
Purdue Cooperative Extension Service

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# In This Issue



# Insects, Mites, And Nematodes

**Alfalfa Weevil and Freezing Temperatures** - (*Christian Krupke, John Obermeyer, and Larry Bledsoe*)

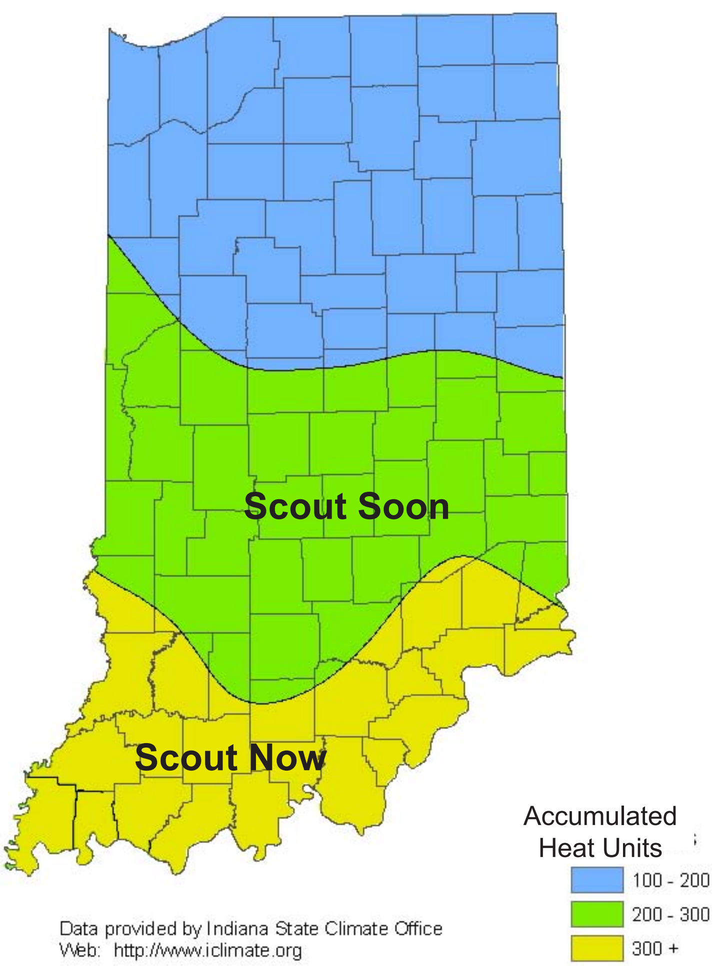
- Alfalfa weevil activity had begun before the cold snap.
- Cold temperatures likely had little effect on populations.
- Damage and heat unit accumulations are the basis of management decisions.

Richard Huntrods (Feldun Purdue Agricultural Center near Bedford), and Betsy Bowers (Ceres Solutions), reported the beginning of alfalfa weevil feeding in southern counties before the cold temperatures this past week. With the sudden onslaught of below-freezing temperatures one may expect the emerged larvae to be nothing more than so many tiny popsicles. But this is not the case – alfalfa weevil larvae in the first 2 larval instars are able to withstand temperatures as low as -2ºF, much lower than those reached in any of the past few nights. Interestingly, the larger/older larvae are less cold-tolerant, which is the opposite of the usual trend in insects. This increased cold hardiness of young larvae is likely an adaptation to the early spring feeding period of this insect, when sudden, brief freezes do happen occasionally. With that knowledge in mind, we can focus on what to do about weevils this season – since they have most certainly not all perished. Note that if a field has extensive freeze damage to the foliage, many weevils may die of starvation, which may be a small silver lining for some producers.

Field scouting for alfalfa weevil damage should begin when approximately 200 heat units, base 48°F, have accumulated from January 1 (see map below). Sampling a field to determine the extent of alfalfa weevil damage and average stage of weevil development is best accomplished by walking through the field in an "M-shaped pattern." Ten alfalfa stems should be examined in each of 5 representative areas of the field for a total of 50 stems from the entire field. Consider that south facing slopes and/or sandy soils warm sooner and should be included in the sampling. Each stem should be examined for: (1) evidence of tip feeding by alfalfa weevil larvae; (2) maturity of the stem, i.e., pre-bud, bud and/or flowers; and (3) stem length. The average size (length) of weevil larvae should also be noted. Although large alfalfa weevil larvae are relatively easy to find, small larvae are difficult to see; thus, very close examination of leaves may be required to detect "pin-hole" feeding, small black fecal pellets and small off-white larvae.

If the application of an insecticide is required early in the weevil season, producers have the option of using a material that has good residual action. Later in the season, short residual insecticides should be used and producers should pay close attention to harvest restrictions. Management guidelines, which are based on heat unit accumulations, will be given in an upcoming *Pest&Crop*.

**Accumulated Heat Units Base 48 Since January 1**
**Alfalfa Weevil Growth and Development**




**Bug Scout says, "As new alfalfa growth from freeze-damaged plants appear, carefully inspect for weevil feeding!"**

## Black Cutworm Spring Arrival Met With Hostile Conditions - (*Christian Krupke, John Obermeyer, and Larry Bledsoe*)

- Black cutworm moths arrived before recent freeze.
- Exposed moths/eggs likely died during cold snap.
- Moth arrival has just begun.
- Timing of scouting can be improved by tracking heat unit accumulations.
- Don't rely on insecticide-treated seed to prevent economic damage.

Many of our pheromone trapping cooperators throughout the state captured black cutworm moths before the recent freezing temperatures - refer to the "Black Cutworm Adult Pheromone Trap Report" for details on page 3. This was attributed to warm wind currents from the southwestern portions of the country. However, the majority of those early arrivals and any eggs laid have likely perished; being a southern migrant they are not as cold-hardy as our overwintering species (e.g., variegated cutworm). This is good news, although more moths will undoubtedly arrive in coming weeks.

Moth arrival, along with the use of heat units to predict the beginning of larval activity, gives us an indication of potential severity of the problem and locations of concern. Thus, we are able to predict with some degree of accuracy when and where crop damage is likely to occur based on these data. We will track heat unit accumulations and predicted damage for your area in future issues of the *Pest&Crop*.

