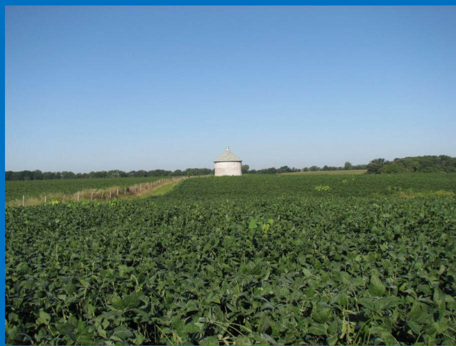

Corn & Soybean News

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Pre-harvest corn disease scouting observations

Scouting reports across Kentucky this week have indicated that farmers need to be aware of stalk rots and ear rots as they prepare for and begin corn harvest. Pockets of fields scouted across the state have stalk rot issues that range from minor to severe, in some cases causing pre-harvest lodging (Figure 1). A variety of ear rots have been observed across the state as well. It is important to identify fields that may have stalk rot and/or ear rots to ensure timely harvest, proper storage of moldy grain, and determine the potential for mycotoxin issues.

Figure 1. Lodging caused by stalk rots (Picture Kiersten Wise)

Stalk rots

There are several fungi that can cause stalk rots, and often samples need to be observed in a diagnostic laboratory to confirm the cause of the stalk rot. Stalk rots can cause yield losses from lodging and stalk breakage. In 2020, several fields across the state have exhibited premature senescence and top dieback, similar to symptoms of anthracnose top dieback. Anthracnose top dieback is a phase of anthracnose stalk rot, caused by the fungus *Colletotrichum graminicola*. Anthracnose top dieback is commonly observed in late grain fill as bleached or yellow

Figure 2. Above, Anthracnose top dieback (Picture Kiersten Wise); **Figure 3.** At right, premature plant death caused by Diplodia stalk rot (Picture Kiersten Wise)

leaves and stalks appear in the upper canopy while surrounding plants are still green (Figure 2). Symptoms of anthracnose stalk rot typically appear just prior to senescence, although symptom expression differs among hybrids. Lesions of anthracnose generally appear as long, narrow, brownish-black streaks or lesions on the surface of the stalk. Older lesions of anthracnose are darker and may be shiny in appearance and extend into the rind of the stalk. The internal tissues of the stalk, or pith, may also have brownish discoloration that will be hard to distinguish from other stalk rots, like Diplodia stalk rot, which is another common stalk rot in Kentucky. Diplodia stalk rot can also result in premature senescence and plant death during grain fill (Figure 3), so it is important to send samples to the Plant and Pest Diagnostic Laboratory for accurate diagnosis of the causal stalk rot.

Stalk rot management

Scout fields prior to harvest to determine if stalk rots are present, and if lodging is a concern. Fields that have moderate to high levels or stalk rot or stalk breakage should be harvested as early as possible to prevent lodging and yield losses. The fungi that cause anthracnose stalk rot and Diplodia stalk rot overwinter in crop residue, and the disease is more severe in corn-on-corn rotations. Resistant hybrids are available, and farmers can also choose hybrids with good stalk strength ratings. A combination of resistant hybrids, crop rotation, minimizing in-season stresses, and early harvest are recommended to prevent yield loss from these diseases.

Ear rots

Several different fungi cause ear rots, and the environmental conditions at and just after silking, and prior to harvest influence which ear rot may be problematic in a given year. Additionally, the fungi that cause Gibberella ear rot and Fusarium ear rot produce mycotoxins as a by-product of the infection process.

Figure 4. Diplodia ear rot (Picture at left by Kiersten Wise)

Figure 5. Fusarium ear rot (Picture above by Kiersten Wise)

Diplodia ear rot

Diplodia ear rot is caused by the fungi *Stenocarpella maydis* and *S. macrospora*. These fungi survive in residue and infects plants shortly after pollination. Humid weather and rains prior to and after pollination will favor disease development. Diplodia ear rot is identified by white fungal growth on the cob, often forming a mat of fungus across the ear (Fig. 4). Infected kernels may also be brown-gray in appearance. Small, black fungal structures called pycnidia may form on the kernels or the cob. The fungus is reported to produce a mycotoxin called diplodiatoxin in South America and South Africa, however, no reports of toxic effects of grain on livestock or humans due to Diplodia ear rot have been reported in the United States. Grain dockage may still occur, however, due to moldy grain. More information on Diplodia ear rot can be found in University of Kentucky publication: http://plantpathology.ca.uky.edu/files/ppfs-ag-c-05.pdf

