1997 Ohio IPM Block Grant Reports

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

1997 North Central Ohio Tree Fruit IPM Program "Weather-based Predictive Systems for Apple Disease Management"

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Bridging the Gap: Enhancing Information Exchange and Advocating the Use of Environmentally Sound Turfgrass IPM Practices

1997 North Central Ohio Tree Fruit IPM Program "Weather-based Predictive Systems for Apple Disease Management"

Principal Investigator:

Ted W. Gastier, Extension Agent, Huron County

Abstract:

Eighteen apple located in the counties of Erie, Huron, Lorain, Ottawa, and Sandusky, enrolled 25 blocks of commercial production. Integrated Pest Management (IPM) methods for monitoring and controlling apple pest insects and mites have allowed these growers increased flexibility in the application of control materials. These growers, however, have lacked adequate the same flexibility in their disease control practices due to the insufficient information about orchard temperatures and duration of leaf wetness events. The environmental factors of temperature and leaf wetness contribute to the development of apple diseases such as scab, fireblight, sooty blotch, and fly speck. Weather monitoring equipment has been installed previously in two orchards but has not been utilized because of calibration factors and lack of grower confidence with the instrumentation.

Implementation:

Eight sites, chosen as representative of the north central production area, were enrolled in the SkyBit AgWeather Products program during the months of April through September. Four weather products were received each day for the eight sites by e-mail through the AgVAX account of Ted Gastier. Included were:

1.) Hourly Data for temperature, precipitation, and leaf wetness during the previous 24 hour period plus the expected values for the same factors during the present 24 hour period.
2). A 48 Hour and a 7 Day Forecast for temperatures, probability of precipitation, average wind speed, and a spraying key.
3). An IPM Apple Insect Product based on biofixes for Oriental fruit moth, tufted apple bud moth, codling moth, spotted tentiform leafminer adults, and apple maggot.
4). An IPM Apple Disease prediction package for apple scab, fire blight, and sooty blotch.

This information was shared with six apple growers by FAX or e-mail. Monthly precipitation totals, hours of leaf wetness, and mean temperatures were computed with QuattroPro.

Additional daily climatological data for eight Ohio locations was downloaded from (gopher://twister.sbs.ohio-state.edu:70/0/wxascii/climate/climinfo02.K...) where ... represents CAK for Akron-Canton Airport, CVG for Cincinnati, CLE for Cleveland International Airport, CMH for Columbus, DAY for Dayton, MFD for Mansfield, TOL for Toleado, and YNG for Youngstown. This data base also includes historic temperature and rainfall records since 1875. The Cleveland and Toledo locations situated to the east and west, respectfully, of the apple production were used for base comparisons. Data from the other six locations was filed for future Statewide expansion of apple climatological reporting and forecasting. Mean monthly temperatures, normal precipitation, and current precipitation totals were calculated on QuattroPro.

The National Weather Service monthly climate tables for Cincinnati, Cleveland, and Columbus were downloaded from (http://www.NWS.NOAA.GOV/climatex.shtml#dec). This data lists historic records for the 1961-1990 period. Included are monthly mean temperatures; the number of degrees F to be added or subtracted from the mean to reach the threshold of Below or Above normal; and values of Below, Moderate, and Above monthly precipitation amounts.

Temperature readings were recorded manually from two maximum-minimum thermometers located near Milan on a farm central to the north-central production area. A Spectrum Technologies leaf wetness/ temperature sensor was also utilized at this location. Hourly temperatures and periods of leaf wetness were downloaded on a laptop computer with the Spec ware software and printed in chart and graph form. Monthly totals of leaf wetness and mean temperatures were calculated using QuattroPro.

The MARYBLYT software for the predictive forecasting of fireblight was sampled for two orchards with data from the SkyBit Hourly Data Package during April and May. The fire blight predictive portion of the SkyBit AgWeather IPM Apple Disease Product was examined during potential infection periods in May. The disease product is an experimental model under development by Dr. Jim Travis, Penn State University Fruit Pathologist.

1997 Weather Data

Month	April	May	June	July	August	Sept.	Oct.	Nov.
	Mean Temperatures (^{o}F)							
Farm	45.0°	52.3°	69.5°	70.2°	67.8°	62.3°	53.1°	
SkyBit Central		52.4°	68.7°	70.9°	67.2°	62.4°	52.3°	
Spectrum Technologies						61.8°	52.6°	37.4°
Toledo	44.7°	52.8°	68.6°	71.5°	67.1°	62.7°	52.4°	36.5°
SkyBit West		52.2°	68.8°	71.5°	67.3°	62.6°		
SkyBit East		52.3°	68.1°	71.0°	67.2°	62.7°		
Cleveland	44.0°	52.9°	68.4°	70.6°	67.5°	62.9°	52.8°	39.0°
	Precipitation (inches)							
Farm	1.55"	8.55"	6.85"	3.95"	6.6"	4.3"	1.45"	
SkyBit Central		8.26"	4.00"	1.98"	5.74"	2.67"	1.59"	
Toledo	1.55"	6.96"	4.40"	2.62"	3.95"	4.73"	1.24"	2.16"
SkyBit West		8.17"	5.33"	2.30"	4.83"	4.04"		
SkyBit East		8.05"	4.25"	1.87"	5.30"	3.12"		
Cleveland	2.20"	4.21"	3.34"	1.51"	5.26"	4.25"	1.63"	2.58"

	Hours of Leaf Wetness							
SkyBit Central		233	187	100	299	219	134	
Spectrum Technologies						215	183	256
SkyBit West		218	182	131	264	244		
SkyBit East		242	203	99	283	217		

KEY: All temperatures in degrees F. Source of temperatures: Farm - maximum, minimum thermometers; Toledo and Cleveland National Weather Service-calculated from daily highs and lows; SkyBit and Spectrum Technologies-24 hour average daily temperatures.

