Corn & Soybean News

September 2023
Volume 5, Issue 9

Martin-Gatton
College of Agriculture,
Food and Environment

Grain and Forage Center of Excellence

First Confirmation of Tar Spot on Kentucky Corn in 2023

Tar spot on corn was confirmed by the University of Kentucky Plant Disease Diagnostic Laboratory (PDDL) from samples collected in Caldwell County. This is our first confirmation of tar spot in Kentucky for 2023.

So far, this is the only location in Kentucky in 2023 where tar spot has been confirmed. At this point in the season, no management is needed if tar spot is confirmed in a field, however we still need to document confirmed cases to monitor for future disease spread and impact. Tar spot was found in Todd and Ohio Counites in 2021, and Lincoln County in 2022.

Tar spot on corn, caused by *Phyllachora maydis,* is usually first observed when the causal fungus produces small black structures called stromata on leaf tissue (Figure 1). These structures protrude from the leaf surface and affected areas of the leaf feel rough or bumpy. The stromata can also be present on leaf sheaths and husks.

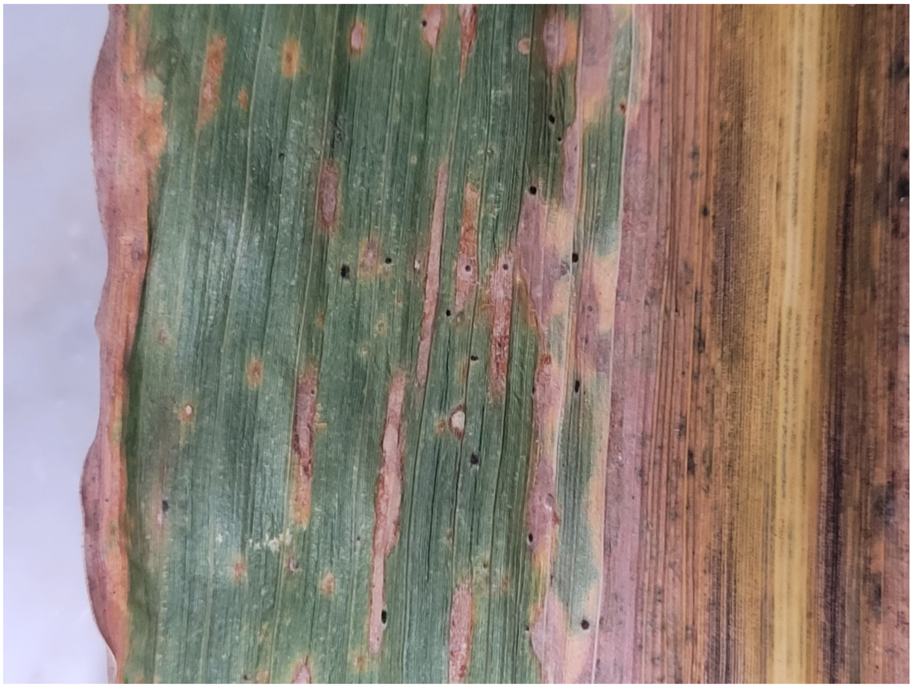

Figure 1. Signs of tar spot observed on a corn sample from Caldwell County in 2023. (Picture Kiersten Wise)

Tar spot was first confirmed on corn in the United States in 2015. Since 2015, it has been reported in multiple Midwestern and eastern states and Ontario Canada, and as far south as Georgia and Florida. A map of the current tar spot distribution in the United States can be found on the corn ipmPIPE website: https://corn.ipmpipe.org/tarspot/.

Yield loss due to tar spot varies, and depends on hybrid susceptibility, infection timing, and environmental conditions. Fungicide applications at tasseling/silking (VT-R1) for diseases such as southern rust will also effectively manage potential tar spot outbreaks. We continue to learn about this disease, and research in our specific climate is needed to optimize management recommendations for Kentucky.

For additional information on tar spot see these resources from the Crop Protection Network:

Tar Spot of Corn—web book
An Overview of tar spot

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Welcome Dr. Samuel Revolinski

We would like to introduce Dr. Samuel Revolinski, Assistant Professor in Weed Physiology, Biochemistry, and Molecular Genetics in the Martin-Gatton CAFE Department of Plant and Soil Science.

Dr. Revolinski began working with plant genetics and pest management during his undergraduate degree at the University of Minnesota – Twin Cities. He then attended Washington State University where he explored the genetic controls of flowering time, and theoretical models explaining the maintenance of genetic variation in self-fertilizing weeds populations. Samuel continued his research as a postdoctoral researcher where his work included genomic resequencing, genomics for population genetics in weeds and a massive herbicide resistance screening program that screened *B. tectorum* from across the state of Washington for resistance to various herbicides in order to map genes contributing to herbicide resistance in *B. tectorum*.

In addition to contributing to class instruction, Dr. Revolinski's program will develop an herbicide resistance screening program for the state of Kentucky, uncover the genetic and physiological mechanisms underlying herbicide resistance, and explore genetic adaptions that contribute to the success of various weeds across Kentucky.

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University of Kentucky presents
2023 Fall Crop Protection Webinar Series

Beginning Nov. 2, 2023, the University of Kentucky Martin-Gatton College of Agriculture, Food and Environment will present a series of four webinars covering field crop protection. Hosted through the Southern Integrated Pest Management Center, the webinars will feature UK extension pest management specialists discussing weed science, plant pathology and entomology topics. Continuing education credits for Kentucky pesticide applicators and Certified Crop Advisors will be available.

The Thursday morning webinars will take place via Zoom at 10 a.m. EST/ 9 a.m. CST, and pre-registration is required for each webinar. The webinars are open to agriculture and natural resource County extension agents, crop consultants, farmers, industry professionals, and others, whether they reside or work in Kentucky or outside the state.