Because of the sporadic outbreak nature of this pest, the tried, true, and economic approach to black cutworm management is to scout fields (especially weedy areas), determine infestation and damage levels, and use a rescue treatment, if needed. Producers using insecticide-treated seed may have a false sense of security concerning black cutworm control. Certainly the systemic activity of these newer insecticides during the seedling stage should help suppress small larvae feeding on plants. However, this protection is short-lived and fields attracting egg-laying moths during multiple flights will likely experience significant damage and stand losses. Last year brought some heavy damage to some Indiana producers' fields from this insect, despite the fact that most all of the corn seed planted in the state is treated with insecticide. Bear in mind that the insecticide is no guarantee against loss – pressure from early season insects such as black cutworm, combined with slow emergence and growth (as we saw in early to mid-May of 2006) can combine to place seed treatments under tremendous pressure and reduce efficacy.

**Black Cutworm Adult Pheromone Trap Report**
**Week 1 = 3/29/07 - 4/4/07 Week 2 = 4/5/07 - 4/11/07**

| County | Cooperator | BCW Trapped Wk 1 | BCW Trapped Wk 2 | County | Cooperator | BCW Trapped Wk 1 | BCW Trapped Wk 2 |
|---|---|---|---|---|---|---|---|
| Adams | Roe/Mercer Landmark | 8 | 0 | Miami | Sweeten/Advanced Ag Solutions | 0 | 0 |
| Allen | Gynn/Southwind Farms | 2 | 0 | Newton | Ritter/Purdue CES | 4 | 0 |
| Benton | Babcock/Ceres Solutions | 2 | | Newton | Babcock/Ceres Solutions | 1 | |
| Benton | Babcock/Ceres Solutions | 6 | | Porter | Hutson/Purdue CES | | 0 |
| Clay | Bower/Ceres Solutions, Brazil | 0 | 0 | Putnam | Nicholson/Nicholson Consulting | 0 | 0 |
| Clay | Bower/Ceres Solutions, Clay City | 2 | 0 | Randolph | Boyer/DPAC | 0 | 0 |
| Clinton | Foster/Purdue Entomology | 4 | | Rush | Doerstler/Pioneer Hi-Bred | 3 | |
| Daviess | Venard/Venard Agri-Consulting | 10 | 0 | Shelby | Gabbard/Purdue CES | 6 | 1 |
| Elkhart | Kauffman/Crop Tech | 0 | | Starke | Wickert/Wickert Agronomy Services | 1 | 0 |
| Fulton | Jenkins/Fulton-Marshall Co-op | 0 | | Sullivan | Bower/Ceres Solutions, Sullivan W | 0 | 0 |
| Gibson | Hirsch/Hirsch Family Farms | 0 | 3 | Sullivan | Bower/Ceres Solutions, Sullivan E | 9 | 0 |
| Hamilton | Beamer/Beck's Hybrids | 5 | 0 | Sullivan | Bower/Ceres Solutions, New Lebanon | 3 | 0 |
| Jennings | Biehle/SEPAC | 0 | 0 | Tippecanoe | Krupke/Purdue Entomology | 0 | 0 |
| Knox | Bower/Ceres Solutions, Freelandville | 2 | 0 | Tippecanoe | Obermeyer/Purdue Entomology | 0 | 3 |
| Knox | Bower/Ceres Solutions, Fritchton | 0 | 0 | Tipton | Johnson/Pioneer Hi-Bred | 0 | |
| Knox | Bower/Ceres Solutions, Oaktown | 4 | 0 | Warren | Mroczkiewicz/Syngenta | 0 | 0 |
| Lake | Kleine/Kleine Farms | 0 | 0 | White | Reynolds/ConAgra Snack Foods | 2 | 0 |
| Marshall | Barry/Fulton-Marshall Co-op | 0 | 0 | Whitley | Walker/NEPAC | 9 | 0 |
| Marshall | Misch/Pioneer Hi-Bred | 0 | 0 | | | | |

# Weeds

**Poison Hemlock Control in Corn and Soybean** – (*Glenn Nice and Bill Johnson*)

- The problem
- Control
- Corn and soybean
- Corn
- Soybean

Poison hemlock's toxic properties are famous. It was used to kill the Greek philosopher Socrates in 399 BC[1]. It has been the cause of poisoning in cattle, being lethal at a dose of 5.3 g of plant/kg of body weight[2]. For a more complete description of poison hemlock see the following article, "Poison Hemlock – The Toxic Parsnip" on the Purdue Weed Science web site <http://www.btny.purdue.edu/weedscience/2003/Articles/PHemlock03.pdf>.

Although poison hemlock has been troublesome in pastures and rangeland for quite some time, it has typically sat beyond the borders of corn and soybean fields, being content to watch from railway tracks and the ditch. This may no longer be the case. The adoption of no-till has promoted a weed shift favoring some of the perennials and biennials. Bill and I receive calls regarding control of hemlock in row crops, particularly in soybean. Most often growers and applicators were concerned that glyphosate alone just prior to planting or as the 1st postemergence spray did not provide adequate control. We noticed that poison hemlock is actively growing in ditch banks and along field edges. So the purpose of this article is to provide some guidance on how to manage this weed.

Poison hemlock is a biennial, meaning that it takes two years for it to complete its life cycle. The first year it exists as a low lying rosette (Figure 1), then it will bolt after over wintering and be three to eight feet tall at maturity. Poison hemlock flowers in June or July and once seed is produced generally dies late July and August. We generally receive calls regarding the control of poison hemlock when it has reached maturity and is flowering out. Biennials are often more susceptible to chemical control in the first year of growth when they are rosettes.

### Control

Poison hemlock historically has not been a problem in corn and soybean. Because of this there is not a large body of research done on poison hemlock's control in corn and soybean. If you have poison hemlock in your no-till field it is a good idea to add either dicamba or 2,4-D in your burndowns and to target poison hemlock in the first years growth, while it is still a rosette. Below are some of the options available to suppress or control poison hemlock in corn and soybean situations.

Fig. 1. Poison hemlock in a row crop field
(*Photo: Glenn Nice*)

***Corn and Soybean:*** Burndown applications of glyphosate plus 2,4-D (1 lb ai/A) in the fall can control rosettes in the fall or in the early spring. Applications of 2,4-D of rates higher than 0.5 lb ai/A require a 30 days waiting period before planting soybean and 7 to 14 days before planting corn (see specific label for details). Glyphosate labels recommend applications from bud to flower.

Glyphosate can also be used POST in RR soybean and corn.

***Corn:*** Burndown or PRE applications of Basis (0.5 oz/A) plus 2,4-D LVE (1 pt/A) or Basis (0.3 to 0.5 oz/A) plus 2,4-D (1 pt/A) plus atrazine at 0.5 to 1 lb ai/A. There is a 7 to 14 day planting restriction when using 2,4-D to planting corn, see specific product label for details. Basis will provide some residual control of germinating poison hemlock.