Precipitation at farm from standard rain gauge; National Weather Service measurements at Cleveland and Toledo; and SkyBit from Hourly Weather Product.

Leaf wetness-hourly reports from Spectrum Technology sensor and SkyBit Hourly Weather.

Discussion:

A strong correlation for mean monthly temperatures existed during the 1997 season between all sources of data. This would indicated that temperature readings from the National Weather Service for Toledo and Cleveland might be adequate for determining mean temperatures in our production area. Rainfall events during the growing season, and particularly during summer thunderstorms, tended to lack correlation as would be expected. Examination of the leaf wetness periods indicated that dew was a larger factor than rainfall events. Also dew was usually not occurring until after midnight on a typical summer evening.

One portion of the Forecast Weather Product from SkyBit was considered valuable by growers. The Spraying Key listed expected wind directions and velocities on a 3-hour basis for the next 48 hour period and for each day during the next 7. The Key rated each interval on a scale of 0 to 10 with 0 being least favorable and 10 most favorable to make spray applications. It was assumed that no precipitation was expected during favorable spray periods. Generally a wind speed of 8 mph rated a 6 while a wind speed of 5 rated an 8. Growers found good reliability in using these Spray Key forecasts in planning spray applications. An additional source for wind predictions was found at gopher://twister.sbs.ohio-state.edu:70/0/nmc/FOXE47.KWBC> and will be considered in 1998.

MARYBLYT predictions developed locally generated possible infection periods on May 18, 19, 24, 30, and 31. The SkyBit AgWeather Apple Disease Product indicated possible infection and damage on May 19, 24, 25, and 30. This product, though experimental, might be valuable in future years as a check against local MARYBLYT predictions.

Some minor difficulties were encountered in launching the Spectrum Technologies temperature/leaf wetness sensor which interfered with completing weather information until September from that source. Earlier data was incomplete and not included. Three sensors are now placed and will be ready for monitoring leaf wetness and temperatures during 1998.

Extension Program Implementations:

Growers continue to financially support and participate in a program that make sense economically, allows for the production of high quality fruit, and allows for the judicious use of pesticides based on orchard and weather conditions. As we gain experience in using various weather products, we will build confidence in disease prediction as we have established confidence in our insect and mite monitoring program. A continuing challenge is the timely delivery of information to growers not yet on the Web or with FAX machines.

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

Alfalfa Variety Resistance to Potato Leafhopper: Evaluation and On-Farm Demonstration of an Effective IPM Strategy

Principal Investigator:

R. M. Sulc, Assistant Professor, Horticulture & Crop Science

Abstract:

The potato leafhopper (*Empoasca fabae*) is the most serious insect pest affecting alfalfa production in the midwestern United States. More insecticides are applied to control this pest than any other in alfalfa. Economic thresholds for this pest are commonly exceeded at least once and often twice each year in Ohio. Varieties with resistance to potato leafhopper (PLH) have just become available this year, as several industry breeding programs were able to incorporate host resistance from glandular-haired alfalfa germplasm into varieties with acceptable agronomic characteristics. Evaluations of these PLH-resistant varieties began in 1996. Our objectives this year were to: 1) continue the 1996 evaluation of the glandular-haired alfalfa varieties for resistance to PLH and agronomic performance, 2) establish on-farm trials comparing PLH-resistant and standard alfalfa varieties, 3) and expand the investigation to determine what level of PLH resistance is needed to eliminate economic losses in forage yield and quality of alfalfa. Glandular-haired varieties demonstrated significant and dramatic improvements in forage yield and reductions in PLH nymphal populations compared with standard varieties where insecticide was not used to control PLH. All varieties responded to insecticide applications, but the response was greatest with the standard varieties. Newer experimental glandular-haired varieties demonstrated continued improvement in PLH resistance. On-farm research and demonstration plots were established in six counties.

Glandular-haired varieties developed for resistance to PLH were compared with standard (without glandular hairs) varieties in small plot trials at Western and Northwest Branches. The trial established in 1996 at Western Branch was continued, which is part of a four-state evaluation of PLH-resistance in alfalfa. Three new small plot trials were seeded in 1997 at these two sites. At Western and Northwest Branches, variety trials were established which were not and will never be treated with insecticides. At Western Branch, another experiment was established to determine what level of resistance is needed in alfalfa varieties to prevent economic losses of forage yield and quality. This experiment is one of three locations in cooperation with Forage Genetics and Pioneer Hi-Bred Int'l, Inc. Fourteen varieties were seeded which differ in resistance to PLH, varying from 0 to approximately 50% resistant plants. Insecticide treated control plots of each variety are included in the trial, along with the untreated plots. Data from this trial has not yet been analyzed and summarized.

At Wooster and at six on-farm sites, a resistant glandular-haired variety is being compared with a standard alfalfa variety in both insecticide treated and untreated plots. Plot size is about 40 x 40 ft at most of the on-

farm sites, and 100 x 100 ft. at Wooster. In these trials, plots were scouted weekly for PLH population levels, but data have not been summarized. During the growing season, large differences in PLH yellowing and PLH population levels were observed among varieties at certain times. The glandular-haired varieties showed greater resistance to PLH than the standard varieties, although all varieties were damaged when PLH levels were very high. At several on-farm sites, weed competition and slow establishment were a problem, particularly with the glandular-haired varieties. However, excellent establishment of all varieties was observed at other sites.

