Corn & Soybean News

June 2020

Volume 2, Issue 3

Considerations for early vegetative growth stage fungicide applications on corn

There is renewed interest early vegetative stage (V-stage) fungicide applications in corn this year in Kentucky, especially those occurring at the four to six leaf collar (V4-V6) growth stages. Some of this interest is driven by the wet spring, and perceived risk for foliar disease development. With rainfall in western Kentucky from the remnants of tropical storm Cristobal, there are many questions on the need for early V-stage fungicide applications this year.

Below we discuss a few of the factors to take into consideration when deciding on whether or not to apply early V-stage fungicide applications.

1. University research shows the optimum timing for foliar fungicide application is VT/R1.

Figure 1. Common rust on corn. (Photo: Kiersten Wise)

Over a decade of multi-state University research indicates that **tasseling or early silking (VT/R1) is the optimal timing for foliar disease control and yield response from foliar fungicide applications, compared to applications that occur at early vegetative growth stages.** While early V-stage applications can result in modest yield increases in some situations, these applications are less likely to provide an economic return. Recent detailed multi-state research found that early V-stage applications resulted in a yield increase of approximately 1-3 bu/A, depending on fungicide class, compared

Figure 2. Southern rust on corn. (Photo: Kiersten Wise)

to a 3-7 bu/A yield increase from applications that occur at VT/R1. (https://doi.org/10.1371/journal.pone.0217510).
It is important to remember that a V4-V6 application of fungicide to corn will not protect the ear leaf or above from disease that develops around tasseling, and a second fungicide application may be needed at VT/R1 in fields receiving early fungicide applications.

2. Fungicide class may affect yield response

In the previously mentioned research, fungicide class influenced yield response with applications of products containing both strobilurin (QoI; FRAC group 11) and triazole (DMI; FRAC group 3) fungicide classes being more likely to result in a positive return on fungicide investment compared to applications of products containing only a strobilurin or triazole fungicide active ingredient. This result was true for applications that occurred in early V-stages, as well as VT/R1 applications.

Fungicide classes and efficacy of specific fungicide products for foliar diseases are described in the updated fungicide efficacy table for management of corn diseases, which is developed by the national Corn Disease Working Group, and posted on the Crop Protection Network website:
https://cropprotectionnetwork.org/resources/publications/fungicide-efficacy-for-control-of-corn-diseases

3. Few foliar diseases require management in the early vegetative growth stages

Farmers may be concerned about foliar diseases that can appear early in the season, like anthracnose leaf blight (caused by the fungus *Colletotrichum graminicola*), which can be present in young corn. Typically, symptoms of this disease are confined to lower leaves throughout the growing season, and do not typically require management. Common rust of corn, caused by the fungus *Puccinia sorghi*, is present at low levels in many Kentucky corn fields every year in early growth stages. The fungus that causes common rust produces brown to brick red pustules that are present on upper and lower surfaces of the leaves (Fig. 1). Young leaves are more susceptible to rust infection than mature leaves. In most years, common rust does not require management in hybrid field corn in Kentucky, and the greatest concern is that common rust is accidentally confused for the more damaging disease southern rust.

Southern rust of corn, caused by *Puccinia polysora*, is of annual concern, and this year the movement of tropical storm Cristobal through western Kentucky has some farmers worried that the disease could cause damage earlier than normal. Although southern rust has been confirmed in Louisiana, as of June 8, it has only been confirmed in one parish at very low incidence and severity. Even if inoculum (spores) from Louisiana is deposited in Kentucky cornfields, conditions over the next week across western Kentucky are forecasted to be dry with cooler temperatures and lower humidity, which does not favor rapid and widespread southern rust development. We will be scouting and monitoring fields over the next few weeks to watch for southern rust, and issuing alerts for fungicide use if they are necessary.

Southern rust is first observed as raised, dusty orange pustules on the upper surface of the leaf (Fig. 2). Pustules will typically be present only on the upper surface of the leaf. The disease is easily confused with common rust, which usually produces pustules on both sides of the leaf. If southern rust is suspected, the fastest way to get a diagnosis is to submit samples to your County Agent to be diagnosed at the Kentucky Plant Disease Diagnostic Laboratory. Throughout 2020, confirmations of southern rust will be posted on the cornipmpipe website here: https://corn.ipmpipe.org/southerncornrust/. On the map, red counties/parishes indicate that southern rust has been confirmed by university/Extension personnel.

The potential impact of southern rust in Kentucky in 2020 will depend on the crop growth stage of a field once southern rust is confirmed in an area. Previous research from southern states indicates that fungicide applications around tasseling and through milk stage (R3) are most effective at protecting yield. More information on timing of fungicide applications for southern rust can be found in Table 2 of the Crop Protection Network publication “Southern Rust” which can be read here.

