Issue 925

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These e-Updates are a regular weekly item from K-State Extension Agronomy and Kathy Gehl, Agronomy eUpdate Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have any questions or suggestions for topics you'd like to have us address in this weekly update, contact Kathy Gehl, 785-532-3354 kgehl@ksu.edu, or Dalas Peterson, Extension Agronomy State Leader and Weed Management Specialist 785-532-0405 dpeterso@ksu.edu.

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eUpdate Table of Contents | 09/22/2022 | Issue 925

1. Soybean seed filling and dry down rate before harvest

The latest USDA-National Agricultural Statistics Service crop progress and condition report released September 19, 2022 classified 51% of the soybean crop to be in fair or good condition. Overall, 40% of all soybeans in Kansas are dropping leaves, ahead of 34% from last year and the average .

Weather outlook

The weather conditions expected for the last portion of September will be critical for soybeans as related to seed filling and determining final seed weight.

Current conditions have been much warmer than normal thus far in September. In addition, current forecast projections favor high confidence in continued warmth the remainder of September and into early October. While there are some chances for moisture, they will remain limited to the next few days with below-normal precipitation also significantly favored into early October. Seasonally, we continue the weekly decrease in normal precipitation as we head towards the driest season of the year (winter). As a result, below-average precipitation unfortunately means potentially very little, if any, moisture. Warm and dry conditions will favor overall low humidity, increasing drought and wide day/night temperature swings.

Soybean seed-filling

Soybeans will reach final maturity with high seed water content, moving from 75-80% (R6) to around 50% (R7) from beginning of seed filling until final maturity (Figure 1). Final maturity is defined as the formation of the black layer in the seeds. The process of seed dry matter accumulation and moisture changes will depend on the maturity group (affecting the length of the season), planting date, and weather conditions experienced during the latter part of the reproductive phase.

As described for corn, seed water loss for soybeans can also divided in two phases: 1) before "black layer" or maturity, and 2) after black layer.

The overall contribution of seed weight to final yields can be study by evaluating changes in seed weight during the seed filling period, building a dataset portraying the rate and duration of the changes in seed filling (Figure 2). In the example presented below, overall seed filling last more than one month (37 days) until black layer (no changes in seed weight) was achieved. to the graph of seed filling provides a visual of the overall rate, increase in seed weight per day, and the duration of the seed filling (Figure 2), with this information we can improve our understanding of potential impacts of stress conditions during this time of the season for soybeans. In the example presented in Figure 2 you can see the impact that decreasing the effective duration of the seed filling period has in the final yield, if the duration is reduced by one week (from 37 to 30 days) the attainable yield went from 61 to roughly 50 bushels per acre. Potential impacts (beyond the current heat/drought) on leaf green area imposed by insects, diseases, hailstorm, and any other abiotic stress conditions such as cloudy days and early frost impacting the crop during the coming weeks will negatively affect the seed filling conditions for soybeans.

For this current season, we can expect large yield impacts due to the current heat + drought conditions, resulting in poor seed weight. In overall, seed weight contributes roughly in 30-40% of the final total yield for this crop, emphasizing the impacts of the stress conditions on the attainable yields.

