

# Crop Profile for Corn (Sweet) in New York

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## General Production Information



Sweet corn is one of the most important vegetable crops produced in New York, in terms of acreage, crop value and number of producers. Fresh market and processing sweet corn are produced for local, regional, and national markets. With the exception of rust and seed decay, sweet corn has relatively few disease problems relative to other vegetables. A wide variety of insects attack the crop, causing losses in yield as well as quality. However quality is critical, especially in the fresh market wholesale business. Wholesale buyers of sweet corn can reject entire shipments if damage levels are as low as 10%. New York sweet corn producers generally use sound integrated pest management practices in managing insects and other pests.

While a relatively large number of insecticides are registered for use, organophosphates remain important tools for resistance management and/or control for pests such as seed corn maggot, flea beetles, garden symphylans, and aphids. Weeds are also major pests of sweet corn. Without the registration of new, effective materials to replace them, the loss of chlorpyrifos, diazinon, terbufos, atrazine, alachlor, metolachlor, bentazon, and propiconazole would have significant impacts on production and profitability.

Registration of new materials by the EPA, even those designated as "low risk", does not guarantee that NY growers will have immediate access to them. NYS Department of Environmental Conservation conducts its own in-depth reviews before registering new pesticides in NY, and may or may not register new materials for portions of or for the entire state.

## Basic Commodity Information

**State Rank:** 4<sup>th</sup> in fresh market; 5<sup>th</sup> in processing

**% U.S. Production:** 7% for fresh market; 8% for processing

**Acres Planted:** 23,000 fresh market; 40,400 processing

**Acres Harvested:** 21,200 fresh market; 39,300 processing

**Cash Value:** \$23,065,000 fresh market; \$15,116,000 processing

**Yearly Production Costs:** \$450 fresh market; \$230 processing (from 1996 survey)

**Production Regions:** Fresh market sweet corn is grown throughout all the agricultural regions of New York, with significant production in Chautauqua, Columbia, Delaware, Erie, Monroe, Niagara, Rockland, Onondaga, Ontario, Orange, Rensselaer, Suffolk, Ulster, and Washington Counties. Processing acreage is concentrated in the central and western regions, including Cayuga, Genesee, Livingston, Monroe, Ontario, Orleans, Steuben, Wayne, Wyoming, and Yates Counties.

**Commodity Destination(s):**

- **Fresh Market:** 24%
- **Processing:** 76%

## Cultural Practices

Sweet corn is a warm-season vegetable that is well adapted to production in New York. It is a popular mainstay item at roadside markets and, consequently, is grown in every rural county in the state. A wide array of varieties are available to commercial growers differing in color (yellow, white, or bicolor), length of season, sugar content and stability (su, se, sh2, and other genetic variations), and ear size and shape. Sweet corn is tolerant of a wide range of soil conditions, and is typically planted in upstate NY from early April through early July. Growers and processors schedule plantings to ensure a steady supply through the season to satisfy market demands. Fields are direct seeded at approximately 10-15 lbs seed per acre. Spacing is usually 30-36 inches between rows and 8-12 inches between plants. Some fresh market growers use clear plastic mulch as tunnels to speed maturity of early plantings. The plastic is removed when plants are 6-12 inches tall. Most processing acreage is planted under contract with a processing company, and processing varieties are for the most part not used for fresh market. There is almost no mixing of fresh market and processing product streams. Under normal temperatures, most varieties reach fresh market maturity 18-21 days from first silking. These are mostly hand-picked, although machine harvesting is becoming somewhat more common in fresh market corn. Once-over harvest is the norm. Processing varieties are harvested at a later stage of maturity than fresh market varieties, and are 100% machine harvested. Advances in sweet corn genetics have widened the "harvest window" for sweet corn considerably over the past decade. Experienced growers consider 6-7 tons per acre to be a good yield for processing and 300-350 crates per acre a good yield for fresh market (4-4.5 dozen ears per crate). Fresh market producers who are wholesaling and shipping sweet corn typically cool the harvested crop using water, ice, refrigeration, or a combination. Processing sweet corn is delivered directly to a plant and usually processed within hours of harvest. Bird damage is a serious problem for fresh market producers, and to a lesser extent, for processing sweet corn growers. Bird flocks can cause growers to lose entire fields due to feeding damage to the ears.

## Insect Pests

### Seedcorn Maggot (*Delia platura*)

**Frequency of Occurrence:** Sporadic, but damage can be extensive.

**Damage Caused:** The larvae or maggots of this fly burrow into corn seed, often destroying the germ, which causes seed death or poor germination. Injury is more prevalent during cool, wet springs.

**% Acres Affected:** 100% at risk; typically 5-10% affected per year.

**Pest Life Cycles:** The seedcorn maggot is common throughout the northeastern US, where it overwinters primarily as a puparium in the soil. During spring planting, the first generation of flies emerges. They lay eggs one to two weeks later just below the surface of recently plowed ground. High crop residue and fresh manure also attract flies which feed on the organic matter. The maggots hatch in four to seven days and feed primarily on decaying organic matter. After feeding for seven to 21 days, the larvae pupate in the soil, usually near the place of larval feeding. The entire life cycle is completed in three to four weeks. There may be three or five generations of seed corn maggots per season; however, the first and second are the most destructive.

**Timing of Control:** Preplant.

**Yield Losses:** Stand losses from seed maggots can reach as high as 30%.

**Regional Differences:** None.

**Cultural Control Practices:** The following cultural practices help minimize losses from this insect: incorporating crop residues well before planting; avoiding manure applications before planting; avoiding low, wet areas; and shallow planting to speed emergence. No resistant varieties are available.

**Biological Control Practices:** Naturally occurring predators, parasitoids, and pathogens, including nematodes, may help suppress infestations, but we lack information in this area.

**Post-Harvest Control Practices:** None.

**Other Issues:** Although the above cultural practices are important in the control of seed maggots, seed treatment with an insecticide is still necessary. Corn is somewhat less susceptible to significant damage than beans, but is still very much at risk.

