Final Project Report to the NYS IPM Program, Agricultural IPM 2002-2003.

Title: Cucurbit Pest and Crop Management Systems Evaluation

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Type of grant: This project was funded by theUSDA RAMP Program under contract 2001-51101-11048.

Systems comparison trials

Project location(s): **NY counties:** Ontario, Albany, Schoharie, Columbia; several counties in Massachusetts; several counties in Ohio.

Abstract:

In 2002 a long-term cucurbit crop systems pest and crop management evaluation was continued at NYSAES Geneva. This project is a continuation of a sweet corn systems project conducted 1995-1999. Systems are located in the same fields as the previous sweet corn evaluation meaning that land has now been managed under the particular systems for 8 years. A team of vegetable experts evaluated four systems for producing cucurbit crops including Conventional, IPM Present, IPM Future, and Organic. Commercial scale plots of cucumbers, melons, zucchini, and pumpkins were grown under these systems and compared on the basis of economic, environmental, and pest control efficacy factors. In addition, demonstrations of the systems were conducted on growers' farms in eastern New York, Ohio, and Massachusetts.

Background and justification:

Demonstrations on grower farms have been used extensively by the New York Vegetable IPM Program to introduce farmers, extension specialists, extension agents, and agribusiness people to the successful use of IPM practices. Evaluations of the impacts of demonstrations indicate they are an effective way of increasing adoption of IPM among vegetable farmers. Many farmers want to see demonstrations before they consider adopting sustainable management practices.

An on farm component of this project is linked with a NYSAES systems evaluation site. Evaluations of IPM techniques for growing cucurbits have shown that environmental and economic benefits can accrue to growers by their adoption. Reductions in pesticide use can result from using IPM techniques including scouting and thresholds for insects and diseases and innovative cultivation techniques and cover crops for weed pests. Reductions in fertilizer use of can result from using techniques such as cover crops. Experience with cucurbit growers indicates the techniques are not widely adopted. For other crops, side-by-side demonstrations on growers' farms on other crops have resulted in increased adoption of IPM practices by growers.

Often demonstrations are set up in side-by-side comparison fields of 1 to 10 acres where one side of the field is managed using growers' techniques while the other side of the field is managed using the new techniques being considered. However, demonstrations on grower farms present limitations to collecting reliable data for use in evaluating entire systems of

practices. They sometimes do not allow for detailed data collection that can indicate the need for improvements to systems and also elucidate unexpected synergistic benefits when various pest and crop management components are combined. Often farmers do not have sufficient time or resources to devote to a demonstration to allow collection of scientific data. As the demonstration progresses and the grower observes success on the IPM side of the field, s/he often adopts the IPM practices on the conventional side of the field. By season's end the conventional side of the field is managed using IPM techniques, reducing observed impacts of IPM practices in terms of economics and environment. We have overcome this problem by conducting some demonstrations on university research farms where it can be certain that treatments remain constant for the season and where detailed data is collected.

From 1992-1994 a team of vegetable research and extension staff conducted a systems demonstration for cabbage at the Vegetable Research Farm at NYSAES Geneva. Conventional, IPM Present, IPM Future, and Organic systems were defined and compared on the basis of yield and quality, economics, and environmental impact. Results indicated that while yield and quality acceptable to all cabbage markets could be achieved under all four pest management systems, there were quite different economic and environmental costs associated with each system. In general, the Conventional system was the least expensive economically but the most expensive environmentally, the Organic system had the least environmental impact but was often the most expensive economically (although the extra cost may be recouped by receiving a higher price for the product), and the two IPM systems tended to be midrange both environmentally and economically. From 1995 through 1999 the systems comparison was changed to an evaluation of fresh market sweet corn. The five-year commitment allowed us to establish the project on land that could be designated for each system. Cucurbit crops, melons, cucumbers, zucchini, and pumpkins have been the focus of the project since the 2000 growing season.

In New York, Ohio and Massachusetts cucurbit crops: 1) are a valuable crop for small fresh market growers, 2) have heavy pest pressure from insects, weeds, and diseases, 3) have high pesticide use (especially fungicides), 4) innovative techniques for pest and crop management have been developed, 5) FQPA threatens a large percentage of pesticides available to cucurbit farmers, and 6) pesticide residues can be particularly high in some cucurbit crops.

Since the land used for the research station site of this study will be in production from the different systems for 8 years, there is a unique opportunity to evaluate the long-term effects of different pest and crop management systems.

Objectives:

The overall goal of the proposed work is the education of farmers, extension specialists, extension agents, and agribusiness people about the adoption of IPM/ICM and organic production techniques. It will focus on cucurbit crops for the proposal period but it is part of an overall vegetable educational effort that is on-going. The previous five years of the project have focussed on fresh market sweet corn. Prior to that a three year project was conducted with cabbage at a different location.

Individual Objectives:

1**)** At New York State Agricultural Experiment Station (NYSAES) at Geneva evaluate and demonstrate four defined pest and crop management systems for cucurbit crops on the basis of the ability of the systems to produce cucurbits with low environmental impact and economically. Determine which system of cucurbit pest and crop management can best address the Food Quality Protection Act.

