IPM
Integrated
Pest
Management

1997 New York State Vegetable Project Reports Relating to IPM

Cornell University
Cornell Cooperative Extension

1/98 NYS IPM Publication #123

Demonstrations of Sustainable Vegetable Pest and Crop Management: Fresh Market Sweet Corn

Funded by NE SARE - ACE

Curtis Petzoldt, Vegetable IPM Coordinator, Cornell University ,M. Hoffmann, S. Reiners, A. Seaman,W. Pool, G. Harman, P. Curtis, A. Shelton, G. White, L. Willett

Objectives

Overall Goal: The overall goal of the proposed work is the education of farmers, extension specialists, extension agents, agribusiness people, and consumers about the need to adopt sustainable IPM/ICM production techniques. It will focus on fresh market sweet corn for the proposal period but it is part of an overall vegetable educational effort which is on-going.

Individual Objectives:

1) On growers' farms demonstrate to farmers, extension specialists, extension agents, and agribusiness people the economic and environmental benefits of adoption of various IPM/ICM techniques as part of a more sustainable approach to vegetable production.

2) At New York State Agricultural Experiment Station (NYSAES) at Geneva conduct one demonstration site to compare all defined pest management systems for fresh market sweet corn.

3) Collect and evaluate pest, pesticide use, economic, environmental impact, yield, and quality data to compare the systems at the farm sites and the university site.

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

5) Work with a major supermarket and its growers to implement sustainable practices for fresh market sweet corn; Identify the corn to consumers as produced using IPM/ICM practices .

Abstract: Four sweet corn pest and crop management systems (organic, IPM/Present, IPM/Future, and conventional) were defined and implemented on grower farms and on a university research farm. The first years results showed differences among the four systems in terms of economics, pest control efficacy and environmental impact. Generally the conventional and IPM systems were the most profitable while the organic system showed the least environmental impact. Information on the comparisons was disseminated to growers and other food industry personnel. In cooperation with Wegmans supermarkets consumers were informed of IPM practices on sweet corn which were documented by growers. Fifteen growers participated in documenting IPM practices and in many cases have reduced pesticide use. Five of the fifteen growers were among the nine involved in the demonstrations conducted in this project.

Specific Project Results:

Objective 1: For Objectives 1 and 2 four systems were defined for pest and crop management by a group of extension and faculty at Cornell with knowledge of current and future sweet corn production practices. These were Conventional, IPM Present, IPM Future, and Organic. Table 1 shows the specific definitions of the systems.

Several differences in system definitions between Objective 1 and Objective 2 occurred for a number of logistical reasons. In most cases the differences occurred as a result of grower decisions on management practices over which the investigators had no control. In general, grower cooperators experienced weather and planting conditions which caused them to change plans resulting in their being unable to implement the weed and rotational aspects of the different systems. Therefore, systems in grower fields were limited to the definitions for insect and disease management options. This was a major reason for conducting the more controllable demonstration in Objective 2.

In grower fields, the IPM future treatment insect management strategy was modified to include the use of *Trichogramma ostriniae* and Bacillus thuringiensis (Bt) for European corn borer (ECB) management. Pheromone traps for ECB, corn earworm (CEW) and fall armyworm (FAW) were placed near each field to help determine optimal release times for the *Trichogramma* as well as the most effective Bt product for the pest complex present.

Table 2 shows the summary of data from grower demonstration fields. Table 3 shows more detailed results of the Trichogramma releases in the IPM Future fields. In four of the five fields, where Trichogramma and Bt were used, commercially acceptable insect control was achieved.

The Organic system was not implemented in grower fields in 1997. Rather than assume that organic growers encounter the same problems and pests as conventional and IPM growers of sweet corn, a survey of organic sweet corn growers was conducted to identify major problems and pests associated with organic production. The results of this survey are presented narratively later in the report. During the current offseason a plan for demonstrations with organic growers will be formulated based on the results of the survey.

