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Extension Agronomy

eUpdate

09/28/2018

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. Wheat planting conditions as of late-September 2018

September has returned to a wetter pattern in the west (Figure 1). In the majority of the wheat growing region of the state, namely central and western Kansas, this was accompanied by warmer than normal temperatures and windy conditions. Therefore, estimated root zone soil moisture is relatively low in the west as compared to eastern Kansas (Figure 2).

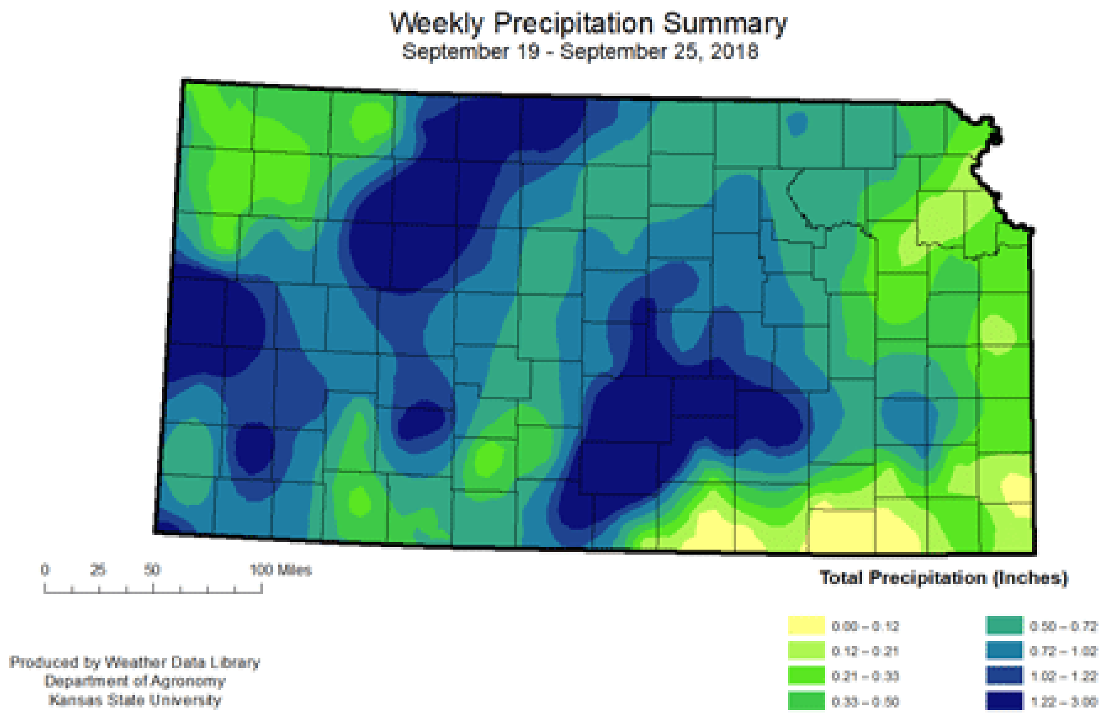

Figure 1. Total cumulative precipitation in the period between September 19 and 25, 2018. Map by K-State Weather Data Library.

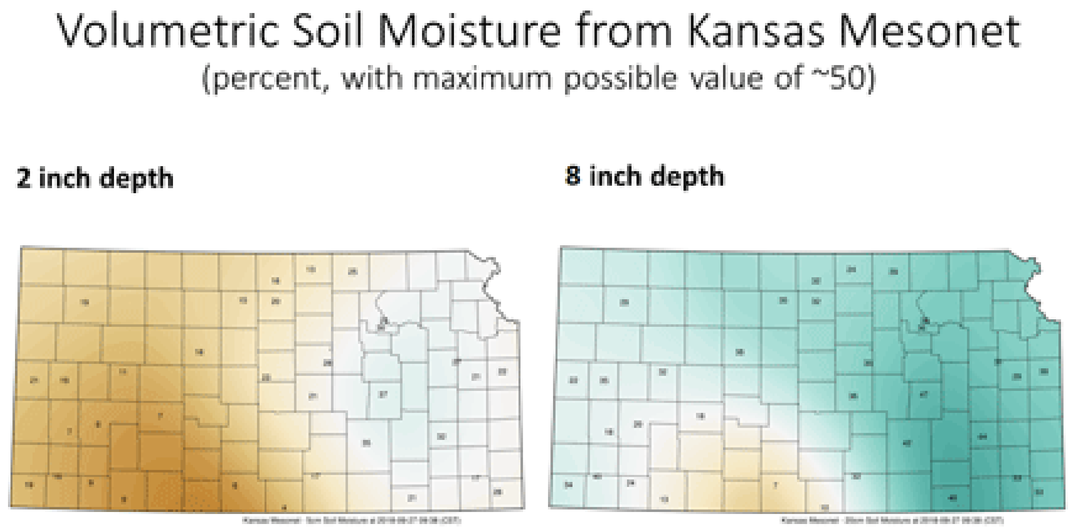

Figure 2. Measured surface soil moisture in percent of soil volume as of 27 September 2018. Map by Kansas Mesonet.

Weather Forecast

The weekly precipitation forecast for Kansas indicates that the probability of precipitation for the next 7 days exists for totals ranging from 0.1 inches in western Kansas to as much as 1.75 inches in the eastern portion of the state (Figure 3). Despite the drier profile in western Kansas, the forecast is favorable and might bring much needed moisture for a good start to the wheat-growing season.

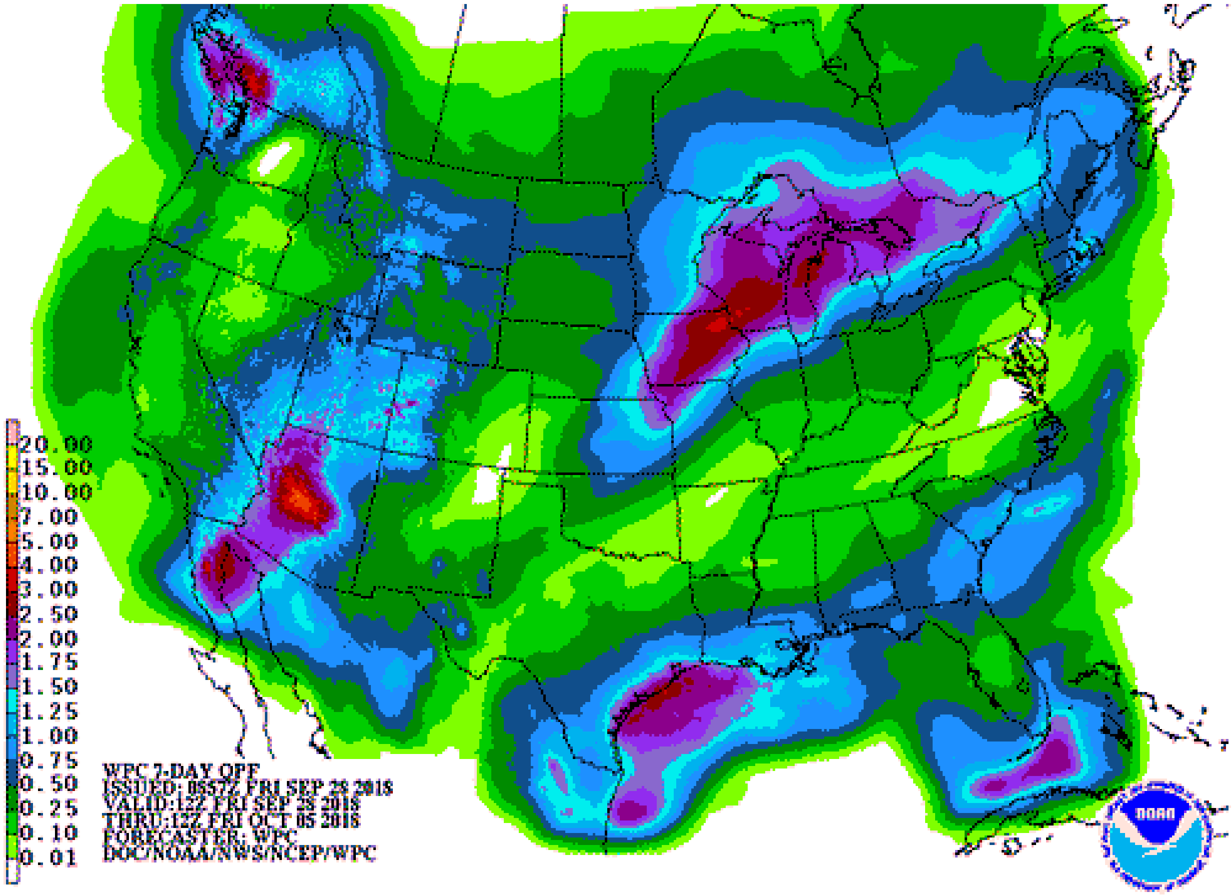

Figure 3. Weekly precipitation forecast as of September 28, 2018 by the National Weather Service Weather Prediction Center (NOAA). Precipitation probabilities in Kansas for the next 7 days' range from 0.10 to 1.75 inches.

Possible challenges for wheat planting and crop establishment

The current wheat planted acreage in Kansas, according to the USDA-NASS crop progress report, was 21% as of September 28. This is slightly below the 1994 – 2016 average of 30% (Figure 4), and the crop might be favored by the forecast rain.

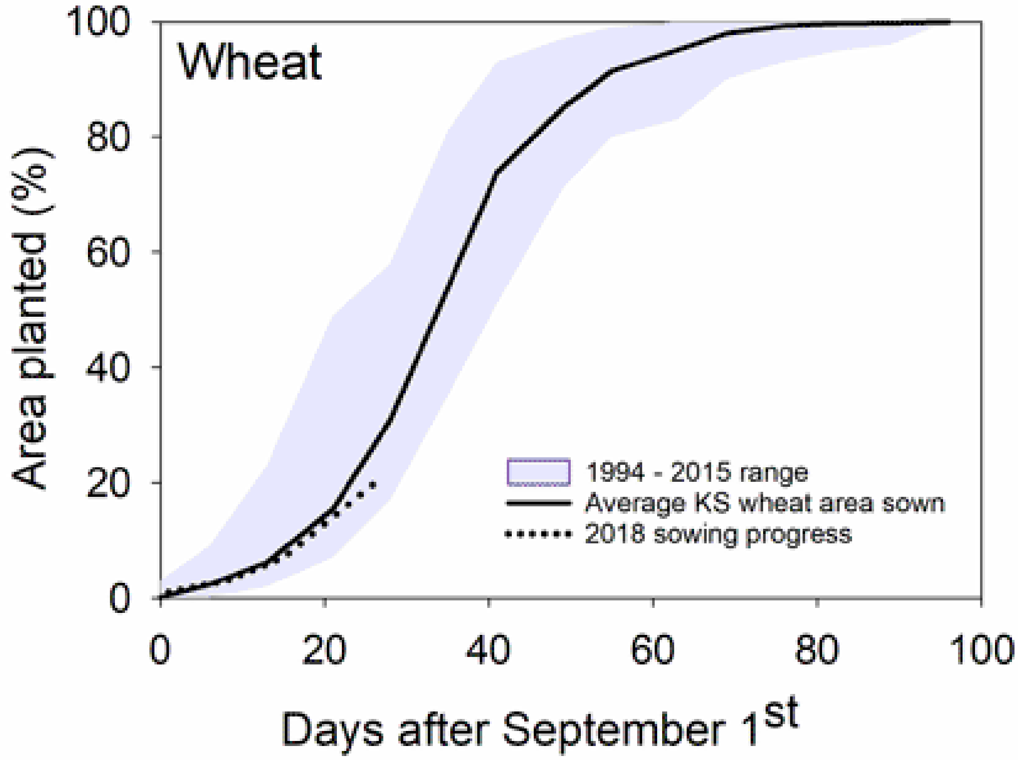

Figure 4. Percent wheat area in Kansas planted by as function of time; starting September 1. Purple area and solid line show the long-term range and average, and the dotted line shows 2018 progress. Data shown for the period 1994 – 2018 as reported by the USDA-NASS Crop Progress Reports (https://www.nass.usda.gov/Publications/National_Crop_Progress/).