Dr. Kiersten Wise
Extension Plant Pathologist
(270) 365-7541 - Ext. 21338
kiersten.wise@uky.edu

Sporadic beetles that may affect earlier stages of corn: Corn flea beetles, Sugarcane beetles, and White Grubs

In addition to corn rootworms and wireworms there is a set of beetles (Coleoptera) that can become sporadic pests in corn. These beetles include billbugs, corn flea beetle, grape collaspis, seedcorn beetles, southern con leaf beetle, southern corn rootworm, sugarcane beetle, and white grubs. Here I will describe three of these species that in the last years I had the opportunity to see in corn fields in central and western Kentucky.

Corn flea beetle. The corn flea beetle is a minute-sized (2 mm or 1/12 in. in length) black insect (Figure 1) that has thickened hind legs used to leap considerable distances when disturbed. Although high numbers of flea beetles can cause feeding on leaves that may appear pretty serious, usually plants recover and insecticides are not necessary. Its feeding on leaves is through the stripping away the top layer of plant tissue, causing elongated scratch marks or small circular holes on the leaves. However, the damage caused by this insect is economically important when plants are shorter than six inches tall and transmission of the bacterial pathogen *Pantoea stewartii* (formerly *Erwinia*), which causes Stewart's disease in corn occurs.

This disease is commonly named Stewart's wilt or bacterial leaf blight. The bacterium is more efficiently acquired and transmitted by these beetles than other Coleopteran pests. Plants infected as seedlings often die, and stunted survivors suffer yield loss or produce no ears at all.

Figure 1. A tiny corn flea beetle and typical feeding damage. (Photo: Ric Bessin)

Sugarcane beetle. The sugarcane beetle is a black beetle approximately 1.5 cm long (half inch) and can cause damage in corn as seedlings or during late whorl stage (Figure 1). These beetles are in the same family as the Japanese or June bugs. However, in this case the adult beetles cause damage to corn plants whereas the larvae are suspected to feed on decomposing organic matter and roots.

They can affect sugarcane, rice, tobacco, greenhouse roses, strawberry, sweet potato, and turfgrasses. It has been reported that these beetles feed and survive on Bermudagrass. In 2019 this insect was found causing damages in seedling corn in a Butler County corn field. Some areas of the field showed plants completely killed. A couple of damaged plants showed entrance holes in the stalk just below ground level, with tunnels going to plant crowns and suckers (Figure 2).

Figure 2. Feeding damage caused by sugarcane beetle and developing sucker in affected plant. (Photo: Raul T. Villanueva)

Also, stunting and center leaves were desiccated (deadheart) (Figure 3). This insect was previously reported in Kentucky in 2003. There is not curative recommendation for management of active sugarcane beetle infestations in corn. However in Mississippi, where there are recurrent issues with this pest, the highest rates of insecticide seed treatments and in furrow pyrethroids may be used as preventive management tactics.

Figure 3. Stunted corn seedlings showing deadheart symptoms and suckers. (Photos: Raul T. Villanueva)

White grubs. This is a complex group of many species that can have a one-year or 2- to 4-year life cycle. The species that had a generation every 2 to 4 year (period depends of species or latitude of regions) are called "true white grubs" (Figure 4). To identify species of white grubs, consultants examine the raster pattern of the grubs. The raster has different arrangements of small hairs and spines on the underside of the last abdominal segment, as shown by arrow in Figure 4.

The main threat of white grubs is to seedling corn. Seedlings can wilt and die before growing, resulting in stand loss and plants can be stunted. Damage by first- and third-year larvae is not as severe as second-year larvae; the latter grubs tend to cause the most damage because they feed on the roots throughout the year. White grubs can cause serious economic damage and are of concern to corn growers. Infestations of true grubs can be severe when corn is planted after sod or pasture. Under this situation soil insecticides may be recommended for their management. Farmers can notice the presence of this insect noticing areas clear of plants where the insect has eaten the roots in pastures, corn, or sorghum due to a patchy distribution of white grubs.

Figure 4. White grub (left)) and a close up of the raster (right) of a *Phyllophaga* species. (Photos: Raul T. Villanueva)

Dr. Raul Villanueva
Extension Entomologist
(270) 365-7541 - Ext. 21335
raul.villanueva@uky.edu

Dicamba alternatives for Palmer amaranth and waterhemp control in RR2X Soybean

The EPA has officially canceled the labels of Xtendimax, Engenia, and FeXapan and has ceased the sale and distribution of the three products effective June 3, 2020. The exceptions are that farmers and commercial applicators may apply product that was in their possession, as of June 3, 2020, up until July 31, 2020. These limited applications will still need to follow all previous label restrictions. In addition, Tavium (Dicamba plus S-metolachlor) was not included in the cancelation order and may continue to be sold, distributed, and used per label directions.