Potato leafhopper populations reached extremely high levels across much of the state during the summer of 1997. In the established stand at Western Branch, significant and dramatic differences in yield were observed among the glandular-haired and standard susceptible alfalfa varieties (Table 1). The glandular-haired varieties were superior in yield in the absence of insecticide treatment, demonstrating improved resistance to PLH. Although insecticide treatment increased yield of all varieties across the three summer harvests, it would not have provided a positive net return for the resistant varieties at the second harvest, but did for the standard varieties. It is also important to note that the resistant varieties were similar in yield to the standard varieties in treated plots (Table 1). The glandular-haired varieties are more dormant, i.e. they begin growth later in the spring and regrow more slowly after harvest. However, this did not translate into reduced yields for the glandular-haired varieties where PLH was controlled.

Table 1. Forage yield of resistant and commercial check varieties grown without (Untrt) and with (Trt) insecticide treatment for PLH at South Charleston, OH in 1996-97.

Variety	**Cut 1, 1997**		**Summer, 1997**		**Total 1997**		**Total 1996-97**	
type	**Untrt**	**Trt**	**Untrt**	**Trt**	**Untrt**	**Trt**	**Untrt**	**Trt**
Resistant	2.12	2.32	3.13**	3.53	5.25**	5.86	6.79**	7.95
Standard	2.21+	2.34	2.53	3.46	4.74	5.81	5.49	8.15
+, ** Indicates statistically significant difference at P=0.10 and P=0.01, respectively, between resistant and check varieties within a treatment.								

The glandular-haired varieties included in the 1996 seeding at Western have at best 35% PLH-resistant plants. Newer experimental varieties being developed by plant breeders have over 50% resistant plants. Several of these newer experimental varieties (Exp.1-Exp.4) were included in the new unsprayed trials established at Western and Northwest Branches in 1997. They were superior in yield (according to LSD at P=0.05) to the first commercially released glandular-haired varieties and the standard check variety included in the trials (Fig 1). Visual ratings of PLH yellowing (not shown) and PLH nymphal counts reflected the higher resistance level of these newer experimental lines (Fig. 2).

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 1996 findings demonstrating that glandular-haired varieties are dramatically superior to standard alfalfa under heavy PLH pressure. Although the first glandular-haired varieties to be released will benefit from timely insecticide treatment when PLH populations are high, this may not be the case as varieties with higher levels of resistance are developed. Our results in 1997 demonstrate that plant breeders are still making significant improvement in PLH resistance. Varieties may soon be available which will derive no economic benefit from insecticide treatment for PLH, especially if they are combined with other methods in an integrated control program. Further research is needed to develop such integrated control programs. These 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.

Extension Program Implementation:

The objective of the extension component of this project is to effectively deliver to extension clientele the information gained from the research trials. The on-farm trials established at several sites around the state provided growers the opportunity to view these new PLH resistant varieties first hand. Field days were held at several sites. 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 1997. Data were presented in November to Extension Specialists from Iowa, Minnesota, South Dakota, and Wisconsin and representatives of all the major alfalfa breeding and seed marketing companies in the U.S. The data will be distributed to interested Extension 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 this winter. Data were reported in the 1997 Ohio Forage Performance Trials report and in Country Journal. Articles are being written summarizing the results which will appear in several nationally distributed popular press agricultural publications. Results will be presented in February at the National Alfalfa Symposium in Bowling Green, KY. In summary, the results are being widely publicized, and are providing growers with valuable information as they consider adoption of PLH-resistant varieties.

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

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Bridging the Gap: Enhancing Information Exchange and Advocating the Use of Environmentally Sound Turfgrass IPM Practices

Principal Investigators:

Michael Boehm and David Shetlar

Abstract:

There are ~2.4 million acres of turf consisting of more than 2.5 million home lawns and 350,000 commercial, municipal, and sport turf areas. Economic expenditures on turf and turf-related products contribute nearly $1.2 billion annually to Ohio's economy. Expenditures for pesticides and fertilizers account for ~$100 million per year. Considerable technology exists allowing for the management of high quality turf with fewer fertilizer and pesticide applications. Unfortunately, however, a coordinated effort geared toward conveying this information and technology to Ohio's citizenry has yet to be fully realized. The goal of this project is to enhance information exchange between the University and Ohio's citizenry by linking the powerful capabilities of the World Wide Web with the tangible qualities of turfgrass education/demonstration plots. This project represents a truly interdisciplinary and multi-agency effort bringing together Extension personnel from across Ohio and relates directly to Ohio's environment and economy. Its implementation will greatly enhance our connection with Ohio's citizenry and will serve as a model for other commodities.

Extension Program Implementation

The overarching goal of this project is to enhance the exchange of information regarding the use of environmentally sound turf health management strategies between the University and Ohio's homeowners, lawn care companies, municipalities, and parks and recreation personnel via the coordinated efforts of state and county extension personnel. Specific objectives of this project include:

1. The establishment of seven regional turfgrass education plots; and the,
2. The implementation of an electronic turfgrass networking resource designed for homeowners, school districts, commercial lawn care companies, municipalities, and parks and recreation personnel.

