Planting Date Effects on Corn Silage Yield and Quality
Joe Lauer, University of Wisconsin – Madison

We have written quite a bit about planting date effects on corn grain yield (high moisture and dry corn). What about its effects on corn silage? As planting date becomes more delayed, there is an increased likelihood that fields intended for grain will be harvested for silage, especially if the year remains cool.

The grain yield response of full-season hybrids to planting date at Arlington for the last 10 years has been described previously. These treatments were established using 8-row plots; four rows were harvested for silage and four rows were harvested later for grain. Figure 1 describes the planting date effect on corn silage yield. The date when maximum forage yield occurs is April 24 nearly 4 days earlier than the date of maximum grain yield on April 28 for these same plots. The relationship is more 'broad shouldered' than what is measured for grain; in other words the planting date window is longer than it is for grain with forage yields still within 95% of maximum yield on May 15.

Figure 1. Corn forage yield response of full-season hybrids (104-108 RM) to planting date during 2003 to 2012 at Arlington, WI (N= 235 plots).

The size of the plant 'factory' is not affected by planting date. The number of leaves, the size of the stalk, shank and husk is largely genetically controlled. However, starch content is affected by planting date. Thus, the digestibility of the stover and grain pools is different (Figure 2). Digestibility of stover (ivNDFD) is close to a flat line across the range of planting dates tested (although linear and quadratic coefficients were significant). Starch content decreases with later planting dates.

Figure 2. Corn forage ivNDFD and Starch content response of full-season hybrids (104-108 RM) to planting date during 2003 to 2012 at Arlington, WI (N= 235 plots).
When yield and quality is combined using the Milk2006 performance index, we find that Milk per Ton (quality) is not affected as much as Milk per Acre due to the forage yield impact (Figure 3). The optimum planting date for corn silage when measured using Milk per Acre is the same as it is for grain yield. The difference is that the planting date window is slightly longer for silage than it is for grain.

Figure 3. Corn forage Milk per Ton and Milk per Acre response of full-season hybrids (104-108 RM) to planting date during 2003 to 2012 at Arlington, WI (N= 235 plots).

Table 1. Corn grain yield response of an adapted corn hybrid treated with Ascend® plant growth regulator to an untreated check during 2012.

<table>
<thead>
<tr>
<th>Location</th>
<th>Ascend (bu/A)</th>
<th>Untreated (bu/A)</th>
<th>Difference (bu/A)</th>
<th>LSD(0.10)</th>
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<tr>
<td>Arlington</td>
<td>227</td>
<td>129</td>
<td>-2</td>
<td>NS</td>
</tr>
<tr>
<td>Chippewa Falls</td>
<td>135</td>
<td>149</td>
<td>-14</td>
<td>5</td>
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<tr>
<td>Coleman</td>
<td>261</td>
<td>170</td>
<td>-9</td>
<td>NS</td>
</tr>
<tr>
<td>Fond du Lac</td>
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<td>202</td>
<td>+1</td>
<td>NS</td>
</tr>
<tr>
<td>Galesville</td>
<td>226</td>
<td>225</td>
<td>+1</td>
<td>NS</td>
</tr>
<tr>
<td>Hancock</td>
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<td>118</td>
<td>+10</td>
<td>6</td>
</tr>
<tr>
<td>Janesville</td>
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<td>-10</td>
<td>NS</td>
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<td>Lancaster</td>
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<td>-19</td>
<td>10</td>
</tr>
<tr>
<td>Marshfield</td>
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<td>-12</td>
<td>11</td>
</tr>
<tr>
<td>Seymour</td>
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<td>201</td>
<td>-1</td>
<td>NS</td>
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<tr>
<td>Valders</td>
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<td>223</td>
<td>+20</td>
<td>NS</td>
</tr>
</tbody>
</table>

Evaluation of Ascend®: Hormones that Stimulate Corn Growth

Joe Lauer, University of Wisconsin – Madison

During years with strong grain prices numerous products appear that seem too good to be true. If there was any growing season when a corn root growth enhancer should work it was during the drought of 2012. Ascend® is touted as a "... tool to increase plant efficiency" and "... can stimulate higher yields through a larger root mass ..."

Ascend® contains the plant growth regulators cytokinin (0.09%), gibberellic acid (0.03%) and indole butyric acid (0.045%). It can be applied on the seed, in-furrow at planting, 2x2 or 3 inches below the seed at planting, at the 3-4 leaf stage and/or at the 8-11 leaf stage.

We tested the plant growth regulator Ascend® by applying it to an adapted hybrid and comparing it to the same hybrid left untreated at eleven locations in Wisconsin. Applications were made at the labelled rate and timing of 3.2 oz/A at V3-V4. Locations that exhibited significant drought stress included Chippewa Falls, Lancaster, Janesville, Arlington and Fond du Lac. Hancock was an irrigated site.

