

CORN AND SOYBEAN SCIENCE GROUP NEWSLETTER

Cooperating Departments: Agronomy, Agricultural Economics,
Biosystems and Ag. Engineering, Entomology, Plant Pathology
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2003 PLANT AND SOIL SCIENCES FIELD DAY: The Agronomy Department is sponsoring a Plant and Soil Sciences Field Day on Thursday, June 12, 2003. This Field Day will feature four major demonstrations from 2 to 4:00 p.m. and four tours from 4 to 8:00 p.m. Events are planned for all members of the family. There will be an educational quiz for the younger folks (your children), a weeds garden and a crops garden featuring many species not normally grown in Kentucky such as cotton, rice, kenaf, etc. There will be a display of the latest turf grass varieties for your lawns.

The four demonstrations will be: 1. No-till Tobacco, 2. Latest in Bale Wrapping for Hay or Silage, 3. Precision Ag Equipment and Soil Sampling, and 4. Managing Soil Water Run-off. The tours will highlight Tobacco, Forages (including the latest on MRLS), and Corn. The tour stops will be as follows: **Tour 1: TOBACCO MANAGEMENT** – Stop 1: Trickle Irrigation for Burley Tobacco Production, Stop 2: No-Till Tobacco Management, Stop 3: Burley Tobacco Variety Development.

TOUR 2: MRLS and PASTURE MANAGEMENT – Stop 1: Mare Reproductive Loss Syndrome Overview, Stop 2: Managing Pastures for Horses, Stop 3: Grazing Tolerance of Forage Varieties. **TOUR 3: NEW DEVELOPMENTS IN HAY AND SILAGE** – Stop 1: Improving Red Clover as a Hay Crop, Stop 2: Hay Storage Methods to Protect the Crop, Stop 3: Weed Control in Grass/Legume Crops for Hay or Silage. **TOUR 4: CORN FOR GRAIN AND SILAGE** – Stop 1: Silage Production Decisions, Stop 2: Clearfield and Roundup Ready Corn Management Decisions, Stop 3: The Fit for Bt Corn, Stop 4: Soil Fertility Decisions for Grain and/or Silage Corn.

A completely new feature of this Field Day will be drawings for door prizes donated by Agri-Industry including seed corn, herbicides, and the biggest one of all, a small John Deere tractor that will fit your needs. The drawings will be at 5:00, 6:00, and 7:00 p.m. and will be posted for everyone to check. There will be a large tent with many exhibits from the latest in biotechnology, sweet sorghum for syrup to the identification of insects. An evening meal prepared by the Kentucky Beef and Pork Producers Associations will be available for the whole family to enjoy. **PUT THIS DATE ON YOUR CALENDAR NOW AND BRING THE FAMILY.** More information on this Field Day can be seen at the following website: http://www.uky.edu/Ag/GrainCrops/2003_Field_Day.htm

AN UPDATE ON CONTINUOUS CORN IN KENTUCKY: The acres of continuous corn in Kentucky are increasing each year. There are some problems that occur when corn is grown continuously in the same field. To update you on some of these problems, the following 3 articles will highlight the effect of continuous corn on yield potential and what disease and insect problems may occur.

Continuous Corn: Can it Yield? Chad Lee and John Grove, Extension and Research Agronomists

One of the first questions many farmers ask about continuous corn is: Can I get the same corn yields with continuous corn that I can get in a rotation? The answer is yes, but only once in a great while. Research compared continuous corn to a corn/soybean rotation for 14 years at Lexington, Kentucky (see Table 1). During the 14 years of comparison, continuous corn yields beat corn/soybean only twice. Continuous corn did not do any better when compared with other crop rotations. Continuous corn yields beat corn/wheat/double-crop soybean once out of 11 years and corn/forage once out of five years tested. The two years that continuous corn beat corn/soybean had something in common. Both of those years were relatively dry and disease levels were very low but not sure why this would occur. Conversely, 1990, 1992, and 1997 were years with high levels of Diplodia. Those three years were some of the worst years for continuous corn yields when compared to corn yields in other rotations.