Status Report

Establishment of Regional Turfgrass Education Plots

Four regional turfgrass education plots (RTEPs) were established between July and September 1997 in Lucas, Hamilton, Franklin, and Clark counties, respectively. Three additional RTEPs are scheduled for seeding in May 1998 in Cuyahoga, Lorain, and Mahoning counties, respectively. Ease of accessibility and management as well as ensuring optimal visibility were among the primary factors considered during the establishment phase of the RTEPs. In general, the RTEPs were established on community college campuses and metro parks to ensure easy access and high visibility.A list of RTEP site locations and participants is provided in Appendix A. Each RTEP contains a stand of tall fescue, Kentucky bluegrass, endophytic perennial ryegrass, and a bluegrass- perennial ryegrass blend. Each sward will be maintained at two mowing heights (high and low) and under two fertility regimes (optimal and minimal). Additional treatments will be incorporated to meet the specific county/region needs. Plot maps, directions to the RTEPs, and information pertinent to homeowners and commercial lawncare specialists will be provided via the WWW resource discussed below. A locally intensive advertising campaign is scheduled to commence in May 1998. Announcements highlighting the RTEPs will be via press releases, OSUE service notifications, fliers to garden centers and commercial lawncare specialists, the Buckeye Yard and Garden Line (ENLTT), the Master Gardener's Program, the Ohio Turfgrass Foundation, the Ohio Lawn Care Association, and the University's and the College's alumni newsletters, respectively.

Implementation of "TIPS" - A WWW Turfgrass Information Program Service

A WWW turfgrass information resource referred to as TIPS is under development. Planning and development of this site by OSU turfgrass extension specialists, county agents, and resource users began in September 1997 and is ongoing with an expected date of completion and public access scheduled for June 1998. The computer expertise and WWW site development experiences of Dr. Chuck Curtis and his staff are greatfully acknowledged for their assistance in making TIPS a reality. The goal of TIPS is to render information in a user friendly WWW platform that will be readily available to any individual with access to the internet. Besides highlighting information regarding the RTEPs described above, information and WWW links available via TIPS will make it possible, through a single location, to engage a wide diversity of people and provide information and technical resources for their individual needs. Step- by-step, self-guided RTEP maps, considerations for making appropriate turfgrass selections, watering, fertilization, mowing, and pesticide application recommendations, are examples of the type of information that will be available via TIPS. Links to Ohioline and the Buckeye Yard and Garden Line, extension function announcements, and interactive links with Ohio's turfgrass extension personnel will be features of the WWW resource. Promotion of the resource will be as described above.

Appendix A

List of RTEP Site Locations and Participants

Established 1997

1. Clark County - Springfield Clark County Extension Center	Pam Bennett, Clark Co. Extension Agent
2. Lucas County - Toledo Owens Community College	Chris Foley, Assistant Professor, Owens CC Amy Stone, Horticulturist, ABEC Norm Moll, Lucas Co. Extension Agent Craig Everett, Wood Co. Extension Associate
3. Franklin County - Westerville Inniswoods Metro Gardens,	Phyl Fieldmier, Director, Inniswoods Gardens Jane Martin, Franklin Co. Extension Agent

Metropolitan Park District of
Columbus & Franklin Co.

4. Hamilton County - Cincinnati
Cincinnati State and Technical Community

Ben Wright, Landscape Horticulture Program Coordinator, CSTCC
Denny Baker, Representative of Cannon Turf Supply Inc. & Instructor CSTCC
Joe Boggs, Hamilton Co. Extension Agent

Scheduled for Establishment Spring 1998

5. Cuyahoga County - Cleveland
Cuyahoga County Community College, East Campus

Jack Kerrigan, Cuyahoga Co., Extension Agent

6. Lorain County - Lorain
Lorain Community College

Charles Behnke, Lorain Co. Extension Agent

7. Mahoning County - Youngstown
Mahoning County Office

Erik Drapper, Extension Agent

For further information contact Michael Boehm , Assistant Professor, Dept. of Plant Pathology, The Ohio State University or the Ohio IPM Office.

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

Principal Investigators:

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

Abstract:

Weed control is a very important factor in profitable vegetable production, and herbicides are used by most vegetable growers in Ohio for this purpose. Using cover crops for weed control would result in the reduction of herbicide use, while also improving soil structure and fertility, and reduction of soil and environmental pollution. Most research in this area has been on over-wintering cover crops killed in the spring for mulch. The objective of this project was to determine if cover crops sown in the spring and killed for mulch can control weeds well enough to produce acceptable tomato yields. From the results treatments with field peas as cover crops produced better or comparable yields to the hand weeded control, even though weeds overcarne the mulch halfway through the season. The results confirmed observations form a previous experiment in 1996 with the same treatments.

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*) and field peas (*pisum sativum*) were sown on April 24th in the different ratios and seed rates shown for treatments in Table 1. There were 18 treatments including 3 controls, all replicated 4 times. On June 24th cover crop biomass was harvested from 0.5 sq.m areas of treatments 1 to 15. Peas and rye foliage was dried and weighed separately. Cover crops were undercut on June 25th and treatments 17 and 18 were cultivated with a rototiller. One month old seedlings of the tomato variety Marglobe were hand transplanted on June 26th to 27th, 50 plants per plot in 2 rows, with a spacing of 2 ft between rows and 1.5 ft between plants. Disease control was carried out following recommendations for the State of Ohio, and pests were controlled based on scouting. Toronto plants were destructively harvested from all treatments on July 31st and August 1st, and tomato leaves to= the tips of the plants for tissue nutrient analysis picked on August 19th. Data was collected on soil temperatures, flowering, fruiting and fruit ripening of tomato plants. Treatment 18 was hand weeded as required. Ten plants from each plot were tagged for harvesting, and fruit was picked as it ripened. Soil samples were taken before sowing the cover crops and at the end of the season.