Burndown or POST applications of dicamba (0.5 pt/A) or 2,4-D can suppress to control poison hemlock. Dicamba provides good control where 2,4-D can provide fair control. Dicamba can be applied before planting and postemergence from spike to 36 inch tall corn or until 15 days before tassel emergence. Risks of injury increases after corn is eight inches tall, the use of drop nozzles are suggested. Drop nozzles should be used when applying 2,4-D (0.17 to 0.25 lb ai/A) after the corn is eight inches tall for added safety.

***Soybean:*** Burndown applications of glyphosate (1 lb ae/A) plus 2,4-D (1 lb ai/A) ether in the fall or early spring on rosettes of can provide good control of poison hemlock. There is a 7 day waiting period after 2,4-D applications of 0.5 lb ai/A or less, but a 30 day waiting period with applications above 0.5 lb ai/A to plant soybean. Glyphosate can be used POST in RR soybean.

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[1]Larry W. Mitich. 1998. Poison-hemlock (Conium maculatum L.). Weed Technology, Vol. 12:194-197.
[2]J. Vetter. 2004. Poison hemlock (Conium maculatum L.). Food and Chemical Toxicology, Vol. 42 1373-1382.

**Burndown and Planting Changes to Harmony Extra XP –** (*Glenn Nice and Bill Johnson*)

Due to the recent cold weather, many growers will consider terminating a poor wheat stand before harvest and planting corn or soybean this spring.

Harmony Extra XP [thifensulfuron + tribenuron] is often used in Indiana to control wild garlic and many winter annual weeds in winter wheat. Application timing is from 2-leaf stage, but before the flag leaf is visible in wheat. For wild garlic control the label recommends 0.5 to 0.6 oz/A plus a surfactant applied when wild garlic is less than 12” tall. Until recently, the rotation restriction for planting field corn or soybean has been 45 days before planting. Which in a normal growing season when wheat is double cropped with corn or soybean works out pretty well. However, what happens in the odd case where the decision is made to burndown the wheat and plant corn or soybean at non-double cropped times? For example if the wheat is damaged from a spring frost.

A new supplemental label for Harmony Extra XP now allows the planting of field corn or soybean 14 days after application at 0.3 to 0.6 oz/A. This will also allow the use of Harmony Extra XP as a burndown/preplant herbicide option in those case where garlic might be a problem. Always read and follow pesticide labels.

# Crop Management

**Identifying Wheat Growth Stages** - (*Gregory Shaner, Shawn P. Conley, and Bill Johnson*)

For effective management of wheat, it is important to recognize the stages of growth as the crop develops. Heading date is a common indicator of relative maturity, but the ability to recognize other growth stages is important for judging the progress of the crop and making management decisions, such as application of fertilizer, herbicides, or fungicides, and for predicting the consequences of disease or injury to the crop. The Feekes and Decimal (Zadoks) scales are the most common growth stage systems for wheat. The Feekes scale is older and has been used widely since the early 1950s. The Decimal scale is designed to make finer distinctions among stages of crop growth, and is probably used more in Europe than in the U.S., although pesticide labels in the U.S. are starting to use both scales.

The Feekes scale divides growth stages into 11 major categories. Head emergence, flowering, and grain filling (Feekes Growth Stages 10 and 11) are further subdivided. The Feekes Growth Stage scale is presented in Table 1 (on page 7), with a description of the crop development stage that corresponds to each number. The Decimal scale comprises 9 major divisions (1-9), with 10 possible subdivisions (0-9) for each major division. For example, the tillering stage is denoted by 2 in the Decimal scale, and the second digit indicates the number of tillers per plant. The Feekes scale simply notes whether tillers have begun forming (FGS 2), or whether tillering is essentially complete (FGS 3), without requiring the counting of tillers, although tiller number per plant could be appended after the “2”, e.g., FGS 2.4.

The most difficult task in describing crop growth stage is determining leaf number and tiller number. Accurate determination of leaf and tiller number requires that plants be dug up and carefully separated. To determine leaf number, position the plant so that the first true leaf is on the left. Because winter wheat has an opposite leaf arrangement the next leaf will be on the right side of the plant. By spring, the first 2 leaves may have died and withered, so the plant needs to be inspected carefully to find the remnants of these leaves. The next leaf would be counted only if that leaf was at least one-half the length of the preceding leaf. Continue counting leaves up the stem until the total number of leaves is determined. It is important that tillers be differentiated from leaves and counted separately. To distinguish tillers from a leaf look for the presence of an independent sheath, called a prophyll, which is located at the base of each tiller. Unlike leaves, tillers are counted as soon as they emerge. Once leaf number and tiller number have been identified, the subsequent key characteristics to be noted are node formation, flag leaf emergence, boot stage, head emergence, flowering, and finally grain development.

In winter wheat, the period from beginning of tillering to completion of tillering may extend for a considerable time, from autumn into the following spring. Likewise, the precise limits of FGS 4 and 5 are not clear. Depending on planting date, variety, and weather in the fall, plants may reach the pseudo stem erection stage in the fall, or only in the spring as the crop comes out of dormancy.

Jointing (FGS 6, DC 31) can be clearly determined. The original Feekes scale simply defined stage 6 as when the first node was visible at the base of the shoot. The Decimal scale provides a more precise definition for this stage, namely when the distance between the crown and the first stem node is at least 1 cm (0.4 in.), and we have included this in the growth stage table. When the second aboveground node is at least 2 cm (0.8 in.) above the first node, the plant has reached FGS 7 or DC 2. The ability to recognize FGS 6 is important because it’s the cutoff for many herbicides, especially those that contain 2,4-D, dicamba (Banvel, Clarity), MCPA, Olympus, Osprey, and Aim. Application of these products after jointing can result in malformed heads, sterility, and reduced yield.

The stage when the flag leaf first appears (FGS 8, DC 7) is important for application of a foliar fungicide. Stems of soft red winter wheat in Indiana typically have 4 aboveground nodes when fully developed. The sheath of the uppermost leaf (flag leaf, F) arises from the top node. The leaf below the flag leaf (F-1) arises from the next node down, etc. Thus, leaf F-3 arises from the lowest aboveground node. The lowest aboveground node is near the ground when it first appears, but will move upward as the stem elongates. At FGS 8, there are usually two clearly differentiated nodes on the stem. The lower node will average about 7 cm (2-3/4 in.) above the soil line. The second node (from which leaf F-2 arises) will be about 15 cm (6 in.) above ground. The third node will usually be visible, but because it is only about 1 cm (0.4 in.) above node 2, it is not counted. As the wheat continues to grow, the distance between nodes increases, and the fourth node becomes evident. Feekes 8 (DC 7) is the cutoff for Harmony Extra and Harmony GT, two products that are commonly used for control of wild garlic, and Express, commonly used for control of chickweed, Canada thistle and other winter annuals. Feekes growth stage 9 (DC 39) is the cutoff for Stinger, Starane, Widematch, and Buctril. Stinger is commonly used for Canada thistle, dandelion, and marestail control and Buctril for mustards, lambsquarters, ragweeds, and smartweeds.