At seven of eleven locations there was no statistical difference when using Ascend®. At three of eleven locations, the untreated plots yielded more than plots treated with Ascend®. At one of eleven locations, Ascend® treated plots yielded more than untreated plots.

At none of the sites that had significant drought stress during the growing season did Ascend® stimulate higher yields. Across all locations there was no statistical difference between corn treated with Ascend® (196 bu/A) and untreated corn (200 bu/A).

Vegetable Crop Update 5/4/2013

The third issue of the Vegetable Crop Update is now available. This issue contains information on managing cabbage diseases and more. Click [here](#) to view this update.

Soybean Emergence and Germination Common Issues

Shawn Conley, Soybean and Wheat Extension Specialist

Common issues growers may have concerning soybean emergence and germination are discussed by Wisconsin State Soybean and Wheat Extension Specialist Dr. Shawn Conley. In a spring field, Shawn gives tips on seeding depth, soil compaction issues, loss of cotyledon at emergence, frost damage, and general stand assessment.

To watch, click on the image below.
Alfalfa Removal in Spring
Mark Renz Extension Weed Scientist, University of Wisconsin-Madison

While removal of old stands is recommended with fall applications, many fields are now slated for removal due to winter-kill. This can be challenging, but options exist depending on the situation. Below I discuss management options for common scenarios this spring. If using herbicides, remember to read the label of the products used, as plant-back restrictions can vary between products.

SPRING REMOVAL AS ALFALFA GREENS-UP

Alfalfa can be removed with herbicides and/or aggressive tillage. While tillage can result in > 80% mortality, tillage implement, operation of equipment as well and environmental conditions can dramatically affect control. Spraying an herbicide prior to tillage is usually conducted as this combination greatly improves chances of alfalfa mortality. For no-till fields, spring herbicide application can provide good to great removal depending on the year. In years with little regrowth and stressed plants (like this year) alfalfa plants often resprout and require control in the following crop (SEE BELOW). Most labels recommend at least four inches of regrowth to maximize control. While many herbicides are available to remove alfalfa, the most popular active ingredients include glyphosate, 2,4-D, and/or dicamba. While glyphosate has no plant-back restrictions for other crops, 2,4-D and dicamba do. The restriction varies depending on the crop, rate, and product so read the label carefully. In a typical year the restriction for 2,4-D (7-14 days for corn) and dicamba (0-30 days for corn) can be met easily prior to planting corn without a yield hit. This year however an application of one of these products may result in a one to four week delay in planting.

SPRING REMOVAL DURING/AFTER ALFALFA HARVEST

Due to the drought and limited hay in many parts of the state, interest exists in harvesting the first crop of alfalfa before terminating the stand. The best option for this scenario is to apply glyphosate 36 hours or longer before harvesting. Up to 1.5 lbs ae/A is registered for this type of application. This will allow for hay harvest, and improve effectiveness of removal due to the delayed application timing and larger sized alfalfa. I am not aware of any other herbicides that can be used in this fashion. Another option would be to harvest the hay, let the alfalfa regrow then apply an herbicide to eliminate the stand. This option, while effective would result in at least 2 weeks of additional time before planting to allow harvest and regrowth. Plant-back restrictions would then also need to be followed for the products selected.

CONTROL OF VOLUNTEER ALFALFA IN OTHER CROPS

While the goal is to kill plants with the removal treatments, some alfalfa plants can survive and will need to be managed in the following crop, especially in spring removal. For Roundup-Ready crops, glyphosate is the logical choice and is effective, unless removing Roundup-Ready alfalfa. Other products that are effective in corn include products that contain dicamba or clopyralid. I am not aware of effective non-glyphosate options in soybeans. Make applications in a timely fashion, as I expect significant yield loss could be seen from volunteer alfalfa in fields.

Seedcorn maggot degree days and corn and soybean risk in cool, wet soils
Eileen Cullen, Extension Entomologist

One of the earliest potential pests of corn and soybean is seedcorn maggot, Delia platura. Seedcorn maggot is a soil insect pest of seeds and emerging seed leaves. Corn and soybean (and vegetable crops) are more susceptible to seedcorn maggot damage under conditions that delay emergence, such as cool spring temperatures and wet field conditions that cause soil surface crusting.

This article, website links, and attached Extension fact sheets offer degree-day phenology model information for seedcorn maggot adult flight peak. The information is particularly applicable to conventional fields in the absence of seed treatment, and organic production systems. Planting as close as possible to the ‘fly-free’ period between seedcorn maggot generations will minimize risk and serves as the primary cultural control for this spring soil insect pest.

