Sweet Corn

Where: Grand Gallery (main level) Room A & B
MI Recertification credits: 2 (1B, COMM CORE, PRIV CORE)
CCA Credits: NM(0.5) PM(1.0) CM(0.5)
Moderator: Hal Hudson, Extension Educator, Tuscola Co. MSU Extension

2:00 pm	Sweet Corn Genetic Traits Observations from the Field in 2012 • Fred Springborn, Field and Vegetable Crops Educator, MSU Extension
2:30 pm	Sweet Corn Insect Management Update • Rick Foster, Entomology Dept., Purdue Univ.
3:00 pm	Sweet Corn Weed Management and Control Update • Mark VanGessel, Plant Science Dept., Univ. of Delaware
3:30 pm	Strip Tillage and Deep Nitrogen Placement in Sweet Corn • Erin Haramoto, Horticulture Dept., MSU • George Van Houtte, Northern Farm Market, Romeo, MI • Tom and Vicki Zilke, Zilke Vegetable Farm, Milan, MI
4:00 pm	Session Ends

Sweet Corn Insect Management Update

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Corn earworm is the most consistent and serious insect pest of sweet corn in the Midwest. The damage to processing sweet corn can reduce yield but the losses to fresh market sweet corn growers can be devastating, because an infested ear has no value.

A short review of the biology of corn earworms is helpful because it helps to explain the best way to manage this pest. The female moths prefer to lay their eggs on green silks. They will lay them on other plants, on other parts of the corn plant, or on brown silks if no green silks are available, but their strong preference is to lay eggs on green silks. The eggs are laid one at a time on the silks. It takes about 3 days for the eggs to hatch and, upon hatching, the little larvae begin to crawl down the silk to get inside the ear. This movement may take anywhere from one hour to one day. Once that larva is inside the ear, it is very difficult to reach it with insecticides and so it is pretty much safe at that point. To kill that larva before it gets established in the ear tip, you need to have a residual, contact insecticide present on the silk between the egg and the tip of the ear. Remember that silks are growing each day, so new, untreated potential egg laying sites are available every night. Many of our insecticides will provide lengthy periods of residual activity, but the growth of the silks requires that we spray frequently.

The management strategy widely used for earworms on sweet corn is to monitor adult activity with a pheromone trap and apply insecticides when more than 10 moths per night are being caught in the trap and the crop is in a vulnerable stage, meaning there are green silks present on the plant. Insecticides should be applied every 2-5 days, depending on the trap catch and the temperature. The interval between sprays should be shortened when catches are higher or when high temperatures exceed 85 degrees. The threshold of 10 moths per night was not developed as a result of research, but rather was developed by pest managers through their experience. This management strategy has been used successfully for several decades. For many years, we have received excellent control of corn earworms with pyrethroid insecticides. Over the past several years, resistance has begun to be a concern and so we have looked at various alternative products for earworm control.

Only a few earworms are able to survive our harsh winters, so the majority of our problems arise from moths that migrate from the southern US. Usually, there is a relatively minor first generation of earworms in June and then a much large generation in late July and August. However, at times we do see significant populations of moths at unexpected times during the season. As a result, corn earworm pheromone traps are an important tool to monitor moth activity. I will try to convince you that every serious sweet corn grower needs to have his/her own pheromone trap.

Figure 1 shows pheromone trap catches during a typical growing season. Notice the relatively small first generation in mid to late June and the much larger second generation that starts in early August. July is a month when we usually have very little earworm activity.