The study in Lexington is not the only place where continuous corn yielded less than corn in some type of crop rotation. Continuous corn yielded about 15 bushels per acre less than corn from a corn/soybean rotation at

Princeton in 2002. There were no visual differences in disease levels in that experiment.

While the economics may favor continuous corn, the agronomics do not. So, what is a farmer to do? Pest management becomes very critical. The research at Lexington indicates that when disease is not a factor, continuous corn does very well. Farmers with continuous corn will need to be very good managers of weeds, insects and diseases. Other articles in this edition will focus more on pest management in continuous corn. Farmers will also need to factor the historically lower yields of continuous corn into their budgets. When looking at projected yields and contract marketing, the farmer should be aware that yields with continuous corn are historically 5 to 10% lower than corn yields in a rotation.

Table 1. Crop Rotation Effect on Corn Yield in Lexington, Kentucky.

Year	Continuous Corn	Corn/Soybean	Corn/Wheat/DC Soybean		Corn/Forage	
-----Corn Yield (bu/A)-----						
1984	116	122	+6 ^a	--	--	--
1985	145	175	+30	--	--	--
1986	98	103	+5	--	--	--
1987	130	116	-14	135	+5	--
1988	68	79	+11	97	+29	--
1989	141	155	+14	169	+28	--
1990	114	142	+28	141	+37	--
1991	94	107	+13	108	+14	--
1992	147	181	+34	190	+43	183 +36
1993	150	157	+7	169	+19	162 +12
1994	140	109	-31	135	-5	108 -32
1995	145	154	+9	166	+21	168 +23
1996	149	158	+9	173	+24	184 +35
1997	118	140	+22	151	+33	144 +26
1984-1997	125 ± 25 ^b	136 ± 30		--	--	--
1987-1997	127 ± 26	136 ± 30		149 ± 29	--	--
1992-1997	141 ± 12	150 ± 24		164 ± 19		158 ± 29

^a Numbers following corn yield are the difference between the corn yield from that column to the corn yield from continuous corn.

^b Numbers following “±” are standard deviation, which is a method of measuring yield variability.

Insect Pests and Continuous Corn: Ric Bessin, Entomology Specialist

There is an increasing trend for more corn to follow corn on many farms. While this may be a good marketing decision, it will create some new insect management issues. In particular, growers need to watch carefully for building corn rootworm populations. Western corn rootworm is a very destructive pest that is nearly completely controlled with rotation in Kentucky. A typical sign of corn rootworm during the early summer is plant lodging due to a lack of brace roots. During late May and early June, the rootworm larvae destroy the brace roots.

Corn growers that have begun to grow corn continually on the same ground should watch for western corn rootworms or rootworm adult beetles. Eggs laid in last summers corn fields will hatch in late spring and the larvae will feed on the root systems of corn plants. Generally, keeping a field in corn a second year only increases the potential for rootworm slightly. But each year a given field is kept in continuous corn, the risk of economic losses to corn rootworm increases.

So how does a grower decide if they need to control corn rootworm in continuous corn? They need to scout fields in the summer to make management decisions the following spring. In Kentucky, growers are encouraged to scout corn weekly during the July for the rootworm adult beetles. The number of beetles per plant are counted on each of twenty consecutive plants in at least five locations per field. Growers are advised to use a soil insecticide at planting if they are growing continuous corn or rotate to another crop **only if** they noticed an average at least of one

beetle per plant last summer. In fields where something other than corn was grown last year, no soil insecticide is needed for rootworm. Once above-ground symptoms of corn rootworm begin to appear, there are no effective rescue treatments.

