1996 Ohio IPM Block Grant Reports

1996 Geauga County IPM Program

Principal Investigator:

Mardy Townsend, Extension Agent, Geauga Co

Abstract:

Three apple orchards and five vegetable farms participated in the 1996 Geauga County IPM Scouting program. Two of the orchards had been in business for four generations, and the other for more than 30 years. The experience of the vegetable growers ranged from three to twelve years. This difference in experience is generally representative of Geauga's horticulture industry. The apple growers were interested in fine tuning their pest control strategies and identifying beneficial insect populations. The vegetable growers were more interested in identifying the specific pest problems of the year.

Two part-time scouts for the summer were hired. The orchard scout was employed from early June to mid-September. The vegetable scout was employed from late June to early September. The Geauga County Extension Agent trained both scouts.

Vegetable Scouting Program

The cool wet weather and soils of spring and early summer caused many early symptoms of physiological stress in all vegetables except the cole crops, making it often a challenge to distinguish between weather related stress and insect or disease damage. The unusually cool temperatures persisted through the entire season, allowing very high populations of flea beetles and striped cucumber beetle the entire growing season. High aphid populations caused leaf deformation early in peppers. Potato leaf hopper (PLH) populations in vegetables and field crops were the highest in many years. PLH caused severe hopper burn on green beans and potatoes. Colorado potato beetles on potatoes were monitored, and economic thresholds developed using the model in the 1996 Ohio Vegetable Production Guide (OSUE).

Diseases were also monitored. High aphid populations caused a higher incidence than normal of mosaic viruses in vine crops. Also in vine crops, levels of bacterial wilt transmitted by cucumber beetles were higher than usual. The unusually low temperatures, and unusually dry August, delayed development of fungal diseases except for early blight in tomatoes, which was very severe this year. Septoria leaf spot was also severe in tomatoes. The vine crop fungal diseases did not appear until the end of August.

The vegetable scout walked the entire fields of each operation on each visit. The scout monitored traps for corn earworm (CEW) in all pepper fields and variegated cutworm in one tomato field. Unlike 1995, CEW in peppers was not a problem this year. A copy of the written report, along with a verbal explanation, was given by the scout at the end of each visit.

Apple Scouting Program

The orchard scout monitored traps for codling moth (CM), San Jose Scale, and apple maggot. Trees were visually scouted for rosy apple aphid, white apple leafhopper, European red mite (ERM), and spotted tentiform leafminer. Predator insect populations were also monitored. Apple growers found that methodical scouting confirmed their suspicions of their worst insect problems. ERM and CM were the two biggest problems in 1996, although an outbreak of rosy apple aphid occurred in one orchard. One site had ERM pressure all summer, beginning the first week of June. No beneficials were ever seen there. Across the three orchards, ERM peaked the last week in July. Lacewing adult and larvae were first seen the week of July 22-26, and peaked during the second and third weeks of August. Growing degree days were tracked and used to determine the BioFix for CM. CM populations had two peaks; the first was the week of June 17-21, and second was the week of August 19-23. CM was caught all summer, beginning June 1.

The trap counts from the orchards were totaled on to a form, along with observations, and a copy left with the grower at the end of each visit. The apple growers liked the systematic scouting of their orchards. All were able to lengthen the time between some sprays. However, the frequent rains made spraying according to thresholds very difficult.

Extension Program Implementation:

The scouts brought reports into the office by Thursday morning each week. Pertinent information from the Ohio ICM Newsletter and trap counts were included in the weekly "Northeast Ohio Integrated Pest Management Newsletter". Results were also discussed at evening Growers' Meetings.

For further information contact the Ohio IPM Office.

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

Principal Investigator:

Mark Bennett, Associate Professor, Dept. of Horticulture and Crop Science

Abstract:

The fresh market sweet corn crop in Ohio produces a farm value of approximately $13.5 million. The production of early sweet corn in Ohio, particularly sugary enhanced (se) and shrunken-2 (sh2) cultivars, is still risky due to seedling establishment problems from poor germination in cold soils. Many sweet corn growers are using standard (su) sweet corn hybrids for early season crops, because they can be planted early in cold soils and still produce acceptable stands. However, these older su varieties are being replaced by se and sh2 endosperm types which have better eating quality and postharvest attributes.

The use of clear plastic mulch over a trench of sweet corn can lead to a 10-14 day advantage in earlier harvest. The objective of this research was to determine whether bioprimed seed, when combined with clear plastic mulch and row covers can provide even earlier and more successful production of early fresh market sweet corn when planting se and sh2 cultivars in cooler soils. Biopriming is a combination of seed hydration and inoculation of seed with beneficial bacteria (*Pseudomonas aureofaciens*, strain AB254) to protect sweet corn from *Pythium ultimum* seed decay. Data from this study in 1995 showed earlier germination under clear plastic mulch compared to bareground controls. Harvests were 6-9 days earlier from treatments planted under clear plastic mulch compared to controls.

Materials and Methods:

Plots in 1996 were again established at the OSU Horticulture Farm in Columbus. Two sweet corn varieties 'HMX 3364' (sh2) and 'Tuxedo' (se) were planted on May 20. Each plot consisted of 2 rows spaced 24 inches apart with seeds planted 7 inches apart within the rows. Plots were established using a cone seeder. Treatments consisted of standard fungicide treated seed (control) and bioprimed seed planted on bareground, under clear plastic mulch, under row covers or a combination of mulch and row covers. Treatments for each cultivar were planted in 4 replications. Fertility, weed control, and pest control were managed based on recommended commercial practices. All plots were harvested twice; the first harvest occurred when ears reached optimum maturity for fresh market sales. The second harvest removed the second or smaller ear from the plants. Plant height, ear height, length and diameter along with percent kernel moisture were measured and recorded from each treatment at the time of the first harvest (see Table 1).

Results and Discussion:

Colony forming units (cfu's) of AB254 per seed achieved with spring 1996 biopriming ranged from 160 million (for se 'Tuxedo') to 8.5 billion for sh2 'HMX 3364'. These cfu levels are considered more than adequate for control of *P. ultimum* under most conditions, based on prior reports.

Emergence of 'HMX 3364' and eventual yields were largely unaffected by stand establishment treatment. Best early emergence of 'Tuxedo' (under cool, wet conditions of spring '96 in central Ohio) is seen for combinations of control or BP seed with one or two plasticulture inputs. Considering the high cost to purchase, install, and remove row covers, mulch alone is still the recommended practice for early sweet corn production. Bioprimed seed again performed best in combination with clear plastic mulch. Total yields (combination of two harvests) were not affected by our treatments (p value = .34). Harvest 1 and harvest 2 data, however, indicate differences in crop uniformity are influenced by stand establishment choices, and are important for the majority of producers which use once-over harvest methods (Table 1).

Extension Program Implementation:

Results will be presented in the 1996 Processing Vegetable Research Report, and included in talks to sweet corn growers and industry reps at the Fruit/Vegetable Congress (Toledo, February 1997) and other meetings in the region.

Table 1: Combining Bioprimed Seed, Clear Plastic Mulch and Row Covers for Earliest Sweet Corn Production - 1996.