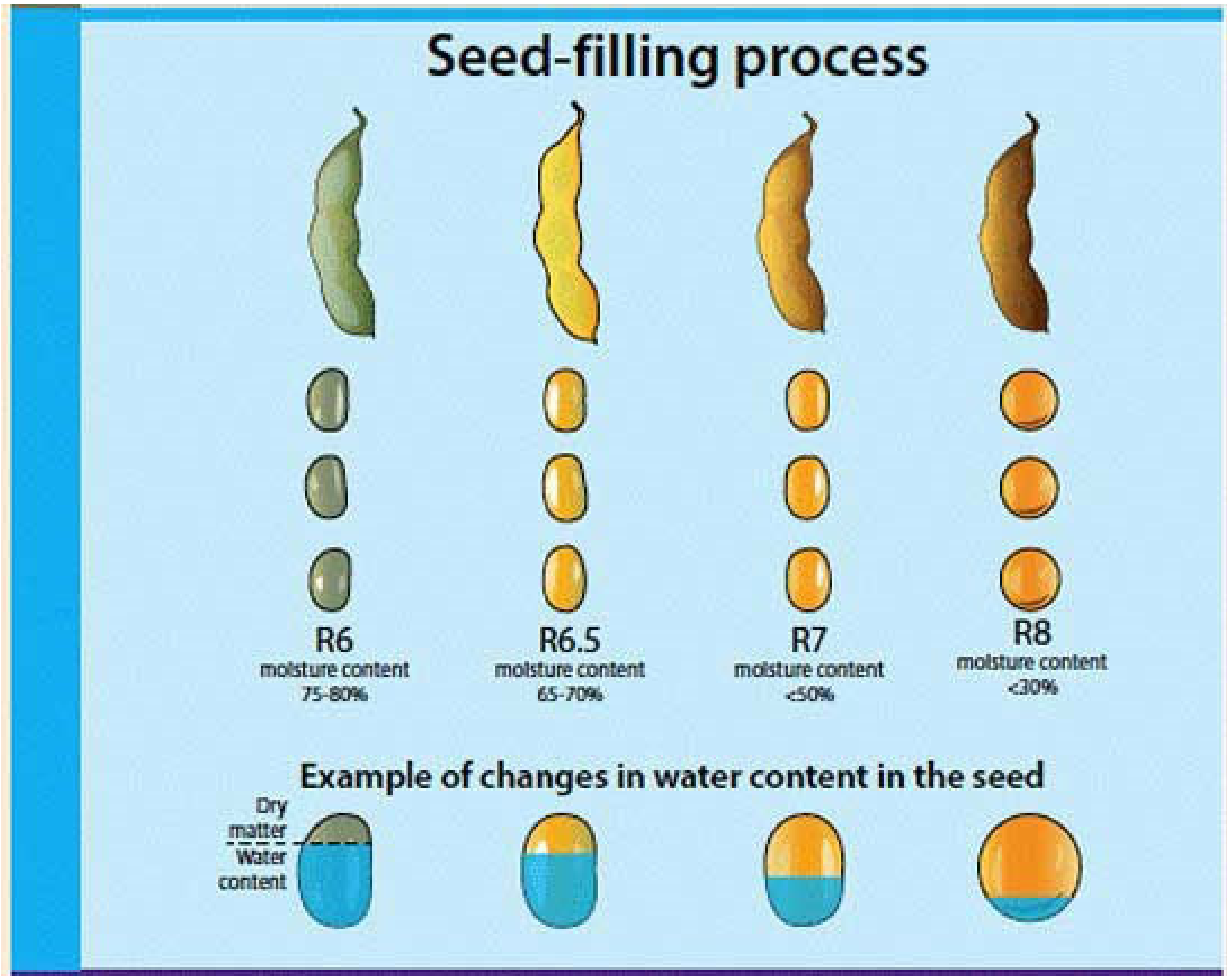

Figure 1. Soybean seed filling process from full seed to full maturity. Photo and infographic prepared by Ignacio Ciampitti, K-State Research and Extension. Taken from Soybean Growth and Development, MF3339.

