COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

LEXINGTON, KY 40546

Corn & Soybean Science Group Newsletter

Available online at: www.uky.edu/Ag/CornSoy

March, 2004
Volume 4, Issue 1
Editor: Dr. Chad Lee

Cooperating Departments:
Agronomy, Agricultural Economics, Biosystems and Agricultural Engineering, Entomology, Plant Pathology

In this Issue:

1. Soybean Rust Update

Don Hershman, Plant Pathology

Due to increased farm press coverage over the past year, producer interest in the rapidly developing soybean rust situation is at an all time high. Articles about the history and biology and the current and planned surveillance activities can be found in previous articles (Kentucky Pest News, March 10, 2003 and Corn and Soybean Science News, May, 2003). That information will not be covered here.

Soybean Rust in 2003

The main news is that although soybean rust is expected to arrive in the United States within the next five years, it did not arrive in 2003! The disease did, however, spread throughout most of the main soybean-growing regions of Brazil, and was also detected in Bolivia. There are unconfirmed reports that soybean rust has crossed the equator and is now in the northern hemisphere. If this is true, then the potential spread of rust spores into the U.S. via air currents becomes more likely.

Brazilian soybean producers lost an estimated $1 billion due to soybean rust in 2003. Government officials in Brazil say they expect fewer losses this year because most farmers are ready and waiting to spray with fungicides as soon as soybean rust makes an appearance. Many of them were taken by surprise last season, which contributed to the excessive losses. We will see how it all plays out to the south of us over the next 4 months or so.

The big soybean rust issues that have been surfacing here are: 1) fear over importing the soybean rust pathogen in soybean shipments from Brazil and other rust-affected countries, and 2) fungicides.

Importation of Soybean Rust

Few scientists I have talked with, or heard speak, think that commerce will be the means by which soybean rust makes its way into the continental U.S. Having said this, everyone I have heard speak on the topic also believes it is not an improbable scenario. On the plus side, the soybean rust pathogen is not seed-borne, but it can be associated with infested trash in seed.

There are no formal studies that I am aware of that indicate how long rust spores could survive in a shipment of soybean grain or seed. At a recent conference in St. Louis hosted by the American Soybean Association, I heard that it takes a minimum of 60 days for a shipment of soybean to make its way into a U.S. port following harvest. Under normal circumstances, the rust fungus would not be expected to survive in trash for this length of time. However, rust spores might remain viable in containment longer than we think because of the high moisture level and lack of light in the hull of a cargo ship. There is a great need for research to be conducted in this area. In the meantime, officials with the Animal and Plant Health Inspection Service (APHIS) are on high alert and are closely scrutinizing each shipment of soybean whose port of origin is a county with known infestation of soybean rust. There is a great deal of unrest and concern by all parties involved that we do everything possible to keep rust from being imported with grain shipments.

Most scientists at this point are still convinced that soybean rust will naturally make its way into this country as a result of wind-blown spores from South America, or perhaps in the winds of a hurricane system originating over Africa.

Fungicides

It remains a fact, that the only means of curbing an active case of soybean rust at present is by applying a minimum of two fungicide applications, and perhaps three, if the first spray was made before crop flowering. There are no effective cultural practices or resistant varieties to deploy at this time. I have not seen any data that would indicate that many farmers would be able to get away with a single fungicide application unless the disease comes in very late in the season. Most of the data I have seen shows that two sprays with a good rust fungicide will give decent results as long as the first application is made before rust gets a foothold. But even then, some yield is likely to be lost since better than 80-85% control does not appear to be possible given the current arsenal of fungicides at our disposal. Most fungicide protocols I have seen involve one application at first sighting or the beginning of flowering, which ever comes first, followed by another application around mid to late pod fill. Everyone with actual soybean rust experience seems to insist that treatments are only highly effective when applied preventatively. Apparently, once rust gets rolling in a field, no amount of fungicide will do a very good job in slowing it down. Crop defoliation can occur in as short as two weeks from the time of initial sighting. This gives you some idea how destructive soybean rust can be.