Cultivar: 'TUXEDO'	Harvest	Percent Germination*						
Treatment	Dates	11 DAP	17 DAP	21 DAP	29 DAP	32 DAP	36 DAP	44 DAP
UTC (bareground)	8/2; 8/6	64	82	82	80	80	80	74
UTC/mulch	8/6; 8/8	79	82	80	81	80	80	76
UTC/mulch/row cover	8/2; 8/6	71	78	78	77	77	77	76
UTC/row cover	8/6; 8/8	77	82	80	81	81	82	77
Bioprimed (bareground)	8/2; 8/6	41	67	74	74	76	76	71
Bioprimed/mulch	8/2; 8/6	75	83	84	84	83	81	78
Bioprimed/mulch/row cover	8/2; 8/6	69	71	72	73	73	72	68
Bioprimed/row cover	8/6; 8/8	47	69	69	69	69	71	66
LSD (0.05)		22.9	12	NS	NS	NS	NS	NS
p value				0.15	0.215	0.179	0.384	0.502
CV		29.4	12.5	11	11.2	10.5	10.7	12.1

Cultivar: 'HMX 3364'	Harvest	Percent Germination*						
Treatment	Dates	11 DAP	17 DAP	21 DAP	29 DAP	32 DAP	36 DAP	44 DAP
UTC (bareground)	8/2; 8/6	72	86	86	85	86	84	78
UTC/mulch	7/26; 8/2	74	80	81	80	80	80	76

UTC/mulch/row cover	7/26; 8/2	82	81	80	81	80	80	78
UTC/row cover	8/2; 8/6	82	88	88	88	88	88	82
Bioprimed (bareground)	8/2; 8/6	64	78	78	76	76	75	74
Bioprimed/mulch	7/26; 8/2	74	79	78	76	76	76	76
Bioprimed/mulch/row cover	7/26; 8/2	67	73	67	68	68	68	66
Bioprimed/row cover	7/26; 8/2	74	86	80	76	73	72	69
LSD (0.05)		NS	NS	10.8	NS	NS	NS	NS
p value		0.058	0.083		0.084	0.145	0.264	0.608
CV		12.4	9.7	11.2	13.8	15	14.7	12.1
* DAP = days after planting								

Table 1: Combining Bioprimed Seed, Clear Plastic Mulch and Row Covers for Earliest Sweet Corn Production - 1996. (cont)

Cultivar: 'TUXEDO'	Measurements on 3 plants				
	44 Days after Seeding		Marketable crates/A**		
Treatment	Plant Ht. (in)	Dry Wt. (g)	Harvest 1	Harvest 2	Total
UTC (bareground)	29.1	83.7	301	52	353
UTC/mulch	33.5	94	288	18	306
UTC/mulch/row cover	28.4	79.1	163	181	344
UTC/row cover	28.7	65.7	306	67	373
Bioprimed (bareground)	25.6	53.9	52	262	314
Bioprimed/mulch	31.6	97.1	184	150	334
Bioprimed/mulch/row cover	26.5	73.1	96	181	277
Bioprimed/row cover	25	42.5	122	49	171
LSD (0.05)	NS	NS	131.3	81.4	NS
p value	0.14	0.186			0.342
CV	16.6	43.5	65.1	79.1	38.2

Cultivar: 'HMX 3364	Measurements on 3 plants				
	44 Days after Seeding		Marketable crates/A**		
Treatment	Plant Ht. (in)	Dry Wt. (g)	Harvest 1	Harvest 2	Total
UTC (bareground)	23.8	60.4	239	207	446
UTC/mulch	30.2	109.9	189	194	383
UTC/mulch/row cover	31.9	122.1	169	290	459
UTC/row cover	26.9	78.8	194	257	451

Bioprimed (bareground)	25	69.3	272	155	427
Bioprimed/mulch	30.8	112.5	158	249	407
Bioprimed/mulch/row cover	28.2	88.1	161	226	387
Bioprimed/row cover	28.5	90.5	114	228	342
LSD (0.05)	3.89	35.03	NS	NS	NS
p value			0.118	0.496	0.575
CV	12.6	32.4	42.3	37.5	21.1
* DAP = days after planting					
** crate = 56 ears					

Table 1: Combining Bioprimed Seed, Clear Plastic Mulch and Row Covers for Earliest Sweet Corn Production - 1996. (cont)

Cultivar: 'TUXEDO'	Harvest Measurements				% Kernel
Treatment	Plant Ht. (in)	Ear Ht. (in)	Ear Length (in)	Ear Diam. (in)	Moisture
UTC (bareground)	40.7	8.2	7.8	1.5	81
UTC/mulch	43.9	10.6	8.1	1.6	83
UTC/mulch/row cover	48.5	8.5	8.6	1.7	83
UTC/row cover	43.7	8.4	7.8	1.4	79
Bioprimed (bareground)	42.4	7.9	7.9	1.6	80
Bioprimed/mulch	47.2	10.1	8.8	1.6	83
Bioprimed/mulch/row cover	54.8	10	8.6	1.6	82
Bioprimed/row cover	42.5	10.4	7.3	1.3	84
LSD (0.05)	8.1	NS	0.52	0.2	2.2
p value		0.188			
CV	14.3	20.2	7.2	10.6	2.5

Cultivar: 'HMX 3364'	Harvest Measurements				% Kernel
Treatment	Plant Ht. (in)	Ear Ht. (in)	Ear Length (in)	Ear Diam. (in)	Moisture
UTC (bareground)	40.2	8.2	7.4	1.6	81
UTC/mulch	43.9	10.6	7.4	1.4	83
UTC/mulch/row cover	48.5	8.5	7.6	1.4	83
UTC/row cover	43.7	8.4	7.6	1.7	79
Bioprimed (bareground)	42.4	8	7	1.6	80
Bioprimed/mulch	47.2	10.1	7.6	1.5	83
Bioprimed/mulch/row cover	54.8	10	7.6	1.3	82

Bioprimed/row cover	**42.5**	**10.4**	**7.1**	**1.3**	**84**
LSD (0.05)	**8.09**	**NS**	**NS**	**0.13**	**2.2**
p value		**0.188**	**0.118**		
CV	**14.3**	**20.2**	**5**	**10.3**	**2.5**
LSD (0.05)	**3.89**	**35.03**	**NS**	**NS**	**NS**
p value			**0.118**	**0.496**	**0.575**
CV	**12.6**	**32.4**	**42.3**	**37.5**	**21.1**
*** DAP = days after planting**					
**** crate = 56 ears**					

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

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Comparing Economic Thresholds of Potato Leafhopper on Alfalfa

Principal Investigator:

Gary W. Wilson, Hancock Co. Extension Agent

Abstract:

The potato leafhopper (PLH) continues to be the most serious insect affecting alfalfa production in Ohio. We conducted a special study with established alfalfa at The University of Findlay Equestrian & Pre-Vet Center to emphasize the importance of the economic threshold of the PLH and determine the amount of reduced alfalfa yield and quality that actually happens as a result of the crop damage. We have designed a 4x replicated research plan using 20 ft by 50 ft established alfalfa plots which will involve collecting quality and yield data for each hay cutting on each plot. Potato leafhopper populations will be varied in the following ways:

1. No spraying
2. Spraying every 2 weeks
3. Spraying at established economic threshold
4. Spraying 2 times over established economic threshold

PLH scouting will be completed on a weekly basis, along with 5 one-acre plus adjoining alfalfa variety plots. The same exact alfalfa plots used in 1995 were used in 1996 to also test if alfalfa damaged the year earlier by PLH will continue to adversely affect alfalfa yield and quality the following year. The plots were also sprayed identical to 1995.

