

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

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Introduction: Four sweet corn pest and crop management systems (Organic, IPM/Present, IPM/Future, and Conventional) were defined and implemented at NYSAES Geneva (1995-1999) and on grower farms (1997-1999). The systems were compared on the basis of **economics**, pest control **efficacy** and **environmental** impact.

Methods: The 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 fresh market sweet corn growers; IPM Present -those practices which follow IPM Elements (Petzoldt et al 1999); IPM Future – IPM Present practices plus those practices that may still be under research or expensive to implement; Organic – following NOFA-NY guidelines (NOFA-NY 19__).

-Economics of each of the systems were evaluated by defining a typical farm profile growing fresh market sweet corn. Surveys were sent out to approximately 24 sweet corn growers during the 1997 growing season with 9 growers responding. A typical fresh market sweet corn farm has 275 total production acres with 100 acres planted to field crops, 100 acres to other vegetables and 75 acres planted to sweet corn. To determine ownership costs, repair costs and estimated life expectancy for each implement, the frequency of use on all production acres was calculated and general assumptions were made about practices (G. White, pers comm). A 30% premium price was used for Organic system calculations.

-Pest control efficacy was evaluated using scouting data and end of season evaluation of corn ears for pest damage.

-Environmental impact was evaluated by means of the Environmental Impact Quotient (Kovach et al 1992), pesticide use, and synthetic fertilizer use.

-The site at NYSAES contained all four systems and allowed for a rotational component to be introduced. Each system consisted of an early and a late planting of a half-acre each year. At the NYSAES site the IPM Future system could not include the use of *Trichogramma ostrinae* because of the potential for interplot interference.

-Grower sites varied in size from 1 to 5 acres. Each farm had either one or two of the systems present in a field with the intent to represent all four systems each year. In reality, the Organic system could only be located on three grower sites and the pest management practices we demonstrated on those farms were not different from the IPM Future system sites. In grower fields, the IPM Future insect management strategy was modified to include the use of *Trichogramma ostrinae* and *Bacillus thuringiensis* (Bt) for European corn borer (ECB) management. Actual economic data was not obtained from growers since this is confidential information

Results

NYSAES Geneva site: Table 1 shows the results of 5 years of study at NYSAES. All 4 systems were profitable on average although the Organic system was significantly less profitable than either the Conventional or IPM Future systems. The Organic system was significantly more costly to implement than the other three systems while the Conventional system was significantly cheaper. All four systems resulted in acceptable marketplace levels of insect damage for their particular markets. While damage from the worm pests of sweet corn was highest in the Organic, aphid levels were very low compared to Conventional – perhaps as a result of low natural enemy populations in the Conventional plots after pesticide applications. The Organic system used significantly fewer pesticide applications and pounds of fertilizer than the other three systems. The Organic and IPM Future systems used significantly less active ingredient of pesticide and had significantly lower EIQ ratings than the other two systems. IPM Present used significantly less pesticide and had a significantly lower EIQ than Conventional. The use of vetch as a cover crop provided a large portion of the nitrogen required for a corn crop.

Grower farm sites: Table 2 shows the results of 3 years of grower farm evaluations. On grower sites, the differences among the systems were less dramatic in terms of efficacy and environment but the relationships were approximately the same. All systems achieved an average of less than 5% insect damage. The use of *Trichogramma ostrinae* as an inundative release kept worm infestations at low levels in the IPM Future and Organic plots.

Discussion: Results indicate that there is not any one system of growing sweet corn in New York that is clearly better than another from all three viewpoints of economics, efficacy, and environment. There are clear advantages to certain systems based on what goals are to be optimized. IPM systems appear to be reasonable compromises that attain high economic return while reducing environmental impact.

