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In This Issue

Insects, Mites, And Nematodes

Nematode Updates: Following the Corn and Soybean Nematodes – (Jamal Faghihi, Christian Krupke and Virginia Ferris)

As we predicted in our last article, corn nematode was a problem in some of the corn fields. We found needle nematodes, some in high numbers, in most corn samples that we received in our laboratory this spring. As we indicated before, these nematodes are problematic in cool and wet springs, the conditions that most of us experienced this year. If you had patches of stunted corn seedlings with deformed root systems, needle nematodes could have been the problem. However, due to higher soil temperatures these nematodes ceased their activities and have disappeared until next time corn is grown in infested fields, assuming the proper conditions will be present. The surviving corn plants should be on their way to recovery and most likely all the symptoms will disappear even though some yield losses will occur. These nematodes are no longer being found in soil, thus soil samples taken from now on will not produce any needle nematodes, even if they were there before. You might want to keep the problem spots in mind next time you grow corn and send a root/soil sample, in about a month after planting, to our laboratory for analysis.

Figure 1. Soybean Cyst Nematode

On the other hand, the first generation of soybean cyst nematodes have completed their life cycle. The white and yellow females should be visible on susceptible (Figure 1) or partially-resistant soybean roots. If soybean cyst nematode has been a problem or is suspected to be a problem, the whole root system, with the surrounding soil, can be placed in a bucket of water to dislodge the soil from roots. The young white or yellow females will be visible with the naked eye or with slight magnification. If you have planted a resistant soybean cultivar in your field, this might be the best time to find out how resistant the cultivar truly is. Even though resistance to soybean cyst nematode is stated on the label, the cultivar might not be actually resistant. By observing the number of white or yellow females you can estimate the degree of resistance of the soybean cultivar toward this field population. We urge you to start monitoring your fields for presence of soybean cyst nematode. If you have not sampled for SCN in the past, or have used resistant soybean for several years, you need to sample for this nematode. As we stated before, we have noticed a major drop in number of samples received in our laboratory for soybean cyst nematode analysis so far this year. We need to continue to monitor cyst populations as a crucial management practice for soybean cyst nematode. We have maintained the same charge of $10/sample for nematode analysis, which will be the submitter's responsibility, unless they provide us with a billing party.

If you have any question about these or any other kinds of nematode, you can call 765-494-5901 or send an email to jamal@purdue.edu. Soil samples for nematode analysis can be sent to: Nematology laboratory, Purdue University, Department of Entomology, Smith Hall, 901 W. State Street, West Lafayette, IN 47907-2089.

Japanese Beetle Treatment Guidelines - (*John Obermeyer, Christian Krupke, and Larry Bledsoe*)

- Beetle damage usually looks worse than it is.
- Corn and soybean damage particulars and treatment guidelines are given.
- Controlling adults to prevent grub damage is impractical.

News flash … Japanese beetle are emerging and can be seen throughout the state on corn and soybean plants. OK, not that news worthy. How about … some areas of the state are seeing tremendous numbers of beetles while some areas report low populations. Again, old news, as this happens every year. Here is a headline sure to grab attention … Japanese beetle – their presence and damage is usually perceived worse than it is. Please refer to the following treatment thresholds.

Field Corn: Japanese beetle feed on corn leaves, tassels, and silks. Generally leaf and tassel feeding can be ignored. If beetles are present and feeding on corn silks, an insecticide should be applied only if on average the silks are being cut off to less than 1/2 inch before 50% pollination has taken place. This rarely happens on a field-wide basis. Don't be overly excited by this pest's tendency to clump on a few ears within an area and eat the silks down to the husks. With sufficient soil moisture, silks will grow from 1/2 to 1 inch per day during the one to two weeks of pollen shed. Silks only need to be peeking out of the husk to receive pollen. Refer to Bob Nielsen's articles in this week's Agronomy Tips for exhaustive information on the corn fertilization process. Besides, beetles are often attracted to silks that have already completed the fertilization process even though they are still somewhat yellow. Check for pollen shed and silk feeding in several areas of the field, Japanese beetles tend to be present only in the outer rows of the field. Don't be influenced by what you think you may see from windshield surveys! Get out into fields to determine beetle activity. Be sure to walk in beyond the border rows before drawing any conclusions.

Soybean: Soybean plants have the amazing ability to withstand considerable leaf removal (defoliation) before yield is impacted. The impact of defoliation is greatest during flowering and pod fill because of the importance of leaf area to photosynthesis, and ultimately to yield. Therefore, approximately 15% defoliation from bloom to pod fill can be tolerated before yields are economically affected (refer to the following dynamic thresholds based on growth stage, market price, and cost of treatment). This defoliation must occur for the whole plant, not just the upper canopy. The beetles often congregate in areas of a field where they are first attracted to weeds such as smartweed. Typically if economic damage occurs, it is only in these areas. Therefore, spot treatments should be considered. Don't be overly alarmed by these bright, iridescent beetles that feed on the top canopy of the soybean plants. Consider that as they feed their defoliation allows for better sunlight penetration into the lower plant canopy!