This year, late planting and cool wet weather limit grower options to delay planting any further to avoid peak seedcorn maggot flight. However, the information is very useful to plant around seedcorn maggot peak flight to the degree possible in fields at risk. Risk is relatively higher this year as first generation seedcorn maggot will peak over the next couple of weeks where corn and soybean planting are underway. If weather conditions promote timely crop emergence after planting, this can also help minimize risk.

Nearly all conventional corn and much of the soybean seed come coated with a neonicotinoid insecticide seed treatment that offers protection from seedcorn maggot.

Fields at risk for seedcorn maggot include fields without insecticide seed treatment. Small grain or legume green cover crop incorporation, weed cultivation, and manured fields with decomposing fresh organic matter increase attractiveness of fields to adult seedcorn maggot flies at spring planting.

Seedcorn maggot overwinters in the soil as pupae. Adult flies emerge in spring once the ground has thawed and sufficient heat units, or degree days, have accumulated. Peak spring emergence of the overwintered (first) generation will occur at 360 Fahrenheit degree days (base 39°F) or 200 Celsius degree days (base 3.9°C). Most of the seedcorn maggot eggs will be laid during peak flight, and degree days can be used to avoid planting during this peak flight.

To track seedcorn maggot degree days for your area, click here or visit:
http://www.soils.wisc.edu/uwex_agwx/thermal_models/scm

You can also view seedcorn maggot degree days for Wisconsin on The IPM Toolkit app available to users for free for iPhones and iPads through the University of Wisconsin’s Integrated Pest Management Program. From the app choose the
First generation seedcorn maggot adult flights have peaked in southern and southwestern Wisconsin. Follow the daily degree day accumulations on the Wisconsin map at the link above to check your area. First generation peak is occurring over the next week or more (depending on temperatures) as you move north on the degree day map.

Seedcorn maggot has three generations in the Midwest. The first generation occurs in spring when field corn and soybean seeds are usually most susceptible to larval feeding damage, particularly under cool wet soil conditions. During subsequent generations, established corn and soybean seedlings and young plants are no longer vulnerable to seedcorn maggot.

For more information on calculating seedcorn maggot degree days for your area, the following UW Extension resources are available free online:


*Publication A3972-01 content is applicable to conventional non-seed treated fields and provides step by step instructions on how to calculate degree days using the UW Extension Ag Weather website.*


http://learningstore.uwex.edu/Seed-Corn-Maggot-P1177.aspx

To learn more about insect degree days, click here

http://labs.russel.wisc.edu/cullenlab/insect-degree-day-models/

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**Handy Bt Trait Table Updates**

Eileen Cullen, Extension Entomologist

More corn hybrids contain multiple transgenic traits, and cost of this seed is steadily rising. Meanwhile, refuge requirements are changing for stacked trait and pyramided trait corn. Planting the correct refuge with knowledge of the insect spectrum controlled and suppressed is critical to insect resistance management.

Some refuges remain 20% and ‘structured’, planted in a block or series of rows. Others are reduced to 5% or 10%, in a block or ‘in the bag’ mixed with the Bt seed itself. This fact sheet from Michigan State University and University of Wisconsin Extension (click here), updated May 2013, provides a quick reference to the currently available Bt traits, spectrum of insect control, and refuge percentage and location requirements.

To view this fact sheet, scroll down to the end of this newsletter.

**Wisconsin Pest Bulletin 5/9/13**

A new issue of the Wisconsin Pest Bulletin from the Wisconsin Department of Agriculture, Trade and Consumer Protection is now available. The Wisconsin Pest Bulletin provides up-to-date pest population estimates, pest distribution and development data, pest survey and inspection results, alerts to new pest finds in the state, and forecasts for Wisconsin’s most damaging plant pests.

Issue No. 2 of the Wisconsin Pest Bulletin is now available at:

http://datcpservices.wisconsin.gov/pb/index.jsp


**Wisconsin Winter Wheat Disease Update – May 8, 2013**

Damon Smith, Extension Field Crops Pathologist, Department of Plant Pathology, University of Wisconsin-Madison

Wheat in southern Wisconsin is still very early in development. At last scouting many varieties were looking good and responding well to warmer temperatures and frequent rain. As I mentioned in my April 24th update (http://ipc.m.wisc.edu/blog/2013/04/wisconsin-winter-wheat-disease-update-april-24-2013/), Septoria leaf blotch was present at low levels in several cultivars in the variety trial at the Arlington Agricultural Research Station. Septoria is still active in these plots and increasing slowly on susceptible cultivars.