2) Evaluate the long term (>5 years) effects of production of crops using different crop and pest management systems on the same land.

3) Demonstrate and compare the four pest and crop management systems on grower’s farms in New York, Ohio, and Massachusetts.

4) Publicize the results of the comparisons through field days, presentations at grower meetings, and conventional and electronic publications.

Procedures:

Geneva site

Figure 1 shows the outline for the four crop and pest management systems for 2002 for the Geneva site. Figure 2 shows the cropping history of the Geneva site since 1994. A very wet spring caused all planting to take place during the

In general the four systems were defined based on the following criteria: Conventional – those practices which were thought by extension and faculty to be commonly used by cucurbit growers; IPM Present -those practices which follow IPM Elements; IPM Future – IPM Present practices plus those practices that may still be under research or expensive to implement; Organic – following NOFA-NY guidelines. Only half of each designated two-acre field is planted to the crops on which the project is focussing for that particular year. The other half of the field is planted to a rotational crop shown in the system definition. Each system consisted of a planting of four cucurbit crops – cucumbers, zucchini, melons, and pumpkins.

Economics of each of the systems were evaluated by using costs of production and pest management practices previously identified in this project when growing sweet corn. Total costs are calculated for each system based on the actual operations performed for the particular system. Wholesale prices were obtained from local farms and from websites indicating prices in the Boston and New York markets and used in the calculations of net and gross income. Environmental impact was evaluated by means of the Environmental Impact Quotient, pesticide use, and synthetic fertilizer use. Pest control efficacy was compared among the systems based on weekly scouting records and weed maps. Yellow sticky card traps and scouting techniques were used to evaluate levels of beneficial insects in the plots. Harvest data for each crop in each system were collected. Total crop yield and marketable yield were recorded.

Collection of data that may reveal long-term impacts of the systems was initiated in 2002. In cooperation with the Soil Health Program Work Team at Cornell, evaluations of soil health among the four systems were conducted. Soil samples were collected and analyzed for soil microbial activity (Rangarajan). Bulk density, soil organic matter, and rainfall infiltration data were collected. Rainfall infiltration was measured using an infiltrometer device for a period of one hour in a defined area. This device simulated rain at a rate of 12 inches per hour and allowed runoff to be collected and measured. Any water that did not runoff penetrated the soil. Preliminary data were collected (not reported here) using the bait-lamina test for biological activity and a recording penetrometer for soil compaction.

Figure 1: Cucurbit System Outline 2002 Geneva

PLANTING SYSTEM				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkin	BG; DS	BG; DS	DS, strip till	T; strip till
Cucumber	BG; DS	T; BP; TR	T; BP; TR	T; BG; TR
Zucchini	BG; DS	T; BP; TR	T; BP; TR	T; BG; TR
Melon	T; BP; TR	T; BP; TR	T; BP; TR	T; BP; TR
T = Transplants; DS = Direct Seed; BP = Black Plastic; BG = Bare Ground; TR = Trickle irrigation				
FERTILITY PRACTICES				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Nitrogen Phosphorous Potassium	100#N 70#P 70#K	80-100#N 70#P 70#K	30-50#N use PSNT 30#P 30#K	45#N 45#P 27#K
Pumpkins	Broadcast: 40#NPK (15-15-15) and disk. Band: 30#NPK (15-15-15) at planting. Sidedress: 30#N (34-0-0) at vine run	Plow down cover crop Broadcast: 40#NPK (15-15-15) and disk. Band: 30#NPK (15-15-15) at planting. Sidedress: 30#N (34-0-0) at vine run	Roll down cover crop Band: 30#NPK (15-15-15) at planting; PSNT: Sidedress 20#N (34-0-0) if less than 40ppm	Roll down cover crop Broadcast: 30#NPK (5-5-3 composted chicken manure (CCM)); PSNT: Sidedress 15#N (5-5-3 CCM) if less than 40ppm
Cucumber Zucchini	Broadcast: 40#NPK (15-15-15) and disk. Band: 30#NPK (15-15-15) at planting. Sidedress: 30#N (34-0-0) at vine run.	Plow down cover crop Broadcast: 40#NPK (15-15-15) and disk. Fertigate: 20#NPK (soluble 15-16-17) at vine run 20#N (34-0-0) at fruit set.	Plow down cover crop Broadcast under plastic: 30#NPK (15-15-15) PSNT: Fertigate 20#N (34-0-0) @ vine run & fruit set if < 40ppm.	Plow down cover crop Broadcast: 30#NPK (5-5-3 CCM) PSNT: Sidedress 15#N (5-5-3 CCM) @ vine run & fruit set if < 40ppm.
Melon	Broadcast under plastic: 40#NPK (15-15-15) and disk. Fertigate: 20#NPK (soluble 15-16-17) @ 1 week, 3 week after planting, and fruit set	Plow down cover crop Broadcast under plastic: 40#NPK (15-15-15) and disk. Fertigate: 20#NPK (soluble 15-16-17) @ 1 week, 3 week after planting, and fruit set.	Plow down cover crop Broadcast under plastic: 30#NPK (15-15-15) and disk. PSNT: at vine run & fruit set; Fertigate 20#N (34-0-0) if < 40ppm	Plow down cover crop Broadcast under plastic: 30#NPK (5-5-3 CCM) Fertigate: 15#N soluble fish fertilizer (12-2-1) at fruit set.
COVER CROP MANAGEMENT				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Seeding Rate	Left fallow over winter	Cereal rye (60#/A) & Hairy vetch (40#/A) fall planted.	Cereal rye (60#/A) & Hairy vetch (40#/A) fall planted.	Cereal rye (60#/A) & Hairy vetch (40#/A) fall planted.
Management	Chisel plow or disk crop residue and to control fall weeds	Mow rye/vetch at flowering or heading Plow down cover	Pumpkin: Roll rye/vetch with stalk chopper 2X. Roundup. Cuc, Zuc Mel: Mow rye/vetch at flowering or heading & plow	Pumpkin: Roll rye/vetch with stalk chopper 2X. Cuc, Zuc Mel: Mow rye/vetch at flowering or heading & plow
Rye/vetch rolled using a Buffalo rolling stalk chopper. Roll when rye starts to head out to lay cover in direction of planting. Roll a second time just before planting. Rye/vetch seeded with no-till grain drill in Future system				