**Chemical Controls:**

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	# of Appl.	PHI <sup>1</sup> days	REI hours
<i>chlorpyrifos</i> (Lorsban)	80 P <sup>4</sup> <5 F	commercial seed treatment	1 oz/100 lbs seed; =0.01 lb ai/acre	before planting	1	70	NA
<i>chlorpyrifos</i> (Lorsban)	0 P 3-5 F	grower-applied seed treatment	1 oz/100 lbs seed; =0.01 lb ai/acre	at planting	1	70	12
<i>diazinon</i> (Diazinon)	0 P 20 F	planter-box treatment	0.25 oz/100 lbs seed=0.025 lbs ai/acre	at planting	1	70	24
<i>terbufos</i> <sup>2</sup> (Counter)	10 P 15 F	in-furrow soil applied	1.3 lbs ai/acre	at planting	1	70	48
<i>lindane</i> <sup>3</sup> (Isotox)	0 P 1-5 F	planter box treatment	2 oz product/100 lbs seed	at planting	1	70	24

1. PHI on this and all tables indicates the typical number of days between application and harvest, not label PHIs.
2. Primarily applied for corn flea beetle control, but does provide some seed maggot control.
3. Used primarily on Long Island.
4. P=processing sweet corn acreage; F=fresh market sweet corn acreage.

**Use in IPM Programs:** The use of commercial or grower applied seed treatments is consistent with Cornell IPM recommendations.

**Use in Resistance Management:** None reported

**Efficacy Issues:** Producers rely primarily on chlorpyrifos for seed maggot control. Trials need to be conducted on the

efficacy of terbufos and tefluthrin in the absence of chlorpyrifos under NY conditions.

**Alternatives:** Little research has been conducted on alternatives to organophosphates for seed maggot control. It is possible that fipronil may be effective, but several years of research would need to be conducted to determine its efficacy. A new product, thiamethoxam (trade name Adage; Novartis) may be an effective alternative, but trials would need to be conducted.

### **Corn Flea Beetle**(*Chaetocnema pulicaria*)

**Frequency of Occurrence:** Annually, although population pressure varies considerably from year to year.

**Damage Caused:** Adult beetles leave numerous, short etching or scratch marks on corn leaves, usually parallel to the leaf veins. Such direct feeding is insignificant, unless large numbers of beetles attack slow-growing corn, especially during a cold spring. By far the most important damage results from Stewart's wilt, caused by a bacteria that is introduced into the plant and spread by beetle feeding. See "Stewart's Wilt" section for more information.

**% Acres Affected:** 100%

**Pest Life Cycles:** The corn flea beetle is a small black beetle (3/32 inch long) that overwinters in litter and trash around fields. In early spring, beetles are active on weeds and then move to corn seedlings during May and June. Infestations are more severe after a mild winter followed by a cold spring. Adult feeding on foliage is seldom detrimental, but it is through such feeding that Stewart's wilt is transmitted. Eggs are scattered on the soil surface around young plants. Larvae hatch in 10 to 14 days and begin to feed on and tunnel into roots. They feed for three to four weeks before pupating in the soil. Three or more generations are completed each year.

**Timing of Control:** Seedling through mid-whorl; at planting if pest pressure is high.

**Yield Losses:** Losses due to Stewart's wilt (vectored by the corn flea beetle) can be as high as 80%. Yield losses due to corn flea beetle feeding alone is rarely more than 5%.

**Regional Differences:** None.

**Cultural Control Practices:** Planting of varieties with resistance or tolerance to Stewart's wilt is a very important control measure. However, variety selection decisions (especially for fresh market sweet corn) are driven more by consumer demands (e.g. ear size, taste, and appearance) rather than by disease tolerance decisions. Fields planted midseason generally have lower beetle infestations than early- or late-planted fields.

**Biological Control Practices:** Little is known about the impact of natural enemies on corn flea beetles.

**Post-Harvest Control Practices:** Although not a good soil conservation practice, fall plowing reduces overwintering populations.

**Other Issues:** Results of research on varietal reaction to Stewart's wilt conducted in other states is used for NY recommendations on variety selection.

**Soil-Applied Insecticides for Corn Flea Beetle and Corn Rootworm Control:**

<b>Pesticide</b>	<b>Target Pest<sup>1</sup></b>	<b>% Trt.</b>	<b>Type of Appl.</b>	<b>Typical Rates lbs ai/acre</b>	<b>Timing</b>	<b># of Appl.</b>	<b>PHI days</b>	<b>REI hours</b>
<i>carbofuran</i> ( <i>Furadan</i> )	CR FB	5 P 15 F	in-furrow	1.0	at planting	1	70	48
<i>tefluthrin</i> ( <i>Force</i> )	CR	10 P <1 F	soil-applied, banded	0.12	at planting	1	70	48
<i>phorate</i> ( <i>Thimet</i> )	CR FB	0 P <1 F	soil applied	1.2	at planting	1	70	48
<i>terbufos</i> ( <i>Counter</i> )	CR FB	10 P 15 F	in-furrow soil applied	1.0	at planting	1	70	48

1. See "European Corn Borer" section for foliar insecticides for flea beetle control.

2. CR=corn rootworms; FB=flea beetles

Use in IPM Programs: The use of soil-applied insecticides is consistent with Cornell IPM recommendations under certain circumstances, e.g. during years of very high corn flea beetle pressure. Severity of corn flea beetle populations (and hence, of Stewart's wilt disease) can be forecasted using winter temperature data. This gives an indication of risk for the upcoming season.

**Use in Resistance Management:** None reported

**Alternatives:** Thiamethoxam (Adage), a new insecticide from Novartis, may be a useful alternative for flea beetle control in sweet corn.

### **European Corn Borer** (*Ostrinia nubilalis*)

**Frequency of Occurrence:** Annually.

**Damage Caused:** Larval feeding on leaves, stems and tassels can result in stalk breakage. Direct boring and feeding in the ears renders them unsalable.

**% Acres Affected:** 100%

**Pest Life Cycles:** Fifth instar larvae overwinter in the stalks of corn or other host plants. They pupate in April or May, and moths emerge to mate and lay eggs. Egg masses, consisting of 5-50 flat, white to cream-colored shiny eggs, are laid on the undersides of corn leaves. Hatching occurs in three days to a week, depending on temperatures. Larvae feed on stems, leaves and ears. There are one to three generations per season, depending on the strain present in the area (univoltine or bivoltine) and the weather conditions.

**Timing of Control:** Mid-May through September.

**Yield Losses:** Can be as high as 100% in fresh market sweet corn even when damage is only 10-15% unmarketable ears. Wholesale buyers can reject entire loads even if worm infestations are relatively light. Pest pressure can vary considerably from year to year.