One challenge that fields already planted can face is high soil temperature stress, which can lead to germination problems especially in wheat varieties with high-temperature germination sensitivity (varieties that will not germinate when soil temperatures are greater than 85 degrees F). Average weekly 2-inch soil temperature during September 22-28 ranged from 64 to 72 degrees F (Figure 5). Earlier planted wheat likely encountered soil temperatures above 85 degrees F resulting in poor germination due to hot soil temperatures. Sufficient rainfall event will continue to decrease soil temperatures and germination should occur.

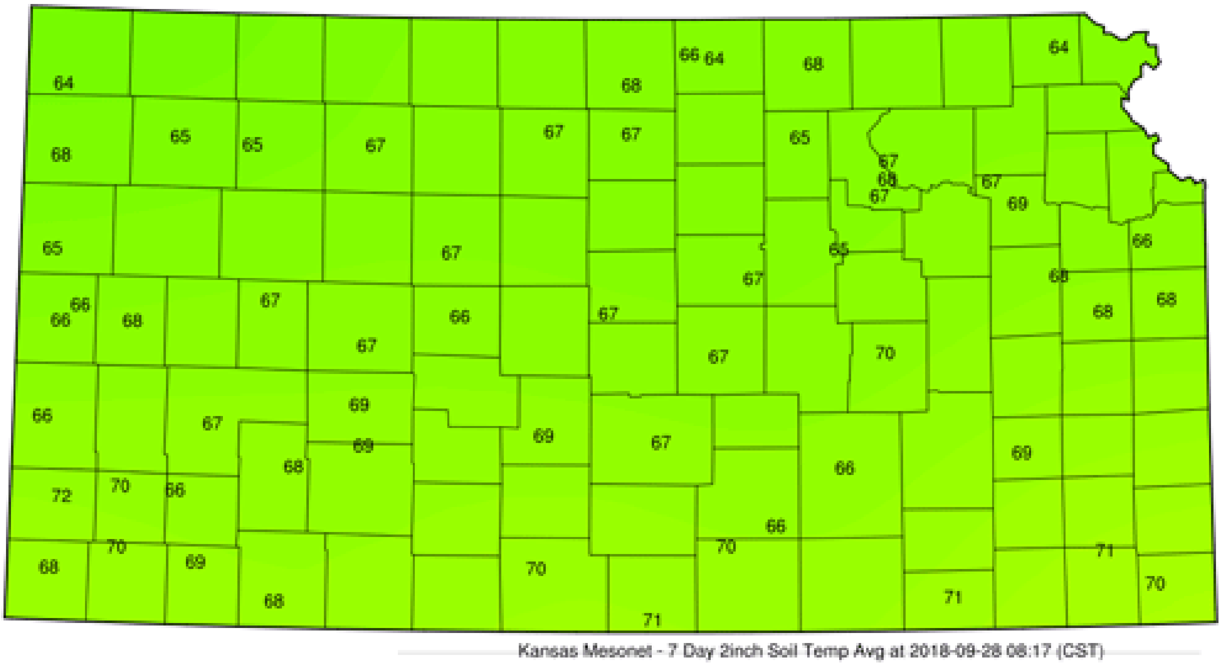

Figure 5. Weekly average 2-inch soil temperature during the September 22 – 28 period. Map by Kansas Mesonet.

With about 80% of the winter wheat area still to be planted, the crop sowing progress in the following days will depend on weather conditions. While many producers might try to plant some acres before the forecast rain, a delay in planting progress can be expected after the rains, especially in central Kansas, depending on total precipitation and soil moisture conditions.

If precipitation is excessive, producers should not hurry and sow wheat into extremely moist soils. Planting wheat under wet conditions can present either mechanical or biological challenges.

Mechanical challenges include:

- Inability to get the equipment in the field to perform plowing or sowing operations.
- Mudding up the equipment after field operations are started.
- Increased soil compaction due to machinery traffic in moist soils. Soil compaction can restrict adequate root growth, affecting plant anchorage and decreasing its ability to uptake water and nutrients.

Biological challenges include:

- Delayed crop emergence due to wet and cold soils.
- Possibly increasing early-season disease and insect problems.

Planting wheat into a dry topsoil can also be challenging. While a good seed distribution is generally achieved when sowing wheat into dry soils, if the forecast rain does not materialize, the lack of moisture for germination can result in uneven stands and high within-field stand variability (Figure 6), which can ultimately impact grain yield. Otherwise, the forecast rain will help ensure a good stand establishment.

Figure 6. Uneven wheat stands resultant from sowing into dry soils. Photo by Romulo Lollato, Extension wheat and forage specialist.

Even in late September, we are still in the optimum planting date range for wheat for most of the state, so producers should not hurry and sow wheat into extremely moist soils. Waiting for the water to drain and/or evaporate so the soil dries adequately before performing the sowing operation would be the best option.

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2. Wheat variety selection and the emerging vulnerability to stem rust in Kansas

In recent years, diseases like stripe rust and wheat streak mosaic have drawn the attention of many wheat growers in Kansas. This attention is justifiable given that recent outbreaks of stripe rust and wheat streak mosaic have cost growers more than $200 million in the last 3 years alone. Unfavorable weather patterns such as drought or freeze injury, and heat stress during grain fill, have also further damaged the crop in recent years and have contributed to declines in overall productivity and loss of potential income for growers.

Wheat growers in Kansas are making some adjustments to reduce their risk of disease and other hazards influencing their wheat production. One way that growers are responding is by selecting varieties that better able to tolerate drought and mature slightly later than other varieties, thus reducing the risk that the crop will be damaged by a late spring freeze. Some producers are also moving toward varieties that have better genetic resistance to wheat streak mosaic and stripe rust. While these are important adjustments that can reduce the risk of yield loss to the current problems, a closer look at these varieties suggests that we may be unknowingly exposing ourselves to other wheat production threats simply because we are making some potentially incorrect assumptions. Let me explain…

In a sense, the population of wheat varieties available to growers goes through a selection process every year. That sounds very academic, but here is the pattern. We are naturally drawn to select wheat varieties that yield well in our area. This performance is a product of how well a variety handles the weather conditions and diseases that dominated this year or during the most recent 2-3 years of testing. On the surface, this makes perfect sense, but let us look at some potential pitfalls of this approach. This strategy works well as long as production conditions remain similar to the years of testing, or if the varieties have characteristics that allow them to be successful over a broad range of conditions (weather, disease, soil types, etc.) that occur within a region. Problems can emerge; however, if we select varieties that perform well in the short term (1-3yrs) but are not well adapted for the full range of conditions that may occur. When the variety encounters conditions that expose a previously unrecognized vulnerability, its productivity can drop dramatically.

This pattern repeats its self with respect to many characteristics, but let us consider an example related to disease susceptibility. Specifically, let us look at the trend toward growing wheat varieties in Kansas that are highly susceptible to stem rust. Now you might be thinking to yourself, “Do they really mean stem rust? When was the last time we saw an outbreak of stem rust in Kansas or the Great Plains?” These are valid questions. It has been a long time since we had serious problems with stem rust in Kansas (it was 1986, in case you are wondering). Interestingly, there is a strong correlation between the decades without an outbreak of stem rust and the wide spread use of wheat varieties with genetic resistance to the disease. It turns out that the last time we were planting many acres to stem rust susceptible varieties was… (Yep, you guessed it) 1986. The concern here is that it has been so long since we have experienced major problems with stem rust, that we are assuming that this disease is no longer a threat. As a result, we are allowing this base of genetic resistance to erode through our variety selection decisions.

Figure 1. Stem rust is able to attack leaves, stems, and heads of the wheat. When severe, stem rust causes yield losses exceeding 40%. To make matters worse, the stem damage caused by stem rust also predisposes plants to lodging and complicates harvest operations. Photo by Erick DeWolf, K-State Research and Extension.

Recent data on the wheat varieties grown in Kansas indicates that the percentage of acres planted to stem rust susceptible varieties has increased dramatically in the past decade (Figure 2). In 2018, stem rust susceptible varieties were grown on almost 35% of the acres in western Kansas, as compared to near 0% of the acres in 2009. The trend is also present to a lesser extent in central Kansas, where the acres planted to stem rust susceptible varieties is approximately 10%. There are multiple varieties responsible for this trend including (in alphabetical order) Avery, Byrd, Brawl CL Plus, LCS Mint, LCS Pistol, T158, and TAM 114 (Figure 2, inset). Given the recent release of high yielding varieties that are also susceptible to stem rust (Langin and Lonerider, for example), this trend is likely to continue.

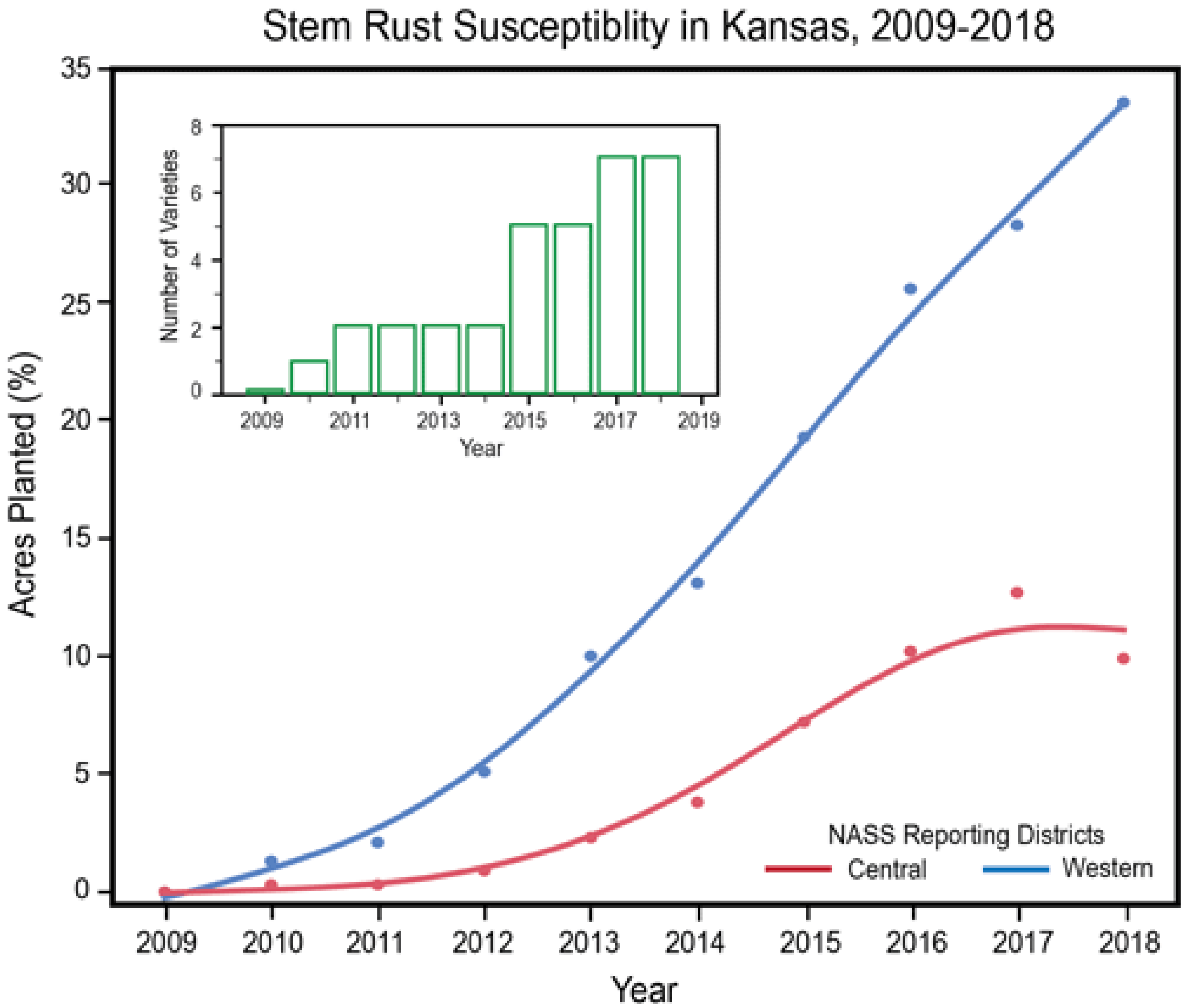

Figure 2. Trends in number of varieties widely marketed and planted in Kansas that are susceptible to stem rust. Figure by Erick DeWolf, K-State Research and Extension.