Grower fields also presented the opportunity to test distress-call-based bird scare devices since several growers had fields with bird pressure (not the case at the research farm location). Results of the bird scare tests are shown in Table 4.

Results of Organic Grower survey

To ensure that organic systems demonstrated in organic grower fields addressed problems relevant to organic growers, the first year of this project we surveyed organic sweet corn growers to identify constraints and concerns.

A comprehensive survey of fresh market vegetable growers in NY, NJ, and PA conducted as part of a phase I grant from the national IPM Implementation Program shows that sweet corn is not widely grown by organic farmers. Of the 204 survey respondents growing sweet corn, 8.3% (17) were organic growers. While sweet corn was the most frequently grown crop for conventional/IPM growers responding to the survey, it ranked 20th for organic growers. We identified seven organic sweet corn growers in NY, and were able to interview six. Five growers were in upstate NY and one was on Long Island.

- All the growers marketed all or part of their sweet corn through a CSA
- Total acreages of sweet corn grown by the group ranged from 0.25-8 acres

Nutrient Management:

- Sources of fertility included plowed down green manures or cover crops, on-farm produced compost, and bagged organic fertilizers or commercially produced compost.
- Compost applications ranged from 10-16T/A.
- Nutrient management information of interest include: More precise Cornell soil test that includes analysis of cation exchange capacity and micronutrients, better methods for estimating nutrient release from organic sources, and a method for tracking nitrogen availability.

Insect Management:

- European corn borer (ECB) and/or corn earworm (CEW) was the most serious insect pest.
- Estimates of corn culled because of insect damage: upstate 0-10%; on Long Island 10-70%
- Because CSA members accept more imperfections, up to 5-10% of corn going to CSA members might be infested with ECB or CEW.
- Only one of the growers owned a sprayer suitable for sweet corn.
- A parasitic wasp for ECB control would be useful, but it would need to be cost effective

Disease Management:

- Not generally a problem, although smut, rust, and Stewart's wilt are in fields to some extent.

Weed Management:

- Weeds were a serious problem for two of the growers; one who plants in cool soil for a mid-July harvest, and one who does not have tractor mounted cultivation equipment.
- All of the growers cultivate 2-4 times for weed control, using a wide variety of cultivators.
- Three of the growers interseed cover crops into the corn at last cultivation.
- Growers did not indicate a need for additional weed management information.

Based on the survey, we plan to address organic grower's pest management needs by demonstrating releases of *Trichogramma ostriniae* for ECB control. We plan to address nutrient management needs by loaning growers Cardi meters to help them track nitrogen release in different parts of their rotation. The other nutrient management

needs identified are beyond the scope of this project, but will be brought up as extension needs to be addressed by the wider system.

Objective 2: Refer to Table 1 for the systems definitions. Fields were a half acre each and consisted of an early and a late planting. A second acre for each system is available to introduce a rotational aspect into the systems for the next two years of the project. Descriptions of the management of the second acre are also in Table 1. Table 5 shows the results of the 1997 trials compared in terms of economics, efficacy, and environment as an average of the early and late plantings. All four systems were profitable. All four systems resulted in acceptable levels of insect damage from a marketability standpoint. Generally the Conventional and IPM Future plantings resulted in the highest net return per acre in dollars. The Organic system resulted in the lowest environmental impact when measured in four different ways. Figure 1 shows that the Organic system also had the largest number of beneficial insects present in the field. Table 6 shows a three year average of the systems comparison.

Objective 3:

a) The results presented in Objectives 1 and 2 compare the four defined systems for the farm and university sites in the terms described in Objective 3

b) Currently economic calculations are based on cost of production information collected by Barnes and White in 1991. An update of this survey data was initiated under this project with White in order to determine current costs of production. A survey was sent to representative growers and information has been received from growers. Results are now being evaluated and new production cost figures will be calculated based on the updated information.

Objective 4:

-The plots at the NYSAES research farm were discussed and made available for inspection at the sweet corn and snap bean field day held in August. About 45 were in attendance.

