Issue 711

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eUpdate

09/21/2018

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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1. Common causes of late-season stalk lodging in corn

Mid-summer heat and drought stress followed by late season rain is a perfect storm for stalk rot development, particularly Fusarium stalk rot. Reports from the eastern half of the state indicate we are likely to have an above-average amount of stalk rot in 2018.

Stalk lodging in corn occurs when the stalk weakens and breaks at some point below the ear (Figure 1). When this occurs, it results in harvest losses and slows down harvesting considerably. Grain moisture levels may also be unacceptably high in lodged corn.

Figure 1. Stalk rot in corn at Kansas River Valley Experiment Field, 2016. Photo by Eric Adee, K-State Research and Extension.

The first things to consider when stalk lodging occurs are either stalk rot diseases or corn borer damage. In fact, we often find stalk rot disease organisms (charcoal rot, Fusarium, Gibberella, anthracnose, and Diplodia) on corn with stalk lodging and stalk rot is often the ultimate cause of lodging. But in most cases, the stalk rot diseases were only able to infect the plants because certain other factors predisposed the plants to disease infection.

What are the most common causes of stalk lodging in corn throughout the state?

Carbohydrate depletion in the stalk during grain fill. Higher-yielding, “racehorse” hybrids tend to produce superior yields at the expense of late-season stalk integrity. These hybrids translocate a high percentage of carbohydrates from the stalks to the ears during grain fill. The latter is reflected with a substantial reduction in the stalk diameter from flowering until maturity (stem shrinking process). This weakens the lower stalk until eventually it will break over, possibly after becoming infected with a stalk rot disease. However, this does not mean producers should stay away from these hybrids. These hybrids have to be managed well. They should be harvested early, shortly after physiological maturity. This may mean harvesting the corn at about 20-25 percent grain moisture. Early harvest can result in discounts for high moisture, but it is better than leaving those hybrids in the field so long that stalks break.

Hybrid differences in stalk strength or stalk rot susceptibility. Some hybrids have genetically stronger stalks than others do. This is often related to a hybrid's yield potential, as mentioned above, and how it allocates carbohydrates during grain fill. However, there are also genetic differences in stalk strength due to other reasons, including better resistance to stalk rot diseases. If a field of corn has stalk lodging problems, it could be due in part to hybrid selection.

Poor root growth and other stresses. Cold, waterlogged soils, severe drought, and soil compaction can all result in short, inadequate root systems and crowns that are damaged to the point that water and nutrients cannot effectively move through them. Under these conditions, the roots may not be able to extract enough water and nutrients from soil to support plant growth and carbohydrate production. When carbohydrate production is below-normal during any part of the growing season, the ears will continue to take what they need during grain fill, which can leave the stalks depleted even under average yield conditions. The developing ear always has priority for carbohydrates within the plant.

Poor leaf health. Any factor that results in poor leaf health will reduce carbohydrate production. When carbohydrate production from photosynthesis is inadequate due to loss of green leaf area in the leaves, the plant will mobilize reserves from the crown and lower stalk to complete grain fill (see carbohydrate depletion above).

Southern rust continues to arrive in Kansas earlier in the growing season, perhaps due to the overall warming trend in recent years (Figure 2). Where delays in planting from spring rainfall occur, southern rust can build to high levels earlier in the plant's life cycle, resulting not only in direct loss from the disease, but also in secondary losses from increased levels of stalk rot.

Figure 2. Southern leaf rust in corn. Photo by Doug Jardine, K-State Research and Extension.

Gray leaf spot is the other important foliar disease in Kansas that can affect stalk rot (Figure 3). While 2017 was an “average” year for gray leaf spot, there were individual fields with high levels of the disease. Unfortunately, many of these fields went untreated due to reduced input investments related to low corn prices.

Figure 3. Gray leaf spot on corn. Photo courtesy of Alison Robertson—© APS. Reproduced, by permission, from Wise, K., et al., eds. 2016. A Farmer's Guide to Corn Diseases. American Phytopathological Society, St. Paul, MN.

Many of the highest yielding hybrids lack good resistance to leaf diseases because the use of resistance genes can cause a "yield drag" in the hybrid. Therefore, when growing these hybrids, producers should be ready to apply a fungicide should leaf diseases develop. Bacterial leaf streak continues to spread in the state, however, its relationship to yield loss or increases in stalk rot are still unknown.

Spider mites were also bad in many cornfields in 2017, especially in the southwest. Previous research from the 1980s indicated a high correlation between spider mite leaf damage and increases in stalk rot incidence and severity.