Reports of stripe rust have been prevalent in southern states this season. Many states in the deep-south and transition zone have reported low to moderate incidence of stripe rust. Reports have been slowly moving north. This week, Dr. Stephen Wegulo, Extension Plant Pathologist at the University of Nebraska reported stripe rust on wheat at the 3rd or 4th leaf stage in Mead, Nebraska (Fig. 1). This is extremely early to see stripe rust and can severely impact yield if found at this stage. Dr. Wegulo reported very high incidence and moderate severity on susceptible varieties. Furthermore, this report is at
a latitude that is getting closer to that of southern Wisconsin. While I haven’t seen any stripe rust this season in Wisconsin, it wouldn’t hurt to begin to keep your eyes peeled for rust if you are planning herbicide treatments on wheat in the next couple of weeks. Also, don’t forget to scout for powdery mildew at this stage too. I haven’t seen any powdery mildew, but look for it while performing any maintenance spraying.

For more information about rusts, and stripe rust in particular, check out my previous articles located at http://ipcm.wisc.edu/blog/2013/04/wheat-scouting-and-little-more-about-rusts/ and also at http://ipcm.wisc.edu/blog/2013/03/using-fungicides-on-wheat/.

Figure 1. Close-up of stripe rust on a young wheat plant near Mead, NE. Photo Credit: Stephen Wegulo, University of Nebraska.

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**UW-Extension/Madison Plant Disease Diagnostic Clinic (PDDC) Update**

Brian Hudelson, Ann Joy, and Andrew Pape, Plant Disease Diagnostics Clinic

The PDDC receives samples of many plant and soil samples from around the state. The following diseases/disorders have been identified at the PDDC from April 20, 2013 through April 26, 2013.

<table>
<thead>
<tr>
<th>PLANT/SAMPLE TYPE</th>
<th>DISEASE/DISORDER</th>
<th>PATHOGEN</th>
<th>COUNTY</th>
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<td>FRUIT CROPS</td>
<td>Sphaeropsis Canker</td>
<td><em>Sphaeropsis</em> sp.</td>
<td>Fond du Lac</td>
</tr>
</tbody>
</table>

For additional information on plant diseases and their control, visit the PDDC website at [pddc.wisc.edu](http://pddc.wisc.edu).

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**Follow us on**

![Facebook](image1.png)  ![Twitter](image2.png)
The seedcorn maggot (SCM), *Delia platura*, is a soil insect pest of corn, soybean, and vegetable crops. Small grain or legume green cover crop incorporation, weed cultivation, and animal manure organic matter can increase attractiveness of fields to adult SCM flies at spring planting. However, conventional SCM management methods of synthetic insecticide seed treatment and cover crop or weed herbicide burn-down are incompatible with organic agriculture. This publication addresses cultural control integrated pest management (IPM) strategies for SCM in corn and soybean. Planting crops during the “fly-free” period between SCM generations, when the insect population is entering its non-feeding pupal stage, can minimize SCM damage. This fact sheet provides information on SCM identification, life cycle, crop damage symptoms, and the use of insect degree days to forecast fly-free periods during the growing season.

**Appearance**

Eggs of the seedcorn maggot are white, oval-shaped, and approximately 0.04 inch (1 mm) long. The larvae are cream-colored, legless maggots with a tapered head and wedge-shaped anterior end (figure 1). Larvae complete three instars increasing in length from 0.03 inch (0.7 mm) to approximately 0.25 inch (7 mm) when full-grown. The pupae are light reddish brown, cylindrical capsules, 0.20 inch (5 mm) long by 0.06 inch (1.5 mm) wide, becoming darker brown prior to emergence as adults (figure 2).

Adult seedcorn maggot flies are dark gray and approximately 0.2 inch (5mm) long, about half the size of a common housefly. The thorax (middle section behind the head) is bulkier than the abdomen and covered with numerous bristles (figure 3). The wings are clear with distinct wing venation, and overlap the body when the fly is at rest.
**Life cycle**

Seedcorn maggots overwinter in the soil as pupae. Adult flies emerge in spring once the ground has thawed and sufficient heat units, or degree days, have accumulated for SCM to reach the adult stage. Estimating peak spring emergence, the point at which 50% of the adult fly population has emerged, is possible with an understanding of insect degree days (see below for explanation). Peak spring emergence of the overwintered generation will occur at 360 Fahrenheit degree days (base 39°F) or 200 Celsius degree days (base 3.9°C).

Female seedcorn maggot flies are attracted to fields with decaying organic matter associated with spring cover crop incorporation, weed cultivation, or animal manure application. After mating, females lay eggs in freshly plowed fields. Eggs are deposited at the soil surface, singly or in small clusters. Eggs are difficult to see in the soil, but this is not necessary for management purposes. Eggs hatch within 2–4 days and develop through three larval instars. These occur entirely in the soil where the maggots burrow into seeds and feed on cotyledons (seed leaves) of germinating seeds. Maggots also feed on the hypocotyl of germinating soybeans. Larval development is followed by the non-feeding pupal stage, after which the next generation of adult flies emerges.