If you were fortunate enough to already have product in your possession or your local commercial applicator has product to apply or are able to source Tavium then you can continue to make applications of these products for control of waterhemp and Palmer amaranth under previous label restrictions. Although as always, it is not recommended to apply any of these products in close proximity of susceptible plants (i.e. sensitive soybean, tobacco, and grapes).

There may be a few growers who did not have product in hand, don't have a local commercial applicator with product in stock, or have access to Tavium; yet have RR2Xtend soybean planted in fields infested with waterhemp and Palmer amaranth. Unfortunately, in this scenario a farmer's options are very limited due to widespread glyphosate resistance in these two species, and continually spreading PPO resistance. Here are a few scenarios and options grower have if they are in this situation:

Scenario 1. ***RR2Xtend soybeans planted but not emerged and Palmer/Waterhemp are also not emerged.*** A robust preemergence residual with at least two if not three effective sites of action should be applied immediately prior to soybean and/or Palmer/waterhemp emergence. A list of products that contain two to three effective sites of action are listed in Table 1. An overlapping residual should be planned as outlined in Scenario 2.

Scenario 2. ***RR2Xtend soybean are emerged, a preemergence herbicide was applied and still active.*** In this case it is recommended to use an overlapping residual. This is applying another residual herbicide before the original preemergence herbicide breaks. Depending on the environment most preemergence herbicides suppress waterhemp and Palmer emergence for three to six weeks. It is recommended to apply the overlapping residual three to four weeks after the original preemergence herbicide application. This overlapping residual should get you close to crop canopy with minimal emergence.

A list of products that may be applied postemergence in soybean that have residual control of waterhemp and Palmer are listed in Table 2. It should be noted that these products often have the same active ingredients as many preemergence products. A season maximum use rate should be followed if the overlapping and original preemergence herbicides have the same active ingredient. Season maximums are also noted in Table 2 along with maximum soybean growth stage for application and postemergence application rates.

Scenario 3: *RR2Xtend Soybeans are emerged and Palmer/Waterhemp are emerged.* This is really a worst-case scenario as herbicide options are limited to none. The only option is the use of a PPO-inhibiting herbicide such as Flexstar, Cobra, or Ultra Blazer although there are multiple known populations of PPO-resistant Palmer and waterhemp in the state of Kentucky. Either way these PPO-inhibiting herbicides should be applied to plants that are less the 4" in height, using 15 to 20 GPA carrier volume, and medium droplets to assure quality coverage and maximum efficacy if the weeds are still susceptible.

In this case it is also advised to apply a postemergence residual (Table 2) to suppress any further emergence of waterhemp and Palmer.

Lastly, if a farmer is still planting soybean or will be planting double crop soybean it is recommended to only plant RR2Xtend soybean on acres that do not have infestations of waterhemp and Palmer amaranth due to the limitations now placed on the dicamba products. If you must plant double crop RR2Xtend beans onto infested acres, it is recommended that you use a robust residual and plan for an overlapping postemergence residual for control of the amaranths.

Table 1. Preemergence herbicides with two to three effective sites of action for residual control of Palmer amaranth and waterhemp.

Trade Name	Active Ingredients	Effective SOA Group #'s
Authority Elite / BroadAxe XC	sulfentrazone + S-metolachlor	14 + 15
Authority Edge	sulfentrazone + pyroxasulfone	14 + 15
Authority Supreme	sulfentrazone + pyroxasulfone	14 + 15
Authority MTZ	sulfentrazone + metribuzin	14 + 5
Trivence	flumioxazin + metribuzin + chlorimuron	14 + 5
Fierce EZ	flumioxazin + pyroxasulfone	14 + 15
Fierce XLT	flumioxazin + pyroxasulfone + chlorimuron	14 + 15
Fierce MTZ	flumioxazin + pyroxasulfone + metribuzin	14 + 15 + 5
Panther Pro	flumioxazin + metribuzin + imazethapyr	14 + 5
Prefix	fomesafen + S-metolachlor	14 + 15
Warrant Ultra	fomesafen + acetochlor	14 + 15
Intimidator	fomesafen + S-metolachlor + metribuzin	14 + 15 + 5
Boundary	S-metolachlor + metribuzin	15 + 5
Matador-S	S-metolachlor + metribuzin + imazethapyr	15 + 5

Table 2. Herbicides with effective residual activity for control of Palmer amaranth and waterhemp that can be applied postemergence to soybean.

