anti-drift nozzles do reduce the amount of drift compared to the traditional flat fan nozzle. Visually, the turbo flood nozzle seemed to have the most effect on reducing spray drift.

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

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Predicting Spring Slug Problems Based on Fall Sampling

Principal Investigators

Terry Beck, Wayne County Extension, Wooster, OH
Ronald B. Hammond, Department of Entomology, OARDC

Abstract:

Sampling during the past years has suggested that the size of the spring slug population appears correlated with the slug numbers the previous fall. We developed the hypothesis that fall slug counts might be an indicator of spring populations. This proposal addressed the hypothesis that fall sampling can be a predictor of spring slug populations and damage. Results indicate that there is a strong possibility that fall population sampling can indicate which fields have a good potential for problems in the spring and which fields do not. All fields with a moderate population in the spring were preceded by significant slug numbers the previous fall. Fields having few slugs in the fall did not have many slugs in the spring. In only a few fields were moderate fall slug populations not followed by many slugs in the spring. Thus, growers could obtain information based on fall sampling that will enable them to either 1) more closely monitor fields if moderate to high slug populations are present in the fall, or 2) assume that if numbers of slugs are reduced, that the potential for a slug problems in the spring are reduced and use their time more efficiently in the spring.

Summary:

We had sampled numerous corn and soybean fields in the fall of 1997. Adult gray garden slug counts ranged from <1.0 slugs per trap (in 3 fields to be considered fields with low fall populations) to 1.6 to 7.6 slugs per trap in 7 fields (to be considered moderate to high fall populations). We beer trapped sampled during the spring of 1998. Holes were cut in the soil with a cutter, and then a plastic container was placed into the holes. These containers then were filled 1/3 full with a heavily flavored beer. An aluminum-covered, 1 ft2 roofing shingle was placed over the holes. The following morning, the number and species of slugs underneath the shingles were recorded. Ten such traps will be placed in each field. Sampling occurred on a regular basis. Because little slug damage occurred, in situ counts of slugs directly on the plants were not taken as planned. No data on slug injury, stand counts, and other relevant agronomic parameters were taken as crop injury was not sufficient to justify the effort. Sampling continued into the fall of 1998.

Table 1 presents slug counts per trap from various fields for the 4 slug species. Although numerous samples were taken in the fall of 1997, only data from the single date having the largest collection of slugs from the fall of 1997 are presented. Numerous fields had a significant population of gray garden slugs, most had marsh slugs, while few fields had many banded or dusky slugs Beginning with the late April and early May samples in 1998, many fields had significant populations of slugs. Gray garden slugs were numerous in the City

Garden and Hutton fields, both fields having had many gray garden slugs in the fall. Marsh slugs were numerous in most fields, with the same fields also having generally high populations in the fall. Banded and dusky slugs were relatively low in the fall of 1997 and again in the spring of 1998. The only fields which did not match up were the South Well-North field and the Wharton field which had moderate to high populations of the gray garden slugs in the fall, but not in the spring. Statistical analyses were done on the data from 1997 and from early spring (either from the 29 April or 6 May sample); data from all 7 fields were included in the analyses. Linear correlation analyses were conducted on the number of slugs in the fall with the number collected in the spring for each species.

Gray Garden Slugs - When all 7 fields were included in the analysis, linear correlation indicated a poor fit ($r = 0.46$, $P = 0.30$). Examining the data suggested that the South Well-North field did not fit well with the other data points; there was a large slug population in the fall in this field that was followed by a very small population in the spring. When data from the South Well-North field were removed from the analysis, the correlation became significant ($r = 0.84$, $P = 0.03$).
Marsh Slugs - When all 7 fields were included in the analysis, linear correlation again indicate a very poor fit ($r = 0.13$, $P = 0.77$). While in general most fields had numbers that greatly increased from fall to spring, there were 2 fields that did not follow this scenario. The population decreased slightly in the Wharton field and remained somewhat similar in the South Well-North field. When these 2 fields were removed from the analyses, the correlation improved dramatically ($r = 0.90$, $P = 0.04$).
Banded and Dusky Slugs - There were too few slugs to obtain meaningful analyses for either slugs. No banded slugs were collected in the fall samples. There were few dusky slugs collected in the fall of 1997, which only allowed us to determine their presence within a field. Linear correlations were not possible.