Making two fungicide applications to soybean would represent a paradigm shift for Kentucky soybean producers. Two applications will be needed to collect 80 to85% of expected yield. This brings into question how sustainable multiple fungicide applications will be here over the long haul. The cost of two applications will be $30 to50$/A, depending on the materials and the rates used.

Currently, Quadris is the only fungicide labeled in the U.S. that is highly effective against soybean rust. Kentucky and most other soybean-producing states are latching onto a "national section 18 application" that will allow the use of many additional products should soybean rust makes its way into the U.S. in 2004. I feel we will be successful in the section 18 registration. If so, there will be at least five or six additional fungicides that will be made available for use in combating soybean rust. Availability and the ability to apply the fungicides on a timely basis, however, are much less certain. In fact, one of the factors that has driven the section 18 process is an awareness by fungicide manufactures that no one company would be able to meet the demand for fungicide if the demand was very high. There are lingering questions that availability might continue to be a problem even if more fungicides are made available. There are a lot of soybean acres in the U.S.! Understandably, chemical manufactures are not going to greatly ramp up the production of additional fungicide stocks until a market for the additional product exists.

There has also been considerable discussion on the reality that many soybean producers will have difficulty in getting their fields sprayed on a timely basis unless they have access to their own spray equipment. In addition, with an increasing awareness that fungicide penetration into the crop canopy is essential for effective soybean rust control, questions have been raised as to how well existing spray technology will perform.

A key to effective fungicide use for soybean rust control will be rapid detection and rapid application of fungicides, when needed. Regarding rapid detection, there are plans being implemented right now to train plant disease diagnosticians and plant pathologists (like me) in the art of field/laboratory identification of soybean rust. In addition, a highly specific and accurate PCR-based diagnostic test is in the final stages of development. We cannot offer training on this yet because we have nothing to show you. But once soybean rust is found in Kentucky or any neighboring state, I am certain there will be many field clinics available for you to learn how to identify soybean rust in the early stages of infection.

All in all, the soybean industry in Kentucky and throughout the county will be greatly challenged once soybean rust arrives here. It seems only prudent for you to prepare yourself now for the eventual arrival of soybean rust by becoming better educated about the disease and the challenges it will present. To this end, Paul Bachi and I have developed a simple web site to help guide you through the jungle of soybean rust information on the web. The internet is, in fact, "dripping" with information on the disease. I encourage you to take some time soon and check out the University of Kentucky Soybean Rust web site. It is a great gateway to available published resources and current facts/updates on soybean rust. The Soybean Rust web site is at the following address:
www.ca.uky.edu/agcollege/plantpathology/PPAExten/SoybeanRust.htm

2. Soybean Seed Size – Does Size Matter?

Dennis B. Egli, Agronomy

This is an easy question to answer because yes, no and maybe are all correct. Let's take the no's first.

Do soybean varieties that produce large seeds yield more than varieties with small seeds? The answer is **NO.** Varieties show a lot of variation in seed size, from quite small (nearly 4000 seeds per pound) to rather large (roughly 2000 seeds per pound), but seed size does not affect yield potential. Its seems logical that large seeds would produce higher yields than small seeds, but the soybean plant is not necessarily logical – the plant adjusts the number of pods and seeds that it produces to compensate for variety differences in seed size. A small-seeded variety produces more pods and seeds than a large-seeded variety, but the yield stays the same. Varieties should be selected for their yield potential, disease resistance or maturity without worrying about seed size.

Do large soybean seeds have a better chance of emerging from the soil after planting than small seeds? Again the answer is **NO.** Good stands are an important beginning to producing a high-yielding soybean crop, but planting larger seeds will not help. The quality of planting seed is the key – seeds with high germination and vigor levels are more likely to produce good stands, but quality is not related to seed size. Seed quality is determined during seed production, harvesting and storage, so check the seed tag to determine the germination of the seed you purchase. High quality seeds can be found in large- and small-seeded varieties.