**Regional Differences:** Pest pressure can vary greatly, and some geographical regions (e.g. Niagara County, Long Island) consistently have higher corn borer populations than other regions.

**Cultural Control Practices:** Destruction of corn residue and plowing in the fall (a poor practice in terms of soil conservation) can destroy a large percentage of overwintering larvae. Recent research has shown that early maturing varieties are more susceptible to corn borer damage.

**Biological Control Practices:** A variety of natural enemies can help suppress ECB infestations including predatory lady beetles, minute pirate bugs and lacewings, and fly and wasp parasitoids. Bird predation of overwintering larvae may also be important. See "Other Issues" and "Alternatives" for information on biological control alternatives.

**Post-Harvest Control Practices:** None.

**Other Issues:** ECB is perhaps the most important insect pest of sweet corn, and research on its control is ongoing (Hoffmann, Shelton, Seaman, Straub). New classes of foliar insecticides (e.g. spinosad and biologicals such as

*Beauveria bassiana*) are being tested for control of ECB as well as their effects on important natural enemies of ECB (Shelton, Straub). The use of Bt transgenic corn is being investigated as well as introduction of the parasitoid *Trichogramma ostriniae* (Hoffmann, Seaman). Host plant resistance is also being researched (Hoffmann).

**Foliar Insecticides for European Corn Borer and Other Pests of Sweet Corn:**

<b>Pesticide</b>	<b>Target Pest<sup>1</sup></b>	<b>% Trt.</b>	<b>Type of Appl.</b>	<b>Typical Rates lbs ai/acre</b>	<b>Timing</b>	<b># of Appl.</b>	<b>PHI days</b>	<b>REI hours</b>
<i>chlorpyrifos</i> (Lorsban)	ECB	1 P <1 F	Foliar, ground or air.	1.2	whorl stage	1	30	12
<i>cyfluthrin</i> (Baythroid)	ECB, CEW, FAW	9 P <1 F	Foliar, ground or air.	0.03	late whorl to harvest	1	7	12
<i>esfenvalerate</i> (Asana)	ECB, CEW, FB, A	<1 P 12 F	Foliar, ground or air.	0.04	late whorl to harvest	1 P 2-3 F	7	12
<i>lambda-cyhalothrin</i> (Warrior)	all	78 P 75 F	Foliar, ground or air.	0.02	late whorl to harvest	1-2 P 2-5 F	7	24
<i>methomyl</i> (Lannate)	all	0 P 17 F	Foliar, ground or air.	0.4	late whorl to harvest	1 P 1-2 F	3	48
<i>methyl parathion</i> (Penncap-M)	ECB, A	0 P 23 F	Foliar, ground or air.	1.0	late whorl to harvest	1-2	3	48
<i>permethrin</i> (Ambush)	ECB, FB, CEW, FAW	1 P 20 F	Foliar, ground or air.	0.125	late whorl to harvest	1 P 2-4 F	3	12

<i>thiodicarb</i> ( <i>Larvin</i> )	ECB, CEW, FAW	0 P 30 F	Foliar, ground or air.	0.75	late whorl to harvest	1 P 1-3 F	3	48
<i>carbaryl</i> ( <i>Sevin</i> )	CEW FB	0 P 2 F	Foliar, ground or air.	1.0	late whorl to harvest	1	3	12
<i>oxydemeton-methyl</i> ( <i>Metasystox-R</i> )	A	0 P <1 F	Foliar, ground.	0.5	late whorl to harvest	1	3	12

1. Key to pests: ECB=European corn borer; CEW=corn ear worm; FAW=fall army worm; A=aphids; FB=flea beetles.

**Use in IPM Programs:** Managed under a processor-supported IPM program that includes weekly scouting and treatment only when thresholds are exceeded, most processing sweet corn typically receives two insecticide applications per season. This varies from 0-3 applications depending on pest pressure. Between 5-15% per year of processing sweet corn receives no foliar insecticides. Three to four applications are made on approximately 1% of the crop acreage; in these cases, the target pest is fall armyworm, not European corn borer. Many fresh market producers also use IPM, some through an organized marketing program. Insecticide applications tend to be higher in fresh market sweet corn than in processing because the tolerances for insect damage to ears is lower for fresh market sweet corn. The number of applications ranges from 0-5 per planting for fresh market sweet corn.

**Use in Resistance Management:** While resistance has not yet been reported, non-pyrethroid classes of insecticides need to be available for continued resistance management.

**Alternatives:** Transgenic Bt sweet corn cultivars have recently been introduced in New York (400 acres in 1998 for processing and fresh market). These were generally effective on ECB, but much less so on fall armyworm and corn ear worm. Although not yet registered, spinosad (Spintor) has shown a high degree of efficacy in research trials. Bt (foliar applied) and *Beauveria bassiana* have not proven as effective as most other currently available materials.

### Corn Earworm(*Helicoverpa zea*)

**Frequency of Occurrence:** Annually.

**Damage Caused:** Larvae feed directly on sweet corn ears, particularly at the tips. This renders the ear unsalable for fresh market. CEW is much less of a problem for processing sweet corn, since the tips of infested ears are removed during processing.

**% Acres Affected:** 100% at risk; typically up to 50% affected per year.

**Pest Life Cycles:** Corn earworms (CEW) overwinter as far north as southern NJ, but only on Long Island in NY. The first occurring infestations in early summer originate from successfully overwintering individuals. A second generation arises late in the season. Late-season populations, the only one to affect upstate NY, arise from moths migrating from southern states. Female moths are highly attracted to fresh-silking sweet corn for oviposition. Eggs are typically laid one per ear, and hatch in 2-10 days depending on temperatures. Hatching larvae feed on silks and work their way to the kernels at the ear tip. They go through six instar stages, when they drop to the ground, burrow into the soil, and pupate. Moths emerge from the pupa in 10 to 25 days.

**Timing of Control:** Mid-July through September.

**Yield Losses:** Can be as high as 100% in fresh market sweet corn even when damage is only 10-15%. Wholesale buyers can reject entire loads even when worm infestations are relatively low.

**Regional Differences:** Pest pressure is higher on Long Island and in the Hudson Valley than in other parts of the state.