- About 150 growers and others attended the Sweet Corn School at the 1997 NYS Vegetable Conference in February where growers learned how to implement Objective 5.

-Various aspects of this project have been presented at grower and scientific meetings in: Burlington VT 2/25/97; Bergen, NY 3/7/97; White River Junction VT, 4/3/97; Bradford, ONT 4/9/97; Canandaigua, NY 4/29/97; Ithaca, NY 4/30/97; Washington, DC 6/27/97; Pittsburg, PA 8/6/97; Houston, TX 8/29/97; Clemson, SC 10/16/97; and Auburn, AL 11/5/97.

-An IPM educational video was produced by Wegmans Food markets and shown on local television and in stores.

-The projects were discussed at 3 Extension twilight meetings during the growing season with a total of about 25 growers.

-Willett, Lois Schertz. "Marketing Fresh Sweet Corn Grown with IPM Methods: An Econometric Analysis" Selected Poster Presentation. American Association of Agricultural Economics, Toronto, Canada, July 27 - 30, 1997.

Reports and Articles Expected:

1. Report in NYS IPM Program Reports for Vegetable Projects, Jan 1998
2. Portions of the work reported at the NYS Vegetable Conf. and Proceedings, Jan 1998

Objective 5:

IPM Elements have been defined for fresh market sweet corn. These elements consist of practices that Cornell staff, growers, and retailers agree are critical to the practice of IPM in upstate NY on sweet corn. Each element has been assigned a point value depending on whether it is thought to be more or less important to the practice of IPM. Growers in the labeling effort have kept documentation of the practice of lack of practice of each element. The points have been totaled and to be labeled as IPM grown a grower's field must achieve at least 80% of the points available. A survey of 206 fresh market sweet corn growers conducted by the NY Ag Statistics Service in 1995 indicated that most growers were achieving between 40 and 70 % of the IPM Element points. The fifteen growers participating this project all achieved at least 80% of the points available with some fields reaching 100%. Of the nine growers participating in the demonstration plots for this years project, five were participants in the Wegmans IPM labeling effort.

Sales of sweet corn at Wegmans stores using the IPM label have increased during the IPM labeling effort by as much as 50%, although it is unknown how much of the increase is attributable to the IPM label. This increased sales represents increased opportunity for New York sweet corn growers to sell product to consumers opening significant new markets.

Economic Analysis:

An additional economic analysis completed for this project used retail level data from 22 comparable stores over the same 12 week period during the 1995 and 1996. All stores are within a single major supermarket chain located in the state of New York. One of the 22 stores sold IPM corn during 1995. Sixteen of the 22 stores sold IPM corn in 1996. An econometric demand model was conceptualized and estimated. The model includes variables for quantity, price, IPM, and some demographic variables such as gender, age, education and household size for the average shopper in each store.

Results suggest that the demand for sweet corn is price inelastic (-0.911). Demand increased when the average age, education and household size of the shopper increases. The demand for fresh sweet corn fell when a larger percent of females shopped in the store. Stores that sold corn grown with IPM methods and marketed with the IPM label had increased sales of nearly 15 percent over stores selling corn grown and marketed conventionally. However, store produce managers felt that increased sales were likely a result of their efforts with displays and not necessarily due to increased awareness of IPM corn.

Potential Contributions and Practical Applications

-Continued adoption of IPM and organic practices described in these systems have the potential to reduce environmental impact as measured by the EIQ by at least 50% based on the first years results.
-IPM labeling has the potential to increase adoption of IPM techniques in fresh market sweet corn from a 40 - 70 percent level (based on a baseline survey conducted by NYS Ag Statistics Service) up to a 80 to 100% level.
-Adoption of IPM techniques have the potential to keep growers at least as profitable as they are using conventional techniques.