Seedlings from large seeds will be larger than those from small seeds. But the affect of seedling size will be lost when the crop produces a complete canopy (needed for maximum yield) and will not carryover to yield.

When it comes to determining planting rate, the answer is **YES** – seed size does make a difference. Seed size is very important, along with seed germination, when calculating how much seed to plant. Planting the same weight or bushels of a large seeded (fewer seeds per pound) and a small seeded (more seeds per pound) variety will result in large differences in plants per acre. The drought in the Midwest late last summer reduced seed size of many varieties (reports of seed counts as high as 4000 per pound are circulating). It is necessary to check the seed count on every seed lot of every variety each year. Too many plants per acre is a waste of valuable seed (and money) and could reduce yield if plants lodge. Too few and yield will also be reduced. Seed size and seed quality are both important at planting.

Do large seeds at harvest mean high yields? This question is more complicated and the best answer is **MAYBE**. Soybean yield is determined by pd number, seed number and seed size. More pods and seeds are produced by a 70 bushel crop than by a 30 bushel crop. Seed size at harvest for these two crops may be the same, so harvested seed size would not relate to yield. Seed size at harvest depends on the weather during flowering and pod set (pod and seed number) and during seed filling (seed size). Predicting yield from seed size at harvest is tricky as large-, small- or normal-sized seeds may be associated with high or low yields depending on the vagaries of the weather. The answer to the seed size question at harvest is definitely a resounding maybe!

Large is generally associated with good in our society – but with soybean seed large or small makes almost no difference.

3. Quadris and Warrior Use on Soybean

Don Hershman, Plant Pathology, Doug Johnson, Entomology and Jim Herbek, Agronomy

Table 1. Yield results from two studies at UKREC, Princeton, KY, 2003.					
		Yield (bu/A)			
Treatment*	**Rate/A**	**Study 1: A3703**		**Study 2: P94B74**	
Non-treated	-	42.2	bc**	66.0	b
Quadris	6.2 fl oz	40.1	c	68.5	ab
Warrior	2.56 fl oz	48.2	ab	68.3	ab
Quadris+Warrior	6.2 + 2.56 fl oz	51.0	a	70.8	a
*Treatments applied at the R4 stage.					
**Means within a column with a common letter are not significantly different; Ryan's-Q, P=0.05					

In 2003, an estimated 30,000 acres of soybean in Kentucky were treated during early- to mid-pod formation (R3 to R5) with a single application of Quadris fungicide (6.2 fl oz/A) + Warrior insecticide (2.56 fl oz/A). This represents a major change in how soybean is produced here, since almost no fungicides and very little insecticide, have been applied to soybean over the past 20 years. Activity in 2003 was the result of a "guarantee program" initiated by the chemical manufacturer, Syngenta. This program did not target any specific insect or disease pests, and was based solely upon an observed +6.85 bu/A average yield response to the treatment in 13 grower fields in southern Indiana and Kentucky during 2002. The cost of applying 6.2 fl oz/A Quadris + 2.56 fl oz/A Warrior is about $23/A, assuming a $4/A cost for application.

In 2003, we did a great deal of work to discern if the apparent yield increase could be repeated in replicated studies and, if so, where Quadris + Warrior might fit in Kentucky soybean production. Specifically, we implemented two replicated small plot studies at the UKREC in Princeton. Both studies included treatments of Quadris or Warrior alone and in combination, and compared them with a non-treated check. One test also included applications at three soybean growth stages (R3, R4, and R5). In addition, we implemented three large-scale, replicated strip tests in grower fields and collected data from six grower fields that had been treated with Quadris + Warrior, but where non-treated check blocks were left. Finally, we summarized yield data from 51 non-replicated grower trials across west Kentucky. A portion of our 2003 data is presented below.

Table 2. Distribution of Yield Results for Quadris + Warrior Application in 51 Non-Replicated Field Trials, KY, 2003.