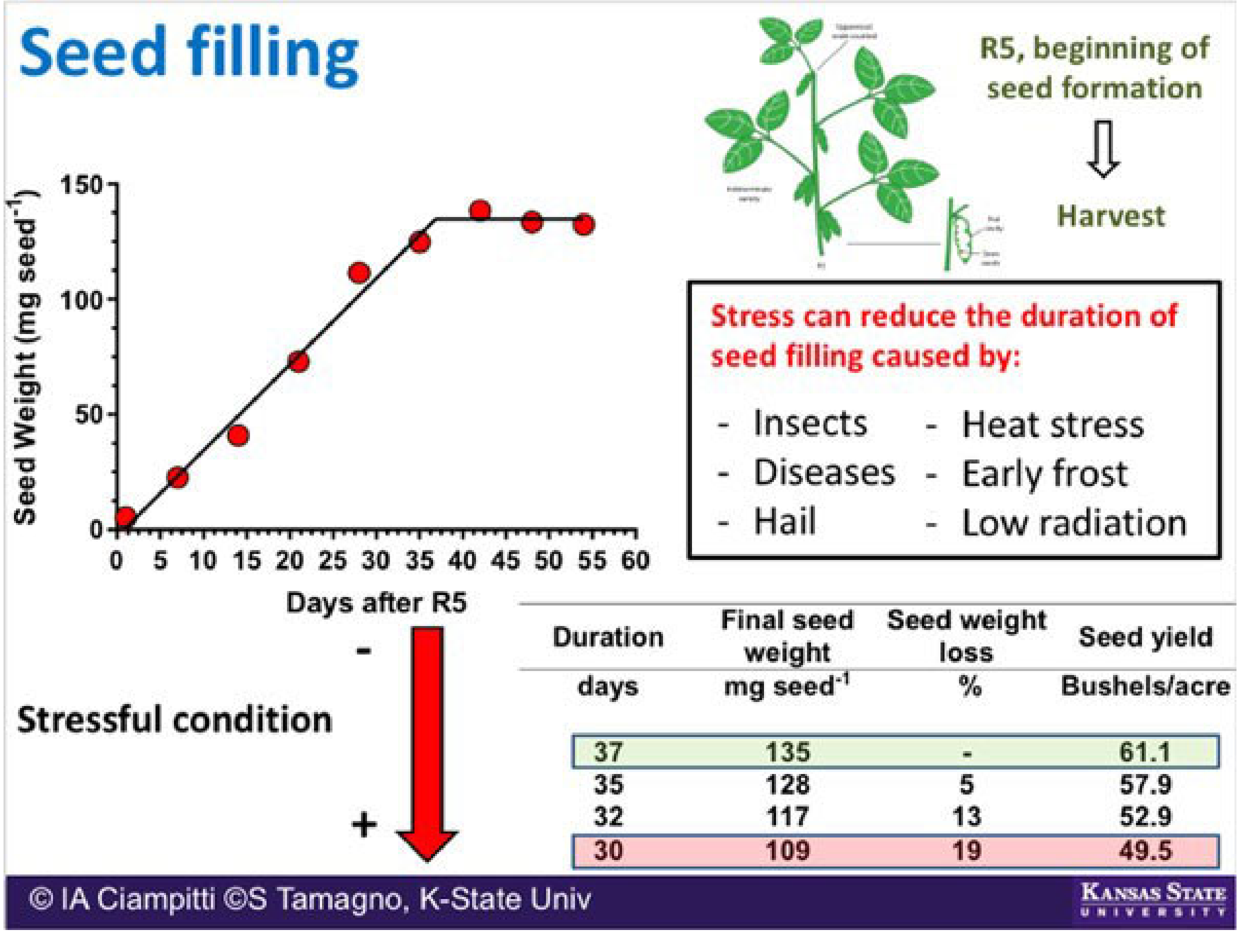

Figure 2. Soybean seed weight changes from beginning of seed filling (R5) to full maturity. Photo and infographic prepared by Ignacio Ciampitti and Santiago Tamagno, K-State Research and Extension.

Soybean dry down

Soybeans will reach final maturity with high seed water content, moving from 90% to around 60% from beginning of seed filling until final maturity. Final maturity is defined as the formation of the black layer in the seeds. The dry down rate will depend on the maturity group (affecting the length of the season), planting date, and weather conditions experienced during the latter part of the reproductive phase.

To address the question related to the dry down rate for soybeans, a study was conducted to investigate the changes in water content from black layer formation (maturity) until harvest time (Figure 2). During the last days of September and mid-October 2016, the overall dry down rate was around 3% per day (from 58% to 12% seed moisture) – taking an overall period of 15 days.