Fusarium ear rot

Fusarium ear rot is primarily caused by the fungus *Fusarium verticilliodes*. This fungus infects corn after pollination, and infection is favored by warmer temperatures. Fusarium-infected ears may have white to purple fungal growth on the cob, or symptoms may appear as discolored kernels scattered throughout a cob or associated with insect feeding (Fig. 5). Visible fungal growth may not be obvious on the cob, but a white "starburst" pattern in kernels can sometimes be observed on ears infected by this fungus. The mycotoxin fumonisin is associated with Fusarium ear rot.

Figure 6. Gibberella ear rot (Picture Kiersten Wise)

Gibberella ear rot

Gibberella ear rot is primarily caused by the fungus *Fusarium graminearum*, which also causes Fusarium head blight of wheat. This fungus infects corn during early silking, and also forms a white mat on the cob like Diplodia ear rot, but often with a pinkish color (Figure 6). The fungal mat typically begins at the ear tip and progresses down the cob. This ear rot is less common in Kentucky because the fungus prefers cool, wet weather after silking to infect ears, but pockets of Kentucky had cooler than normal temperatures at and after silking this year, and those areas should be aware that this ear rot can be present and may be a mycotoxin risk. The mycotoxins deoxynivalenol (DON; vomitoxin) and zearalenone are associated with the fungus that causes Gibberella ear rot.

Ear rot management

Regardless of which ear rot is present in a field, farmers should scout fields prior to harvest and determine the level of incidence of any ear rot in the field. If ear rots are observed in a field, affected areas should be harvested early and grain segregated to avoid contamination of non-infected grain. Grain harvested with suspected ear rots should be dried to below 15% moisture. If grain is stored above this moisture content, mold can continue to grow, and any mycotoxins present can continue to accumulate in grain. All grain contaminated by any ear rot fungus should be stored separately from good grain, and if stored long term, it should be stored below 13% moisture to prevent further growth of fungi. If ear rots that are associated with mycotoxins are suspected, send grain or silage samples to a testing laboratory prior to feeding.

Several publications on ear rots and mycotoxin management are available through the Crop Protection Network: https://cropprotectionnetwork.org/resources/publications. These publications provide information on ear rot identification and management, mycotoxin testing, as well as answers to frequently asked questions about mycotoxins, and storing moldy grain.

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The known and unknown: Choosing herbicide tolerance packages for 2021

As the 2020 harvest begins, many will already be making choices for the 2021 growing season. This will include choosing soybean varieties and herbicide tolerance packages. While making choices for the next growing season can be difficult, this year's decision is likely to be even more difficult. Not only will farmers have more choices when it comes to herbicide tolerance packages, but there is a great unknown going into 2021.

That unknown is the availability of dicamba for applications to dicamba tolerant soybean. Three dicamba formulations of Xtendimax, Fexapan, and Engenia had their labels vacated on June 3, 2020. While this vacation was untimely, the truth is that these herbicide labels were set to expire in December 2020 anyway along with Tavium whose label was not included in the court-ordered vacation. With all four labels looking to receive reapproval going into 2021, there is no doubt that getting the labels reinstated as they were in the past is going to be quite difficult. The reality is, it is completely unknown if dicamba herbicides will be available in 2021 for control of weeds in Roundup Ready 2 Xtend soybean and/or what timings and restrictions will be on those labels if reinstated.

Fortunately, there are now numerous other herbicide tolerance packages available to help with control of herbicide resistant weeds. In this article we will discuss each herbicide tolerance package and what it offers for weed control in 2021, with a focus on the big three troublesome weeds: waterhemp, Palmer amaranth, and horseweed.

Liberty Link

The Liberty Link system which offers resistance to glufosinate (Liberty) has been on the market for close to a decade and has been used successfully by Kentucky farmers. While this trait package is the oldest on the list, glufosinate is still a strong herbicide that provides effective control of horseweed, Palmer amaranth, and waterhemp. To date there are no known glufosinate resistant weeds in the state of Kentucky.

