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November 19, 2004 - No. 27

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Insects, Mites, and Nematodes

Corn Rootworm in 2004 – (John Obermeyer and Larry Bledsoe)

- It was a relatively quiet year in Indiana for rootworm larval damage.
- Heavy June rains may have knocked the rootworm numbers back, but certainly not out.
- Beetle numbers were impressive, especially in some areas south of I-70.
- Ample moisture at mid season helped with root regeneration.

Rain makes grain! With record corn yields being realized by Indiana producers, it would seem that rootworms caused little root damage. Reports of plant lodging from rootworm were far and few between this past season. As well, three of four of our rootworm efficacy trials scattered in northern Indiana had very little root damage. However, high western corn rootworm beetle numbers found in our soybean sweeps in late summer indicate that these insects have an exceptional ability to rapidly re-colonize vacate habitat. Surviving larvae that developed in Indiana cornfields were obviously supplemented by adults transported from surrounding areas by wind.

Rootworm larval hatch and development seemed to be on schedule this past spring. Then much of the state's

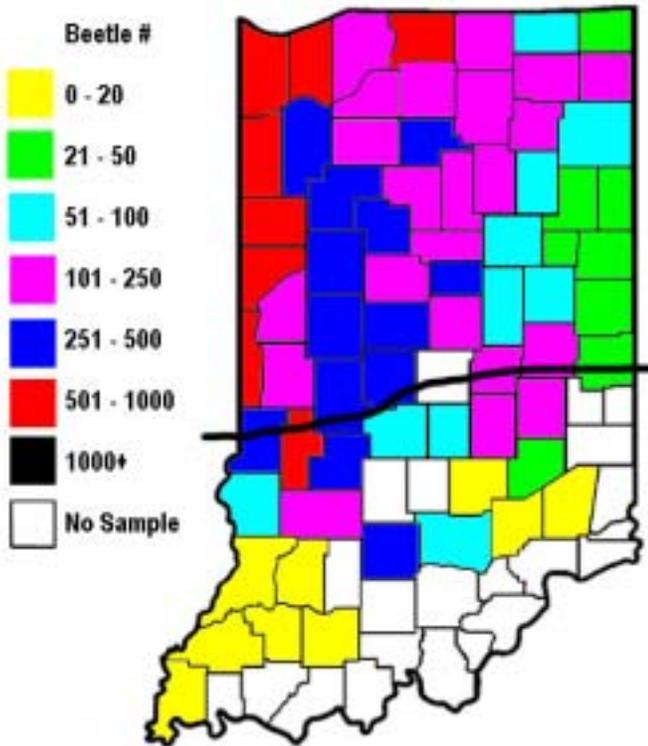
areas with higher risk to rootworm received tremendous rain events about mid-June when newly hatched larvae are vulnerable to saturated soil conditions. As the season progressed we heard very little about rootworm damage and goose-necked corn, except where high winds caused some significant damage. Our assumption was that many of the young larvae drowned.

Once beetle emergence was in full swing, it became obvious that many larvae had fed and survived. The soybean sweeps conducted in many counties of the state revealed that impressive numbers of western corn rootworm beetles not only existed, but were in record numbers south of Interstate 70. The numbers of adult rootworm found south of I-70 in 2004 does not correspond to elevated numbers observed in 2003. This suggests that persistent winds from the north and west carried many rootworms during their dispersal flights. If you desire to see the state map with specific soybean sweep numbers from 2004, click [HERE](#). Once roots were dug in later summer it became obvious that root feeding did occur but most damaged plants, with the help of ample soil moisture, were able to regenerate a substantial root mass and still produce good to excellent yields.

The teachable moment from 2004 is the rootworm's biotic potential. You may recall that rootworm beetle

numbers were at a five year low the previous season (2003). Then add the heavy rains during egg hatch of 2004. Even so, this year's beetle numbers were very high in many areas of the state. When you consider that each female western corn rootworm beetle is able to produce and lay over 1,000 eggs, and the adults can travel 50 or more miles per season, they certainly have the numbers and odds in their favor!

2004 Western Corn Rootworm Sweep Net Survey in Soybean (Number per 100 Sweeps)



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Perceived Risks to Western Corn Rootworm Damage in First-Year Corn – (John Obermeyer and Larry Bledsoe)