A similar trend toward stem rust susceptibility is occurring throughout the southern and central Great Plains. Recent variety surveys indicate that more than 40% of the wheat varieties planted in Eastern Colorado are highly susceptible to stem rust. The distribution of susceptible varieties extends into Oklahoma, Nebraska and Texas with more than 9% of the acres planted to susceptible varieties within some important wheat producing regions (Figure 3). The presence of stem rust susceptible acres in the southern US is critical because the disease is more likely to survive the winter in these regions. An outbreak of stem rust in Texas dramatically increases the risk of disease problems in Kansas, Colorado and Nebraska.

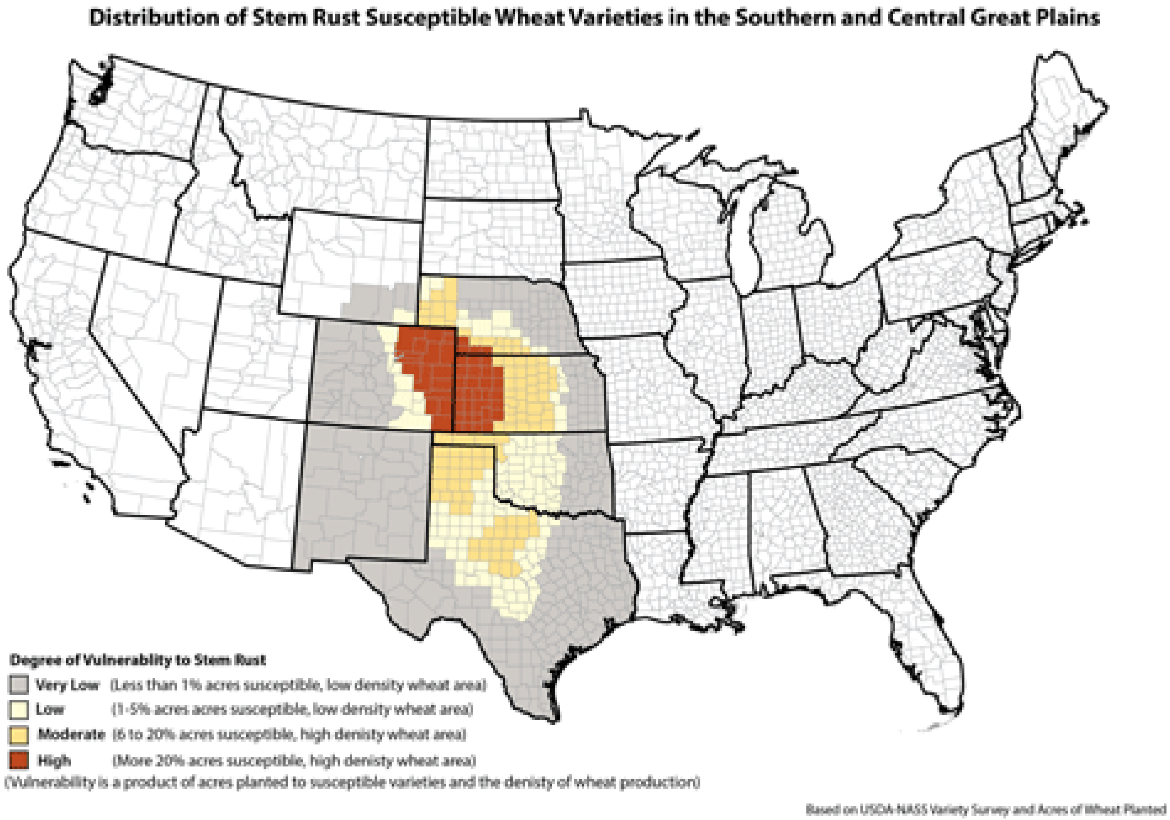

Figure 3. Percentage of acres planted to stem rust susceptible varieties is the central and southern Great Plains. Map by Erick DeWolf, K-State Research and Extension.

Returning to the patterns of variety selection and underlying assumptions, we would ask, “Are we unknowingly creating a vulnerability to stem rust through our variety selection?” The current variety surveys indicate that we are assuming that conditions will remain similar to recent years and that stem rust will remain a minor concern. At the same time, our variety choices are eroding the base of genetic resistance that help to ensure that stem rust remains a minor problem.

Disease epidemics are influenced by many factors including weather and regional use of genetic resistance. If an outbreak of stem rust did occur within the next few years, many growers would likely use fungicides to slow the spread of disease and reduce yield losses. This costly and incomplete solution is complicated by the need to manage multiple diseases each potentially requiring different application timing and methods. Fortunately, there is an alternative. We can take corrective action by simply selecting varieties that are well adapted for the wheat production in Kansas and have stem rust resistance (Table 1). We have good options available, so let’s use them. Hopefully we can address this vulnerability before we have serious problems in our wheat.

Table 1. Wheat varieties with a good yield record and resistance to stem rust.

Hard Red Wheat	**Hard White Wheat**
Bob Dole	Antero
DoubleStop CL Plus	Danby
Everest	Joe
Gallagher	
Larry	
Oakley CL	
SY Monument	
SY Grit	
SY Rugged	
WB Grainfield	
WB 4303	
WB 4458	
WB 4721	
Tatanka	
Zenda	

Varieties listed in alphabetical order

For a more complete listing of see "Wheat Variety Disease and Insect Ratings 2018" (MF991) from K-State Research and Extension.

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3. Forecasting 2018 Kansas corn yields

Precise and reliable yield forecast tools could play a foundational role in supporting policy formulation and decision-making processes in agriculture. For farmers, reliable yield forecasts might represent a source for considering changes in management practices during the reproductive phase of the field crops.

For this study, a final yield forecast tool was developed by utilizing satellite imagery of current corn growing conditions across the state. The main steps to forecast yields were:

1) Data collection (2009-2017 period)

a) USDA-National Agricultural Statistics Service (NASS) county-level data was collected to determine yield distributions at the district level.

b) MODIS (820-ft x 820-ft pixel size) satellite information with an image every 8 days until the beginning of August

c) CropLand Data Layer or spatial distribution of the different crops throughout the state

2) Building and Validation of Yield Forecasting Models (YFM)

a) For building the models, NDVI (Normalized Difference Vegetation Index) was utilized, collected from corn producing regions within a county.

b) Yields at the county-level were estimated before harvest from satellite information and compared against the final yields reported by USDA-NASS at the county-level.

3) Building and Validation Layer for Corn 2018

Information from the CropLand Data Layer is available for corn in Kansas from 2006 until 2017 – but current corn locations across the state are not available for the 2018 season until next year. Therefore, a complex statistical technique was employed (random forest prediction) to predict corn geo-locations across the state for the current season.

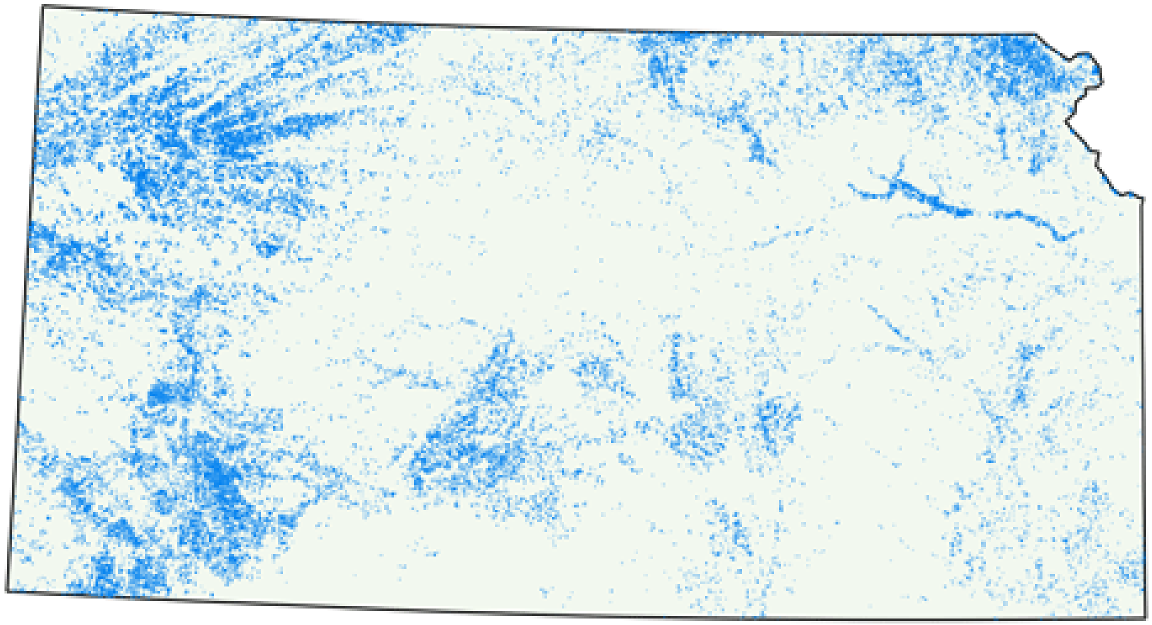

Figure 1. Geolocation for corn fields predicted by the Random Forest classification model for 2018.

4) Validation of previous years

Forecasted yield at the state-level from previous years (2009-2016) was validated by comparing those yields with the August yield estimation and the final yield from USDA-NASS. The yield forecasted via the satellite model was quite precise in predicting the yields from past-seasons.

5) 2018 Kansas Corn Yield Forecast

As a last step on the yield estimation, the yield and crop map models previously built were utilized to forecast the 2018 corn yield for Kansas. Satellite information from planting until the present was aggregated to provide a more reliable yield prediction.

Based on the satellite yield model developed by our team, the state-level yield prediction will be 130 bushels per acre (termed in Figure 2 as "Sat. October"), which is close to both the August and September yield estimations of 129 and 131 bushels per acre released by USDA-NASS.