**Cultural Control Practices:** Varieties with tight husks are more resistant to infestation. Because CEW immigrate, early-maturing varieties may be less subject to infestation. Cultural controls alone often will not provide adequate levels of control to meet fresh market wholesale standards.

**Biological Control Practices:** A variety of natural enemies may help suppress CEW infestations but information is lacking.

**Post-Harvest Control Practices:** None.

**Chemical Controls:** The following are labeled for CEW control: carbaryl, cyfluthrin, esfenvalerate, lambda-cyhalothrin, methomyl, permethrin, and thiodicarb. See "European Corn Borer" section for pesticide use information.

### Fall Armyworm (*Spodoptera frugiperda*)

**Frequency of Occurrence:** Sporadic, but damage can be significant.

**Damage Caused:** Larvae move deep into the whorls of young corn plants where feeding results in large, irregular holes visible in the new leaves as they unfold. Infested plants look ragged and torn, and copious amounts of frass are found on the emerging tassel and leaves. The greatest damage is caused by larvae moving to and feeding on the ears, reducing their market value.

**% Acres Affected:** 100% at risk; typically up to 50% affected per year.

**Pest Life Cycles:** The fall armyworm does not overwinter in the Northeast. Infestations result from moths migrating from southern states. Its arrival in NY is dependent upon weather patterns. Numbers are usually highest along coastal areas, and later in the growing season. Females lay eggs at night in masses of 50 or more on the leaves of whorl stage corn, small grains and grasses. Eggs hatch into larvae within 10 days, depending on temperatures. Larvae become full grown within two to three weeks after hatching, at which point they crawl or drop to the ground and pupate in the soil. The pupa stage last about 10-14 days; the adults emerge and make their way to the soil surface.

**Timing of Control:** Mid-July through September.

**Yield Losses:** Can be as high as 100% in fresh market sweet corn even when damage is only 10-15%. Wholesale buyers can reject entire loads even when worm infestations are relatively low.

**Regional Differences:** Pest pressure tends to be higher in Long Island than in upstate NY.

**Cultural Control Practices:** Planting early varieties, where practical, may be useful in avoiding this pest. This practice is of only marginal value, however, since the market demands both fresh market and processing sweet corn through the entire season.

**Biological Control Practices:** A variety of natural enemies may help suppress FAW infestations but information is lacking.

**Post-Harvest Control Practices:** None.

**Other Issues:** Typically, of all the worm pests of sweet corn, FAW is the most difficult to manage. Research in the Hudson Valley (Straub) has shown that pyrethroids are generally superior to other insecticide classes.

**Chemical Controls:** The following are labeled for FAW control: cyfluthrin, lambda-cyhalothrin, methomyl, permethrin, and thiodicarb. See "European Corn Borer" section for pesticide use information.

### Corn Leaf Aphid (*Rhopalosiphum maidis*)

**Frequency of Occurrence:** Occur annually; economic significance is sporadic.

**Damage Caused:** Aphids cause injury to sweet corn by removing plant sap with their needleline mouthparts. High populations can cause discoloration of outside husk layers, making corn unattractive to consumers. Corn leaf aphids are the primary vectors of maize dwarf mosaic virus and perhaps barley yellow dwarf virus. Economic infestations usually don't occur until mid-summer or later. For processing sweet corn, insecticide treatments are rarely justified. However, aphicides are frequently used as needed in fresh market sweet corn, due to the very low tolerance wholesale buyers have for aphids in or on husks.

**% Acres Affected:** 100% at risk; up to 40% affected per year.

**Pest Life Cycles:** Corn leaf aphids have soft, green, pear-shaped bodies about 1/8 inch in length. Both winged and wingless adult forms are found together. They overwinter on small grains as either eggs or females that give birth during early spring. Wingless females continue to produce offspring without mating for numerous generations. During late May and June, as wheat, barley and other cereals mature and become less succulent, winged aphids develop and migrate to corn and wild grasses to spend the summer.

**Timing of Control:** Early tassel through harvest. If barley yellow dwarf virus is a threat, applications to whorl-stage corn may be justified.

**Yield Losses:** Can be up to 100% in fresh market sweet corn. Producers have had entire loads rejected due to the presence of a few aphids on the husks.

**Regional Differences:** None.

**Cultural Control Practices:** Early season corn is less likely to be infested. No resistant varieties are available.

**Biological Control Practices:** A variety of predators, especially lady beetles, parasitoids and pathogen help suppress infestations. These can be protected by using foliar insecticides judiciously.

**Post-Harvest Control Practices:** None.

**Chemical Controls:** Oxydemeton-methyl, esfenvalerate, lambda-cyhalothrin, methomyl, and methyl parathion are labeled for aphid control. See "European Corn Borer" section for pesticide use information. Probably much of the methyl parathion used by fresh market producers is for aphid control, not ECB.

**Use in IPM Programs:** Scouting procedures and thresholds have been established for fresh market sweet corn.

**Efficacy Issues:** Some producers are finding that aphids are not always well controlled by available insecticides.

**Alternatives:** A new insecticide, pymetrozine (trade name Fulfil; Novartis) may be an effective alternative, but trials have not yet been conducted to test its efficacy.

### Cutworms (*Agrotis ipsilon*)

**Frequency of Occurrence:** Sporadic, but damage can be significant.

**Damage Caused:** Young larvae feed on the leaves of young plants, and older cutworms bore into or sever the stem at or

below ground level. As a result, crop stands can be significantly reduced.

**% Acres Affected:** 100% at risk; typically 5-15% affected per year.

**Pest Life Cycles:** The black cutworm is the most important species of cutworm attacking sweet corn. Moths blow into the area on southerly winds. Moths become active during April when females deposit eggs on surface trash and low dense growth of weeds, usually in areas of fields that are poorly drained. Eggs hatch in 7-14 days and larval infestations occur by the time corn is planted. After feeding for four to five weeks during May to early June and developing through seven instar stages, larvae pupate in the soil. The second and third generations appear during the summer, but do not injure sweet corn.

**Timing of Control:** Seedling stage.

**Yield Losses:** Can be up to 50% in severely affected fields.

**Regional Differences:** None.

**Cultural Control Practices:** Avoid fields with a history of cutworm problems. Avoid fields containing weeds, especially winter annuals such as chickweed, or control weeds well before planting. No resistant varieties are available.