Stay green, another characteristic in hybrids, is highly correlated to stalk rot resistance and reduced lodging. The stay green effect associated with the use of strobilurin fungicides has also been reported to reduce lodging. This same characteristic may also interfere with grain dry down in the field.

High plant density. Plants become tall and thin when supra-optimal populations are used, which result in thin stalks with inadequate strength. In addition, plant-to-plant competition for light, nutrients, and water enhances the competition for carbohydrates between the stalk and ear within the plant, thus reducing the vigor of the cells in the stalk and predisposing them to invasion by stalk rot.

Nutrient imbalances and/or deficiencies. Nutrient imbalances and/or deficiencies predispose corn plants to stalk rot and stalk lodging. Both potassium and chloride deficiency have been shown to reduce stalk quality and strength, and stalk rot resistance. High nitrogen levels coupled with low potassium levels increase the amount of premature stalk death and create an ideal situation for stalk rot and lodging. Soil chloride levels should be maintained above 20 lbs per acre.

Figure 4. High plant density corn presenting late-season stalk lodging. Photo by Ignacio Ciampitti, K-State Research and Extension.

Corn rootworm and corn borers. Damage caused by the corn rootworm and the European corn borer can predispose the corn plant to invasion by stalk rotting organisms, as well as lead to outright yield loss.

Mid-season hail damage. Similar to the damage caused by insects, the physical damage caused by mid-season hail can set up the plant for invasion by stalk rotting organisms. Stalk bruising and the resulting internal damage may also physically weaken corn stalks, making them more likely to lodge later in the season.

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2. Understanding late-season purpling in corn

Favorable weather conditions in some areas of western Kansas have resulted in purple coloration of corn plants. When purple coloration occurs later in the season on the leaf, stem, husk, silk, or anther tissues, this can be related to the production and accumulation of a pigment called anthocyanin. Anthocyanin is derived from another pigment, "anthocyanidin," that is comprised of a sugar-like molecule. The accumulation of anthocyanin occurs when the plant is not capable of translocating sugars to different part of the plant.

Source (leaves): Sink (grains) Imbalance Issue

The late-season purple coloration phenomenon takes place when photosynthetically active tissues of the plants are acting as sources of sugars, while the sinks (ears – when present) are not utilizing sugars as fast as the sugars are being produced. When this happens, the flow of sugars within the plants is disrupted and the sugars can accumulate in various areas of the plants, causing an unusual purple coloration. This could be a result of several different factors:

- *Environment-by-genetic interaction* - There may be a specific hybrid response to environmental conditions, such as cool nights followed by sunny days, causing a buildup of sugars. The presence or absence of the genes associated with the production of anthocyanin is specific to certain hybrids.
- *Restricted root development* - Restrictions in root growth, which may be due to several different factors -- such as drought stress, saturated soils, soil compaction, cool temperatures, herbicide injury, insect feeding, or shallow planting -- may cause a reduced demand for sugars, thus increasing purple coloration. This situation is more likely to occur early in the vegetative stages.
- *Poor ear development or barren plants* - Ear development may be impaired by any number of factors (biotic and abiotic stresses), causing a disruption in the demand for sugars from photosynthesis. Barren plants (when ears are not present) tend to show this purpling in the leaves and stem. This can occur at almost any reproductive stage of the crop season.
- *Excellent growing conditions are providing more resources than needed* – The excellent growing season in some areas has resulted in healthy plants with significant amounts of photosynthetically active leaf area. Kernel abortion has been minimized, ears are completely filled, and thus there may be photosynthetic sugars in excess of what is needed by the grain filling process. This could be an indication that seeding rates were less than optimal for the conditions present.

Regardless of the specific factor that causes anthocyanin accumulation, the production of the purple coloration is associated with some kind of restriction in the utilization of carbohydrates produced during photosynthesis.

Purple coloration can occur on the stems or leaves (Figure 1). Purple coloration can also be seen in the reproductive structures such as husk, silk, and anther tissues (Figure 2).

Figure 1. Purple color on stem and leaves of corn plants during the vegetative period (five-leaf stage), due to buildup of anthocyanin. Photo by Ignacio Ciampitti, K-State Research and Extension.

Figure 2. Purple color on leaves of corn plants during the reproductive period. Photo by Ignacio Ciampitti, K-State Research and Extension.

With corn now nearing physiological maturity (black layer), the crop is advancing into the grain-fill period and reaching the end of its life cycle. As this process continues, water and nitrogen uptake by the roots will be decreasing until the end of the season. The root system has a very high demand for sugars at its peak of activity. As it decreases in physiological activity, sugars may accumulate in the lower sections of the stem (Figures 3 and 4).