Table 1: System definitions

Conventional	IPM Present	IPM Future	Organic
Crop History- South Half			
1994 - sweet corn 1995 - summer/ sudex, fall/ rye 1996 - summer/sweet corn fall/rye 1997 - summer/ snap beans fall/ fallow	1994 - cabbage 1995 - summer/ sudex, fall/ rye 1996 - summer/sweet corn fall/ rye 1997 - summer/buckwheat fall/ rye	1993 - cucurbits; 1994 - fallow/weeds 1995 - summer/ sudex, fall/ rye vetch 1996 - summer/sweet corn fall/ rye vetch 1997 - summer/ soybean fall/ rye vetch	1993 - summe/ alfalfa; fall/ rye vetch; 1994 - summer/buckwheat; fall/ rye vetch 1995 - summer/ sudex, fall/ rye vetch 1996 - summer/sweet corn fall/ rye vetch 1997 - summer/ soybean fall/ rye vetch
Crop History- North Half			
1994 - sweet corn 1995 - summer/sweet corn 1996 - summer snap beans fall, fallow 1997 - sweet corn fall, fallow or rye	1994 - cabbage 1995 - summer/sweet corn fall/ rye 1996 - summer/ buckwheat fall, rye 1997 - summer/sweet corn fall/ rye	1993 - cucurbits; 1994 - fallow/weeds 1995 - summer/sweet corn fall/ rye vetch 1996 - summer/ swt clover fall/ rye vetch 1997 - summer/sweet corn fall/ rye vetch	1993 - summer/ alfalfa fall/ rye vetch; 1994 - summer/buckwheat; fall rye/vetch 1995 - summer/sweet corn fall/ rye vetch 1996 - summer/swt clover fall/ rye vetch 1997 - summer/sweet corn fall/ rye vetch
Varieties and planting dates			
Var./plant date Delectable/May 28th Zenith/June 25th	**Var./plant date** Delectable/May 27th Zenith/June 25th	**Var./plant date** Delectable/May 27th Zenith/June 23rd	**Var./plant date** Delectable/May 27th Maverick & Zenith/June 23rd
Fertility Practices - Early & Late Planting			
Broadcast: 40 # NPK/Acre(15/15/15) before planting	**Broadcast:** 40# NPK/Acre(15/15/15) before planting Rye planted fall 96, plowed under spring 97	**Rye/Vetch** planted fall 96, plowed under spring 97	**Rye/Vetch** planted fall 96, plowed under spring 97
At seeding: 40 #N/Acre (34/0/0) banded 2 " below and beside seed	**At seeding:** 40 #N/Acre (34/0/0) banded 2 " below and beside seed	**At seeding:** 40 #NPK/Acre (15/15/15) banded 2 " below and beside seed	**At seeding:** no fert. added in this system
1st sidedress: 40 # N/Acre (34/0/0)	**1st sidedress:** 40 # N/Acre (34/0/0)	**1st sidedress:** eliminated, based on PSNT	**1st sidedress:** not used in this system
Total N: 120 #/Acre	**Total N:** 120 #/Acre	**Total N:** 40 #/Acre Vetch	**Total:** 40 #/Acre Vetch
Insect Management Practices			
Corn rootworm (CRW), seed corn maggot (SCM) and flea beetles (FB): Use Counter @ 8.7 lb/A at planting treatment.	**CRW, SCM, and FB:** Rotation; Use forecast and action threshold for flea beetles. Lorsban seed treatment	**CRW, SCM, and FB:** Rotation; Lorsban seed treatment	**CRW, SCM, and FB:** Rotation for CRW; no controls available for SCM and FB