Dr. Kiersten Wise

Webinar #1: ***Do multiple corn fungicide applications pay?***

November 2, 2023

Registration: https://zoom.us/webinar/register/WN_CfQFt0dQSnq5ifdnaSre7A

Dr. Carl Bradley

Webinar #2: ***What have we learned from nearly two decades of research on soybean with foliar fungicides?***

November 9, 2023

Registration: https://zoom.us/webinar/register/WN_3SvKPhEDSSWcYhnUnLrvsQ

Dr. Travis Legleiter

Webinar #3: ***Managing the offensive spread of weeds***

November 16, 2023

Registration: https://zoom.us/webinar/register/WN_SIOzGyibQiOk4A6pTRHGmw

Dr. Raul Villanueva

Webinar #4: ***Insects in field crops during two years of partial drought and heat wave***

November 30, 2023

Registration: https://zoom.us/webinar/register/WN_AqvCh08TQGCAJXvKxqdwFA

Martin-Gatton
College of Agriculture,
Food and Environment
University of Kentucky.

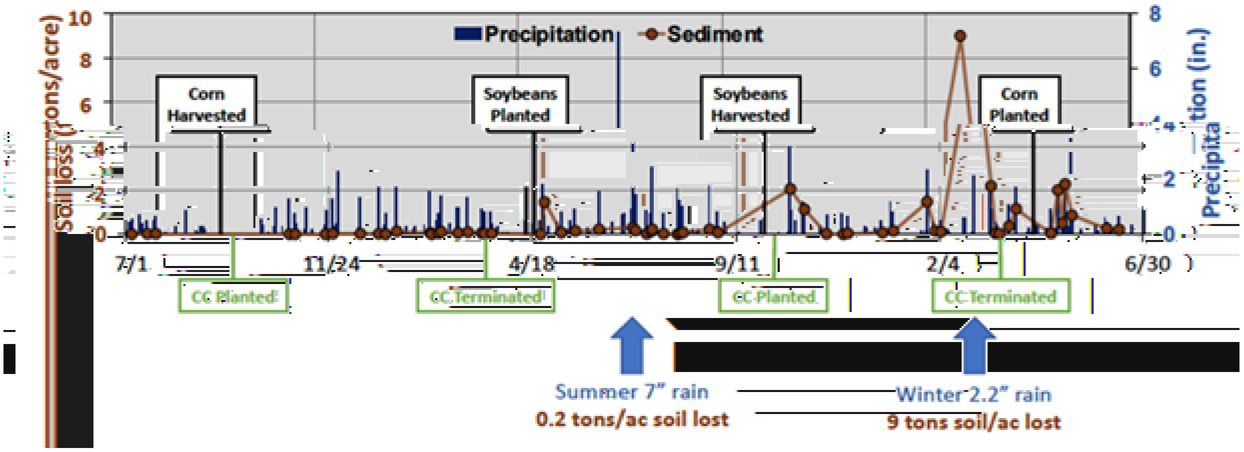
Hosted by Southern IPM Center

Soil Health, Erosion and Fall Field Management

Fall harvest has begun and this is a good time to look ahead and plan for better soil health. Soil health has several important aspects, but first and foremost is soil erosion prevention. Soil loss equals topsoil loss and topsoil is where the largest portion of soil and plant biology occurs. Eroded soil is typically higher in the smaller mineral particles (clay, silt) and organic matter/humus – the 'good things' that contribute to soil water and nutrient retention/cycling and crop productivity.

In Kentucky, most soil erosion is caused by water/rainfall. Water erosion soil losses are driven by storm length and strength, and Kentucky is receiving fewer, but stronger, storms. Figure 1, below, shows the tons of soil lost per acre, by rainfall event, for 2 years in a monitored no-tillage field area with a 5-6% slope and under a corn/full-season soybean rotation. The focus is on winter/spring rainfall when most erosion happens, so the timeline begins in the summer when corn is being grown, starting July 1 of Year 1, and ending June 30 of Year 3 (Fig. 1).

Figure 1. Soil loss and rainfall, by event, for 2 years of a corn-soybean rotation. Note: "CC" stands for a winter wheat cover crop



Corn was harvested, and the wheat cover crop planted, in early to mid-September of Year 1 (Fig. 1). In the next winter/early spring (Year 1/Year 2) period there is very little soil loss. Corn residues and the wheat cover crop acted like a close growing grass sod (Fig. 2), providing excellent soil protection against erosion despite several winter/early spring rainfall events that were often equal to or greater than 2 inches (Fig. 1).

After cover crop termination and soybean planting at the start of Year 2, corn and cover crop residues continued to protect the soil and late spring/early summer soil erosion losses were low (Fig.1). Summer rainfall can be heavy, and a strong storm (7 inches) occurred mid-summer of Year 2. The soybean crop was at full canopy (Fig. 3), which intercepted the rain, dissipating its energy and minimizing erosion. Soil loss was small, about 0.2 tons/acre (Fig. 1).

Soybean was harvested, and the wheat cover crop planted, in early to mid-October of Year 2 (Fig.1). In the first part of second winter/early spring (Year 2/Year 3) period, rainfall events were generally light/small, and the soybean residues and wheat cover crop provided adequate soil erosion control. Just prior to cover crop termination in mid-March of Year 3, a 2.2-inch rain resulted in a large soil loss (9 tons/acre). The soil protection provided by the wheat cover crop and soybean residues was not adequate, given the conditions (5-6% slope, soil already wet, residue breakdown, thin cover crop) that combined (Fig. 4) to favor soil erosion in this event. The second cover crop, after soybean, was planted about one month later than the first cover crop, after corn (Fig.1). An example of a thin, patchy cover crop that was established into soybean residue is shown in Figure 5.