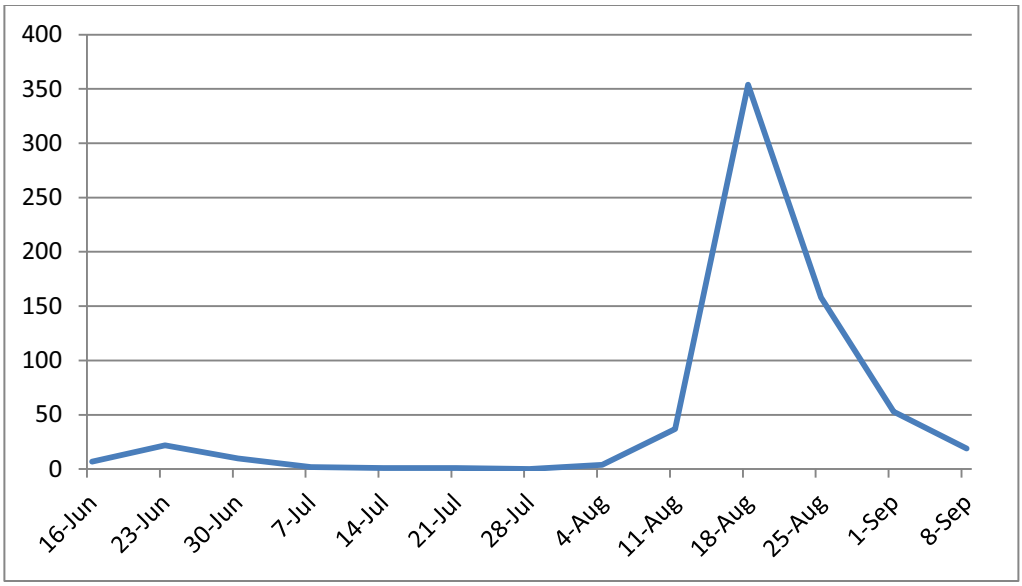

Figure 1. Weekly corn earworm pheromone trap catch at the Meigs Research Farm near Lafayette, IN, 2009.

Everyone remembers that last winter and spring were very warm. These warm temperatures affected corn earworms in at least two ways. First, it meant that they were capable of surviving the winter further north than usual. Second, it meant that they became active earlier than normal. Figure 2 shows the results of our trapping in Lafayette, IN in 2012. We caught our first moth on April 9! Obviously, there was no corn silking at that point to worry about but that date is fully two months earlier than what we would normally expect. We had a small peak in early May when there could have been some very early sweet corn in a vulnerable stage. Most importantly, look at the big peak which began in early July and remained high for the remainder of the season. July is usually a pretty easy month, but not in 2012. The main point is that without a pheromone trap, you might not know that the moths were active in fairly high numbers, at least until you started harvesting sweet corn.

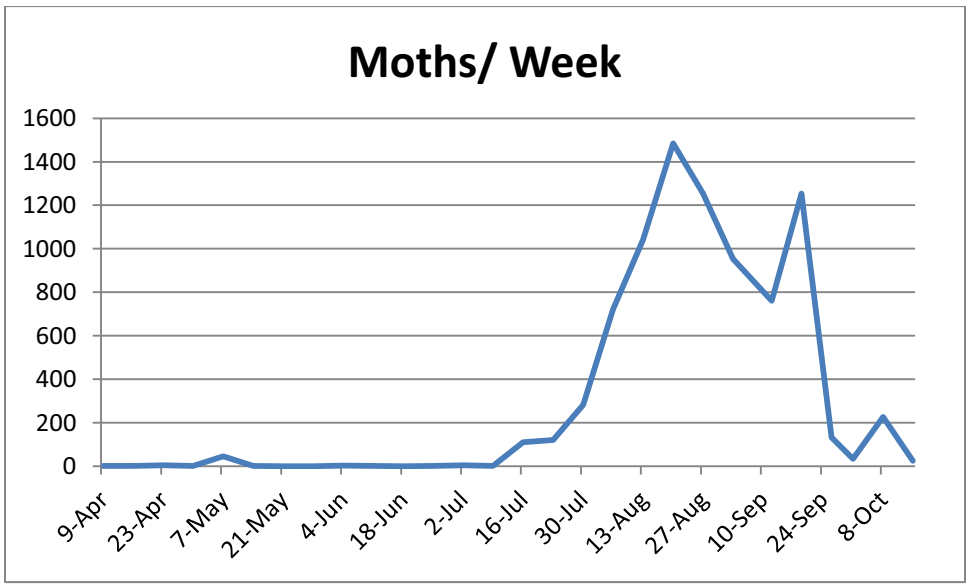

Figure 2. Weekly corn earworm pheromone trap catch at the Meigs Research Farm near Lafayette, IN, 2012.