Figure 1: Pest and crop management systems 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 1998 - summer/sweet corn fall/ fallow 1999 - summer/snap beans fall/ fallow	1994 - cabbage 1995 - summer/ sudex, fall/ rye 1996 - summer/sweet corn fall/ rye 1997 - summer/buckwheat fall/ rye 1998 - summer/sweet corn fall/ rye 1999 - 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 1998 - summer/sweet corn fall/ rye vetch 1999 - summer/soybean fall/ rye vetch	1993 - summer/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 1998 - summer/sweet corn fall/ rye vetch 1999 - summer/soybean fall/ rye vetch
Crop History- North Half			
1994 - sweet corn 1995 - summer/sweet corn 1996 - summer/snap beans fall/ fallow 1997 - summer/sweet corn fall/ fallow or rye 1998 - summer/snap beans fall/ fallow 1999 - summer/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 1998 - summer/ buckwheat fall/ rye 1999 - 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 1998 - summer/ soybean fall/ rye vetch 1999 - 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 1998 - summer/ soybean fall/ rye vetch 1999 - summer/sweet corn fall/ rye vetch
Varieties and planting dates			
Var./plant date Delectable/May 20th-28th Zenith/June 24th-25th	Var./plant date Delectable/May 20th-28th Zenith/June 24th-25th	Var./plant date Delectable/May 20th-28th Zenith/June 24th-25th	Var./plant date Delectable/May 20th-28th Maverick & Zenith/June 24th-25th
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 in fall plowed under in spring	Rye/Vetch planted in fall plowed under in spring	Rye/Vetch planted in fall plowed under in spring
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 N: Hairy 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.	CRW, SCM, and FB: Rotation;	CRW, SCM, and FB: Rotation

Figure 1: (cont.) Pest and crop management systems definitions.

Conventional	IPM Present	IPM Future	Organic
<p>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</p>	<p>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</p>	<p>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</p>	<p>ECB, FAW, CEW: apply Dipel @ 1 lb/A or Xentari @ 1.5 lb/A according to results of scouting and trapping as described in IPM Scouting Procedures Late planting; apply 1 spray Xentari @ 1.5 lb/A at tassel, hand apply corn oil/Bt mix directly to corn silks.</p>

Disease Management Practices

<p>Seedling disease and damping off: Early & Late: Seed treatment with Captan 400, Imazilil, Apron FL, Lorsban</p>	<p>Seedling disease and damping off: Early & Late: Seed treatment with Captan 400, Imazilil, Apron FL, Lorsban</p>	<p>Seedling disease and damping off: Early & Late: Seed treatment with Maxim, Apron FL, Lorsban and T-22 (<i>Trichoderma</i>,) in planter box.</p>	<p>Seedling disease and damping off: Early & Late: Seed treatment with T-22 (<i>Trichoderma</i>,) in planter box.</p>
<p>Stewart's wilt: Crop resistance Early planting Delectable Late planting Zenith</p>	<p>Stewart's wilt: Crop resistance Early planting Delectable Late planting Zenith</p>	<p>Stewart's wilt: Crop resistance Early planting Delectable Late planting Zenith</p>	<p>Stewart's wilt: Crop resistance Early planting Delectable Late planting Maverick</p>
<p>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); 2 sprays/season</p>	<p>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, 4 sprays/season</p>	<p>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 PHI , 4 sprays/season</p>	<p>Common rust: Early planting not a pest Late planting: Plant rust resistant variety Maverick</p>