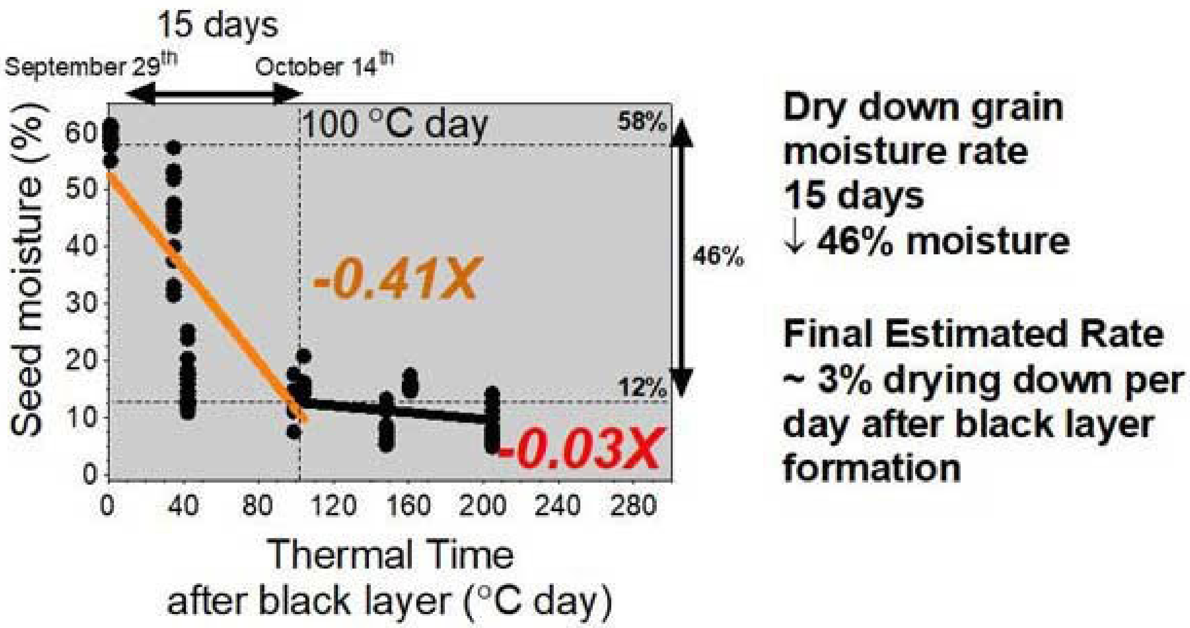

Figure 3. Grain moisture dry down (orange line) across three hybrids and different N rates near Manhattan, KS. Horizontal dashed lines marked the 58% seed moisture at black layer formation. * Graph prepared by Ignacio Ciampitti, K-State Research and Extension.

**Note: It is desired to reach harvest with 13% seed moisture to maximize the final seed volume to be sold, thus the importance of timing harvest with the right seed moisture content.*

Soybean dry down rate was three-time faster, 3% per day, relative to corn at 1% per day. These dry down rates for corn and soybeans are primarily affected by temperature, humidity, and overall water content at the point of black layer formation (maturity). These main factors should be considered when the time comes to schedule soybean harvest.

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2. Test to prevent nitrate and prussic acid poisoning

Many Kansas cattle operations rely on some type of harvested feed to use in the winter months and common among those sources is forage sorghum, millets, sorghum-sudangrass, and sudan. Forages in the sorghum family are prone to two different problems for feeding cattle, nitrate poisoning and prussic acid (hydrocyanic acid, HCN) poisoning. Millet (proso and pearl) do not contain prussic acid but can have nitrates. Prussic acid and nitrate poisoning are easy to get confused because both result in a lack of oxygen availability to the animal and are more likely to occur when the plant is stressed (fertility, hail, drought).

Table 1. Key characteristics of nitrate and prussic acid poisoning.

Item	Nitrate	Prussic Acid
Plant parts most affected	Base of plant	Young or new growth
Types of plants	Many, especially sorghum family, pigweed (palmer amaranth, redroot, waterhemp), kochia, oat hay	Many (> 3,000 plant species), sorghums including Johnson grass, white clover, birdsfoot trefoil, Indiangrass, *Cyndon* spp. (Bermuda)
Grazing problems	Rarely a problem unless forced to eat entire stem or extremely high levels.	Consumption of newest growth
Hay	Not impacted by drying	Not impacted by drying
Silage	Reduced 40-60% by ensiling	Reduced 40-60% by ensiling
Green Chop	High risk	Less risk than hay, not as much reduction as silage
Time of death	Several hours after consumption	Within minutes of consumption, treatment can rarely occur fast enough to save the animal
Blood/Oxygen	Chocolate brown colored blood, hemoglobin converted to methemoglobin and unable to carry oxygen	Blood bright cherry red, hemoglobin contains oxygen, but not available to cells

In dry areas of the state, cattle may be removed from pasture early. Bringing hungry cattle into pens with weeds can be very dangerous as the nitrate concentration may be elevated throughout the plant and animal intake high. Manure in corrals can contribute to the elevation of nitrates in the weeds. Elevated nitrates may not result in death but could cause abortions.

The current KSU forage fact sheet on prussic acid poisoning indicates that prussic acid potential dissipates as the forage dries. Additionally, hay or silage that likely contained high cyanide concentrations at harvest should be analyzed before it is fed. This second statement is often forgotten and it's assumed that when the plant dries, all the cells are ruptured and any HCN is released. To confirm this, we measured dhurrin content in sorghum hay. The dhurrin content was stable from 1 to 10 weeks of dry storage. In the plant, dhurrin (the precursor to HCN in sorghum species) and the enzyme that converts it to cyanide, are stored in separate compartments within the cell. When the plant is eaten, the compartments are ruptured, and the cyanide formed and released. While the enzyme that converts dhurrin to cyanide is inactivated with drying, rumen enzymes can make the same conversion after consumption. If hay is made from forages in the sorghum family or other susceptible species, testing for prussic acid in forage that has suffered from drought, hail or fertility issues is advised. The frequency of issues with prussic acid in harvested forages may be relatively low, however, testing is cheap compared to the cost of losing even one animal.