Kill the beetles to prevent grubs?: Japanese beetle develop from grubs that fed on organic matter and/or the roots of plants last fall and this spring. Therefore it seems logical that killing adult beetles this year should prevent grub damage in 2007. However it simply doesn't work that way. Researchers' attempts to draw in beetles to encourage them to lay eggs for subsequent grub damage in research plots have generally failed. Entomologists for years have been trying to understand this fickle creature. Basically, the adults feed, mate, and lay eggs when and where they want to. The grubs are just as unpredictable. Research attempts to correlate grub presence to crop damage have usually been inconclusive. Damage does occur, but we are just not usually able to predict when or assess how much. Consider that each beetle mates and lays eggs several times during its oviposition period. To prevent egg laying in a field, one would need to treat multiple times during July and August, which is not economic or practical.

Should controls be needed, refer to publications E-219-W, Corn Insect Control Recommendations – 2006, or E-77-W, Soybean Insect Control Recommendations – 2006 for labeled products. These and other field crop related publications can be viewed electronically at <http://www.entm.purdue.edu/entomology/ext/targets/e-series/fieldcro.htm>.

Treatment Thresholds for Insect Defoliated Soybeans

Percentage Defoliation*										
Soybean Growth Stage	**Market Price - $5/bu Cost of Treatment**					**Market price - $6/bu Cost of Treatment**				
	$6/A	**$8/A**	**$10/A**	**$12/A**	**$14/A**	**$6/A**	**$8/A**	**$10/A**	**$12/A**	**$14/A**
V1-2	40-50	45-55	50-60	45-55	55-65	35-45	40-50	45-55	45-55	50-60
V3-4	40-50	45-55	50-60	55-65	55-65	40-50	45-55	45-55	50-60	50-60
V5-6	45-55	45-55	50-60	55-65	55-65	40-50	45-55	50-60	50-60	50-60
V7+	40-50	40-50	45055	50-60	55-65	35-45	40-50	40-50	45-55	50-60
R1	25-35	30-40	35-45	40-50	40-50	25-35	25-35	30-40	30-40	35-45
R2	20-30	25-35	30-40	35-45	35-45	20-30	25-35	25-35	25-35	30-40
R3	15-25	20-30	20-30	25-35	25-35	10-20	15-25	20-30	20-30	20-30
R4	10-20	15-25	15-25	20-30	20-30	10-20	10-20	15-25	15-25	20-30
R5	15-25	15-25	20-30	20-30	25-35	10-20	15-25	15-25	15-25	20-30
R6	15-25	20-30	25-35	25-35	30-40	10-20	20-30	25-35	25-35	30-40
Percentage Defoliation*										
Soybean Growth Stage	**Market Price - $7/bu Cost of Treatment**					**Market Price - $8/bu Cost of Treatment**				
	$6/A	**$8/A**	**$10/A**	**$12/A**	**$14/A**	**$6/A**	**$8/A**	**$10/A**	**$12/A**	**$14/A**
V1-2	35-45	40-50	40-50	40-50	45-55	30-40	35-45	40-50	40-50	45-55
V3-4	35-45	40-50	45-55	45-55	45-55	35-45	40-50	40-50	40-50	45-55
V5-6	40-50	45-55	45-55	45-55	50-60	40-50	40-50	45-55	45-55	45-55
V7+	35-45	35-45	40-50	40-50	45-55	35-45	35-45	40-50	40-50	45-55
R1	20-30	25-35	30-40	30-40	30-40	20-30	25-35	25-35	30-40	30-40
R2	15-25	20-30	25-35	25-35	25-35	15-25	20-30	20-30	25-35	25-35
R3	10-20	15-25	15-25	15-25	20-30	10-20	15-25	15-25	15-25	20-30
R4	10-20	10-20	10-20	15-25	15-25	5-15	10-20	10-20	15-25	15-25
R5	10-20	10-20	15-25	15-25	20-30	10-20	10-20	15-25	15-25	15-25
R6	15-25	15-25	20-30	20-30	25-35	10-20	15-25	20-30	20-30	20-30

* The defoliation level needed before a control is applied will vary somewhat depending on insect numbers and stage of development, growing conditions, variety grown, expected yeild, economic factors, and plant population counts. All of these factors must be taken into consideration when making control decisions. The defoliation figures are shown as a range in each category. This range is included so that limiting factors can be considered. When a few limiting factors are present, the control decision value will normally be at the higher end of the scale. Under some circumstances or conditions management guidelines given above may need to be adjusted from what is given. Based on 50 bushel per acre yield.