So, while no-tillage soil management can help reduce soil erosion, these stronger, heavier storms present a serious challenge, even to fields under no-till soil management. But there are some things that can be done to enhance no-till soil erosion control.

Use existing resources – crop residues. The crop residue remaining after harvest is the 'frontline' resource available to prevent/slow soil erosion between harvest and canopy closure of the next crop grown in the field (Fig. 2). Residue protects soil aggregates from raindrop energy and impact, lessening soil particle detachment, the first step in the water erosion process. Avoid fall field operations that diminish residue's erosion control effectiveness. Don't 'size' residue with a rotary chopper, disc, or vertical tillage tool. Those small residue pieces are more likely to float/move downhill during strong storm events, leaving soil areas uncovered and unprotected (Fig. 4). Bigger residue pieces are more likely to get hung together and dam water movement and soil particle transport, the second step in water erosion of soil. Don't enhance crop residue decomposition, biologically, chemically, or physically – soil erosion protection needs to last through the winter into early spring. Kentucky winters are relatively mild and residue breakdown continues slowly but surely all winter long.

Figure 2. Grass sod and recently harvested corn

Figure 3. Full-season soybean at full canopy.

Figure 4. Favorable for soil erosion.

Figure 5. Thin, patchy winter cover crop in soybean residues.

Use existing resources – soil aggregates. Soil aggregates also contribute to soil erosion resistance. Strong, water stable aggregates enhance water infiltration rather than runoff. At the end of the season, soil aggregation is at a maximum. Aggregation is enhanced by fresh carbon additions and the seasonal growth of the crop has provided both exudates and root biomass. Soil biology (both macro and micro) acts all growing season long on these new carbon sources, forming organic matter/humus and bringing organic and mineral particles (clay, silt, and sand) together to form aggregates. Aggregate damage happens when aggregates are crushed (compaction) or disrupted (broken). Fall tillage, especially any kind of surface tillage, causes aggregate damage by both mechanisms. The surface disruption that occurs with vertical/disc tillage breaks up aggregates near the surface, while the compaction of aggregates happens due to considerable weight/pressure at the blade tips.

Consider using additional resources – winter cover crops. Fall surface tillage and/or residue sizing, either chopping or cutting, means that additional resources might be needed to prevent/slow erosion. Full-season soybean residue levels often look adequate for erosion control in the fall but degrade quickly and leave these fields vulnerable to springtime erosion. In these instances, a winter cereal cover crop, especially winter cereal rye, is needed to reduce erosion risk. The more dense, fibrous winter cereal root system helps maintain aggregation as it holds soil in place. If the winter cereal cover crop planting date is sufficiently early, the shoot biomass also provides some additional aboveground protection against raindrop detachment and further aggregate destruction.

Soil erosion remains a major threat to long-term productivity in many areas of Kentucky. Most of our agricultural lands exhibit slope and many of our field soils are covered by silt loam topsoils. These conditions, combined with our rainfall patterns, make Kentucky agriculture vulnerable to soil erosion. No-tillage soil management does a lot to reduce soil erosion risk, but no-tillage practices can be strengthened to guard against erosive precipitation events that result in catastrophic soil loss. Improved soil health begins with soil erosion control.

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Fall Residual Herbicides May be an Option for Italian Ryegrass Management

Italian Ryegrass Control on April 10, 2023 Following Fall Herbicide Applications Applied on November 2, 2022.

Roundup PowerMax 3 – 40 fl oz/a

Gramoxone – 2 pt/a

Roundup PowerMax 3 – 40 fl oz/a + Zidua SC – 5 fl oz/a

Gramoxone – 2 pt/a + Boundary – 2 pt/a

Italian ryegrass (aka annual ryegrass) is no longer just a problem for Kentucky wheat growers! Kentucky grain crop producers across the state are dealing with ryegrass escapes and burndown failures prior to corn and soybean planting each spring with complaints increasing yearly.

Fall applied residual herbicides are a common and critical component of ryegrass management programs in Kentucky winter wheat. In contrast, we rely solely on spring burndown applications for control of winter annuals, including ryegrass, prior to corn and soybean planting. While this strategy is highly effective against the majority of winter annual weed species, Italian ryegrass is now challenging this strategy. We need to implore alternative strategies to reduce the pressure on spring burndown applications that are increasingly failing to control Italian ryegrass. This is where the use of fall residual herbicides, similar to the strategy in winter wheat, is an option that can relieve the pressure on the spring burndown applications.

Several products that contain pyroxasulfone or S-metolachlor either have federal label language or 24 (c) special needs labels that allow for application in the fall for control of Italian ryegrass or fall germinating weeds. A list of products that have label language allowing for fall applications is contained in Table 1, along with application rates and replant restrictions.

Table 1. Herbicide products with federal or 24(c) labels allowing for fall applications for suppression of Italian ryegrass emergence prior to corn and/or soybean planting the following spring.

Trade Name Product	Active Ingredients (Site of Action Group #)	Labeled Application Timing	Fall application Rate (Medium Soils)[ab]	Replant Restrictions
Anthem Maxx	Pyroxasulfone (15) + fluthiacet-methyl (14)	Fall applications for controlling weeds germinating in the fall or winter annuals	Corn – 4 to 5 fl oz/a Soybean – 3.5 to 4.5 fl oz/a	Corn & Soybean – 0 Months
Boundary	S-metolachlor (15) + metribuzin (5)	Control of glyphosate-resistant Italian ryegrass in the fall prior to soybean or corn planting the following spring (24c Special Needs Label)	Corn & Soybean – 1.8 to 2 pt/a	Corn – 4 Months Soybean – 0 Months
Dual II Magnum[c]	S-metolachlor (15)	Fall application for residual control of glyphosate resistant Italian ryegrass in corn and soybean -	Corn & Soybean – .33 to 1.67 pt/a	Corn & Soybean – 0 Months
Helmet MTZ	Metolachlor (15) + metribuzin (5)	For control of glyphosate-resistant Italian Ryegrass in the fall prior to soybean planting the following spring	Soybean – 2 pt/a	Corn – 8 Months[d] Soybean – 0 Months
Zidua SC	Pyroxasulfone (15)	Fall/Winter application for controlling weeds germinating in the fall, or winter annual weeds	Corn & Soybean – 3.25 to 5 fl oz/a	Corn & Soybean – 0 Months