Management recommendations common to both prussic acid and nitrates include:

- Test first, don't gamble. Keep in mind, different labs use different tests that have different scales.
- Feed animals with a known safe feedstuff(s) and have them full before introduction to potentially problematic feeds. Don't turn in hungry.
- Ensiling will reduce concentrations of either by 40-60% in well-made silage, but silage put up under less-than-optimal conditions could still contain very high levels. If extremely high before ensiling, a 50% reduction may not be enough to result in safe feed.
- Dhurrin concentrates in the upper portion of the plant and with more plant growth (>24"), concentration levels may be diluted if measuring the whole plant.
- Nitrate concentrates in the base of the plant and is least in head and leaves, grazing or cutting high can reduce nitrate levels in the forage.
- Do not harvest drought stressed forage within 7 to 14 days after good rainfall to reduce the levels of accumulated nitrates.

If testing before grazing, samples should reflect what the animals are expected to consume, generally leaves and upper portion of the plant. Sample a minimum of 15 sites across a given field. One method is to sample from each corner and the center by walking diagonal lines and sample plants every 50-100 steps or as appropriate for field size.

We expect levels of nitrates and prussic acid to be variable across a field, so more samples are better than less. A rule of thumb is to sample 10 to 20 % of the bales per field or cutting as a minimum. Be aware of areas of the field that exhibited more plant stress than others. If large enough areas, you may want to sample them separately. Your acreage size and feeding methods likely factor into this decision. Use a forage probe that cuts across all plant parts in a bale rather than a grab sample from individual bales or windrows. Most county extension offices can help with sampling procedures and equipment.

Prussic acid in sorghum following a freeze event

Frost causes plant cells to rupture and prussic acid gas forms in the process. Because the prussic acid is in a gaseous state, it will gradually dissipate as the frosted/frozen tissues dry. Thus, risks are highest when grazing frosted sorghums and sudangrasses that are still green. New growth of sorghum species following frost can be dangerously high in prussic acid due to its young stage of growth. Prussic acid content decreases dramatically during the hay drying process and during ensiling. It is recommended to wait ten days until after a killing freeze before grazing. Sorghum and sudangrass forage that has undergone silage fermentation is generally safe to feed.

For more complete information on these problems see these publications Nitrate Toxicity, Prussic Acid Poisoning, and Managing the Prussic Acid Hazard in Sorghum. If you have samples with high prussic acid concentrations, and are willing to share information on variety, growth, fertility, and harvest conditions, it will be helpful as we strive to better understand this issue.

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3. Testing methods for nitrates in forages

When making harvesting or feeding decisions for forages that have potentially accumulated nitrates, our human tendency is to want immediate answers. A representative sample sent for laboratory analysis is by far the best test of nitrate toxicity. However, while shipping and laboratory turnaround times are really very good, it will take several days to get results. Two types of quick tests exist, and it is important to understand the limitations of these tests when considering their use.

Quick Tests

Diphenylamine Quick Test– This solution of concentrated sulfuric acid is available from some county extension offices. Appropriate precautions must be taken in handling and storing the solution. This solution is most useful for evaluating standing green forage. The green stem can be split open and when drops of the solution are placed on the stem, a color change occurs when nitrate is present. Because nitrates accumulate in the base of the plant, testing from the base upwards until no color change occurs can be helpful in determining a harvest plan. An Oklahoma State University study comparing the diphenylamine test to a standard laboratory test indicated a large percentage of false positives (46%), this dropped to 24% if two stems were positive. The rate of false negative readings was 5.1%. In this study, the relative color change after 10 seconds had a low relationship (r=0.38) to the laboratory nitrate values. A Montana State University field study found 71% of samples correctly categorized with 23% false positives and 6% false negatives.

Test strips – Nitrate test strips have primarily been used to test nitrates in water or soil or to assess the need for additional fertilization in growing plants. Various types of test strips or kits are available. Some require you to press the test strip to the moist surface of a cut plant, or squeeze sap from the plant with pliers, a garlic press or hydraulic press, and others suggest a dried and ground sample. Testing may require additional solutions and several steps to get to the final step of a color change (red-violet dye). Reading the color change with a reflectometer or other tool provides more consistent results than the human eye. Smart phones have been tested as a possible way to read the color change but there are some consistency issues across phones and platforms. Researchers at Montana State (Meccage et al.) compared the test strips to laboratory values and found 71% correctly categorized, 13% false positive and 16% false negative. If using this type of test be sure to understand any expiration date on the materials and appropriate storage conditions for unused portions.