Figure 1 (cont.)

SEED VARIETY & SPACING				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkins 7.5' R x 24" OC	Magic Lantern, 115 DTM Harris	Magic Lantern, 115 DTM Harris	Magic Lantern, 115 DTM Harris	Magic Lantern, 115 DTM Harris
Cucumber 7.5' R x 18" OC	Eureka, 56DTM Stokes; 12"O.C.	Eureka, 56DTM Stokes	Eureka, 56DTM Stokes	Eureka, 56DTM Stokes
Zucchini 7.5' R x 20" OC	Revenue, 46 DTM Seedway	Revenue, 46 DTM Seedway	Revenue, 46 DTM Seedway	Revenue, 46 DTM Seedway
Melon 7.5' R x 24" OC	Pulsar, 80 DTM Stokes	Pulsar, 80 DTM Stokes	Pulsar, 80 DTM Stokes	Pulsar, 80 DTM Stokes
7.5 ft rows based on available equipment and sprayer width; O.C. = on center				
WEED MANAGEMENT				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkins	Curbit broadcast @ 4 pt/A; post plant do not incorporate. Cultivate/hand weed between/in rows.	Command ME 3.2 oz/A in 18" band at planting; do not incorporate. Cultivate/hand weed between/in rows.	Rolled cover-crop mulch, strip till planting, hand weed in rows. Roundup 1-1.5 pts/A; Strategy 3 pt/A broadcast.	Rolled cover-crop mulch & strip till planting; hand weed in rows.
Cucumber	Prefar4E + Alanap2L (10 pt/A + 12 pt/A) pre; incorporate. Cultivate/hand weed between/in rows.	Black plastic Strategy 1.5 pt/A and hand weed between plastic.	Black plastic Cultivate between plastic	Cultivate/hand weed between/in rows. Spring tine weeder 1 or 2 times before transplanting.
Zucchini	Curbit 4 pt/A broadcast, post plant do not incorporate; Poast if needed. Cultivate/hand weed between/in rows.	Black plastic Strategy 1.5 pt/A band between plastic.	Black plastic Cultivate between plastic.	Cultivate/hand weed between/in rows. Spring tine weeder 1 or 2 times pre transplant.
Melon	Black plastic Prefar 4E + Alanap2L (5 pt/A + 6 pt/A) Band between plastic, incorporate. Cultivate/hand weed between/in rows.	Black plastic Strategy 1.5 pt/A band between plastic.	Black plastic Cultivate between plastic.	Black plastic Seed annual ryegrass & white clover or annual medics between plastic.
SPRAY EQUIPMENT for insect and disease control				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Insecticides	Air blast sprayer	Straight boom sprayer single nozzle, TwinJet spray tips	None required	None required
Fungicides	Air blast sprayer	Straight boom sprayer; 3 nozzle adjustable row application kit, TwinJet spray tips	Straight boom sprayer; 3 nozzle adjustable row application kit, TwinJet spray tips	Straight boom sprayer; 3 nozzle adjustable row application kit, TwinJet spray tips

Figure 1 (cont.)