Yield Range (bu/A)	**Number of fields**
0 or less	2
+0.1 to 2	9
+2.1 to 4	12
+4.1 to 6	12
+6.1 to 8	11
+8.1 to 10	3
> 10.1	2
Average: +4.63 bu/acre*	
*Significantly higher than non-treated yields; locations treated as replications, ANOVA, *P* = 0.03	

Overall, we found that defoliation was delayed by about one week in most tests when Quadris was applied by itself or in combination with Warrior. In most fields, we also found that these same treatments reduced stem anthracnose by about 40 to 50%. Control of pod anthracnose was highly variable across all tests. Neither defoliation nor stem/pod disease were affected by Warrior application.

In the two small plot studies, no significant yield increases were found when Quadris or Warrior was applied alone, or when the combination was applied at the R3 or R5 stage (data not shown). However, in both tests Quadris + Warrior applied at R4 significantly increased yield compared to the check (Table 1). This was true in spite of the fact that Quadris alone and Quadris + Warrior both reduced percent defoliation and percent stem anthracnose. Foliar disease and insect pressure were extremely low in both studies, so these cannot account for the observed yield effects.

Across 51 non-replicated field trials (Table 2), yield response to an application of Quadris + Warrior ranged from zero bu/A (net loss of -$23/A; i.e, the cost of the product plus application) to a high of 12.1 bu/A (net gain of +$77.19).

In Summary

- In replicated small plot studies, Quadris + Warrior, but neither product applied alone, significantly increased yields.
- In one test where the stage of application was studied, significant yield improvement was detected only when application was made at the R4 stage, but not at R3 or R5.
- Observed yield response to Quadris + Warrior ranged from zero bu/A to a high of 12.1 bu/A, and was frequently in the range of 3.0 – 8.0 bu/A (net gain +$1.84 to +$43.24).
- The greatest response tended to occur in early plantings and/or maturity group III and IV varieties.

So, what is going on? To be honest, we do not know. If yield increases were the result of delayed defoliation and/or to stem disease control alone, we should have seen the same yield response regardless of whether Quadris or Quadris + Warrior were applied. We did not. Also, of the eleven fields we scouted on a weekly basis, there was not enough foliar disease or insect pressure to account for any yield differences in any of fields. At present, we can offer no explanation why adding Warrior to Quadris would bump up yields in the absence of any obvious insect activity. It is fairly well known that strobilurin fungicides, like Quadris, incite a so-called "greening effect" in treated plants that is unrelated to pest control. It is possible that Quadris + Warrior, but neither pesticide alone, may sufficiently alter plant physiology so that higher yields are promoted.

Clearly, there is a great deal more work that needs to be done. Plus, we have only been discussing a single year's results. Nonetheless, the yield results look promising enough that you might consider testing the treatment on a limited acreage basis in 2004. In the meantime, we will be repeating most of the work we did in 2003, as well as adding some additional studies. We all have an interest in identifying situations most likely (and least likely) to show an economical response to Quadris + Warrior.

4. Corn Populations and Nitrogen Rates

Chad Lee, Agronomy

The cost of corn seed keeps getting higher and there doesn't appear to be a stopping point in site. Seed treatments and various genetic technologies have added to the cost of a typical unit of corn seed. In addition to higher seed prices, farmers are also experiencing higher N prices.

The current seeding rate recommendation of corn grown for grain is a range of 22,000 to 30,000 seeds/A. The lower number is targeted for less productive fields and the higher number is for more productive fields. For farmers producing corn for silage, the recommended population range is 24,000 to 30,000 seeds/A.

Some farmers are pushing this upper limit by planting populations greater than 30,000 seeds/A. The introduction of variable rate planters has introduced the idea of targeting different populations across the field, based on prescription maps. Some of these farmers are varying N rates in addition to the seed rates. All of these factors drive home the point that corn plant populations and N rates are ongoing questions.

One research project initiated in 2003 investigated various plant populations and nitrogen rates for both silage and grain yields. The first year of the project suggested that the maximum population of 30,000 seeds/A was as high as a corn population should go. In that study, corn was planted from 22,000 to 33,000 seeds/A. Silage yields were similar across all populations. In addition, grain yields were similar across all populations.