Sample collection for nitrate testing

Nitrate concentrations within a given field can be highly variable. In one Kansas study, nitrate concentration of 23 large round bales of sudan from a single field averaged 2764 ppm, but ranged from 1525 to 6250 ppm on an as-fed basis. This is similar to other reports of "hotspots" within fields and wide variability.

When collecting samples for nitrate determination more samples are needed to represent the potential variation. In some cases, segregating and testing bales from different locations in the field may be warranted. The rule of thumb is to sample 10-20% of bales of a given forage lot for nutrient analysis. A forage lot should represent the same field, cutting, maturity and harvest condition and usually is less than 100 tons. When nitrate toxicity is a concern, sampling 20% of bales would be a minimum and some have suggested to sample up to 40%. Knowledge of actual field conditions should be used in planning for sampling.

When collecting samples from a large round bale use a bale corer, start from the wrapped side (with net wrap or twine) of the bale and core toward the center. Approximately 75% of the hay is in the outside 18" of the bale and sampling in this direction will maximize the number of layers within the bale that are sampled to get a representative sample.

If sampling standing forage, the sample collected should represent the grazed or harvested portion. No need to sample the base of a corn stalk unless cattle will be forced to eat that far down on the stalk. Sampling standing forage is more awkward. One approach is to sample every 50 to 100 feet in diagonals across the field. Chop up samples into smaller pieces, mix well in a large bucket or tub. Use a quartering method to create a subsample for analysis.

For more information refer to KSU publication MF3029 Nitrate Toxicity.

There is a short video that discusses and demonstrates forage sampling. It addresses all types of testing, including nitrate testing. The video can be viewed at: https://bit.ly/3FsgJoI

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4. Management considerations for no-till wheat following sorghum or other summer crops

With fall harvest progressing at earlier than normal rates, favorable wheat prices, and many row-crop acres chopped for silage, producers may consider planting wheat back into freshly harvested summer crop residue, especially if they receive some essential precipitation. While the current drought conditions offer significant challenges (see recent eUpdate article on planting wheat into dry soil), there are additional considerations when seeding wheat immediately after harvest of a summer crop. Following are several key management considerations to keep in mind, a more detailed discussion on these can be found in K-State publication MF-2641, Managing No-Till Wheat Following a Summer Crop in Eastern Kansas.

Variety Selection: If planting wheat after corn, adapted varieties with the best ratings for fusarium head blight (scab) should be used. Due to moisture use by the previous summer crop, varieties with high levels of drought tolerance should be used. As wheat after a summer crop is generally planted later, varieties with good ratings for winter hardiness and late fall tillering should be selected. These ratings are available in K-State publication MF991, Wheat Variety Disease and Insect Ratings 2021.

Planting Date: Wheat should be planted as soon as possible after harvest. Later planting dates shorten the window available for the formation of fall tillers, which are the more productive than spring-initiated tillers.

Seeding Rate: Seeding rates should be increased with delayed planting or in challenging high-residue environments where adequate stand establishment may be difficult. As previously mentioned, delayed planting reduces the opportunity for the initiation of fall tillers, increasing seeding rates can overcome some of that reduction.

Harvest Considerations: Evenly spreading crop residue at harvest is a key action that can positively affect the productivity of the subsequent wheat crop. Uneven distribution of the summer crop residue can make it difficult to maintain adequate depth of seed placement and can also result in uneven nutrient availability as areas with higher crop residue will likely immobilize more nitrogen.

Seeding Equipment and Seeding Depth: Seeding to adequate depth in high-residue conditions is necessary to ensure healthy crown development, maintain access to sufficient soil moisture in drying conditions, and reduces the potential for winter injury. Producers should make sure that their drill is set to achieve adequate depth in the thickest layers of crop residue. Drills and air-seeders often need additional ballast (weight) added to the drill to maintain adequate downforce to cut through the residue and place seed at the target depth. Producers should use ground speeds that maximize the performance of the seeding operation. Often increasing ground speed aids in the flow of residue through the seeding tool, however increasing speed also increases the ballast and downforce requirements necessary to achieve the target seeding depth.