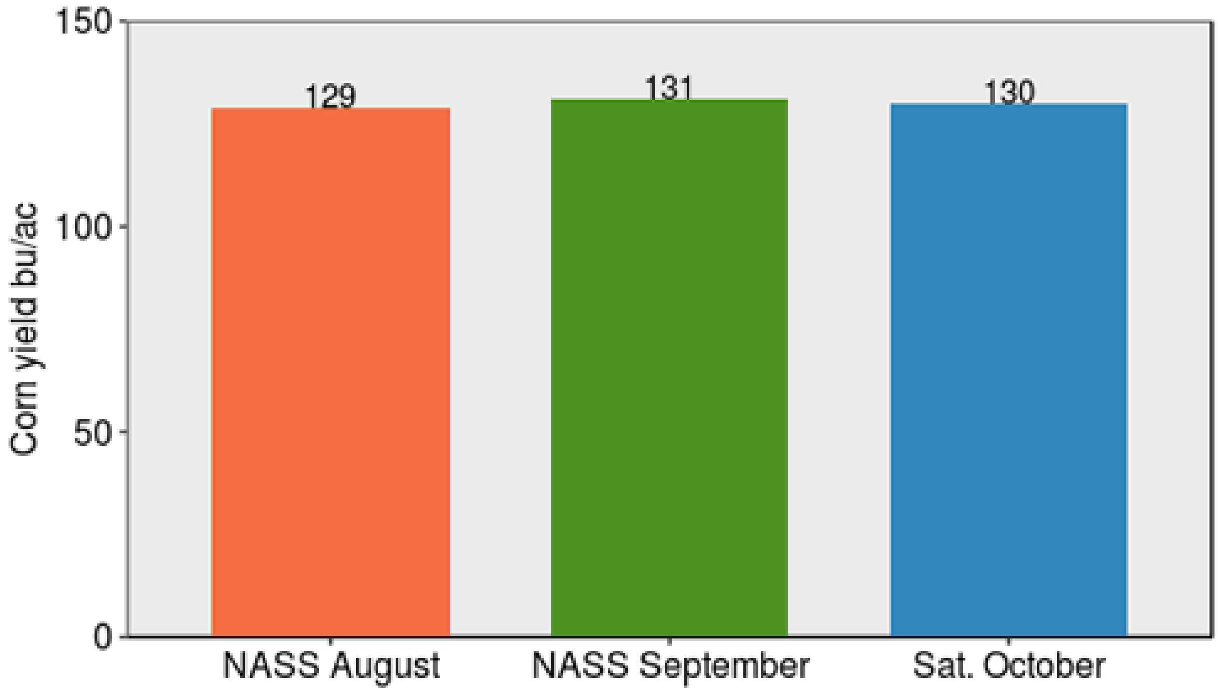

Figure 2. Forecasting corn yields derived from satellite data for the state of Kansas.

As a last step, we are currently working on a providing yield estimates at county-level for our next yield forecast, so stay tuned for further details on this coming release.

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4. Green stem syndrome in soybeans

Soybean harvest is slowly starting across the state (2% complete, according to the USDA Kansas Agricultural Statistics report from September 24), which is near the last 5-year average. Soybean seed filling conditions were quite variable across the state and greenness remains in some fields.

Green stem syndrome in soybean is a condition by which the stem remains green while the seeds are mature and ready to harvest. In parts of the state, there are many fields of soybeans with brown pods but green stems (Figures 1, 2, and 3). A hard freeze will kill the leaves and stems, but it still may take a while for the leaves to drop if leaves are still green.

Producers can either harvest these soybeans now if the seed moisture is dry enough, or wait until the leaves have dropped and the stems have dried down. In most cases, it would be best to harvest sooner rather than later to reduce losses from shattering and lower seed quality. Harvesting beans before the leaves have dropped can be messy and gum up the combine, but at least the yield level will be maintained. Harvesting soybeans with green stems can be challenging. Make sure harvesting equipment is sharp and in top condition, and take it slow in the field.

Figure 1. Green stems and brown pods (seeds are mature) characterize green stem syndrome in soybean. Infographic developed by Ignacio Ciampitti, K-State Research and Extension.

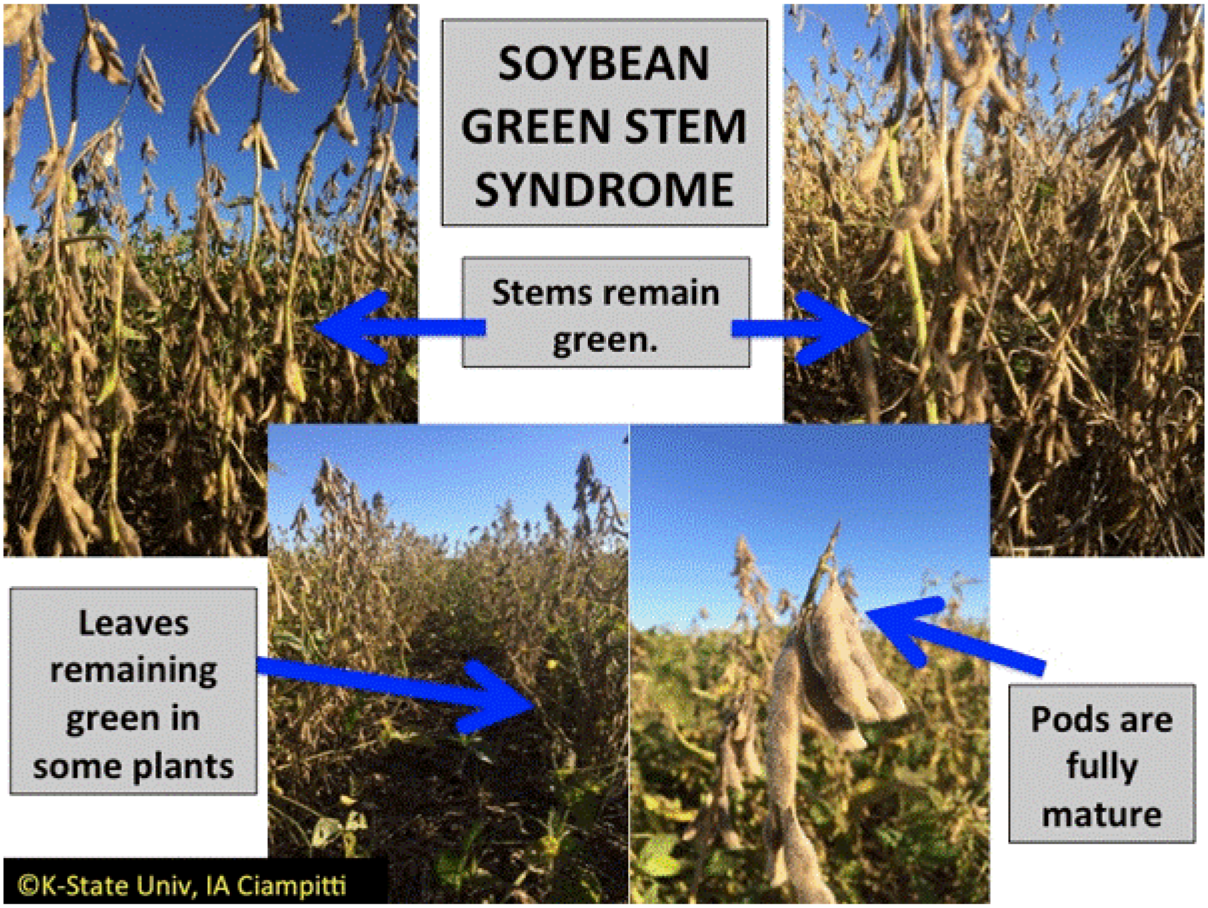

Figure 2. Green stem syndrome in soybeans. Infographic developed by Ignacio Ciampitti, K-State Research and Extension.

Causes of green stem syndrome

What causes this unusual situation? It is most likely due to a combination of early-season stress, low pod counts, and improved late-season growing conditions.

In a normal situation, soybeans will accumulate carbohydrates and proteins in the leaves and stems up until seeds begin to form (R5). The leaves provide the photosynthates needed by the newly formed seeds as they begin filling. As the seeds continue to get bigger, their need for photosynthates will eventually become greater than what the leaves can provide through photosynthesis. As this occurs, the plants will move carbohydrates and nutrients from the leaves and stems into the seeds. This can be referred to as "cannibalization" of the vegetative tissue (rapid senescence and defoliation), but it is a normal process. This eventually causes leaves to turn yellow and drop, and stems to turn brown and die.

The fewer the number of seeds, due to abiotic or biotic stresses, the lower the demand for photosynthates produced by leaves and stems. If demand is low enough, the leaves and stems are never "cannibalized" for their carbohydrates and protein. As a result, the leaves and stems will remain green longer than normal, even up through physiological maturity of the beans. Late-season rainfall can make the problem worse by keeping the plants alive after the seeds have dried down. It will take either a frost or chemical desiccant to kill the leaves and stems in this situation. If the leaves are still green and intact when pods have turned brown and have reached 13-14% moisture, it is usually an indication of mid-season stress around flowering/pod set and low yield potential – at least relative to the amount of foliage produced.

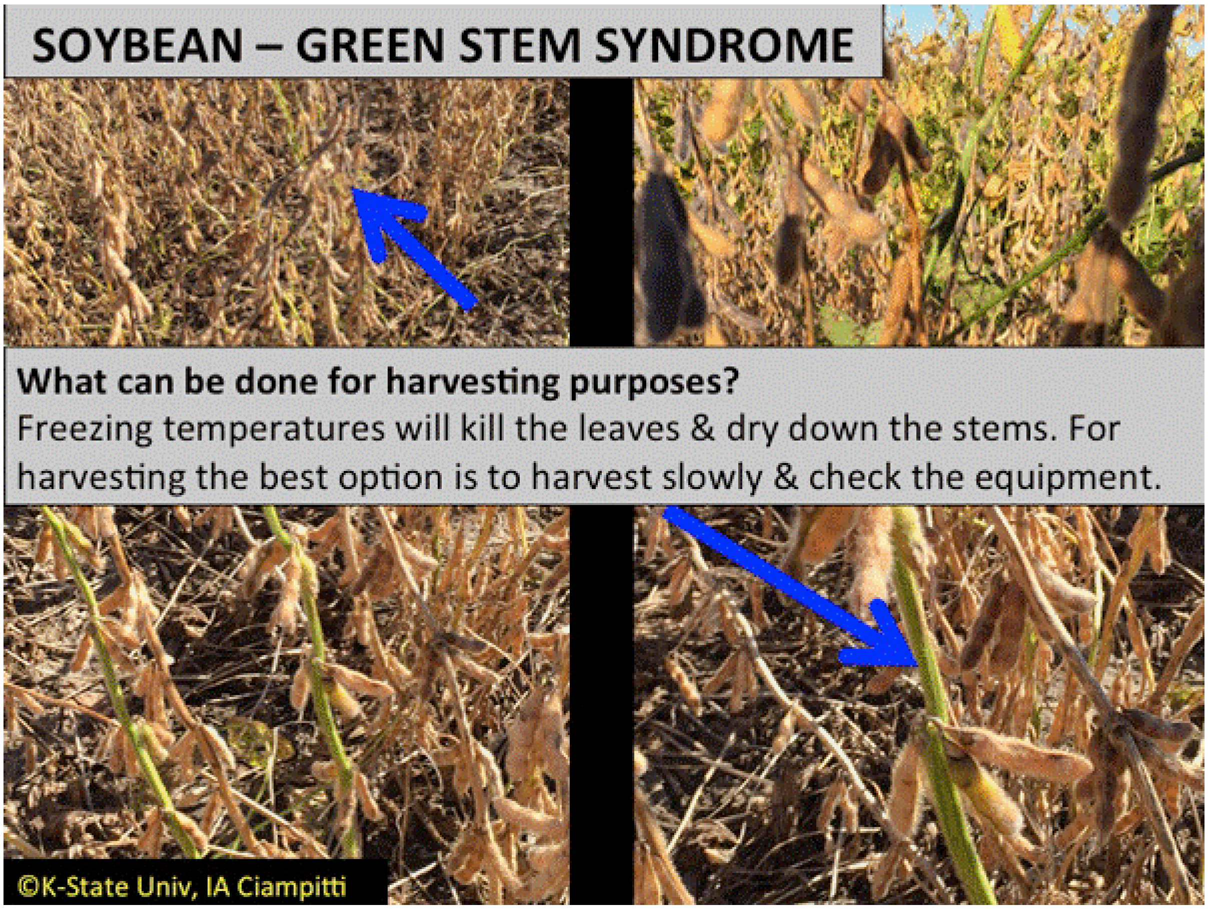

Figure 3. Green stem syndrome in soybeans and suggested harvesting operations. Infographic developed by Ignacio Ciampitti, K-State Research and Extension.