1996 PLH populations as indicated in Table 1 started off much slower than the previous year. The 1996 Spring was very cool and wet which probably slowed PLH from establishing as quick. Also due to wet weather the first cutting was also delayed, which started our PLH scouting later than normal on July 2nd. At that time and actually the only time all year was PLH actually at threshold and we never reached 2x threshold in these plots the entire year. This factor became a mystery because many other alfalfa fields in the county reached much higher populations. We did continue our program by spraying the one set of plots every two weeks, and even without reaching threshold, we still measured height differences of over three inches in the sprayed plots, but these did not show similar differences in yield.

Yield results are indicated in Table 2. As expected, the stress from the previous year's unsprayed high PLH populations carried on into the next year showing a significant yield difference with P=.045. But as a result of much lower PLH populations, the 2nd cutting showed no significant difference with p=.80 and the 3rd cutting also showed no significant yield difference with p=.61.

Forage Quality data was also collected and comparisons made. Very little difference in quality was noted throughout the project except protein data from 2nd cutting which approached being significant. This data is available upon request.

Alfalfa stand counts were also taken starting in May and continued 4 times through the year to October. The stand counts ranged from 38 to 96 plants/sq. ft. Leaf analysis tissue data was also taken showing all nutrients as sufficient. Neither the stand count or leaf analysis data showed any significant differences and the data is available upon request.

Conclusions:

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

2. Even in years of lower PLH populations, like 1996, 1st cutting alfalfa yields can still be reduced from PLH pressures the previous year.

3. After two years of this PLH research, alfalfa stand counts still show no significant differences between PLH populations.

4. This research definitely needs to be continued in 1997 using the same plots with the same treatments. It is highly probable that due to stress, the plots not sprayed could have thinner stands. Also it is also possible by cutting adjoining alfalfa later, that PLH populations could be driven into the PLH plots to better conduct the research.

Extension Program Implementation:

This research on PLH was presented on 5 different occasions for pesticide applicator recertification and also a Poster Session was presented at the American Society of Agronomy Conference in Indianapolis in November 1996.

Table 1. Observation of average PLH population based on sweep net sampling and height measurement.

Potato Leafhopper Populations					
			Adult	Nymph	
Week	Replication	Avg.	PLH Count/	PLH Count/	Notes
	#	Height	10 Sweeps	10 Sweeps	
			Avg.	Avg.	
7-2-96	1's	7.75"	5.25	0	Plots 2's & 3's sprayed
	2's	8.00"	6.25	0	7-3-96
	3's	8.25"	4.75	0	
	4's	8.25"	5.75	0	

7-10-96	**1's**	**16.50"**	**5.50**	**0**	
	2's	**17.25"**	**.25**	**0**	
	3's	**17.25"**	**0**	**0**	
	4's	**16.50"**	**6.25**	**0**	
7-17-96	**1's**	**18.75"**	**17.75**	**1.50**	**Plot 2.s sprayed**
	2's	**22.25"**	**7.25**	**0**	**7-18-96**
	3's	**22.75"**	**5.00**	**0**	**Field Cut 7-22-96**
	4's	**19.50"**	**13.75**	**0**	**3.5" height difference**
7-31-96	**1's**	**4"**	**0.75**	**0**	**Plot 2's sprayed**
	2's	**4"**	**1.75**	**0**	**8-1-96**
	3's	**4"**	**0.25**	**0**	
	4's	**4"**	**1.75**	**0**	
8-7-96	**1's**	**11.75"**	**5.00**	**0.25**	
	2's	**13.25"**	**.75**	**0**	
	3's	**13.25"**	**5.00**	**0**	
	4's	**11.50"**	**2.00**	**0.25**	
8-14-96	**1's**	**19.75"**	**7.50**	**0**	**Plot 2's sprayed**
	2's	**23.50"**	**4.25**	**0**	**8-15-96**
	3's	**21.00"**	**6.25**	**0.50**	**3.75" height difference**
	4's	**20.00"**	**8.00**	**0**	
8-20-96	**1's**	**25.25"**	**4.50**	**0**	**First sign of natural**
	2's	**27.75"**	**1.25**	**0**	**population decrease -**
	3's	**26.25"**	**4.75**	**0.25**	**2.5" height difference**
	4's	**25.75"**	**2.75**	**0.25**	**Field Cut 8-26-96**

Insecticide: Pounce - 4 oz./Acre

1's - No Spray
2's - Spray Every 2 Weeks
3's - Threshold
4's - 2 x Threshold

Table 2. Alfalfa yields under different leafhopper management strategies.

Yield Results			

		1st Cut	2nd Cut	3rd Cut	
Spray Treatment	**# of**	**6-25-96**	**7-22-96**	**8-26-96**	**Total Yield**
	Replications	**Ton/Acre**	**Ton/Acre**	**Ton/Acre**	
Every 2 Weeks	**4**	**2.7**	**1.4**	**1.1**	**5.2**
2x Threshold	**4**	**2.1**	**1.3**	**1.1**	**4.5**
Threshold	**4**	**2.1**	**1.3**	**1.0**	**4.4**
No Spray	**4**	**2.2**	**1.4**	**1.1**	**4.7**

*Insecticide used was permethrin (Pounce 3.2 EC - 4 oz./Acre)

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

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Ohio Integrated Pest Management
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Evaluation of Alfalfa Cultivar Resistance to Potato Leafhopper as an Effective IPM Strategy

Principal Investigators:

R. M. Sulc, Assistant Professor, Horticulture & Crop Science
H. R. Willson, Associate Professor, Entomology

Abstract:

The potato leafhopper (PLH) is the most serious insect affecting alfalfa production in Ohio, reaching economic thresholds in one to two summer growth cycles each year. The greatest economic impact of PLH on alfalfa is through yield reduction, but it can also reduce crude protein content, reserve carbohydrates in taproots, and subsequent regrowth. Chemical control and early cutting have been the only effective management options available to reduce economic losses caused by the PLH, until recently. In the mid-1980's researchers at Purdue University and Kansas State University released alfalfa germplasm with improved resistance to PLH. The resistance was associated with the presence of short glandular hairs on the leaves and stems. This germplasm exhibits resistance through reduced survival of PLH adults and nymphs feeding on the foliage, and by a reduction in egg-laying and feeding preference of adults. Since the mid-1980's, several commercial alfalfa breeding companies have been working to incorporate this PLH resistance trait into alfalfa varieties that will meet industry standards for productivity, persistence, and pest resistance. Six varieties with the glandular-hair trait will be released for commercial sale beginning in 1997. Performance of these varieties has not been adequately evaluated in the field under natural PLH infestations. The objective of this project was to evaluate the performance of commercially available alfalfa varieties and glandular-haired experimental varieties under natural infestations of the PLH, and to determine the economic impact of variety resistance on alfalfa production.