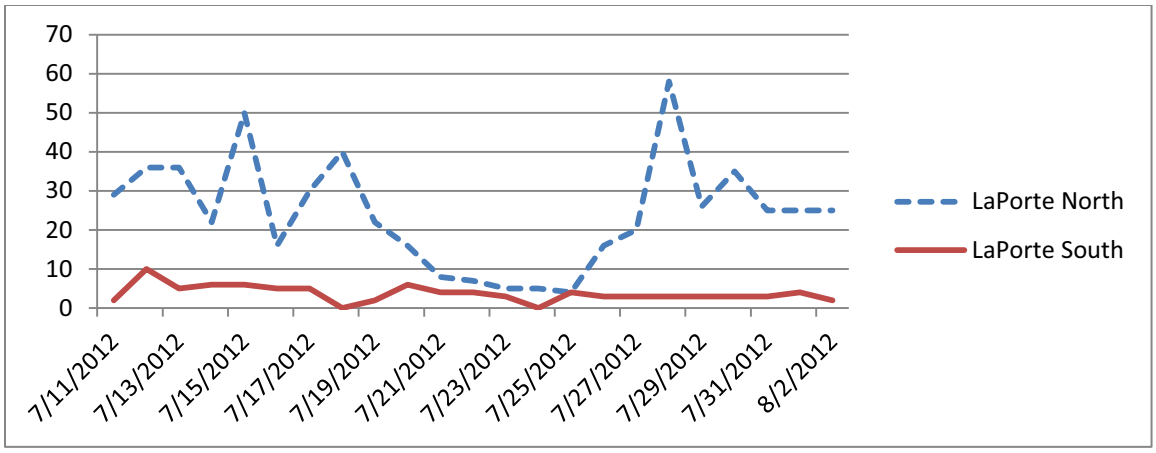

Figure 3. Daily corn earworm pheromone trap catch in two locations in LaPorte Co., IN in 2012.

For many years, I have been telling sweet corn growers that they need to have their own pheromone trap. At Purdue, we have a network of trappers around the state that report their counts to me and I post them on the web. That information is useful to some extent, but is not a replacement for having your own trap. This was demonstrated clearly to us in 2012. We have a trap at the Pinney Purdue Farm, located in the southern part of LaPorte County, which borders Michigan. One of our larger sweet corn growers, located in northern LaPorte County, called me about severe earworm damage in his sweet corn. He had been using data from the Pinney trap to make his spray decisions. Shortly thereafter, I gave him a pheromone trap which he started to monitor immediately. Figure 3 shows the comparison between his trap catches and those at the Pinney Farm, in the same county. The counts were the same on one sampling date but on every other date, the counts were higher in the northern location, often much higher. Again, sweet corn growers should have their own traps.

Several years ago, we initiated a study to look more closely at the relationship between pheromone trap catch and egg laying. You may recall last year, I reported that while the cumulative trap catch tracks very closely with the cumulative egg deposition over the course of the season, there was a very weak relationship between daily trap catch and egg laying. As we puzzled over these results, it occurred to us that a grower would not use a single night's trap catch to make a spray decision without considering what had occurred before. When we went to a 3-day rolling average instead of daily catches, the results were significantly better.

Another way of looking at the data was to look at the total trap catch and total egg deposition for each of our nine planting dates, which started in mid-March and concluded in late July. Figure 4 shows that our pheromone traps did a good job of predicting oviposition during the latter portion of the season, but the traps greatly underestimated the number of eggs laid early in the season. The date of silk initiation for the first 5 planting dates was June 15, 17, 30, July 7, and 16, respectively. We used two varieties in this study and the results were very similar for the other variety (Fastlane). These data confirm what we had intuitively thought, that early planted sweet corn was much more vulnerable to attack by corn earworm and, therefore, the threshold should be lower than 10 moths/night. 2010 was a particularly cool year, so the dates of silking may have been earlier for these plantings in a more normal year.

