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Cold damage in corn and winter wheat concerns

Kaitlyn Bissonnette & Greg Luce

The unseasonably cold, wet spring has presented numerous challenges across the state, especially in areas where corn has already been planted or where wheat has hit the jointing stage. In particular, freezing temperatures and excessive rains have created concern for the survival of corn seed(ling)s and also some winter wheat stand concerns

Effect on stands

With the vast majority of the state's corn acreage not yet planted but with calendars indicating that it is that time of year, there are a few important points to remember before rushing out to plant this season. The soil is still very, very cold and poses a significant risk to yield potential. The first water the corn seed takes in (imbibes) is very important. Imbibition is the process by which seeds absorb water for the initiation of germination. A chilling effect occurs when water colder than 50°F is imbibed. The imbibition of cold water disrupts the reorganization of cells during rehydration and can result in the loss of seed vigor or seed death. The most critical time for imbibition is within 24 hours of planting. Therefore, imbibitional chilling effects are more severe when seeds are planted into soils 50°F or colder compared to planting into warmer soils followed by a drop in temperature.

Sprouted corn can generally withstand a frost or freezing conditions because the growing point is beneath the soil. However, we are experiencing some dramatically low temperatures. Temperatures between 28°F and 32°F are damaging, but can become lethal when they fall below 28°F. Though the air temperature has been colder than this, soil temperatures are likely at or above 28°F and may have helped to insulate the seed and seedlings during the cold spells. If freeze damage to corn is suspected, it is important to allow several days to evaluate whether the effects were lethal.

Temperature fluctuations over the winter also likely affected a small portion of the winter wheat acreage, especially in areas of a field where planting depths may have been shallow. Generally, winterkill is not a common occurrence in Missouri, but it is not unheard of. To assess the extent of the damage in a potential winter kill situation, take note of the affected acreage and determine if the root systems are still developing (healthy, white crowns and roots). In most areas, winterkill is not a primary concern, but stands may be thin due to late planting and dry fall conditions. For grain production, wheat stands should ideally have about 25 plants per square foot with 3-5 tillers per plant. Wheat stands of 12-15 plants per square foot, or less, are good candidates for replanting to corn, soybeans or grain sorghum. A hula hoop is a good way to measure stands of wheat or you can count plants down a row using the following chart as a guide for length of row equal to 1 square foot:

Row Width	Length of Row to Equal 1 sq ft
7”	20.5”
7.5”	19.25”
8”	18”
10”	14.4”

Impact of a late freeze on wheat

Wheat in the central to northern portions of Missouri are typically not yet jointed and appear to have tolerated the freezing temperatures very well. The impact of freezing temperatures is of most concern on the jointed wheat in the southern portions of the state.

Wheat development in southern Missouri is at Feekes 7 (2nd node) in many fields and even approaching Feekes 8 (flag leaf) in the very southern Bootheel counties. Freeze injury in wheat depends on stage of development and duration of freezing temperatures. Wheat freeze injury at jointing (Feekes 6) is possible when temperatures fall to 24 degrees or lower for longer than two hours. Wheat freeze injury at boot (Feekes 9) has the potential to occur when temperatures fall to 28 degrees or below for longer than two hours. Feekes 7 and Feekes 8 are somewhere in between. The best time to monitor any type of freeze injury is several days after the freezing event. Split stems and carefully monitor heads for damage. The Kansas State Wheat Freeze Injury Guide provides further information on freeze damage in winter wheat and how best to evaluate the severity of the damage.

Disease impacts

Freezing temperatures and prolonged moisture can predispose young corn plants to seedling diseases, especially when germinating seed and seedlings are damaged early in the season. This is especially true when pathogen levels are high and cold, wet conditions persist for several weeks. Cellular damage from freezing wounds the plant and may allow for the infiltration of pathogenic bacteria or other disease-causing pathogens into the young plants. Pythium likes wet soil around 50°F and can still be damaging even when seed treatments are applied. Make sure soil temperatures are adequate and soil is not too heavily saturated with water prior to planting this spring.