**Biological Control Practices:** Naturally-occurring predators, parasitoids, and pathogens may help suppress infestations but information is lacking.

**Post-Harvest Control Practices:** None.

**Chemical Controls:** Carbaryl, chlorpyrifos, esfenvalerate, and lambda-cyhalothrin are all labeled for use in sweet corn. See table in "European Corn Borer" section. Except in years with serious cutworm outbreaks, typically only 1-5% of the acreage is treated with these materials for cutworm control, usually with chlorpyrifos.

**Use in IPM Programs:** A scouting procedure and thresholds have been established for cutworm control. Esfenvalerate and lambda-cyhalothrin can be used for as-needed applications.

### Sap Beetle (*Carpophilus lugubris*)

**Frequency of Occurrence:** Sporadic.

**Damage Caused:** Adult sap beetles (also known as picnic beetles) invade injured ears, such as those with corn borer tunnels. They also feed on the pollen as it ripens on the tassels and later as it lodges in the leaf axils. Larvae can feed on developing kernels on the upper half of the ear. Sap beetle damage can be more serious than worm damage in processing corn because of the location of the injury and the likelihood of insect contamination. Sap beetle damage is

often highest in corn damaged by other pests, such as worms or birds.

**% Acres Affected:** 100% at risk; typically up to 10% affected per year.

**Pest Life Cycles:** Adult and pupal stages of the dusky sap beetle overwinter in corn refuse in the soil or in protected places above the ground. Winter survival is an important factor in determining spring populations: many overwintering adults are killed by freezing temperatures in December and January. Beetles and larvae feed on plant tissue as well as on frass of worm pests. Eggs are deposited on worm frass on ear tips or on silks, and on wet accumulations of pollen. Full-grown larvae leave the ear, drop to the ground and burrow into the soil to form pupal cells. In summer, one generation takes about 30 days from egg laying to adult emergence. At least two or three overlapping generations occur each year.

**Timing of Control:** Ear-fill through harvest.

**Yield Losses:** Up to 30% in severely affected fields.

**Regional Differences:** None.

**Cultural Control Practices:** Avoid varieties with short husks or poor tip cover. Clean cultivation is recommended because beetles overwinter in crop residue. It is especially important to destroy or remove infested ears of corn.

**Biological Control Practices:** Unknown.

**Post-Harvest Control Practices:** None.

**Other Issues:** Regular sprays for worm pests generally minimize the threat of sap beetle infestations.

**Chemical Controls:** Diazinon and lambda-cyhalothrin are labeled for control of this insect. Very little if any diazinon is applied to sweet corn. See "European Corn Borer" section for lambda-cyhalothrin use.

### **Western Corn Rootworm** (*Diabrotica virgifera virgifera*)

**Frequency of Occurrence:** Sporadic, but increasing in importance, especially in upstate NY.

**Damage Caused:** Adults feed on leaves, tassels and silks. In high populations, significant silk feeding can interfere with pollination, resulting in poor kernel development and tip-fill. Larvae feed on roots, weakening plants and making them more susceptible to lodging during high winds.

**% Acres Affected:** 100% at risk; up to 50% affected per year.

**Pest Life Cycles:** Western corn rootworms overwinter as eggs.

**Timing of Control:** At planting; and midseason through harvest.

**Yield Losses:** Up to 50% in severely affected fields.

**Regional Differences:** Presently, this is more serious in upstate NY.

**Cultural Control Practices:** Rotating away from corn for one year is a very effective control measure. Late-season planting will decrease the risk of damage from overwintering populations.

**Biological Control Practices:** Naturally-occurring predators, parasitoids, and pathogens help suppress infestations.

**Post-Harvest Control Practices:** None.

**Chemical Controls:** Terbufos, phorate, and tefluthrin are labeled for control. See "Corn Flea Beetle" section for pesticide use information.

### Garden Symphylans (*Scutigera immaculata*)

**Frequency of Occurrence:** Sporadic, but can be significant.

**Damage Caused:** Symphylans feed on roots and cause plant stunting.

**% Acres Affected:** 2-3%

**Pest Life Cycles:** Symphylans are small, white, centipede-like creatures, and little is known about their biology.

**Timing of Control:** at planting

**Yield Losses:** Usually minimal, but can be significant under severe infestations.

**Regional Differences:** This pest seems to be confined to the far western NY counties, where early sweet corn is grown on gravelly, extremely well-drained, coarse-textured soils.

**Cultural Control Practices:** Unknown.

**Biological Control Practices:** Unknown.

**Post-Harvest Control Practices:** Unknown.

**Chemical Controls:** Fonofos (Dyfonate) and chlorpyrifos (Lorsban) are the only labeled pesticides for this pest. While they are used on a relatively small percentage of the sweet corn acres in the state (5-10% of the fresh market acreage; soil applied at planting), it is critical for growers to have access to an effective control measure. Dyfonate is in the process of tolerance revocation; existing stocks can be used. Producers in affected areas have a critical need for an effective alternative control.

## Slugs

**Frequency of Occurrence:** Sporadic. Damage is usually more frequent in cool wet springs, and in fields where reduced tillage has been practiced.

**Damage Caused:** Slugs can damage or kill small plants by direct feeding on the leaves or by severing the plant at ground level.

**% Acres Affected:** 100% at risk; typically up to 5% affected per year.

**Pest Life Cycles:** Slugs can overwinter at any stage of development, often in the burrows of small mammals or worms. Slugs begin to move, hatch, feed, and lay eggs in the spring when temperatures are consistently above 40° F. There is often little or no slug activity in the field during periods of dry weather, however, there may be extensive feeding in damp areas.

**Timing of Control:** Early spring.

**Yield Losses:** Usually minimal, but can significantly affect stand in severely affected fields.

**Regional Differences:** None.

**Cultural Control Practices:** Minimize crop debris on soil surface.

**Biological Control Practices:** None.

**Post-Harvest Control Practices:** None.

**Chemical Controls:** Metaldehyde is labeled for control of slugs, but <1% of the acreage is treated annually.

## Diseases

### Anthracnose (*Colletotrichum graminicola*)

**Frequency of Occurrence:** Sporadic, but increasing in frequency.

**Damage Caused:** The disease causes blighting of the leaves and stems, weakening plants. Lodging may occur. Foliage and stem tissues of any age are susceptible, but older leaves are usually affected first. Lesions start small, but may enlarge and caused leaves to become necrotic.