Rootworm Beetles Aplenty in Some Corn Fields - (*John Obermeyer and Christian Krupke*)

Some reports of tremendous numbers of rootworm beetles in soon-to-pollinate cornfields have been received. This doesn't come as a surprise considering the larval root damage that has occurred in some fields. It will not be surprising to see some lodging this week, given the saturated soils present throughout much of the state. Even though fields, or areas of fields, may be thick with beetles, treatment decisions should be based only on silk damage. Follow the treatment threshold for Japanese beetle silk clipping in the previous article. Rootworm beetle populations may reduce in numbers as intra- and inter-field movement takes place.

Soybean Aphid Numbers Remain Low – (*Christian Krupke*)

Research and sentinel plots are revealing very few soybean aphids (<www.sbrusa.net>, select soybean aphid in the upper left to view the national map). Pest managers monitoring customer's fields are reporting the same, zero no to few (less than 10/plant) aphids. Although some areas of Minnesota have applied treatments for high populations, This trend is pretty much the same throughout the Midwest, which is good news since aphids often move into Indiana from out-of-state. Stay tuned.

Black Light Trap Catch Report - (*John Obermeyer*)

	6/28/06 - 7/3/06							7/4/06 - 7/10/06						
County/Cooperator	**VC**	**BCW**	**ECB**	**SWCB**	**CEW**	**FAW**	**AW**	**VC**	**BCW**	**ECB**	**SWCB**	**CEW**	**FAW**	**AW**
Dubois/SIPAC Ag Center	2	2	0	0	0	0	14	0	2	0	0	0	0	3
Jennings/SEPAC Ag Center	0	4	0	0	0	0	16	0	4	0	0	0	0	4
Knox/SWPAC Ag Center	0	0	10	0	3	0	2	1	1	3	0	2	0	2
LaPorte/Pinney Ag Center	0	5	43	0	0	0	4	0	3	3	0	0	0	2
Lawrence/Feldun Ag Center	1	0	1	0	0	0	25	0	2	0	0	0	0	5
Randolph/Davis Ag Center	0	10	0	0	0	0	4	4	8	0	0	0	0	32
Tippecanoe/TPAC Ag Center	12	48	3	0	0	0	142	13	10	0	0	0	0	43
Whitley/NEPAC Ag Center	0	10	2	0	0	0	54	2	5	0	0	0	0	37

VC = Variegated Cutworm, BCW = Black Cutworm, ECB = European Corn Borer, SWCB = Southwestern Corn Borer, CEW = Corn Earworm, FAW = Fall Armyworm, AW = Armyworm

Plant Diseases

Soybean Sudden Death Syndrome – (*Andreas Westphal, Scott Abney, and Gregory Shaner*)

•A rainy growing season may promote symptoms of SDS

Wet periods with short intervening dry periods have characterized the spring and early summer in many areas of Indiana. Soil conditions were favorable for field operations in late April and early May. Cold soil delayed emergence of corn and soybean planted in early May and many plantings took several weeks to emerge. After the mid-May rains, planting probably resumed in some fields before they were sufficiently dry. Both situations put soybean seedlings under stress and facilitated early infection of the roots with the SDS pathogen. Recent heavy rains, now that many soybeans are in reproductive stages of development, may be the trigger for development of SDS.

Sudden death syndrome is caused by the soil-borne fungus *Fusarium solani* f. sp. *glycines* (another name—*Fusarium virguliforme*—has been proposed for this fungus, but has not gained general acceptance). The fungus occurs in soybean fields in nearly all areas of Indiana, and can cause SDS when conditions are favorable. *Fusarium solani* f. sp. *glycines* invades soybean roots early in the season, but it is only at mid-season when plants are in reproductive growth stages that aboveground symptoms of SDS occur. Heavy rains during reproductive stages are a critical predisposing factor for SDS. The current front is bringing much moisture to many areas of the state, but comes at a time that could promote development of SDS. Wet soil when the soybean plant is in a reproductive stage of growth stimulates the fungus to produce toxins in the root system, which the plant translocates to the leaves, where they induce foliar symptoms. This year, initial symptoms of SDS have appeared in plants just at the beginning of flowering and in some instances even before that.