Nitrogen was applied at 120 lbs of actual N per acre and 200 lbs of actual N per acre. The additional N did not increase silage or grain yields in most situations. The extra N did increase the yield of a leafy hybrid planted at the lowest population, but had no effect at higher seeding rates.

There are a couple things to consider from last year's study. For example, 2003 was one of the wettest years on record. Water was not a limiting factor. Because water was not limiting, there would have been less competition between corn plants and this should have favored higher populations. On the other hand, the soil type was a moderately productive soil in most years. This field produced yields over 200 bu/A in 2003, but 150 bu/A would be considered a typical year. Would a population response have occurred on fields with more productivity? One more factor was that this study was conducted in the eastern half of Kentucky and may not correlate as well to the western half of the state.

So, current research still does not support higher plant populations or higher N rates, at least for the eastern half of Kentucky. Plant populations in the range of 22,000 to 30,000 plants/A is sufficient for excellent corn yields in the eastern half of Kentucky. The current N recommendations for your soil type are still the best rates to follow.

For more information contact your local county extension agent. In addition, you can go online to the grain crops website at www.uky.edu/Ag/GrainCrops/.

5. Double cropped soybean: How important is plant height?

Todd Pfeiffer, Agronomy

Is plant height useful in variety selection for double cropping? Double-cropped soybean has a delayed planting date compared to full season soybean. This delayed planting shortens the vegetative growth period and reduces plant height, particularly for maturity group 3 and 4 soybeans. Taller plant height has been explained as one reason why some varieties are adapted for double cropping. For example, both Amcor (maturity group 2) and Stressland (maturity group 4) are taller varieties and both performed well in lower yielding environments such as double cropping. Since lowest pod height is related to plant height, double crop soybean is subject to greater harvest losses (Grabau and Pfeiffer, 1989).

Two separate analyses were conducted to determine the relationship between plant height and yield. The first analysis used data from the Kentucky Soybean Performance Tests from 1984 to 1996 and relied on calculating correlation coefficients. The correlation coefficient (*r*) indicates the relationship between plant height and yield. An *r* that is close to zero and is nonsignificant indicates no relationship between height and yield. A significant *r* closer to one (1) indicates that taller varieties yielded more, while an *r* closer to negative one (-1) indicates that shorter varieties yielded more. Plots were harvested with a small plot combine. Cutting height varies from 3 to 6 inches with these combines, although it wasn't measured directly in these tests.

Fifteen double crop environments from the Kentucky Soybean Performance Tests where data on both yield and plant height were reported were analyzed. Correlation coefficients were calculated between plant height and yield for all varieties in the test and for the varieties in each maturity group: maturity group 3, maturity group 4, and maturity group 5 (Table 1).

In 7 of the 15 environments there was a positive relationship between plant height and yield (r was significant). These seven environments indicated that a taller soybean variety produced higher yields. In two of the 15 environments there was a negative relationship between plant height

Table 1. Average yield and plant height and the correlation between them for 15 double-crop tests in the Kentucky Soybean Performance Tests 1984-1996. The environments are presented ranked by average yield. The last column lists those maturity groups in each year for which the correlation between variety height and yield was significantly greater than zero within that maturity group.

Environment Yield Rank	Yield Avg.	Yield Range	Height Avg.	Height Range	*r* †	Maturity Groups with Significant *r*
	------bu/a------		------in-------			
1	49.0	38-58	30	15-42	-0.20	--
2	48.8	29-78	38	24-48	0.11	--
3	48.3	29-62	36	26-44	-0.28*	MG5 (- *r*)
4	44.7	32-56	33	13-44	0.26*	--
5	40.1	27-56	35	22-46	0.48**	--
6	38.1	18-54	30	15-37	-0.21	--
7	37.6	27-48	26	17-31	0.00	MG3
8	36.8	29-44	33	22-41	-0.46**	--
9	35.5	23-47	38	28-50	0.06	--
10	32.5	22-46	38	27-45	0.41**	MG4
11	32.4	15-46	23	15-33	0.76**	MG3, MG4
12	30.7	15-40	24	14-38	0.27*	MG4
13	28.6	21-36	31	17-41	-0.02	--
14	21.3	13-29	24	16-40	0.56**	MG3, MG4
15	19.8	12-34	21	18-29	0.63**	MG3, MG4, MG5
mean	*36.3*		*31*			