**% Acres Affected:** 100% at risk; up to 20% affected per year.

**Pest Life Cycles:** Anthracnose is a fungal disease of several different grasses and small grains. It can be seed-borne and once introduced into a field it can survive on corn stubble. Stalks in contact with or buried beneath the soil provide an unfavorable environment for winter survival of the pathogen. Once the disease occurs in the field, spores can be spread by wind, rain, insects, and farm machinery. The disease can become very prevalent in no-till systems.

**Timing of Control:** all season.

**Yield Losses:** up to 25% in severely affected fields.

**Regional Differences:** None.

**Cultural Control Practices:** Rotation away from corn and other susceptible grains for at least one year can break the disease cycle.

**Biological Control Practices:** None.

**Post-Harvest Control Practices:** Crop debris should be destroyed as soon as possible to remove this source of disease for other plantings and to initiate decomposition.

**Other Issues:** No pesticides are registered to manage anthracnose.

### Common Rust (*Puccinia sorghi*)

**Frequency of Occurrence:** Occurs almost annually, although disease severity varies from year to year depending on weather.

**Damage Caused:** Early infections (whorl up to tassel stage) can weaken plants and result in smaller ears with dehydrated kernels. Later infections typically do not affect yield, but the brown pustules on the husks render ears unsalable

for fresh market. Fresh market producers have not widely adopted mechanical harvesting in part because in rust infected fields, machine-picked ears become covered by rust and are rendered unmarketable.

**% Acres Affected:** 100% at risk; up to 60% affected per year.

**Pest Life Cycles:** Spores of the fungus are reintroduced from southwestern states each year. All above-ground tissues are susceptible to infection, but leaves are more severely affected. Pustules containing golden-brown to cinnamon-brown spores appear on both leaf surfaces, tassels, and husks on infected plants.

**Timing of Control:** whorl through tassel; especially on later planted corn.

**Yield Losses:** Can be up to 20% in processing sweet corn fields with early infections; and up to 50% in fresh market sweet corn (due to cosmetic damage).

**Regional Differences:** Certain geographical locations (e.g. Genesee County, Long Island) seem to be particularly prone to rust infection, perhaps due to prevailing wind patterns.

**Cultural Control Practices:** Resistant varieties should be planted whenever possible. Planting near corn fields of different maturity may be useful in minimizing disease spread. Fields with poor air drainage should be avoided where possible.

**Biological Control Practices:** None.

**Post-Harvest Control Practices:** None.

**Other Issues:** Research is currently being conducted on the biology, epidemiology, and control of common rust in sweet corn (Dillard).

**Chemical Controls:**

Pesticide	% Trt.	Type of Appl.	Typical Rates lbs ai/acre	Timing	# of Appl.	PHI days	REI hours
<i>propiconazole</i> <i>(Tilt)</i>	8 <sup>1</sup> P 10 F	ground, foliar	0.1	prior to tassel	1.2	30	24

<i>chlorothalonil</i> <sup>2</sup> ( <i>Bravo</i> )	0 P <1 F	ground, foliar	0.6-1.5	prior to tassel	--	30	48
<i>maneb</i> <sup>3</sup> ( <i>Maneb, Manex</i> )	0 P 1-5 F	ground, foliar	1.125	prior to tassel	1	30	24
<i>mancozeb</i> <sup>3</sup> ( <i>Dithane</i> )	0 P <1 F	ground, foliar	1.125	prior to tassel	--	30	24

1. Ranges from 0-15% per year, depending on disease pressure.
2. For fresh market sweet corn only.
3. Some processors discourage the use of these fungicides.

Use in IPM Programs: A scouting and sampling procedure has been developed for determining need for fungicide applications.

**Use in Resistance Management Programs:** None reported.

**Efficacy Issues:** Chlorothalonil is labeled for fresh market sweet corn only. Some food processors discourage the use of maneb or mancozeb.

**Alternatives:** Azoxystrobin (Quadris), tebuconazole (Folicur), and an experimental material, CGA279200, were found to be effective in recent trials.

### Common Smut (*Ustilago maydis*)

**Frequency of Occurrence:** Occurs almost annually, but not always at economically damaging levels.

**Damage Caused:** The disease is easily recognized by the production of large galls on ears, leaves and tassels. Young galls are silvery-white to greenish in color. As they mature, they develop into masses of powdery dark-brown to black spores.

**% Acres Affected:** 100% at risk; up to 75% affected per year.

**Pest Life Cycles:** Smut spores overwinter on top of the soil as teliospores. During spring, teliospores develop basidiospores which are carried by air currents to susceptible tissues. Smut is most common during dry, hot summers. Infections often develop through wounded tissues caused by hail, cultivation, or excessive insect feeding injury.

**Timing of Control:** Seedling through ear formation.

**Yield Losses:** Usually small, <5%. However, fresh market producers have not widely adopted mechanical harvesting in part because in smut infected fields, machine-picked ears become covered by smut and are rendered unmarketable.

**Regional Differences:** None.

**Cultural Control Practices:** Rotation away from corn for at least one year helps break the disease cycle, but is not completely effective. Varieties vary in their susceptibility.

**Biological Control Practices:** None.

**Post-Harvest Control Practices:** Crop debris should be destroyed as soon as possible to remove this source of disease for other plantings and to initiate decomposition.

**Other Issues:** No pesticides are registered to manage common smut.

### Northern Corn Leaf Blight(*Exserohilum turcicum*)

**Type of Pest:** Fungus

**Frequency of Occurrence:** Sporadic.

**Damage Caused:** The disease causes a blighting of the leaves, weakening the plant. Plants can withstand up to 20% leaf blight at tassel stage before yield is significantly reduced.

**% Acres Affected:** 100% at risk; typically <5% affected per year.

**Pest Life Cycles:** This fungus causes several types of leaf lesions, depending on the genetic make-up of the host plant. The fungus survives as spores or chlamydospores with or without plant debris. The disease is initiated by overwintering spores or ones that may be blown in from other areas.

**Timing of Control:** whorl through tassel.

**Yield Losses:** On very susceptible varieties, losses can run as high as 100%.

**Regional Differences:** None.

**Cultural Control Practices:** Resistant varieties are available to commercial growers. Crop rotation away from corn for at least one year is recommended. Fields with poor air drainage are at greater risk of infection.