Key take-aways

1. Freeze damage in corn – wait a few days to evaluate the impacts of freeze damage on stand in corn. Not all freeze damage is lethal.
2. Suspected winterkill in wheat stands – Examine the roots of several affected plants for new root growth (healthy, white crowns and roots). In thin stands, it is helpful to quantify the number of plants per square foot to determine if a replant is necessary.
3. Wheat that is not jointed can withstand extremely cold conditions. Jointed wheat should be given several days after the freeze before determining if there is any significant damage.
4. Most importantly, plant when soils are warmer and not heavily saturated

Luckily, warmer days are almost upon us. Keep an eye on those soil temperatures before jumping into your planter to maximize your yield potential.

Early Season Soybean Diseases

Kaitlyn Bissonnette

As soybean planting approaches, it is important to make early season management decisions to reduce losses from the two most damaging soybean diseases: sudden death syndrome (SDS) and soybean cyst nematode (SCN). The pathogens of both diseases can infect soybean roots shortly after germination, making early season management of these diseases critical.

Sudden death syndrome

SDS is caused by the soil inhabiting fungus Fusarium virguliforme, survives on soybean residues and produces survival structures which can withstand the elements for several years. Its name is derived from the "sudden" appearance of foliar symptoms that occur after the plants begin to flower. Symptoms of SDS begin as interveinal chlorosis (yellowing) and necrosis (tissue death) of the leaves (Figure 1) and can eventually result in defoliation if infection is severe. Though the first observable symptoms of the disease are in the leaves, the pathogen is localized in the roots. For this reason, foliar fungicides are not effective in controlling the pathogen. When the lower stems and taproots of a soybean plant are split in half, affected plants will have a white to cream-colored pith (the center of the root) with a tan to brown discoloration of the cortical tissue (the tissue surrounding the pith) whereas the cortical tissue of a healthy plant will remain white (Figure 2).

(figure 1) Foliar symptoms of SDS. Note the interveinal chlorosis (yellowing) and necrosis (tissue death).

(figure 2) When the lower stem and taproot of a soybean plant is cut in half, the inner tissues of healthy plants will be white in appearance (bottom) whereas plants infected with Fusarium virguliforme will have a tan to brown discoloration (top). *(Photo by G. Munkvold, Iowa State University)*

Root infection by F. virguliforme can begin as soon as roots have emerged from the seed and is favored by cool, wet soils. For this reason, management of SDS begins at planting. Methods of managing SDS once it is present include: delaying planting until soils have warmed (> 60°F), improving soil drainage, reducing compaction, selecting SDS resistant varieties, and crop rotation. Fusarium virguliforme also is capable of surviving and increasing on corn residues, so the traditional corn-soybean rotation may not be sufficient to substantially reduce the amount of fungal inoculum (disease-causing particles) in the soil. Breaking up this traditional rotation with a small grain or other non-host crop can help decrease inoculum levels. Most commercially available seed treatment fungicides are ineffective in controlling F. virguliforme, but fluopyram (Ilevo; Bayer Crop Science) has been shown to have some efficacy in reducing infection severity. Most importantly, if SDS is confirmed in a field, avoid continuous soybean production to reduce the buildup of fungal inoculum in the soil.

Soybean cyst nematode

Soybean cyst nematode, a plant-parasitic roundworm, is another soil-inhabiting pest found throughout the soybean growing regions of the United States and is well established in Missouri. SCN juveniles penetrate the root tissue and establish feeding sites, called syncytia, which then reduce water and nutrient uptake in the plant and ultimately result in yield reductions. In Missouri, SCN is capable of reproducing on soybean roots at a rate of three to six generations per year (Figure 3). When symptoms of SCN damage are visible, plants appear stunted and yellowed or result in bare patches in the field. Frequently, symptoms of SCN damage are not visible, but there still can be up to 30% yield loss. Additionally, the presence of SCN in conjunction with the SDS pathogen in a field can increase the severity of SDS foliar symptoms.