Trade Name	Postemergence Rate[a]	Active Ingredient(s)	Season Max Cumulative a.i. Rate (lb ai/a)	Max Soybean Growth Stage
Anthem Maxx	2.5 to 4.5 fl oz/A	pyroxasulfone + fluthiacet	0.266 0.0089	V6
Dual II Magnum	1 to 1.33 pt/A	S-metolachlor	2.4	V3
Outlook	14 to 21 fl oz/A	dimethenamid-P	1.125	V5
Prefix	2 to 2.33 pt/A	S-metolachlor + fomesafen	2.48 0.375[b]	90 Day PHI[c]
Warrant	1.25 to 1.9 qt/A	acetochlor	3	R2
Warrant Ultra	48 to 65 fl oz/A	acetochlor + fomesafen	3 0.34[b]	R2
Zidua SC	2.5 to 5 fl oz/A	pyroxasulfone	0.186	V6

[a] Postemergence rates for medium soils with 1.5 to 3% OM, refer to label for coarse or fine soils or soils with low %OM.
[b] Maximum cumulative rate in alternate years
[c] PHI= Pre Harvest Interval

Dr. Travis Legleiter
Assistant Extension Professor - Weed Science
(270) 365-7541 - Ext. 21323
travis.legleiter@uky.edu
@TravisLegleiter

All herbicides drift – not just Dicamba

It is no secret that all herbicides can drift, but unfortunately dicamba has become the poster child of off-target movement over the last couple of years. While dicamba drift is a topic of focus, it should be noted that all products have the potential to drift when the incorrect spray techniques are used and when applications are made in the wrong weather conditions. Here are a few things to keep in mind before making your herbicide application in order to keep your product on its target and off your neighbors' corn, soybean, wheat, tobacco, grapes, tomatoes, garden, rosebushes, magnolia tree, etc.

What we you can't control

The weather is certainly not within our control and we can only work around it. Unfortunately, the weather often does not cooperate with our plans in agriculture and can make timely herbicide applications difficult. There is a lot of give and take with the weather, but you should always be aware of the impact weather can have on herbicide drift.

Wind speed

Wind speed is the greatest contributor to herbicide drift and regardless of all other factors' herbicide applications should be avoided if winds are above 10 mph. Wind at these speeds are capable of carrying even large droplets off target.

Temperature and Humidity

Droplets produced by broadcast nozzles are prone to evaporation and shrinkage in size if exposed to the correct environments. Shrinking of droplet size is not good for limiting off-target movement as smaller droplets are more prone to drift. Fortunately, the environmental parameters for this scenario are high temperatures and low humidity, which are rare in the state of Kentucky. Although rare, applicators should be aware that their droplet size may decrease after leaving the sprayer under these conditions.

Temperature inversions

Temperature inversions have always been known to contribute to herbicide off-target movement but have been especially highlighted since the release of dicamba tolerant soybean. A ground level temperature inversion is a cold air mass that is trapped next to the ground below a warm air mass. This situation typically occurs in the overnight hours during the summer when the ground cools the air next to it and the cold air becomes trapped underneath the warm air that was heated throughout the day. These inversions typically setup just before sunset and are dispersed a couple of hours after sunrise.

If you spray into a temperature inversion there is a fraction of the spray volume of very small droplets that will become suspended in the trapped air mass. These suspended droplets will then stay with the air mass that will move unpredictably along the earth's surface looking for lower elevation. Eventually these suspended droplets will drop out of the air more than likely off-target. In contrast if you were to spray without an inversion these suspended droplets would be carried upward out of the atmosphere with the rising warm air.

The fraction of the tiny droplets that can become suspended in a temperature inversion is small, but with the sensitivity of our crops to products like dicamba even those small fractions can cause damage.

It is known that temperature inversions are common on June, July, and August summer nights so all herbicide applications should be made during the day when these events are rare. Although this is typically when winds are highest so finding a happy medium can be difficult.

What you can control

Droplet Size

Droplet size is the greatest contributing factor of herbicide drift that you can control. Herbicide applications using fine droplet spectrums or smaller are prone to drift even in low wind speed situations. Herbicide applications should made with droplet spectrums in the Medium to Ultra Coarse droplet spectrums depending on the herbicide type. Contact herbicides (e.g. Liberty or Flexstar) typically require a smaller droplet to achieve coverage and thus a medium to coarse droplet spectrum is desired and increases in spray volume (15 to 20 gallons per acre) can assure adequate coverage. Whereas systemic herbicides (e.g. Roundup or Enlist One) can be applied with Very Coarse to Ultra Coarse droplets and achieve adequate coverage and control. The use of larger droplet spectrums decreases the number of driftable fines (droplets less than 200 microns in diameter) that are prone to off-target movement even in ideal wind speeds of 5 mph. Droplet size can be controlled with the following factors.

Nozzle type

The number of nozzle types available to an applicator for herbicide applications has increased dramatically over the last decade. The number of options an applicator has when looking through a modern spray nozzle catalog can be overwhelming. A couple of design features that applicators should look for in their nozzles that will help keep their droplet size in the appropriate range are pre-orifice or two stage nozzles and air induction nozzles.