Once the flag leaf blade has fully emerged, the flag leaf sheath extends. By this time, the head enclosed in this leaf sheath is swelling, and the plant enters the boot stage (FGS 10). The heads of all plants in a field will not emerge from the boot synchronously. Stages 10.1 through 10.5 are best assigned according to when heads on about half the plants have reached the indicated degree of emergence.

Flowering in wheat begins roughly in the middle of the head and progresses both upward and downward. Flowering at a given position in the head can be judged by the presence of extruded anthers.

Ripening is judged by removing developing kernels from the center of several heads and determining whether the contents are watery, milky, or at the soft or hard dough stages.

By the time wheat has reached FGS 8, leaves F-5 and below are usually withered, from infection by *Septoria*, *Stagonospora*, and other fungi. The next leaf up (F-4) usually withers about the time heads have fully emerged. In the absence of *Septoria* and *Stagonospora* blotches, powdery mildew, or other foliar diseases, leaves F-3 through F should remain green until the wheat approaches maturity. Often, however, disease destroys leaves at each layer of the canopy prematurely. Fungicide control is aimed at maintaining these leaves, particularly F and F-1, in a healthy condition.

If a grower is planning to apply a fungicide at flag leaf emergence (FGS 8), it would be helpful to know when that stage will be reached, relative to some earlier, easily determined growth stage. The jointing (FGS 6) and 2-node (FGS 7) stages can be accurately determined if a wheat field is monitored frequently. The time required for a plant to progress from either of these stages to FGS 8 is not constant. It depends on weather conditions, particularly temperature. Over many years, we have monitored wheat crop development in various field trials, and the following observations can give some guidelines for the time required for plants to progress from one growth stage to another. We found that it takes about a week to progress from FGS 6 to FGS 7, and another 8 days to go from FGS 7 to FGS 8 (with a range of 5 to 10 days). It can take from 3 to 8 days for the flag leaf blade to fully expand (going from FGS 8 to FGS 9). It can take from 9 to 16 days to progress from FGS 9 to full head emergence (FGS 10.5) or the beginning of flowering (FGS 10.5.1).

To correctly determine crop growth stage, identify the following characteristics in order. Refer to Table 1 (on the following page) for the corresponding numerical assignment.

1. Count the leaves on the main shoot
2. Count the tillers
3. Count the nodes
4. Flag leaf emergence
5. Boot stage initiated
6. Head emergence
7. Flowering or anthesis
8. Grain developmental stage

**Considerations for Planting Corn into Damaged Fields of Wheat** - (*Bill Johnson, Tony Vyn, Jim Camberato, Christian Krupke, & Bob Nielsen Depts. Of Botany & Plant Pathology, Agronomy, and Entomology*)

Many folks are still assessing the condition of wheat fields damaged by the low temperatures of the past week. In some situations, additional damage to wheat has occurred from standing water in fields due to frequent rains this winter and spring. Some growers may decide replanting damaged wheat fields to corn is a viable economic option. Some of the key considerations for doing so are described in this article.

**Killing the Remaining Stand of Wheat**

For damaged wheat fields that will be planted to corn, complete and timely control of the existing wheat is more important than if planting to soybean. Corn is more sensitive to early-season weed competition than soybean. Living wheat plants are essentially weeds and can absorb nitrogen and make it unavailable for the corn plants during the same growing season.

Use of a glyphosate-based burndown program should include the use of glyphosate at 1.5 lb ae/A + 2.4-D at 1-2 pts/A. The herbicide 2,4-D is needed to control glyphosate-resistant marestail which is very prevalent in southern Indiana and help with control of emerged common lambsquarter and ragweed. Apply in a spray volume of 10 to 15 GPA and include AMS if you have hard water.

The other program for controlling an existing stand of wheat is a Gramoxone-based program. It may be advisable to consider the use of Gramoxone Inteon (3 to 4 pt/A) + atrazine (at least 1.5 lb ai/A) + 2,4-D(1 to 2 pt/A) if one desires to plant corn as soon as possible. This mixture is more expensive than glyphosate + 2,4-D, but could provide a more rapid burndown of the wheat and minimize the early-season competition between the remaining wheat and newly planted corn. Apply this mixture in 15 to 20 GPA of carrier volume. A rain 3-4 days after application can help move the atrazine into the roots of wheat to provide additional control. If the cold weather conditions continue or you do not get the rain forecast for this week, this mixture may be more desirable since the activity Gramoxone is less influence by temperature than glyphosate.

Regardless of whether you use a glyphosate or Gramoxone-based program, keep in mind that wheat is somewhat tough to kill in the spring during cold weather conditions and a follow up treatment may be necessary to completely control the existing wheat plants. It likely will not pay to use reduced herbicide rates. Also, it may be advisable to wait until we have a day or two of daytime air temperatures above 50ºF to get the maximum herbicidal activity out of the products.

**Table 1. Soft Red Winter Wheat Crop Growth Stages**

| Visual Description | Decimal | Feekes |
|---|---|---|
| **Germination** | | |
| Dry seed | 00 | |
| Start of imbibition | 01 | |
| Imbibition complete | 03 | |
| Emerged radicle | 05 | |
| Emerged coleoptile | 07 | |
| Leaf at coleoptile tip | 09 | |
| **Seedling Growth** | | |
| First true leaf | 10 | 1 |
| First leaf unfolded | 11 | |
| 2 leaves unfolded | 12 | |
| 3 leaves unfolded | 13 | |
| 4 leaves unfolded | 14 | |
| 5 leaves unfolded | 15 | |
| 6 leaves unfolded | 16 | |
| 7 leaves unfolded | 17 | |
| 8 leaves unfolded | 18 | |
| 9 or more leaves | 19 | |
| **Tillering** | | |
| Main shoot only | 20 | |
| Main shoot and 1 tiller | 21 | 2 |
| Main shoot and 2 tillers | 22 | |
| Main shoot and 3 tillers | 23 | |
| Main shoot and 4 tillers | 24 | |
| Main shoot and 5 tillers | 25 | |
| Main shoot and 6 tillers | 26 | 3 |
| Main shoot and 7 tillers | 27 | |
| Main shoot and 8 tillers | 28 | |
| Main shoot and 9 or more tillers | 29 | |
| **Stem elongation** | | |
| Pseudo stem erection | 30 | 4-5 |
| 1st detectable node | 31 | 6 |
| 2nd detectable node | 32 | 7 |
| 3rd detectable node | 33 | |
| 4th detectable node | 34 | |
| 5th detectable node | 35 | |
| 6th detectable node | 36 | |
| Flag leaf visible | 37 | 8 |
| Flag leaf ligule and collar visible | 39 | 9 |

