Title: **Cucurbit Pest and Crop Management Systems Evaluation**

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Type of grant: Systems comparison trials

Project location(s): Northeast and Great Lakes states

Abstract:

In 2001 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 7 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 general the IPM Present system was the most profitable, the Organic system was least profitable while the other two systems were mid range in profit. No-till or minimum tillage was used in the IPM Future and Conventional plots, proved to be inconsistent in results, and will be removed as a component of the systems next year. The Organic system resulted in lowest environmental impact, while the Conventional system had the highest environmental impact and the two IPM systems were mid-range. Insect and disease pests were adequately controlled for all four systems while weeds interfered with production in the two systems using no-till production. The results of this trial allow us to make recommendations that can help growers produce cucurbits in a manner that is environmentally sound and profitable.

Background and justification:

From 1992-1994 a team of vegetable research and extension staff conducted a systems evaluation project 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. While yield and quality acceptable to cabbage markets could be achieved under all four pest management systems, there were quite different economic and environmental costs associated with each system. 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, and the two IPM systems tended to be midrange both environmentally and economically. In addition, a number of specific practices were evaluated including impacts on natural enemy populations resulting from a least toxic pest management approach, efficacy and economics of the brush hoe for weed control, efficacy, economics, and environmental impact of changing the conventional herbicide program, efficacy of the electrostatic sprayer for insect control, and using repellents and portable electric fence for exclusion of woodchucks. This portion of the project was funded by NYS IPM.

Fresh market sweet corn was the subject of the evaluation from 1995 through 1999. Land at the Geneva Veg Crops Farm was allocated to this project on a permanent basis, allowing us to incorporate cultural and crop management practices such as rotation, cover crops, and others. A summary of the definitions of the four systems (Conventional, IPM Present, IPM

Future, and Organic) for sweet corn and of the 5 year results is contained in the IPM reports for 2000. It has also allowed us to establish a two-acre field that has been under continuous organic management for 7 years. This portion of the project was funded by NE SARE and NYS IPM and was integrated with grower farm demonstrations of the 4 systems. Among the results were: similar economic and environmental rankings of the systems as seen in the cabbage trial, the recognition that fresh market sweet corn could be grown profitably under an organic system, the demonstration of significant nitrogen contributions from cover crops, observations that higher natural enemy populations resulting from fewer insecticide applications resulted in better control of aphid populations and an evaluation showing that the ZEA LATER applicator gave good control of corn earworm in an organic system although requiring significant labor inputs.

In 2000, the project was converted to a focus of cucurbit crops. Definitions of the same four systems were developed for four cucurbit crops and are contained in a report in the 2000 IPM reports as are results from the 2000 season. This report is for the 2001 season funded by the NYS IPM Program. The next three years of the project have been funded through USDA RAMP along with companion demonstrations of cucurbit crop and pest management systems on growers' farms in eastern New York, Massachusetts, and Ohio.

Objectives:

1) Refine the pest and crop management system definitions for four cucurbits (melon, cucumber, zucchini, and pumpkin) that were developed in 2000.
2) Evaluate and compare the defined pest management systems for the four cucurbit crops
3) Collect and evaluate pest, pesticide use, economic, environmental impact, yield, and quality data to compare the systems.
4) Publicize the results of the comparisons by meetings and reports
5) Plan for the collection of data to compare the long term soil quality and pest pressure (especially weeds) differences that may be developing among the systems

Procedures:

The updated definitions of the four systems evaluated are shown in Figure 1. 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. Figure 2 shows the cropping history of the 4 systems plots since 1994 – one year before the project began with a 5 -year focus on sweet corn. 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 2 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. These were calculated for each system based on the use of these products. Pest control efficacy was compared among the systems.