**Biological Control Practices:** None.

**Post-Harvest Control Practices:** Crop debris should be destroyed as soon as possible to remove this source of disease for other plantings and to initiate decomposition.

**Chemical Controls:** Chlorothalonil (fresh market), propiconazole, maneb and mancozeb are labeled for use. See "Rust" section for pesticide use information.

### Seed Rots (various species)

**Frequency of Occurrence:** Sporadic, but damage can be extensive.

**Damage Caused:** Seed rots cause pre- and post-emergence damping-off and poor stand establishment.

**% Acres Affected:** 100% at risk; typically 1-5% affected per year.

**Pest Life Cycles:** Seed rots are caused by several fungi, including *Fusarium* spp., *Diplodia* spp., *Pythium* spp., *Penicillium* spp., and others. These are soil-borne pathogens with wide host ranges.

**Timing of Control:** Before planting.

**Yield Losses:** Yield loss as a result of stand loss can be as high as 40%.

**Regional Differences:** None.

**Cultural Control Practices:** Avoid fields with poor drainage. Avoid planting into cold, wet soils. No resistant varieties are available, but some types (i.e. sh2 varieties) are more susceptible.

**Biological Control Practices:** Trichoderma (T-22/Rootshield) may provide protection against seedling diseases in fresh market sweet corn, but results are inconsistent.

**Post-Harvest Control Practices:** None.

**Other Issues:** Fungicides such as carboxin and dividend are not labeled for seed treatment use in NY. Seeds treated in other states (e.g. California and Idaho) may be sold in NY, but treating seeds in NY is not legal.

**Chemical Controls:**

<b>Pesticide</b>	<b>% Trt.</b>	<b>Type of Appl.</b>	<b>Typical Rates</b>	<b>Timing</b>	<b># of Appl.</b>	<b>PHI days</b>	<b>REI hours</b>
<i>captan</i> ( <i>Captan</i> )	100 P 95 F	commerical seed treatment	3.5 fl. oz product/cwt seed	before planting	1	70	NA
<i>thiram</i> ( <i>Thiram</i> )	100 P 95 F	commerical seed treatment	5 fl. oz product/cwt seed	before planting	1	70	NA
<i>metalaxyl</i> <sup>1</sup> ( <i>Apon</i> )	80 P 60 F	commerical seed treatment	1-2 fl. oz product/cwt seed	before planting	1	70	NA
<i>carboxin</i> ( <i>Vitavax</i> )	100 P 40-50 F	commerical seed treatment	3.6 fl. oz product/cwt seed	before planting	1	70	NA
<i>dividend</i> <sup>2</sup> ( <i>Dividend</i> )	20 P 20-30 F	commerical seed treatment	label rates	before planting	1	70	NA

1. Use of metalaxyl is being phased out, to be replaced by mefenoxam seed treatment.

2. This fungicide replaces imazalil, previously used on approximately the same percentage of sweet corn seed. Only sh2-types are treated.

**Use in IPM Programs:** Use of fungicide seed treatments are consistent with Cornell IPM recommendations.

**Use in Resistance Management Programs:** None reported.

**Efficacy Issues:** Thiram and Apron should be used together and not separately, since Apron is only effective against

*Pythium* species. Dividend is effective against *Penicillium* and *Fusarium* species.

**Alternatives:** Maxim seed treatment may be used as early as 1999, but problems have been reported with treatments.

### **Stewart's Wilt** (*Erwinia stewartii*)

**Frequency of Occurrence:** In the last decade, the disease has been present at least in low levels each year. Severity and extent of the disease depends on population levels of the vector, the corn flea beetle (see "Corn Flea Beetle" section). There was a severe outbreak in 1989.

**Damage Caused:** This bacterial disease invades and plugs the vascular system of plants. The extent of damage is dependent on the stage of growth when the infection occurs, the strain of the bacterium, and the susceptibility of the host. Early infection can lead to collapse and wilt. Early infection may not kill the entire seedling, but will kill the main growing point, leaving the plant to tiller but yield no ears. In older plants, chlorotic streaks with wavy margins occur.

**% Acres Affected:** 100% at risk; up to 50% affected per year.

**Pest Life Cycles:** The bacterium gains entry into the plant by the feeding of the corn flea beetle (see "Corn Flea Beetle" section). The bacterium overwinters in the alimentary track of the beetle. In the spring, up to 40% of the emerging beetles may harbor the bacterium. By mid-season, the number of contaminated beetles increases significantly.

**Timing of Control:** From seedling emergence through late whorl stage.

**Yield Losses:** Can be as high as 80% in susceptible varieties of sweet corn, and tolerant varieties may still suffer yield losses up to 5%.

**Regional Differences:** None.

**Cultural Control Practices:** Resistant varieties should be planted whenever possible, but losses have even been seen in these varieties. A forecasting program is available to predict the severity of flea beetle infestations based on winter temperatures and snow cover. Fields planted midseason generally have lower beetle infestations than early- or late-planted fields.

**Biological Control Practices:** Little is known about the impact of natural enemies on corn flea beetles.

**Post-Harvest Control Practices:** Fall plowing reduces overwintering populations, although this is not a good soil conservation practice.

**Other Issues:** Insecticides used to control corn flea beetles are the only pesticides available for control of Stewart's wilt.

## Viruses

**Frequency of Occurrence:** Sporadic.

**Damage Caused:** Viruses can cause stunting, mosaic coloration, leaf stippling, excessive tillering, multiple ears, and poor kernel development.

**% Acres Affected:** 100% at risk; typically <5% affected per year.

**Pest Life Cycles:** The maize dwarf mosaic virus (MSMV) is transmitted by the corn leaf aphid. Barley yellow dwarf virus (BYDV) is a common virus of small grains which has recently caused some losses in sweet corn. BYDV is also vectored by aphids (both corn leaf aphids and grain aphids).

**Timing of Control:** mid-June through growing season.

**Yield Losses:** In cases of extreme infection, losses can approach 100%. Typically, losses are less than 1%. Losses due to BYDV remain unknown.

**Regional Differences:** MDMV primarily affects corn planted in the Hudson Valley and in upstate NY.

**Cultural Control Practices:** Timing of planting may affect risk of viral diseases by avoiding peak aphid activity. Early plantings may be more at risk of BYDV, while later plantings are more prone to MSMV infection.