Nine experimental varieties having the glandular-hair trait were compared with five standard commercially available varieties in a trial seeded 20 May 1996 at the OARDC Western Branch near South Charleston, OH. Variety performance was compared without insecticide treatment and with preventative insecticide applications to control PLH. Data are presented as means of the five standard varieties and the six glandular-haired varieties to be released in 1997. Potato leafhopper populations at the site were very high in 1996. Significant differences in yield were observed in both the first and second cuttings among glandular-haired varieties ('Resistant') and commercial varieties ('Checks'), and among treated and untreated sets of plots (Table 1). In untreated plots, the average seasonal dry matter yield of the six resistant varieties was nearly twice the average yield of the five commercial check varieties. In treated plots, resistant varieties averaged 12 % less than the commercial checks. There was an economic benefit to treating all varieties in both cuttings. Insecticide treatment increased average seasonal yield of resistant varieties by 0.5 tons/acre and of commercial check varieties by 1.6 tons/acre. Differences in leafhopper yellowing and canopy height were

similar to the differences in forage yield (Table 1).

Table 1. Total seasonal forage yield, canopy height, and potato leafhopper (PLH) yellowing ratings of resistant and commercial check varieties grown without (Untrt) and with (Trt) insecticide treatment for PLH at South Charleston, OH in 1996.

Harvest/	Yield (T/A)		Height (in)		PLH yellowing[1]	
Variety	Untrt	Trt	Untrt	Trt	Untrt	Trt
First Growth						
Resistant	1.01**	1.29*	11.6**	17.4**	1.1**	0
Checks	0.39	1.39	7.3	18.8	5.6	0
Second Growth						
Resistant	0.57**	0.76**	9.5**	11.4**	1.1**	0
Checks	0.36	0.95	6.9	4.2	2.9	0
Total						
Resistant	1.57**	2.05**	--	--	--	--
Checks	0.75	2.34	--	--	--	--

'Yellowing rated from 0 = no yellowing or stunting to 9 = more than 80% leaf area yellowed with severe stunting.
*, ** Indicates statistically significant difference at P=0.05 and P=0.01, respectively, between resistant and check varieties within a growth cycle or for total yield. Resistant averages include data from six experimental glandular-haired varieties to be released in 1997. Checks include data from five standard commercial varieties.

The large yield differences observed were due to several factors. The trial was planted May 20 due to excessive spring rainfall, and PLH populations were well over economic thresholds during early seedling development in June. PLH pressure remained high throughout the remainder of the growing season (even after first harvest), and dry weather also limited alfalfa growth. Two applications of insecticide were necessary to prevent PLH damage in the treated plots in the first crop, and one application was made to the second crop.

Potato leafhopper nymph populations were dramatically reduced on glandular-haired varieties compared with the commercial check varieties in untreated plots when PLH pressure was high (data not shown). This agrees with previous greenhouse and field studies showing reduced egg-laying, nymph survival, and retarded nymph development on individual plants having the glandular-hair trait. Adult populations did not differ greatly between resistant and commercial check varieties. The reduction in nymph populations in the resistant varieties is significant, because the greatest PLH injury to alfalfa usually occurs with the advent of high nymph populations.

PLH resistant varieties represent a significant new tool in alfalfa pest management, especially if these varieties prove to have acceptable forage yield in the absence of PLH. These varieties and future ones with even greater PLH resistance will provide significant economic and environmental benefit to alfalfa producers and society at large by reducing or eliminating the use of insecticides to control this pest. Although PLH is recognized as an important pest of alfalfa in Ohio and other midwestem states, growers often fail to regularly scout alfalfa and apply insecticides in a timely manner when PLH activity warrants treatment. These data demonstrate that the impact of PLH feeding is much less on untreated PLH resistant varieties than on untreated susceptible varieties. Therefore, these varieties with improved PLH resistance show promise in providing a significant measure of insurance in situations where timely control of PLH is not practiced, which is often the case. However, these resistant varieties will probably benefit from timely insecticide treatments during periods of intense PLH activity. Thus, it should be recognized that these glandular-haired alfalfa varieties should still be scouted periodically to prevent economic loss under conditions of intense PLH activity. Further research is needed to determine whether action thresholds currently recommended for susceptible varieties will need to be adjusted for PLH resistant varieties. Future breeding efforts may lead to further improvements in host resistance to the point where insecticide treatment will never be needed.

These results should be interpreted with care, as this is only seeding year data. Alfalfa performance should be evaluated over several years before concrete conclusions can be drawn regarding productivity and persistence. These results also need to be confirmed in larger on farm plots using commercial seed lots, as this study was conducted using small plots (5 x 20 ft) due to the limited quantity of seed available in 1996.

Extension Program implementation:

The objective of the extension component of this project is to deliver to extension clientele the information gained from the research trial. This study is providing valuable information to producers considering adoption of these newer glandular-haired varieties. Results to date demonstrate the tremendous potential benefits of host resistance to PLH. Three field days and several informal plot tours were held during 1996 to show producers, extension agents, and seed and chemical industry professionals the difference in PLH resistance exhibited among varieties. Data were presented to the Extension/Industry Alfalfa Advisory Council in November. That group consists of 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 Extension Agronomists in all states via email. First-year results of the study will be presented at grower and industry training meetings this winter. Data are being reported in the 1996 Ohio Forage Variety Performance Trials report which is circulated through normal Extension channels, and will also be published in Country Journal. Articles have been written summarizing the results which will appear in several nationally distributed popular press agricultural publications. A press release will be issued in December from the Section of Communications and Technology of The Ohio State University. Future extension activities include working with producers next year to establish on-farm trials comparing the new resistant alfalfa varieties with standard susceptible 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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Evaluation of Calcium Chloride for Control of Botrytis Fruit Rot on Strawberry

Principle Investigators:

Michael E. Ellis, Professor, Plant Pathology
Larry V. Madden, Professor, Plant Pathology
Omer Erincik, Graduate Student, Plant Pathology

Abstract:

Botrytis fruit rot (gray mold) is the most economically important disease of strawberry in Ohio and the world wide. Over 90% of all fungicides used on strawberry are for control of this disease. Recent studies on other crops have indicated that calcium salts, primarily calcium chloride are effective for controlling fruit rots and other diseases caused by Botrytis. Of significance to this proposal is that many strawberry growers across the Midwest are currently using calcium chloride in bloom and preharvest sprays and claim to be getting substantial disease control. At present, there is no data to support the use of calcium chloride for Botrytis control on strawberry. The purpose of this research is to develop scientific data to support or disprove the benefits of calcium chloride for disease control on strawberry. If calcium chloride is effective, its use could be considered as a cultural practice (foliar nutrient) and would greatly reduce current fungicide use resulting in less deposition of fungicide in the environment as well as significant economic savings to growers. If we can demonstrate positive benefits, the use of calcium chloride for fruit rot control will be directly incorporated into our current extension recommendations for strawberry disease control.