Pre-orifice or two stage nozzles contain two orifices, hence the name two stage nozzle, as compared to the traditional flat fan nozzle that contains a single exit orifice. The use of a pre-orifice allows for the flow (or size of the nozzle) to be set prior to the spray solution exiting the exit orifice or the second stage. The use of two orifices allows for overall larger droplet spectrums at higher pressures and less influence of pressure on droplet size. There are numerous two stage nozzles available that are capable of producing medium to coarse droplet spectrums across a wide pressure range that can be ideal for contact herbicide applications.

A second nozzle design that will further increase droplet size and is often paired with the two-stage design is air-induction. This design is the simple feature of drawing air into the spray solution just prior to the exit orifice to create larger air-filled droplets that are less prone to drift. These nozzles are capable of producing very coarse to ultra-coarse droplet spectrums that are ideal for systemic herbicide applications.

PWM – Pulse Width Modulation

Many newer sprayers now come equipped with PWM or pulse width modulation. This technology offers a different method of adjusting the sprayers output as it speeds up or slows down in the field. A traditional sprayer adjusts the spray solution pressure as the machine speed changes in the field (higher pressure at higher speeds and lower pressure at lower speeds). A PWM uses duty cycles or on/off pulses to adjust sprayer output as the machines speed changes to maintain spray output. Thus, with a PWM system maintains a constant pressure and droplet size throughout the field. This is a true advantage for these systems when it comes to drift control management.

One note is that air induction nozzles cannot be used on sprayers with PWM technology, the rapid on/off cycling does not allow for the proper performance of these nozzles.

Nozzle size

Nozzle size contributes to spray droplet size in that smaller nozzles produce smaller droplet spectrums than larger nozzles. This relationship is especially true if an applicator is using a single stage nozzle, but even two stage and air induction nozzles are prone to this factor. Thus, if an applicator is deciding between two nozzle sizes and drift reduction is a concern, they should opt for the larger nozzle size.

Pressure

The pressure of the spray liquid at the nozzle also influences droplet spectrum size with higher pressure resulting in smaller droplets and lower pressure resulting in large droplets. Much like nozzle size this relationship is exaggerated with the singe stage nozzles and less so with two stage and air induction nozzles, although there is still some influence of pressure on these newer designs.

Overall applicators should opt for the correct nozzle design and at the very least use two stage nozzles that are less prone to droplets size variances due to pressure changes.

Boom Height

Boom height is often overlooked or missed as in important factor for reducing herbicide drift. Herbicide broadcast nozzles are designed to be used at a height of 18 to 24 inches above the target. More often than not applicators are applying herbicide with boom heights twice if not triple the recommended height. While boom height may seem trivial, it is critical in reducing herbicide drift. The higher the boom is above its target the more time the droplet spends in the state of "fall" from the nozzle to the target. The longer it takes the droplet to travel from the nozzle to the target the more likely it is to move off target.

In a study conducted at the UKREC in 2018, we found that increasing the height of the boom from 24 inches to 48 inches off the ground tripled the downwind drift potential regardless of the nozzle type. In the worst case scenario, a fine to medium droplet producing nozzle drifted to distances of 200 ft downwind at the 48" boom height as compared 40 to 50 ft at a boom height of 24 inches, with an average wind speed of 7 mph.

Dr. Travis Legleiter
Assistant Extension Professor - Weed Science
(270) 365-7541 - Ext. 21323
travis.legleiter@uky.edu
@TravisLegleiter

Timely soybean planting is pivotal to profits

Mild weather and concern for delayed planting of double crop soybeans provides motivation to consider harvesting wheat a bit earlier this spring and drying the crop when possible. Harvest moisture is dictated by the available drying system, with 15%, 17% and 20% or higher suggested for bins without heat, bins with heat, and high temperature dryers, respectively, A recent survey of cash prices for wheat and soybeans showed current levels near $5 and $9 per bushel, respectively. Current energy prices are similar to last fall, with LP gas around $1.40 per gallon.

A spreadsheet was developed to help producers weigh the costs of wheat drying with the probable loss in soybean yields due to delayed planting. It considers grain and energy prices along with a few other related factors that are then used to calculate gross profits from the soybean crop and net returns to the wheat enterprise after subtracting drying and handling costs. Potential yield losses per day are considered also for both crops. For wheat, a field drying rate is assumed to calculate the drying cost as harvest progresses. Of course, towards the end of harvest, wheat will usually be dry enough to store or market directly from the field but may result in over-drying which is an additional cost. By that time potential soybean yields will have fallen off dramatically.

To look at an example, consider the 'pivotal' harvest date where potential soybean yields reach a break point. This varies from year to year depending on available heat units or degree days for crop development. You would want to start harvest several days earlier to avoid working much beyond that date and allow for harvest capacity and a few delays due to weather and/or mechanical problems. With current grain prices, a soybean yield of 45 bushels per acre, and daily yield loss of 2.3% (1 bushel per acre per day), the costs of delayed planting can be calculated. For wheat, an average yield of 85 bushels per acre with a 0.5% loss per day for delayed harvest can be assumed. Drying costs will vary between systems, but with current energy prices and an initial moisture level of 26%, the drying and handling cost would be about 26 cents per bushel (or $22 per acre). The gross return for soybeans and net return for wheat after paying for drying and handling (D & H) would be $405 and $403, respectively (Table 1) when high temperature drying is available to allow harvest to begin one week before the 'pivot' harvest date (week -1).