Purple coloration problems have also been observed in situations with multiple ears, without indication of problems in ear size or grain set, and in plants located near field borders with sufficient soil-air resources. This indicates that the plant has an imbalance between sugar accumulation and allocation (Figure 4).

Figure 3. Darker purple color on the lower stem section of corn plants, due to buildup of anthocyanin.

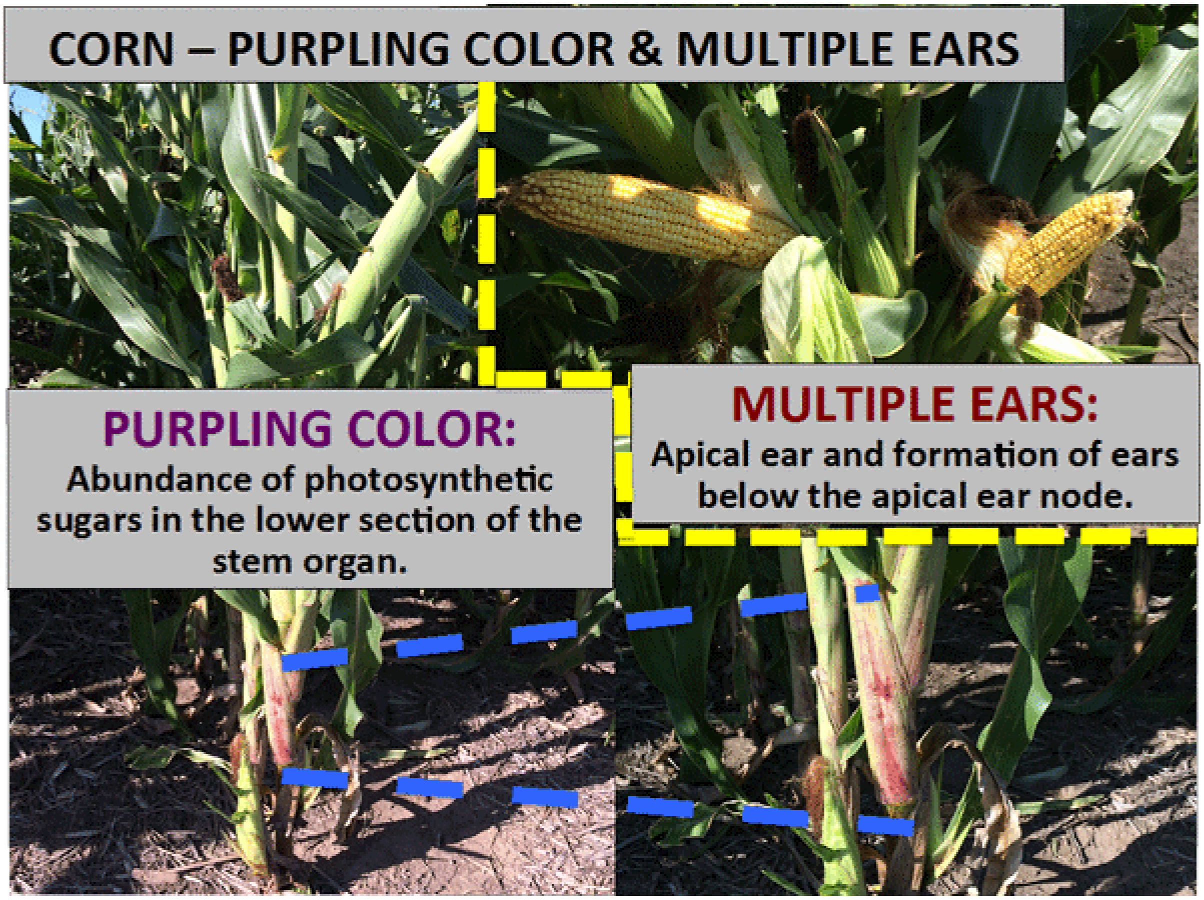

Figure 4. Purple color on the lower section of the stem on plants around milk stage (R3, reproductive stage) with the presence of multiple ears. Photo by Ignacio Ciampitti, K-State Research and Extension.

In summary, purpling is an indication of a surplus of photosynthetic sugars, generally promoted by an imbalance between source:sink (e.g., plant sugars are an excess of what is needed either due to poor kernel set or especially favorable conditions).

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3. Late-season purpling in grain sorghum

Purpling of plant tissues in sorghum can become more frequent during the fall. In many cases, this relates to an abundance of photosynthetic sugars and accumulation of a pigment called anthocyanin (reddish-purple pigment) within the plants. Anthocyanin is a sugar-containing glucoside compound. The accumulation of reddish-purple anthocyanin pigment within the plant is primarily due to an imbalance between continued production of photosynthetic sugars by leaves (the "source") and small demand for those sugars by grain (the "sink"). This results in sugar and anthocyanin buildup within the plants.