Table 1 continued

Conventional	IPM Present	IPM Future	Organic
Insect Management Practices (cont.)			
European corn borer (ECB), fall armyworm (FAW, corn ear worm (CEW): apply Ambush @ 9.6 oz/A every 7 days beginning at early silk; switch to Larvin @ 25 oz/A if FAW is present	**ECB, FAW, CEW:** apply Ambush @ 9.6 oz/A according to results of scouting and trapping as described in IPM Scouting Procedures; switch to Larvin @ 25 oz/A if FAW is present	**ECB, FAW, CEW:** apply Ambush @ 9.6 oz/A according to results of scouting and trapping as described in IPM Scouting Procedures; switch to Larvin @ 25 oz/A if FAW is present	**ECB, FAW, CEW:** apply Dipel @ 1 lb/A according to results of scouting and trapping as described in IPM Scouting Procedures Switched to Xentari @ 1.5 lb/A for late planting
Disease Management Practices			
Seedling disease and damping off: Early & Late: Seed treatment with Captan 400, Imazilil, Apron FL, Lorsban	**Seedling disease and damping off:** Early & Late: Seed treatment with Captan 400, Imazilil, Apron FL, Lorsban	**Seedling disease and damping off:** Early & Late: Seed treatment with Maxim, Apron FL, Lorsban and T-22 (*Trichoderma*,) in planter box.	**Seedling disease and damping off:** Early & Late: Seed treatment with T-22 (*Trichoderma*,) in planter box.
Stewart's wilt: Crop resistance Early planting Delectable Late planting Zenith	**Stewart's wilt:** Crop resistance Early planting Delectable Late planting Zenith	**Stewart's wilt:** Crop resistance Early planting Delectable Late planting Zenith	**Stewart's wilt:** Crop resistance Early planting Delectable Late planting Maverick
Common rust: Early planting: not a pest Late planting: apply Penncozeb DF @ 1.5 lb/A with first insecticide spray; subsequent sprays with insecticides; 7 day pre harvest interval (PHI); no more than 4 sprays	**Common rust:** Early planting not a pest Late planting: Scout and apply Bravo 720 @ 2 pts /A at early whorl and when 50 % of plants have at least one pustule; subsequent sprays on 7 day interval; 14 day PHI	**Common rust:** Early planting not a pest Late planting: Scout and apply Tilt @ 4 oz/A at early whorl and at first pustule appearance; subsequent sprays at 7 day intervals; 14 day PHIi , no more than 4 sprays	**Common rust:** Early planting not a pest Late planting: Plant rust resistant variety Maverick
Weed Management Practices			
Broadleaves and grasses: 1) Atrazine Nine-O @ 1.25 lbs /A plus Dual II @ 2.0 pts; broadcast applied 1 day after planting 2) standard cultivation at time of sidedressing 6-8" stage	**Broadleaves and grasses:** 1) Atrazine Nine-O @ 6.7 oz /A plus Dual II @ 10.7 oz/A banded over the row in 10" wide band at planting. 2) standard cultivation at time of sidedressing 6-8" stage	**Broadleaves and grassell** 1) Dual II @ 10.7 oz/A banded over the row in 10" wide band at planting 2) standard cultivation at time of sidedressing 6-8" stage Band Basagran @ 2 pts/A for broadleaves if needed	**Broadleaves and grasses:** 1) Rye/vetch cover crops in 1996 and 1997 2): Brush hoe at 14" corn height; hand weed as necessary, standard cultivation as necessary
1997 cover crops in 1998 planting areas			
summer 1997: Snap beans fall 1996: left fallow	summer 1997: buckwheat 60#/A fall 1996: rye 120#/A	summer 1997: forage soybean 40-60#/A fall 1996: rye 40#/A vetch 40#/A	summer 1997: forage soybean 40-60#/A fall 1996: rye 40#/A vetch 40#/A
1996 cover crops in 1997 planting areas			
summer 1996: Snap beans fall 1996: left fallow	summer 1996: buckwheat 60#/A fall 1996: rye 120#/A	summer 1996: sweet clover 15#/A fall 1996: rye 40#/A vetch 40#/A	summer 1996: sweet clover 15#/A fall 1996: rye 40#/A vetch 40#/A

Table 2: Results of 1997 Sweet Corn Systems Comparison - On Farm Averages.