Table 1. Changes in soybean and wheat yields, wheat drying costs, and returns to the double crop enterprise during a 3-week harvest period with no extreme weather losses.

	Soybeans		Wheat							Net DC Returns*
		Gross					All	Returns		
Week	Yield	Return	Yield	MC	D & H Cost		Costs	Gross	Net	
+ / -	bu/ac	$ / ac	bu/ac	%wb	$ / bu	$ / ac	$ / ac	$ / ac	$ / ac	$ / ac
-1	45.0	$ 405	85.0	26.0	$ 0.26	$ 22	$ 22	$ 425	$ 403	$ 208
0	45.0	$ 405	82.1	19.0	$ 0.12	$ 10	$ 25	$ 410	$ 386	$ 191
+1	38.2	$ 344	79.2	12.0	$ 0.10	$ 8	$ 37	$ 396	$ 360	$ 104
+2	32.5	$ 292	76.5	11.0	$ 0.17	$ 13	$ 56	$ 383	$ 327	$ 19

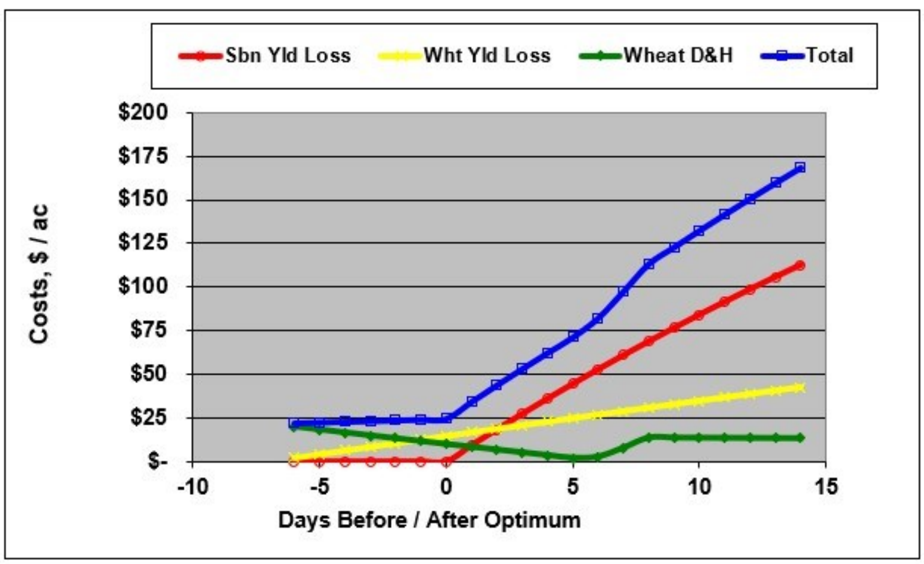
* Returns assuming a double crop production cost of $600/ac.

To be profitable, this total must cover production costs for double crop enterprises, which vary widely but were estimated to be $600 per acre this year by UK's Agricultural Economics Department (https://anr.ca.uky.edu/content/decision-aids-budgets-calculators). This value includes machinery costs but not land rent, but this can easily be added for individual operations. Table 1 shows that a profit of $208/ac could be expected when harvesting wheat a week before the 'pivot' date. Each row in the table shows how these costs and returns change through a 3-week harvest period. Note that if harvest is delayed two weeks beyond the ideal period, returns to the operation can fall sharply due primarily to lower potential soybean yields and over-drying cost if wheat dries in the field below the market moisture level (usually 13.5%).

Data in the table are shown in more detail in Figure 1, where daily changes in soybean and wheat yield losses, wheat drying and handling, and the total of these costs are illustrated. Corresponding net returns for the double crop enterprise (last column in Table 1) show an average about $2.4 per acre-day before the 'pivot' harvest date (due to wheat drying) and increase to about $11 per acre for each day that soybean planting is delayed afterward (due to lower yields)! For these reasons, farmers who have dryers will be interested in harvesting wheat early this spring to boost soybean yields and net profits.

More information on wheat drying is provided in Chapter 10 of UK's Wheat Management Guide http://www2.ca.uky.edu/agcomm/pubs/id/id125/10.pdf and at UK Cooperative Extension Service offices, The spreadsheet is available on the Biosystems and Agricultural Engineering website (www.uky.edu/bae) or by contacting the author.