From a physiological perspective, such a sugar buildup might be related to biotic/abiotic stresses that resulted in poor pollination, which reduced the number of grains per head. When this happens, the total amount of grain produced by the head is insufficient to utilize all the sugars generated by photosynthesis. Thus, the sugars and anthocyanin accumulate in the leaves and stems.

Figure 1. Purpling in sorghum during grain filling. Photo by Ignacio Ciampitti, K-State Research and Extension.

Typically, symptoms occur in the upper stem and leaves, close to the head (Figure 1). Less frequently, the symptoms occur in lower sections of the stems (Figure 2). Purpling is occasionally found in heads with poor grain formation and when there has been stressful weather conditions around flowering (either before or after this stage), followed by a return to favorable conditions during grain filling.

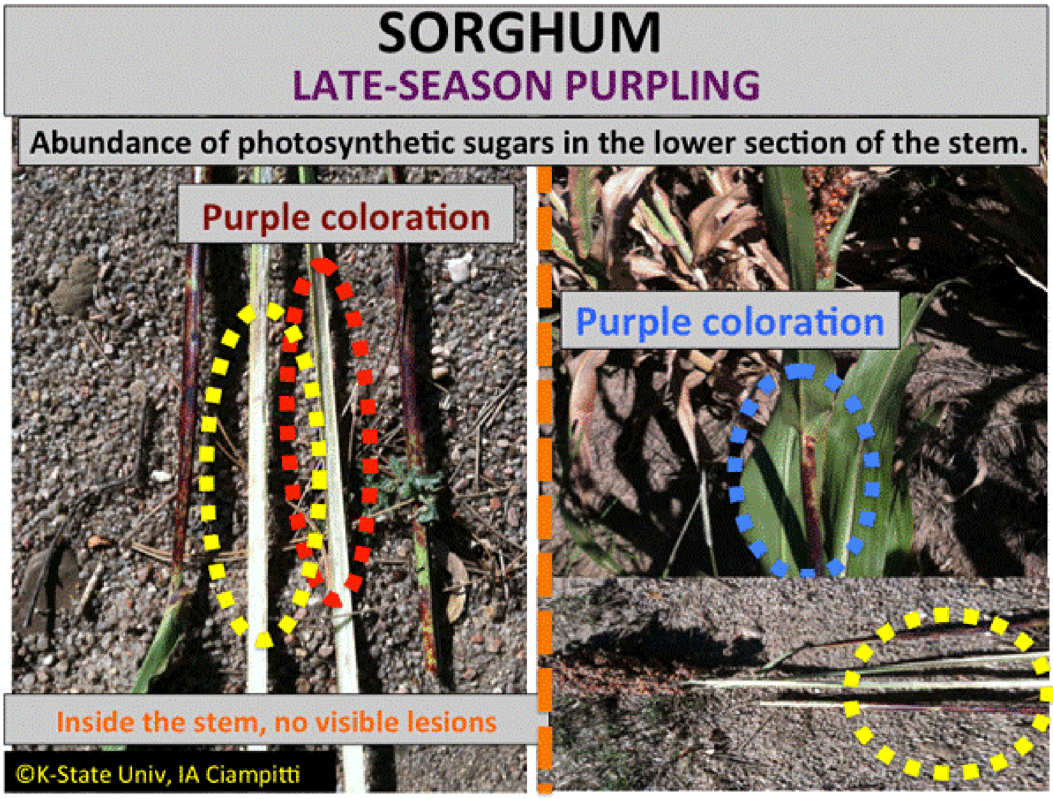

Figure 2. Reddish-purple sorghum plants during the grain-filling period. Photo by Ignacio Ciampitti, K-State Research and Extension.

To diagnose the cause of purpling in the stem, split the stem open to check for any damage or discoloration inside. If the stem is white with a creamy texture, and without brown spots or lesions, this indicates the stem is still functional and mobilizing nutrients (carbon) and water from the main plant to the head. In that case, we can say that the purpling is related to an accumulation of sugar within the plant due to lower-than-normal demand by the grain.

Regardless of the specific factor causing this buildup of reddish-purple coloration by anthocyanin late in the season, the purpling does not affect plant functionality. Instead, it is a warning sign associated with the occurrence of an earlier stress that affected the plant and reduced grain development.