[a] Check the herbicide label for product rates to use on fine and coarse soils

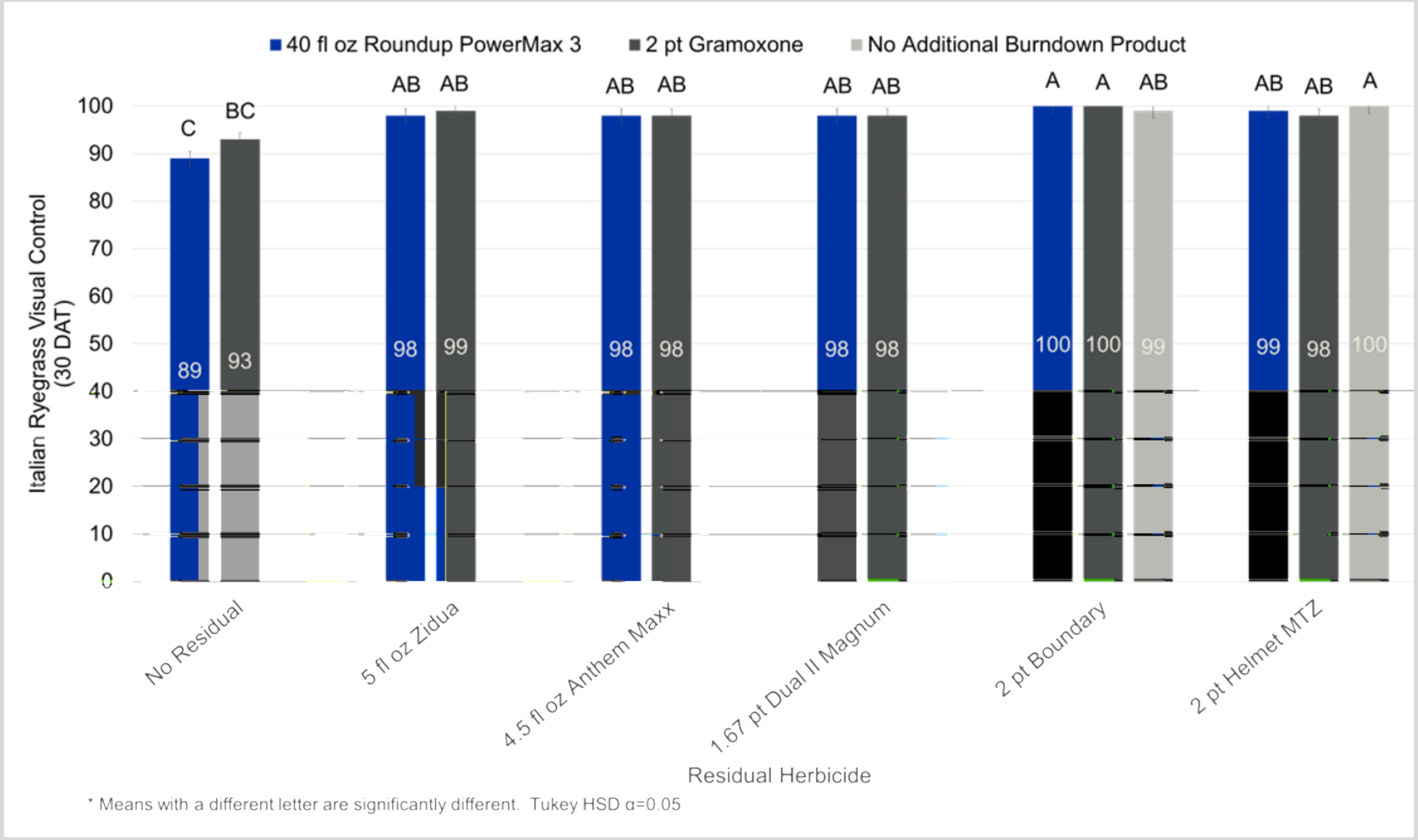
[b] Refer to label for maximum seasonal/yearly rate allowance for each active ingredient.

[c] Numerous generic formulations of S-metolachlor and metolachlor exist on the market. Check product label to assure fall applications for control of ryegrass are labeled for each specific product prior to use.

[d] At the time of publication, a Helmet MTZ 24(c) revision is under review to change corn replant restrictions from 8 months to 4 months. Check the latest KY 24(c) supplemental label for current replant restrictions.