DISEASE MANAGEMENT/powdery mildew				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Scouting	Scout and spray at first sign of disease	Scout and spray at first sign of disease	Scout and spray at first sign of disease	Scout and spray at first sign of disease
Pumpkins Melon	Nova+Bravo alternated w/Quadris 7day schedule. Stop sprays early Sept.	Nova + Bravo alternated w/Quadris 7 day schedule. Stop sprays early Sept.	Nova + Bravo alternated w/Quadris 14day schedule. Stop sprays early Sept	Armicarb or other bicarbonate 7 day schedule. Stop sprays early Sept.
Cucumber Zucchini	Nova + Bravo alternated w/Quadris 7day schedule	No sprays or Nova + Bravo to prolong picking	No sprays or Nova + Bravo to prolong picking	No sprays or use Armicarb
Powdery mildew: scout fields starting in July apply fungicides every 7-14 days after first sign of disease. Alternate Nova /Bravo with Quadris to avoid resistance development; begin with Nova/Bravo.				
INSECT MANAGEMENT/ Cucumber beetle				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Scouting: Melons Cucumber Zucchini	Spray on 7 day schedule	Scout: cotyledon to 4 leaf stage. Threshold: >1 beetle/ plant.	Admire is systemic no further action needed	Row covers until blossom then remove
Scouting: Pumpkin	Spray on 7 day schedule	Scout at cotyledon to 4 leaf stage. Threshold: >5 beetle/ plant or damage	Admire is systemic no further action needed	Row covers until blossom then remove
Pumpkins Cucumber Zucchini Melon	Sevin XLR 32 floz/A; broadcast.	Sevin XLR 32 floz/A banded at threshold.	Admire in furrow 2.5 oz/1000 ft of row (DS) or drench 0.02ml/plant (T)	Row covers until blossom then remove. Surround 0.5lb/Gal as needed after fruit set.
Scouting: Cotyledon to 4 leaf stage: Inspect 5 sites 5 plants per site; attention to field margins. If plants along the field edge are heavily damaged or have greater than 1 beetle/plant treat within 24 hours. From fifth leaf to harvest treat only if feeding damage is noticeable or blossoms or fruit are infested.				

Figure 2: Geneva site cropping history

Vegetable Systems Cropping History

	Year	Conventional North	Conventional South	IPM/Present North	IPM/Present South	IPM/Future North	IPM/Future South	
Pre-project	1994 Sum	Sweet Corn	Sweet Corn	Cabbage	Cabbage	Fallow	Fallow	Buckwhe
	1994 Fall	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	Rye/vetc
Sweet Corn Sys-tem	1995 Sum	Sweet Corn	Sudex	Sweet Corn	Sudex	Sweet Corn	Sudex	Sweet Co
	1995 Fall	Fallow & rye*	Rye	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetc
	1996 Sum	Snap Beans	Sweet Corn	Buckwheat	Sweet Corn	Sweet Clover	Sweet Corn	Sweet Cl
	1996 Fall	Fallow	Fallow & rye*	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetc
	1997 Sum	Sweet Corn	Snap Beans	Sweet Corn	Buckwheat	Sweet Corn	Soybeans	Sweet Co
	1997 Fall	Fallow & rye*	Fallow	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetc
	1998 Sum	Snap Beans	Sweet Corn	Buckwheat	Sweet Corn	Soybeans	Sweet Corn	Soybean
	1998 Fall	Fallow	Fallow & rye*	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetc
	1999 Sum	Sweet Corn	Snap Beans	Sweet Corn	Buckwheat	Sweet Corn	Soybeans	Sweet Co
	1999 Fall	Fallow & rye*	Fallow	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetc
Cucurbit Sys-tem	2000 Sum	Snap Beans	Cucurbits	Buckwheat	Cucurbits	Soybeans	Cucurbits	Cucurbit
	2000 Fall	Fallow	Fallow	Rye/vetch	Fallow	Rye/vetch	Fallow	Rye/vetc
	2001 Sum	Cucurbits	Sweet Corn	Cucurbits	Soybeans	Cucurbits	Soybeans	Soybean
	2001 Fall	Fallow	Fallow	Rye/vetch	Rye/vetch	Rye/vetch	Rye/vetch	Rye/vetc
	2002 Sum	Sweet Corn	Cucurbits	Cucurbits	Soybeans	Soybean	Cucurbits	Cucurbit
	2002 Fall	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetch	Rye/vetch	Rye/vetc
	2003 Sum	Cucurbits	Sweet Corn	Soybean	Cucurbits	Cucurbits	Soybean	Soybean

* Half of field was planted to rye and half was left fallow.

On Farm Sites:

We were able to collect complete data sets from 38 farm fields in Ohio (6), eastern New York (19), and Massachusetts (13). Several additional fields in each area resulted in incomplete data sets as a result of weather or logistical problems. Each of the 38 fields was categorized into one of the four systems. However, because of variation in farmer/cooperator equipment, farm characteristics, state pesticide registrations, regional marketing preferences, and other factors commonly encountered on working farms, the systems definitions were not completely consistent with those at the Geneva site or with each other. Figure 3 summarizes the differences in the on farm systems definitions from the Geneva definitions in Figure 1. If no difference is listed for a particular system and strategy combination in Figure 3, then the system strategy was identical to the Geneva location. Only pumpkins, zucchini, and cucumbers were in the fields on grower farms - there was no opportunity to include melons in 2002. In eastern New York and Ohio modifications within systems resulted in additional "subsystems" being evaluated. For the purposes of overall evaluation the subsystems were grouped into one of the larger four systems. Table 1 summarizes the system crop combinations evaluated in 2002. Interestingly very few of the growers willing to cooperate in the project were growing cucurbits in a Conventional system.