Purpling in sorghum can also become more apparent as cooler temperatures slow the movement of plant sugars into grain. This results in a lower than normal demand by the grain as described above and the associated accumulation of photosynthetic sugars. This is often apparent in high elevation areas of western Kansas and areas of northwest Kansas that are typically the first to experience cooler temperatures, especially nighttime temperatures, as grain sorghum is completing the grain filling stages.

Will the purpling reduce yields?

Not directly, but whatever stress occurred earlier to reduce grain counts within the head will almost surely affect yields. A reduction in grain counts due to any biotic (insects, diseases) or abiotic (heat, drought) stresses will produce an unbalance of sugar and anthocyanin buildup if weather conditions during the reproductive stages are favorable for good photosynthesis and plant growth (Figure 3).

Figure 3. Purpling in sorghum, September 2016. Photo by Tom Maxwell, K-State Research and Extension.

Remember to continue scouting your acres for early identification of any potential problems affecting your crops before harvest time.

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4. Soybean dry down rate before harvest

The latest USDA-National Agricultural Statistics Service crop progress and condition report classified 56% of the soybean crop to be in good or excellent condition. Overall, 28% of all soybeans in Kansas are dropping leaves.

The weather conditions expected for mid-September to mid-October will be critical for soybeans as related to seed filling and determining final seed weight.

While current conditions have been warmer-than-average, temperatures are expected to trend towards cooler-than-normal during the next 8 to 14 day period. This pattern is expected to continue for October. There is a slight chance for wetter-than-normal conditions in the short term (6-10 days), but the outlook for October favors equal chances for wetter-than-normal conditions in the southwestern third of the state, and equal chances for the rest of the state. Keep in mind that there is a significant drop in normal rainfall amounts from September to October as we move into what is typically the drier part of the year.

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.

Changes in the water content during the seed-filling process (Figure 1) were previously described in our "Soybean Growth and Development" poster. 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.

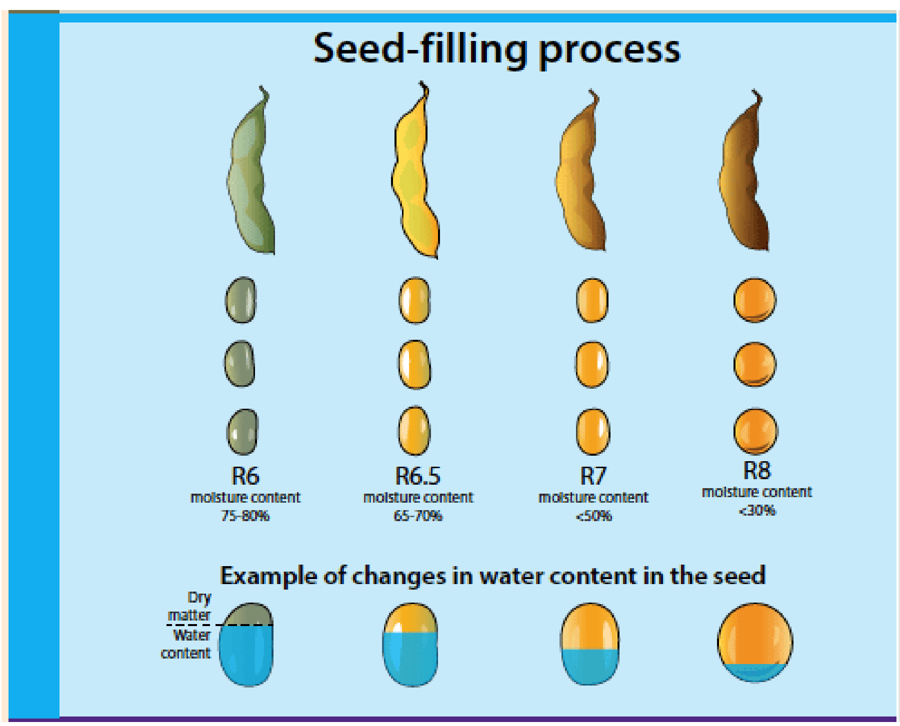

Figure 1. Soybean seed filling process from full seed to full maturity. Photo and infographic prepared by Ignacio Ciampitti, K-State Research and Extension. Taken from Soybean Growth

[and Development](#).

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.