Results obtained from field studies conducted in spring of 1996 indicate the foliar applications of calcium chloride had no effect on control of Botrytis fruit rot or on fruit firmness, color, soluble solids or titratable acidity. Greenhouse experiments will be conducted in winter of 1997 to study the effects of calcium chloride on these fruit quality characteristics under more controlled conditions. Field experiments will be repeated in spring of 1997 so that results can be published in a referred journal. Although our results indicate that the use of calcium chloride does not control Botrytis fruit rot, it is important to confirm these results so that growers are aware of the efficacy of this treatment.

Field studies conducted in spring 1996

Methods:

A field trial was established at Maurer's strawberry farm at Wooster, OH. Plots consisted of 4 rows, 1 meter long. All treatments were replicated 4 times in a completely randomized block design. Calcium chloride was applied at the rate of 4.5 lb/A starting at early (25%) bloom and repeated 4 times at 4-day intervals. A higher rate (9 lb/A) was applied at 50% bloom and 10 day later when green fruit were present. Ronilan (a standard fungicide for Botrytis control) was applied according to current recommendations for comparison and one treatment was left untreated to serve as the control. All plots were inoculated with a conidial suspension of *Botrytis cinerea* at 50% bloom. Plots were harvested 3 times and the percentage of marketable and Botrytis infected fruit was recorded. Twenty five fruit per replication for each treatment were evaluated for post-harvest disease development in the laboratory. Fruit were placed in 5 liter plastic humidity chambers and observed for 10 days for Botrytis infection. Ten fruit per replication were evaluated for fruit firmness, color, soluble solids and titratable acidity in Dr. Joe Scheeren's laboratory using standard techniques.

Results:

Much of the data is currently being analyzed. Field data on efficacy of calcium chloride on control of Botrytis fruit rot are presented below.

Treatment	**Yield total weight (kg)**	**Total fruit number**	**% Marketable fruit**	**% Gray mold infected fruit**
CaC'2 4.5lb/A	**16.2 a**	**1475 a**	**77.6 b**	**17.9 a**
CaC'2 9 lb/A	**16.1 a**	**1427 a**	**72.5 b**	**21.6 a**
Ronilan 2 lb/A	**16.9 a**	**1204 a**	**95.9 a**	**3.6 b**
Untreated Control	**16.7 a**	**1383 a**	**74.2 b**	**19.2 a**

All data in the above table are based on the combined results from 3 harvests. Numbers within columns followed by the same number are not significantly different.

The data indicate that calcium chloride did not provide control of Botrytis fruit rot at both rates tested. Ronilan provided excellent control. Although data is still be analyzed, it appears that calcium chloride had no effect on post-harvest development of Botrytis, or any other fruit quality, parameters we measured. Data on post-harvest disease development and effects on fruit quality characteristics will be sent in a supplement to this report as soon as the data is fully analyzed.

We feel that it is important to verify these results by repeating the field trial in 1997. We will request one more year of funding in order to complete this study.

For further information contact Michael E. Ellis Professor, Dept. of Plant Pathology, OARDC or the Ohio IPM Office.

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Evaluation of Corn Hybrids for Resistance to Gray Leaf Spot

Principal Investigators:

Peter R. Thomison, Horticulture and Crop Science
Patrick Lipps, Extension Plant Pathology

Abstract:

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

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

In 1996 we conducted field tests to evaluate the performance of a limited number of corn hybrids known to have some degree of resistance to GLS with maturities acceptable for production in Ohio. The goal of our study was to help corn growers identify profitable corn hybrids for use in regions of the state where GLS can be a major yield limiting factor.

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

Field plots were established at six on-farm sites in Wayne, Holmes, Coshocton, Knox, Fairfield and Ross Counties that have a history of heavy gray leaf spot pressure. Plots were located in fields which have been

continuously cropped to corn. Hybrids were planted in strip plots at least four rows wide (in 30-inch or 38-inch row spacings) and 300 feet in length.

A set of 20 hybrids compared in the on-farm strip tests (described above) was also planted at the Ohio Corn Performance Test site at West Lafayette in Coshocton county, a site previously cropped to corn with a history of gray leaf spot. The experimental design was a randomized block with four replicate plots. Each plot consisted of four 30-inch rows 25-feet in length.

Disease assessments were made in each plot location two to three times at approximately two week intervals. Assessments were made on 21 August, 29 August, 11 September, and 25 September, but each plot was not assessed on each date. Hybrids were assessed for GLS by estimating the percentage of the ear leaf covered by lesions on six plants per plot. Disease assessment scales were used to estimate severity percentages. The average severity was calculated for the six plants per plot and plot means were used for statistical analysis. Area under disease progress curve (AUDPC) was calculated from percentage ear leaf are affected to determine differences in disease increase over time. The incidence of stalk rot was determined using the "squeeze" method, i.e. squeezing the stalk above the brace roots and recording the number of stalks that crushed easily. At least 10 plants in each plot were checked for stalk rot. Stalk lodging (stalk breakage below the ear), test weight, and grain moisture were recorded at harvest and yields were adjusted to 15.5% moisture.

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

As of 5 December, 1996 certain agronomic performance data including grain yield had not yet been obtained for several test sites due to harvest delays caused by inclement weather. Table 1 shows disease reactions of hybrids common to four of the test sites in Wayne, Holmes, Knox and Coshocton Counties. In each of the strip plot evaluations, the susceptible check exhibited higher GLS disease ratings, as much as two times more leaf tissue affected, than hybrids characterized as having some resistance. One of these hybrids, Pioneer 3335, had disease ratings that were not significantly lower than that of the check.

TABLE 1. Reaction of commercial hybrids to gray leaf spot in on-farm strip plot test at four locations in east central Ohio, 1996.**

	Ear Leaf	
Brand/Hybrid	**Affected**	**AUDPC****
Pioneer 3352	16.3	5.9
ICI 8342	22.7	7.6
Northrup King N6800	26.5	8.4
Porter 5111	25.5	8.5
Doebblers 75X-2	24.8	9.9
LG Seeds V2504	31.5	10.6
LG Seeds V2524	26.7	10.5
Asgrow RX701	33.4	10.7
Doebblers 66XP	31.1	10.6
Porter 5408	33.9	10.9
ICI 8541	32.5	10.4

DeKalb DK634	37.3	11.6
Northrup King N7070	37.0	12.6
Asgrow RX770	34.0	11.9
Pioneer 3335	50.5	16.7
Pioneer 3394	57.2	21.1
LSD (P = 0.05)	10.7	5.3

*last assessment for Holmes, Knox, Coshocton Counties on 25 September , 1996 and for Wayne County on September 11, 1996. All assessments were estimates of the percentage ear leaf area affected.

**AUDPC = Area under disease progress curve

Extension Program Implementation:

Results of this study will be reported at 1997 winter meetings for county ag agents, crop producers and agricultural industry personnel. Data collected has been summarized in an Agronomy Fact Sheet (AGF-130) and a Plant Pathology Circular. Information from the study will also be utilized in ICM newsletter articles and shared with trade magazines for wider distribution.