(figure 3) White females of the soybean cyst nematode (small) and nitrogen fixing nodules (large) on soybean roots. Females are about the size of a pinhead and contain around 250 eggs each. *(Photo by G. Tylka, Iowa State University)*

The first step in an active SCN management program is to sample the soil in fields where soybeans are grown and to get your SCN egg count (each egg is a potential disease-causing unit). Remember: take the test, beat the pest. To sample for SCN, subdivide large fields into 20 acre sections, collect at least 15-20 soil cores from each section, and thoroughly mix the cores from within each section together. Collected samples can be submitted to the University of Missouri SCN Diagnostic Lab with a completed nematode sample submission form indicating that an SCN egg count is needed. Sampling for SCN can occur at any point during the growing season, but SCN counts are most informative when soil is collected at or shortly following harvest or just prior to planting. Additional information on how to soil sample and how to submit samples to the SCN Diagnostic Lab can be found on their webpage (scndiagnostics.com).

Management of SCN relies on the use of resistant varieties and crop rotation to non-host crops. The primary source of resistance in commercially available soybean varieties is derived from a single source, PI 88788, which has resulted in many SCN field populations adapting to SCN resistant varieties in Missouri. The most effective way to manage SCN still begins by selecting an SCN resistant variety, but it is important to rotate the varieties planted each year. By rotating varieties, even if those varieties have the same source of resistance, the ability of the pest to adapt to PI 88788 can be slowed.

The key to keeping SCN numbers low is to test your soils and manage your populations while the numbers are low. When egg counts are high, yearly testing, crop rotation to non-hosts, and rotation of SCN resistant varieties can be employed over multiple seasons to reduce the SCN population density. In some cases, nematode-protectant seed treatments could be an additional management option. If possible, avoid growing continuous soybeans in heavily infested fields. Additional information on active SCN management can be found on the SCN Coalition website (thescncoalition.com) and on the MU Extension website (extension2.missouri.edu/G4450).

Key take-aways

1. Sudden death syndrome – reduce disease risk by planting into warm soils, improving soil drainage, reducing compaction, selecting an SDS resistant variety, and rotating crops
2. Soybean cyst nematode – employ active SCN management tactics: 1) test your soil to know your number; 2) select SCN resistant varieties and rotate the variety each year; and 3) rotate to non-host crops such as wheat or corn
3. If either disease is present in your field – avoid continuous soybeans and rotate to non-host crops

New Entomologist Joins Plant Sciences Kevin Rice

Welcome Kevin Rice as the new MU Extension entomologist. Kevin received a bachelor's degree in biology from the University of North Carolina at Asheville and a master's degree from Auburn University. At Auburn, he studied the effects of red imported fire ants on native arthropod assemblages in natural systems. After graduating from Auburn University, he received a temporary position at the USDA-ARS lab in Maricopa, Ariz. and investigated pest and predator movement in field crops. Rice served as an area extension agent with the University of Arizona shortly there after, working closely with field crop growers and industry stakeholders. Kevin then moved to Ohio State University, where he completed his doctorate degree in entomology. His dissertation examined the effects of invasive emerald ash borer on a native plant species chemical defense, growth and reproductive allocation. This affected the development and survival of native swallowtails consuming these host plants. His post-doctoral work at Penn State and the USDA-ARS focused on economic damage created by invasive herbivores in field, vegetable and orchard crops. You can reach Kevin at RiceKev@missouri.edu, 573-882-2838

Fire ants may be hitching rides in imported hay Kevin Rice

Red imported fire ants are an invasive species that were unintentionally introduced to Alabama from South America during the 1940's. Since then, they have established populations in at least 13 states from North Carolina and Florida west to California. Because they are an invasive species, very few predators attack them in the United States, and thus, they experience increased population growth and greater abundance in introduced regions compared with their native range.

Fire ants are voracious predators that attack native insects, birds, reptiles, and small mammals. When disturbed, fire ants will defend themselves against larger mammals, including humans and livestock, with a painful sting. Their venom contains formic acid, creating a blister like appearance and intense burning/itching in humans. Even worse, fire ants release an alarm pheromone when they are disturbed, encouraging their nest mates to also attack. Therefore people usually receive multiple stings. Hypersensitivity to fire ant stings requiring medical attentions, occurs in less than 1% of people.