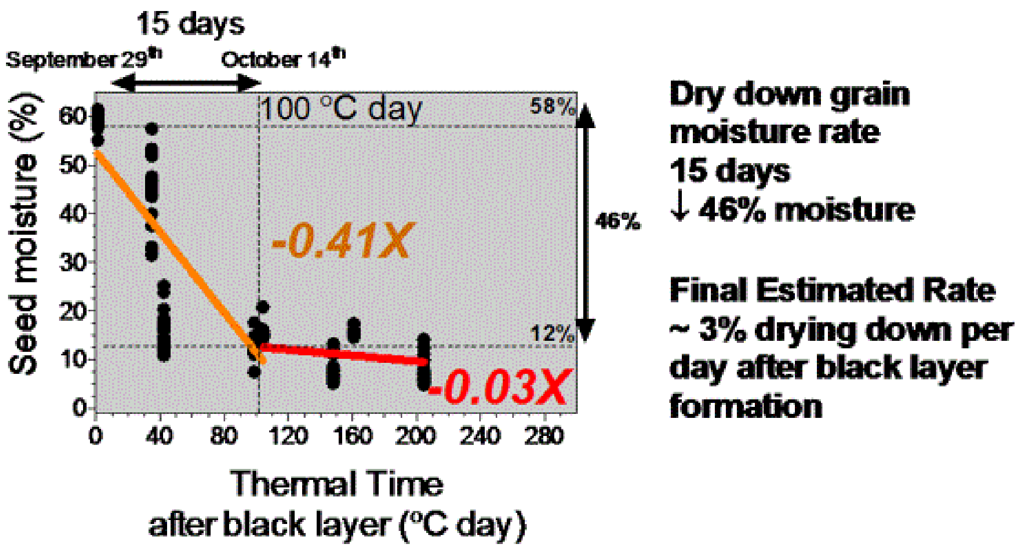

Figure 2. Grain moisture dry down (orange line) across three hybrids and different N rates near Manhattan, KS. Horizontal dashed lines marked the 58% seed moisture at black layer formation.* Graph prepared by Ignacio Ciampitti, K-State Research and Extension.

*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.

For more information on dry down rates for corn, see the eUpdate article, "Rate of dry down in corn before harvest", in the September 7, 2018 issue.

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5. Fall control of bindweed

Field bindweed is a deep-rooted perennial weed that severely reduces crop yields and land value. This noxious weed infests just under 2 million acres and is found in every county in Kansas. Bindweed is notoriously difficult to control, especially with a single herbicide application. In fall but prior to a killing freeze, can be an excellent time to treat field bindweed -- especially in a year when good fall moisture has been received. This perennial weed is moving carbohydrate deep into its root system during this period, which can assist the movement of herbicide into the root system.

Figure 1. Field bindweed ready for a fall treatment. Photo by Curtis Thompson, K-State Research and Extension.

The most effective control program includes preventive measures over several years in conjunction with persistent and timely herbicide applications. The use of narrow row spacings and vigorous, competitive crops such as winter wheat or forage sorghum may aid control. No-till has been very beneficial for managing bindweed by providing routine herbicide treatments through time and not breaking up the root system and dragging root segments around the fields. No-tillage maintains much of the bindweed seed soil bank at a depth too deep to germinate. It is common to see a resurgence of bindweed after tilling fields that have been in long-term no-till.

Dicamba, Tordon, 2,4-D ester, Facet L (also generics) and glyphosate products alone or in various combinations are registered for suppression or control of field bindweed in fallow and/or in certain crops, pastures, and rangeland. Apply each herbicide or herbicide mixture according to directions, warnings, and precautions on the product label(s). Single herbicide applications rarely eliminate established bindweed stands.

Applications of 2,4-D ester and glyphosate products are most effective when spring-applied to vigorously growing field bindweed in mid to full bloom. However, dicamba and Tordon applications are most effective when applied in the fall. Herbicide treatments are least effective when applied when bindweed plants are stressed.

Facet L, at 22 to 32 fl oz/acre, a new quinclorac product that replaced Paramount at 5.3 to 8 oz, or QuinStar quinclorac products, can be applied to bindweed in fallow prior to planting winter wheat or grain sorghum with no waiting restrictions. All other crops have a 10-month preplant interval. Quinclorac products can be used postemergence in sorghum to control field bindweed during the growing season. In past K-State tests, fall applications of Paramount have been very effective as shown below (Tables 2 and 3).

Additional noncropland treatments for bindweed control include Krenite S, Plateau, and Journey.

Considerable research has been done on herbicide products and timing for bindweed control. Although the research is not recent, the products used for bindweed control and the timing options for those products haven't changed much since this work was done. As a result, the research results in the tables below remain very useful today.

Table 1. Fall vs. spring and summer herbicide application for control of field bindweed in the Texas Panhandle: 1976-1982.