| Visual Description | Decimal | Feekes |
|---|---|---|
| **Booting** | | |
| Flag leaf sheath extending | 41 | |
| Boot swollen | 45 | 10 |
| Flag leaf sheath opening | 47 | |
| First visible awns | 49 | |
| **Inflorescence emergence** | | |
| First inflorescence spikelet visible | 50 | 10.1 |
| ¼ of inflorescence visible | 53 | 10.2 |
| ½ of inflorescence visible | 55 | 10.3 |
| ¾ of inflorescence visible | 57 | 10.4 |
| Inflorescence completely emerged | 59 | 10.5 |
| **Anthesis** | | |
| Anthesis begins | 60 | 10.51 |
| ½ of anthesis complete | 65 | |
| Anthesis complete | 69 | |
| **Milk development** | | |
| Kernel watery ripe | 71 | 10.54 |
| Early milk | 73 | |
| Medium milk | 75 | 11.1 |
| Late milk | 77 | |
| **Dough development** | | |
| Early dough | 83 | |
| Soft dough | 85 | 11.2 |
| Hard dough | 87 | |
| **Ripening** | | |
| Kernel hard (difficult to split by thumbnail) | 91 | 11.3 |
| Kernel hard (cannot be dented by thumbnail) | 92 | 11.4 |
| Kernel loosening in daytime | 93 | |
| Overripe | 94 | |
| Seed dormant | 95 | |
| Viable seed has 50% germ. | 96 | |
| Seed not dormant | 97 | |
| Secondary dormancy | 98 | |
| Secondary dormancy lost | 99 | |

Adapted from J.E. Nelson, K.D. Kephart, A. Bauer, and J.E. Connor. 1988. Growth staging of wheat, barley, and wild oat. MSU Coop. Ext. Ser., Bozeman, MT and Univ. Idaho Coop. Ext. Ser., Moscow, ID.

**Tillage Options**

Tillage options for corn planted into damaged wheat fields have to be considered in light of trying to make the best out of a challenging situation. Some of the unique features about trying to establish corn into wheat versus soybean or corn stubble from the previous year are that wheat may have negatively affected the soil physical (moisture and temperature) and chemical (nitrogen availability and potential allelopathic substances) environment for corn.

Just how well corn will perform depends on the quantity of wheat biomass cover, soil conditions, and the weather conditions following wheat kill or incorporation and subsequent corn planting. We don't have much experience with spring tillage options for corn following wheat cover crops, but we know from previous research with corn following wheat and rye cover crops in Ontario (Raimbault et. al., 1990; Raimbault et. al., 1991; Tollenaar et. al., 1993) that there are some things we can do to help corn get off to a good start.

*Early Kill for No-till Corn.* If you are intending on no-till, chemically kill the wheat as soon as the decision has been made to plant the field to corn (see herbicide recommendations above). Early kill reduces further soil moisture loss from the seedbed zone, starts the wheat decomposition process sooner, limits further wheat dry matter production, and may reduce the presence of any allelopathic substances. Although we wouldn't recommend delaying corn planting past the optimum date range, allowing some time after the chemical kill of the wheat before planting corn will be helpful to the early corn establishment from the perspective of soil moisture/temperature and potentially harmful insects (see the insect section below).

*Row Cleaners for No-till Corn.* Row cleaner attachments for the corn planter are even more helpful for no-till corn into decaying wheat residues than they are for no-till corn after soybean or wheat stubble from a previous year. Set the row cleaners aggressively. It may be helpful to remove a bit of soil in the row rather than just simply trying to brush aside decaying wheat plants. Simple coulters ahead of seed openers are not as effective as row cleaners when seeding corn following cereal cover crops (Raimbault et. al., 1991).

*Early Tillage for Conventional-till Corn.* If the objective is to use tandem disks or combination tillage tools to establish your seedbed, try to till at least a week in advance of corn seeding to help reduce the negative effects due to potential allelopathic (plant toxic) substances that may be released with the high volumes of decomposing wheat.

*Seedbed Optimization for Conventional-till Corn.* It is essential to avoid soil compaction from working the soil when it is excessively wet and to avoid seedbed moisture loss to the extent that it is possible. Moisture evaporation from the soil surface will be slower from beneath a wheat canopy than it would be from a bare soil. Try to reduce tillage depth and to leave the seedbed in as firm a condition as possible to help retain moisture in the seedbed zone.

*Pre-plant N Application for Both No-till and Conventional-till Corn.* As the dead wheat plants decompose (and incorporation by tillage will speed up that process), soil N availability to corn may be reduced even if the wheat has already received its optimum rate of N fertilizer. It may be helpful to ensure adequate N availability to the young corn crop by adding N in starter fertilizer, and by applying additional pre-plant N to meet the normal recommended N requirement for the 2007 corn crop.

**Credits for Nitrogen Fertilizer Applied to Wheat**

Some of the nitrogen (N) fertilizer applied to wheat that may subsequently be abandoned due to freeze damage could be available to a replacement corn crop. Very little N will have been taken up by the wheat plant prior to the freeze damage (< 25 lb N/ac at jointing), so most of the N carryover to corn will be determined by how much nitrate N is retained in the soil.

Losses from 28% UAN applied to wheat will be higher than typically experienced with pre-plant anhydrous ammonia for corn in early spring. Predicting how much N is carried over is difficult because it depends on when the N was applied, the soil type, and the weather from now through early June. Warm and wet weather, especially heavy rainfall resulting in leaching on sandy soils or ponding on heavy soils, will cause the most N loss. Losses of 28% applied to wheat may range from 30 to 50%, but could be higher or lower depending on the remaining spring weather.

One way to get a somewhat better estimate of N carryover to corn is to collect soil cores to a depth of one foot and send them to a commercial soil testing laboratory to have them analyzed for nitrate-N. The closer to sidedressing this is done the better. Standard recommendations suggest sampling when corn is at the four to six leaf stage; hence it is called the presidedress soil nitrate test or PSNT (Brouder & Mengel, 2003). Soil samples need to be dried before mailing to the laboratory.