Figure 1: Cucurbit System Outline

FERTILITY PRACTICES				
	Conventional	IPM/Present	IPM/Future	Organic
Nitrogen Phosphorous Potassium	100#N 70#P 70#K	100#N 70#P 70#K	70#N use PSNT 40#P 40#K	0#N 0#P 0#K
Pumpkins Cucumber Zucchini	Broadcast: 40#N of 15-15-15 and disk in. Band: 30#N of 15-15-15 at planting. Sidedress: 30#N of 34-0-0 at vine run	Plow down cover crop Broadcast: 40#N of 15-15-15 Band: 30#N of 15-15-15 at planting. Sidedress: 30#N of 34-0-0 at vine run	Roll down cover crop Band: 40#N of 15-15-15 at planting Sidedress: PSNT to test for nitrate level Band 30#N 34-0-0 if less than 30ppm	Roll down cover crop Use compost with high N at planting time if required by PSNT
Melon	Broadcast: 40#N of 15-15-15 and disk in. Apply 20#N of 34-0-0 through trickle at vine run & fruit set	Plow down cover crop Broadcast: 40#N of 15-15-15 Apply 20#N of 34-0-0 through trickle at vine run & fruit set	Plow down cover crop Apply 20#N of soluble 15-15-16 through trickle at vine run & fruit set	Plow down cover crop Apply 20#N of soluble fish fertilizer 12-2-1 through trickle at vine run & fruit set.
COVER CROP MANAGEMENT				
Seeding Rate	Left fallow over winter	Cereal rye & Hairy vetch fall planted 60#Rye 40#Vetch/Acre	Cereal rye & Hairy vetch fall planted 60#Rye 40#Vetch/Acre	Cereal rye & Hairy vetch fall planted 60#Rye 40#Vetch/Acre
Management	Chisel plow or disk crop residue and to control fall weeds	Mow rye/vetch at flowering or heading Plow down cover	Roll rye/vetch with stalk chopper Spray low rate of glyphosate after rolling.	Roll rye/vetch with stalk chopper. Plow and prepare seedbed for fall cover .
Rye/vetch rolled using a Buffalo rolling stalk chopper. Roll cover twice. Roll when rye starts to head out to lay cover in direction of planting. Roll a second time just before planting . Spray low rate of glyphosate after rolling and before planting to kill cover and control perennial and fall weeds. Rye/vetch seeded with no-till grain drill in future system				
SEED VARIETY & SPACING				
Pumpkins direct seeded 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, slicing, direct seeded 7.5' R x 12" OC	Dasher II, 58DTM Seedway	Dasher II, 58DTM Seedway	Dasher II, 58DTM Seedway	Dasher II, 58DTM Seedway
Zucchini, direct seeded 7.5' R x 20" OC	Revenue, 46 DTM Seedway	Revenue, 46 DTM Seedway	Revenue, 46 DTM Seedway	Revenue, 46 DTM Seedway
Melon, transplants 7.5' R x 24" OC	Athena, 83 DTM Seedway	Athena, 83 DTM Seedway	Athena, 83 DTM Seedway	Athena, 83 DTM Seedway
7.5 ft rows based on available equipment and sprayer width				
Weed Management				
	Conventional	IPM/Present	IPM/Future	Organic
Pumpkins	Command 4EC (clomazone) preplant incorporate, cultivate between rows, hand weed in rows	Curbit 18" wide band at planting, do-not incorporate, cultivate between rows, hand weed in rows	Rolled cover-crop mulch, glyphosate herbicide & no-till planting, hand weed between rows	Rolled cover-crop mulch & no-till planting, hand weed between rows

Figure 1: (cont.)

Cucumber	Prefar 4E + Alanap 2L (bensulide + naptalam) pre-emerg incorporate, cultivate between rows, hand weed in rows	Curbit 18" wide band at planting, do-not incorporate, cultivate between rows, hand weed in rows	Rolled cover-crop mulch, glyphosate herbicide & no-till planting, hand weed between rows	Rolled cover-crop mulch & no-till planting, hand weed between rows
Zucchini	Curbit apply post plant do-not incorporate, cultivate between rows, hand weed in rows	Curbit 18" wide band at planting, do-not incorporate, cultivate between rows, hand weed in rows	Rolled cover-crop mulch, glyphosate herbicide & no-till planting, hand weed between rows	Rolled cover-crop mulch & no-till planting, hand weed between rows
Melon	Black plastic mulch Cultivate between plastic	Black plastic mulch Cultivate between plastic	Black plastic mulch Cultivate between plastic	Black plastic mulch Seed Annual ryegrass & White clover between plastic
SPRAY EQUIPMENT for Insect and Disease Control				
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
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 Cucumber Zucchini Melon	Use Nova + Bravo alternated with Quadris on 7 day schedule	Use Nova + Bravo alternated with Quadris on 7 day schedule	Use Nova + Bravo alternated with Quadris on 14 day schedule	Use Kaligreen on 14 day schedule
Powdery mildew: scout fields starting in July apply fungicides every 7-14 days, coverage is important. Use systemic's if possible. Alternate fungicides of different classes to avoid resistance development. Alternate Nova /Bravo mix with Quadris begin with Nova/Bravo				
INSECT MANAGEMENT/ Cucumber beetle				
	Conventional	IPM/Present	IPM/Future	Organic
Scouting: Melons Cucumber Zucchini	Scout at cotyledon to 4 leaf stage. >1 beetle/ plant threshold.	Scout at cotyledon to 4 leaf stage. >1 beetle/ plant threshold.	Admire is systemic no further action needed	See below
Scouting: Pumpkin	Scout at cotyledon to 4 leaf stage. >5 beetle/ plant threshold.	Scout at cotyledon to 4 leaf stage. >5 beetle/ plant threshold.	Admire is systemic no further action needed	See below
Pumpkins Cucumber Zucchini Melon	Spray with Sevin 80S 1.25 lbs/Acre at threshold	Spray with Asana XL 8 oz/Acre at threshold	Admire applied in furrow 2.5 oz/1000 ft of row or drench melon transplants.	Use row covers until blossom for cucumber, zucchini and melons
Cotyledon to 4 leaf stage: Inspect 5 sites 5 plants per site pay particular 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.				