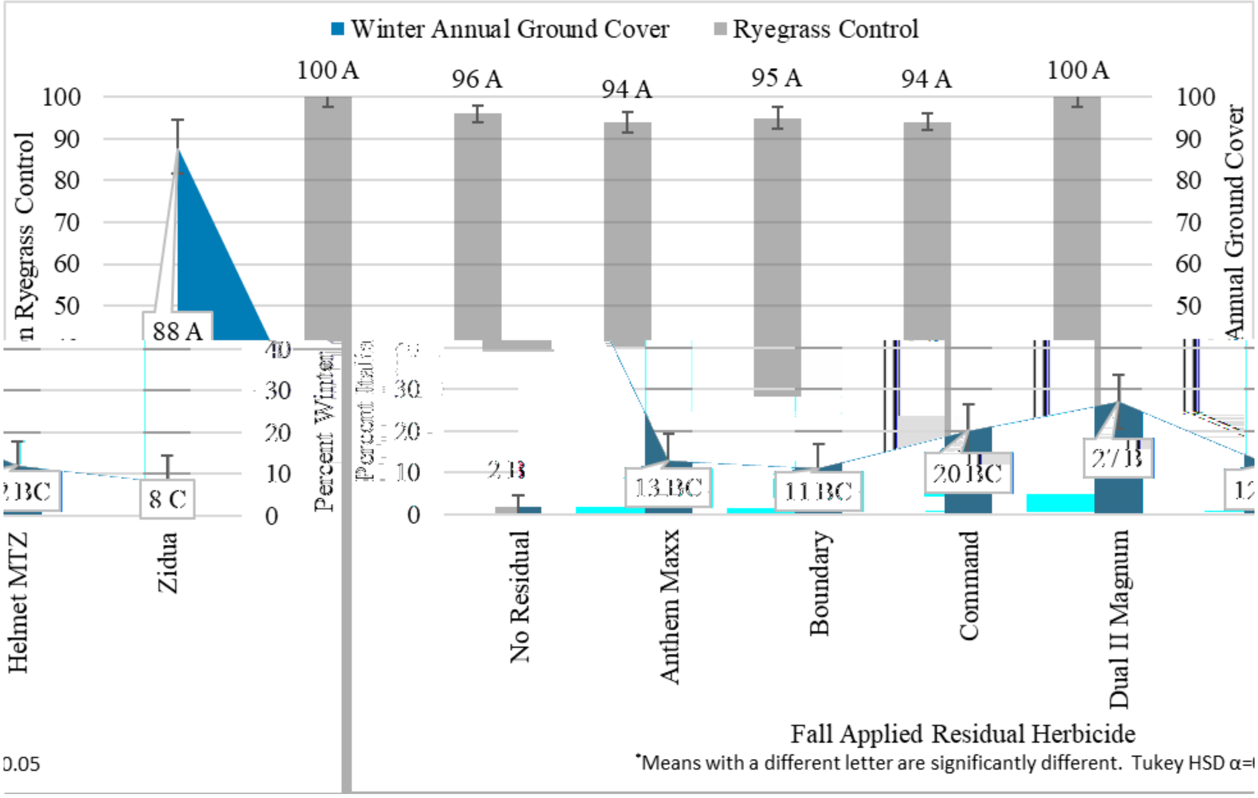
A research trial was initiated at the University of Kentucky Research and Education Center in Princeton, KY in the fall of 2022 evaluating fall residual herbicide applications for ryegrass control. The study included Zidua, Anthem Maxx, Dual II Magnum, Boundary, and Helmet MTZ as residual herbicides each applied with glyphosate or paraquat. Applications of each treatment were applied on November 2, 2022 to a field with an established population of ryegrass. At the time of application ryegrass had emerged and ranged from one to two inches in height. Results of the experiment can be found in following figures with summary results directly below the figure:

Figure 2. Italian ryegrass control and winter annual ground cover in the spring following a fall residual herbicide application.



- All treatments resulted in 89% or greater burndown of emerged ryegrass 30 days after treatment.
- The use of Boundary or Helmet MTZ without glyphosate or paraquat provided greater than 95% control of the small ryegrass plants that were emerged at the time of application.

Figure 2. Italian ryegrass control and winter annual ground cover in the spring following a fall residual herbicide application.



- All residual herbicides provided greater than 94% ryegrass control the following spring and had greater control than a burndown herbicide alone which provided 2% control of ryegrass.
- Winter annual ground cover was significantly reduced by all residual herbicide as compared to a fall burndown without a residual herbicide.

Table 2. Italian ryegrass density on April 3, 2023, following herbicide applications applied November 2, 2022.

Fall Applied Residual Herbicide	Ryegrass Plants per ft^2	
5 fl oz Zidua	0	A
4.5 fl oz Anthem Maxx	1	A
4.67 pt Dual II Magnum	2	A
2 pt Boundary	2	A
2 pt Helmet MTZ	1	A
No Residual Herbicide	14	B

[a] Means with a different letter are significantly different. Tukey HSD α=0.05

- Italian ryegrass density five months after fall residual applications was reduced to one to two plants per square foot as compared to a non-residual burndown application with 14 plants per square foot.

My Recommendation for The Fall of 2023

These are my recommendations for those farmers dealing with Italian ryegrass based off this initial year of research.

- Farmers dealing with a highly suspected or confirmed glyphosate resistant Italian ryegrass population should apply a fall application of a tank mixture of paraquat (Gramoxone) plus either Boundary or Helmet MTZ. We know that paraquat and metribuzin have synergistic activity on Italian ryegrass thus the use of a residual premix with metribuzin will be beneficial.
- Farmers still able to control ryegrass with glyphosate should apply a residual herbicide with either glyphosate or paraquat. Those choosing to use paraquat see above for recommended residual tank mix partner. Those using glyphosate should include any of the residual herbicide listed in Table 1, all provided significant reductions in spring ryegrass densities.
- Plan to follow up with a spring burndown application to control any escapes. All residual herbicides provided significant reductions in ryegrass populations but did not provide 100% control of ryegrass in the spring.
- Those acreages that are highly susceptible to erosion will need to weigh the risk of erosion over the winter months from a fall application in contrast with the benefits of ryegrass control. Some acres are likely to pose too great of a risk of significant erosion to justify a fall residual application. We will be further exploring the use of cover crops with a fall residual to reduce this risk.

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Grain Filling – The Final Stage in the Production of Yield

Grain-filling is the final event in the production of yield by a grain crop. The vegetative plant has stopped growing; the production of the leaves that power plant growth and the roots that nourish them is finished. The number of grains the plant will produce is fixed and the tiny grains are ready to start growing. Grain filling is the main event, all of the preliminary events are over. The preliminary events are essential, but the heavy lifting for yield occurs during grain filling.