	Conventional	IPM Present	IPM Future
# Fields	8	3 7	6
Efficacy			
Yield (dozen ears) per Acre*	*(750 to 1,000)*	*(750 to 1,000)*	*(750 to 1,000)*
% Insect Damaged Ears	0.71%	0.74%	0.73%
% Aphid Infested Ears	5.09%	4.81%	9.45%
# Dozen Lost to Insects	5 to 7	6 to 7	5 to 7
$ Lost to Insects	$13.37 to $17.83	$13.92 to $18.56	$13.72 TO $18.29
Environment			
Avg. # Insecticide Sprays	1.25	1.09	.80
Lbs Pesticide Formulated Product	0.5	1.8	.50
Avg. EIQ Field Use Rating	1.5	12.2	1.3

*Yield per acre is an estimate of actual yield obtained from cooperating growers. It is expressed as a range in this table and variables dependent on yield are also expressed as a range

Table 3: Results of inundative releases of *Trichogramma ostriniae* for control of European corn borer

Location	# of Releases	Rate of Parasitism	% Ear Damage	# Bt Sprays
# 1	4	100%	0.0%	2
# 2	4	60-90%	22.5%	2
# 3	3	90%	10.0%	1
# 4	4	60-88%	9.0%	1
# 5	4	100%	5.5%	0

Note: Rate of parasitism determined by inspecting European Corn Borer egg masses collected in the field.

Table 4: Percent bird feeding damage in areas with and without bird scare devices

Location	Bird Scare	No Bird Scare
# 1	0	30%
# 2	0	4%
# 3	0	16%

Note: Data for "No Bird Scare" in fields 2 & 3 was collected at varying distances from the bird scare device; proximity to the scare device may have affected bird activity in the "No Bird Scare " area.

Table 5: Results of 1997 Sweet Corn Systems Comparison - Research Farm, Early & Late Averages.

	Conventional	IPM Present	IPM Future	Organic
Economics				
Yield (dozen ears) per Acre	774	577	842	404
Marketable (dozen ears) per Acre (Yield -Insect damage)	738	557	781	379
Cost of Production	$467.91	$528.67	$387.20	$410.46
Gross $/Acre @ $2.50 doz ($3.50 Organic)	$1,846	$1,393	$1,951	$1,328
Net Return (Gross $ - Cost of Production)	$1,378	$864	$1,564	$917
Efficacy				
% Insect Damaged Ears	4.53%	2.74%	6.83%	5.90%
% Aphid Infested Ears	4.25%	4.08%	0.62%	0.37%
# Dozen Lost	36	20	62	24
$ Lost to Insects	$89	$50	$154	$85
Environment				
# Pesticide applications	5.5	5.5	4.5	1.5
Lbs Pesticide FP	19.0	10.2	4.8	4.5
EIQ Field Use Rating	300.0	208.4	58.4	6.3
Lbs Fertilizer	203.1	203.1	121.5	0.0