Seedcorn maggot has three generations in the upper midwestern United States. A complete life cycle, from egg to adult, generally requires about 3–4 weeks in Wisconsin, depending on temperature and location. The first generation occurs in spring when field corn and soybean seeds are most susceptible to SCM larval feeding damage. During subsequent generations, established corn and soybean stands are no longer vulnerable to SCM damage.

**Damage**

Seedcorn maggots feed below ground on seeds and germinating seedlings. The larvae penetrate seeds, leaving holes or scarring, and these can cause decay. Damaged seeds may fail to emerge. Crop stand loss can be widely distributed throughout the field and may require replant under heavy infestations. Damage to both corn and soybean can occur, but is usually more severe in soybean fields.

On soybean, maggots burrow into the seed (figure 4). If the seed germinates, maggots feed on the cotyledons causing brown feeding scars. Soybeans may emerge as characteristic “snakehead” seedlings with missing cotyledons (figure 5). On corn, all parts of the germinating seed are susceptible to feeding (figure 6).

**Figure 3. Seedcorn maggot adult fly**

**Figure 4. Seedcorn maggot larvae feeding on soybean seed**

**Figure 5. Soybeans emerge with missing cotyledons as “snakehead” seedlings after seedcorn maggot have fed below ground on germinating seeds**
Because SCM larvae infest germinating seeds below ground, the likelihood of SCM crop stand damage increases with time between planting and seedling emergence. Crop stands are more susceptible to SCM damage under environmental conditions that delay emergence, such as cool spring temperatures and wet field conditions that cause soil surface crusting. A rotary hoe can be used to break up hard soil surfaces and help promote stand emergence. However, SCM damage may go unnoticed or be difficult to distinguish from problems caused by seedling fungal diseases or other soil insect pests.

**Cropping system perspective on seedcorn maggot**

Since seedcorn maggot flies are attracted to lay eggs in fields with decaying organic matter, incorporation of a small grain or legume green manure cover crop in spring can increase potential for SCM damage (figure 7).

The risk of SCM problems in corn and soybean increases with tillage intensity and crop residue incorporation. No-till and minimum tillage attract the lowest densities of adult SCM flies. Populations increase moderately with chisel plowing where residue is incorporated in the process of inverting the soil. Plowed and disked fields are most attractive to flies.

Adult flies prefer fields in which legumes are incorporated prior to crop planting as compared to grass incorporation. Previous research in Ohio found significantly greater numbers of SCM adults in plots where alfalfa was incorporated prior to soybean planting, followed by rye, soybean residue, and corn residue. More SCM are found where live, green legume, or grass cover crops (rather than dead crop residue) has been incorporated into the soil. Soybean planted into a rolled or crimped winter rye cover crop may be attractive to adult flies as rye plant material begins to decompose, but it will be less attractive than when incorporated with greater soil disturbance.

Damage potential to corn, soybean, and vegetables is greater when a crop is planted within 17–21 days (2.5–3 weeks) of incorporating a living green cover crop, particularly if planting is done immediately or shortly after tillage.

**Figure 6.** Seedcorn maggot larvae feeding on corn seed

**Figure 7.** Adult seedcorn maggot flies are attracted to lay eggs in fields where a green cover crop has been incorporated in spring shortly before corn or soybean planting.
Management

There is no economic threshold or rescue treatment option for SCM adults or larvae in the soil. Once larval feeding has occurred, it is too late to suppress further damage. This is true regardless of cropping system—conventional or organic. Accordingly, SCM management strategies must follow a preventive approach.

Incorporating grasses instead of legumes, practicing no-till or conservation tillage with minimal green crop residue incorporation, or waiting to plant for 2.5–3 weeks after cover crop incorporation will decrease attractiveness of fields to SCM flies. Planting into warm, dry soil promotes rapid emergence and shortens the time seeds are exposed to SCM larvae. However, one or more of these practices may be incompatible with a grower’s organic system plan or under a given year’s weather conditions. Therefore, an understanding of the SCM life cycle can be used to reduce the risk of damage.

A key cultural control is to plant during the fly-free window between SCM generations, when the population is nearing its non-feeding pupal stage. Determining the fly-free period and timing of the pupal stage in the field requires an understanding of insect degree days.

Insect degree days

Insect degree days measure heat unit accumulation required for insect development. Degree days are calculated on a daily basis, with each day’s value added to the previous sum for a cumulative total. The date from which to begin degree day accumulation for a particular insect is referred to as the biofix date. This event may be a calendar date for insects that overwinter in the local area, or an event such as peak pheromone trap catch for migratory insects.