'Deciding' how many grains the crop will produce is usually considered a critical event that, in large part, determines yield, but I think we make a mistake if we discount the importance of grain filling. At the beginning of the grain-filling period yield is essentially zero, no yield has been accumulated – all of the yield is produced during grain filling.

It is difficult to exactly define the start of grain filling (when the grains start their rapid accumulation of dry weight) , but growth stage R5 is a good approximation for soybean, while growth stage R2 approximates the beginning for corn. Grain filling ends at physiological maturity (maximum grain dry weight) which occurs at approximately growth stage R7 in soybean and R6 in corn.

Yield is a function of the total rate of grain growth (pounds per acre per day) and the duration of grain growth (days). The rate is determined by the capacity of the plant, via photosynthesis and remobilization of stored nutrients, to supply the raw materials for grain growth. Duration is defined by how long the grains keep growing. It is not surprising that both rate and duration are usually directly associated with yield. The faster and the longer the grains grow, the greater the yield. The length of the grain-filling period is under genetic control. In fact, there are many historical examples where plant breeders selecting for yield, inadvertently selected for a longer grain-filling period.

The grain-filling period has several interesting characteristics. First, it is relatively short – only 30 to 40 days in most crops. This amounts to 25 to 33% of the total growth cycle (planting to maturity) for a crop that takes 120 days to mature. Way over half of the total growth cycle is taken up by preliminary activities. These activities are necessary, but all of yield is produced in the last 30 to 40 days. Producing high yields in such a short time puts a lot of stress on the plant to supply the necessary carbohydrates and other nutrients. Any disruption of plant growth during this period can reduce yield.

The second interesting characteristic involves the plant's initiation of leaf senescence shortly after the beginning of grain filling. During senescence, the plant breaks down its photosynthetic machinery in the leaf and translocates the nitrogen and other nutrients to the developing grain. Destroying its photosynthetic capacity just when the crop finally starts to produce yield doesn't seem to be the best strategy to make high yields. Senescence, however, is not all bad; remobilizing the breakdown products to the grain leaves less nitrogen and other nutrients in the stover, resulting in a more efficient use of nutrients.

The length of the grain-filling period is affected by temperature – as temperature decreases, the length of the grain-filling period increases. This relationship may explain why remarkably high yields often occur in relatively cool climates (e.g., high wheat yields in Europe). A famous crop physiologist at the University of Kentucky, the late W.G. Duncan, once theorized that the ideal environment for high yield was a high elevation dry climate with irrigation (water not limiting). The high dry climate provided high levels of solar radiation (fewer clouds) and high temperatures during the day to maximize photosynthesis, but lower temperatures at night resulted in a longer grain-filling period. High photosynthesis and a long grain-filling period equals high yield.

Water stress during grain filling will accelerate leaf senescence, shorten grain filling, and reduce yield. In this case, water stress acts as a 'hidden' stress because the visual aspects of senescence (leaf yellowing and abscission) proceed normally, just faster, so it's not noticeable (unless well-watered plants are available for comparison) until harvest when the smaller grains and lower yields are obvious. Interestingly, once water stress accelerated leaf senescence in our experiments, watering the soybean plants to relieve the stress did not stop the accelerated senescence. Apparently, only a few days of stress (3 days in our experiments) are needed to accelerate senescence, shorten grain filling, and reduce yield. Water stress during seed filling may be a more important yield-limiting factor than commonly thought.

All yield is produced during grain filling. The old adage that yield is 'made' early in seed filling is not necessarily true – the potential is there, but stress can easily reduce it. Yield is not 'made' until the seeds reach physiological maturity.

Adapted from Egli, D.B. 2021. Applied Crop Physiology: Understanding the Fundamentals of Grain Crop Management. CABI. 178 pp.

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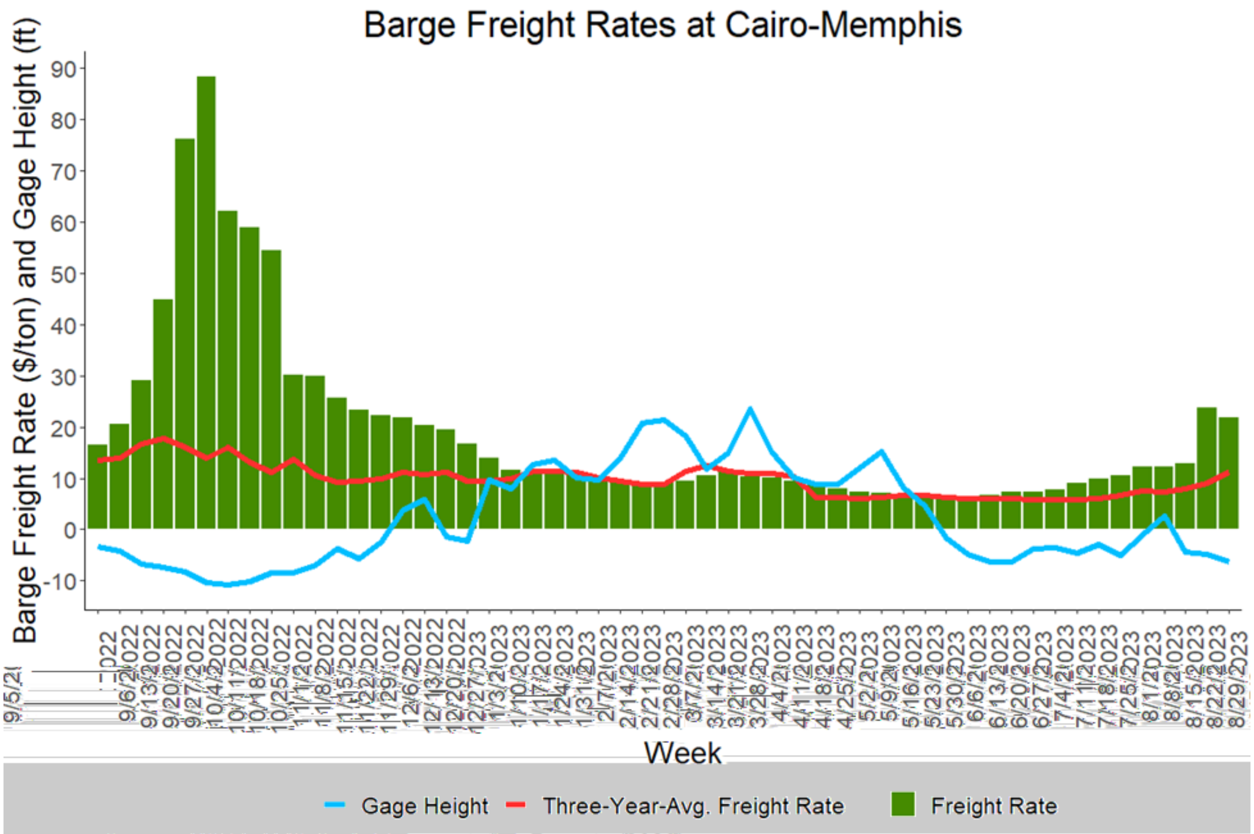
Low River Levels, Barge Freight, and Widening Basis