† correlation coefficient

* significant, ** highly significant, an *r* value with no * is not significantly different from zero.

and yield, indicating that shorter plants produced higher yields. The correlation coefficient was >0.50 and significant in only three of the 15 environments. These three environments ranked 15, 14 and 11 for yield and 15, 13 and 14 for height.

Three trends are evident: 1) as double-crop soybean yields increased the magnitude of the correlation between yield and height decreased; 2) as the average plant height in an environment got shorter the magnitude of the correlation between yield and height increased; and 3) the relationship between taller plant height and higher yield occurred more frequently in the earlier maturity groups.

Specific notes on differential yield losses due to low pod height and cutting height were not made. In previous reports combine cutting height in Kentucky producers' fields averaged 4.2 inches. In double cropped plots, maturity group 3 and early maturity group 4 varieties showed a 3% yield loss in stubble at 4 inch cutting height and a 10% yield loss in stubble at 6 inch cutting height while late maturity group 4 and maturity group 5 varieties had <1% yield loss in stubble at both cutting heights. This may have contributed to the greater number of significant relationships between plant height and yield in the earlier maturity groups.

The second analysis used data from a soybean breeding experiment. In that experiment I selected the 10 tallest lines from the first year yield tests and paired them with 10 lines of random height that had similar maturities. This was done in four years. In each subsequent two-year period these twenty lines were tested in late planted yield tests. This information is presented in Table 2.

Table 2. Height group yields and plant heights for four sets of tall and random soybean lines each grown in double-crop tests for two years.

Set	Height Group	Yield Avg.	Yield Range	Height Avg.	Height Range
		-------bu/a-------		------in------	
A	Tall	32.2	29.4-36.7	35	32-39
	Random	33.2	25.9-35.4	31	28-33
B	Tall	22.3	18.1-26.3	33	28-40
	Random	22.6	16.5-28.2	26	16-32
C	Tall	37.6	26.5-42.2	44	38-50
	Random	37.9	31.5-42.5	36	22-41
D	Tall	42.2	36.9-45.7	42	38-46
	Random	42.2	30.9-48.8	38	35-42

The average yields in these tests ranged from moderately low to high (22 to 42 bu/a) for double-crop environments. Similarly, the heights ranged from fairly short to tall (26 to 44 in) for double-crop environments; close to the range seen in the Kentucky Soybean Performance Test data in Table 1. Although the height groups differed in height in the double-crop tests both height groups in each set yielded the same.

My Interpretation

Plant height is used as a substitute for measuring vegetative growth. Although it is not a perfect substitute it is acceptable. Overall, the relationship between variety height and yield in double-cropped soybean is small. In the poorest environments with reduced growth and low yields, taller varieties have an advantage and tend to yield more because they produce more vegetative growth and have higher low pod heights. This is particularly true for earlier maturing varieties in which the photoperiod response produces flowering earlier in the season. Only in the lowest yielding environment was vegetative growth limited in maturity group 5 varieties so that taller varieties did yield more. Thus, selection of tall varieties will not guarantee higher yields in double-crop plantings. When choosing varieties for double cropping, I recommend placing the greatest emphasis on yield data while avoiding the shortest varieties in the earlier maturity groups.

Further Information

Grabau, L.J. and T.W. Pfeiffer. 1989. Stubble losses of Kentucky soybeans. Agronomy Notes Vol.22, No. 2. University of Kentucky

Chad D. Lee, Grain Crops Extension Specialist

Cooperative Extension Service
University of Kentucky
Department of Agronomy
Ag Distribution Center
229 Stadium View Road
Lexington KY 40546-0229

Official Business