LLGT27

The LLGT27 soybean system offers resistance to glufosinate (Liberty), glyphosate (Roundup), and isoxaflutole (Alite 27). This package brings a lot of potential to the table for control of waterhemp and Palmer amaranth. Not only does it offer the use of glufosinate for control of these weeds postemergence, but also offers the use of an HPPD inhibitor (Alite 27) preemergence. The ability to apply Alite 27 to these soybean allows for an additional site of action in the soybean year that no other soybean trait package offers.

Although there are stipulations that come with Alite 27. This product can only be applied preemergence to LLGT27 soybean. It is encouraged to tank mix Alite 27 with additional residual herbicides to protect against resistance selection and to expand the weed control spectrum. Furthermore, the Alite 27 label is only valid in 15 counties in Kentucky as of the date of this article, so check the label before application to assure use is allowed in your county.

Enlist E3

The Enlist E3 soybean system has gained in adoption over the past two growing seasons with Kentucky growers and adoption is expected to continue to increase. The advantage that the Enlist system offers over all other currently available soybean systems is the availability of two effective postemergence options, glufosinate (Liberty) and 2,4-D (Enlist One), for control of waterhemp, Palmer amaranth, and horseweed. The Enlist system also has tolerance glyphosate (Roundup). Having two options for postemergence control offers flexibility to a farmer's herbicide program when not only considering what weed species are present, but what surrounding sensitive crops are present.

Even though the Enlist system has the most postemergence options, it is still extremely important to continue to use robust soil residual herbicides in this system for control of waterhemp and Palmer amaranth.

RoundupReady 2 Xtend

The Roundup Ready 2 Xtend system comes with the greatest question, simply due to the unknown of dicamba herbicide label registrations. This soybean system offers resistance to both dicamba and glyphosate. A farmer must have alternative plans if they want a successful weed control program in this soybean system due to widespread glyphosate resistance in horseweed, waterhemp, and Palmer amaranth and the unknown availability of dicamba. That alternate plan is going to have to rely almost exclusively on soil residual herbicides. As with all these soybean systems the use of a robust multi-SOA preemergence residual is highly encouraged. Farmers will also need to plan to make an overlapping residual application. An overlapping residual application is made in crop at 3 to 4 weeks after the first residual application to give an additional residual layer before the first one begins to break. In a perfect world the farmer can plan for overlapping residuals and the dicamba labels will be reinstated for use over the top of soybean to clean up any escaped pigweeds.

Until new dicamba labels are approved a farmer should not assume those postemergence herbicides will be available. If the dicamba labels were not reinstated the only semi-viable postemergence options for Palmer amaranth and waterhemp control will be PPO-inhibitors such as fomesafen (Flexstar). Although there is a fairly large percentage of the pigweed populations in Kentucky that are PPO-resistant, this option will not be viable on those populations.

Roundup Ready 2 XtendFlex (Pending registration)

The Roundup Ready 2 XtendFlex system is still awaiting EU approval at the time of this article and thus is not commercially available to farmers. It is hopeful that the approval will come soon despite all the current disruption in the world.

The approval of this trait package will bring much relief as it offers dicamba (Xtendimax), glyphosate (Roundup), and glufosinate (Liberty) resistance. The addition of glufosinate resistance expands postemergence options for waterhemp, Palmer amaranth, and horseweed control. This flexibility will also benefit those producers who have fields surrounded by dicamba sensitive crops.

Despite this flexibility of postemergence options it is highly encouraged that famer still utilize residual herbicides. Research supported by the Kentucky Soybean Board conducted at the University of Kentucky over the last three years has shown that the use of a robust multi-SOA preemergence herbicide in the XtendFlex system has a greater influence on waterhemp and Palmer control than selection of postemergence herbicides applied.

Bottom Line and What We Do Know

The ultimate choice is up to the farmer with consideration of not only their current weed control needs, but also all the other trait characteristic they desire in soybean to perform best on their fields.

Regardless of which trait package they choose, if a farmer is dealing with Palmer amaranth and waterhemp they must use preemergence residual herbicides. Every single one of these soybean trait packages will ultimately fail if a farmer relies on postemergence applications alone. Research at the University of Kentucky with the support of the Kentucky Soybean Board has consistently shown that waterhemp and Palmer amaranth escapes at the end of the season are significantly lower when using a complete herbicide program with preemergence herbicides as compared to programs that rely on postemergence applications alone. In addition, our southern colleagues are reporting cases of dicamba, 2,4-D, and glufosinate resistance in pigweed making all of the above-mentioned soybean packages of little value for postemergence options. The use of residual herbicides is a must if we are to preserve our current soybean trait technologies.