Dry weather has again caused the Mississippi River levels to fall to near-record lows. When the Mississippi River is low, barge traffic slows, causing barge freight prices to increase. Since local commodity basis is a function of transportation costs, higher barge freight rates cause the basis to widen at elevators bordering the Mississippi River. Figure 1 shows river barge freight rates for the 2022-23 marketing year compared to the three-year average. The three-year average indicates that we typically see small fluctuations in barge freight rates. Thus, barge rates likely have a small effect on local commodity basis when river levels are sufficient. However, in 2022, the river level at Memphis hit a historic low of -10.81 feet, nearly stopping all barge traffic and sending barge freight rates to a record high of nearly $90/ton of grain. As of September 5th, the river level declines have caused barge rates to increase to $30/ton. Although data is not included in the graph, the September 12th river level at Memphis is -9.56 feet. Current weather forecasts look dry, and without sufficient rainfall, barge

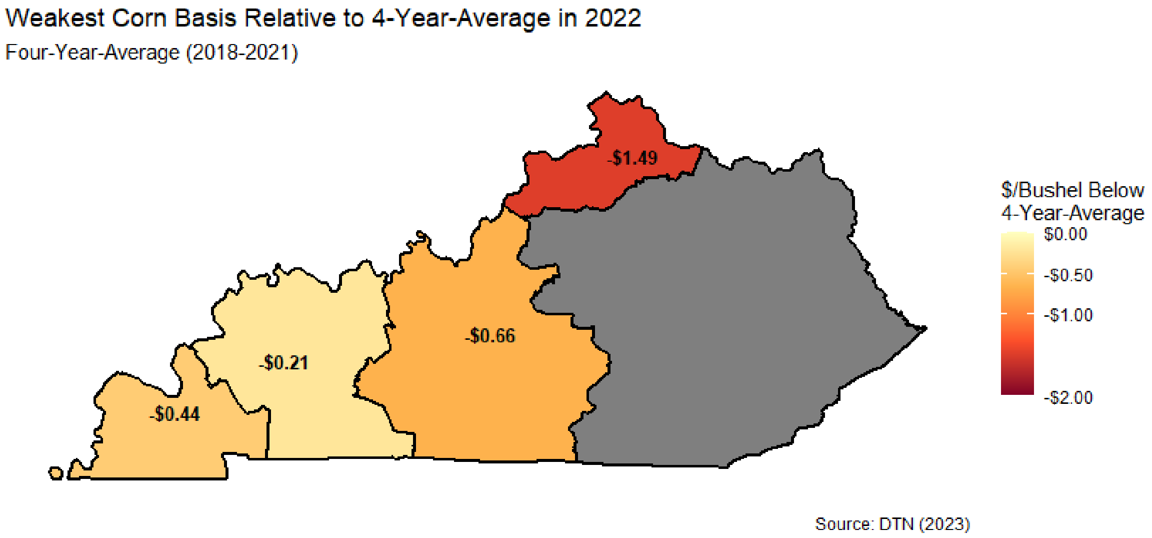


Source: USDA-AMS Grain Transportation Reports (2023)

Figure 1: Recent River Level height and Recent Barge Freight Rates compared to the Three-Year Average Freight Rate (September 2022-September 2023).

freight rates may increase similarly to last year, causing another situation in which commodity basis drops.

Figure 2 indicates the weakest corn basis in 2022 compared to the 4-year average for four of the main corn-producing districts in Kentucky. As the river levels were lowest during harvest season, producers without storage were forced to deliver and could not avoid the low basis. Producers unlikely to avoid the basis risk included those taking the spot price, hedging through futures, or using hedge-to-arrive contracts in which the basis is set near or at delivery. At the absolute minimum, hedging producers in Kentucky could have experienced realized prices of $0.21-$1.49/bushel under their expected price when the hedge was set.



Source: DTN (2023)

Figure 2: Weakest 2022/23 Marketing Year Corn Basis relative to the 4-Year-Average in the Four Main Corn Producing Ag Districts

Interestingly, basis was the most resilient in the "Midwestern" region, which could be driven by high local demand. Proximity to the river played a part in reducing the effect in the "Purchase" region, where the basis was at a maximum $0.44 under the average yearly basis. Surprisingly, the largest effects were found in the "Central" and "Northern" regions. As the river continues to drop, barge prices will likely continue to increase, which could again cause the basis to widen. In this case, hedging producers will likely experience prices below their expected price, which could cause issues with farm profitability and cash flow.