If a grower decides to control corn rootworm, there are several control options available. These include traditional granular liquid insecticides used during planting, seed treatments, Bt rootworm hybrids, and rotation to another crop. Cost, level of expected control, marketing concerns, and equipment requirements are factors used to select control methods.

Monitor Diseases In Continuous Corn: Paul Vincelli, Extension Plant Pathologist

Crop rotation is one of the most fundamental disease control practices available. By rotating to different plant species, some of which may not be hosts to infectious microorganisms that attack corn, producers essentially starve those microorganisms. Growing continuous corn will undoubtedly increase disease risk, by favoring the buildup of microorganisms that feed on corn. The question is, by how much? Issuing an answer to this question is forecasting, since no one knows for sure, and frankly, I don't feel that biological organisms listen very carefully to my forecasts. However, my expectation is that some farms--but not all farms--will suffer increases in disease that erases profitability. Over its history, corn has generally been less damaged by diseases than other major agronomic crops (with the southern corn leaf blight epidemic of 1970 a significant exception). Thus, I wouldn't expect a statewide calamity to occur as acreage of continuous corn increases. In long-term continuous corn, some fields will likely develop damaging, profit-robbing levels of disease, but other fields may suffer only minor losses, especially if attention is paid to disease scouting and management.

I therefore caution producers to monitor their fields of continuous corn carefully for diseases, especially those described below, and make appropriate management decisions as diseases develop.

Gray Leaf Spot

The most common disease of concern in continuous corn is gray leaf spot, especially under conservation tillage systems. While this disease can cause significant yield loss (up to 70% in very severe outbreaks on a susceptible hybrid), the disease often develops as the crop approaches maturity, such that dramatic yield loss is uncommon in Kentucky. Nevertheless, yield loss does occur from reduced grain fill, particularly if disease develops above the ear leaf within two weeks of silking. In addition to direct loss of kernel size and lower test weights, a severe outbreak of gray leaf spot may lead to reduced stalk strength and standability, predisposing the crop to lodging.

The fungus that causes gray leaf spot attacks corn almost exclusively; it survives in corn leaf residue; and the spores spread easily in air currents. Continuous corn provides an opportunity for this disease to increase in severity because it leads to the presence of more corn leaf residue in the field, especially in fields under some sort of conservation tillage. Thus, producers growing continuous corn should select hybrids with as high a resistance as possible, especially under conservation tillage. The available hybrids have varying degrees of *partial resistance* to this disease. One will still see disease develop with these hybrids, just not as much as in fully susceptible hybrids. Check with your seed supplier for information on the level of gray leaf spot resistance of corn hybrids you are considering.

Diplodia Ear Rot

Another disease of concern in continuous corn is Diplodia ear rot. Like the gray leaf spot fungus, the fungus that causes this ear rot attacks only corn and it survives in corn residue. The spores are spread by rainsplash, so they tend not to move very far, and it might take a few years for a serious problem to develop in many fields. However, some corn hybrids are very susceptible to this disease, and infections by Diplodia ear rot commonly consume the entire ear. Thus, if Diplodia pressure has built up in a field and weather conditions favor infection around silking, *susceptible hybrids can be badly diseased, affecting up to 75 to 80% of the ears in a field in the worst outbreaks*. This is not a disease to be casual about. One should scout fields of continuous corn carefully before harvest for Diplodia ear rot. If 2 to 3% or more of the ears are diseased from Diplodia, either rotate away from corn or select a hybrid with a rather high level of Diplodia ear rot resistance. Unfortunately, there are not very many hybrids that meet this criterion, so you may have to shop around for an appropriate hybrid.