Because fire ants are from the tropics, they are unable to survive Missouri winters. However, because of a cold dry spring, Missouri will likely experience a hay shortage, requiring imports from southern states. Bales of hay from southern states can harbor fire ants, as they have in past years. Hay being shipped to states outside the quarantined area need to be inspected and certified by USDA or state regulatory officials. The certification needs to be available to the buyer. Additionally, buyers should visually inspect each hay bail for fire ants. Attractive baits such as hot dogs or peanut butter can be placed next to bails for an hour then scouted for fire ants. If ants are detected in hay arriving from southern states, several specimens should be collected and university extension officials contacted.

Red imported fire ants are 1/8-1/4 inch long. They can be distinguished from other ants by a two segmented petiole (or waist), and 10 segmented antenna, ending in a two-segmented club. Fire ants are reddish brown in color and have a distinctive stinger at the tip of the abdomen.

Two Specific Concerns about Drought/Heat Effects on Soybean and Corn Seedlings

William Wiebold

A few parts of Missouri have nearly water-saturated soil conditions, but much of the Missouri grain crop growing area is experiencing dry soils and hot temperatures. The United States Drought Monitor may be underestimating the effect of the unusual combination of sparse precipitation and hot temperatures. Conditions can change rapidly and may be variable even within a field because the interaction between soil physical characteristics and plant water availability. Our experiences with and knowledge about early season water stress are limited. This report presents information about two unusual conditions that result from drought/heat effects on seedlings and young plants.

Rootless Corn Syndrome

Corn plants produce two root systems. The first root system consists of roots that emerge from the seed and nourish the seedling. The second root system consists of adventitious (nodal) roots that form at stem nodes below and above the soil surface. This is the main root system of the corn plant. Plant health and yield is closely tied to the health and function of these roots. Nodal roots are present as early as the 1-leaf stage and rapidly expand in number and length during vegetative growth. The earliest nodal roots form about ¾ inch below the soil surface.

All roots require soil moisture to form and grow. Because corn nodal roots form near the soil surface they are highly dependent on soil moisture near the surface. In most years, spring precipitation keeps the soil wet enough for roots to grow. But, early season drought can dry soil to a point where roots cannot grow. This is compounded by hot soil surface temperatures. Root growth is inhibited and even prevented by hot, dry soil.

A syndrome called rootless corn may occur (Figure 1). Affected seedlings have normal primary roots, those roots that developed from the kernel. But, they lack adventitious roots. These plants may appear normal, but begin to lodge when plants are about 15 inches tall because they are weakly anchored. Most Missouri corn is well past any concern. But, late planted corn, including fields that were replanted, may be vulnerable to rootless corn syndrome if the soil surface is unusually dry. Preventive actions are few. If replanting corn, try not to till. Tillage wastes precious water. Previous crop residue that remains on the soil surface reduces water evaporation and slows the rise in soil temperature.

Figure 1 Rootless corn syndrome. Note lack of development of nodal roots. *Source: UM Extension*

Heat Canker in Soybean

This is an unusual occurrence in soybean related to soil surface temperature. Because evaporating water cools soil, the condition usually occurs when precipitation is sparse and the soil surface is extremely dry. The Missouri network of weather stations has recently reported soil temperatures above 95°F at the 2-inch level under bare soil. Soil surface temperature are usually much warmer. Early in the growing season plants are small and sunlight impinges on the soil surface. Soil absorbs the light and gains in temperature. With sparse leaf area, hot air temperatures, and bright sunshine, it is not uncommon for surface temperatures to exceed 120°F.

Soybean seedlings that are just emerging and up to V2 are vulnerable to heat canker. Young hypocotyl cells (region below the cotyledons) where the hypocotyl touches the soil surface cannot tolerate hot temperatures and die (Figure 2). This can occur as a ring around the stem or just on one side. The region appears "pinched" because water has escaped and the cells have shrunk. The region will quickly darken. Affected plants often die. With heat canker, the root system remains white and looks normal. This can be used to distinguish between a seedling disease in which roots are discolored and this environment caused condition.

Figure 2 Heat canker. Note dead cells where hypocotyl touched soil surface. *Source: American Soybean Association*

This is a rare occurrence, but this is a year with rare combinations of sparse precipitation and hot temperatures. When heat canker is suspected, often only a few seedlings are affected. Very localized conditions can influence the severity. However, hundreds of thousands of Missouri soybean acres have been planted during dry, hot weather. Heat canker could be more widespread and affect a large portion of seedlings than usual. There is little that can be done once heat canker is visible – the damage has been done. Previous crop residue that remains on the soil surface reduces water evaporation and slows the rise in soil temperature. It is rare to see heat canker in no-tillage fields.