Although good correlations were not obtained when all fields were included, strong correlations were obtained when a single field, or 2 fields, were removed from the analyses. In those fields, numbers of slugs were high in the fall samples but declined in the spring. Although those scenarios might cause a grower unnecessary concern, they would not cause a grower to miss a slug population that is large in the spring. All fields with relatively moderate to high populations of slugs in the spring had been preceded by a similar size population of slugs the previous fall. Although the predictive capability of fall sampling might not be able to predict a specific population density, it should indicate to a grower the need for spring monitoring if fall populations are high, and lack of concern if fall populations are non-existent.

Following the 1st week of May samples, we had sent out notices to growers to be aware of potential slug problems. However, this information proved to be somewhat faulty because following hot, dry weather conditions in May, slug populations and their activity generally disappeared. However, following significant rainfall that began on 5 June, slug populations again became active and we saw many more slugs by the 9 and 17 June samples. By this time, most crops were actively growing and plants were large enough to withstand any injury. However, we did receive reports of isolated slug problems throughout the state following these rainfall events. It is our belief that if the weather conditions in May were more conducive to slugs, we would have had serious slugs problems in some areas.

Of note, we have been collecting similar data over the past 3-4 years in a number of fields. From these fields, we were able to examine (20 field situations over that time period. For the gray garden slug, the main slug pest, correlations of fall to spring slug populations were highly correlated, ranging from $r = 0.63$ to $r = 0.92$ ($P = 0.005$ and 0.0001, respectively). In the latter case, analysis was conducted after removing a single field that had an extremely high population of slugs in the fall (>24 per trap) but few in the spring ((5 slugs per trap). All other fields were included in the analysis, including all the fields from 1997-1998 that were included in this report.

Fall Sampling in 1998
From the initial fall sampling of 1998, it appears that many slugs have survived the past summer. Gray

garden slugs are already being observed in numerous fields in moderate numbers, and dusky slugs are being seen at higher populations than in previous years. Sampling will continue into November. We will be making predictions as to potential slug problems next spring later this winter.

Extension Program Implementation:

As with any pest management program, the ability to predict the problem, or lack thereof, can be an extremely useful tool in integrated pest management (IPM). Although we do not assume that fall sampling will lead to predictions of specific population levels within a field, we do feel that it will give growers an edge in their battle against slugs. It will provide them with the knowledge that slug populations and the potential for economic injury are either low, or that populations and damage potential are great. In the latter situations, more intensive monitoring would then be required. Although situations do exist where a large fall slug population are not followed by significant slug numbers in the spring, the only result would only be extra time spent in sampling, not a loss of the crop and/or reduction in yield.

Whether further efforts by a grower entails only a concerted monitoring program towards slugs, conducting some tillage in suspect fields to reduce the level of infestation and injury, altering planting dates, or taking another action to reduce the potential for economic losses, remains to be seen. However, the knowledge of potentially damaging populations will give the growers something that they did not have in the past.

For further information contact Terry Beck, Ohio State University Extension, Wayne County or the Ohio IPM Office.

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Testing the Multipher Trap for Codling Moth and the Leafroller Complex, and Refining Disease Prediction Systems for North Central Ohio Apple Orchards

Principal Investigators:

Ted W. Gastier, Huron County Agricultural Agent

Abstract:

Eighteen fruit growers in North Central Ohio enrolled 23 apple blocks and 6 peach blocks in the 1998 North Central Ohio Tree Fruit IPM Program. Scout/technicians made weekly orchard visits to monitor populations of insect and mite pests as well as beneficial insects and mites. The disease component for apples was monitored with local climatological records, SkyBit Weather Products, and temperature/leafwetness sensors. The objectives of this project were; 1). To test the Multipher trap for monitoring codling moth and the leafroller complex, 2). To monitor temperatures and leaf wetness at three locations, 3). To compare two weather reporting methods at each of the above locations, 4). To utilize predictive computer software for managing fire blight and hardware for managing apple scab, 5). To deliver timely disease management information to growers and Extension Personnel.