Insect degree days are useful because insects develop through each life cycle stage incrementally, depending on temperature. Development is bounded by lower and upper developmental thresholds. The lower developmental threshold, or base temperature, is the temperature below which development stops. For example, SCM overwinters as pupae in the soil. It does not resume development in spring until air temperature meets and exceeds its lower developmental threshold, or base temperature, of 39°F (3.9°C). SCM degree days can then be calculated each day until enough heat units have accumulated for adult flies to emerge from the soil.

Insect development occurs faster at warmer temperatures and more slowly at cooler temperatures, within an optimal range between lower and upper developmental thresholds.

Calculating insect degree days

Progression through an insect’s life cycle in the field can be estimated using temperature data from a weather station nearest the field or farm where IPM decisions are made. This information is accessible online and is unique to each state. Once you know the degree days required for a particular insect pest life cycle event (e.g., peak adult emergence, pupal development), you can estimate when these events will occur by calculating and accumulating degree days from the appropriate biofix date. The daily formula for calculating insect degree days (DD) is:

$$DD = \frac{\text{maximum temperature} + \text{minimum temperature}}{2} - \text{base temperature}$$

Each day’s DD calculation is added to the previous sum for a running cumulative total. If the average daily temperature for a given day is less than the insect’s base temperature, then zero insect degree days are accumulated for that day.

The UW-Extension Ag Weather website (www.soils.wisc.edu/uwex_agwx) provides thermal models and a degree day calculator (www.soils.wisc.edu/uwex_agwx/thermal_models/degree_days) for field and forage crop insect pests in Wisconsin and Minnesota, including alfalfa weevil, European corn borer, common stalk borer, and seedcorn maggot. This website allows users to access weather station air temperature data to conveniently check insect degree day accumulation for their location. This is useful when a field crop scouting and/or treatment action decision window is approaching.
If internet access is unavailable, the degree day formula above can be calculated by hand each day, and degree days can be accumulated from the biofix date. Daily maximum and minimum temperatures can be obtained from a local newspaper or on-farm air temperature devices.

**Determine SCM peak adult emergence**

For growers to adjust planting dates to match the SCM fly-free period, it is first necessary to determine when 50% of the population has emerged as flies. The majority of eggs will be laid in the soil during this period of peak fly activity. From the biofix date of peak adult emergence, SCM egg and larval development times are known and can be used to estimate when SCM will enter the pupal stage in the soil.

**Three methods have been suggested by previous research to determine SCM adult emergence peak(s):**

1. Calculate SCM degree days beginning January 1. Peak adult emergence of first generation occurs at 360 Fahrenheit degree days (FDD) (base 39°F) or 200 Celsius degree days (CDD) (base 3.9°C) (table 1).
2. Assume peak adult emergence occurs at the date of spring tillage since adult SCM flies will be attracted to freshly plowed fields with decomposing plant organic matter.
3. Set yellow pan traps filled with soapy water around field edges. Check weekly during spring, and identify and count SCM flies to determine adult emergence peak(s).

**Plant during the fly-free window**

By calculating SCM degree days, growers can avoid planting field corn, soybean, and later crops such as sweet corn or vegetables during peak adult emergence when risk of SCM damage to untreated seeds is highest (table 1).

From the date of first-generation peak adult emergence, an additional 450 Fahrenheit degree days (250 Celsius degree days) can be accumulated to predict when first-generation larvae will enter the pupal stage. The egg stage requires 54 Fahrenheit degree days (30 Celsius degree days) and the three larval stages require 367 Fahrenheit degree days (204 Celsius degree days). In addition, a minimum of 65 Fahrenheit degree days (36 Celsius degree days) is required between adult emergence and egg laying. Therefore, approximately 450 Fahrenheit degree days (250 Celsius degree days) after peak adult emergence, developing SCM larvae should have reached the pupal stage, further minimizing the risk of injury to developing seeds. Accounting for peak adult emergence, egg laying, egg and larval stages, this represents a seasonal accumulation, from January 1, of approximately 846 Fahrenheit degree days (470 Celsius degree days).

Another important aspect of the cultural control approach to SCM management is knowledge of field history, including previous cropping practices and SCM problems. This will help guide future management improvements. Keeping records of how well weather station insect degree day data has targeted the fly-free window will allow growers to make necessary modifications to fit a particular location or microclimate.

**Table 1. Seasonal accumulation of seedcorn maggot degree days from January 1 biofix date to adult emergence peaks for first, second, and third generation flies**

<table>
<thead>
<tr>
<th></th>
<th>First generation</th>
<th>Second generation</th>
<th>Third generation</th>
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<td>Fahrenheit degree days (FDD)</td>
<td>360</td>
<td>1,080</td>
<td>1,800</td>
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<tr>
<td>Celsius degree days (CDD)</td>
<td>200</td>
<td>600</td>
<td>1,000</td>
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</table>
Seedcorn maggot degree days can be calculated on the degree day calculator website as follows:

1. First, select the latitude and longitude location nearest the farm or field for which you wish to calculate seedcorn maggot degree days.