What can be done for harvesting purposes?

Eventually, freezing temperatures will kill the leaves and dry down the stems. Otherwise, the utilization of desiccants to kill leaves and drop the stem moisture down is a viable option, but only if the producer wants to harvest the field soon, before a freeze is likely to occur. If the stems and/or leaves are still green when the field is harvested, the best option is to harvest slowly and make sure the harvesting equipment is sharp and in excellent condition.

We recommend scouting your field right before harvest to better understand what environmental conditions led to the green stems. As always, make sure to time your harvest for the optimum seed moisture content in order to maximize the final grain volume to be sold. More information on soybean dry down rate can be found in eUpdate Issue 711.

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5. The challenge of collecting a representative soil sample

At first glance, soil sampling would seem to be a relatively easy task. However, when you consider the variability that likely exists within a field because of inherent soil formation factors and past production practices, the collection of a representative soil sample becomes more of a challenge.

Before heading to the field to take the sample, be sure to have your objective clearly in mind. For instance, if all you want to learn is the average fertility level of a field to make a uniform maintenance application of P or K, then the sampling approach would be different than sampling for pH when establishing a new alfalfa seeding or sampling to develop a variable rate P application map.

In some cases, sampling procedures are predetermined and simply must be followed. For example, soil tests may be required for compliance with a nutrient management plan or environmental regulations associated with confined animal feeding operations. Sampling procedures for regulatory compliance are set by the regulatory agency and their sampling instructions must be followed exactly. Likewise, when collecting grid samples to use with a spatial statistics package for drawing nutrient maps, sampling procedures specific to that program should be followed.

Regardless of the sampling objectives or requirements, some sampling practices should be followed:

- A soil sample should be a composite of many cores to minimize the effects of soil variability. Take a minimum of 12 to 15 cores from a relatively small area (two to four acres). Taking 20-30 cores will provide results that are more accurate. Take a greater number of cores on larger fields than smaller fields, but not necessarily in direct proportion to the greater acreage. A single core is not an acceptable sample.

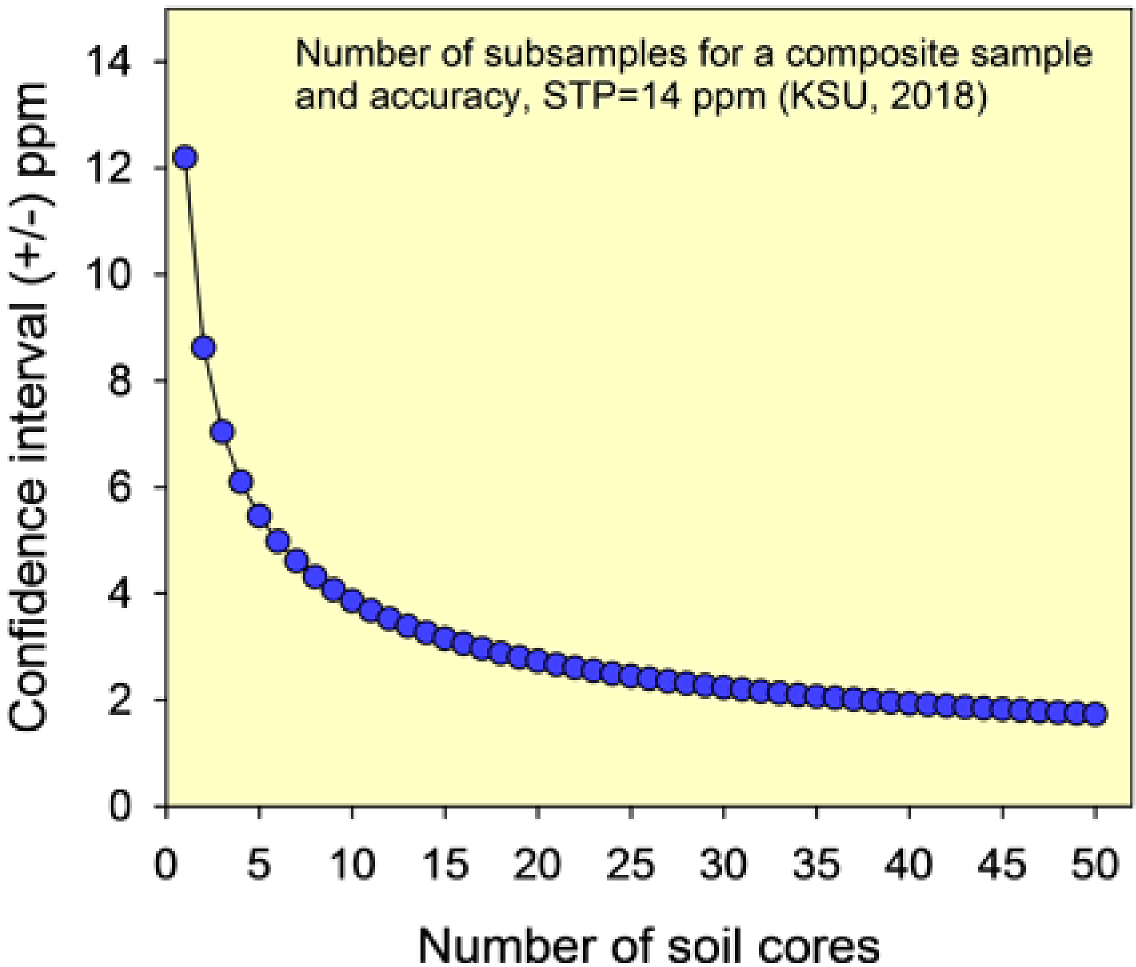

Figure 1. The level of accuracy of the results of a soil test will depend, in part, on how many subsamples were taken to create the composite sample. In general, a composite sample should consist of 15 or more subsamples. For better accuracy, 20-30 cores, or subsamples, should be taken and combined into a representative sample.

- Use a consistent sampling depth for all cores because pH, organic matter, and nutrient levels often change with depth. Match sampling depth to sampling objectives. K-State recommendations call for a sampling depth of two feet for the mobile nutrients – nitrogen, sulfur, and chloride. A six-inch depth is suggested for routine tests of pH, organic matter, phosphorus (P), potassium (K), and zinc (Zn) (Figure 2).
- When sampling a specific area, a zigzag pattern across the field is better than following planting/tillage pattern to minimize any past non-uniform fertilizer application/tillage effects. With a GPS system available, recording of core locations is possible. This allows future samples to be taken from the same locations in the field.
- When sampling grid points for making variable rate nutrient application maps, collecting cores in a 5-10 foot radius around the center point of the grid is preferred for many spatial statistical software packages.

- Avoid unusual spots obvious by plant growth and/or visual soil color/texture differences. If information on these unusual areas is desired, collect a separate composite sample from these spots.

- If banded fertilizer has been used on the previous crop (such as strip tillage), then it is suggested that the number of cores taken should be increased to minimize the effect of an individual core on the composite sample results, and to obtain a better estimate of the average fertility for the field.
- For permanent sod or long-term no-till fields where nitrogen fertilizer has been broadcast on the surface, a three- or four-inch sampling depth would be advisable to monitor surface soil pH.

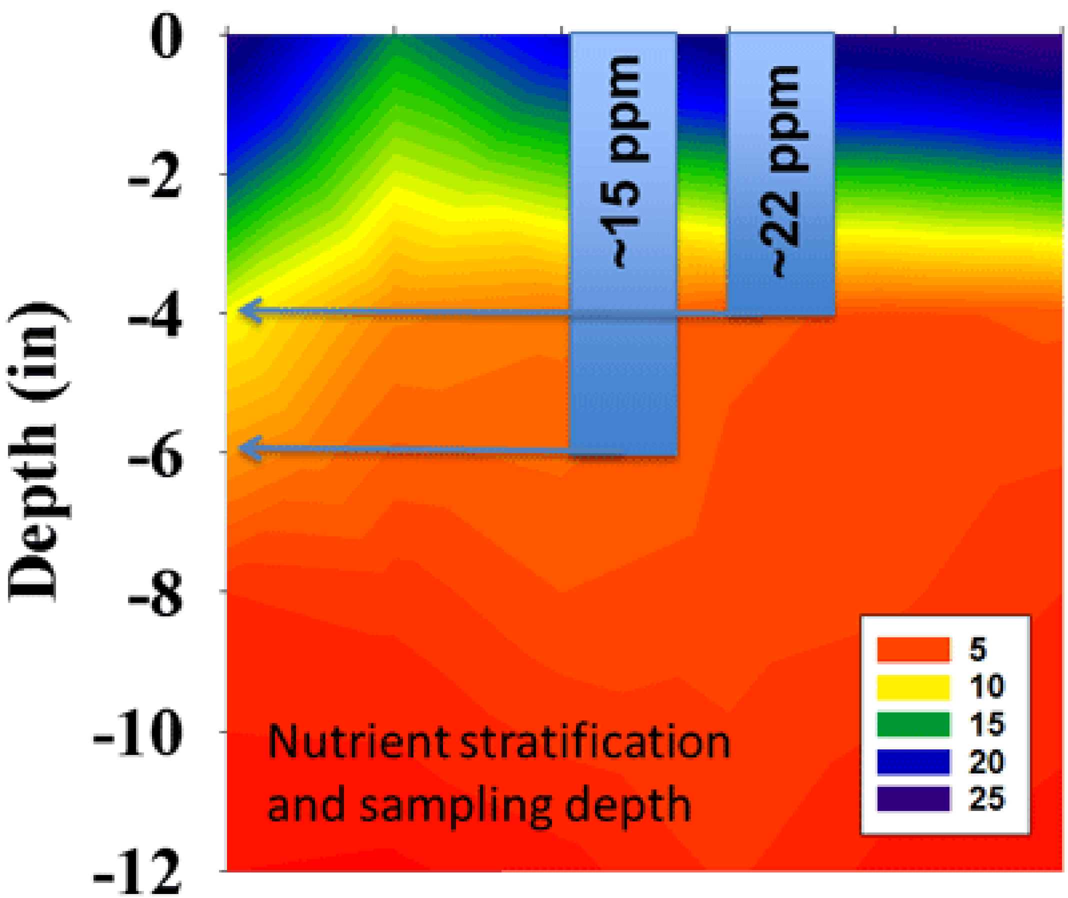

Figure 2. Consistency is sampling depth is particularly important for immobile nutrients like P. Stratification of nutrients and pH can be accentuated under reduced tillage.

Soil test results for organic matter, pH, and non-mobile nutrients (P, K, and Zn) change relatively slowly over time, making it possible to monitor changes if soil samples are collected from the same field following the same sampling procedures. However, there can be some seasonal variability and previous crop effects. Therefore, soil samples should be collected at the same time of year and after the same crop.

Soil testing should be the first step for a good nutrient management program, but it all starts with the proper sample collection procedure. After harvest in the fall is good time for soil sampling for most limiting nutrients in Kansas.

For instructions on submitting soil samples to the K-State Soil Testing Lab, please see the accompanying article "Fall soil sampling: Sample collection and submission to K-State Soil Testing Lab" found in this eUpdate issue.