Fig. 1. Daily operating costs for drying wheat and planting soybeans early compared with field drying and delayed planting using current prices ($9.00 for beans, $5.00 for wheat and $1.40 for LP gas).



Dr. Sam McNeill
Extension Agricultural Engineer
(270) 365-7541 - Ext. 21326
smcneill@uky.edu

Soybean management following an abnormally wet - and at times - cool (and frozen) Spring

Although this soybean season started out fairly mild, within the last couple of months there have been some real challenges for soybean producers. First, the freeze event in early May hurt emerged soybeans. The freeze was particularly cold, with almost every location in Kentucky falling below 32°F and some locations remaining below freezing for many hours.

The fear was that any of the soybean crop that was aboveground and even some of the crop that was belowground, but very near the soil surface, would be completely killed. However, as warm days have passed since the freeze, it became evident that even though the main growing point of the plant may have been killed, the nodes at the cotyledons remained viable and have begun to grow and compensate for the loss of the main growing point (Figure 1C). There is considerable research across the nation, including Kentucky, that if the cotyledonary nodes survived, there would be no yield losses. In each of those studies, favorable growing conditions remained throughout the rest of the growing season.

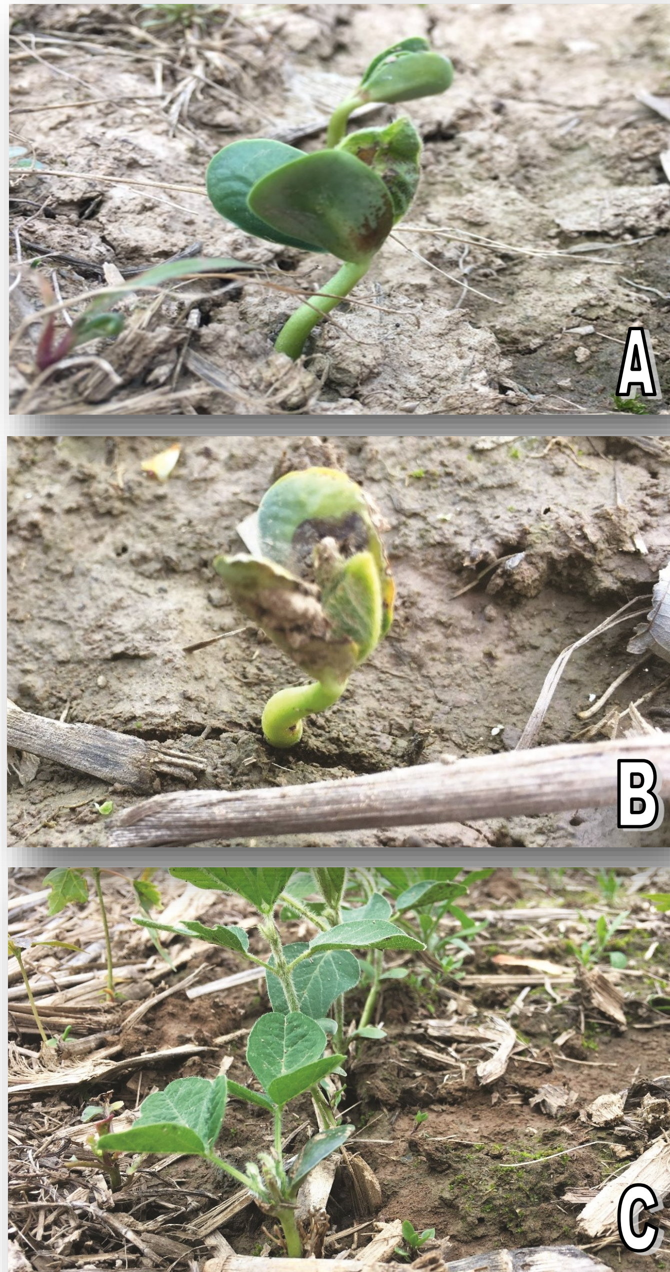


Figure 1. Soybean seedlings 2 days (A), 6 days (B), and 17 days (C) after the May freeze event. (Photos: Carrie Knott)

Figure 2. Soybean cotyledons that were damaged most likely by slugs. The cotyledons in panel A were dug and were below ground, while the soybean seedling in panel B is severely damaged and likely will not survive. (Photos: Carrie Knott)

The next challenge that has impacted many producers across Kentucky were a repeat offender, slugs. The last several years of cloudy, cool and wet springs have really favored slug feeding. This year is no exception. Smaller soybeans are at greater risk because slugs are more likely to eat most of the aboveground tissue. Larger plants may have some defoliation, but rarely does that defoliation on larger plants hurt yields. On the smaller plants, slugs can severely reduce plant stands, causing farmers to replant or fill-in holes in the fields.