Methods:

The Multipher trap is a reusable monitoring device based on pheromone lures and pest strips. Trapped specimens remain intact and thus improving proper identification by growers. Each orchard operation had a least one set of three Multipher traps and three conventional wing traps for monitoring codling moths. Single Multipher traps were also used in both apple and peach orchards to monitor redbanded leafroller populations. Additional Multipher traps were hung for tufted apple budmoth, Oriental fruit moth, lesser peachtree borer, peachtree borer, obliquebanded leafroller, variegated leafroller, fruittree leafroller, eyespotted bud moth, and spotted tentiform leafminer. Three leafwetness/temperature monitors were installed at three locations. These monitors had been purchased with funding from a 1997 IPM MiniGrant. Weather products were purchased from SkyBit, Inc. for geographical locations represented by the three monitor sites, Daily climatological records were downloaded from websites for Fremont, Norwalk, and Elyria. These locations were the closest official weather stations to the monitor sites. The Maryblyt fire blight prediction software was utilized and the Modified Mills Chart for apple scab was provided to growers for their consideration. Wetting periods and temperatures were shared with all producers receiving the North Central Ohio Fruit IPM Newsletter. Forty-four hard copies of this newsletter plus the Ohio Fruit ICM News were distributed weekly to growers, Extension personnel, and fruit industry organizations. In addition, 161 E-mail addresses received electronic versions of the Ohio Fruit ICM News.

Results & Discussion:

The codling moth was the one insect species selected for direct comparison of trap catches between the conventional wing trap and the Multipher trap. Table 1 shows the results.

Codling moth pressures were light in North Central Ohio apple orchards which might explain the difference between the seasonal averages of the two types of traps. However, the patterns of increased and decreases between generations was evident for both types. The ease of use was often mentioned by both scouts as to one advantage of the Multipher as the "stickiness" of the wing trap bottom was eliminated, thus making weekly trap servicing easier and faster. This was true for all species monitored with the exception of spotted tentiform leafminer. The high populations of adults (often in the thousands) required dumping them on a grid for counting. The cost reduction was another advantage of the Multipher. Based on a useful life of at least 4 years for the Multipher, the annual cost of sets of three is as follows:

Conventional wing trap with plastic top, sticky bottoms, and pheromone lures - $65.16
Multipher trap with vaportape and pheromone lures $22.98

Temperatures were less variable than leaf wetness. A benefit of the SkyBit products was the forecast for wind speed related to clock time. Many growers used this product for determining "spray windows" due to the high degree of accuracy. A.E. "Sandy" MacDonald, of the National Weather Service, suggested that the wind and temperature forecasts are correct 80 to 90 percent of the time. But predictions of heavy rain, snow, and hail are accurate only 25 percent of the time. The reason: Temperature and wind patterns stretch over vast areas but most weather systems that drop precipitation are quite small.

Results of Climatic Conditions Monitored for Apple Disease Management

The disease predictive devices, Maryblyt and the Modified Mills Chart, were less timely and more cumbersome to use than the SkyBit Disease Predictive Products. The Skybit products also included the summer apple diseases of sooty blotch and fly speck for which we lack manual models. One challenge for distributing the SkyBit information on a daily basis is the number of growers still lacking FAX or E-mail capabilities. Electronic transmission was provided for 13 growers and county Extension personnel.

Extension Program Implementation:

The value of Multipher traps will be shared at the 1998 Fruit and Vegetable Congress with growers encouraged to try orchard monitoring as the basis for pest management. Those with either E-mail or FAX will be advised to consider utilizing SkyBit products for both climatological and apple disease predictions. We desire to expand our successful IPM program beyond the "Fruit Belt" of Northcentral Ohio because of the benefits to the environment, to addressing social concerns with pest management, and to the sustainability of Ohio tree fruit producers.

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