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

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No Till / Zone Till of Pumpkins into Cover Crops

Principal Investigators:

Brad Bergefurd, Extension Agent, OSU Extension
Bob Precheur, Vegetable Specialist, Horticulture

Abstract:

Pumpkin growers throughout Ohio face problems of 1) adequate weed control 2) cleanliness of pumpkins as the fruit lays on the soil when harvested 3) for Pick- Your- Own operations customers having to walk in muddy fields under some harvest conditions and 4) moisture retention in dry soils under certain drought conditions experienced throughout Ohio.

The objective of this trial is to evaluate the potential of direct seeding pumpkins into a cover crop using no till and zone tillage techniques for benefits of weed control, moisture retention and fruit cleanliness and the effects upon fruit yield and quality.

The outcomes of this project should provide information to growers, researchers, crop specialists and Extension Agents in determining if no-till and/or zone till planting of pumpkins into a particular cover crop may benefit Ohio producers.

Results:

1996 was the second year of this no till pumpkin trial. In 1995 fruit yields for two Jack-O-Lantern pumpkin cultivars ('Howden', 'Jackpot') and one pie pumpkin cultivar (' Baby Pam') were grown as observation cultivars comparing production systems ranging from (1) No Till into a mowed Rye Cover Crop (2) Minimum Till (Double Disking mowed Rye stubble then planting) and (3) Conventional planting method (Mowed Rye stubble moldboard plowed under then soil disked prior to planting). Best fruit yields in 1995 for ' Baby Pam ' were from the conventional tillage treatment, 3824 fruit per acre, compared to 1619 fruit per acre in the minimum tillage treatment. Total marketable fruit yields for 'Howden' and 'Jackpot' were also best for the conventional tillage treatment, 2206 fruit per acre and 3235 fruit per acre, respectively. Percent (%) plant stand was greater for all three cultivars under the conventional tillage treatment in 1995.

Growing conditions for this trial in 1995 were very poor. Due to a very wet spring, wettest in 44 years in Hillsboro, planting dates were delayed. The Rye crop prevented the soil from drying out making plots unworkable. Following planting, growing conditions became extremely dry causing the soil to become very hard resulting in a reduced plant stand. Weather conditions of extreme heat and humidity in 1995 resulted in pumpkin plants with many male blossoms resulting in a reduced or no fruit set. These weather conditions resulted in lower yields not only for this trial but for pumpkin producers throughout the state.

As in the spring of 1995, the 1996 spring planting season was also one of the wettest on record in the Hillsboro area, with over 17 1/2 inches of rainfall in April and May. We had hoped to make an early spring seeding of 5 different cover crops, then no till/zone till a pumpkin crop into the treatments in early June. However, the spring seeded cover crops were not able to be planted since field work was not able to be started until the last week of May and the first week of June. Therefore 5 cover crop treatments, Bluegrass, Wheat, Alfalfa, Annual Rye and Oats were seeded in October of 1996 and the No Till planting will be established in the Spring of 1997. Harvest data from the 1997 plantings will be available in the Fall of 1997.

Potential benefits from No Till and/or Zone Till planting techniques of a pumpkin crop into a cover crop include:

1) Fruit Cleanliness - pumpkins grown in cover crops are cleaner at harvest compared to pumpkins grown without a cover crop. The cover crop provides a buffer between the pumpkin and the ground, allowing the pumpkin to stay clean all season long.

2) Customer Satisfaction- for growers who have Upick operations where customers walk into the field to pick their pumpkin, customers will not come out of the field with muddy shoes and dirty clothes.

3) Satisfactory weed control- weed control for this trial in the 1995 season was fair, although some growers experienced very poor weed control using this growing technique throughout Ohio in 1995. Certain cover crops inhibit germination of annual weed seeds by preventing light from reaching them and probably through allelopathic effects. However perennial weeds should be cleaned up before trying a no till / zone till cover crop planting.

4) Reduced herbicide and fungicide applications. Cover crops may allow for a decreased use of herbicides for weed control. Fungicides use for ground rots of pumpkin fruit may also be reduced since the cover crop prevents direct contact of the soil with the pumpkin fruit, reducing the possibly of soilborn fungi attacking the fruit.

Problems to consider from using cover crops and no till / zone till planting techniques for pumpkin production include:

1) Under wet spring planting conditions spring seeded cover crops may not be able to be planted early enough to get adequate mulch cover and / or cover crop mulches have a tendency to hold moisture and prevents soil from drying out. Under a dry planting season this may be beneficial to seed germination but under wet spring conditions, like in 1995 and 1996, planting dates can become delayed due to unworkable field conditions.

2) Cover crop mulches have a tendency to keep soil temperatures slightly cooler, therefore planting dates may need to be adjusted accordingly for an early fall pumpkin harvest.

3) The Rye mulch in 1995 harbored mice and voles which caused extensive feeding damage to the fruit resulting in many low quality pumpkins. Growers throughout Ohio also experienced increased mice damaged fruit under Rye and Wheat mulch conditions. Damage will also be monitored under the cover crops plantings in 1997.

4) Seed emergence and plant stands were reduced under minimum and no tillage treatments due to a crusting of the soil in 1995. Under dry field conditions irrigation may be necessary for proper seed emergence. Seeding rates may need to be increased under these production practices.

Extension Program Implementation:

A progress report was made to growers, industry, researchers and extension personnel who attended the OSU Extension Enterprise Center Horticulture Field Nights in Hillsboro in 1995 and 1996. Results of the 1995 and 1996 research trials were and will be presented at the Ohio Fruit & Vegetable Growers Congress in 1995 and in February 1996.

Summary:

No till and/or Zone till planting of a pumpkin crop into cover crops are an option for many Ohio pumpkin producers. It won't necessarily work for all growers every season. 1995 and 1996 were seasons where it DID NOT work very good for our trials and for many growers. Trials similar to this one will need to be conducted to give average results over several growing seasons. Benefits of no till and zone till have been shown to be effective planting techniques for some vegetable crops and agronomic crops.

Table 1. 1995 No Till Pumpkins into Rye Cover Crop. Observation trials. Harvest Date 10/26/95

Variety	Marketable Fruit/Acre	Tons Marketable Fruit/Acre	Ave. Frt.Wt.	% plant stand
Baby Pam	2206	1.3	.93 lb.	65
Howden	588	1.3	2.20 lb.	65
Jackpot	2500	8.1	6.54 lb.	75

Table 2. 1995 Minimum Till Treatment. Observation trials. Pumpkin Harvest Date 10/26/95

Variety	Marketable Fruit/Acre	Tons Marketable Fruit/Acre	Ave. Frt.Wt.	% plant stand
Baby Pam	1619	0.51	.55 lb.	70
Howden	882	2.13	2.56 lb.	70
Jackpot	1618	3.81	3.49 lb.	85

Table 3. 1995 Conventional Till Treatment. Observation trials. Pumpkin Harvest Date 10/26/95

Variety	Marketable Fruit/Acre	Tons Marketable Fruit/Acre	Ave. Frt.Wt.	% plant stand
Baby Pam	3824	2.2	1.10 lb.	95
Howden	2206	6.8	5.90 lb.	100
Jackpot	3235	9.1	5.60 lb.	95

Table 4. 1996 Cover Crops Treatments Seeding Rates. Seeded 10/2/96. Hillsboro, Ohio.