Nutrient Management: In general, higher rates of fall applied nitrogen are necessary for wheat when planted after corn or sorghum. This is especially true for after sorghum which generally his residue that is lower in nitrogen content, making it more likely to immobilize available nitrogen. An additional 30 lb/ac of Nitrogen should be applied for wheat following grain sorghum or sunflowers as compared to other crops. Wheat planted after soybeans should not have its nitrogen application lowered relative to continuous wheat as the organic nitrogen release from the soybean crop is likely to occur too late to significantly benefit the wheat crop.

Herbicide History: Producers should check the label of all products used in the proceeding crop and their plant back restriction to wheat. Precipitation received since application can play a large role in potential injury to the wheat crop by any herbicide residual.

Allelopathy: The potential effect of allelopathy of sorghum residue on wheat stand establishment and yield is often difficult to separate from nutrient availability and other potential yield limiting factors. Concerns over allelopathy should not discourage producers from no-till planting wheat after grain sorghum when the aforementioned production concerns are addressed.

Grain sorghum termination and desiccation with glyphosate

While drought has or will accelerate maturity in most of the state, some producers interested in facilitating a timely sorghum harvest may be thinking of applying glyphosate as a desiccant. Will this affect standability or yield of the sorghum crop?

The answer to the question about standability is "yes," applying glyphosate as a desiccant to sorghum can affect the stalk quality and standability of sorghum in some cases. Unlike corn, grain sorghum is a perennial plant and remains alive until it is killed by a hard freeze. Killing the plants before a freeze can affect the integrity of the stalks. For that reason, inspect sorghum field for existing stalk issues prior to applying the glyphosate. If stalk rots are present, applying glyphosate may increase the chance of plant lodging if not harvested in a timely manner.

The answer to the second question about the effect of a desiccant on sorghum yields is not as straightforward. It depends of the timing of the desiccant application.

Most glyphosate labels require that applications be made to the sorghum crop when grain moisture is at 30% or less to minimize any possible yield reductions. In addition, there is a seven-day period between time of application and harvest.

Sorghum response to pre-harvest glyphosate treatments

If glyphosate is applied at the correct time, K-State research in 2011 and 2012 by former Agronomy graduate student Josh Jennings found that using a desiccant did not affect sorghum yields.

From 2011 to 2013, he established six field trials to test the effect of pre-harvest glyphosate treatments on sorghum. In 2011 to 2012, field trials were conducted at Belleville, Manhattan, and Ottawa. In 2012 to 2013, field trials were located in Belleville, Manhattan, and Hutchinson (yield not collected in 2012).

Table 1 summarizes the effect of the pre-harvest treatments on grain sorghum. The response was similar in all harvested experiments, so the data below is averaged across the five field trials over the two-year period.

Table 1. Effect of pre-harvest glyphosate applications on grain sorghum (averaged across five sites in 2011 and 2012).

	Glyphosate	No glyphosate

Yield (bu/acre)	98	99
Grain moisture (%)	12.1	12.3
Test weight (lbs/bu)	60.4	60.2
Seed size (300 seeds, grams)*	5.81	5.90
* 2011 only		

Glyphosate was applied to the sorghum crop when grain moisture was approximately 18-22%. Grain harvest occurred 8-11 days following the application. Average yield reduction to the sorghum crop when sprayed with glyphosate was about 1 bushel or roughly 1% less than untreated.

A potential question is whether the presence of aphids, headworms, or other insect pests in the head should make any difference in the decision to use desiccants. There is no research on this, but by the time a desiccant is applied, grain filling is complete and yield reducing insect damage is unlikely. The presence of insects at this late stage of development should not play any role in the decision of whether to use a desiccant.

Wheat response to pre-harvest glyphosate treatments to sorghum

In addition to getting the sorghum crop ready for harvest earlier than normal, desiccants can be helpful in cropping systems where wheat is planted directly after sorghum harvest. Killing the sorghum plants early can help save soil moisture for the wheat crop.

The research mentioned above also tested the effect of using a sorghum desiccant on the yield of wheat planted directly after sorghum harvest. Wheat yield responses varied across field trials over both years, so the data in Table 2 includes wheat yields within each field trial over both years of the experiment.

Table 2. Mean winter wheat yields following treated and untreated sorghum.

	Location and year					
Sorghum pre-harvest treatment	Belleville (2011-2012)	Manhattan (2011-2012)	Ottawa (2011-2012)	Belleville (2012-2013)	Manhattan (2012-2013)	Hutchinson (2012-2013)
				Yield (bu/acre)		
Glyphosate	40	45	54	39	51	34
No glyphosate	38	36	51	38	49	35

Averaged over all three locations in 2011-2012, when glyphosate was applied to the sorghum pre-harvest, wheat yielded 12-13% more on average than wheat following untreated sorghum. This is equivalent to an average increase of about 5-6 bushels/acre. Averaged over all three locations in 2012-2013, wheat yields following grain sorghum treated with pre-harvest glyphosate were increased by only 1%, or less than a bushel.