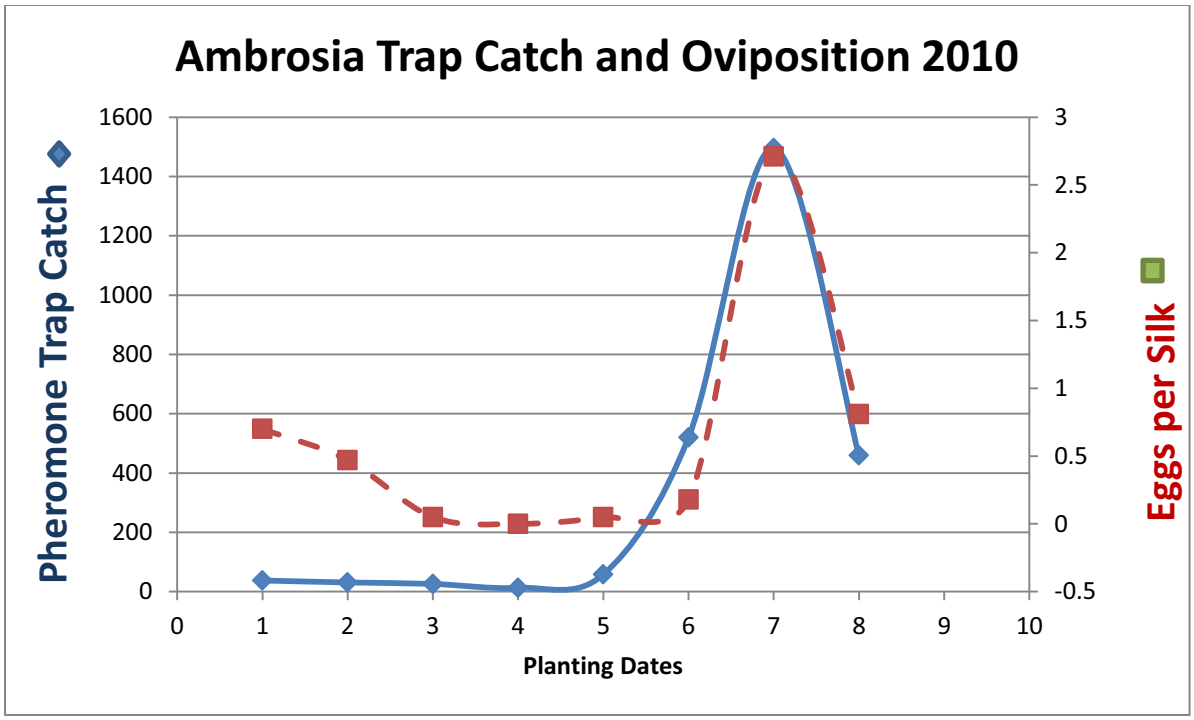

Figure 4. Relationship between total pheromone trap catch and total egg deposition for eight planting dates at Meigs Farm near Lafayette, IN in 2010.

So, given this new information, how should growers use corn earworm pheromone trap information to make spray decisions. Although the research is ongoing and we are still trying to determine the full meaning of the data we have collected, growers should consider the following suggestions.

1. Every serious sweet corn grower should have his/her own pheromone trap.
2. The threshold of 10 moths per night has been used successfully by growers throughout the Midwest over several decades. Use of this threshold has reduced the number of insecticide applications while avoiding unacceptable levels of damage in the vast majority of situations. Although our new data show that the threshold isn't perfect, it is still useful during the second half of the growing season.
3. When you have early season sweet corn that silks before the neighboring field corn, the threshold of 10 moths/night is probably too high. Prior to mid-July, I would treat my sweet corn if it were in a vulnerable stage (green silks present) and I was catching any moths in the trap.

In 2012, we had numerous reports of pyrethroids failing to adequately control corn earworms. We recommended that those growers switch to either Coragen or Radiant, which had shown themselves to be very effective in our small plot trials over several years. The growers were not happy that they had to use more expensive products, but they were very satisfied with the levels of control received. Since many of our earworms are migrants, I still don't think we can say that we will always have this level of pyrethroid resistance in the populations that move northward, but we need to be prepared to make the switch to these other products if poor control is observed.

Finally, in the past when we have evaluated Bt sweet corn varieties, we have been less than overwhelmed with the control they provided. It was not uncommon to find as many as 50% of the ears with small earworms. The larvae were stunted and caused much less damage than earworms in other varieties, but the larvae were still there and reduced the marketability of the product, especially for fresh market sales. As a result, we have recommended, especially late in the season when earworm pressure is heavy, that

growers spray their Bt corn. The combination of sprays and the Bt resistance provided superior quality compared to either the sprays or Bt alone. However, this year I included GSS 30437 in my trial and was extremely impressed with the results. Even under extraordinary pressure, there were only a few ears with a small worm present or any kernels with damage. This variety could reasonably be grown without any sprays or at least with a reduced spray program.

For more information about managing earworms or other insects in sweet corn, see:

Vegetable Insect Management edited by Rick Foster and Brian R. Flood. Available at http://meistermedia.com/store/mpro.html.