Vegetable Systems Cropping History

	Year	Conventional North	Conventional South	IPM/Present North	IPM/Present South	IPM/Future North	IPM/Future South	C North
Pre-project	1994 Sum	Sweet Corn	Sweet Corn	Cabbage	Cabbage	Fallow	Fallow	Buckwhea
	1994 Fall	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	Rye/vetch
Sweet Corn System	1995 Sum	Sweet Corn	Sudex	Sweet Corn	Sudex	Sweet Corn	Sudex	Sweet Cor
	1995 Fall	Fallow & rye*	Rye	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetch
	1996 Sum	Snap Beans	Sweet Corn	Buckwheat	Sweet Corn	Sweet Clover	Sweet Corn	Sweet Clo
	1996 Fall	Fallow	Fallow & rye*	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetch
	1997 Sum	Sweet Corn	Snap Beans	Sweet Corn	Buckwheat	Sweet Corn	Soybeans	Sweet Cor
	1997 Fall	Fallow & rye*	Fallow	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetch
	1998 Sum	Snap Beans	Sweet Corn	Buckwheat	Sweet Corn	Soybeans	Sweet Corn	Soybeans
	1998 Fall	Fallow	Fallow & rye*	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetch
	1999 Sum	Sweet Corn	Snap Beans	Sweet Corn	Buckwheat	Sweet Corn	Soybeans	Sweet Cor
	1999 Fall	Fallow & rye*	Fallow	Rye	Rye	Rye/vetch	Rye/vetch	Rye/vetch
Cucurbit System	2000 Sum	Snap Beans	Cucurbits	Buckwheat	Cucurbits	Soybeans	Cucurbits	Cucurbits
	2000 Fall	Fallow	Fallow	Rye/vetch	Fallow	Rye/vetch	Fallow	Rye/vetch
	2001 Sum	Cucurbits	Sweet Corn	Cucurbits	Soybeans	Cucurbits	Soybeans	Soybean
	2001 Fall	Fallow	Fallow	Rye/vetch	Rye/vetch	Rye/vetch	Rye/vetch	Rye/vetch
	2002 Sum	Sweet Corn	Cucurbits	Soybean	Cucurbits	Soybean	Cucurbits	Cucurbits

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

Results and discussion:

The year 2000 had moisture challenges that caused a 1 month late planting and did not really allow a fair evaluation of the systems that had been defined. Therefore, only one significant change was made in the system definitions for 2001 – we added gyphosate to the pumpkin, zucchini and melon weed control tactics for IPM Future in order to thoroughly kill the cover crop. Tables 1 and 2 show the results of 2001 evaluations.

Economics: The IPM Present system was the most profitable for three of the four crops - cucumber ($5,330/A), zucchini ($6,022/A) and pumpkin ($3,307/A). IPM Present was least profitable for melons but still returned a profit of $4,527 per acre. The Conventional system was the most profitable melon system with $6,595 per acre net return. Conventional finished second to IPM Present for pumpkins and cucumbers and third to IPM Present and IPM Future for zucchini in profitability. The IPM Future system was second most profitable for melons and zucchini but barely broke even on pumpkins and lost $340 per acre in cucumbers The Organic system was very profitable for melon at $4,879 per acre but broke even or lost money on the other three crops.

While all four systems successfully used plastic culture for melon production, no-till production was used for cucumbers, zucchini, and pumpkins in IPM Future and Organic. No-till systems proved to be highly unpredictable and most losses in these systems appeared to be as a result of weed competition. Of the 6 settings where no till production was used, three lost money, two essentially broke even, and only one (IPM Future zucchini) was profitable. More conventional tillage systems were used in the Conventional and IPM Present plots. Of the six settings where conventional tillage was used, all six were profitable (between $1,820 and $6,022 per acre). As a result, the decision has been made to abandon the no-till aspects of the IPM Future and Organic systems for the next three years of the trial. Significant revamping of these two systems definitions is underway.