Results of the soil nitrate test are typically reported in parts per million (ppm) or milligrams per kilogram (mg/kg) which are equivalent in value. If more than 25 ppm nitrate-N are found in the sample then no additional N is recommended. At lower levels of nitrate-N, adjustments can be made to sidedress N rates. If little nitrate-N is found it might indicate that ammonium form of N had not yet been converted to the nitrate form as well as indicating loss of nitrate-N from the root zone so some interpretation of the results is needed.

**Insect Management Issues**

Planting into freeze-damaged wheat (or any existing crop) can present some unique insect challenges. The main issue involves the insects feeding upon the remnants of the dying crop. There are insects feeding in the early-season wheat that will also attack corn - the main ones being armyworm, brown stink bug, and black cutworm. All are early-season pests that feed on a wide variety of plants, including corn (this is why weedy fields are often problematic in terms of black cutworm infestations). These insects will continue to feed happily on wheat that is not completely dead, and are capable of transitioning to any other food source that comes along.

Producers must avoid the worst case scenario of dying wheat in the presence of germinating corn by ensuring that the wheat crop is completely dead before the corn germinates. This means killing the wheat with an herbicide (such as glyphosate) and then allowing it time to die completely - as long as 2 weeks - before corn begins to germinate. The temptation is to apply the herbicide treatment and replant within the same day or two, but this sets up a "perfect storm" for insects that will be plentiful and hungry as the wheat begins to die. Growers should aim to have a period where there is no "green" plant material in the field for a few days to allow these pests to either move out of the field in search of other food sources, or die of starvation.

**Related References**

Brouder, Sylvie & Dave Mengel. 2003. The Presidedress Soil Nitrate Test for Improving N Management in Corn (AY-314-W). Purdue Univ. Extension. [On-Line]. Available at <http://www.agry.purdue.edu/ext/pubs/AY-314-W.pdf>. (URL verified 4/11/07).

Conley, Shawn. 2007. Know Your Wheat Growth Stage to Predict Wheat Freeze Injury. Purdue Univ. [On-Line]. Available at <http://www.agry.purdue.edu/ext/coolbean/2007%20_PDF/Wheat.pdf>. (URL verified 4/11/07).

Conley, Shawn & Bill Johnson. 2007. Planting Soybean into Freeze Injured Wheat. Purdue Univ. [On-Line]. Available at<http://www.agry.purdue.edu/ext/coolbean/2007%20_PDF/Soybean_replant_SPS.pdf>. (URL verified 4/11/07).

Hammond, Ron & Bruce Eisley. 2007. Corn Planted into Wheat Fields. C.O.R.N. Newsletter, Ohio State Univ. [On-Line]. Available at <http://corn.osu.edu/story.php?setissueID=172&storyID=1017>. (URL verified 4/11/07).

Herbek, Jim & Lloyd Murdock. 2007. Wheat Damage from Cold Temperatures. Univ. of Kentucky. [On-Line]. Available at <http://www.uky.edu/Ag/GrainCrops/Briefs/WheatFreezeApril2007.htm>. (URL verified 4/11/07).

Klein, Robert & Drew Lyon. 2007. Assessing Freeze Injury to Winter Wheat. Crop Watch Newsletter, Univ. of Nebraska. [On-Line]. Available at <http://cropwatch.unl.edu/archives/2007/crop6/wheat_freeze.htm>. (URL verified 4/11/07).

Lee, Chad & Patty Scharko. 2007. Freeze-Damaged Wheat Options for Forages. Univ. of Kentucky. [On-Line]. Available at <http://www.uky.edu/Ag/GrainCrops/Briefs/WheatFreezeForageOptionsApril2007.htm>. (URL verified 4/11/07).

Nafziger, Emerson. 2007. Cold Temperatures and Wheat. The Bulletin, Univ. of Illinois. [On-Line]. Available at <http://www.ipm.uiuc.edu/bulletin/article.php?id=672>. (URL verified 4/11/07).

Paul, Pierce, Jim Beuerlein, & Dennis Mills. 2007. What Will Cold Temperatures Do To Our Wheat? C.O.R.N. Newsletter, Ohio State Univ. [On-Line]. Available at <http://corn.osu.edu/story.php?setissueID=173&storyID=1030>. (URL verified 4/11/07).

Raimbault, B.A., T. J. Vyn, and M. Tollenaar. 1990. Corn response to rye cover crop management and spring tillage systems. Agron. J. 82:1088-1093.

Raimbault, B.A., T.J. Vyn and M. Tollenaar. 1991. Corn response to rye cover crop, tillage methods and planter options. Agron. J. 83:287-290.

Tollenaar, M., M. Mihajlovic, and T.J. Vyn. 1993. Corn growth following cover crops: Influence of cereal cultivar, cereal removal, and nitrogen rate. Agron. J. 85:251-255.

**Planting Soybean into Freeze Injured Wheat** - (*Shawn P. Conley and William Johnson*)

Recent cold weather and advanced wheat growth stages in southern Indiana may lead to a significant amount of wheat acres being torn up and planted to either corn or soybean. Prior to making any tillage or replant decision growers should immediately contact their crop insurance agent. Adjusters will wait ~7 days before they will assess a freeze damaged field. Since each policy is written a little differently we cannot discuss the specifics; however growers should be aware that location within the state (i.e., if you are in a double crop region) and wheat crop growth stage may come into play as factors that determine which crop they plant next (corn or soybean). If the decision to move to soybean is made based on either economics or rotation, the question of nodulation will arise, especially if spring nitrogen was applied to the wheat crop. Very little recent research has been published on this topic. However, several of my colleagues around the country have conducted side projects to quantify the affect of nitrogen on soybean yield. In a nut-shell there was no yield response when comparing any N rate (30 to 600 pounds of N) to the untreated check (0 pounds of N). N rate did have a significant effect on the number of nodules per plant, but yield was not affected. This is partly due to the speed at which rhizobial bacteria can colonize and infect a soybean root (10 to 14 days). Unfortunately, to my knowledge none of these studies were conducted planting into heavy wheat residue, so I have no data that shed light on the impact of residue on N immobilization in these systems.