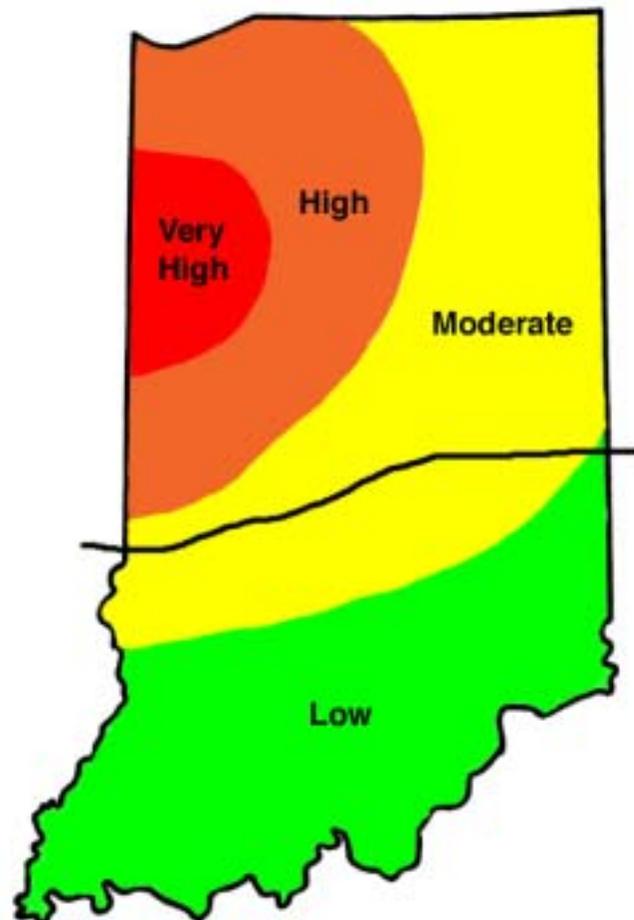
- Ultimately weather has the biggest impact on rootworm numbers and potential damage.
- Risks of next season's WCR damage is based on beetle numbers and past trends.
- The following risks are to be used as a guideline, refinement should be done on a local level.
- First-year rootworm "fringe" area has been lowered in the state.
- Risk categories defined below.

As learned from this past season, weather continues to be, and will always be, the major influence on insect numbers and subsequent crop damage. Numerous other biotic and agronomic variables occurring statewide or in localized areas make predictions of corn rootworm problematic.

Nevertheless, the following risk map has been developed by previous year's soybean sweeps taken while western corn rootworm (WCR) beetles were actively laying eggs and frequency of reported larval damage. Because we draw these conclusions from, at best, a few fields sampled per county there is a large margin of error. We continue to encourage pest managers to monitor soybean fields in their *specific* area so that more precise risks can be assigned and appropriate management strategies implemented.

Because of last season's influx of significant western corn rootworm beetles to soybean fields further south and east in the state than previously seen, a "moderate" risk has been extended to counties well below Interstate 70. Though it may take several years before widespread, first-year corn damage is noted in these areas, we think it is prudent for producers to consider this pest as establishing there. Producers in these "fringe" areas may consider on-farm, strip trials with rootworm products to determine the economical impact of this insect in their first-year corn. The following article, "Rootworm Soil Insecticides: Choices, Considerations, and Efficacy Results," may give some guidelines in choosing a product.

Perceived First-Year Corn Rootworm Risk Areas



“Very High” indicates that consistently high numbers of WCR beetles have been found in soybean fields. First-year WCR damage is likely and may be severe in parts of or whole fields.

“High” risk indicates that most soybean fields sampled or observed in that area contained high numbers of WCR beetles coupled with the fact that first-year corn rootworm damage frequently occurs.

“Moderate” risk means that WCR beetle numbers vary from field to field and that significant first-year rootworm damage is expected to be spotty.

“Low” risk areas have consistently low WCR beetle numbers in soybean with few, if any, damaged first-year corn fields expected.

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Rootworm Soil Insecticides: Choices, Considerations, and Efficacy Results - (John Obermeyer and Larry Bledsoe)

- Four delivery methods for rootworm insecticide exist, none provide perfect control.
- Brief discussion of each delivery method and product rootworm efficacy compared.

When one uses a soil insecticide it is important to remember that protection of the primary portion of the root system from economic rootworm attack is the goal. Also, one needs to understand that products do not provide 100% control (60-80% control more likely) and occasionally some economic damage may occur depending on the larval population, weather, planting date, plant development, and time of larval hatch. All of these factors can ultimately impact product performance and must be considered when using a soil insecticide. The important things for producers to understand are the positive and negative aspects of each product, and determine which one(s) fits best within their farming system. Also, one needs to understand what the warranty for each product really means. Additionally, it makes sense to have untreated check strips in fields to gauge the performance and economics of the products used.

Listed below, by application method, are the current registered soil products and their efficacy in protecting roots in 2004 Indiana and Illinois university rootworm trials. Separation by application technology was made so that like-products could more easily be compared. There is no consideration of other insect pests, e.g., wireworms, white grubs, cutworms, in these evaluations.

Insecticide-coated seed: There have been many questions about the pre-applied insecticide seed

treatments available for corn. The attractiveness of having a soil insecticide “wrapped” directly on the seed is understandable. Cruiser (1.25mg rate) and Poncho 1250 (1.25 mg rate) are both from the newer insecticide class, nicotinoids. These products must be custom applied to seed with specialized equipment, therefore producers must order them at the time of seed purchase. Using seed-applied insecticides for corn rootworm control in high-risk areas (see previous article) may be a gamble. This is because of the inconsistencies that have been seen in university trials throughout the Midwest. The labels literally state “protect” or “protection” from rootworm...not control. For producers in areas with low to moderate rootworm pressure, these seed treatments may be beneficial and may also offer protection from other soil insect pests, e.g., wireworms, seedcorn maggots, etc.