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6. Fall soil sampling: Sample collection and submission to K-State Soil Testing Lab

Soil testing provides producers and homeowners important information concerning the fertility status of the soil. This information can help produce better crops and reduce costs by guiding management decisions like the type and amount of fertilizers to apply. If you plan to do your own soil sampling and use the K-State Soil Testing Laboratory, the following outline provides specific information on methods for collecting soil samples and mailing instructions.

- To take a sample, you will need a probe, auger or spade, and a clean pail. (If you're also having the soil analyzed for zinc, be sure to use a plastic container to avoid contamination from galvanized buckets or material made of rubber.) You will also need soil sample containers and a soil information sheet from your local Extension office or fertilizer dealer. You can also order soil sample bags online from K-State Research and Extension by clicking here.

- Draw a map of the sample area on the information sheet and divide your fields into uniform areas. Each area should have the same soil texture, color, slope, and fertilization and cropping history.
- From each area, take a sample of 20-30 cores or slices for best results. At the very minimum, 12-15 cores should be taken per sample. Mix the cores thoroughly in a clean container and fill your soil sample container. For available nitrogen, chloride, or sulfur tests, a subsoil sample to 24 inches is necessary.

- Avoid sampling in old fencerows, dead furrows, low spots, feeding areas, or other areas that might give unusual results. If information is desired on these unusual areas, obtain a separate sample from the area.
- Be sure to label the soil container clearly and record the numbers on the soil container and the information sheet.
- Air dry the samples as soon as possible for the available nitrogen test. (Air drying before shipment is recommended, but not essential, for all other tests.) Do not use heat for drying.
- Fill out the information sheet obtained from your Extension office, or download a sheet.
- Take the samples to your local Research and Extension office for shipping. Samples may also be sent directly to the lab by placing them in a shipping container. Information sheets should be included with the package. Shipping labels can be printed from the Soil Testing Lab website listed below. Mail the package to:

Soil Testing Laboratory
2308 Throckmorton PSC
1712 Claflin Road
Manhattan, KS 66506-5503

A listing of the types of soil analysis offered, and the costs, is available on the Soil Testing Lab web site, http://www.agronomy.k-state.edu/services/soiltesting . You can also contact the lab by email at soiltesting@ksu.edu and by phone at 785-532-7897.

For more information on the proper procedures for the Soil Testing Laboratory, see K-State publication MF-734 at: https://www.bookstore.ksre.k-state.edu/pubs/MF734.pdf. Detailed information on soil sample collection can be found in the accompanying article "The challenge of collecting a representative soil sample" in this eUpdate issue.

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7. Fall has arrived and the Mesonet freeze monitor returns

Cold weather is coming. While we have not had freeze warnings yet, it is only a matter of time. The average freeze date in northwest Kansas is as early as the first week of October. Although, southeast Kansas doesn't usually see freezing temperatures until the end of the month (Figure 1).

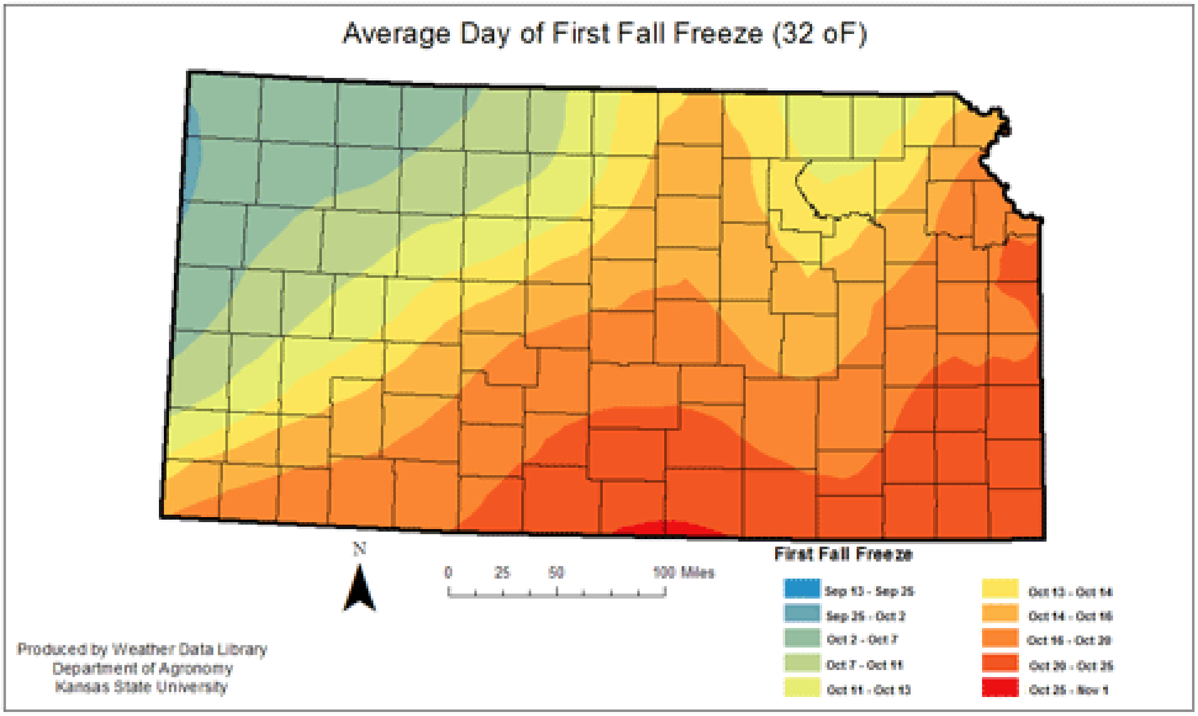

Figure 1. Average fall freeze dates (Weather Data Library).

Historically, almost all parts of the state have recorded freezing temperatures as early as September. Earliest first freeze on record in Kansas is September 3, 1974, when many stations dropped below freezing.

The Kansas Mesonet's Freeze Monitor (http://mesonet.k-state.edu/weather/freeze/) is now available for the 2018 fall frost/freeze season. This tool displays the coldest temperatures observed across Kansas during the previous 24 hours. It answers the frequent question: *How cold did it get last night*? It also tracks the first fall freeze date for each station for comparison to local climatology. Data updates every twenty minutes on both the map and the table (Figure 2).

Another tool important for producers and gardeners is the duration below freezing, as some crops and commodities have lower thresholds for damage. This feature allows users to select options to view maps/data of the duration below freezing (32 degrees F) and the number of hours below 24 degrees F. While both are of interest, the lower threshold is of great importance to wheat growers later into the fall season.

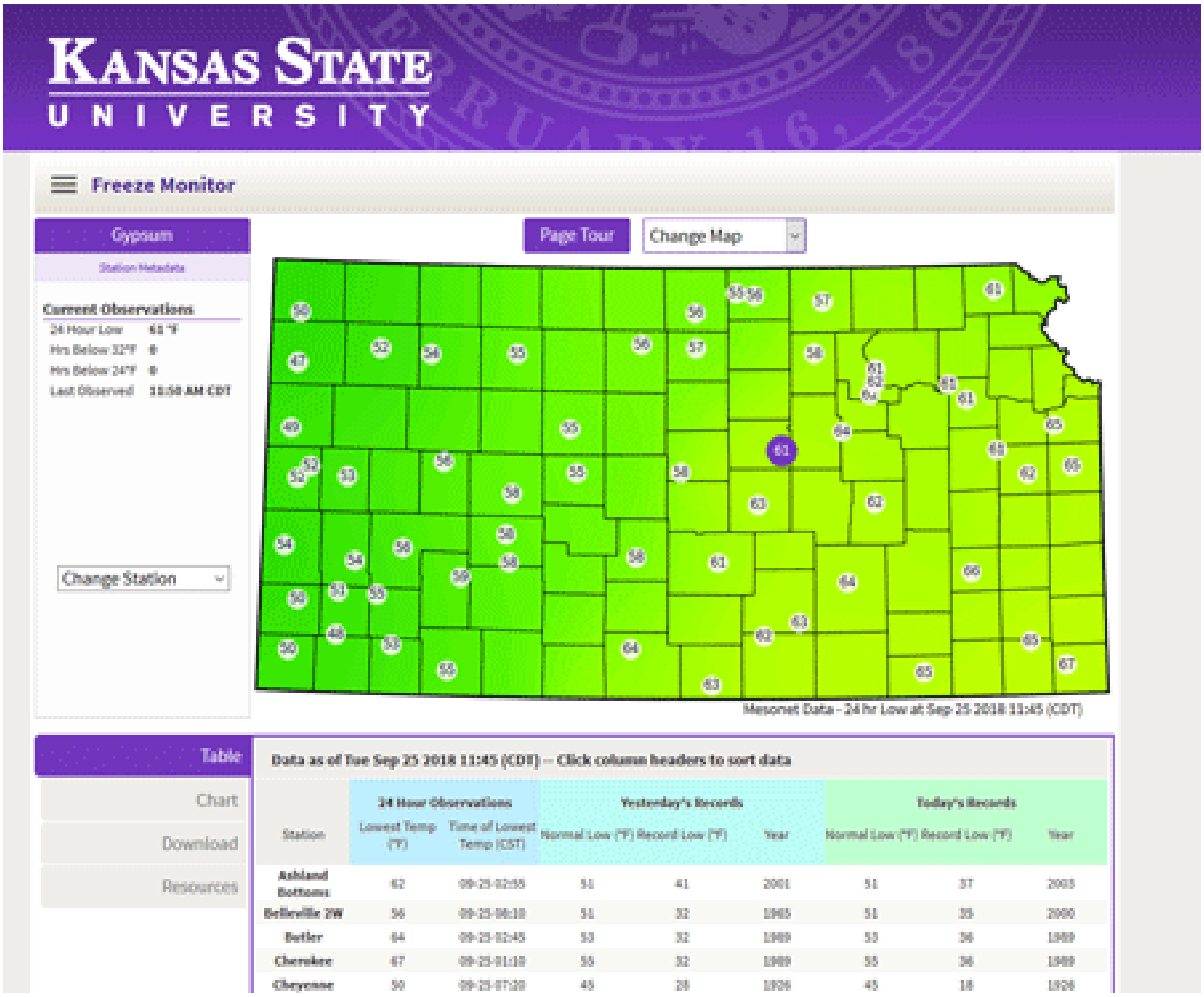

Figure 2. View of the Freeze Monitor webpage: mesonet.ksu.edu/weather/freeze

The data displayed in the tables below the maps can be sorted. Clicking on the header of a particular column will sort the table by that column. This makes it much easier to see what area was the coldest in the state, as well as earliest freeze and earliest climatological freeze data. There are a number of download options, including table and chart data, and images of the maps (Figure 3).