Results And Discussion:

Data from the experiment is summarized in Tables 1-4, and Figures 1-5. May was a cold month and the cover crops put on foliage mostly in June. Before undercutting, the rye was seen to suppress many weeds, especially the grasses. The broad leafed weeds also growing in the rye were stained compared to other treatments. Treatment 10 had the highest cover crop dry weight, while treatment 9 had the least (Fig 1). The treatments with denser cover crop biomass on the soil surface had lower soil temperatures (Fig 2), but towards the end of July, due to heavy rain, much of the cover crop mulch had decomposed. For both soil samplings (Table 2), Rep 4 had lower readings for most of the elements and the CEC, causing the highly significant differences in replicates. End of season values for P and K were slightly higher, while those for Ca, Mg, and CEC were lower. N results were not yet available by the time of writing this report.

One month after transplanting tomato plants form treatments 10, 11, 13, 14, and 15 had highest leaf areas, while treatments 7, 10, 11, 13, and 14 had highest plant dry weights (Table 3). This was probably due to the nitrogen supplied by the field peas in these treatments. Tissue analysis was done when some treatments had tomato plants already flowering and this could have affected distribution of nutrients in the plants. Tomato plants from treatments 5, 7, 9, and 18 had highest levels of nitrogen in their leaves. Treatments 4, 7, 10, 14, and 18 achieved 50% flowering earliest, while 9 and 16 were the latest (Fig 3). Treatments 7, 10, 12, 14, and 18 reached 50% fruiting earliest (Fig 4). Apart from treatment 18, this can be attributed to the nitrogen fixed in the soil by the peas cover crops in these treatments. Plants in treatment 19 had no weeds to compete with. Ripening was again faster in the same treatments (Fig 5). From Table 4, treatments 10, 19, 14, 15, and 7 had the highest yields by weight, while 10, 18, 13, 14, and 2 had the highest fruit numbers. There were no significant differences in the TSS analysis.

Though the cover crops decomposed about one month after undercutting and weeds grew, tomato plants in treatments with field peas grew faster and established dense canopies which contributed to weed control. They yielded better or comparable to the hand weeded control (treatment 18). These results further strengthen the possibility of using spring sown cover crops for weed control in tomato production, and maybe even other vegetable crops. The tomato fruit yields of 45 to 52 metric tons per hectare are quite encouraging.

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, Dept. of Horticulture & Crop Science, The Ohio State University or the Ohio IPM Office.

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Determining which Aphid Species Act as Vectors of Mosaic Viruses on Pumpkin

Principal investigator:

Celeste Welty, Extension Entomologist, Dept. of Entomology, Columbus

Abstract:

Watermelon mosaic virus (WMV) has become common in Ohio pumpkin fields in recent years and is of great concern to commercial growers. Pumpkins are grown on over 3,300 acres in Ohio as a high-value crop for which yield and quality of fruit produced are important. Viruses can reduce yield but more commonly affect quality by causing lumpy fruit with uneven color. We know that WMV is vectored by aphids, but we have not known which of >48 species of aphids trapped in pumpkin fields are the vectors. The objective of this project was to determine which common species of aphids are capable of transmitting WMV to pumpkin plants, and whether certain species are more efficient vectors than others. We will be better able to evaluate aphid monitoring methods and host reservoirs once we know which aphid species can act as vectors.

Aphids of 5 species were tested: *Rhopalosiphum maidis* (corn leaf aphid), *Capitophorus elaeagni* (artichoke aphid), *Aphis gossypii* (melon aphid; species confirmation pending), *Macrosiphum euphorbiae* (potato aphid), and *Myzus persicae* (green peach aphid). A winged aphid of each species was caught in the field then reared on appropriate host plants in a greenhouse until a large colony developed. Wingless adult female aphids from the colony were starved for 2 or 6 hours, exposed to a WMV-infected pumpkin leaf for one minute, then placed on clean individually-caged pumpkin plants for 24 hours to allow virus transmission. Plants were held for 3 weeks after exposure to aphids, then leaves were removed and frozen for testing by ELISA to verify presence of virus. We used one aphid per plant, ten plants per replicate and five replicates per species. As of early December, the transmission tests are completed for four species and nearly completed for one species. ELISA testing is underway and has shown that 21% of plants exposed to melon aphid developed WMV. Based on visual symptoms, we expect that WMV also was transmitted by green peach aphid but not by corn leaf aphid, artichoke aphid, or potato aphid. Results should be complete by late December 1997.

Extension Program Implementation:

An interim report was given at a pumpkin twilight meeting on 30 September in southern Ohio and at a vegetable school in northern Ohio on 19 November. Full results will be presented at our annual growers' congress in February 1998 as well as at regional schools and in newsletters.

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

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

Principal Investigator:

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 equal 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 a comprehensive economic and environmental analysis comparing SSM vs. normal production practices in an actual farm setting.

Methods:

The test field was established in April at the Ron and Bill Piar farm in Mt. Vernon, Ohio. This field was divided into two parts, the west side (Plot A) 35 acres and the east side (Plot B) 37 acres. Canopy herbicide (5 oz./A) was applied to the entire field prior to planting. This field was planted with Roundup-Ready soybeans. Therefore, post emergence applications of Roundup will be applied if warranted.