Figure 1: Numbers of Beneficial insects in fields managed by different systems

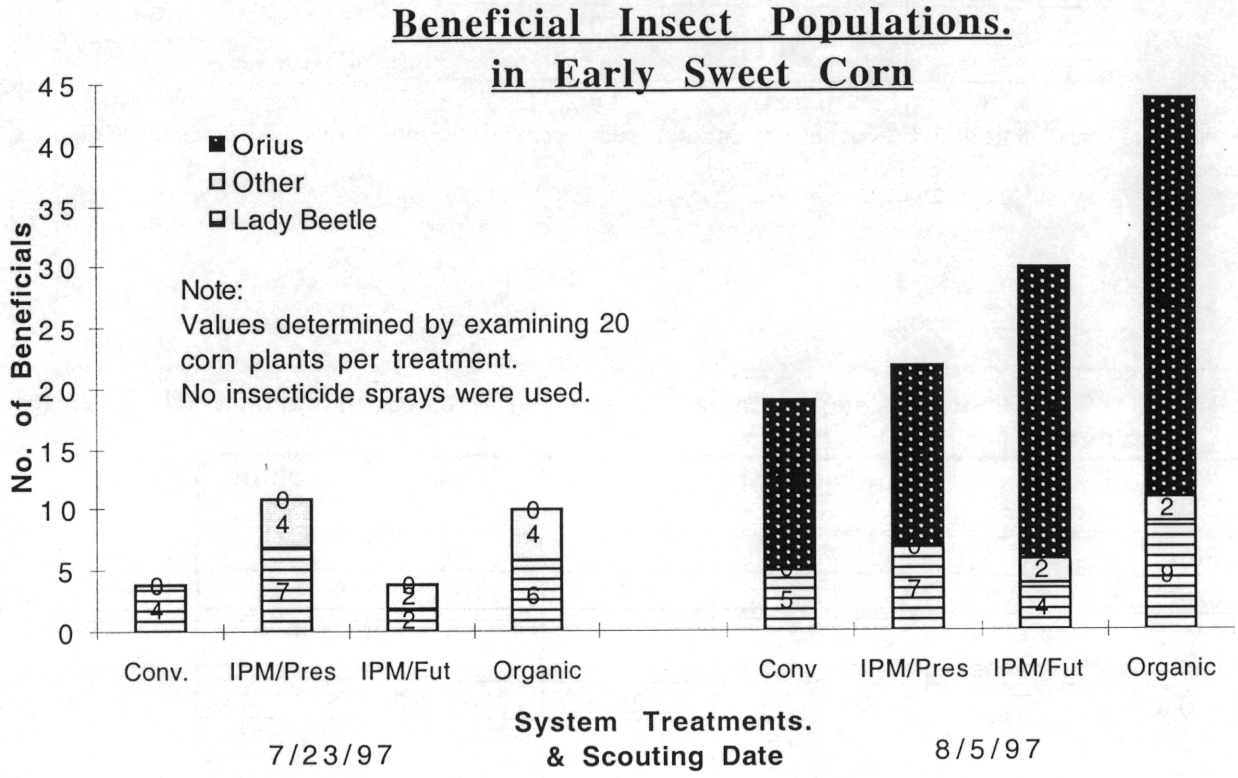

Table 6: 3 year average of Sweet corn systems comparison

	Conventional	IPM Present	IPM Future	Organic
Economics				
1995 Yield, Doz Ears/Acre	1,100 doz	938 doz	920 doz	707 doz
1996 Yield, Doz Ears/Acre	792 doz	1,002 doz	778 doz	416 doz
1997 Yield, Doz Ears/Acre	739 doz	557 doz	781 doz	380 doz
3 Year Avg Yield, Doz Ears/Acre	877 Doz	832 Doz	826 Doz	501 doz
1995 Avg Net Return	$2,226	$1,830	$1,747	$1,771
1996 Avg Net Return	$1,520	$1,953	$1,398	$878
1997 Avg Net Return	$1,373	$861	$1,422	$778
3 Year Avg Net Return	$1,706	$1,548	$1,522	$1,142
Efficacy				
1995 Avg % Insect Damaged Ears	5.31%	10.44%	6.02%	25.23%
1996 Avg % Insect Damaged Ears	19.78%	9.20%	11.85%	35.45%
1997 Avg % Insect Damaged Ears	4.53%	2.74%	6.83%	5.90%
3 Year Avg, % Insect Damaged Ears	9.87%	7.46%	8.23%	22.19%
Environment				
1995 Avg EIQ FUR	306.62	111.77	59.95	2.59
1996 Avg EIQ FUR	218.49	152.82	54.35	4.43
1997 Avg EIQ FUR	220.06	115.38	34.4	3.13
3 Year Avg EIQ FUR	248.39	126.66	49.57	3.38
1995 Lbs N P &K Used	180.6	180.6	120.4	0
1996 Lbs N P &K Used	203.1	203.1	162.3	0
1997 Lbs N P &K Used	203.1	203.1	121.5	0
3 Year Avg Fertilizer Used	195.6	195.6	134.7	0