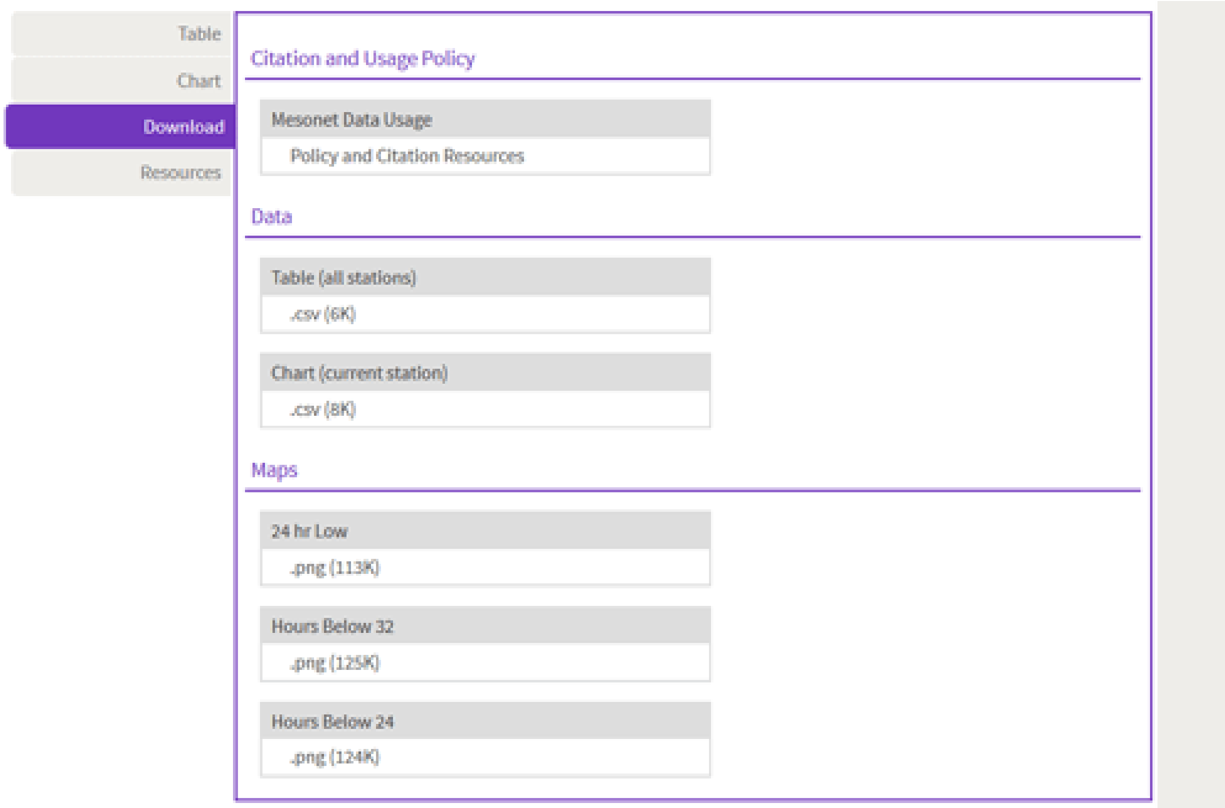

Figure 3. Download options on the Freeze Monitor website.

The Freeze Monitor is updated in the spring, as a new growing season arrives, to show the spring freeze climatology.

The Freeze Monitor is available at: http://mesonet.k-state.edu/weather/freeze/

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8. A brief of global research on drought monitoring

This article is part 2 of a 4-part series focusing on agriculture, climate, and change. The first installment was featured in eUpdate Issue 710 on September 14, 2018.

Drought can decimate agricultural production in the U.S. Great Plains and throughout the world. We all recognize drought. The dull green vegetation; the pallor of dust-filled skies; the dry scratchy throat and persistent cough. Agriculture? Drought can potentially stop agriculture in its tracks. In the High Plains of western Kansas, agriculture affects a third of the regional economy. In Sub-Saharan Africa, drought affects the core food supply, leading to rural exodus and civil unrest. In northwest India, drought amplifies the frequency of heat-related deaths. In Cape Town, South Africa, a two-year drought threatens the water supply for the four million residents. Drought touches our lives and communities in a myriad of ways.

The Palmer Drought Severity Index (PDSI), published in 1965, considered drought cycles of the 1930's and 1950's. The PSDI uses monthly precipitation data and atmospheric demand for water, to estimate any changes in the soil water supply relative to 'normal' conditions. The concept of 'normal', or long-term average weather is central to many drought indices used today. In the U.S., a Drought Monitor (http://droughtmonitor.unl.edu/) displays its index using fire colors—yellow, orange, red , in which drought metrics provide early warning of impending disasters in the U.S. On the global scale, the Global Drought Information System (NIDIS) (https://www.drought.gov/gdm/current-conditions) provides online global drought information (Figure 1) as well as vegetation health index.

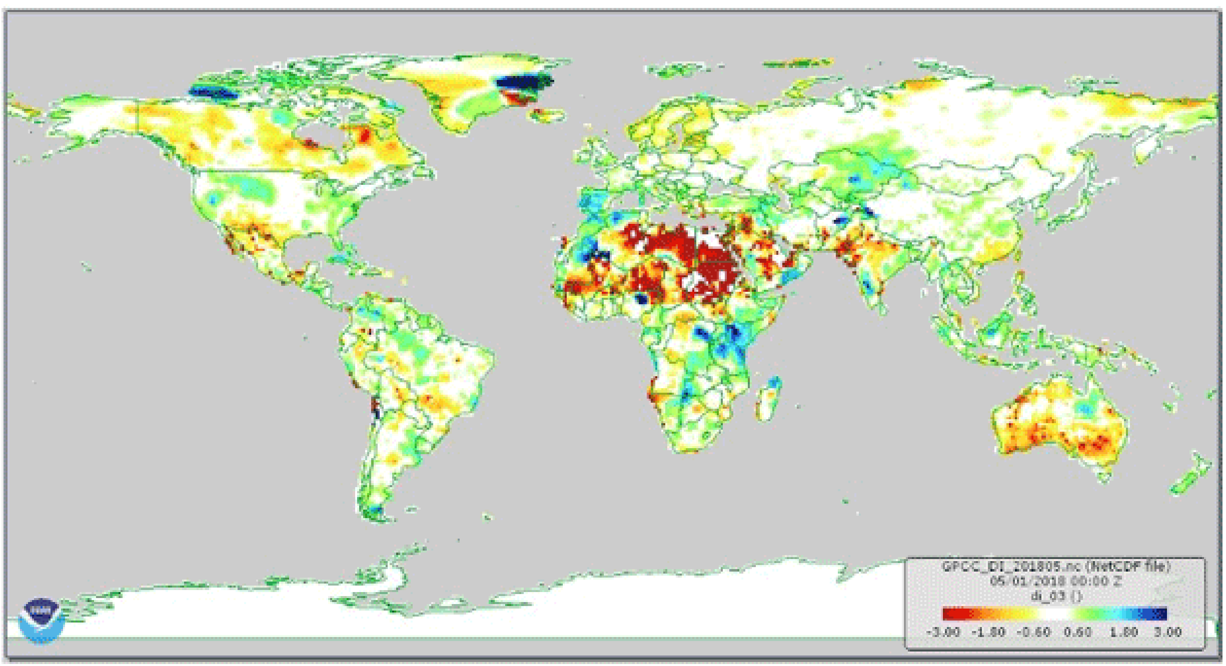

Figure 1. Current Global Drought Monitor. Drought intensity is coded by red colors represent drought and blue colors represent wetting conditions. Source: https://www.drought.gov/gdm/current-conditions

The American Meteorological Society hosted four sessions on drought and food security during its 2018 meetings. One of several global-scale drought monitoring programs utilizes satellite imagery to calculate and map the energy balance for land surfaces. This accounting scheme uses physics to sum inputs and outputs in terms of radiation, evaporation, and warming/cooling of air and land. The thermal band from satellites, representing the surface temperature, conveys critical information of surface water availability. Warmer sectors indicate dry surfaces while the wet regions display cooler temperatures.

Globally, agencies use these techniques to detect and report early-stage and ongoing drought. These early warnings and updates inform emergency drought responses. Earth scientists recognize drought as an integral component of the hydrological cycle. The question remains: *Has a changing climate affected the frequency, duration, or extent of drought?*

Zambreski and Lin (2017) reported a new technique to evaluate long-term climate trends. This method uses Empirical Orthogonal Functions (EOF, a type of principal component analysis) to characterize monthly drought metrics of the U.S. Great Plains over the 20th century (1903 to 2015). The EOF were correlated with each of the localized time series of drought metrics to identify regions with similar historic patterns of wetting and drying cycles (Figure 2). Analyses such as this provide benchmarks against which climate change trends can be usefully compared.

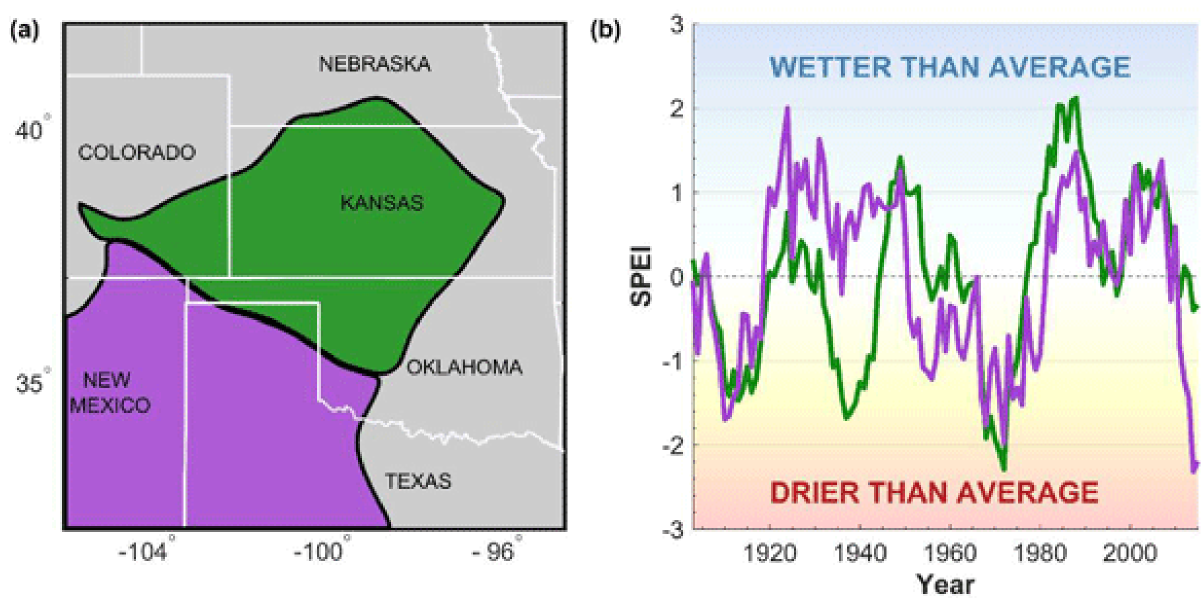

Figure 2. (a) Two sub-regions in the Great Plains for spring drought variability and (b) their corresponding drought time series from 1903 to 2015. Positive values in the time series represent wetter than average conditions, and negative values represent drier than average conditions. There are notable differences in the drought conditions of these adjacent sub-regions during the 1930s (Dust Bowl era) and the period 2010-2015. The drought index is the Standardized Precipitation Evapotranspiration Index (SPEI) on a 3-month time scale.

As earth scientists, we recognize the tools at our disposal to identify and quantify drought. Careful application of these tools can help farmers and water managers anticipate and prepare for the next drought.

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9. 2018 Kansas Soybean Yield and Value Contest

Soybean harvest is just beginning in Kansas. It is a good idea for producers to keep in mind the Kansas Soybean Yield and Value contest as they fire up the combines.

Each year the Kansas Soybean Association, with help from K-State Research and Extension, and sponsorship from the Kansas Soybean Commission, conducts the Kansas Soybean Yield and Value Contest. The contest is a fun way for producers to showcase their high yielding and high quality soybean with other growers in Kansas and to provide information on what production practices they did to achieve those excellent yields. In addition to grower recognition, cash prizes are awarded to the 1st, 2nd, and 3rd place winners for the 9 districts across Kansas and the top three finishers in the quality contest. Contest rules and entry forms are found online at: http://kansassoybeans.org/association/contests/

The yield contest first began in the early 1980's but more detailed historical data began in the early 2000's. When growers submit entry forms for the contest, they are asked to share some of their production practices that they used on the soybean crop. Using this information, we can identify shifts in producer practices over the last two decades from high yielding soybean growers.