In affected plants, leaf tissue between the major veins turns yellow, then brown. Soon, the leaflets die and shrivel. In severe cases they drop off, leaving the petioles (leaf stalks) attached. Stem symptoms offer the best clues for diagnosis of SDS and for distinguishing this disease from brown stem rot. When split, the lower stem and taproot of a plant with SDS will exhibit a dark cortex, but white to tan pith. Brown stem rot may cause similar foliar symptoms, but the leaflets tend to remain attached to the petioles. Plants with brown stem rot have a dark pith, but the cortex is not much discolored. If a plant with symptoms of SDS is dug up when soil is moist, there may be small, light-blue patches on the surface of the taproot. These are spore masses of the SDS fungus. As the plant dries, this color will fade, but when it is seen, in conjunction with the other symptoms mentioned above, a diagnosis of SDS is strongly indicated.

Figure 2. Early symptoms of SDS

Early planting into cool soils favors SDS. Although planting progress was delayed this year, the abnormally cool weather during mid May could mean that fields planted in late May will still be at risk for developing SDS. It is not possible to predict how severe or widespread SDS will be this year, but growers should be on the alert for appearance of symptoms over the next 2 or 3 weeks. Plants killed early by SDS may produce no seed. Plants that develop symptoms later may produce almost as many pods and seeds as healthy plants, but seed will be much smaller.

There is no remedy for plants that develop SDS. Fungicides will have no effect on this disease. Growers should keep records of which fields develop SDS. Even better, growers should map problem areas within fields. SDS rarely affects entire fields. More often, the disease shows up in patches—low areas or areas of compacted soil are often the first to show symptoms. After the first appearance of symptoms, patches may enlarge and more patches may develop as the season progresses. Identification of problem fields can be useful for future planting decisions. A grower should choose a soybean cultivar that is less susceptible to SDS for planting into fields with a history of SDS. Although there are no highly resistant cultivars, some are much less susceptible than others. Late planting may reduce the risk for SDS, but as pointed out above, this may not apply when May is unusually cold.

Figure 3. Advanced symptoms of SDS

Although *Fusarium solani* f. sp. *glycines* alone can cause SDS, there has long been an observed association between this disease and presence of the soybean cyst nematode in a field. Recent studies at Purdue have shown that symptoms become much more severe when both the fungus and the nematode are present in a field. If a field develops symptoms of SDS and the grower does not know that status of soybean cyst nematode in that field, soil should be tested to determine population levels of this pest.

Agronomy Tips

Silk Emergence - (*Bob Neilsen, Purdue University*)

- Corn produces individual male and female flowers on the same plant.
- The ear represents the female flower of the corn plant
- Severe soil moisture deficits can delay silk emergence and disrupt the synchrony of pollen shed and silk availability, resulting in poor kernel set.

As important as the process of pollination is to the determination of grain yield in corn, it is surprising how little some folks know about the details of cornfield sex. Rather than leaving you to learn about such things "in the streets", take the time to read this article and the accompanying one on tassels and anthers (Nielsen, 2005b) that describe the ins and outs of this critical period of the corn plant's life cycle.

The corn plant produces individual male and female flowers (a flowering habit called monoecious for you corny trivia fans.) Interestingly, both flowers are initially bisexual (aka "perfect"), but during the course of development the female components (gynoecia) of the male flowers and the male components (stamens) of the female flowers abort, resulting in tassel (male) and ear (female) development.

The silks that emerge from the ear shoot are the functional stigmas of the female flowers of a corn plant. Each silk connects to an individual ovule (potential kernel). A given silk must be pollinated in order for the ovule to be fertilized and develop into a kernel. Up to 1000 ovules typically form per ear, even though we typically harvest only 400 to 600 actual kernels per ear.

Technically, growth stage R1 (Ritchie et al., 1993) for a given ear is defined when a single silk strand is visible from the tip of the husk. A field is defined as being at growth stage R1 when silks have emerged on at least 50 % of the plants.

Silks begin to elongate from the ovules about 10 days prior to growth stage R1. Silk elongation begins first from the basal ovules of the cob, then proceeds sequentially up the ear. Similarly, silks from the basal (butt) portion of the ear typically emerge first from the husk, while the tip silks generally emerge last. Complete silk emergence from an ear generally occurs within four to eight days after the first silks appear.

As silks first emerge from the husk, they lengthen as much as 1.5 inches per day for the first day or two, but gradually slow over the next several days. Silk elongation occurs by expansion of existing cells, so elongation rate slows as more and more cells reach maximum size. Once pollinated, elongation of an individual silk will stop.

Silk elongation stops about 10 days after silk emergence, regardless of whether pollination occurs, due to senescence of the silk tissue. Unusually long silks can be a diagnostic symptom that the ear was not successfully pollinated.

Silks remain receptive to pollen grain germination up to 10 days after silk emergence, but to an ever-decreasing degree. Natural senescence of silk tissue over time results in collapsed tissue that restricts continued growth of the pollen tube. Silk emergence usually occurs in close synchrony with pollen shed, so that duration of silk receptivity is normally not a concern. Failure of silks to emerge in the first place, however, does not bode well for successful pollination.