Dicamba Injury Mostly Confined to Specialty Crops, Ornamentals and Trees so Far Kevin Bradley

Last year we attempted to provide updates as to the extent of dicamba-injured soybean throughout the United States. We finished the season with approximately 2,700 cases under investigation by the various state Departments of Agriculture, and approximately 3.6 million acres of dicamba-injured soybean acres as reported by university weed scientists. Many have asked us to keep track of this information in 2018, and so we start here with a June 1st update.

As of June 1st, the reports we received from university weed scientists and state Department of Agriculture representatives indicate that almost all of the dicamba injury that has occurred thus far has occurred to specialty crops, vegetables, and ornamental, fruit, and shade trees. Only Arkansas, Mississippi, Missouri, Nebraska, and Texas have reported probable injury to soybean (approximately 800 acres) as a result of off-target movement of dicamba, while Tennessee has reported 100 acres of cotton with dicamba injury. Arkansas, Mississippi, Missouri, Nebraska, Tennessee, and Virginia have each reported injury to various types of trees, ornamental species, garden plants, flowers and berries. With specialty crops and homeowners, these cases are usually reported by total number of plants injured rather than by acreage, but it can vary by state and by individual situation. As of June 1st, approximately 200 tomato plants, 150 ornamental trees, 30 fruit trees, 250 vegetable plants, and 150 berry species were reported with probable dicamba injury in these six states, along with approximately 50 acres of hardwood/shade trees. The states of Alabama, Florida, Georgia, Illinois, Iowa, Kansas, Kentucky, Louisiana, Michigan, North Carolina, North Dakota, Ohio, Pennsylvania, and South Dakota have not reported any incidents of off-target movement of dicamba so far.

As of June 1st, dicamba injury to cucumber, tomato, and blackberry plants, as well as a variety of other specialty crops and ornamental, vegetable, and tree species has been more common than injury to soybean.

Mizzou Integrated Pest Management Field Day on July 10th to Include a Variety of Topics Mandy Bish

The annual Mizzou Pest Management Field Day will be Tuesday July 10th at the Bradford Research and Extension Center, approximately 8 miles east of Columbia, Missouri.

Registration will begin at 8:00 a.m. with opening comments by Dr. Kevin Bradley at 8:30. The morning will include guided wagon tours with stops that feature presentations of research results by university-trained scientists including talks by new state extension plant pathologist Kaitlyn Bissonnette and extension entomologist Kevin Rice. Weed management research topics that will be discussed this year include the latest dicamba research; weather information; cover crops—specifically integration with residual herbicides in soybean production as well as cover crop research related to weed control; and other weed-related topics. Lunch will be served at noon after which attendees will have the opportunity to view plots that showcase a variety of herbicide treatments and weed management programs for use in corn and soybean. These plots will be clearly labeled and mapped out so that they can be viewed easily.

Registration for the field day will be $10.00 to cover cost associated with lunch and refreshments.

To register call 573-884-7945 or send an e-mail to chismt@missouri.edu by Monday, July 2nd.

For certified crop advisors, CEU credits are pending.

The Bradford Research and Extension Center is located at 4968 Rangeline Road, Columbia, MO 65201. To learn more about the largest plant sciences' research farm in the state of Missouri visit the Web site: Bradford.cafnr.org.

To learn more about Mizzou Weed Science, visit the Web site at www.weedscience.missouri.edu or find us on Facebook and Twitter at Mizzou Weed Science.