There are other diseases that can be more of a problem in continuous corn. Stalk rots (especially anthracnose), Pythium seedling diseases, and other foliar diseases would be significant problems in some cases. It is also possible that root rots, normally not a serious problem in corn, would increase in importance. Problems with any of these diseases may become more severe as the period of continuous corn increases from 2-3 years of continuous corn to 4-5 years. More information on all of these diseases is available in the following Extension publications:

1. Diseases of Concern In Continuous Corn

<http://www.ca.uky.edu/agcollege/plantpathology/PPAExten/ppaext.html>

2. Kentucky Plant Disease Management Guide For Corn and Sorghum,
<http://www.ca.uky.edu/agc/pubs/ppa/ppa10a/ppa10a.pdf>

Australasian Soybean Rust: An Exotic Pest Threat: Donald Hershman, Extension Plant Pathologist

Introduction And Outlook

A new, and potentially devastating soybean disease is knocking at the “door” of the continental United States. Australasian soybean rust or, simply, soybean rust, has been closely watched by the U.S. Animal and Plant Health Inspection Service (APHIS) for many years. In 1973, soybean rust made APHIS’ list of the “100 Most Dangerous Exotic Pests and Diseases”. As of 2003, soybean rust is arguably APHIS’ number one exotic pest threat.

Soybean rust, caused by the fungus *Phakopsora pachyrhizi*, is endemic in Eastern Australia, Eastern Asia, and the islands between those landmasses, including Japan, the Philippines and Taiwan. The disease was first reported in Japan in 1902. It was not reported west of India until 1996. It was first observed in Africa in 1997 and by 2001 had spread throughout most of that continent. In 2001, soybean rust was detected in Paraguay and last year it was discovered, and caused yield losses, in parts of Argentina and Brazil. In 2002, soybean rust was estimated to be present in about 5% of Brazil’s soybean acres; current government estimates indicate that soybean rust now infests 99% of the soybean acres in that country. Technically, soybean rust occurs in the U.S., having been found in Hawaii in 1994.

Based upon the rapid spread of soybean rust in Africa and now in South America, it is generally believed that the disease will be detected in the U.S. soybean crop sometime during the next five years. Most scientists believe it will first be detected in the south central soybean corridor (i.e., Louisiana, Mississippi, Arkansas, west Tennessee, southeast Missouri and west Kentucky), followed by movement into the Midwest soybean crop. Because of the airborne nature of the soybean rust pathogen, it is my understanding that there are no plans to implement quarantine measures once the disease is detected here. The soybean rust fungus is, however, on the U.S. Government’s homeland security “Select Agent List”. This means that certain restrictions (yet to be defined) will be put into place the second soybean rust is confirmed in the U.S

Hosts, Pathogen Survival And Impact

Unlike most crop rust pathogens, which have relatively few native host species, *P. pachyrhizi*, has a very diverse host range. The fungus infects 35 leguminous species, representing 18 genera, in the Subfamily Papilionoideae in the Fabaceae (i.e., bean family). Overall, *P. pachyrhizi* infects 95 plant species representing 45 genera; twenty of these hosts reside in the continental U.S. Common host plants include most garden beans, wooly-pod vetch, yellow sweet clover and kudzu. Because kudzu is such a common weed in the southern U.S., there is great concern that it could serve as a continual source of *P. pachyrhizi* inocula. Generally, kudzu begins growth in the spring before soybeans are planted in any given area. Thus, the weed could act as a “disease bridge” by allowing build-up of the rust fungus followed by movement into soybean. This would have great implications in soybean rust epidemiology in the U.S. since kudzu is present as far north as southern Iowa. A recent estimate suggests that kudzu is present on 7 million, widely-dispersed, acres in the U.S. Unfortunately, *P. pachyrhizi* readily infects and develops on kudzu, but the weed is not adversely affected by the disease.

Once *P. pachyrhizi* enters the U.S., the fungus should have little difficulty overwintering in perennial crop and weed hosts in the southern states, especially along the coastal areas of the deep south. More northern overwintering may occur on hardy perennials, in protected locations, during mild winters. Basically, the rust fungus is likely to survive anytime and anywhere infected tissue remains green throughout the winter months. More northern survival on infected host plants in greenhouse facilities is also a possibility.