For those of you serious about semantics, let's review two definitions relevant to sex in the cornfield. Pollination is the act of transferring the pollen grains to the silks by wind or insects. Fertilization is the union of the male gametes from the pollen with the female gametes from the ovule. Technically, pollination is almost always successful (i.e., the pollen reaches the silks), but unsuccessful fertilization (i.e., pollen tube failure, silk failure, pollen death) will fail to result in a kernel.

Pollen grain germination occurs within minutes after a pollen grain lands on a receptive silk. A pollen tube, containing the male genetic material, develops and grows inside the silk, and fertilizes the ovule within 24 hours. Pollen grains can land and germinate anywhere along the length of an exposed receptive silk. Many pollen grains may germinate on a receptive silk, but typically only one will successfully fertilize the ovule.

Severe Drought Stress. The most common cause of incomplete silk emergence is severe drought stress. Silks have the greatest water content of any corn plant tissue and thus are most sensitive to moisture levels in the plant. Severe moisture deficits will slow silk elongation, causing a delay or failure of silks to emerge from the ear shoot. If the delay is long enough, pollen shed may be almost or completely finished before receptive silks are available; resulting in nearly blank or totally blank cobs. Severe drought stress accompanied by low relative humidity can also desiccate exposed silks and render them non-receptive to pollen germination.

The severity of drought stress required for significant silk emergence delay or desiccation can probably be characterized by severe leaf rolling that begins early in the morning and continues into the early evening hours. Such severe leaf rolling is often accompanied by a change in leaf color from "healthy" green to a grayish-tinged green that may eventually die and bleach to a straw color.

Silk Clipping by Insects. Although technically not defined as silk emergence failure, severe silk clipping by insects such as corn rootworm beetle or Japanese beetle nonetheless can interfere with the success of pollination by decreasing or eliminating viable or receptive exposed silk tissue. Fortunately, unless the beetle activity is nonstop for days, continued elongation of silks from the husk will expose undamaged and receptive silk tissue at the rate of about one inch or more per day.

Related References

Kling, Jennifer G. and Gregory Edmeades. 1997. Morphology and growth of maize. IITA/CIMMYT Research Guide 9. Int'l Institute of Tropical Agriculture. Available online at <http://www.iita.org/info/trn_mat/irg9/irg9.htm> [URL verified 7/4/05].

Nielsen, R.L. (Bob). 2005a. A Fast & Accurate Pregnancy Test for Corn. Corny News Network, Purdue Univ. Available online at <http://www.kingcorn.org/news/articles.05/EarShake-0704.html> [URL verified 7/4/05].

Nielsen, R.L. (Bob). 2005b. Tassel Emergence & Pollen Shed. Corny News Network, Purdue Univ. Available online at <http://www.kingcorn.org/news/articles.05/Tassels-0704.html> [URL verified 7/4/05].

Ritchie, S.W., J.J. Hanway, and G.O. Benson. 1993. How a Corn Plant Develops. Iowa State Univ. Sp. Rpt. No. 48. On the Web at <http://maize.agron.iastate.edu/corngrows.html> (last verified 7/4/05).

Russell, W.A. and A.R. Hallauer. 1980. Corn. (a chapter in) Hybridization of Crop Plants. American Soc. of Agronomy-Crop Science Soc. of America. Madison, WI.

Steffey, Kevin. 2005. Rootworm Adults and Silk Clipping. Pest & Crop Bulletin, Univ. of Illinois. Available online at <http://www.ipm.uiuc.edu/bulletin/article.php?issueNumber=15&issueYear=2005&articleNumber=2> [URL verified 7/4/05].

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>.

Tassel Emergence & Pollen Shed - (*Bob Neilsen, Purdue University*)

- Corn produces individual male and female flowers on the same plant.
- The tassel represents the male flower of the corn plant.

Over the next several weeks, the Indiana corn crop will move into the critical flowering stages of pollen shed and silk emergence. Success or failure during this period of the corn plant's life will greatly influence the potential yield at harvest time.

As important as this process is to the determination of grain yield, it is surprising how little some folks know about the whole thing. Rather than leaving you to learn about such things "in the streets", I've developed this article and the accompanying one on silking (Nielsen, 2005b) that describe the ins and outs of sex in the corn field.

Remember that corn has both male flowers and female flowers on the same plant (a flowering habit called monoecious for you trivia fans.) Interestingly, both flowers are initially bisexual (aka "perfect"), but during the course of development the female components (gynoecia) of the male flowers and the male components (stamens) of the female flowers abort, resulting in tassel (male) and ear (female) development.