Whether freeze events or slug damage, considerable damage to a soybean stand must occur to justify re-planting. Data in Kentucky and also across most of the nation indicate that re-plant is not profitable unless the soybean stand falls below about 50,000 plants per acre. Yes, 50,000 plants per acre is likely the economic threshold to justify replanting. However, there are certainly situations where profitability may not be the greatest concern, such as rented fields that are near roads, fields where a landlord lives, fields near your own house/shop, etc.

As much fun as maximizing yield can be for an agronomist and also for producers, this year profitability should be the priority. There is significant research in Kentucky and across the nation that profitable soybeans are produced when there is:

1. adequate (but not excessive) soil fertility as (defined in AGR-1)
2. Replanting fields or areas only when plant population drops below 50,000 plants per acre
3. fungicide applications only as needed based upon resistance package of the cultivar and the weather conditions and presence of plant pathogens
4. insecticide applications only as need ed based upon economic thresholds of the insect pressure and growth stage of the plant

Given that the extended and long-range forecasts are calling for below average or average temperatures for the next month and about average precipitation, we can hope for more favorable soybean conditions that will be conducive to good seed yield.

Dr. Carrie Knott
Grain Crops Extension Specialist, Princeton
(270) 365-7541 - Ext. 21320
Carrie.Knott@uky.edu
@KYGrains

Chad Lee, Ph.D.
Grain Crops Extension Specialist, Lexington
(859) 257-3203
Chad.Lee@uky.edu
@KentuckyCrops

University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Chad Lee, Extension Grain Crops Specialist

Carrie Knott, Extension Grain Crops Specialist

CORN & SOYBEAN VIRTUAL FIELD DAY

CROP AND SOIL MANAGEMENT

JULY 21

8:00–10am (Central)

PRE– REGISTRATION REQUIRED:

https://uky.zoom.us/meeting/register/tJYud-2tpz8iGdwQtJClvkEOPwKspUuQia-o

Pre-registration closes 6/20/2020

SOYBEAN MANAGEMENT— Carrie Knott

LATE PLANTING CORN EFFECT ON YIELD— Chad Lee

IMPACT OF DELAYED PLANTING & TOOLS FOR PRODUCERS— Montse Salmeron

COVER CROP RYE REQUIRES MORE NITROGEN FOR CORN— Dan Quinn

ECONOMICS OF SOYBEAN MANAGEMENT STRATEGIES— Jordan Shockley

UNDERSTANDING & ADDRESSING SPATIAL VARIABILITY IN CORN YIELD— Hanna Poffenbarger

SOIL SAMPLING — Edwin Ritchey

SOIL SAMPLING FOR PRECISION NUTRIENT MANAGEMENT— Josh McGrath

Pesticide & Certified Crop Advisor CEUs will be available for this live event.
For details about obtaining Credits after the event visit KYGrains.info after July 28th

COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT
Grain and Forage Center of Excellence

For Additional information on these events contact Colette Laurent (claurent@uky.edu) Or 270-365-7541

CORN & SOYBEAN VIRTUAL FIELD DAY

JULY 28

INTEGRATED PEST MANAGEMENT

8:00–10am (Central)

Pre-registration Required: Pre-registration closes 6/27/2020

https://uky.zoom.us/meeting/register/tJckdumsrjwpHNfDqUFXJwrQEHeYL1nntGZZ

2020 CORN DISEASE UPDATE -- Kiersten Wise

WHAT'S YOUR NUMBER? MANAGING SOYBEAN CYST NEMATODE POPULATIONS -- Carl Bradley

WEED CONTROL IN 2020 -- Travis Legleiter

PHENOLOGY, BEHAVIOR AND MANAGEMENT OF BEAN LEAF BEETLES — Raul Villanueva

PRE-HARVEST CHORES FOR GOOD POST-HARVEST MANAGEMENT -- Sam McNeill

Pesticide & Certified Crop Advisor CEUs will be available for this live event.
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Useful Resources

KyGRAINS.info

Crops Marketing and Management Update

KATS
Kentucky Agriculture Training School

College of Agriculture, Food and Environment
WHEAT SCIENCE GROUP

http://wheatscience.ca.uky.edu/home

University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Research and Education Center

PO Box 469

Princeton, KY 42445-0469

RETURN SERVICE REQUESTED

Upcoming Events

Please note: The University of Kentucky Research and Education Center/Grain and Forage Center of Excellence is moving forward with its summer educational programming in a COVID-19 safe manner. We look forward to your participation in our educational programming. Please check **https://wheatscience.ca.uky.edu** and **https://www.kygrains.info** for updates.

DATE	EVENT	LOCATION
July 16	Spray Application Update (in place of KATS Spray Clinic)	Virtual
July 21	UK Corn, Soybean & Tobacco Field Day (Crop and Soil Management)	Virtual
July 28	UK Corn, Soybean & Tobacco Field Day (Integrated Pest Management Tour)	Virtual
Aug. 20	Pest Management Field Day	Virtual