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Weed Science Plot Walk Videos

The weed science team at the UKREC is bringing the plots to you through your internet connected devices. In lieu of being able to walk plots in person at the UKREC, a series of plot walk videos has been posted to YouTube for viewing. The videos cover 13 trials evaluating herbicide efficacy in corn and soybean and include 142 unique treatments. All videos were recorded at the plots located at the UKREC with a mixed weed population of Johnsongrass, crabgrass, giant ragweed, horseweed, smooth pigweed, and morningglories; as well as videos from our waterhemp site located in Caldwell County.

You can view the videos on the UK WeedScience YouTube Channel at the link below.

https://www.youtube.com/channel/UCgGSQJBHJl8uWH_M4c8-Y2Q/videos

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Figures 1-3. Photos by Kurt Steinke (Michigan State University)

Don't Know if Your Corn N Program was Good Enough? Do a Corn Stalk Nitrate Test!

Why the CSNT?

This time of year, as corn finishes the season, growers may wonder if their N management program was a success (or not). Used to be that one could watch lower leaves in the corn canopy and gauge whether N had been sufficient. The lower canopy of the corn in Figure 1 looks 'green to the ground', but the corn in Figure 2 and on the left side of Figure 3 is more ambiguous as regards season-long N sufficiency. The right-side row in Figure 3 appears to be N deficient. The advent of "stay-green" corn varieties, and the somewhat qualitative nature of the visual approach, makes this method of season-long N assessment problematic. The corn stalk nitrate test (CSNT) is an alternative way of checking whether the crop generally experienced adequate N availability.

What Is the Basis of the CSNT/Who Should Use It?

The CSNT is based in the observations that corn depletes stalk N when under N stress, maintains stalk N when N is adequate, and accumulates stalk N when N availability is in excess. All corn producers might initially benefit from the CSNT on a few fields every year, or on many fields in a year with unusual weather. If results are usually 'optimal', then less investment in testing is needed. If results are usually 'low, marginal or excess', then the producer should consider adjusting the field's N management program accordingly. Growers doing on-farm research with different N management treatments might benefit from the CSNT. Producers growing corn on manured soils, or after alfalfa, should consider the CSNT. Many growers underestimate N supply from animal manures/alfalfa residues and apply unneeded N fertilizer.

What Is the CSNT/How Is the CSNT Done?

The CSNT is the laboratory determination of the nitrate-N concentration on a sample of stalk segments that were taken after corn physiological maturity. Starting 6 inches above the soil and ending 14 inches above the soil (gives an 8-inch stalk segment) and taking 15 segments to well represent (same as for soil sampling) a uniform field area. Uniformity is important because, like soil test results, CSNT results can exhibit considerable in-field spatial variation (Maresma et al., 2019). See this video (https://youtu.be/N7wBn3dIG-w to view the actual sampling process. AGR-180 (http://www2.ca.uky.edu/agcomm/pubs/agr/agr180/agr180.pdf) also describes sampling. Finally, cut the 8-inch segments into 2-inch segments (Figure 4) before sending to the lab in a paper bag.

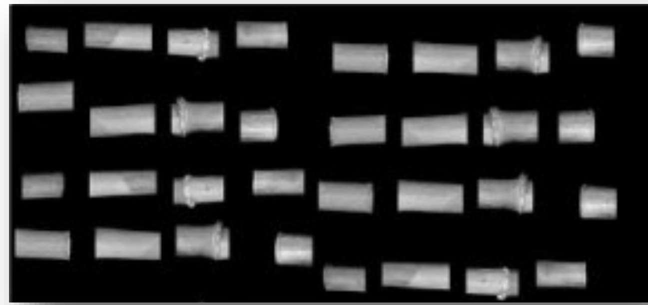

Figure 4. Beegle and Rotz (2009)

How Is the CSNT Lab Result Interpreted?

The relationship of corn yield to the CSNT value is shown in Figure 5. Relative yield was used because of the wide range in maximum yields observed in the research. The response pattern shown in Figure 5 was the same as what was observed in Kentucky (Murdock and Schwab, 2004). There is a wide range in both relative corn yield and CSNT values. Note that the relationship breaks sharply – yield falls quite dramatically at the lowest CSNT values. This 'drop off' causes the range in CSNT values associated with each interpretation 'level' to be narrow at lower CSNT values and wide at higher CSNT values.