Technically, growth stage VT occurs when the last branch of the tassel emerges from the whorl (Ritchie et al., 1993). Portions of the tassel may be visible before the maximum leaf stage (final visible leaf collar) has occurred. Plant height is nearly at its maximum at growth stage VT. Pollen shed may begin before the tassel has completely emerged from the whorl.

The corn plant is most vulnerable to hail damage at growth stage VT since all of its leaves have emerged. Complete (100 %) leaf loss at growth stage VT will usually result in complete (100 %) yield loss by harvest. Even if pollination is successful, the ear shoots will usually die because few leaves remain to produce the necessary carbohydrates (by photosynthesis) to complete grain fill.

An individual tassel produces approximately 6,000 pollen-bearing anthers, although hybrids can vary greatly for this number. The anthers are those 'thingamajigs' that hang from the tassel during pollination. Under a magnifying lens, anthers look somewhat like the double barrel of a shotgun. Approximately 1,000 individual spikelets form on each tassel and each one bears two florets encased in two large glumes. Each floret contains three anthers. An anther and its attached filament comprise the stamen of the male flower.

As these florets mature, elongation of the filaments helps exsert the anthers from the glumes. Pollen is dispersed through pores that open at the tips of the anthers. Pollen shed usually begins in the mid-portion of the central tassel spike and then progresses upward, downward and outward over time. Anthers typically emerge from the upper floret of the pair first, while those from lower floret typically emerge later the same day or on following days. Spent anthers eventually drop from the tassel and are sometimes mistaken for the pollen when observed on the leaves or ground.

The yellow or white “dust-like” pollen that falls from a tassel represents millions of individual, nearly microscopic, spherical, yellowish- or whitish translucent pollen grains. Estimates of the total number of pollen grains produced per tassel range from 2 to 25 million. Each pollen grain contains the male genetic material necessary for fertilizing the ovary of one potential kernel.

The outer membrane of a pollen grain is very thin. Once dispersed into the atmosphere, pollen grains remain viable for only a few minutes before they desiccate. Yet, with only a 15 mph wind, pollen grains can travel as far as 1⁄2 mile within those couple of minutes.

Therein lies the concern of the potential for pollen “drift” from a transgenic corn field to an adjacent non-transgenic corn field and the risk of transgenic “contamination” of grain intended for non-transgenic markets. The good news is that recent research suggests that the overwhelming majority of a corn field’s pollen load is shed in the field itself.

All of the pollen from a single anther may be released in as little as three minutes. All the anthers on an individual tassel may take as long as seven days to finish shedding pollen, although the greatest volume of pollen is typically shed during the second and third day of anther emergence. Because of natural field variability in plant development, a whole field may take as long as 14 days to complete pollen shed.

Peak pollen shed usually occurs in mid-morning. Some research indicates that pollen shed decreases after temperatures surpass 86F. A second “flush” of pollen often occurs in late afternoon or evening as temperatures cool. Pollen shed may occur throughout most of the day under relatively cool, cloudy conditions.

Weather conditions influence pollen shed. If the anthers are wet, the pores will not open and pollen will not be released. Thus, on an average Indiana summer morning following a heavy evening dew, pollen shed will not begin until the dew dries and the anther pores open. Similarly, pollen is not shed during rainy conditions. Cool, humid temperatures delay pollen shed, while hot, dry conditions hasten pollen shed.

Extreme heat stress (100 F or greater) can kill corn pollen, but fortunately the plant avoids significant pollen loss by virtue of two developmental characteristics. First of all, corn pollen does not mature or shed all at once. Pollen maturity and shed occur over several days and up to two weeks. Therefore, a day or two of extreme heat usually doe s not affect the entire pollen supply. More importantly, the majority of daily pollen shed occurs in the morning hours when air temperature is much more moderate.

Related References

Kling, Jennifer G. and Gregory Edmeades. 1997. Morphology and growth of maize. IITA/CIMMYT Research Guide 9. Int’l Institute of Tropical Agriculture. Available online at <http://www.iita.org/info/trn_mat/irg9/irg9.htm> [URL verified 7/4/05].

Nielsen, R.L. (Bob). 2005a. A Fast & Accurate Pregnancy Test for Corn. Corny News Network, Purdue Univ. Available online at <http://www.kingcorn.org/news/articles.05/EarShake-0704.html> [URL verified 7/4/05].

Nielsen, R.L. (Bob). 2005b. Silk Emergence. Corny News Network, Purdue Univ. Available online at <http://www.kingcorn.org/news/articles.05/Silks-0704.html> [URL verified 7/4/05].

Ritchie, S.W., J.J. Hanway, and G.O. Benson. 1993. How a Corn Plant Develops. Iowa State Univ. Sp. Rpt. No. 48. On the Web at <http://maize.agron.iastate.edu/corngrows.html> (last verified 7/4/05).