Insecticide Coated Seed Root-Rating Performance¹, 2004

Location	Best ² Rating	Cruiser 1.25	Poncho 1250	Check
Lafayette, IN	1.50	1.95	1.95	2.55
Wanatah, IN	2.20	5.50	3.70	5.90
Columbia City, IN	1.60	1.95	2.00	3.60
DeKalb, IL	2.35	5.05	3.95	5.00
Monmouth, IL	1.80	5.10	4.10	5.75
Urbana, IL	2.45	4.15	4.05	5.80

¹Root rating: 1 = none to little damage, 6 = severe root pruning, 3.0 or greater - plants likely predisposed to a significant yield loss

²The “Best Rating” is the least amount of rootworm damage for any soil insecticide in the plot

Liquid soil insecticides: Producers have had the option of the liquid insecticides Capture, Lorsban, and Regent for several years. At first, the niche market for these products and their unique application equipment were for producers without granular soil insecticide applicators on their planters, and who were beginning to notice rootworm damage in first-year corn. We became concerned when companies aggressively targeted the rootworm market in high-risk areas of the state. Producers soon found that the performance of these products under high rootworm pressure was inconsistent, some with disastrous results. The recent release of the new John Deere 1790 planter with the FMC “LiquidReady” system as the only insecticide application equipment option certainly has gotten our attention (another aftermarket option for granules include the SmartBox system). We would encourage producers in the very high-risk, first-year rootworm areas contemplating using the currently available liquid insecticides to evaluate their recent experiences with

rootworm. The efficacy results of these products for 2004 are as expected, that is satisfactory performance where rootworm pressure is light to moderate and unacceptable results when feeding is severe.

Liquid Soil Insecticide Root-Rating Performance¹, 2004

Location	Best ²		Lorsban		
	Rating	Capture	Regent	4E	Check
Lafayette, IN	1.50	1.85	1.70	1.80	2.55
Wanatah, IN	2.20	3.65	3.70	3.25	5.90
Columbia City, IN	1.60	1.75	2.05	2.15	3.60
DeKalb, IL	2.35	3.90		3.15	5.00
Monmouth, IL	1.80	3.45		3.00	5.75
Urbana, IL	2.45	3.55		2.65	5.80

¹Root rating: 1 = none to little damage, 6 = severe root pruning, 3.0 or greater - plants likely predisposed to a significant yield loss

²The "Best Rating" is the least amount of rootworm damage for any soil insecticide in the plot

Granular soil insecticides: Granular insecticides have long been considered the standard from which other soil products are compared. They've been criticized for being bulky, dusty, and time consuming albeit considered the most consistent in performance. Though formulations and product names have changed over the last several years, the chemical classes have remained the same...organophosphates and synthetic pyrethroids. EPA has hinted several times in the past that granular soil insecticides, especially the organophosphates, will be phased out. Recent formula registrations and product re-registrations doesn't reflect that. Insect resistance or enhanced biodegradation has not been an issue with the current registered products.

Bt Corn Rootworm: Up until this past season, it looked as though this technology had set a new "benchmark" in rootworm control. The well publicized rootworm damage that occurred in a couple dozen or more fields in Illinois have led to some farmer's reservations about this technology. Other than our efficacy trial at Wanatah (see table below) we are not aware of any YieldGard-CR fields in Indiana that had significant rootworm feeding. The cause for this unexpected damage is still unresolved. All YieldGard seed will be "wrapped" with either Cruiser (low rate) or Poncho (low rate) for protection from other soil insect pests, e.g., wireworms, seedcorn maggots, etc. YieldGard-RW and YieldGard Plus will be very attractive to producers in high-risk areas to first-year corn rootworm damage especially those with the new John Deere 1790 planter. It will be imperative that producers follow refuge guidelines (20% within or adjoining field). The 20% non-Bt refuge will need chemical protection from rootworm, and discussions with producers vary on how they intend to treat this acreage.

Transgenic BT-CRW Root-Rating Performance¹, 2004

Location	Best ²	YieldGard		Check
	Rating	RW	Force	
Lafayette, IN	1.50	1.50	1.65	2.55
Wanatah, IN	2.20	3.10	2.55	5.90
Columbia City, IN	1.60	1.60	1.95	3.60
DeKalb, IL	2.35	2.35	2.65	5.00
Monmouth, IL	1.80	1.80	3.35	5.75
Urbana, IL	2.45	3.15	2.45	5.80

¹Root rating: 1 = none to little damage, 6 = severe root pruning, 3.0 or greater - plants likely predisposed to a significant yield loss

²The "Best Rating" is the least amount of rootworm damage for any treatment in the plot

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Granular Soil Insecticide Root-Rating Performance^{1,2}, 2004

Location	Best ³	Aztec 2.1	CounterCR	Empower	Force	Fortress 2.5	Lorsban	Check
	Rating							
Lafayette, IN	1.50	1.75	1.80	1.95	1.65	1.90	1.85	2.55
Wanatah, IN	2.20	2.60	2.50	4.45	2.55	2.20	3.55	5.90
Columbia City, IN	1.60	1.70	2.30	2.60	1.95	2.45	2.30	3.60
DeKalb, IL	2.35	2.75		4.70	2.65	2.75	3.30	5.00
Monmouth, IL	1.80	3.25			3.35	2.55	2.95	5.75
Urbana, IL	2.45	2.90		4.70	2.45	2.95	2.65	5.80

¹Root rating: 1 = none to little damage, 6 = severe root pruning, 3.0 or greater - plants likely predisposed to a significant yield loss

²All products applied in T-band except for Fortress 2.5G which was placed in-furrow

³The "Best Rating" is the least amount of rootworm damage for any soil insecticide in the plot

Seed-Applied Insecticide Seed Treatments for Secondary Insects – (John Obermeyer and Larry Bledsoe)

- Predicting soil insect infestations is a very inexact science.
- The brief systemic activity of some of these products may protect seed and seedling from some soil insect pests.
- DO NOT use seed-applied insecticides if a soil insecticide for rootworm is being used at planting.
- Conditions that may justify the use of these products.