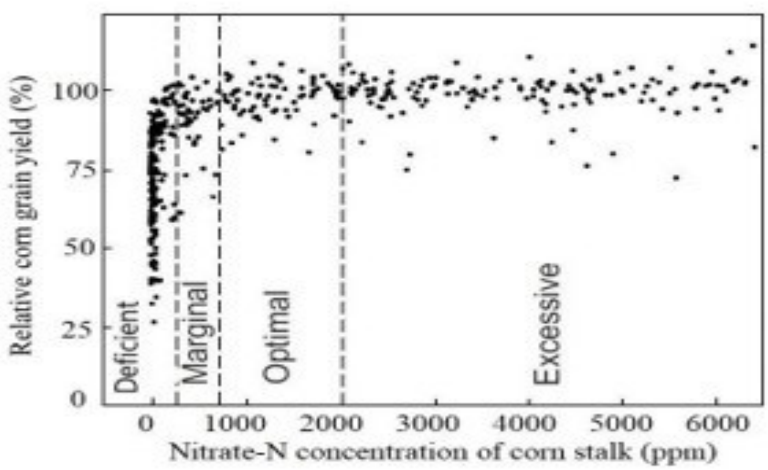

Figure 5. Relative corn yield versus CSNT value (adapted from Tao and Pan, 2019; Sawyer and Mallarino, 2018). Relative yield = 100 x (observed plot yield/average site yield for all plots where additional N did not increase yield).

The interpretation categories, based on UK research, are given below (Table 1). Growers can clearly benefit from this information but should be mindful of interpretive limitations. First, the test ***does not indicate the amount of N either over or under applied*** if the result is 'excessive' or 'low/deficient', respectively. Second, the test result is affected by seasonal weather – is higher in dry years and lower in wet years. Over time, the most economical N rate will result in low CSNT values at the end of a wet season and high CSNT values after a dry year. Third, early-season N stress may limit corn yield in a way that is not indicated by a low CSNT value, and especially if N is applied later – and too late to alleviate that early N stress. Fourth, 'optimal' CSNT values for irrigated corn may need to start at values higher than 700 ppm N (≈ 1000 ppm N) due to greater crop N demand and greater potential for N loss from the soil (Tao and Pan, 2019).

Table 1. Interpretation of CSNT results.

Plant Nitrogen Status	CSNT Nitrate-N (ppm N)	Interpretation
Low/Deficient	Less than 250	High probability that N is deficient. Visual signs of N deficiency are usually apparent.
Marginal	250-700	N availability is close to "optimal" but could result in lower yields that will cause economic losses.
Optimal	700-2000	High probability that yields are not limited by N availability. Visual signs of N deficiency on lower leaves are often observed in this range.
Excessive	More than 2000	High probability that N is greater than needed for maximum yields.

Adapted from Murdock and Schwab (2004).

The ability of any N management scheme (rate, timing, placement and source) to meet corn's N need depends upon the season's soil and weather conditions (and soil by environment interactions on N availability). Don't base next year's N management on a single year's CSNT values. CSNT data collected over several years, combined with seasonal weather information and fertilizer, manure, prior crop and tillage management histories, will better inform future N management decisions.

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High population occurrences of threecornered alfalfa hopper in soybeans in 2020

Figure 1. (A) Adult and (B) nymphal stages of threecornered alfalfa hopper. (Photos: Raul Villanueva, UK)

Description of Threecornered Alfalfa Hoppers

The threecornered alfalfa hopper (*Spissistilus festinus,* Hemiptera: Membracidae) gets its name from the triangular body shape of the adult stage and its common occurrence in alfalfa fields (Figure 1A). However, threecornered alfalfa hoppers have a large list of hosts. In soybeans, they are considered sporadic pests. Threecornered alfalfa hoppers can overwinter as eggs or adults. Adults (1/4 inch long) live under plant debris, and when temperatures increase in April or May, eggs hatch and adults became active and start to feed. In spring, this insect first feeds in the edges of fields and then moves inside the field.

This insect is well distributed in the U.S., and it can be found from the Gulf states to Canada. Adults fly or fall to the ground when disturbed. Nymphal stages of threecornered alfalfa hopper have a very distinctive body shape; the dorsal part of their body has saw-toothed spines (Figure 1B). Nymphs are usually found in the lower parts of plants feeding on the stems.