Sweet Corn Weed Management and Control Update

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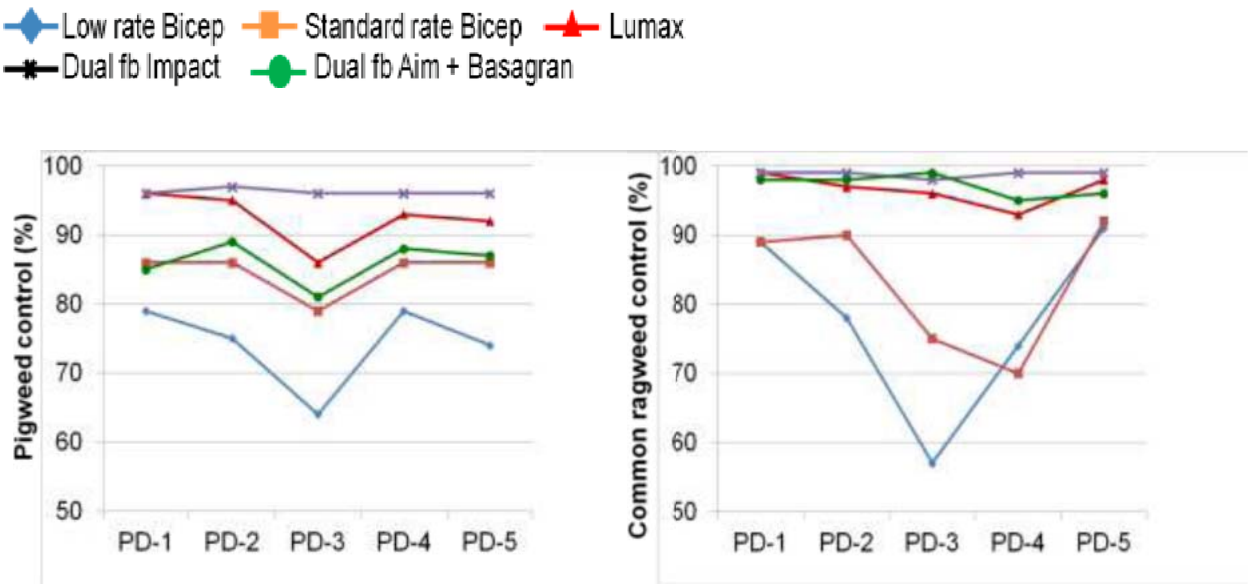
Delaware produces about 3,000 acres of fresh market sweet corn and 7,000 acres for processing. Most of the sweet corn production is under conventional tillage. A small part of the fresh market sweet corn is grown under clear plastic for an early harvest market (prior to July 4). About 25% of the acres of the processing sweet corn are followed with a second crop ("doubled-cropped") of either another vegetable crop or with soybeans. Double-cropping can limit herbicide selection.

Influence of Planting Date on Weed Control

Sweet corn is often planted over a six to eight week period in the Mid-Atlantic region. This range of planting dates encompasses cool weather in early May to warm/hot weather in mid-June. A two-year trial was conducted to evaluate the consistency of various herbicide programs for sweet corn over a range of planting dates. The site was conventionally tilled and sweet corn was planted at 10 day intervals from May 10 to June 20 in 2009, and May 1 to June 10 in 2010. The weed control programs consisted of: a low rate of Bicep, standard Bicep rate, Lumax, Dual II Magnum followed by Impact and atrazine applied postemergence (POST), and Dual II Magnum followed by Aim plus Basagran were applied POST. Weed control was not consistent for the planting dates; however, there was no consistent pattern to interactions. Weed control was most consistent for the Impact POST program.

Influence of planting date on consistency of various herbicide programs for control of pigweed and common ragweed. PD=planting date



Options for Postemergence Grass Control

When sweet corn herbicides applied at planting are not incorporated with rainfall or irrigation, postemergence treatments are often necessary. Broadleaf weeds can be controlled with a variety of herbicides including Aim or Cadet (if weeds are very small), Callisto, Impact, Laudis, Sandea, Option or Accent Q. However, most of these herbicides do not provide excellent control of annual grasses as well as excellent sweet corn safety. Impact, Laudis, Option, and Accent Q will control most of the annual grasses commonly found in sweet corn fields in Delaware, but each has at least one weakness:

Accent Q will not control crabgrass over 1 inch tall. Accent Q causes less injury than the previous formulation of Accent. However, noticeable stunting is often observed on sensitive varieties;

Option is not very effective on crabgrass and will often cause stunting of the crop; Laudis will not control fall panicum, a species that is often found in sweet corn fields; and

Impact is good on most grass weed species in Delaware, but is not very effective on fall panicum that are over 4 inches tall. Sweet corn hybrids tolerate Impact very well.

It should be mentioned that both Impact and Laudis provide better weed control with the addition of a low rate of atrazine.

Rotating to other vegetables the year following sweet corn can sometimes be a challenge with sweet corn herbicides. Laudis and Accent Q prohibit rotating to many vegetables. Option allows rotating to almost all vegetables the following year. Impact label provides guidelines for rotational crops, and based on UD research, most vegetables are very safe when Impact was used the previous year. As a result, when considering effectiveness, crop safety, and rotational flexibility, many growers in DE are using Impact when they need a postemergence herbicide for sweet corn.

Note: this research was conducted with Impact, active ingredient topramezone. Since this work was complete, another topramezone product, Armezon, has been introduced.