2. Next, choose the degree day calculation parameters required. Note: These parameters are usually specific for a particular crop or insect pest. Make sure you are using the correct ones for your particular situation.

The biofix is the date from which to begin calculating degree days. Use January 1 to predict adult emergence peaks for each generation (table 1). Avoid planting untreated seed to recently tilled fields during peak fly emergence.

The date of first generation peak adult emergence can then be used as a biofix from which to accumulate approximately 450 additional FDD (250 additional CDD) to predict when first generation larvae will enter the pupal stage.

3. Choose your data output format:
   a. Choose your end date. The website end date will default to the most recent date for which weather station data are available.
   b. If you select “seven-day summary page,” the value on the bottom right corner of the displayed output table will be the total accumulation of FDD beginning from the biofix start date, but only displaying the last seven days.
   c. If you select “as text, for selected time period, ready for downloading,” the value on the bottom right corner of the last row of displayed output will be the total accumulation of FDD beginning from the biofix start date.

4. Click the “submit” button to obtain your results.
The seed corn maggot (Delia platura) is a perennial pest of the seeds and seedlings of a wide variety of vegetable crops. In addition to corn, maggots will attack beans (kidney, lima, and snap), beets, cabbage, cucumbers, peas, radishes, squash, and turnips. Seed corn maggots can decimate a crop stand if left untreated. They are more of a problem when susceptible crops are planted in succession.

**Appearance**

The yellowish-white larvae are typical fly maggots: 1/5-inch long when fully grown, cream-colored, legless, and wedge-shaped. The maggot’s head end is sharply pointed. Pupae are brown, 1/5-inch long, cylindrical in shape, and rounded on both ends. Adults resemble miniature houseflies. They are dark gray, 1/5-inch long, and their wings are held overlapped over their bodies while at rest. The flies are often mistaken for adult cabbage maggots and onion maggots, but they are smaller in size. Eggs are tiny (about 1/32-inch long), oval, and white.

**Life cycle**

Seed corn maggots overwinter as pupae in the soil. Adult flies emerge in the spring with peak emergence in early to mid-May when swarms of flies are often seen over recently tilled fields. Adults mate within 2–3 days of emergence. Females lay eggs in soils with high organic matter or near seeds and seedlings of susceptible plants. Eggs hatch 2–4 days later. Larval feeding, development, and pupation all occur below ground and the next generation of adults appears within 3–4 weeks. This sequence of events is repeated for the three to five generations that emerge each year.

**Damage**

Seed corn maggot larvae feed in the cotyledons and the below-ground hypocotyl tissue of seedlings, resulting in a variety of damage symptoms. Feeding damage in germinating seeds can kill the seedlings before they emerge. Poor germination or poor plant stands may indicate a seed corn maggot problem. To diagnose, dig the seeds to look for damage. Plants that survive maggot damage to the seed often have holes in the first pair of true leaves or no leaves at all (snakehead seedlings). Damage to the hypocotyls will leave the plant yellow and wilted.

**Scouting suggestions**

Rescue treatments are not effective for seed corn maggots. Once damage is detected, it’s too late to control the maggots. Therefore, there are no economic thresholds for this insect and any insecticides must be applied at planting as a protective measure.

Forecasting the appearance of generations can be accomplished by calculating degree-days starting when the ground thaws in the spring. Degree days are calculated each day using the formula [(daily high + daily low) ÷2] – 39. Use a maximum of 86°F for the high and a minimum of 39°F for the low.
Keep a running total of degree days to anticipate when peak emergences will occur. For the first three generations, this is at 360, 1080, and 1800 degree days, respectively.

The following scouting procedure can be helpful in determining the fly-free periods on a particular field. In early April, place three or four yellow plastic dishpans filled with soapy water along the edge of the field at 100-foot intervals. Every 4–6 days, remove and count the trapped flies and add fresh soapy water to the pans. Keeping a record of the number of flies trapped will indicate when fly numbers are building up or tapering off.

Currently work is being done in Minnesota to evaluate the effectiveness of a pheromone trap for predicting the presence of adult flies.

**Control**

**Cultural control**

Since the adult seed corn maggot is attracted to decaying organic matter, do not plant susceptible crops in fields where animal or green manure has recently been applied.

The faster the seeds germinate and grow, the less opportunity the maggots have to damage the crop. There are a few strategies to hasten germination:

- Wait until soil temperatures are at least 50°F before planting most susceptible crops. Peas and radishes may be planted when soil temperatures are above 40°F.
- Plant seeds as shallowly as feasible to speed germination.
- Soak untreated pea and bean seeds in water for 2 hours before planting to soften the seedcoat.