Dicamba Injured Crops and Plants Becoming More Evident: June 15th Update

Kevin Bradley

A couple of weeks ago we provided a June 1st update of alleged off-target dicamba issues. At that time, most of the injury was confined to specialty crops, vegetables, and ornamental, fruit, and shade trees. We asked university weed scientists and state Department of Agriculture representatives for an update of the situation in their states as of June 15th, and this information is shown in the map and in the tables below. As of June 15th, university weed scientists estimate that there are approximately 383,000 acres of soybean injured by dicamba thus far in 2018. A common theme again this season seems to be that fewer growers are actually turning these incidents in to their state Department of Agriculture for investigation. Of the 15 state Departments of Agriculture that responded to our request for information, there were only 43 cases of alleged injury currently under investigation in soybean (Table 1). However, the incidents and cases of off-target movement of dicamba to specialty crops, vegetables, ornamental species and trees seems to be more prevalent this year compared to last season as they constitute some 111 of the remaining cases under investigation (Table 1).

I have personally witnessed this increasing problem of off-target dicamba injury to "other" crops and tree species in the calls I have received, field visits, and "windshield surveys" of Missouri that I have taken the past few weeks, especially when driving around southeast Missouri last week. In this region, I'm convinced that the adoption of the Xtend trait in cotton and soybean is as high as anywhere in the country. Many growers in this area have adopted the Xtend trait so they don't experience dicamba injury on their soybean crop for a third season in a row. Since the adoption of the Xtend trait is so high in this area, relatively speaking there seem to be fewer soybean fields with injury this year compared to last. However, just as in the past two seasons, there are still fields of non-Xtend soybean in this area showing injury from one end to the other (Figure 2). More surprising to me than that has been the extent of the trees that are showing symptoms of growth regulator herbicide injury in that part of the state where the adoption of this trait is so high (Figures 3 and 4). Non-Xtend soybean fields injured from dicambaNon-Xtend soybean field injured from dicamba

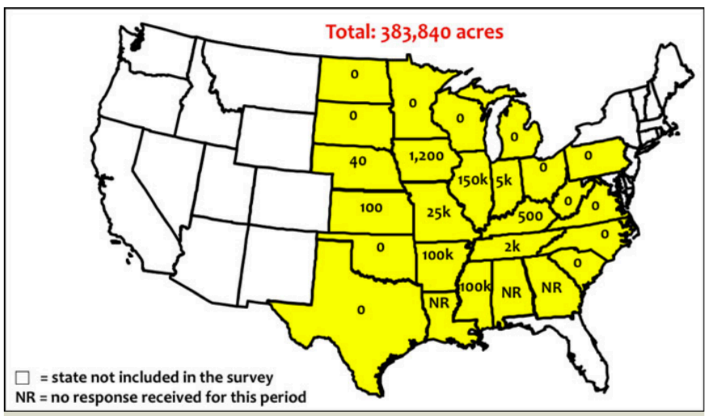

Figure 1 Estimates of dicamba-injured soybean acreage in the U.S. as reported by university weed scientists (as of June 15, 2018).

		Crops and Plants Under Investigation with Alleged Dicamba Injury									
State Reporting*	Total Number of Cases Under Investigation	Soybean	Cotton	Grapes	Melons	Tomatoes	Ornamental Trees	Fruit Trees	Other Vegetable Crops	Annual Flowers	Other
Alabama	1	1									
Arkansas	42	12	2			1	9		2	1	15
Florida	0										
Georgia	0										
Indiana	3	2			1						
Louisiana	2	2									
Mississippi	13	11	2								
Minnesota	1	1									
Missouri	69	12		3	1	15	13	7	15	3	
Nebraska	6	1					3				2
North Carolina	2	0		2							
Ohio	0										
South Dakota	1			1							
Tennessee	14	1				3	8				2
Virginia	0										
Total:	154	43	4	6	2	19	33	7	17	4	19

*No responses received from IA, IL, KS, KY, MI, ND, OK, PA, SC, TX, WI, WV Departments of Agriculture.

Table 1 Official alleged dicamba injury investigations as reported by state Departments of Agriculture (as of June 15, 2018).

Figure 2 Non-Xtend soybean fields injured from one end to the other and showing typical signs of dicamba injury. Pictures taken the week of June 11-15, 2018.

Figure 3 Catalpa trees expressing symptoms of off-target growth regulator herbicide injury.

Figure 4 Bradford pear with apparent symptoms of off-target growth regulator herbicide injury.