Strip Tillage and Deep Nitrogen Placement in Sweet Corn

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Introduction. In strip tillage, strips are tilled into the soil and the crop is planted into these strips; the rest of the soil remains undisturbed. This offers advantages over conventional, full-width tillage in which the whole soil surface is tilled—soil quality may improve in the undisturbed soil between the crop rows and overall the soil is less prone to erosion from wind and extreme rainfall events. Cover crops can add additional organic matter to contribute to soil quality; higher quality soils hold more soil moisture and have a greater ability to provide nutrients to crops. In addition, where soil is undisturbed between the crop rows, cover crop residues can form a weed-suppressive mulch.

Strip tillage also offers the capacity to band fertilizers deep in the crop row behind the shank. Deep banding fertilizers offer many advantages by helping to ensure that fertilizer is taken up by crop roots before it is lost and also placing it out of reach of competing weeds emerging from shallower in the soil or between crop rows. These can increase the nutrient use efficiency of the crop.

Results from an experiment conducted in collaboration with two farmers in eastern Michigan are presented today. The objective of this experiment is to examine how strip tillage with deep N placement, both with and without a preceding oat cover crop, affected sweet corn growth and yield on these two production farms. Results from other strip tilled sweet corn trials conducted by our research group will also be presented—1) an on-going trial at the Southwest Michigan Research and Extension Center (SWMREC) that examines sweet corn growth and soil moisture in strip tilled and moldboard plowed plots, both with and without over-wintering cover crops, and 2) another on-going trial conducted at the Kellogg Biological Station (KBS) in Hickory Corners examining how strip placement might impact yield when strip tillage is done over multiple years.

Methods for on-farm trials. This experiment was conducted in 2012 in collaboration with George Van Houtte (Northern Farm Market; Romeo, MI) and Tom and Vicki Zilke (Zilke Vegetable Farm; Milan, MI). It compared strip tillage (ST) with the tillage practices that these growers typically use prior to planting sweet corn—chisel plow followed by a rototurner for Mr. Van Houtte and two passes with a field cultivator for the Zilkes (abbreviated as CT for their conventional tillage practice). For both tillage types, we had plots with and without a spring-planted oat cover crop so there were four treatments at each site—ST with oats, ST without oats, CT with oats, and CT without oats.

Table 1 shows the timeline of field operations. Oats were planted in mid-April and terminated in early June with glyphosate. In CT plots, initial fertilizer (40 lbs N/acre as urea, plus P and K according to soil test recommendations) was broadcast while it was banded 6" deep in ST plots; all plots also had 40 lbs N fertilizer applied with the planter (2" down and 2" over from the seed) and at sidedress (applied as UAN to the base of the plants). Sweet corn (variety BC0805, a Syngenta "Triple Sweet" variety with the Bt trait) was planted right after tillage at approximately 25,000 seeds/acre. Pre-emergence herbicides were applied after sweet corn planting. Corn plants were sidedressed in early July when the corn was about 6-8" tall. Corn plant height and weed density were monitored periodically during the summer. Sweet corn was harvested in late August or early September and ears were separated into marketable and non-marketable categories based on size.

Table 1. Timeline of field operations in on-farm trials

Operation	2012
Oat cover crop established—variety Ida, about 3.5 bu/acre	4/13
Cover crop terminated with glyphosate	5/30

Fertilizer applied and plots tilled
• ST plots: 2 row Hiniker strip tiller
• CT plots
  • Mr. Van Houtte=chisel plow followed by "roto-turner"
  • Zilkes=field cultivator
Then planting with vacuum seeder
	6/7

Pre-emerge herbicides applied	6/7
Side-dress application	7/5
Sweet corn harvested, weeds collected	8/29