Treatment #	Type	Seeding Rate
1	Control - Bare Ground	-
2	Kentucky Bluegrass	5 lb. / acre
3	Wheat	100 lb. / acre
4	Alfalfa	18 lb. / acre
5	Annual Rye	100 lb. / acre
6	Oats	100 lb. / acre

For further information contact Brad Bergefurd Extension Agent, Ohio State University Extension the Ohio IPM Office.

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Resource Handbook for Twilight Summer Tree Fruit IPM Workshop

Principal Investigator:

Ted W. Gastier, Huron County Agricultural Agent

Abstract:

Tree fruit growers in North Central Ohio were provided with the opportunity to increase their knowledge and sharpen their diagnostic skills at identification and management of insects, mites, and diseases in an orchard setting. On July 17, 1996, Brad, Margaret, and Linda of the A. B. Phillips & Sons Fruit Farm, hosted a Twilight Alternative Apple Pest Management Training Meeting. Growers and Extension personnel were lead in discussions by Dr. Celeste Welty, Extension Entomologist and Dr. Michael Ellis, Extension Plant Pathologist. A reference manual was provided to a representative of each attending orchard. Funding from the IPM Mini-grant supplied those manuals which we trust will occupy a prominent place at the growers' offices.

Description and Contents of Reference Manual: The Alternative Apple Pest Management Resource Handbook was assembled to provide commercial apple producers with a reference manual that could be used by those interested in moving beyond calendar- based spray guides. Background materials for alternative pest management that were included:

1). A copy of Chapter 1 from Rachel Carson's "Silent Spring".
2). Series of Cleveland Press articles titled "Noisy Autumn" by John Troan which were published after the release of "Silent Spring".
3). A short editorial titled "Philosophy of IPM and Sustainable Agriculture" by Ted Gastier and originally included in Vol. 5, No. 17 issue of the "North Central Tree Fruit IPM Newsletter, dated August 10, 1995.
4). Pesticide Laws and Events derived from the "Complete Guide of Pest Control" by George Ware.
5). "Integrated Pest Management (IPM) Disease Management Guidelines for Apples in Ohio, 1994" by Dr. Michael Ellis.
6). The "piece de resistance", a full-color book titled "Common Tree Fruit Pests" by Dr. Argus Howitt. The color pictures and descriptions are intended to assist growers in the identification of pest insects and mites as well as beneficial insects and mites. Correct identification is essential to the success of alternative apple pest management systems including Integrated Pest Management (IPM).

Extension Program Implementations:

Apple producers have been aware of the availability of the "Common Tree Fruit Pests" book as it has been used by our scout/technicians with our IPM program. However, there has been a general reluctance to purchase the book by individual growers because the cost of $30 has been perceived to be excessive. The IPM Mini-grant purchased the books at a volume discount. The quality of the book served as an attraction for the required pre-registration that included $10 per family to defray the cost of a light supper for all thirty-nine participants. We feel that attendance was enhanced through this method and will consider using similar procedures in future Extension programming.

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

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Ohio Integrated Pest Management

THE OHIO STATE UNIVERSITY EXTENSION

Slug Life Cycle and Damage Potential Studies in Ohio

Principal Investigators:

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

Summary and Conclusions:

Slug Species and Life Cycles

The study in 1996 was a continuation of the project that began last year. The fields sampled in 1995 were used again unless circumstances prevented their use. This occurred in a few fields; in those situations, other fields in the same general vicinity with a history of slug problems were sampled.

Supplies were purchased in Wooster and distributed to all county agents in early spring. Numerous visits by Hammond's crew were made to all fields during April and May to take *in situ* samples. More *in situ* samples were taken this spring compared with the previous year. Samples were taken by searching 20 areas per field, approximately 1 ft^2 each, for the presence of slugs.

Weekly beer-trap sampling began after all supplies were delivered. Holes were cut into the soil using a 4" hole cutter, with a 16-oz plastic food cup inserted into the hole. The cup was partially filled with beer and a 1 ft^2 aluminum foil-covered roofing shingle was placed over the cup. Traps were sampled the following day when species and number of slugs were recorded. The beer and cups were removed and the shingle placed back over the hole. Slugs underneath the shingles were counted the following week which constituted passive sampling. The entire process was repeated. This process continued through June, after which samples were taken on a monthly basis.

The spring of 1996 was extremely wet and cool, resulting in late planting in most fields. *In situ* sampling in early spring indicated that adult slugs and eggs were present in very low numbers. In most fields, juvenile and adult slugs were almost nonexistent, with only a few eggs being seen. The few slugs sampled were mostly marsh slugs. This compared with early spring visits in 1995 when numerous eggs were present. The larger number of eggs suggested significant populations in many of the fields (relatively few adults had been seen);

subsequently large slug populations were observed that year. Compared to last year when slug populations were often large, few slugs were collected by the beer traps or the passive samples in 1996. Of note, very few gray garden slugs or dusky slugs were collected. The most numerous slug collected was the marsh slug, and then, only in a few fields. One field in Wayne county had an average of 11 slugs per trap on a single date; however, other samples in that field always were low. This single field is a low lying field that is tends to be wetter during the spring compared to surrounding fields.

Sampling in other fields that were not part of this study also hinted at the absence of slugs. Additionally, telephone calls were made to people associated with the slug problem in Ohio (e.g., crop consultants, other extension agents, and industry representatives). No one was aware of significant problems with slugs this year.

It should be noted that these same fields had been sampled in the fall of 1995. At that time, there were less than 0.5 slugs per trap of any species, with most traps never having slugs. Whether these low numbers were indicative of low slug densities or little slug activity was difficult to ascertain. This had compared with fall sampling in 1994 (done only in Wayne County) where very large slug densities were observed. Slug numbers in Wayne County in the fall months of 1994 ranged from 8 to 20 gray garden slugs, 2 to 5 dusky slugs, and 5 to 13 marsh slugs per single trap. The following spring (reported in last year's report), slug populations were quite high and there was significant damage in numerous fields. The point is that large slug populations in the fall preceded large populations and economic damage the following spring, while a nonexistent fall population resulted in very low spring populations.

Slug Injury/Crop Damage Studies

In 1996, our plan was to conduct the damage studies only in fields having a large slug population prior to planting, or with significant slug injury being observed. Because of the extremely low slug densities this spring, damage studies were not conducted in any of the fields. An attempt was made to conduct damage studies in Wayne County in fields not part of these counties studies, but our attempts also proved fruitless because of the low slug densities.