Both adults and immature forms feed by inserting their piercing mouthparts into stems and sucking sap from leaf petioles, branches and main stem. Feeding usually occurs circling the stem or petiole repetitively, which causes feeding areas to become swollen, and the formation of aerial adventitious roots (Figure 2A) or galls and calluses (Figure 2B). This condition debilitates plants and can cause lodging or breakage in a storm or due to a plants' weight.

Figure 2. (A) Aerial adventitious roots caused by feeding of threecornered alfalfa hopper in soybeans; (B) lodged soybean plant. Notice the callus caused by the feeding of the threecornered alfalfa hopper.
(Photos: Raul Villanueva, UK).

Problem

By the end of July in 2020, threecornered alfalfa hoppers were observed causing damages in several soybeans in Butler County. Soybean fields had plants cut off or lodged at 1 to 3 inches above ground (Figure 3). Based on symptomatology described above, plants presented gall formations and debilitated stems that caused approximately 1 to 2% of lodged plants (Figure 3).

Figure 3. Soybean plants cut off or lodged in Butler Co. (Photo: Gregory Drake, UK)

Field tallies in Princeton shown that the numbers of threecornered alfalfa hoppers were reduced by mid-August, and they increased by the end of August. In a recent survey conducted during the first week of September adult and immature threecornered alfalfa hoppers were observed in sweep net sampling in Caldwell, McLean, Henderson, Daviess, and Ohio counties. Furthermore, in an experimental field of the Research and Education Center, 100% of the plants presented threecornered alfalfa hopper damages in petioles or stems.

Petiole feeding may not cause considerable damages. However, if main soybean stems are debilitated by feeding of threecornered alfalfa hoppers, high winds and rains can cause plant lodging that create harvest issues and consequently reduce yields.

Management
As this is a sporadic pest, a threshold has not been well established to control this pest during the vegetative growth. However, cultural practices, such as weed management around soybean fields can be effective to reduce threecornered alfalfa hopper densities.

There is not an established rule for insecticide treatment for hoppers; some studies have shown that treatment should be conducted when 50% of the plants are girdled and hoppers are present. Sweep netting is recommended to tally this insect. The sampling should be conducted in different parts of the field. If plants are setting pods, a treatment threshold of 1 threecornered alfalfa hopper per sweep is sometimes recommended.

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Stink bug populations surpassing economic thresholds in soybeans in 2020

Several stink bug (Hemiptera: Pentatomidae) species (Figure 1) are key pests of soybeans in Kentucky. They include the green stink bug (*Chinavia hilaris*), brown stink bug (*Euschistus* spp.), southern green stink bug (*Nezara viridula*), brown marmorated stink bug (*Halymorpha* halys) and red shouldered stink bug (*Thyanta custator*). These group of insects are especially damaging during the late part of development of soybeans. Adult and immature stink bug stages feed piercing tender terminals, and developing pods causing direct damages to beans. This injury may cause poor seed formation, aborted seeds, reduced seed size or seed deformation. Therefore, it reduces yield and quality of beans.

Figure 1. Nymphal stages of the brown marmorated (left), green (center) and brown (right) stink bugs.

I noticed an abundant number of egg-masses of stink bugs (Figures 2) while conducting studies and scouting for insects in soybean fields during mid-August. Later, first nymphal stages were observed (Figure 3), and during the first and second weeks of September all immature stages and adults were tallied across ten commercial soybean fields in seven KY counties (McLean, Henderson, Daviess, Ohio, Caldwell, Crittenden, and Lyon), and three research plots at the University of Kentucky's Research and Education Center (REC) in Princeton.

Figure 2. Egg masses of green stink bugs. Mature eggs change color before hatching (right)

Figure 3. First nymphal stage of green stink bug (*Chinavia hilaris*) and hatched eggs.

Compared to the previous year it seems that 2020 is a "great year for stink bugs." Tallies of stink bugs conducted in six Kentucky counties (McLean, Henderson, Daviess, Ohio, Cadwell, Lyon and Crittenden) present a vision of this condition. In at least four commercial (McLean, Henderson, and two in Lyon Co.) and one experimental soybean field the numbers of stink bugs were above the economic threshhold of 36 stink bugs per 100 sweeps (Figure 4). In addition, in other four locations the numbers tallied were considerable high (above 20 stink bugs/100 sweeps).