The entire field was scouted on a regular bi-weekly basis from mid-April through mid-October. 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:

Field data was used to make pesticide recommendations for this field using the following guidelines:

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. Weed pressure, was heavy throughout these plots. Figure 2 shows the herbicide application patterns for this field. In Plot A the farmer decided to spray the entire field based upon weed pressure and past experience. Roundup herbicide was applied at a rate of 1.5 Qt./A

In Plot B only the areas designated with heavy weed pressure received herbicide applications. Treatments were made to approximately 69% (25 out of 35 acres) of the area in Plot B. The boxes in Plot B indicate the areas of the field receiving herbicide applications. These areas received Roundup at a rate of 1.5 Qt./A.

Figure 3 shows the reduced weed pressure in each plot at three weeks after application. Adequate weed control was achieved in both areas of the field. With regular scouting and documentation of weed location herbicides were applied to approximately 69% of the acreage in Plot B. This resulted in a savings of $16.25 per acre (herbicide cost = $11.25 per acre and application cost = $5.00 per acre). The reduction in herbicide usage resulted no apparent impact on yield. Yield data analysis indicates no significant difference in the yield for these two plots. The yields in Plot A and Plot B were 59.7 and 61.2 respectively.

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.

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

Ohio Integrated Pest Management

THE OHIO STATE UNIVERSITY EXTENSION

Evaluation of cover crops for impact on Soybean Cyst Nematode and the Agronomic Impact of Cover Crops.

Principal Investigator:

Alan Sundermeier, Henry County Extension Agent

Abstract:

Pest management of soybean cyst nematode (SCN) has focused on crop rotation and the use of resistant soybean varieties. Shortcomings of these SCN management tools include: increases in the use of soil insecticides to control corn rootworm as a result of planting 2 or more years of continuous corn in crop rotations, limited resistance of SCN resistant soybean varieties to a few races of SCN and loss of effectiveness of SCN resistance in fields where SCN resistant soybean varieties have been repeatedly planted due to race shifting. Local interest in the use of cover crops in crop rotations lead to the question of what influence, positive or negative, cover crops had on SCN. The use of cover crops could have the added values of : enhanced soil tilth, increased soil sustainability, a greater impact on SCN populations than crop rotation alone, shorten required years of rotation between crops of high yielding SCN susceptible soybean varieties and theoretically lengthen the life of SCN resistance currently available in SCN resistant soybean varieties. The objective of this study was to evaluate an alternative cropping system using a cover crop which could actively reduce SCN populations.

This research project consisted of two parts - greenhouse screenings, and field demonstrations of cover crops, to determine their effect on SCN levels and to gather agronomic characteristics of each cover crop. Cover crops were evaluated for non-hosting of SCN, quick growth and ability to produce maximum biomass, soil nitrate contribution, winterkill, and cost.

Materials/Methods:

Greenhouse screenings were conducted on selected cover crops to evaluate their affect on SCN.The greenhouse screenings were conducted at OSU greenhouses at Columbus . Seed for each cover crop were sown on 6/12/97 in sand "conetainers" maintained at 75 degrees F in ebb and flow benches irrigated with tempered water at 80 degrees F. Plants were established at one plant per pot for large seeds, 1-3 plants per pot for medium seed, and 7-10 plants per pot for small seeds. On 6/25/97 each pot was inoculated with 10,000 eggs of *Heterodera glycines* race 3 (soybean cyst nematode). The nematodes were allowed to reproduce on the crops until 7/29/97, when white and yellow female cyst were counted. Hosting ability was then determined.

The results are listed in Table # 1.

Field demonstrations were conducted at the two host farmer locations. Data was not collected from the Bennett farm due to very low initial SCN field counts and weed pressure caused the plots to be mowed. At the Shaffer farm, wheat stubble was incorporated into the soil and the cover crops listed in table # 2 were hand seeded in side by side plots on 8/7/97. Four inch deep soil cores were collected from each plot on 8/7/97 and at the end of the growing season on 9/30/97. Care was taken to locate soil samples precisely where they were taken at seeding time. Soil samples were analyzed for SCN cyst levels. The results are listed in Table # 2.

Agronomic characteristics were determined from these same demonstration plots. Measurements were taken on 9/30/97. Biomass measurements were taken by removing all cover crop plant growth above the soil within one square foot. This material was weighed (wet weight) and then placed in a drying oven at 180 degrees until all moisture was removed and then dry weights were taken. Biomass nitrogen content was calculated by taking biomass dry weight x 3% nitrogen (average nitrogen content in plant material). Soil nitrate was determined on 9/30/97 by analyzing a composite of 12 inch soil cores from each cover crop plot. Winterkill was predicted from past experience. Results are listed in Table # 3.

Results:

Greenhouse screenings - Conclusions: The high cyst numbers on the susceptible soybean, Corsoy 79, makes this a good test for SCN hosts. Red clover, alfalfa and cowpea would be considered non-hosts. Hairy Vetch, winter pea, and oilseed radish would be considered poor hosts. Under Northern Ohio field conditions and the race of SCN looked at in this study, one may conclude that all 6 cover crops tested could be safely grown without significantly increasing the SCN numbers in the soil. One should take into account that greenhouse studies may not necessarily predict field response.