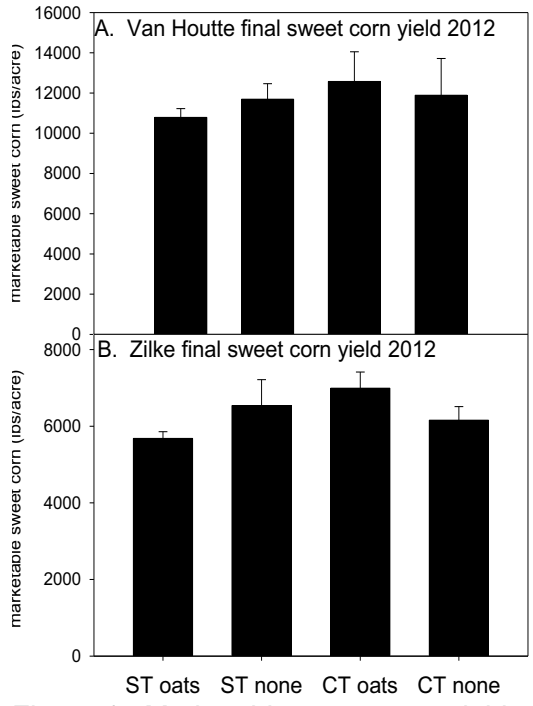

Figure 1. Marketable sweet corn yield at the on-farm trials

Results and Discussion for on-farm trials. Neither of these trials was irrigated and, due to extremely dry weather, early corn plant growth was often stunted in cover-cropped plots, particularly in the ST plots. However, plants were able to respond to timely rains at both sites and final marketable yield did not differ between treatments at either site (Figure 1). Weed density was low throughout the season and similar in all treatments at both sites—averaging between 3-9 weeds per 60' of row one month prior to harvest (not shown). Final weed biomass was also low at each site and did not differ between treatments (not shown).

ST sweet corn trial at SWMREC. This experiment uses a three year rotation of sweet corn, snap beans, and winter squash and was started in 2009; sweet corn (variety Providence) was grown in 2009, 2010, and 2012. As in the on-farm trials, there are four treatment combinations of two different tillage types (strip tillage and moldboard plow (MBP)) and cover crop (winter rye) or no cover crop; this trial is irrigated as needed. Winter rye is established in the fall and terminated the following spring with glyphosate. Fertilizers are either broadcast or banded with the planter; there is no deep banding in ST treatments. Sweet corn is planted in early June and

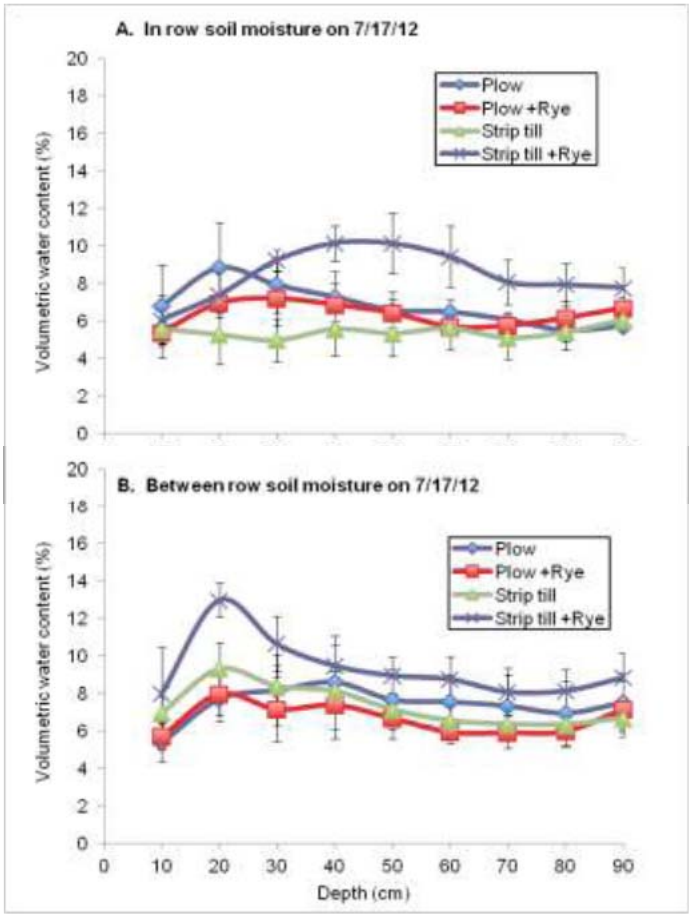

Figure 2. Volumetric soil moisture in corn row (A) and between corn rows (B), 2012 at SWMREC

harvested in late August. Soil moisture was monitored in 2012 both in and between corn rows by inserting a probe (Diviner 2000) into 1 m deep tubes drilled into the soil.

In row soil moisture was higher deeper in the soil profile (40 cm+) in ST plots with rye cover crops compared to the other treatments at one date examined (Figure 2a; other dates are similar but data are not shown). Between row soil moisture was also higher in this treatment at all depths (Figure 2b). This suggests that the combination of cover crop residue and reduced tillage may help to conserve soil moisture. In two of the three years examined so far, sweet corn yields have been similar in all treatments. In 2010, yield was lower in the ST plots with winter rye—plots with rye residue that were moldboard plowed or without residue that were strip tilled had similar yields to plots without residue and moldboard plowing. Lower yield was partly due to poor establishment in the ST rye plots.