Several of my university colleagues who work in cotton have been encountering calls and field visits pertaining to off-target movement of 2,4-D onto cotton as well, presumably as a result of the increase in the adoption of the Enlist cotton trait. As most are aware, non-Enlist cotton is about as sensitive to low doses of 2,4-D as non-Xtend soybean are to dicamba. While very few of these incidents have been officially filed with the state Departments of Agriculture, Table 2 provides estimates from university weed scientists of the cotton acreage that has been injured by either 2,4-D or dicamba as of June 15th.

	Cotton Acreage Estimated with Injury by 2.4-D or Dicamba	
State	2,4-D	Dicamba
Arkansas	5,000	0
Mississippi	5,000	10,000
Missouri	1,500	0
Oklahoma	2,500	0
Tennessee	2,500	100
Texas	450	180

Table 2 Estimates of cotton acreage injured by 2,4-D and dicamba as reported by university weed scientists.

"Recovery" Treatments for Dicamba-injured Soybean. Results from a 2017 Experiment

Kevin Bradley, Shea Farrel and Mandy Bish

Once dicamba injury has occurred to non-Xtend soybean, one of the common questions that will inevitably arise is, "can anything be done now to help the plants recover?" Last year we conducted one field research trial to address this question. In this research, we intentionally injured soybean with a 1/100X rate of dicamba at either the V3 or R2 stages of growth (black and gold bars, respectively, in Figure 1). Two weeks after the soybean were injured with dicamba at either growth stage, a variety of "recovery" treatments were applied to the dicamba-injured soybean. Our rationale for the two-week lapse in time between dicamba application and recovery treatment is that dicamba injury usually will take 7 to 10 days to show up, depending on the environment and rate. The recovery treatments we chose to evaluate included a variety of common foliar fertilizer products, a fungicide (Priaxor), urea with Agrotain, as well as one treatment that consisted of weekly irrigation. In short, we evaluated all of the possible solutions that we've heard promoted to help soybean recover from some kind of injury.

Yield results from the 2017 field experiment are shown in Figure 1. It is important to note that these are only results from one experiment in one season, but we are in the process of repeating this experiment in 2018. In Figure 1, there are two control treatments to which all recovery treatments should be compared; the non-injured control that was never injured by dicamba, and the dicamba-injured control that never received any recovery treatment. Results from the first year of the experiment indicate that when soybean were injured with dicamba at V3, no recovery tactic resulted in soybean yields that were higher than the dicamba-injured control (Figure 1). However, when soybean were injured with dicamba at R2, the weekly irrigation treatment resulted in yields higher than the injured control.

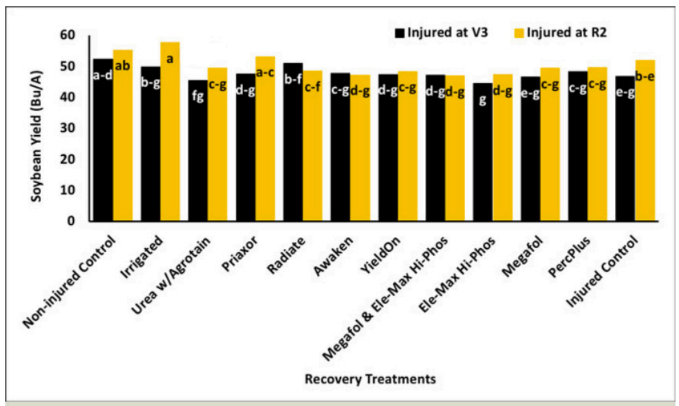

Figure 1 Influence of "recovery" treatments on dicamba-injured soybean yield in 2017.

In fairness, we were surprised that the weekly irrigation treatment following the V3 drift event did not result in higher yields as well. But after looking through the rainfall data for this location in 2017, it was clear that timely rains were received throughout much of the early portions of the season, which likely contributed to the similarity in yield between the dicamba-injured control and all of the recovery treatments at the V3 timing. Overall these preliminary results indicate that the yield-promoting tactics evaluated here, except irrigation, are not candidates for enhancing soybean recovery following dicamba injury, and that the amount of rainfall or irrigation received after the dicamba injury event will have a significant role in determining how well the soybean will recover and yield. This research is being repeated in 2018 and it will be interesting to see if the results will be similar in a less-ideal growing season.