Figure 3: On Farm Cucurbit System Outline 2002 MA = Massachusetts; OH = Ohio; WNY = Western New York

PLANTING SYSTEM				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkin	OH: DS; BG (2)	MA: DS; BG (1) DS; BP (1) OH: DS; BG (1) WNY: T; BG (4)	MA: DS, no-till (1) OH: DS; BG (1)	MA: T; BP (1) OH: DS; BG (1) T; BG (1)
Cucumber		MA: T; BG (2) WNY: T; BP (2)	MA: T; BG (2)	MA: T; BP (3) WNY: T; BP (2) DS; BP (2) DS; BG (2)
Zucchini		MA: T; BP (1) WNY: T; BP (1)	MA: T; BP (1)	WNY: T; BP (2) DS; BP (2) DS; BG (2)
T = Transplants; DS = Direct Seed; BP = Black Plastic; BG = Bare Ground; TR = Trickle irrigation				
FERTILITY PRACTICES				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkins	OH:188N-53P-0K (1)	MA: 57N-57P-57K (1) MA: 11N-61P-63K (1) OH: 12N-12P-12K (1) WNY: 24N-48P-48K (2) WNY: None (2)	OH: 7N-7P-7K (1) MA: 48N-20P-36K (1)	MA: 30N-30P-30K (1) OH: 45N-45P-45K (2)
Cucumber		MA: 95N-95P-95K (2) WNY: No fertilizer (2)	MA: 95N-95P-95K (2)	MA: 74N-21P-42K (3) WNY: 30N-18P-24K (6)
Zucchini		MA: 38N-38P-38K (1) WNY: 75N-75P-75K (1)	MA: 38N-38P-38K (1)	WNY: 30N-18P-24K (6)
COVER CROP MANAGEMENT				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Management In Pumpkin	N/A	N/A	MA: Rye grass mowed (1)	N/A

Figure 1 (cont.)

SEED VARIETY				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkins	OH: Mag. Lantern (2)	MA: Mag. Lantern (2) OH: Magic Lantern (1) WNY: MagLantern (2) WNY: Howden (2)	MA: Mag. Lantern (1) OH: Magic Lantern (1)	OH: Magic Lantern (2)
Cucumber		MA: Napolean(1) MA: Fancy Pack (1) WNY: Eureka (1) WNY: Conquest (1)	MA: Napolean (1) MA: Fancy Pack (1)	MA: X-Country (3) WNY: Olympian (6)
Zucchini		MA: Revenue (1) WNY: Revenue (1)	MA: Revenue (1)	WNY: Revenue (6)
WEED MANAGEMENT				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkins	OH: BG; C (1) OH: BG; Sandea (1)	MA: BP; C; Gramoxone (1) MA: C; (1) OH: BG; HW (1) WNY: BG; C; (4)	MA: BP; C; Roundup, Sandea (1) OH: BG; HW (1)	MA: BP; C; (1) OH: BG; C; HW (2)
Cucumber		MA: BG; C; Prefar (2) WNY: BP; C; (2)	MA: BG; C; Prefar (2)	MA: BP; C; (3) WNY: BP; C; (4) WNY: BG; C; (2)
Zucchini		MA: BP; C; Strategy (1) WNY: BP; C; (1)	MA: BP; C; Strategy (1)	WNY: BP; C; (4) WNY: BG; C; (2)
BP = Black Plastic; BG = Bare Ground; C = Cultivate; HW = Hand Weed				
DISEASE MANAGEMENT/powdery mildew				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkins	OH: N+B and Q (2)	OH: N+B and Q (1) MA: N+B and Q (2) WNY: N+B and Q (4)	OH: N+B and Q (1) MA: N+B and Q (1)	OH: None (2) MA: None (1)
Cucumber		MA: N+B and Q (2) WNY: N+B and Q (2)	MA: N+B and Q (2)	MA: Surround (2) MA: None (1) WNY: Serenade (6) Kocide
Zucchini		MA: N+B and Q (1) WNY: N+B and Q (1)	MA: N+B and Q (1)	WNY: Serenade (6) Kocide
N+B and Q = Nova + Bravo alternated with Quadris				
INSECT MANAGEMENT/ Cucumber beetle				
	Conventional	*IPM/Present*	*IPM/Future*	*Organic*
Pumpkins	OH: Sevin (2)	OH: Admire (1) MA: None (2) WNY: Thiodan (4)	OH: Admire (1) MA: Admire (1)	OH: Rotenone (2), Surround (2) MA: None (1)
Cucumber		MA: Sevin (2) WNY: Pounce (2)	MA: Admire (2)	WNY: None (6)
Zucchini		MA: None (1) WNY: Sevin (1)	MA: Admire (1)	WNY: None (6)

Table 1: Number of farm fields for each system/crop combination.

	Conventional	IPM Present	IPM Future	Organic
Pumpkin	2	7	2	3
Cucumber	0	4	2	9
Zucchini	0	2	1	6
Melon	0	0	0	0

Data were summarized and evaluated by crop and system in a manner similar to that used at the Geneva site. Cost of production figures and prices from the Geneva site were used as estimates in the summarization and calculations for the grower sites. Net return was based on the reported yields for each farm site. EIQ calculations were based on spray records for each site.