Few industry or university replicated trials correlate secondary soil insects to stand and yield losses. Many experiments have been tried but often fail because the insects don't show up or damage to yield correlation was poor. However, we know these losses occur, we just can't predict when and where. Producer testimonials tout promising results with Cruiser, Gaucho, and Poncho 250 so much that some seed companies are pre-treating a majority of their hybrids. Will producers recoup this additional \$4-6/acre (depending on seed drop) expense?

These pre-applied seed treatments are from the new insecticide chemistry, nicotinoids that have systemic activity during the early life of the corn seedling. Data exist that show some seed/seedling protection from seedcorn maggot, wireworms, and cutworms. Certainly the biggest question for producers and researchers is how effective these products are against

white grubs, considered a primary pest by some. Scant data have shown a mixed bag of results, as is true with many granular soil insecticides. Most likely there will be some suppression of grubs, but not control. The labels of these products literally read "protect" or "protection" from grubs.

We strongly feel that combining the seed-applied insecticides with a soil insecticide for rootworm control is an economic mistake. Soil insecticides at the rootworm rate are already labeled to control these secondary insects. Ric Bessin, University of Kentucky corn entomologist, conducted a study for wireworm control this past season <http://www.uky.edu/Agriculture/kpn/kpn_04/pn040913.htm#corsee>. Seed-applied insecticides were compared to a half-rate of Force granular insecticide. Even the half-rate of Force, which we DO NOT recommend, protected the stand better than did Poncho 250 and Gaucho Extra (higher than commercial corn rate).

Should one use the pre-applied insecticide seed treatments for soil insects where rootworm is not a concern? Return on investment of seed applied treatments may improve for some pests if:

- field is planted early (before last week of April)
- field has a recent history of wireworm damage
- field is no-tilled into dying vegetation (e.g., spring weeds)
- field is spread with animal manure before planting
- field is higher yielding (170+)

Weeds

Fall Applied Herbicides for Soybean, Corn and Wheat – (Bill Johnson and Glenn Nice)

Recent rainfall and warm weather conditions has stimulated winter annual weed emergence throughout much of Indiana. It would be advisable to scout fields that won't be tilled this fall to determine the level of winter weed infestations and determine if fall applied herbicide treatments are needed. Fields that were weed-free 3 weeks ago when soils were dry are now showing a lot of new weed growth.

When to apply fall herbicide treatments for soybean or corn

For control of winter annual weeds and dandelion, apply herbicide anytime between now and mid November for best results.

Treatments that can be used in front of either corn or soybean

Glyphosate + 2,4-D controls most winter annuals, biennials, and also dandelion. A glyphosate rate of 0.38 to 0.5 lb of glyphosate acid should be adequate for most winter annuals, but rate should be increased to 0.75 lbs acid where dandelion and other perennials and biennials are present. Apply with ammonium sulfate. 2,4-D should be added if you think you have glyphosate-resistant marestail. A fall applied treatment of glyphosate + 2,4-D won't be effective in suppressing spring emergence of winter annual weeds.

Sencor + 2,4-D controls most winter annual weeds, but not biennial or perennial weeds. A Sencor rate of at least 8 oz/A should be used to provide meaningful residual activity, especially on spring emerging marestail.

2,4-D alone at 1 to 2 lbs ai/A will control many winter annual weeds, but not chickweed or grassy species. Add Express at 0.125 oz/A to control chickweed. Add glyphosate to control grassy species and improve control of dandelion.

Treatments that can be used in front of corn only

Simazine (1 lb ai/A) + 2,4-D controls most winter annual weeds, but is less effective on dandelion and grassy weeds than Basis + 2,4-D or glyphosate + 2,4-D. Simazine does not provide much residual control of summer annual weeds the following spring, so expect to use a typical herbicide program in next year's corn.

Basis + 2,4-D controls most winter annual weeds and dandelion, and has more activity on grassy species than simazine + 2,4-D. Basis does not provide much residual control of summer annual weeds, so expect to use a typical herbicide program in next year's corn.

Treatments that can be used in front of soybean only

CanopyXL + Express + 2,4-D controls most winter annual weeds and dandelion. Rates of CanopyXL range from 2.5 to 4.5 oz/A based on soil type. The 2.5 oz rate is adequate for control of emerged weeds in the fall, but higher rates can extend the length of weed control the following spring. Do not use more than 2.5 oz where soil pH is greater than 6.8.

Backdraft (Scepter + glyphosate) + 2,4-D also provides control of most winter annual weeds, dandelion, plus the glyphosate component will provide control of winter annual grasses that have emerged. This treatment has received quite a bit of attention this fall because of a price reduction.

Valor + Express + 2,4-D + glyphosate will provide control of many winter annual weeds plus dandelion.

Wheat

Most of the wheat is planted by now and fields may have winter weeds just emerging in them. Although some 2,4-D products are labeled for fall applications, wheat appears to be more sensitive to fall applications, particularly prior to tillering and yield loss is possible. Harmony Extra can be applied at 0.3 oz/A in the fall, followed by application of an additional 0.3 oz/A or another herbicide next spring if needed. Wheat should be in at least the 2-leaf stage for a fall application. This treatment is effective on most winter annuals, and a good choice for fields with heavy wild garlic infestations. Peak can be applied at 0.5 oz/A. Peak is also effective on many winter annual weeds and wild garlic. Be cautious of crop rotation restrictions if Peak is used. Soybean can not be planted until 10 months after application. Forage grasses, alfalfa, or clover cannot be planted until 22 months after application. Grain sorghum can be planted the following year.