ST sweet corn trial at KBS. This experiment was conducted in 2011 and 2012 and has three treatments—"conventionally" tilled (one pass with a chisel plow followed by two passes with a field cultivator), strip tilled with the strips in the same location as the previous year (ST same), and strip tilled with the strip location offset from the previous year (ST offset) (Figure 3). Sweet corn (variety Luscious) is rotated with late-harvested cabbage; a spring-planted oat cover crop was seeded prior to sweet corn in all treatments. Nitrogen fertilizer (120 lbs N/acre total) applications were identical to those in the on-farm trials—an initial application was broadcast in CT or deep banded in ST, and subsequent applications at planting and sidedress were the same in all treatments. Weeds were controlled with a pre-emerge application of atrazine and metolachlor. Corn height was measured throughout the season, and soil samples were collected biweekly for soil moisture and inorganic N content down to 8". Irrigation was used as needed. At harvest, sweet corn ears were collected and separated by size into marketable and non-marketable samples and weighed. We also collected 1 m deep soil cores after harvest to measure residual nitrogen that might be lost from the soil over winter (2012 samples have not yet been analyzed so only 2011 data is shown).

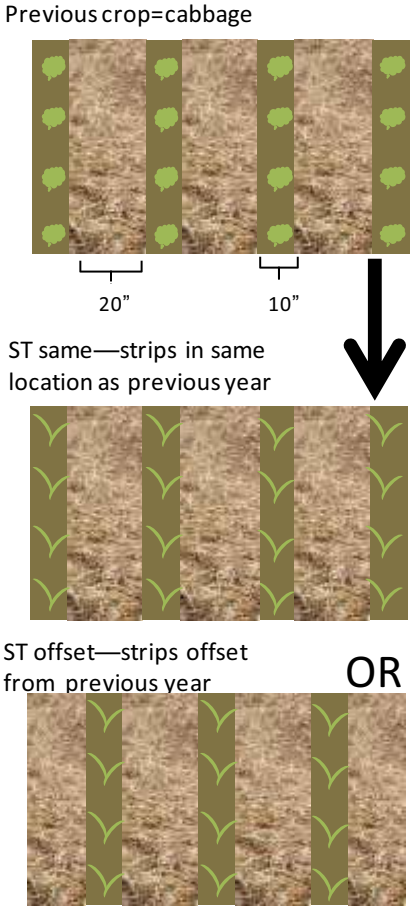

Figure 3. Strip location in strip tilled sweet corn trial at KBS

Soil moisture was similar in all treatments in both years—both in and between the crop rows (data not shown). There were no yield differences between the two ST treatments, so they were lumped together for this presentation. In 2011, yields were higher in ST than in CT but the opposite trend was observed in 2012 (Figure 4). In 2011, there was more residual nitrogen remaining in the soil after harvest in CT plots compared to those in ST regardless of strip location (data not shown). While there are other potential N loss pathways, lower residual nitrogen in ST plots combined with higher yields in these treatments in 2011 suggests that corn plants in the ST plots may have been able to take up more nitrogen than in CT plots.

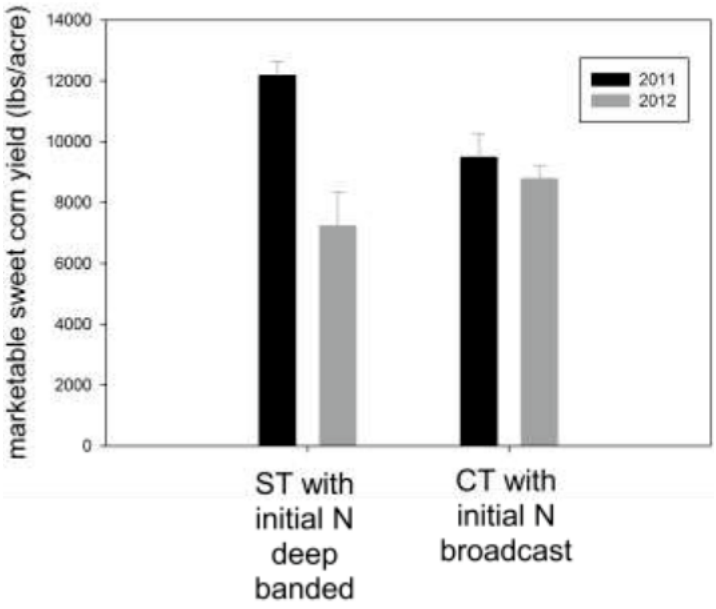

Figure 4. Sweet corn yields in 2011 and 2012 in strip location trial at KBS. Average of the two strip tilled treatments is presented.