		Season of application		
	Rate (lbs ai/acre)	Spring (April or May)	Summer (June, July, or Aug.)	Fall (Sept. or Oct.)
Treatment	**% Control one year after treatment**			
Glyphosate	2.9	83	77	60
Dicamba	1.0	56	41	71
2,4-D ester	1.0	65	49	55
Tordon + 2,4-D ester	0.25 + 0.5	55	56	84
Tordon + Dicamba	0.25 + 0.25	47	73	87
Tordon + Glyphosate	0.20 + 1.6	52	73	79
	% Control two years after treatment			
Glyphosate	2.9	67	63	32
Dicamba	1.0	31	37	34
2,4-D ester	1.0	46	42	10

Source: Field Bindweed Control in Field Crops and Fallow, MF-913
http://www.ksre.ksu.edu/bookstore/pubs/MF913.pdf

Table 2. September-applied treatments for control of field bindweed: Randall Currie and Curtis Thompson, Southwest Research-Extension Center 1992-1993.

Treatment	Rate	Average % control in spring
Dicamba	4 oz	31
Dicamba	8 oz	44
Dicamba	1 pt	85
2,4-D	1 pt	48
Dicamba + 2,4-D	8 oz + 8 oz	82
Paramount	5.3 oz	91
Paramount + Dicamba	5.3 oz + 4 oz	98
Paramount + Dicamba	5.3 oz + 8 oz	97

Source: 1995 Field Day Southwest Research-Extension Center, Report of Progress 739
http://www.ksre.k-state.edu/historicpublications/pubs/SRP739.pdf

Table 3. September-applied treatments for control of field bindweed: Randall Currie, Southwest Research-Extension Center 1992-1997.

Treatment	Rate	Average % Control in Spring
Dicamba	4 oz	19
Dicamba	8 oz	65
Dicamba	1 pt	89
2,4-D	1 pt	72
2,4-D	1 qt	81
Glyphosate	1 qt (IPA)	68
Paramount	5.3 oz	90
Tordon	8 oz	75
Tordon	1 pt	98

Source: 1999 Field Day Southwest Research-Extension Center, Report of Progress 837
http://www.ksre.k-state.edu/historicpublications/pubs/SRP837.pdf

For more information on controlling bindweed, see 2018 Chemical Weed Control for Field Crops, Rangeland, Pastures, and Noncropland, K-State publication SRP-1139.

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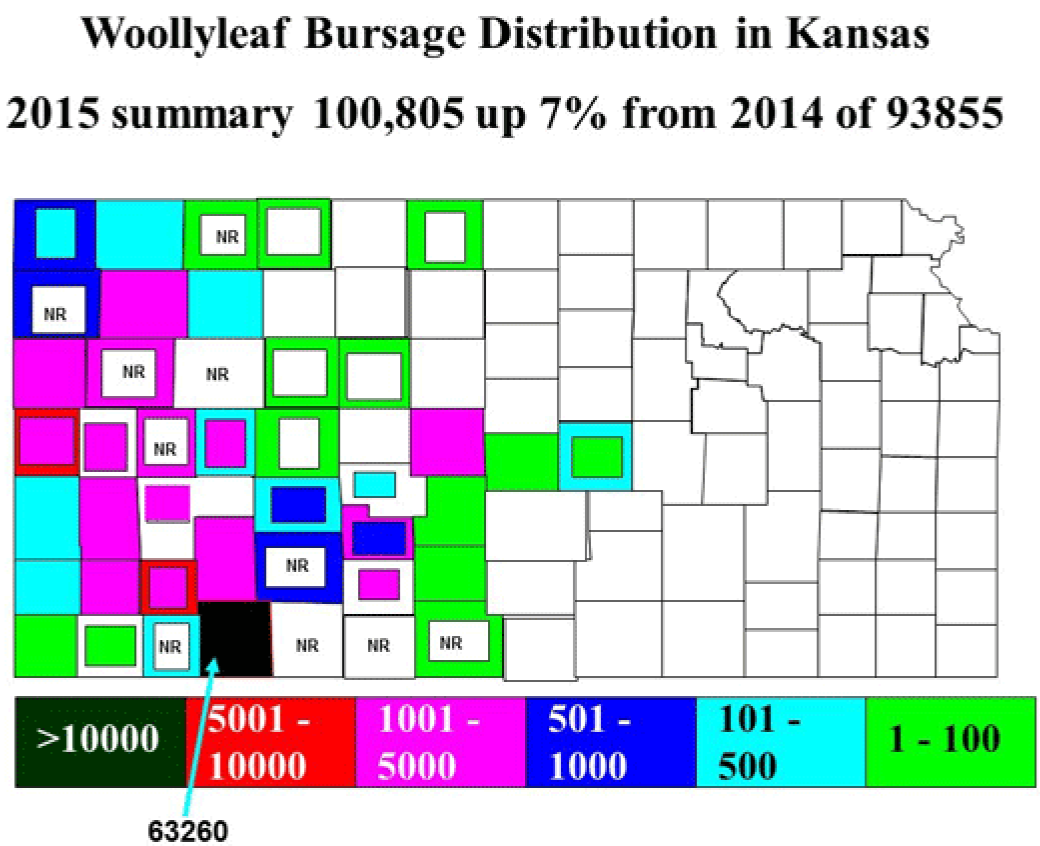
6. Bur ragweed control with early fall treatments

With good moisture conditions in parts of Kansas this year, this is a good time to treat fields for perennial broadleaf weeds such as bur ragweed, bindweed, and Canada thistle.