The following paragraphs describe specific procedures for each geographic region.

Ohio (Jasinski)

There were six sites selected in Ohio to participate in the 2002 Cucurbit System Demonstration. The focus of the project in Ohio was exclusively on pumpkins. Between the four production systems there were two Conventional sites (Tipp City and West Liberty), one IPM Present site (Western Branch research station), one IPM Future site (Western Branch research station), one direct seeded Organic site (Cincinnati) and a small transplant Organic site (Cincinnati).

All seven sites used the Magic Lantern variety. Fields generally were smaller than one acre. Planting dates ranged from early to late June. Between 2 and 4 weeks after planting, a weed map of each field was constructed to evaluate weed management strategies. Each field was scouted 1-2 times a week for cucumber beetles and feeding damage on seedlings from emergence through the 5th or 6th leaf stage. Each scouting session involved inspection of plants, flowers, or fruit at several locations in the field based on plant phenology. After the seedling stage, fields were visited weekly to assess cucumber beetle presence on plants, feeding injury to leaves and stems, and presence of cucumber beetles in flowers. There were also counts of virus and bacterial wilt infected plants. Those fields that received Admire insecticide were also periodically inspected for unusual bee behavior in flowers.

A second weed assessment for each field was made near season end. Late season hand hoeing and selective spot spraying was performed at some sites to clean up weedy escapes. Between early and mid September, all of the sites were harvested. All fruit from four randomly selected 50' sections of row were harvested. Each fruit was weighed and evaluated for cucumber beetle feeding damage to the handle, to the fruit itself, and also for the presence of virus.

Eastern New York (Mishanec and Blomgren)

Twelve of the fields in Eastern NY compared variations on the Organic system. Cucumbers were grown in six of the fields and zucchini the other six. Organic systems using black plastic much or not and direct seeding or transplanting were used. Fields were planted into each of the six treatments on July 20th. Fertility was supplied by cover crops and an application of Fertrell organic fertilizer (500 lb/acre of 4-3-5). All twelve fields were fertilized similarly, using a drop spreader prior to the final harrowing. Mulches were applied using a flat-bed mulch layer. Direct-seeding was done by hand, and transplanting was performed using a Water Wheel transplanter. In 2003, 'Dutch white' clover and annual ryegrass will be seeded between rows of plastic mulch in early spring and between rows of cultivated plots at the time of last cultivation. Transplants were three weeks old. Cucumbers were spaced 12 inches apart, and zucchinis were spaced 24 inches apart. Rows were on 6-foot centers. The direct-seeded treatments were four rows wide by 50 feet long and the transplanted treatments were four rows wide by 100 feet

long. All fields were given adequate irrigation using a drip system. Because planting occurred well after the normal period of stripped cucumber beetle emergence, row covers were not utilized. In sprayed plots, a total of 5 applications of copper were made between 9/9 and 10/2 using a rate of 1.5 lb./acre. Serenade was applied on 9/18, 9/26 and 10/2 using 3 lb./acre during the first application and 4 lb./acre after that. Scouting was performed weekly. Data was collected from 90 feet of the inside two rows of each plot.

The other seven fields in eastern New York consisted of 4 IPM Present pumpkin fields, 2 IPM Present cucumber fields and one IPM Present zucchini field. No growers who matched the conventional system definition were identified as potential cooperators in eastern New York.

Massachusetts (Hazzard and Westgate)

Assessment of grower needs

In Massachusetts, two meetings were held with interested growers in the late spring of 2002. At these meetings we obtained information from the growers about their current production practices for cucumber, pumpkin and zucchini crops. Topics discussed included the varieties used, cultural practices, bed preparation, whether crops are transplanted or direct seeded, IPM scouting methods, herbicides and pesticides applied, and other outstanding questions or problems they face in their production systems for these crops. From information gathered at these discussions we identified growers and systems to work with during the 2002 growing season.

Fields

Thirteen fields had complete data sets in Massachusetts. Five of the fields were IPM Present, four of the fields were IPM Future, and four fields were Organic. Pumpkins, zucchini and cucumbers were grown in the Massachusetts fields.

Scouting

Throughout the growing season fields were scouted weekly for insects and diseases. Weed surveys were done twice in each field, once in early or mid season and the other at harvest. In the early part of the season, when the plants were small, fields were scouted twice per week to monitor cucumber beetle populations; after the beetle population declined or threshold levels were reached and the field treated, scouting was reduced to once per week.

For every defined system at each farm 50 plants, in ten groups of five, were selected and scouted for pests and diseases. Cucumber Beetle damage was also assessed during early crop stages and rated on a scale from 1->20% of plant damaged. Once plants reached the 5-10 leaf stage, individual leaves were checked for aphids, squash bugs and diseases in ten groups of five leaves. Aphid counts were recorded as 0, 1-10 or >10, but were rarely found throughout the season. Squash Bugs were recorded as either present or absent and the life stage found was noted. Likewise, the number of leaves that had Powdery Mildew was recorded.