Field Demonstration of SCN Hosting Ability - Conclusions: This study was located on soil with very high SCN levels. Soybean counts went up as expected. Hairy Vetch , Cowpea, Winterpea, and Alfalfa counts were lowered as the greenhouse screening predicted. Red Clover counts increased - however before seeding counts were very low in comparison , with fall counts remaining low in comparison to other plots. This may be due to field variability in cyst nematode distribution. The SCN population increased in oilseed radish in the field which is in contrast to greenhouse screening host results. Beerseem clover was the only other species to increase SCN counts. Generally, field hosting ability of cover crops followed what greenhouse screenings predicted. Exceptions may be due to field variations in existing SCN populations.

Agronomic Characteristics of Cover Crops - Conclusions: All cover crops tested produced adequate growth to protect soil from erosion. Oilseed Radish germinated quicker and produced the most biomass, competing well with weeds with a lot of foliage and also it grew rootstocks that reached one foot in length and three inches in diameter. Oilseed radish does not produce its own nitrogen, which legumes can, however it can capture excess soil nitrogen and releases nitrogen after decomposition. Beerseem clover has good potential as a naturally winterkilled legume . Hairy Vetch has the best potential for producing the most total nitrogen. All seeds could be planted with a drill either conventional or no-till immediately after wheat harvest.

Discussion:

Oilseed radish is a promising cover crop for Ohio farmers to consider. Although this study could not conclusively state that oilseed radish in not a SCN host, the fast growth, deep rooting, nitrogen capturing ability and natural winterkill make this a good choice to be planted after wheat harvest in SCN infected soils. Further research is needed to study the interaction of these cover crops with SCN over a longer time period and with additional replications.

For further information contact Alan Sundermeier Extension Agent, Ohio State University Extension, Henry County or the Ohio IPM Office.

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Ohio Integrated Pest Management — The Ohio State University Extension

Plant Population and Row Spacing Effects on Gray Leaf Spot and Stalk Rot in Corn

Principal Investigators

Peter R. Thomison, Horticulture and Crop Science
Pat Lipps, Plant Pathology
John Barker, Agric. Sci. Agent, Knox Co.
Ray Griffith, Riverview High School, Coshocton High School
Dave Jordan, Supervisor - Ohio Corn Performance Tests

Abstract:

Gray leaf spot (GLS), caused by the fungus Cercospora zeae maydis, has caused significant yield losses in corn fields in eastern Ohio during the past decade. In 1995 GLS was widespread in other regions of the state and caused damage in west central and north central Ohio where is has not been a problem before. According to estimates of plant pathologists in 1995, GLS was responsible for statewide yield losses of 11% in Indiana and 8 to 9% in Ohio. During the past two years fungal stalk rots including anthracnose, Gibberella and Fusarium stalk rots have also caused damage and yield losses through premature plant death and stalk lodging. Greater interest in narrow rows in corn production along with increasing use of higher plant populations has led to questions concerning the impact of these cultural practices on gray leaf spot and stalk rots. Narrowing row spacing and increasing plant density may create environmental conditions within the crop canopy that are more favorable for disease development. The objective of this study was to evaluate effects of plant population and row spacing on gray leaf spot and stalk rots.

Field experiments were established at three on-farm sites in Coshocton and Knox counties that have a history of heavy gray leaf spot pressure. A susceptible corn hybrid, Pioneer brand 3394, was used in the Coshocton experiments and a moderately resistant hybrid, DeKalb 618, was used in the Knox county experiment. The two Coshocton county experiments were planted at Riverview High School in fields that have been continuously cropped to corn. One of the Coshocton sites was established using no-tillage; the other Coshocton site was established using conventional tillage. The Knox county site was established using no-tlllage and followed soybeans.

Five treatments were evaluated in the no-tillage field experiment in Coshocton county - four plant densities: 18000, 24000, 28000, 34000 plants/A in 38-inch row spacings and one narrow row spacing planted at 34000/A (Table 1). A randomized complete plot design with four replications was used.

Four plant densities: 18000, 24000, 28000, and 34000 plants/A in 30-inch row spacings were compared in the conventional tillage experiment in Coshocton Co. (Table 2). Treatments were replicated six times in a randomized complete block design.

Two row spacings were evaluated in the Knox Co. experiment - (1) a conventional (30-inch) row spacing and (2) narrow (15-inch) row spacing (Table 3). A plant density of 30,000 plants/A was used in both row spacings. Treatments were replicated four times in a randomized complete block design.

Plots were monitored for disease development at silking and thereafter at two week intervals. Foliar disease severity was determined by visually estimating the percentage area of the ear leaf with gray leaf spot lesions. Two to three ratings of disease severity were performed with the first rating in late August during mid-grainfill, and the last in mid-late September at or near physiological maturity. The incidence of stalk rot was determined using the "squeeze" or "pinch" test, 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. A rind penetrometer was used to determine stalk quality when corn achieved physiological maturity. Data was also collected for grain yield and moisture, stalk lodging, test weight, and final plant stand.. Data was interpreted using standard analysis of variance procedures where appropriate.

The incidence of gray leaf spot and stalk rot was not influenced by row spacing (Tables 1 and 3). Disease development was delayed until the late grain filling stages and probably had only negligible effect on grain yields. There were no differences in grain yields between the 15-inch and 30-inch row spacings at either the Coshocton or Knox Co. site. In the no-tillage Coshocton site (Table 1) there were no significant differences in GLS or stalk rot between the varying plant populations. However, at the conventional tillage Coshocton site (Table 2), GLS was greater at lower plant densities but there were no differences in stalk rot. In the no-tillage Coshocton experiment (Table 1) yields of the three highest plant densities out yielded the lowest plant density. Similarly in the conventional tillage study (Table 2), grain yields increased at the higher plant populations.