Other Products for all three Crops

There are a number of different products one can effectively use in the fall. The purpose of that article was to point out a few products that are used on a widespread basis across Indiana and much of the Midwest. If you are interested in how well other products work as fall applied treatments, we have a weed response table in the Weed Control Guide for Indiana and Ohio that shows the relative efficacy of various herbicide treatments for winter weed control when applied in the fall or the spring. Follow this link to view the table and the relative effectiveness of various fall and spring applied burndown treatments on the most common winter annual weeds. <www.btny.purdue.edu/Pubs/WS/WS-16/BurndownTable.pdf>.

Plant Diseases

Asian Soybean Rust Found in U.S. – (Gregory Shaner, Shawn Conley, and Ellsworth Christmas)

The USDA reported Nov 10 that the Asian soybean rust fungus, *Phakopsora pachyrhizi*, was found on soybean plants in Louisiana. This is the first report of the fungus in the continental U.S. Soybean rust was first detected in the Western Hemisphere in 2002, in Paraguay and southern Brazil. Since then it has spread throughout Brazil, and into Argentina and Bolivia. Earlier this year, it was detected in Colombia. It is not yet known how the rust made its way into the U.S., but possibly the strong tropical storms and hurricanes of the late summer carried fungus spores from South or Central America into the southern U.S. Hurricane Ivan may have been the storm responsible.

Now that the disease is here, what does this mean for Indiana soybean producers? At this time it is impossible to predict whether the disease will reach Indiana in 2005, and should it do so, how widespread and severe it might be. Several things contribute to this uncertainty. First, it is not yet known how widespread the fungus is in the South. It is unlikely that the rust found in research plots in Louisiana is the only occurrence. If spores were carried into the U.S. by tropical storms, there may be infections throughout the South. At this time, there are few green soybeans there, but the soybean rust fungus has a broad host range. *Phakopsora pachyrhizi* has been found in nature on about 35 species of legumes other than soybean. About 50 additional species have been susceptible when inoculated with the fungus. Most of these host species are tropical or subtropical, but several occur in the U.S., including the Midwest. Among these are yellow sweet clover (*Melilotus officinalis*), butter bean and lima bean (*Phaseolus lunatus*), kidney bean and green bean (*Phaseolus vulgaris*), and kudzu (*Pueraria lobata*). Rust fungi do not persist in crop residue. They require a living host for growth and production of spores. Any host species whose leaves remain green during the winter can serve as an overwintering site for the fungus. Spores produced on these plants in the spring can initiate disease on soybean in the spring. If the disease becomes severe on soybean crops in the South, then abundant spores may be transported by wind into the Corn Belt during the early summer of 2005. Conversely, if little rust develops in the South next spring, then it is less likely that large numbers of spores will reach Indiana early in the summer.

A major unknown factor in the epidemiology of soybean rust in the U.S. is the weed kudzu. Kudzu is susceptible to soybean rust and supports abundant fungus sporulation. This perennial vine is a native of

Japan and was introduced into the southeastern U.S. for erosion control and as forage. It has subsequently become an invasive weed, and extends into southern Indiana. Kudzu may be an important overwintering host for *Phakopsora pachyrhizi* in the Deep South. Most likely, the soybean rust fungus will only survive the winter where temperatures are mild enough for host plants to retain green leaves. The actual area where the fungus will survive in North America remains to be seen, but best current estimates include southern Florida, south Texas, Mexico, and islands in the Caribbean.

Another uncertainty is weather. *Phakopsora pachyrhizi* does not require unusual weather conditions to thrive—moderate temperatures and frequent dews are sufficient. If the 2005 growing season is dry, then an epidemic is unlikely, even if rust spores reach Indiana. However, if we have well-spaced rains and long periods of dew most nights, rust could develop rapidly. Sustained favorable weather is important because rust is a polycyclic disease. When rust first arrives in a field, there are typically only a few infections. These infections mature into sporulating pustules in about 7 days. Wind disperses the spores produced in these pustules throughout the field, where they can cause more infection. Several infection cycles are required for rust to reach damaging levels.

All soybean varieties in the U.S. are essentially susceptible to rust. There may be differences in degree of susceptibility, but as far as is known, no variety has an effective degree of resistance. Therefore, if weather conditions are favorable and rust spores arrive in Indiana during June or early July, there is a good chance that a severe epidemic will develop. If spores do not arrive until late July or August, the epidemic would probably not be as severe.

During the past 3 years Brazilian farmers have learned a lot about controlling soybean rust with fungicides. Several fungicides are very effective against this disease if used appropriately. Brazilian farmers have found that control is best when fungicide is applied as rust first begins to develop. Currently, only two fungicides effective against rust are registered for use on soybean in the U.S. These are chlorothalonil (Bravo) and azoxystrobin (Quadris). In anticipation of soybean rust's arrival in the U.S., plant pathologists in most soybean-producing states submitted applications to the U.S. Environmental Protection Agency (EPA) for emergency registration (Section 18 registration) of 10 additional products. There were two reasons for doing this.