Weed management will play a significant role as we move from winter wheat to soybean. The first question relates to the plant back restriction for Harmony Extra. Luckily the label was reduced to 14 days just recently, and therefore will not be a problem when moving into soybean. The next hurdle is killing the remaining (surviving) wheat crop. Growers should go with the highest labeled rate of glyphosate for burndown applications and expect to come back with either glyphosate or another grass product at planting or shortly after emergence if there are still live wheat plants in the soybean. Glyphosate-resistant marestail is widespread in southern Indiana so growers should add 2,4-D to the glyphosate to control it. Also consider adding a residual broadleaf herbicide to the mixture if for fields with heavy broadleaf weed pressure, especially competitive weeds such as giant ragweed, common ragweed, common cocklebur, lambsquarter, and morningglories.

# Agronomy Tips

**Know your Wheat Growth to Understand Spring Freeze Injury to Wheat** – (*Shawn Conley*)

With the cold temperatures predicted over the next few evenings there is significant concern over this year's wheat crop. Below I have attached a link to a publication entitled Spring Freeze Injury to Kansas Wheat <http://wheat.colostate.edu/freeze.pdf>. I have removed a table from that publication to stress the importance of growth stage on damage.

Depending upon where you are in the state of Indiana your wheat is anywhere from tillering stage to starting to joint (pre-joint) to jointing. If your wheat is in the tillering stage (the wheat is still relatively short and has prostrate growth) that crop can withstand temperatures down to ~12°F (please see table 2 below). If the wheat is standing upright (pseudostem erection) and just prior to joint (no detectable node) than the temperature that injury occurs is ~20°F. If you are able to detect a node than the temperature where injury occurs is 24°F. Cold injury at jointing can cause moderate to significant yield.

The true extent of injury will not be fully evident until temperature warm up and growth resumes. If you have any further questions please email me at <conleysp@purdue.edu>.

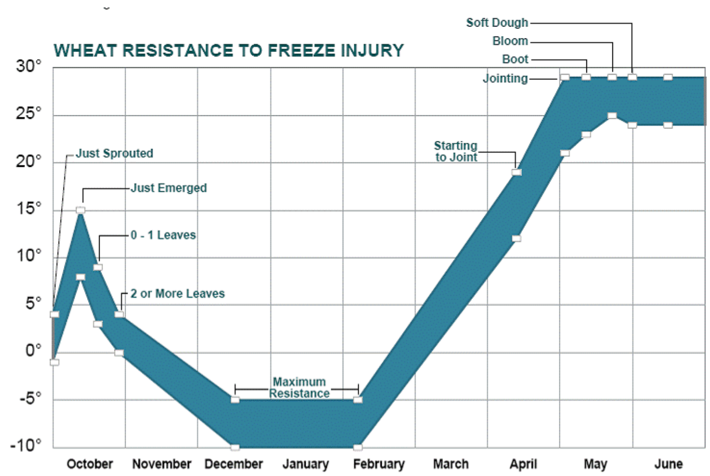


*Figure 1. Temperatures that cause freeze injury to winter wheat at different growth stages. Winter wheat rapidly loses hardiness during spring growth and is easily injured by late freezes (graph adapted from A.W. Pauli).*

**Table 1. Temperatures that cause freeze injury to wheat at spring growth stages and symptoms and yield effect of spring freeze injury.**

| Growth stage | Approximate injurious temperature (two hours) | Primary symptoms | Yield effect |
|---|---|---|---|
| Tillering | 12 F (-11 C) | Leaf chlorosis; burning of leaf tips; silage odor; blue cast to fields | Slight to moderate |
| Jointing | 24 F (-4 C) | Death of growing point; leaf yellowing or burning; lesions, splitting, or bending of lower stem; odor | Moderate to severe |
| Boot | 28 F (-2 C) | Floret sterility; spike trapped in boot; damage to lower stem; leaf discoloration; odor | Moderate to severe |
| Heading | 30 F (-1 C) | Floret sterility; white awns or white spikes; damage to lower stem; leaf discoloration | Severe |
| Flowering | 30 F (-1 C) | Floret sterility; white awns or white spikes; damage to lower stem; leaf discoloration | Severe |
| Milk | 28 F (-2 C) | White awns or white spikes; damage to lower stems; leaf discoloration; shrunken, roughened, or discolored kernels | Moderate to severe |
| Dough | 28 F (-2 C) | Shriveled, discolored kernels; poor germination | Slight to moderate |

**Cold Temperatures & Early Planted, Emerged Corn** - (*Bob Nielsen*)

Average daily low air temperatures over the past three to four mornings have ranged from 22°F to 28°F throughout a large area of Kentucky and southern areas of Indiana. This recent spate of unusually cold temperatures raises questions about injury to early-planted corn and the possibility for the eventual need to replant damaged stands of corn. The concern lays not so much in above-ground frost injury to exposed leaves, but to truly lethal cold-injury to the plants' growing points below ground.

Conventional wisdom (or agronomic legend) says that corn seedlings will tolerate air temperatures down to about 28F before serious injury occurs. One caveat to this statement is that soil temperature typically changes less dramatically than air temperature, thus delaying the onset of cold-injury to the plant's growing point region while it remains below ground. Moist soil will change temperature more slowly than dry soil, thus "insulating" the growing point further from the onset of cold-injury.

Nevertheless, the risk remains for injury to early planted corn in southern Indiana and throughout Kentucky corn from these very cold temperatures in recent days. The key to the replant decision-making process will be evaluation of the health of the growing point region (Nielsen, 2004a).

Depending on the severity of damage, visual symptoms may not be evident for several days to a week after the occurrence of the potentially lethally cold temperatures. Don't worry so much about damage to above-ground leafy tissue as to the potential for injury to the below-ground growing point. Appearance of the growing point region plus visual evidence (or not) of fresh leaf tissue from the damaged above-ground whorl will be the key diagnostics for assessing condition of the stand of corn.

Corn planted, but not yet emerged may eventually exhibit what is often termed "cork-screwed" elongation of the mesocotyl or coleoptile during emergence in response to chilling injury to the cell tissue of those plant parts (Nielsen, 2004b). The worst case scenario in this situation is failure of affected seedlings to emerge; instead leafing out underground.

As with many replant decisions, patience is the key word (Nielsen, 2006). Damaged fields usually need to be given several days to a week to begin their recovery before one can confidently assess their condition and the potential need for replant. The Univ. of Kentucky recently published several articles on corn replanting issues (Corn & Soybean News, Apr 2007).

**Related References**

Corn & Soybean News. Apr 2007. Corn Replanting Issues. Univ. of Kentucky. [On-Line]. Available at <http://www.uky.edu/Ag/CornSoy/cornsoy7_5.htm>. (URL verified 4/7/07).

Nielsen, RL (Bob). 2004a. Growing Points of Interest. Corny News Network, Purdue Univ. [On-Line]. Available at <http://www.kingcorn.org/news/articles.04/GrowingPoints-0507.html>. (URL verified 4/9/07).