Environment: As measured by the EIQ, pesticide use, and fertilizer use, the Organic system resulted in lowest environmental impact, while the Conventional system generally had the highest environmental impact. The two IPM systems were mid-range. Melons proved the exception to this trend with the IPM Future system receiving an application of insecticide (Admire) at transplant while the other three systems never needed foliar applications.

Efficacy: Powdery mildew was present in all four systems on the same date – August 14 – at which time fungicide spray schedules were initiated. The disease did not become serious in any of the four systems and other diseases were only observed sporadically. Diseases did not appear to affect yield in any of the systems.

The major insect pest – striped cucumber beetle – was counted at 3 scouting events early in the season. Total counts of beetles from the three events are presented in Tables 1 and 2. One possible apparent positive effect of the no-till systems in IPM Future and Organic was the lower number of beetles observed in those two systems compared to Conventional and IPM Present where conventional tillage practices were used.

Weed control was very good in the two systems with conventional tillage and in the melons where plastic culture was used for all four systems. The rye/vetch cover crop in the no-till system did not generally provide adequate ground cover to give season long suppression of weed growth. By the end of the season a carpet of dandelions had covered both the IPM Future and Organic plots in most areas, resulting in depressed yields for nearly all of the three crops using no-till in these two systems.

Future: This project has been funded for the next three growing seasons by USDA RAMP along with an on farm component o the project in 3 states – eastern New York, Massachusetts, and Ohio. We will not request IPM funding for the project for the next three years, but will provide reports to the IPM Program at Cornell since several staff on the project are or have been fully or partially funded by NYS IPM dollars. We are most appreciative that the NYS IPM program funding has allowed us to leverage the USDA funding for the continuation and expansion of the project.

The new funding also allows us to complete Objective 5 of this proposal. Plans have been made to evaluate a number of soil qualities in the systems plots. Biological, chemical, and physical characteristics of the plots will be compared over the next three years in cooperation with the Soil Health Program Work Team.

Table 1: Results for cucumber and zucchini 2001

Economics	**Cucumber**				**Z**	
	Conv	**IPM/P**	**IPM/F**	**Organic**	**Conv**	**IPM/P**
Weight in lbs/Acre	16,117	25,655	0	590	10,345	23,912
Gross $/Acre @ $0.25/lb Cuc.	$4,029	$6,414	$0	$148	-	-
Gross $/Acre @ $0.30/lb Zuc.	-	-	-	-	$3,104	$7,174
Total Cost of Prod.	$853	$1,084	$340	$353	$805	$1,152
Net Return/Acre	$3,176	$5,330	-$340	-$205	$2,299	$6,022
Environment						
EIQ	231.7	13.3	28.9	0	98.9	68.2
Lbs Form. Prod.	22.00	1.20	2.63	0	6.31	3.91
Lbs N,P,K	181	151	122	97	181	151
Efficacy						
Date of Powdery mildew	8/14	8/14	8/14	8/14	8/14	8/14
No. Striped Cuc. beetles	2	0	0	0	14	3

Table 2: Results for pumpkin and melon 2001

Economics	Pumpkin				M	
	Conv	IPM/P	IPM/F	Organic	Conv	IPM/P
# 6 cnt melons ($11/box)	-	-	-	-	2,886	2,432
# 9 cnt melons ($12/box)	-	-	-	-	1,361	653
# 12 cnt melons ($12/box)	-	-	-	-	599	472
# 15 cnt melons ($11/box)	-	-	-	-	345	145
Lbs large (15 –30) ($0.15 lb)	6,316	11,108	0	0	-	-
Lbs small (8 – 15) ($0.12 lb)	15,078	25,256	6,416	0	-	-
Gross $/Acre	$2,757	$4,697	$770	0	$7,958	$5,908
Total Cost of Prod.	$937	$1,390	$630	$324	$1,349	$1,337
Net Return/Acre	$1,820	$3,307	$140	-$324	$6,609	$4,571
Environment						
EIQ	35.0	20.3	26.7	0	0	0
Lbs Form. Prod.	3.00	2.35	2.25	0	0	0
Lbs N,P,K	181	151	122	0	162	162
Efficacy						
Date of Powdery mildew	8/14	8/14	8/14	8/14	8/14	8/14
No. Striped Cuc. beetles	28	27	4	0	30	16