First, Quadris appears to be the more effective of the two currently labeled fungicides. However, it has a very specific mode of action against the fungus. Experience with other plant pathogenic fungi suggests that repeated use of this fungicide can lead to development of resistance to Quadris. To avoid development of resistance in *Phakopsora pachyrhizi* to Quadris, farmers should have available fungicides with different modes of action.

Second, supply is a concern. There is not enough of any one fungicide to treat the large soybean acreage that is vulnerable to rust. A greater number of fungicides registered for use against soybean rust considerably increases the supply of effective products. As of now, the EPA has approved Section 18 registrations for propiconazole (Tilt, Propimax, Bumper), myclobutanil (Laredo), and tebuconazole (Folicur). As fungicides are approved under Section 18 registrations, the Cooperative Purdue Extension Service will make this information known. Information on progress of registration of fungicides can be found at <www.ipmcenters.org/NewsAlerts/soybeanrust/quarantine.cfm>.

Little can be done about soybean rust in U.S. soybean-producing areas at this time. Next spring we will be monitoring the progress of rust in southern states through contacts with other plant pathologists. Once soybeans are planted in Indiana, we will monitor fields for first appearance of rust. Growers and other people involved in crop production should also be looking closely at fields. The more people we have scouting, the more likely we are to detect rust when it first arrives in Indiana.

Initial infections of soybean rust are difficult to recognize. Moreover, there are other soybean foliar diseases that may be mistaken for rust. Finding spots on soybean leaves does not mean rust is present. It is critical that any plants suspected of having rust be sent to the Purdue Plant and Pest Diagnostic Laboratory to confirm the diagnosis. A downloadable pdf file that contains instructions for submitting samples to the PPDL can be found at: <www.ppd.l.purdue.edu/ppdl/pubs/IN_soybeanrust_collection.pdf>

A pictorial guide containing images of soybean rust and some “look-alike” diseases can be found at: <www.ppd.l.purdue.edu/ppdl/pubs/soybean_rust_symptoms_web.pdf>

Some questions about cultural practices and their impact on soybean rust are already circulating:

Will early planting reduce the risk of rust? No, early planting will have little effect on rust. It will, however, increase the risk of soilborne soybean diseases such

sudden death syndrome and *Phytophthora* rot, two problems that are widespread in Indiana.

Will switching to an earlier maturity group soybean reduce the damage from rust? No, when early-maturity varieties are substituted for full-season varieties, yield potential is often decreased. This is primarily due to an increased risk of negative environmental factors, e.g., inability of the soybean crop to capture late August rains to compensate for drought. It is in the grower's best interest to plant a full season soybean variety to maximize yield potential. Then, if we get rust, manage the disease with fungicides.

Should I reduce my planned soybean acreage for 2005? No, research indicates that continuous corn systems will lead to decreased yield potential when compared to corn/soybean rotations. See “Rethinking Rotations: More Corn and Less Soybean in the Corn Belt?” <www.entm.purdue.edu/Entomology/ext/targets/p&c/P&C2004/P&C26_2004.htm>.

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Northern Corn Leaf Blight - (Gregory Shaner)

- Why did this corn disease make such a dramatic appearance this year?

Northern corn leaf blight was widespread and severe in Indiana this year on some hybrids. A fungus, *Exserohilum turcicum*, causes the disease. The disease has a long history in Indiana and other states of the eastern Corn Belt. A. J. Ullstrup, a corn pathologist at Purdue, reported that the disease was widespread and severe from 1939-1943. He speculated that the reason farmers became so aware of this disease was because they were particularly observant of the condition of their corn during this time. This was when many of them were first trying hybrid corn, and they wanted to be assured that the crop raised from purchased seed was indeed worth the extra investment. Resistant hybrids have largely brought this disease under control, but in most years we see some northern corn leaf blight in a few fields. This year the disease was severe on some hybrids. Initial infections established early. There was significant defoliation by the early grain filling period.

On susceptible hybrids, the disease is fairly easy to diagnose. Lesions are large (often 3 to 6 in. long), tapering at each end. Unlike lesions of other common leaf blights, the major veins in corn leaves do not restrict the lateral expansion of northern corn leaf blight lesions,

so they may be an inch or more at the widest point. Lesions are gray-green when weather is humid. This is the result of abundant production of spores on the leaf surface by *Exserohilum turcicum*.