After each scouting, a report was left with the grower that included an analysis of pest and disease populations found in each of the systems we scouted. For cucumber beetles a mean was computed and recorded of the number of beetles found per leaf or plant. The percentage plants or leaves with cucumber beetle damage, and Powdery Mildew infestation, was also reported. The field reports also included recommendations for treatments based on the crop production system being followed, the materials being employed, and how the scouting numbers compared to recommended IPM thresholds.

At the beginning of fruit set PSNT samples were taken and results were used to determine how much nitrogen to add to each field. The weed assessment was also done at each farm. The assessment consisted of an inventory of on-site perennial broadleaf, annual broadleaf, perennial and annual grasses, nutsedge and other weeds. Weeds that were present were rated as low, medium or high. The results of the assessments varied greatly between each farm and system.

Harvest

Cucumber and zucchini harvest samples were taken on three harvest days during the 2nd or 3rd week of harvest. Ten plots, each 10' long, were measured, marked, and sampled from every other day for one week. Fruits were separated into fancy grade and culls; the number in each category were counted and weighed in batches.

Pumpkins were harvested once in September and all marketable fruit were counted, and then weighed in small batches.

Results and discussion:

General comments:

Results presented here are for the first year of a three-year project. Therefore results may change as the study progresses for the next two years. Also, 2002 was a very cool and wet year early in the season in all locations resulting in delayed planting. It was extremely dry after planting resulting in lowered yields for many fields.

In addition to the data collected from the specific fields this project has had a number of extension educational impacts that are more difficult to quantify including:

- Discussions among extension staff in Massachusetts, New York, and Ohio to identify optimal pest and crop management systems for IPM and Organic cucurbit growers across the region.
- Discussions between extension staff in the three geographic areas and their growers to understand the current state of cucurbit production and the needs of growers in the areas.
- Observation of the results of the on farm trials by the growers who are hosting them.
- Field days were held in all thee regions to discuss the management system options and results with growers.
- Identification of any weaknesses in various pest and crop management to be addressed by future research.

Geneva

Results by crop and system for 2002 at the Geneva site are shown in Table 2. It was a difficult year to grow cucurbits profitably at this site in 2002 primarily because of weather conditions. Overall however, melons were profitable for every system while pumpkins lost money for every system. While the Organic system was profitable for melons, it lost money in the other three corps resulting in an average loss of $51.50 per acre. The Conventional system lost money growing both pumpkins and cucumbers but made money in zucchini and melons resulting in an average profit of $863 per acre. The IPM Present system lost money on pumpkins but made money in the other three systems resulting in an average profit of $932.75 per acre. The IPM Future system also lost money on pumpkins but made money ion the other three crops resulting in an average profit of $2,282.75 per acre. These results will likely change as other years added to the project.

Environmentally, as measured by the Environmental Impact Quotient (EIQ), the Conventional system had the highest (most harmful) average EIQ across crops at 222.6 per acre, Organic was second at 190.5 per acre. IPM Present was third at 77.5 per acre and IPM Future was lowest at 52.05 per acre. The reason the Organic EIQ was so high in 2002 was the use of Surround for insect control and Armicarb for disease control. Both of these materials are used as preventive sprays and are organically approved but are used at very high rates. Both are also quite expensive. We will consult with organic growers to evaluate whether we should continue to use these materials in the Organic system or whether we should simply accept possible losses from powdery mildew and cucumber beetles from which these materials are designed to protect crops.

All four systems were sufficiently efficacious in controlling the common pests of cucumber beetles, powdery mildew and weeds although as shown inn the data there were differences among the systems in actual numbers of beetles. The Admire systemic insecticide treatment in the IPM Future system protected the plants from beetles all season yet contributed a very low EIQ and amount of formulated product to the system. Admire is quite an expensive treatment however.

Table 3 shows the initial long term soil test results from the four systems at the site. These tests and others will be continued for the life of the project. After eight years organic matter is highest in the Organic system and is also high in the IPM Future system. Likely, as a result bulk density of the soil is lower in these two systems. Seemingly correlated with these results are rainfall infiltrometer readings showing much less runoff from the Organic and IPM Future systems than the Conventional and IPM Present systems. Better soil structure in these systems and higher organic matter resulting from an emphasis on cover crops and fewer trips through the field with heavy equipment may well have contributed to this difference. In 2002, the season was so dry that these advantages were probably not reflected in crop vigor and yield. However, a very wet season in the future will likely give an advantage to the Organic and IPM Future systems. Microbial biological activity measured in the fields showed unexpected results with the two systems with lower organic matter -IPM Present and Conventional showing relatively high levels of activity. The Organic system however showed the highest level of biological activity, The IPM Future system showed the lowest level of activity.