Russell, W.A. and A.R. Hallauer. 1980. Corn. (a chapter in) Hybridization of Crop Plants. American Soc. of Agronomy-Crop Science Soc. of America. Madison, WI.

A Fast & Accurate Pregnancy Test for Corn - (*Bob Neilsen, Purdue University*)

- Silk clipping by insects can interfere with pollination success.
- Silks normally detach from fertilized ovules within days of successful pollination and thus can be used as an early indicator of pollination progress and/or success.

Silk clipping by corn rootworm beetles, Japanese beetles, and other obnoxious critters during pollination can be severe enough to impede pollen capture and germination. While you may be tempted to apply insecticides at the first sign of these insects, Purdue entomologists tell us that treatment is not necessary unless the silks are being continuously clipped back to less than 1/2 inch long before pollination is 50 percent complete (Krupke et al., 2005). Silk length is easy to measure, but how do you determine the progress of pollination?

Obviously, one could wait impatiently until kernel development was visibly apparent. Within about 10 to 14 days after pollen shed, developing kernels will resemble white blisters on the cob (Nielsen, 2004). Unfortunately, by then any insect interference with the pollination process will have already taken its toll on kernel set. Luckily for us, the corn plant exhibits an earlier indicator of pollination progress.

Remember that each ovule (potential kernel) on the ear develops a silk (the functional “style” of the female flower) that elongates and eventually emerges through the ear’s husk leaves the tip of the ear shoot (Nielsen, 2005a). The silks represent the “pathway” for the male gametes in the pollen to fertilize the female gametes in the ovules.

Once a pollen grain is “captured” by a trichome or “hair” of a silk, the pollen grain germinates and develops a pollen tube that contains the male genetic material. The pollen tube penetrates the silk and, with adequate moisture and temperature, elongates down the length of the silk within 24 hours and fertilizes the ovule.

Within 2 to 3 days after an ovule has been successfully fertilized, the base of the silk will collapse and detach from the immature kernel. The kernel itself will usually not be recognizable to the naked eye at this stage. Silks of nonfertilized ovules remain attached, however, and will continue to lengthen and be receptive to pollen for up to 10 days after emergence from the ear shoot. Even if never fertilized, silks will remain attached to the ovules. Within days of full silk emergence, therefore, pollination progress may be estimated on individual ears by estimating percent silk detachment.

The Ear Shake Technique

For each ear, make a single lengthwise cut from the base of the ear shoot to the tip with a sharp knife, through the husk leaves to the cob. Slowly unwrap the husk leaves, taking care not to rip any silks from the ovules yourself. Then gently shake the ear. Silks of fertilized ovules will drop away; silks from unfertilized ovules will remain attached.

With practice, pollination progress can be easily determined by estimating the percentage of silks that fall away from the cob. Sampling several ears at random throughout a field will provide an indication of the progress of pollination for the whole field.

One Last Comment

While the “ear shake” technique helps you estimate pollination progress with respect to ovule fertilization, remember that pollination progress includes pollen shed progress. Check the tassels in early to mid-morning hours to determine whether anther extention and pollen shed are still occurring.

Remember, that anther exsertion and pollen shed typically begin on the central tassel stalk, then spreads progressively throughout the tassel branches (Nielsen, 2005b). If no further pollen shed is likely to occur, it doesn’t matter how badly those nasty insects are clipping silks. Unfertilized ovules will remain unfertilized ovules if there is no pollen left in the field. Spraying the bejeebers out of a field at that point is simply a costly form of revenge!

Related References

Krupke, Christian H., Larry W. Bledsoe, and John L. Obermeyer. 2005. Managing Corn Rootworms - 2005. Purdue Univ. Coop. Ext. Service Pub. No. E-49-W. Online at <http://www.entm.purdue.edu/Entomology/ext/targets/e-series/EseriesPDF/E-49.pdf> [URL verified 7/4/05].

Nielsen, R.L. (Bob). 2004. Grain Fill Stages in Corn. Corny News Network, Purdue Univ. Online at <http://www.kingcorn.org/news/articles.04/GrainFill-0705.html> [URL verified 7/4/05].

Nielsen, R.L. (Bob). 2005a. Silk Emergence. Corny News Network, Purdue Univ. Available online at <http://www.kingcorn.org/news/articles.05/Silks-0704.html> [URL verified 7/4/05].

Nielsen, R.L. (Bob). 2005b. Tassel Emergence & Pollen Shed. Corny News Network, Purdue Univ. Available online at <http://www.kingcorn.org/news/articles.05/Tassels-0704.html> [URL verified 7/4/05].

For other Corny News Network articles, browse through the CNN Archives at <http://www.kingcorn.org/news/archive.html>.