Of note, we have been observant of soybean stands in no-till fields the past few years. We believe that stands are often much smaller than anticipated. To illustrate with an example, one grower in Wayne county plants around 210,000 seeds per acre to achieve 170,000 plants per acre. This often results in 120,000 plants per acre. We think that much of this stand reduction might be caused by slugs. During 1995, we saw improved stands in an experiment where we applied a heavy rate of molluscicide at planting time. We intended to explore this idea this year, having treated numerous soybean fields with molluscicide at planting. However, the low slug densities prevented the collection of meaningful data. However, our observations this year revealed no significant stand reductions in any field that we examined. Rather, we saw some of the best plant stands we have seen. This improvement in stands might have been caused by the lack of slugs, and warrants further investigation.

Recommendations

Although few slugs were collected this year, we have continued to gain a better understanding of slug populations in Ohio. It appears there is a cyclic nature to slug populations, albeit it will take many years of observations to confirm. Over the past few years we have seen two springs with moderate to high slug populations (1994 and 1995) followed by a spring with extremely low numbers (1996). 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.

We are continuing to take *in situ* samples and beer traps in the study fields, and also in surrounding areas. Sampling suggests that slug numbers are on the rise, albeit not to the densities observed in 1994. We are collecting many adult gray garden slugs and numerous marsh slugs. We also have been observing a substantial amount of mating and egg laying. We need to examine the possibility that fall sampling might be indicative of the potential of an economic slug population the following spring. This might lead to predictive capabilities for growers. Additionally, we should examine whether fall molluscicide treatments could control adult slugs before they mate and begin egg laying.

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

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Stink Bug Management on Whole-Pack Processing Tomatoes

Principal Investigator:

Celeste Welty, Dept. of Entomology

Abstract:

Information on stink bug management is needed since stink bug injury has become an increasing problem on tomatoes during recent years. Stink bug feeding causes white corky tissue in tomato flesh. A lack of preferred wild hosts is associated with invasion of some stink bug species into some crops. Because ecological differences occur among stink bug species, with related management implications, we need to determine which species are attacking tomatoes in Ohio. Stink bugs often inhabit the lower canopy where they escape contact with insecticide sprays. Ohio tomato fields are usually sprayed with insecticide at least four times per year as insurance for the high-value crop. The effect of insecticides on stink bugs may be negative due to difficulty of reaching the pest as well as toxicity to natural enemies.

The objectives of this project were to identify stink bug species infesting tomatoes and to characterize their damage; to evaluate tomato varieties of different maturity types for susceptibility to stink bugs; to evaluate survival of stink bugs and natural enemies after treatment with common insecticides; and to determine whether certain field characteristics are associated with infestations.

Field trials to evaluate stink bug injury on six tomato varieties and after several different insecticide treatments were conducted at Hillsboro; plots were scouted weekly and fruit evaluated at harvest. Tomato fields in Darke, Holmes, and Sandusky Counties were surveyed for field characteristics associated with stink bug infestations. Stink bugs were collected for species determination. A feeding behavior study was conducted in a growth chamber; bugs were placed in containers with red fruit and green fruit, and the bugs' location and damage were observed twice per day from egg hatch until adult eclosion. Some harvest and scouting results are shown in Tables 1-4. Damage in the field occurred mostly in late August and early September. Identifications and analysis will be completed in 1997.

Extension Component:

An oral progress report on the project was given to growers and processors at the Darke County Vegetable Tour on 12 August and at the annual vegetable field tour at the Hillsboro site on 19 August 1996. Highlights also were included in VegNet reports that were faxed weekly to growers and processors, and in the recorded Tom-Cast toll-free telephone message. Results will be presented at the Vegetable Growers Congress in February 1997.

Table 1. Yield at harvest in variety trial, Hillsboro, 1996; all culls due to stink bug injury.

	Yield of fruit per sample (kg)						
Variety (& harvest date)	good red	cull red	good green	cull green	% cul	% good of reds	% good of greens
OX88 (8/21)	0.81b	0.02c	2.82a	0.03	1.2c	97.0a	99.5
R9201 (9/10)	2.78a	0.35bc	1.43b	0.08	9.1b	89.3b	93.9
TR12 (9/10)	2.89a	0.32c	1.46b	0.11	9.9ab	86.6bc	92.6
HY696 (9/18)	3.69a	0.55bc	1.25b	0.12	11.9ab	87.1bc	90.6
OH8245 (9/18)	2.68a	0.97ab	1.35b	0.18	20.1ab	75.2bc	87.4
HZ9422 (9/18)	3.32a	1.30a	1.85b	0.22	21.9a	73.0c	88.2
P (trt effect)	0.004	0.003	0.01	0.17	0.0007	0.002	0.12

Table 2. Stink bugs detected by scouting in variety trial, Hillsboro, 1996; mean number of stink bugs per sample in foliage, fruit, and beating samples.

Variety	14 August			21 August			28 August			5 September		
	foliage	fruit	beating	foliage	fruit	beating	foliage	fruit	beating	foliage	fruit	beating
OX88	0	0	0	-	-	-	-	-	-	-	-	-
R9201	0	0	0	0	0	0	0.20	0	0.25	0	0	0.25
TR12	0.17	0	0	0	0	0	0	0	0.17	0	0	0.33
HY696	0	0	0	0	0	0	0	0	0.33	0	0	0.17
OH8245	0	0	0	0	0.17	0.17	0	0	0.50	0.17	0	0.33
HZ9422	0	0	0	0	0	0	0	0	0.00	0	0	0.00
P (trt)	0.46	-	-	-	0.46	0.49	0.33	-	0.54	0.46	-	0.68

Table 3. Yield at harvest on 10 September 1996 in insecticide trial, Hillsboro; all culls due to stink bug injury.

	Yield of fruit per sample (lb)						
Treatment	good red	cull red	good green	cull green	% cull	% good of reds	% good of greens
Untreated	7.7	0.3	5.1	0.1	3.4	96.1	98.2
MVP II	6.2	0.4	5.8	0.0	11.9	96.4	100.0
Warrior	7.3	1.0	4.7	0.2	12.0	89.5	96.0
Penncap-M	6.4	0.6	6.6	0.2	5.0	89.9	98.3
Thiodan	9.6	0.4	4.9	0.0	14.4	96.2	100.0
P (trt)	0.68	0.85	0.59	0.53	0.87	0.90	0.19

Table 4. Stink bugs scouted in insecticide trial, Hillsboro, 1996; treatments applied 7/12, 7/26, 8/9, 8/30.

	Mean per whole-plant sample			Mean per partial-plant sample							
Treatment	6/26	7/3	7/10	7/17	7/24	8/1	8/8	8/14	8/21	8/28	9/5
untreated	0	0	0	0	0	0.00	0.32	0.00	0.00	0.31	0.42

MVP-II				**0**	**0**	**0.08**	**0.00**	**0.00**	**0.00**	**0.08**	**0.57**
Penncap				**0**	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.28**	**0.34**
Thiodan				**0**	**0**	**0.00**	**0.16**	**0.00**	**0.08**	**0.00**	**0.17**
Warrior				**0**	**0**	**0.00**	**0.00**	**0.08**	**0.08**	**0.31**	**0.14**
P (trt)	**-**	**-**	**-**	**-**	**-**	**0.44**	**0.07**	**0.44**	**0.61**	**0.08**	**0.09**

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

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