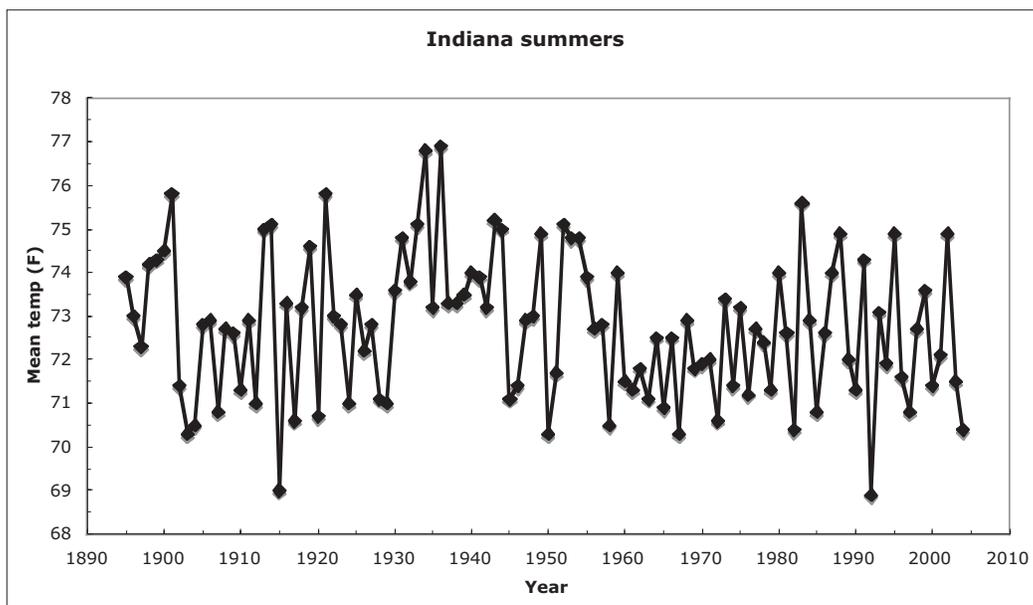
Northern corn leaf blight is a polycyclic disease. Initial infections arise from spores produced on corn residue from the previous year. Once these initial infections develop into lesions, the fungus produces spores on this necrotic tissue. Wind and rain disperse these spores. Those that land on healthy leaf tissue infect and produce more lesions. Because the lesions are so large, only a few infections on a leaf can kill a large percentage of the leaf area. As lesions spread up the plant, killing more leaf tissue, the plant's photosynthetic capability is compromised and yield suffers. Research done from the 1940s through 1960s showed that susceptible hybrids could sustain substantial loss of yield if the disease became established in the crop within 2 or 3 weeks after silking.

In the years following the initial outbreaks of northern corn leaf blight, plant pathologists searched through corn germ plasm to find resistance to this disease. Some inbreds proved to have quantitative resistance. Hybrids made from these resistant inbreds developed little northern corn leaf blight in the field. The fungus could infect these lines, but the disease was slow to spread. Little leaf tissue was destroyed by the time the grain matured, and yield reduction was minimal. Later, another type of resistance was found. This was conferred by any of three single genes (*Ht*, *Ht2*, or *Ht3*) and was designated "chlorotic lesion" resistance. *Exserohilum turcicum* can infect plants that carry any of these genes, but instead of a large necrotic lesion, a chlorotic lesion develops. The fungus produces few or no spores in these chlorotic lesions, so the resistance virtually eliminates secondary inoculum production.

The outbreak of northern corn leaf blight this year teaches an important lesson about field crop diseases. Plant pathologists often use the "disease triangle" metaphor to emphasize that three conditions are necessary for a severe disease outbreak: a susceptible host, a virulent pathogen, and favorable weather. What happened this year with northern corn leaf blight has happened recently with two other "old" diseases: *Diplodia* (*Stenocarpella*) ear rot and anthracnose stalk rot. The lesson these diseases teach is that old pathogens never disappear. For years, we may see very little of them, but when conditions are right, susceptible hybrids can be hit hard.

Northern corn leaf blight thrives when there are long dew periods at night and temperatures are in the range of 64 to 80°F. It is likely that the development of severe northern corn leaf blight this past summer on susceptible hybrids was due in part to the cool weather. Data from the Midwestern Climatological Center (kindly provided by Ken Scheeringa) show that this past summer was the third coolest in Indiana since 1895. For these comparisons, a "climatological summer" is used—June 1 through August 31.

If this year's northern corn leaf blight epidemic was largely influenced by cool weather during the summer, what are the prospects for a problem next year on susceptible hybrids? The graph below depicts the average climatological summer temperature for each year since 1895. The summer of 2004 was the second year of a downward trend in temperature. Examination of the graph shows only a couple of periods when a cooling trend persisted more than 2 years: 1921 through 1924, and 1952 through 1958. In that latter period, the mean temperature did not decrease every year. The summers of 1953 and 1954 had the same mean temperature, and the summer of 1957 was 0.1°F warmer than the summer



of 1956. Given the historical pattern of year-to-year variation in summer temperature, it seems more likely that the summer of 2005 will be warmer than the summer of 2004. How much warmer is another matter. The graph shows that sometimes the reversal was pronounced. See, for example, 1958 to 1959, 1982 to 1983, and 1992 to 1993. In other cases, the reversal was modest, for example, 1902 to 1903, 1945 to 1946, and 2000 to 2001. If next summer is much warmer than last, we may see little northern corn leaf blight. If it is only slightly warmer than the summer of 2004, we could still have favorable conditions for northern corn leaf blight. This, plus the surviving inoculum that will be produced on residue from the 2004 corn crop could mean extra northern corn leaf blight pressure next year.