Weed Management Practices

<p>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</p>	<p>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</p>	<p>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 Brdcst Basagran @ 2 pts/A for broadleaves if needed</p>	<p>Broadleaves and grasses: 1) Flextine broadcast weeder before corn sdlg emergence 2): Brush hoe at 8 -14" corn height; hand weed as necessary, standard cultivation as necessary</p>
1999 cover crops in 2000 planting areas			
<p>summer 1999: Snap beans fall 1999: left fallow</p>	<p>summer 1999: buckwheat 60#/A fall 1999: rye 120#/A</p>	<p>summer 1999: soybean 40-60#/A fall 1999: rye 40#/A vetch 40#/A</p>	<p>summer 1999: soybean 40-60#/A fall 1999: rye 40#/A vetch 40#/A</p>
1998 cover crops in 1999 planting areas			
<p>summer 1998: Snap beans fall 1998: left fallow</p>	<p>summer 1998: buckwheat 60#/A fall 1998: rye 120#/A</p>	<p>summer 1998: soybean 40-60#/A fall 1998: rye 40#/A vetch 40#/A</p>	<p>summer 1998: soybean 40-60#/A fall 1998: rye 40#/A vetch 40#/A</p>
1997 cover crops in 1998 planting areas			
<p>summer 1997: Snap beans fall 1997: left fallow</p>	<p>summer 1997: buckwheat 60#/A fall 1997: rye 120#/A</p>	<p>summer 1997: forage soybean 40-60#/A fall 1996: rye 40#/A vetch 40#/A</p>	<p>summer 1997: forage soybean 40-60#/A fall 1996: rye 40#/A vetch 40#/A</p>
1996 cover crops in 1997 planting areas			
<p>summer 1996: Snap beans fall 1996: left fallow</p>	<p>summer 1996: buckwheat 60#/A fall 1996: rye 120#/A</p>	<p>summer 1996: sweet clover 15#/A fall 1996: rye 40#/A vetch 40#/A</p>	<p>summer 1996: sweet clover 15#/A fall 1996: rye 40#/A vetch 40#/A</p>

Table 1: Results 1995 - 1999 Sweet Corn Systems Comparison - NYSAES, Early & Late Planting Averages.

	Yield (doz. ears)	Marketable (doz. ears)	Cost of Production	Gross \$/Acre	Net \$/Acre
Economics					
Conventional	743.2 a	637.4 a	\$421.31c	\$1,585.21 a b	\$1,169.64 a
IPM Present	647.7 a b	551.5 a	\$479.24 b	\$1,376.84 a b	\$897.60 a b
IPM Future	720.3 a	637.6 a	\$474.31 b	\$1,583.44 a	\$1,109.14 a
Organic	450.5 b	328.0 b	\$539.94 a	\$1,068.94 b	\$529.01 b
	% Insect Damaged Ears	%Aphid Infested Ears	# doz. lost to insects	\$ lost to Insects	
Efficacy					
Conventional	10.9% a	8.1% a	106 a	\$265 a	
IPM Present	8.6% a	6.2% a	96 a	\$241 a	
IPM Future	9.6% a	5.0% a	83 a	\$207 a	
Organic	19.5% a	5.2% a	122 a	\$428 a	
	# Pesticide Applications	Lbs Pesticide FP	Lbs Pesticide AI	EIQ Field Use Rating	Lbs Fertilizer
Environment					
Conventional	7.2 a	17.0 a	6.9 a	250 a	199 a
IPM Present	5.8 a	7.4 b	3.7 b	137 b	199 a
IPM Future	5.2 a	4.4 b c	1.7 c	54 c	129 b
Organic	2.1 b	2.4 c	0.2 c	3 c	0 c

Numbers in a column with a letter in common are not significantly different according to Fishers Protected LSD

Table 2: Results of 1997 - 1999 Sweet Corn Systems Comparison - On Farm Averages.

Efficacy	Yield doz. ears /Acre	% Insect Damaged Ears	% Aphid Infested Ears	# Dozen Lost to Insects/A	\$ Lost to Insects/A
Conventional 15 fields in avg.	(750 to 1,000)	.83%	3.0%	6.2 - 8.3	\$16 - \$21
IPM 61 fields in avg.	(750 to 1,000)	.63%	3.3%	4.7 - 6.3	\$12 - \$16
Trichogramma IPM/F Organic 21 fields in avg.	(750 to 1,000)	4.78%	6.2%	35.9 - 47.8	\$90 - \$120
Environment (Insecticides)	Avg. # Insecticide Sprays	Lbs Insecticide Formulated Product	Avg. EIQ Field Use Rating		
Conventional	2.07	.91	8.96		
IPM	1.30	.72	5.26		
Trichogramma IPM/F and Organic	.48	.81	.51		

*Yield per acre is an estimate of actual yield.

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