Bur ragweed (also called woollyleaf bursage) is a perennial broadleaf weed, and is classified as a noxious weed in Kansas. It is a significant problem on nearly 94,000 acres in the western half of the state. It is adapted to low areas where water runoff collects in cultivated fields or in noncropland areas. Its ability to extract water with its deep perennial root system, which can reach a depth of 15 feet, allows bur ragweed to survive extended periods of drought or harsh weather. These circumstances make it very difficult to control.

Figure 1. Bur ragweed. Photo by Curtis Thompson, K-State Research and Extension.



2. Distribution of bur ragweed in Kansas, in terms of acreage.

Bur ragweed is extremely competitive with crops, and can reduce grain yield by 100 percent in dry years. Even with irrigation, losses of 40 to 75 percent are common. Bur ragweed is more competitive with summer crops than with winter wheat because bur ragweed growth is minimal during much of the winter wheat life cycle. However, in dry years, bur ragweed will deplete soil moisture for fall-planted wheat and without adequate moisture will thereby reduce grain yield significantly.

Flower development begins in late July or early August. Seed contributes to the spread of bur ragweed and likely is a source of new infestations. New plants also arise from the vegetative buds, which develop on the root stocks, thus contributing to the spread of bur ragweed. Tillage also can redistribute vegetative buds, aiding the spread of bur ragweed.

Bur ragweed control is best when treated in late summer or fall, prior to a killing frost, with Tordon tank mixed with dicamba or 2,4-D ester. Control will not be as effective if the bur ragweed plants are under stress at the time of treatment. Bur ragweed is a difficult weed to control, and a single treatment application will usually not be sufficient. A fall treatment with the herbicides mentioned above followed by glyphosate treatments in glyphosate-tolerant crops during the growing season can help manage bur ragweed long-term. However, spring crops may be injured severely from fall applications of Tordon. Wheat has the most tolerance and can be planted 45 days following a ½ pint of Tordon 22K application. Grain sorghum can be planted 8 months after application of 1 pt Tordon

22K. Apply each herbicide or herbicide mixture according to directions, warnings, and precautions on the product label(s).

Table 1. Control of bur ragweed in western Kansas with mid-September treatments

Treatment	Rate	% Control 11 months after treatment (2-year average)
Tordon + Banvel	1 pt +1 pt	82
Tordon + 2,4-D LV4	1 pt + 1 qt	74
Roundup Power Max + Banvel	44 oz + 1 pt	16
Roundup Power Max + 2,4-D LV4	44 oz + 1 qt	27

Source: Woollyleaf Bursage Biology and Control, MF 2239
http://www.ksre.ksu.edu/bookstore/pubs/MF2239.pdf

For more information, see 2018 Chemical Weed Control for Field Crops, Rangeland, Pastures, and Noncropland, K-State publication SRP-1126, or *Woollyleaf Bursage Biology and Control*, K-State publication MF-22239.

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7. Kansas Bankers Association Awards nominations due by November 5

Nominate a deserving Kansas producer or landowner for the 2018 Kansas Bankers Association Conservation Awards Program. This year, the Kansas Bankers Association, K-State Research and Extension, and the Kansas Department of Wildlife, Parks, and Tourism have announced six award categories:

- Energy Conservation
- Water Quality
- Water Conservation
- Soil Conservation
- Windbreaks
- Wildlife Habitat

The purpose of this program is to stimulate a greater interest in the conservation of the agricultural and natural resources of Kansas by giving recognition to those farmers and landowners who have made outstanding progress in practicing conservation on their farms. Last year 185 Kansas producers and landowners were recognized through this program.

Nominations can be made by any person in the county. They should be sent to the County Extension Agricultural Agent or the Kansas Department of Wildlife, Parks, and Tourism District Biologist by November 5, 2018.

The K-State Extension agent for Agriculture and Natural Resources, or the Extension Coordinator, is designated Chairperson of the committee to select persons to receive awards.

For more information, see:
http://www.agronomy.k-state.edu/extension/kansasbankersaward/kansas-bankers-awards.html

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