**Biological Control Practices:** None.

**Post-Harvest Control Practices:** None.

**Chemical Controls:** No pesticides are registered to manage these viruses. MDMV cannot be managed by controlling the aphid vectors. BYDV however, can be managed to some degree by insecticide application during peak aphid infestation periods.

## Weeds

### Broadleaf and Grass Weeds

**Frequency of Occurrence:** Annually.

**Damage Caused:** Reduced yields from weed competition, and loss due to interference with harvesting equipment.

**% Acres Affected:** 100%

**Pest Life Cycles:** A wide range of annual and perennial weed species are present in sweet corn fields in NY. Some of the more common ones include redroot pigweed, common lambsquarters, common ragweed, velvetleaf, several nightshade species, yellow nutsedge, hairy galinsoga, and various annual and perennial grasses.

**Timing of Control:** Preplant, pre-emerge, and postemergence.

**Yield Losses:** Can be as high as 75% in severely affected fields.

**Regional Differences:** Weed spectra can vary regionally.

**Cultural Control Practices:** Cultivation is useful in sweet corn weed control, and is frequently practiced except on the largest acreages. Banding of herbicides is also useful when combined with cultivation.

**Biological Control Practices:** None.

**Post-Harvest Control Practices:** Application of herbicides and/or cultivation after harvest can be useful in controlling perennial weeds.

**Other Issues:** Considerable research is being conducted in weed control in sweet corn, including the use of cultivation; screening new herbicides for crop tolerance and efficacy; determining efficacy of lower-than-labeled rates of herbicide; combining cover crops and banded herbicides; and effects of crop rotation on weed populations (Bellinder). An important focus is developing non-atrazine based weed control programs.

**Chemical Controls:**

Pesticide	% Trt.	Type of Appl.	Typical Rates lbs ai/acre	Timing	# of Appl.	PHI days	REI hours
<i>butylate</i>  ( <i>Sutan</i> )	2 P  <1 F	soil, incorporated	4.2	preplant	1	70	12

<b>EPTC</b> <i>(Eradicane)</i>	1 <1 F	soil, incorporated	5	preplant	1	70	12
<b>atrazine</b> <i>(Aatrex &amp; others)</i>	85 P 80 F	soil incorporated, or ground application	0.5-1.0 <sup>1</sup>	preplant, pre-emerge, or post-emerge.	1	45	12
<b>cyanazine<sup>2</sup></b> <i>(Bladex)</i>	12 P 13 F	soil incorporated or ground application	1.8-2.0	preplant or preemergence	1	70	12
<b>alachlor</b> <i>(Lasso, Partner)</i>	20 P 21 F	soil incorporated or ground	2-2.5	preplant or preemergence	1	70	12
<b>metolachlor</b> <i>(Dual)</i>	45 P 62 F	soil incorporated or ground applied	1.75-2	preplant or pre-emerge	1	70	12
<b>pendimethalin<sup>3</sup></b> <i>(Prowl)</i>	21 P	ground	1	pre-emerge or postemerge	1	60	4
<b>glyphosate</b> <i>(Round-Up)</i>	2 P 7 F	ground	1	preplant	1	80	4
<b>bentazon</b> <i>(Basagran)</i>	27 P 29 F	ground	0.75-1	postemergence	1	55	12
<b>dimethenamid<sup>4</sup></b> <i>(Frontier)</i>	3 P <1 F	soil incorporated or ground applied	1.125	preplant, preemerge, or postemergence (up to 8")	1	45	12
<b>2,4-D</b> <i>(Formula 40)</i>	8 P <1 F	ground	0.25-0.5	postemergence, before corn is 6"	1	45	48

<i>nicosulfuron</i> <sup>5</sup>  ( <i>Accent</i> )	<1 P	ground	0.03	postemergence	1	45	4
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1. Rates vary considerably from 0.1 to 1.5 lb ai/acre depending on application timing and method.
2. Manufacturer will withdraw from market by 2002.
3. Not labeled on fresh market sweet corn.
4. New product; use may increase as growers become more familiar with this herbicide.
5. New product; only labeled on certain processing sweet corn varieties. Future use may increase as the number of varieties increases and growers become more familiar with this herbicide, but the potential for injury to the crop is significant and timeliness of application is critical.

**Use in IPM Programs:** Use of herbicides in conjunction with cultural practices is consistent with Cornell IPM recommendations.

**Use in Resistance Management Programs:** Triazine resistant lambsquarters and pigweed are a problem in some growing areas, although their occurrence has not been quantified. It is critical to have an array of herbicides with differing modes of action to prevent additional resistance problems.

**Efficacy Issues:** 2,4-D can cause serious injury to sweet corn, an important limiting factor in its use. Most herbicides are designed with a relatively narrow spectrum of weed control in order to minimize crop injury. Therefore, producers need a range of available herbicides in their "tool box" for flexibility in managing weeds.

**Alternatives:** A number of new herbicides (or herbicides whose labels are expanding to include more varieties) will become available in the future, and are currently being researched. Examples include Axiom (flufenacet + metribuzin), Accent (nicosulfuron; label expansion), Sempra (halosulfuron), Aim (carfentrazone), Action (fluthiacet-m), and Pursuit (imazethapyr). No alternative herbicides provide the breadth of control of atrazine without significant increases in cost to the producer. For processing corn, increases in herbicide costs may be prohibitive for many growers. Even low rates of atrazine are effective on some species missed by newer products. Based on recent trials, these new herbicides tend to require a higher level of management for proper use, exhibit higher incidences of crop injury, are more weather dependent, and provide a narrower window for timing of application. In the future, there may be a significant shift to herbicide (glyphosate-, glufosinate-, or sulfosate-) resistant cultivars.

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7. Members of the New York State Sweet Corn Advisory Committee, comprised of producers, processors, consultants, researchers, and Extension Educators, provided detailed information on pesticide use and usage patterns in NY processing sweet corn. In addition, they provided perspective on industry needs, and reviewed drafts of this Crop Profile. Pesticide use patterns of fresh market producers were gathered through a survey of twenty-two key fresh market sweet corn producers across the state, as well as from producer pesticide application records from recent IPM on-farm trials. Several fresh market sweet corn producers also reviewed drafts of this Crop Profile.

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