There is such grave concern over soybean rust reaching the U.S. because the disease has such a destructive potential in soybean. For example, when present, soybean rust can cause yield losses ranging from 10 to 100%; documented losses of 30-50% are common.

Symptoms And Disease Progress

Soybean rust is first evident in plants as small yellow-green lesions, usually on the undersides of leaves, about the time the crop begins to flower. Lesions are first typically seen in the lower plant canopy before flowering. The disease then moves rapidly into the upper plant crop canopy during the R3-R4 reproductive stages. Infection and disease progress are favored by moderate temperatures and extended periods of leaf moisture. Long dew periods, common in the summer, are sufficient to encourage infection; rainfall is not needed. Disease progress is greatly, but

temporarily, inhibited during hot (90°F), dry weather. Disease progress quickly resumes when temperatures moderate and free moisture becomes available.

Maturing soybean rust pustules are rather small, are reddish brown in color, and contain small “bumps”, called uredia. Uredia are clearly visible upon inspection with a 10X hand-lens. At this stage, the symptoms are similar in appearance to those associated with bacterial pustule. However, the bumps eventually break open and release masses of spores (called urediospores). In areas heavily infected with soybean rust, farmers walking through their fields have observed clouds of urediospores floating in the air. These masses of spores can be transported in air currents to neighboring or distant soybean fields and cause new disease outbreaks. Soybean leaves affected by rust quickly turn yellow and fall off the plant, usually from the bottom up. Defoliation can progress very rapidly, with complete defoliation often occurring in as little as one week once rust begins to move into the upper plant canopy. Premature defoliation significantly reduces the number of days to maturity of infected plants and results in fewer pods, fewer seeds, and significantly lower seed weights.

Management Options And Economic Considerations

Presently, the only available option for managing soybean rust is to applying foliar fungicides. Worldwide, numerous products are available to manage soybean rust. In the U.S., the only fungicides labeled for use on soybean with rust activity are Bravo and Quadris (both Syngenta products). Of these two materials, based on recent data from other countries, only Quadris has significant activity against soybean rust. Other products are likely to become available for use in the near future either through normal product registration activities, by emergency exemption, or via special local need labels. Presently, there is a great deal of activity in this arena since there is the potential for millions of soybean acres to be treated once soybean rust is detected in this country. As with most rust diseases being managed by modern fungicides with specific modes of action, resistance management is a big concern. Consequently, it is highly desirable for farmers to have access to various active ingredients should soybean rust enter the country. Limited supplies of some products and distribution issues will also come into play.

This whole area of foliar fungicide use to manage soybean rust brings up the matter of production economics. The limited data I have seen, as well as recent presentations I have heard on soybean rust, suggest that a minimum of two, and maybe three applications will be needed to achieve acceptable control of soybean rust when disease pressure is extensive. For example, data I observed from two experiments conducted in Brazil during 2002, had 20-30 % defoliation even after two applications were made with a fungicide known to be highly effective against rust diseases. Limited effectiveness was likely due to massive spore loads of the rust fungus and difficulty in achieving excellent spray coverage late in the season. In any event, applying multiple fungicide applications in the south would be economically challenging. But just as challenging, maybe more so, would be to grow soybean, but not treat the crop if soybean rust becomes yield-limiting.

Long-term, soybean rust will be controlled using resistant soybean varieties. At present, single gene resistance to soybean rust exists; however, this level of resistance is weak and short lived. Soybean cultivars with single gene resistance to soybean rust slow disease progress, but severe yield losses are still likely under heavy disease conditions. Recent work by USDA scientists in Illinois has shown that of 1000 commercial soybean varieties tested, all are susceptible to soybean rust. There is a currently an extensive effort to find new and/or more complete resistance to soybean rust. However, scientists have estimated that it could take up to 10 years to develop agronomically-acceptable soybean cultivars with excellent resistance to soybean rust. It is clear that soybean rust has the potential to greatly impact soybean production and economics in the United States.