Table 2: Results for cucumber and zucchini 2002 - Geneva

Economics	Cucumber					
	Conv	IPM/P	IPM/F	Organic	Conv	IPM/P
Weight in lbs/Acre	1906	5127	14556	200	3494	1548
Gross $/Acre @ $0.25/lb Cuc.	$477	$1282	$3639	$50	-	-
Gross $/Acre @ $0.35/lb Zuc.	-	-	-	-	$1223	$310
Total Cost of Prod.	$630	$797	$760	$442	$660	$91
Net Return/Acre	-$154	$484	$2829	-$392	$563	$218
Environment						
EIQ	304.0	45.6	1.6	114.0	174.0	114
Lbs Form. Prod.	26.0	5.0	.2	15.0	11.25	7.5
Lbs N,P,K	241	206	110	78	241	20
Efficacy (# of SCB)	4	57	1	76	118	3

Economics	Pumpkin					M
	Conv	IPM/P	IPM/F	Organic	Conv	IPM/P
# 6 cnt melons ($10/box)	-	-	-	-	381	59
# 9 cnt melons ($9/box)	-	-	-	-	744	76
# 12 cnt melons ($10/box)	-	-	-	-	1143	47
# 15 cnt melons ($9/box)	-	-	-	-	1688	36
# 18 cnt melons ($10/box)					1797	29
Total cnt melons					5753	248
Lbs large (15 –30) ($0.15 lb)						
Lbs small (>8) ($0.10 lb)	783	874	63	0	-	-
Gross $/Acre	$78	$87	$6	0	$4343	$253
Total Cost of Prod.	$585	$706	$541	$447	$896	$85
Net Return/Acre	-$507	-$618	-$535	-$447	$3446	$168
Environment						
EIQ	166.6	101.7	91.6	216.0	245.8	48
Lbs Form. Prod.	10.31	6.25	7.91	30.0	18.25	5.9
Lbs N,P,K	241	241	110	78	251	20
Efficacy (total # of SCB)	147	125	16	51	45	3

Table 3: Long term soil analysis at Geneva site

Soil Analysis	**Conv**	**IPM/P**	**IPM/F**	**Organic**
Avg % Organic Matter [1] (8years)	2.57	2.14	2.74	3.13
Bulk Density [2] (1 year)	1.31	1.40	1.37	1.16
Run-off Rate in ml/min.	122.05	145.05	30.78	55.58
Biological Activity (ug/min/g dry wt) [3].	2.49	2.79	1.90	2.71

1) Organic matter sampled on May 5th of each year before plowing.
2) Samples taken on 9/18/02 1" deep in undisturbed soil. 4 samples in average. Particle density is 2.65, Higher values have less pore space, lower values have more pore space.
3) Results are presented as the micrograms of FDA hydrolyzed per minute per gram dry wt of soil (ug/min/g dry wt).

On farm sites

Fortunately the grower sites showed much higher levels of profitability in 2002 than did the Geneva site. All crops and systems were profitable on the average. Conventional, with only two pumpkin fields made $1508 per acre. The thirteen IPM Present fields made an average across crops of $1,375 per acre. The five IPM Future fields made $608 per acre. The eighteen Organic fields made $3,547 per acre. These results are not consistent with the Geneva site -at this point we can only explain this with the poor growing conditions at the Geneva site in 2002 and the limited number of fields in some treatments and geographic areas so far in the study. The last two years of the study will certainly cause these figures to be adjusted.

Environmentally, the Conventional fields had a rating of 242.88 per acre, the IPM Present fields had 81.34 per acre, the IPM Future fields had 79.85 per acre, and the Organic fields had an EIQ of 128.95 per acre. Again these numbers will change through the years as the project is completed.

Table 4: On farm results 2002

Economics	Cucumber					
	Conv	IPM/P	IPM/F	Organic	Conv	IPM/P
Weight in lbs/Acre	N/A	9072 (4)	3873 (2)	28658 (9)	N/A	9389 (2)
Gross $/Acre @ $0.25/lb Cuc.	N/A	$2268	$968	$7165	-	-
Gross $/Acre @ $0.35/lb Zuc.	-	-	-	-	N/A	$3286
Total Cost of Prod.	$630	$797	$760	$442	$660	$916
Net Return/Acre	N/A	$1471	$208	$6723	N/A	$2370
Environment						
EIQ f.u.r.	N/A	71.06	56.71	111.69	N/A	67.82
Lbs Form. Prod.	N/A	5 (3)	10.07 (1)	14.63 (4)	N/A	5.31 (2)
Lbs N,P,K	N/A	285 (1)	285 (1)	115.9	N/A	168.8 (2

Economics	Pumpkin			
	Conv	IPM/P	IPM/F	Organic
Lbs Large ($0.10 lb)	20931 (2)	9897 (9)	10724 (2)	5505 (2)
Gross $/Acre	$2093	$990	$1072	$551
Total Cost of Prod.	$585	$706	$541	$447
Net Return/Acre	$1508	$284	$531	$104
Environment				
EIQ f.u.r.	242.88	105.15	59.12	203.77
Lbs Form. Prod.	13.07 (2)	5.62 (5)	3.61 (3)	27.33 (3)
Lbs N,P,K	52.6 (1)	86.9 (3)	125.5 (6)	120 (3)