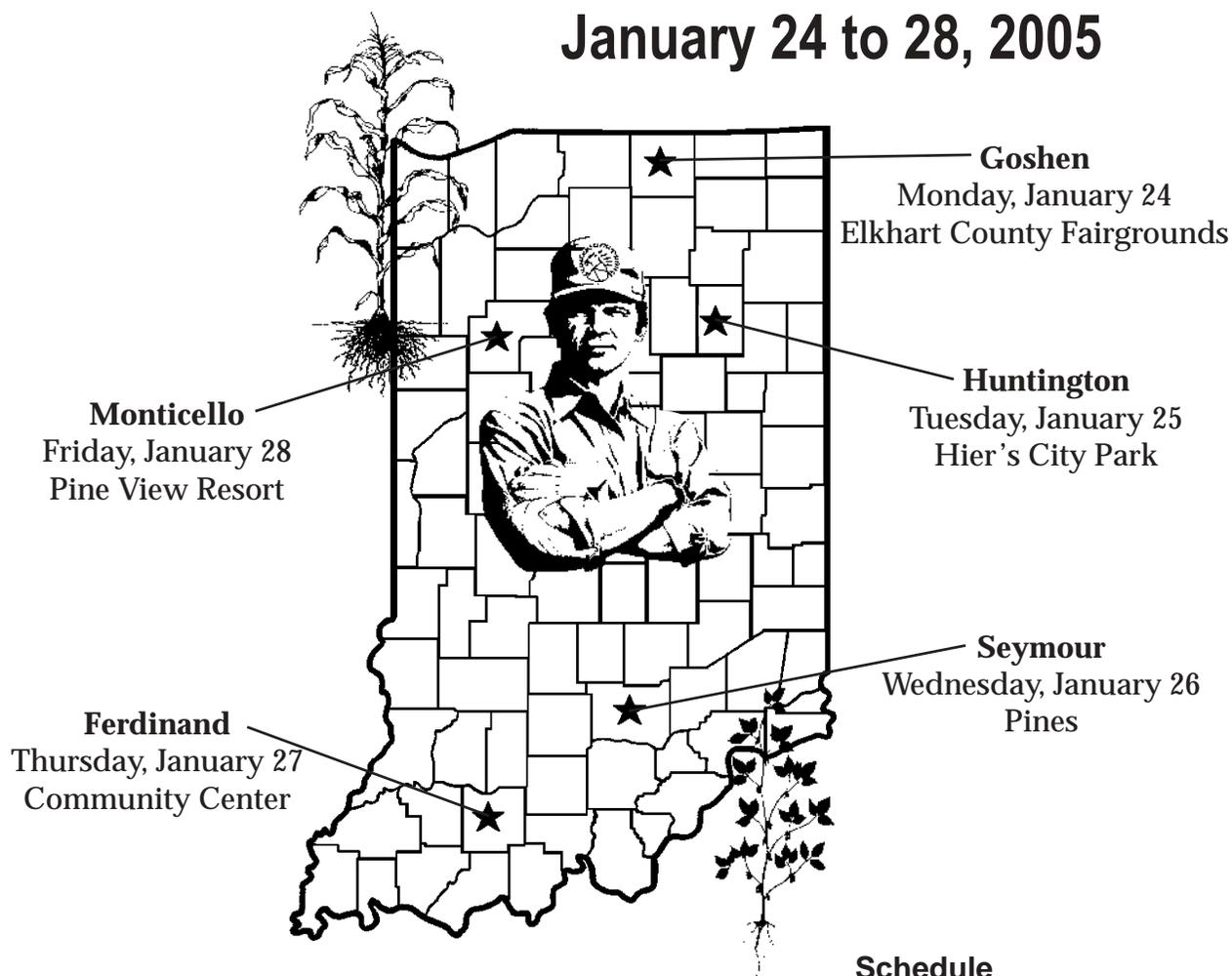
So, what's a grower to do? Corn breeders have worked for many years to incorporate resistance to many diseases into their hybrids. Resistance ratings can be found in seed catalogs or Web sites. Resistance is often quantitative, so rather than describe a hybrid as

“resistant” or “susceptible” to some disease, the seed company assigns a number that reflects the best assessment of the hybrid’s relative resistance. These ratings are commonly on a 10-point scale. For some companies, the higher the number, the greater the degree of resistance. For other companies, the lower the number, the greater degree of resistance, so look at the fine print. The lesson from recent outbreaks of anthracnose, *Diplodia* ear rot, and northern corn leaf blight is that if a farmer grows a susceptible hybrid, and if weather conditions are favorable for a disease, a severe epidemic can develop that will take away a lot of potential yield and income. Therefore, a farmer should consider disease resistance ratings as well as to yield potential, standability, dry down, and other agronomic traits when choosing a hybrid. It’s not necessary to go after the highest possible resistance to all diseases (few hybrids have a resistance package this complete), but one can reduce risk by avoiding hybrids that have poor ratings to one or more diseases.

Mark Your Calendar for the
Location Nearest You...

2005 CROP MANAGEMENT WORKSHOPS

January 24 to 28, 2005



Sponsored by the
Purdue Pest Management Program

in cooperation with the Departments of
Agronomy, Botany and Plant Pathology
and Entomology

Additional Information

John Obermeyer
765-494-4563

8:30-9
9-11:50
11:50-12:35
12:35-4:10
4:10

Schedule

(all locations are
Eastern Standard Time)

Registration
Morning Presentations
Lunch Provided
Afternoon Presentations
CCH/CEU Forms

Topics

(for each location)

Disease, Insect, and Weed Control Strategies
State and Federal Pesticide Regulations
Agricultural Plant Security
Crop Diagnostics

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If there are questions or problems, contact the Extension Entomology Office at (765) 494-8761. Reference to products in this publication is not intended to be an endorsement to the exclusion of others which may have similar uses. Any person using products listed in this publication assumes full responsibility for their use in accordance with current directions of the manufacturer.

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