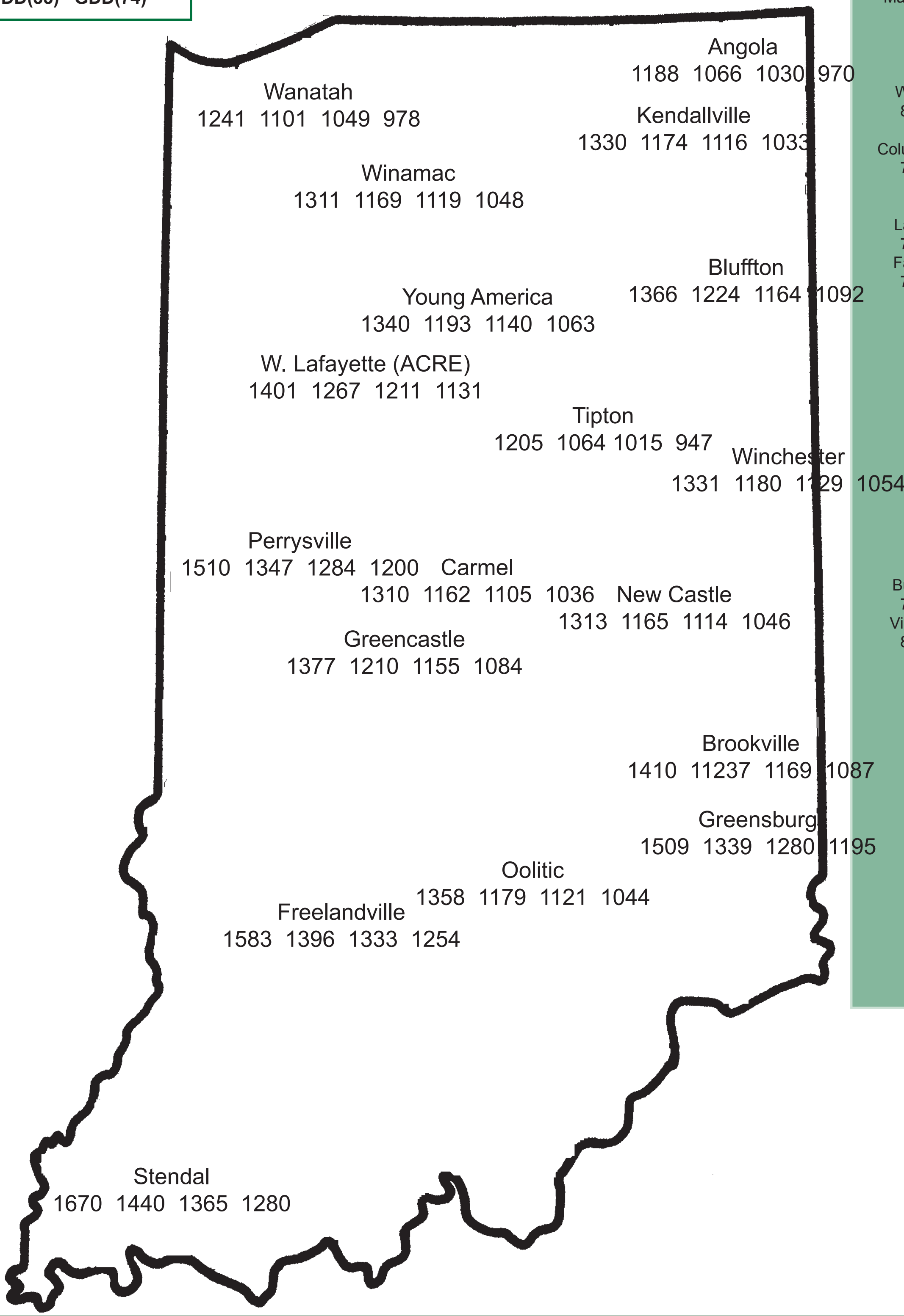
For other information about corn, take a look at the Corn Growers’ Guidebook at <http://www.kingcorn.org>.

Weather Update

Temperatures as of July 12, 2006

GDD(2) = Growing Degree Days from April 12 (2% of Indiana's corn planted), for corn growth and development
GDD(10) = Growing Degree Days from April 26 (10% of Indiana's corn planted), for corn growth and development
GDD(33) = Growing Degree Days from May 3 (33% of Indiana's corn planted), for corn growth and development
GDD(74) = Growing Degree Days from May 10 (74% of Indiana's corn planted), for corn growth and development

MAP KEY
Location
GDD(2) GDD(10) GDD(33) GDD(74)



4" Bare Soil Temperatures 7/12/06

Location	Max.	Min.
Wanatah	85	73
Columbia City	77	72
Lafayette	79	74
Farmland	79	72
Butlerville	78	73
Vincennes	83	76