Extension Program Implementation:

Results of the study will be summarized in the OSU C.O.R.N. (Crop Observation and Recommendation) newsletter. Results will also be presented at extension educational meetings, including field days and plot tours. Data collected will be used in developing production guidelines in regions of the state where GLS and stalk rots are major yield limiting factors.

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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Stand Loss in Soybeans Caused by Slugs

Principle Investigators:

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Ronald B. Hammond, Entomology

Abstract:

This proposal addressed stand losses in soybean fields caused by slugs. Two studies were attempted, one to determine the extent that stand reductions occur in soybean fields, and the second to examine the impact of various plant populations on yield and whether replanting is economically justified.

Stand Reduction: Eleven fields were used in this study. Within 48 hours after planting, plots were established with three replications of three treatments. The treatments were 1) no control, i.e., natural slug populations, 2) recommended control, i.e., 10 lb. per acre rate of Deadline Minipellets applied, and 3) no slugs, i.e., an area where there were no slugs, achieved with two applications of Deadline MPs applied at 20 lb. per acre at two week intervals. Individual plot size was 75 X 75 ft. Beer-trap samples were taken in all plots 1-2 weeks following planting to determine level of control. After sufficient time for complete crop emergence, stand counts were taken. Our intention was to take yield samples from those plots suffering significant damage; however, none of the fields experienced damage.

Plant stands (plants per 25 ft) are given in Table 1. Statistical analyses indicated no differences among treatments in any of the fields. The probability of a significant F value ranged from 0.20 to 0.92. Most fields had excellent stands, ranging from 163,000 plants per acre to >200,000 plants per acre. There were two exceptions. Field 7 had about 134,000 plants per acre (which is still considered to be very good), while Field 10 was at 85,000 plants per acre requiring replanting. This field was being scouted by an IPM consultant who determined that poor planting operations resulted in poor seed depth leading to low germination (few slugs were collected in this field). Field 11 which was adjacent to Field 10, planted at the same time with the same equipment, also had a poor stand and was replanted. No stand counts were taken in this latter field. Field 9 had been flooded and stands were very poor and variable; no stands are reported.

Slug populations were very low this past spring in these fields. Table 2 lists the total numbers of slugs collected in all the fields except for Field 5. As seen, total counts on all sampling dates <= 6 slugs, except for Field 10 where a total of 13 slugs were collected on two dates. However, those 13 slugs were evenly distributed among the treatments; no trends were observed.

The only field having a moderate population of slugs leading to differences among treatments was Field #5 (Table 3). All the slugs were marsh slugs in this field. Five samples were taken in this field, from 15 May to

12 June. Significant differences were obtained on three of the five dates, with both treatments significantly reducing the numbers of slugs. No differences were obtained on the last date, 12 June. However, this was over a month following the first application, indicating that long-term control was achieved. Although numbers of slugs were adequate to get excellent efficacy data, they were not sufficient to cause stand reductions (Table 1). (It is questionable if marsh slugs have a high potential for causing significant stand reductions compared with gray garden slugs and dusky slugs). It should be noted that the rest of this field was treated with the molluscicide on 2 May following planting because of the large population of marsh slugs. Sampling of those treated areas also indicated complete control.

Subsequent observation of emerged plants indicated that little injury occurred. Numbers of marsh slugs in the check were not sufficient to cause noticeable feeding injury.

Plant Stand Establishment: Soybeans were planted on 7 June at various planting rates using a no-till drill into the corn residue. The intent was to replant the lower-rate plantings in mid- June after the plants fully emerge to represent replanting of fields with poor emergence. The treatments were the following seeding rates (seeds planted per acre): 220,000, 160,000, 120,000, 80,000, and 40,000 for the single plantings, and 80,000 + 80,000, 40,000 + 160,000, 0 + 220,000 for the dual, replanted plots. Following emergence, it became evident that the intended plant populations were not achieved. All plots had much higher populations than intended, with the lowest rate being >150,000 plants per acre and the highest >250,000. It was determined that the cause was inexperience with the soybean drill being used. We decided to defer this study.

Extension Program Implementation

Populations were not sufficient to determine whether slugs can cause stand loss, and thus, whether Deadline MPs can prevent such losses. However, data collected from Field 5 **showed the excellent efficacy of Deadline MPs in controlling slugs**.

It appears **there is a cyclic nature to slug populations**. Over the past few years we have seen two springs with moderate to high slug populations (1994 and 1995) followed by springs with extremely low numbers (1996) and then slightly higher numbers (1997). Although the exact cause for the low populations this year is unknown, it probably relates to the drought that occurred in the summer of 1995. What we are aware of is that the significant slug problem in the spring of 1995 had followed a fall with large numbers of slugs, while very low slug densities in 1996 had followed a fall with an extremely low populations.

Sampling in the fall of 1997 suggests that slug numbers are definitely on the rise. We are collecting many adult gray garden, marsh, and dusky slugs. We also have been observing a substantial amount of mating and egg laying. **Our hypothesis is that the spring of 1998 will bring much concern to growers**. Whether populations will be as high as 1994 and 1995 remains to be seen. However, there appears to the possibility that fall sampling might be indicative of the potential of an economic slug population the following spring.

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

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