**Natural control**

Naturally occurring fungal diseases occasionally will greatly reduce seed corn maggot numbers significantly, particularly when flies are abundant and relative humidity is high. During a fungal epidemic, dead or diseased flies can be seen clinging to the highest parts of plants along field edges.

Predaceous ground beetles eat seed corn maggot eggs, larvae, and pupae and can be important in reducing maggot numbers. Because these soil-inhabiting beetles are susceptible to insecticides, avoid using broadcast soil insecticide treatments whenever possible.

**Chemical control**

If you have seed corn maggots one year, you will likely have them in succeeding years. To prevent damage, you have two options: plant treated seed or make a soil application at planting. For details on insecticide recommendations, refer to Extension publication *Commercial Vegetable Production in Wisconsin* (A3422).
More corn hybrids contain multiple transgenic traits, and cost of this seed is steadily rising - $300 or more per bag is not uncommon. Meanwhile, refuge requirements are changing for multi-trait corn. Some refuges remain 20% and ‘structured’, planted in a block or series of rows. Others are reduced to 5% or 10%, in a block or ‘in the bag’ mixed with the Bt seed itself.

**Different products from different seed companies now have different refuges**

Purchasing the right transgenic hybrid for the right pest, and planting it with the correct refuge in the proper location, is critical to profitability and insect resistance management. But this process is increasingly confusing. The table on the second page of this bulletin summarizes, to the best of our ability, the currently available Bt traits and their spectrum of control. The table also gives refuge percentages and locations. We make every attempt to provide the correct information for each Bt option and update the table promptly as changes occur.

However, it is still important for you to take the following steps:
*Understand the terminology used by your seed company
*Understand the biology of each trait, the expected level of control, and refuge requirements.
*Confirm that the seed ordered in late fall is the seed shipped the following spring.
*Keep good planting records.
*For herbicide applications, Ask Twice-Spray Once, especially if you hire a custom applicator.
*Save a representative sample of bag tags = the first thing to check if something goes wrong.
*Most important, if you see unexpected insect damage or poor performance of a trait during the field season, contact your seed dealer or county extension educator promptly so that the field can be visited while the problem is still visible and plant and insect samples can be taken.

**Abbreviations used on page 2:**

<table>
<thead>
<tr>
<th>Insect targets</th>
<th>Herbicide traits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCW</td>
<td>GT</td>
</tr>
<tr>
<td>CEW</td>
<td>LL</td>
</tr>
<tr>
<td>CRW</td>
<td>RR2</td>
</tr>
<tr>
<td>ECB</td>
<td>Glyphosate tolerant</td>
</tr>
<tr>
<td>FAW</td>
<td>Liberty Link or glufosinate tolerant</td>
</tr>
<tr>
<td>SB</td>
<td>Roundup Ready 2 (glyphosate tolerant)</td>
</tr>
<tr>
<td>WBC</td>
<td></td>
</tr>
</tbody>
</table>

Insect targets:
- BCW: black cutworm
- CEW: corn earworm
- CRW: corn rootworm
- ECB: European corn borer
- FAW: fall armyworm
- SB: stalk borer
- WBC: western bean cutworm

Herbicide traits:
- GT: glyphosate tolerant
- LL: Liberty Link or glufosinate tolerant
- RR2: Roundup Ready 2 (glyphosate tolerant)
<table>
<thead>
<tr>
<th>DiFonzo &amp; Cullen's Bt Trait Table May 6, 2013</th>
<th>Bt protein(s)</th>
<th>Insects controlled (bold) or suppressed (italics)</th>
<th>Herbicide tolerance</th>
<th>Refuge %, location in the MIDWEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agrisure Trait Family</strong></td>
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<tr>
<td>Agrisure CB/LL</td>
<td>Cry1Ab</td>
<td>ECB    CEW    FAW    SB</td>
<td>LL</td>
<td>20% within ½ mile</td>
</tr>
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<td>GT, LL</td>
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<td>---</td>
<td>CRW</td>
<td>20% in field/adjacent</td>
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<td>Agrisure 3000GT</td>
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<td>Agrisure Vipera 3110</td>
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<td>5% in the bag</td>
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<tr>
<td>Herculex RW (HXRW)</td>
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<td>Herculex XTRA (HXX)</td>
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<tr>
<td>Optimum AcreMax (AM-R)</td>
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<td>20% in the bag (CRW) &amp; 20% - ½ mile (ECB)</td>
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<td>5% within ½ mile</td>
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<td>LL, RR2</td>
<td>20% in field/adjacent</td>
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<tr>
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<tr>
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<td>20% in field/adjacent</td>
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<tr>
<td>Refuge Advanced Powered by SmartStax</td>
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<td>BCW    CEW    ECB    FAW    WBC    SB</td>
<td>CRW</td>
<td>5% in the bag</td>
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