Nielsen, RL (Bob). 2004b. Corkscrewed Corn Seedlings. Corny News Network, Purdue Univ. [On-Line]. Available at <http://www.kingcorn.org/news/articles.04/Corkscrew-0501.html>. (URL verified 4/7/07).

Nielsen, RL (Bob). 2006. Corn Replant Decision-Making. Corny News Network, Purdue Univ. [On-Line]. Available at <http://www.kingcorn.org/news/articles.06/Replant-0515.html>. (URL verified 4/7/07).

For other Corny News Network articles, browse through the CNN Archives at <http://www.kingcorn.org/news/archive.html>. For other information about corn, take a look at the Corn Growers' Guidebook at <http://www.kingcorn.org>.

**Perspective on Planting Dates & Corn Yield Potential** - (*Bob Nielsen*)

Conventional wisdom says that the prime planting window for achieving optimum corn yields in much of Indiana opens about April 20 and closes about May 10. This "window"' typically opens about one week later across the northern tier of Indiana counties (cooler conditions) and about one week earlier across the southern tier of Indiana counties (warmer conditions).

According to the latest (Apr 9) USDA crop progress report, zero planted corn acres were reported for Indiana (USDA-NASS, 2007). Compared to the 2002-2006 average planted acres for this date, Indiana corn growers are about 3% behind "schedule". Rainfall occurring throughout the state even as I write will undoubtedly cause further delays to a serious start for planting the 2007 Indiana corn crop.

**What are the consequences of a delayed start to planting?** How important a predictor of statewide corn yield is planting date anyway? Does late planting in and of itself guarantee lower than normal yields? Interestingly, the planting date effect on statewide yield is somewhat paradoxical.

If one reviews the data for average statewide planting dates and corn yield for the past twenty-four years, there is NOT a strong relationship between the date by which half of the state's corn crop is planted and the subsequent statewide average corn grain yield (Fig. 1). In fact, less than 15 % of the variability in statewide corn grain yield during the past twenty-four years can be explained by planting date.

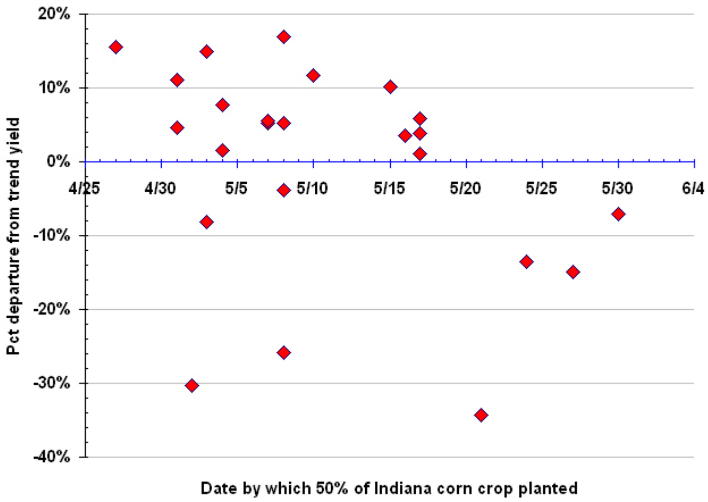


Fig. 1. Percent departure from trend corn yield in Indiana for 24 years (1983-2006) and dates by which at least 50% of the state's corn crop was planted. [Data source = USDA-NASS].

**So what's the deal?** Why do agronomists preach about the importance of timely planting and yet the statewide statistical data do not appear to substantiate this importance? Let me try to explain.

The reality is that corn grain yield potential does indeed decline, on average, by one to two bushels per acre per day of delayed planting after about May 10. That means, for example, that corn planted on May 30 would be expected to yield from 20 to 40 bushels less than corn planted before May 10. Delayed planting beyond early May will typically result in lower corn yields because of a number of factors, including a shorter growing season, insect & disease pressure, and moisture stress during pollination. Indeed, the data in Fig. 1 show that the four years with the greatest delay in planting at least 50% of the crop were years with yields significantly lower than trend.

The good news is that planting date is but one of many yield influencing factors (YIFs) for corn. All of the other YIFs interact with planting date to determine the overall yield potential for any given year. In other words, although we know that early-planted corn will usually yield more than later-planted corn, the exact or absolute yield level is dependent on a host of other YIFs. Therefore, it is possible for early-planted corn in one year to yield more than, less than, or equal to later-planted corn in another year depending on the exact mix of YIFs for each year. That is the reason why statewide average corn grain yields frequently vary by plus or minus 10% from the expected trend yield from year to year.

For example, the crop years 1997 and 2000 represent early and late planting dates in Indiana. The date by which half of the state's corn crop was planted in 1997 and 2000 was May 3 and May 17, respectively. Yet, the earlier planted 1997 crop yielded 8.2% BELOW trend yield for that year and the later planted 2000 crop yielded 5.8% ABOVE trend yield according to the Indiana Agricultural Statistics Service. Why? Different YIFs in different years.

**Bottom Line:** Don't carried away about the influence of planting date on total corn production. "Mudding in" a crop early to avoid planting late will almost always end up being an unwise decision. While important, planting date is only one of many yield-influencing factors for corn.

**Related References**

USDA-NASS. 2007. Crop Progress (9 Apr). USDA-NASS, Washington, D.C. [On-Line]. Available at <http://usda.mannlib.cornell.edu/usda/current/CropProg/CropProg-04-09-2007.pdf>. (URL verified 4/11/07).

# Bits & Pieces

**2007 Popcorn Agri-Chemical Handbook Available Online** – (*Genny Bertalmio*)

The 2007 *Popcorn Agri-Chemical Handbook* is now available at <http://www.popcorn.org/handbook> to insure everyone in the popcorn industry is informed about products registered for use on popcorn or in popcorn storage facilities. The handbook lists agri-chemicals registered, special use restrictions, the status of a chemical under special review by the Environmental Protection Agency (EPA) and residue tolerances established by EPA, CODEX and Japan.

The Popcorn Board urges you to provide the above link to your growers or download, print and distribute the updated version of this critical information to them. Contact Genny Bertalmio, 312.673.4883 or <mailto:gbertalmio@smithbucklin.com> , for further information or if you require a hard copy

The Popcorn Board accepts voluntary contributions to insure continued funding of its efforts to provide this important information to the popcorn industry. Checks should be mailed to the Popcorn Board, 401 N. Michigan Avenue, Chicago, IL 60611-4267.

# Weather Update