In 2011, applications of glyphosate, on average, were applied 22 days earlier than glyphosate treatments in 2012. The first freeze date was also 12 days later in 2011 than in 2012. As a result, the pre-harvest applications of glyphosate were applied, on average, 38 days prior to the first freeze in 2011 and only 6 days prior to the first freeze in 2012. A hard freeze soon after a pre-harvest glyphosate application to sorghum essentially negated the effect of the glyphosate application.

Summary

The use of glyphosate as a preharvest desiccant on grain sorghum will reduce the moisture level of grain sorghum and may allow producers to harvest the crop earlier than normal. However, care must be taken to ensure the crop is harvested in a timely manner. If not, the desiccant could increase lodging potential. If applied at the proper time (after physiological maturity - formation of black layer at the bottom of the sorghum grains), a desiccant will probably have little or no effect on sorghum yields.

Applications of glyphosate to grain sorghum prior to fall harvest can also help improve the performance of the following wheat crop if applied early enough in the late summer/early fall. Wheat yields following glyphosate-treated grain sorghum, on average, were 6% greater in 2011-2012 compared to 2012-2013 when glyphosate treatments were made at least 38 days prior to the first freeze date. When pre-harvest glyphosate is applied to the grain sorghum crop later than that, response of wheat yields following treated sorghum may be minimal.

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5. Kansas Ag-Climate Update for August 2022

The statewide average temperature for August was 78.9°F, and was 1.8° above normal. This ranks as the 31st warmest August out of the last 128 years, dating back to 1895. Departures ranged from +1.1° in the northeast to +2.6° in the central and southeast (Figure 1). Combined with June and July, the average temperature was 78.6°, or 1.8° above normal, and ranks 18th warmest. This June-August ranks as 6th warmest on record in the northwest and 9th warmest west central.

The statewide average precipitation for August was 1.21 inches, or 2.30 inches below normal. This was the 7th driest August on record. Six of the nine climate divisions had a 'Top 10' driest August. The average 3-month total precipitation for June, July and August was 7.68 inches, or 3.73 inches below normal, and ranks as 20 inches driest. It was the 4th driest June through August on record in the west central, and 7th driest in the northwest.

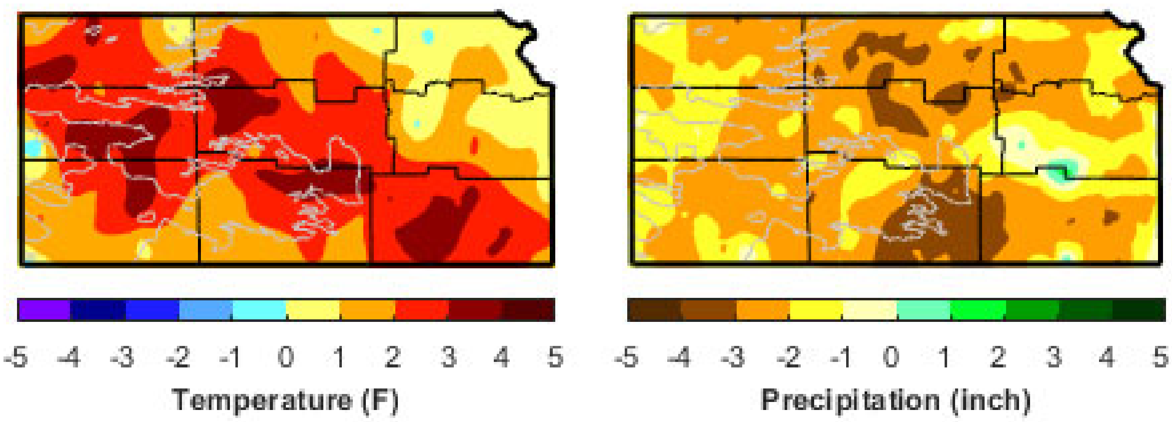

Figure 1. Departures from normal temperature (°F) and precipitation (inches) for August 2022.

View the entire August 2022 Ag-Climate Update, including the accompanying maps and graphics (not shown in this eUpdate article), at http://climate.k-state.edu/ag/updates/

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