Surveillance And Diagnostic Activities

There are actually two species of fungi that cause soybean rust. Neither of these species currently resides in the U.S. Thus far in this article, I have been discussing the rust caused by *P. pachyrhizi*. This is the rust disease of greatest concern because of its potential to damage crop yields and its aggressiveness. Another species, *P. meibromiae*, also exists and actually is more widely distributed than *P. pachyrhizi*. However, *P. meibromiae* is a weak pathogen and causes only minor economic damage to crops. Because of the significant practical differences between soybean rust caused *P. pachyrhizi* and *P. meibromiae*, there is a great deal “riding” on the accuracy of species identification. A wrong identification could trigger massive numbers of unneeded fungicide applications. The alternate situation is also possible, where an inaccurate identification could result in sprays not being applied when needed.

Beginning with the 2003 cropping season, there will be a great emphasis on monitoring the U.S. soybean crop (and kudzu and other legumes) for *P. pachyrhizi*. All private and state diagnostic clinics, regional diagnostic centers, county agricultural agents, extension specialists, crop consultants, industry agronomists, and farmers will

be on high alert for soybean rust. Governmental agencies such as APHIS, Office of Pest Management Policy (OPMP), and EPA will also be on high alert and active. To increase the chances of finding soybean rust should it enter this country, and to reduce the chance of a misidentification of the fungal species involved, APHIS has established a protocol for detecting soybean rust (or soybean rust causal agents in other plants) in the U.S. In Kentucky, all suspect rust cases on soybean (and other legumes) are to be submitted to one of Kentucky's two Plant Disease Diagnostic Laboratories (PDDL's). The PDDL's will accept soybean rust samples from any source, but we strongly encourage submission of samples through local county extension offices. The main reason for this is to preserve a trail of information that would allow us to go back to the exact site of sampling, if necessary. This type of information is often lost or not collected when clientele submit samples directly to the PDDL's. It is critical that we have the capability to return to the exact spot from which a specific plant sample is submitted. The specific sampling protocol is as follows:

Gently lay leaf, stem, or pod tissue between two sheets of paper towels, place in a zip-lock plastic bag, and store the sample in a refrigerator (a cooler chest with ice is acceptable) until it can be transported to your local county extension office. If samples must be stored at room temperature for more than 6 hrs, place the collected tissue (with paper towels) in a paper bag to reduce the possibility of mold growth. As soon as refrigeration becomes available, place the paper bag with specimen into a plastic bag, seal it, and store in the refrigerator until the sample can be transported to an extension office. Care should be taken to make certain that the outside of the bag is not contaminated by the sample as you are placing it into either the plastic or the paper bag. The goal here is to reduce the risk of rust contamination of new geographic areas as the sample is moving through the transportation system.

It is essential that the following information be recorded on a piece of paper and included with each sample submitted: date, exact location (GPS coordinates if available, nearest road intersection, verbal description of field location and area with a field, etc), county, host plant, collector's name and phone number, farm operator's name and phone number. In cases where a sample is collected in one county, but submitted from another, please specifically note this on the UK Plant Disease Identification Form sent with the sample. Take samples to your local county extension office for rapid shipment to one of the PDDL's. Make absolutely certain that you include a UK Plant Disease Identification Form with EACH sample submitted.

Once received, the specimens will be examined by a trained diagnostician to determine if the symptoms suggest a rust disease caused by a *Phakopsora* spp.. Anything that is suspicious and/or unknown will be forwarded to a designated mycologist with USDA, APHIS in Beltsville, Maryland for further work and species identification. Initial positive detections of *Phakopsora* spp. will only come from this USDA/APHIS facility.

Additional Information

There is a great deal of detailed information on the web in regard to soybean rust. A major site that will also get you to other sources of information is: http://www.aphis.usda.gov/ppq/ep/soybean_rust/

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