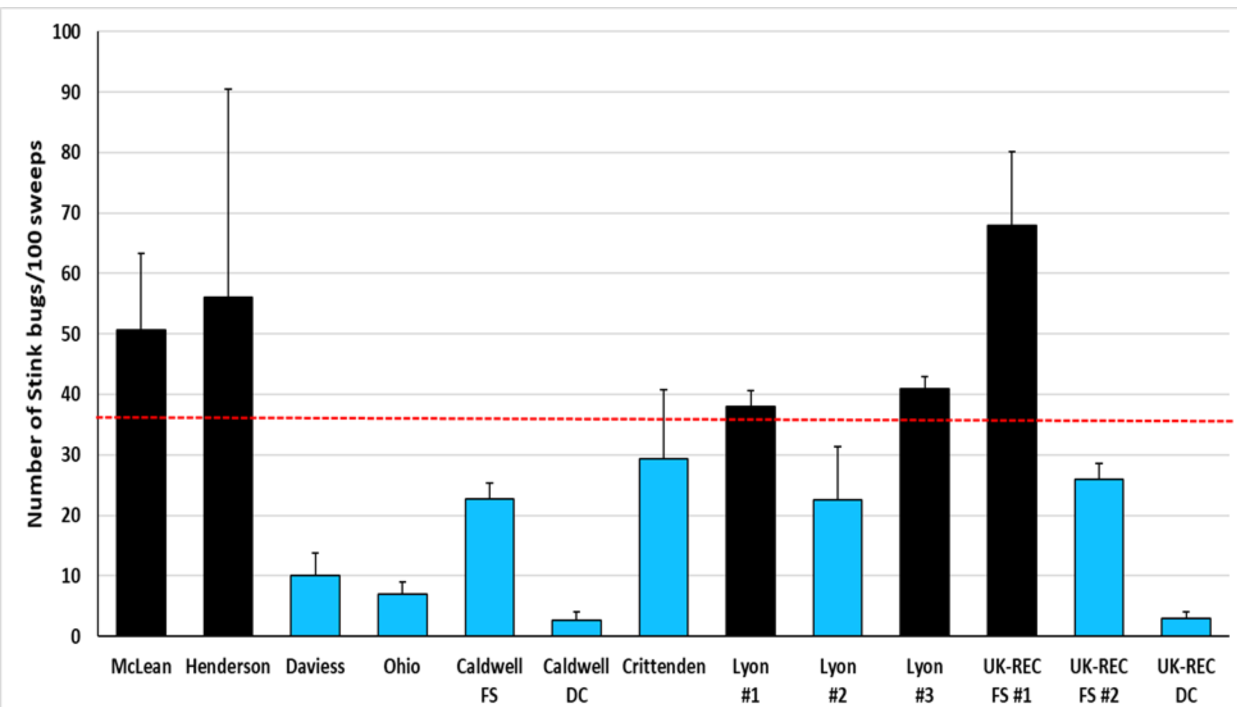

Figure 4. Mean (±SEM) numbers of stink bug tallies conducted during the first and second week of September in 7 KY counties and 7 research plots at the REC-Princeton. Economic threshold shown by red dashed line.

Two of the sites surveyed had double crop soybeans (beans that were planted after wheat) and the pods are not fully developed compared with full season soybean fields; thus these fields showed the lowest numbers of stink bug tallies (≤ 3 stink bugs/100 sweeps) (Figure 4). This situation occurs even when the fields are contiguous such as the sites UK-REC FS#1 and UK-REC DC (Figures 4 and 5). However, double crop soybean fields are not necessarily free of stink bugs because as beans mature and the full season soybeans are harvested, the stink bugs will move to these sites.

Figure 5. View of a full season (left) and double crop (right) soybeans planted contiguously. Depending on the bean maturity stage stink bugs will colonize fields with more mature beans.

Management

Scouting for stink bugs is one of the most important tools for its management. Although, beat cloths was recommended in the past as a tool for tallying insects, nowadays; narrower rows and higher plant densities make it difficult to be used. Sweep netting is the preferred method to tallying stink bugs. It is recommended an application of insecticides if stink bug tallies are above the economic threshold (36 bugs/100 sweeps). Pyrethroids or other mode of action insecticides can be used to reduce stink bug populations.

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