Producers have a small number of options to manage basis risk. Hedging or HTA contracts are typically used to minimize price risks; however, they leave the producer susceptible to basis risk, which is usually more stable than commodity prices. However, last year, lower river levels caused unpredictable basis patterns, and unfortunately, we are in a situation where the same events could occur again. If we continue to experience dry summers and river level decreases, Kentucky producers may need to rely on forward contracts at harvest, which lock in price and basis pre-delivery, or basis contracts, which lock basis before river levels decline. Compared to hedging, a pitfall of these contracts is that they limit the flexibility of when and where grain is delivered. If the basis falls in the short term, producers may want to utilize on- or off-farm storage to suspend cash sales until the basis improves.

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Save the date !

Feb. 8, 2024 - National Corvette Museum - Bowling Green, Ky

KCHC

Kentucky Crop Health Conferenc

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National Corvette Museum

Tickets go on sale Nov. 1, 2023 - Visit: https://kchc2024.eventbrite.c

(non-refundable after Jan. 25, 2024)
Lunch included - CCA and Kentucky PAT education credits will be available

Physiological Maturity –
The End of the Line (almost)

Physiological maturity (PM) in grain crops occurs when seeds or kernels reach their maximum dry weight. Physiological maturity represents the end of the line as far as the production of yield goes. Environmental stress or disease and insect infestations after PM will not affect yield *per se*, but they might influence harvestable yield (and grain quality) and it is the harvestable yield that puts money in the producer's pocket.

The vascular connection between the mother plant and the seed is severed at PM, so the seed no longer receives water or other raw materials (mostly sucrose and a few amino acids) for growth (to keep it simple, 'seed' refers to both soybean seeds and corn kernels). The seed is isolated from the mother plant at PM and is essentially in storage on the plant.

Seed moisture concentrations at PM are stable across environments and specific for each crop. Soybean seeds reach PM at 55 to 60% moisture. Corn kernels contain 34 to 38% moisture at PM compared with 37 to 44% for wheat. Interestingly, the moisture concentration at which seeds germinate is the same as the concentration at PM.

Seeds are not ready to harvest at PM, moisture levels are too high, so they must dry to a harvestable water concentration before harvest begins. Water loss after PM is primarily a function of environmental conditions (temperature, wind speed, solar radiation, and water vapor content of the air). If its hot and dry the seeds will dry much faster than if its cool and wet. Water levels in the seed may actually increase in extremely wet conditions. Soybean seeds dry much faster than corn kernels, probably because the soybean pods are more exposed to the environment and are less of a barrier to water loss than the husks covering corn kernels.

All seeds on a plant do not reach PM at the same time, which is not surprising, given that they did not start growing at the same time. The occurrence of PM is more uniform, however, than the beginning of seed growth. Consequentially, determinations of PM are usually based on the proportion of seeds that have reached PM, rather than waiting until all seeds on the plant are at PM. Estimating PM a few days early does not make much difference in seed dry weight (yield), because seed growth slows as the seeds approach PM, so very little yield is accumulated in the last few days before PM.

There may also be variation in the timing of PM in a field, often as a result of variation in water availability. Plants on eroded hill tops, for example, which experience more water stress, often reach PM before those in lower areas that are not stressed.

Seed moisture concentration or individual seed dry weight can be used as an indicator of PM, but they are not practical in the field, given that daily estimates are needed to pinpoint PM. Fortunately, research has identified visual seed characteristics of PM that are easy to use in the field.

Soybean: A soybean seed reaches PM when it first turns yellow and yellow seeds are usually found in yellow or brown pods. A plant would reach PM when all the seeds on the plant are completely yellow.

Growth stage R7 (one normal pod on the main stem has turned brown or tan) is an acceptable indicator of PM. In our research with several varieties, 96% of the seeds were either completely or partially yellow at growth stage R7. We could not detect any difference in yield between plants harvested at growth stage R7 or at full maturity (growth stage R8). Physiological maturity is usually taken as when 50% or more of 10 consecutive plants in the row have reached growth stage R7.

Corn: The appearance of a black layer at the base of the corn kernel signifies that there will be no more movement of water or raw materials into the kernel – the kernel is at PM. When the milk line that marks the division between the solid and liquid endosperm in the kernel nears the base of the kernel (75% of the kernel's length contains solid endosperm), the kernel is at PM. Growth stage R6 is an acceptable indicator of PM in corn.

Physiological maturity is an important growth stage in grain crops because it represents the end of the grain-filling period. Yield is made at PM, so management after PM will not increase yield, although stress after PM can reduce the harvestable yield.

Adapted from Egli, D.B. 2021. Applied Crop Physiology: Understanding the Fundamentals of Crop Management. CABI. 178 pp.

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KENTUCKY YIELD CONTESTS

The Kentucky Extension Yield Contests are administered by the University of Kentucky Cooperative Extension Service. Funding for the contest comes from the Cooperative Extension Service, the Kentucky Corn Growers Association, Kentucky Soybean Board, Kentucky Small Grain Growers' Association and numerous Agribusinesses.

To enter click the link and **please read the rules carefully.**

Kentucky Corn Yield Contest Rules

Kentucky Soybean Yield and Quality Contest

UPCOMING EVENTS

2023 Fall Crop Protection Webinar Series

#1 Dr. Wise	*November 2, 2023*
#2 Dr. Bradley	*November 9, 2023*
#3 Dr. Legleiter	*November 16, 2023*
#4 Dr. Villanueva	*November 30, 2023*

2024 Winter Wheat Meeting

February 1, 2024

Kentucky Crop Health Conference

February 8, 2024

Wheat Field Day

May 14, 2024

Corn, Soybean & Tobacco Field Day

July 23, 2024

Cooperative Extension Service
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