MULTI STATE CUCURBIT SYSTEMS STUDY: THREE YEARS OF RESEARCH AND WHAT WE FOUND

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Background:

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 with similar results. 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 2000.

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 economically with low environmental impact.
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.

Procedures:

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 that follow IPM Elements; IPM Future – IPM Present practices plus those practices that may still be under research or expensive to implement; Organic – following USDA guidelines. Only half of each designated two-acre field was planted to the focus crops for that particular year. The other half of the field was planted to a rotational crop. 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 were 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. Environmental impact was evaluated by means of the Environmental Impact Quotient, pesticide use, and synthetic fertilizer use. Pest control efficacy was compared based on weekly scouting records and weed maps. Beneficial insects, total crop yield and marketable yield were recorded.

Collection of data that may reveal long-term impacts of the systems was initiated in 2002 and continued through 2004. In cooperation with the Soil Health Program Work Team at Cornell, evaluations of soil health were conducted. Soil samples were collected and analyzed for soil microbial activity, bulk density, soil organic matter, and rainfall infiltration.

On Farm Sites: We were able to collect complete data sets from 103 farm fields in Ohio, eastern New York, and Massachusetts between 2002 and 2004. Each of the 103 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. Only pumpkins, zucchini, and cucumbers were in the fields on grower farms - there was no opportunity to include melons. 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. Interestingly very few of the growers willing to cooperate in the project were growing cucurbits in a Conventional system.

For on farm sites 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.

Results:

Table 1: Long term soil analysis at Geneva site

Soil Test	Conv	IPM/P	IPM/F	Organic
Avg % Organic Matter [1] (10 years)	2.49	2.11	2.79	3.11
Bulk Density [2] (3 year)	1.22	1.34	1.26	1.21
Run-off Rate in ml/min.	112.4	86.7	35.3	28.3
Biological Activity (ug/min/g dry wt) [3].	2.49	2.79	1.9	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).

Table 2: Root Rot bioassay tests at Geneva site

System	1995		2002		2003		2004	
	Root wt (g/pot)	RRR (1-9)	Root wt (g/pot)	RRR (1-9)	Root wt (g/pot)	RRR (1-9)	Root wt (g/pot)	RRR (1-9)
Conv.	26.6	2.7	38.8	7.3	23.8	7.9	22.1	7.3
IPM Pre	23.1	3.6	40.6	3.3	27.2	5.8	32.8	2.9
IPM Fut	27.1	3.4	46.4	2.7	36.9	3.3	47.3	2.1
Organic	25.2	3.8	44.3	4.1	27.9	5.6	67.4	3.6

RRR=Root Rot Rating

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Table 3: Results for cucumber, zucchini, pumpkin, and melon 2000 to 2004 – Geneva site

	Cucumber				Zucchini			
Economics	**Conv**	**IPM/P**	**IPM/F**	**Organic**	**Conv**	**IPM/P**	**IPM/F**	**Organic**
Weight in lbs/acre	5,382	13,544	11,897	3,823	4,309	15,185	14,421	1,914
Gross $/Acre @ $0.25/lb Cuc.	$1,244	$2,894	$2,350	$725	-	-	-	-
Gross $/Acre @ $0.35/lb Zuc.	-	-	-	-	$1,376	$4,793	$4,801	$620
Total Cost of Production	$673	$1,102	$980	$684	$717	$1,330	$1,278	$749
Net Return/acre	$571	$1,792	$1,370	$41	$660	$3,463	$3,524	($129)
Environment								
EIQ	271.5	44.8	19.5	22.8	126.2	82.0	54.0	43.2
Lbs Formulated Product	24.1	3.5	1.3	3.0	8.2	5.2	3.0	6.0
Lbs N,P,K	211	161	70	70	211	174	70	51
Efficacy								
# cucumber beetles	25	74	22	81	109	136	50	137

	Pumpkin				Melon			
Economics	**Conv**	**IPM/P**	**IPM/F**	**Organic**	**Conv**	**IPM/P**	**IPM/F**	**Organic**
Total count melons	-	-	-	-	3,964	2,907	2,475	1,523
Weight in lbs/acre	14,555	12,730	5,866	897	-	-	-	-
Gross $/acre	$1,918	$1,669	$1,306	$47	$4,263	$2,955	$3,144	$1,941
Total Cost of Production	$812	$794	$690	$530	$1,291	$1,246	$1,193	$1,239
Net Return/acre	$1,107	$875	$615	($483)	$2,971	$1,709	$1,951	$701
Environment								
EIQ	119.0	79.6	88.7	43.2	152.0	71.2	55.6	51.8
Lbs Formulated Product	7.7	4.7	6.1	6.0	11.0	4.9	2.9	6.6
Lbs N,P,K	217	211	121	63	191	191	104	69
Efficacy								
# cucumber beetles	107	127	37	55	33	46	15	70

Table 4: On farm results 2002 to 2004 (103 fields in New York, Massachusetts and Ohio)

	Cucumber				Zucchini			
Economics	**Conv**	**IPM/P**	**IPM/F**	**Organic**	**Conv**	**IPM/P**	**IPM/F**	**Organic**
Weight in lbs/acre	N/A	11,374	9,779	20,366	N/A	6,062	6,018	11,072
Gross $/acre @ $0.25/lb Cuc.	N/A	$2,047	$1,760	$3,660	-	-	-	-
Gross $/acre @ $0.35/lb Zuc.	-	-	-	-	N/A	$2,122	$2,106	$3,875
Environment								
EIQ	N/A	63	55	222	N/A	158	169	3.56
Lbs Formulated Product	N/A	4.2	3.6	23.0	N/A	10.0	9.8	1.19
Lbs N.P.K	N/A	231	231	116	N/A	337	427	51

	Pumpkin			
Economics	**Conv**	**IPM/P**	**IPM/F**	**Organic**
Lbs Large ($0.10 lb)	40,256	36,404	39,329	16,183
Gross $/acre	$4,025	$3,640	$3,933	$1,618
Environment				
EIQ	225	209	247	122
Lbs Formulated Product	11.6	10.4	15.5	16.4
Lbs N.P.K	69	160	132	51