When comparing yields over the last 20 years, state soybean yields have improved almost 8 bushels per acre (bu/acre) while contest entrants have gained nearly double that (15 bu/acre) in the same span of time (Figure 1). This indicates that soybeans are a crop that can be managed for higher yield when proper high yield practices are adopted. The 2017 state-average yield was 37.5 bu/acre versus average yield contest of 79 bu/acre, with an average yield gap between high yield and state-average close to 42 bu/acre, previous year gap was 37 bu/acre.

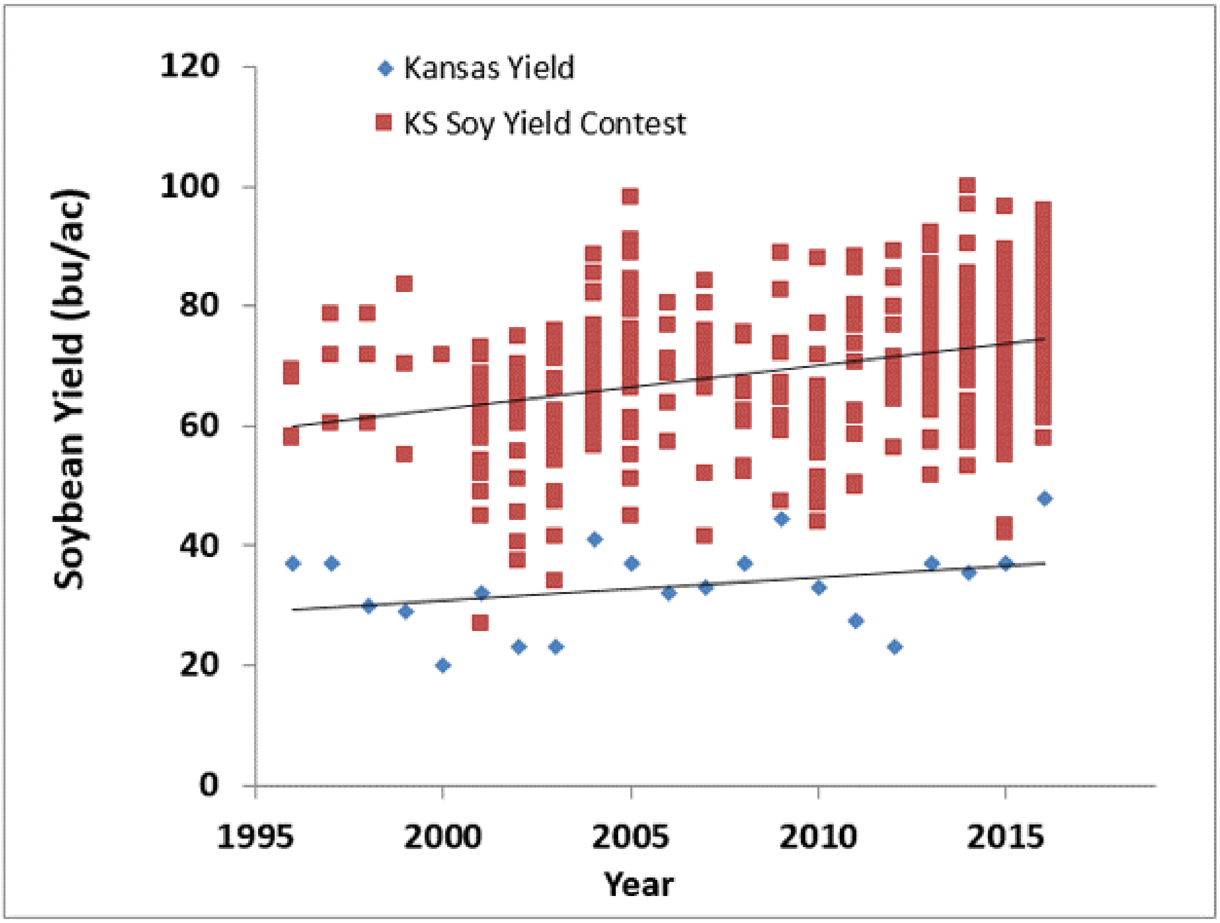

Figure 1. Difference in yield between state-average as reported by Kansas Ag Statistics and the entries in the Kansas Soybean Yield Contest from 1996 to 2016.

A few soybean production practices have changed over time as well. Over the last decade, producers in the soybean yield contest have moved to a lower seeding rate (Figure 2). In 2001, seeding rate averaged just over 165,000 seeds per acre while recently, seeding rates dropped below 150,000 seeds per acre, with an estimated annual rate of seeding rate drop of 1044 seeds/acre per year since 2000 (Figure 2). This may be a function of seed prices increasing over time and producers have more confidence in final plant stand with improved planting equipment and seed treatments. In addition to seeding rate changes, soybean row spacing has also seen a decline over time with narrower rows (<30 in) being adopted more by growers in the Kansas Soybean Yield Contest (Figure 3). This decline is likely due to reduction in use of drills and the increase use of planters to sow soybean.

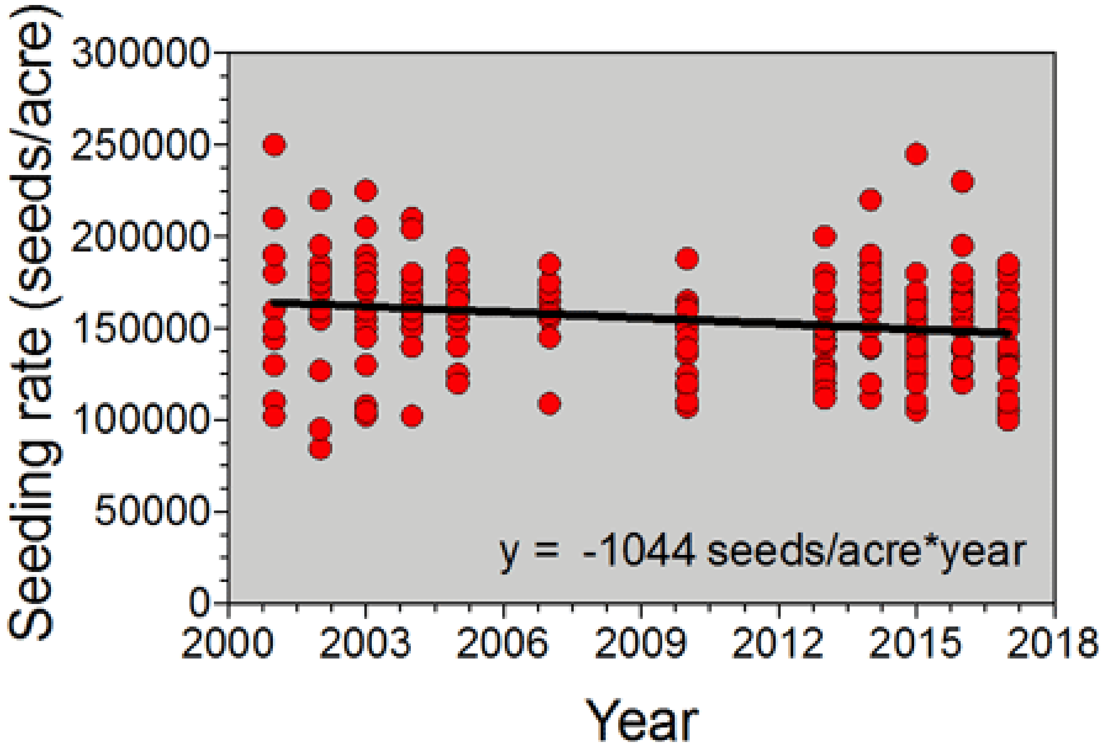

Figure 2. Seeding rate of contestants in the Kansas Soybean Yield Contest from 2001 to 2017.

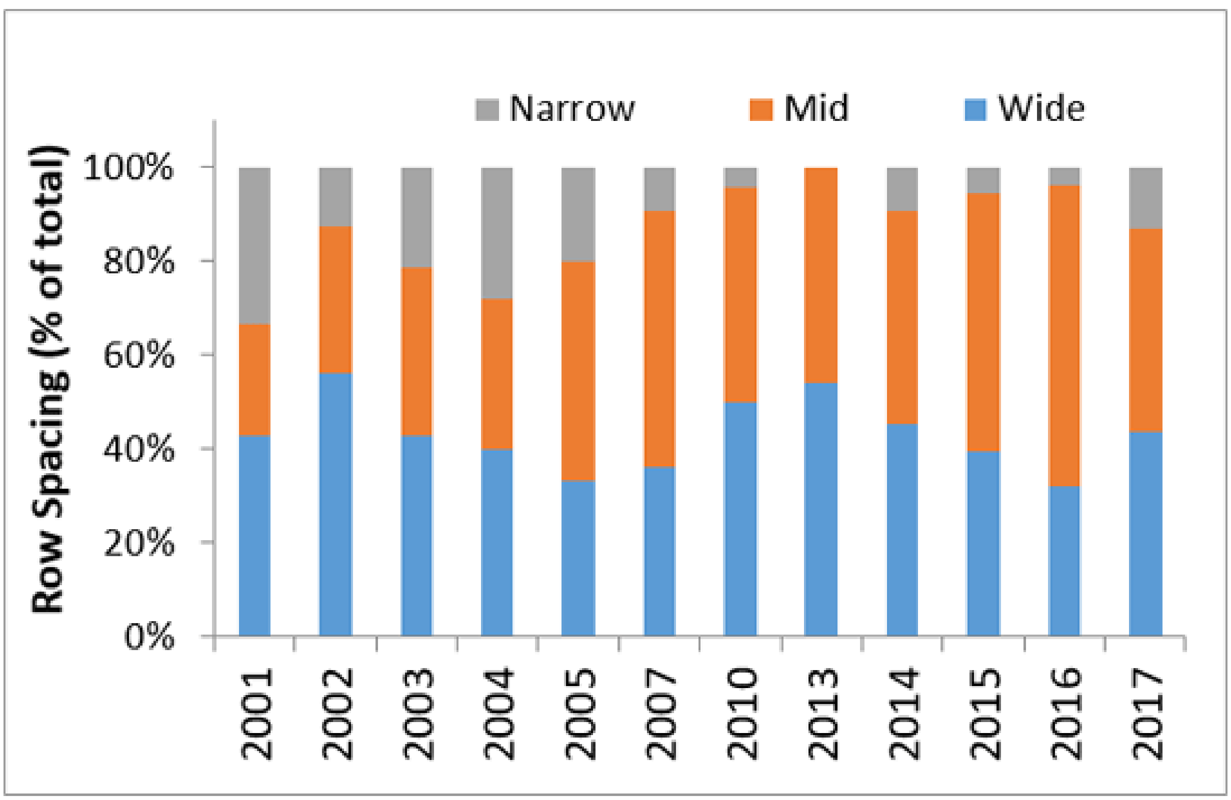

Figure 3. Row spacing of Kansas Soybean Yield Contest entrants from 2001 to 2017. Narrow rows were any spacing 10-in or less. Wide rows were any spacing 30-in or greater. Mid-rows were any spacing between 10- and 30-inch.

Since 2004, Kansas soybean producers have had the opportunity to enter their soybeans into the Value Contest. With this information, the contest is able to showcase the true end-use value of soybeans including protein, oil, and other value added products.

With many field crops, a relationship exists between yield and protein where protein decreases as yield increases. However, in the case of the Kansas soybean yield contest, there does not appear to be a strong relationship in protein (slight negative relationship) nor in oil (slight positive relationship) relative to yield (Figure 4).

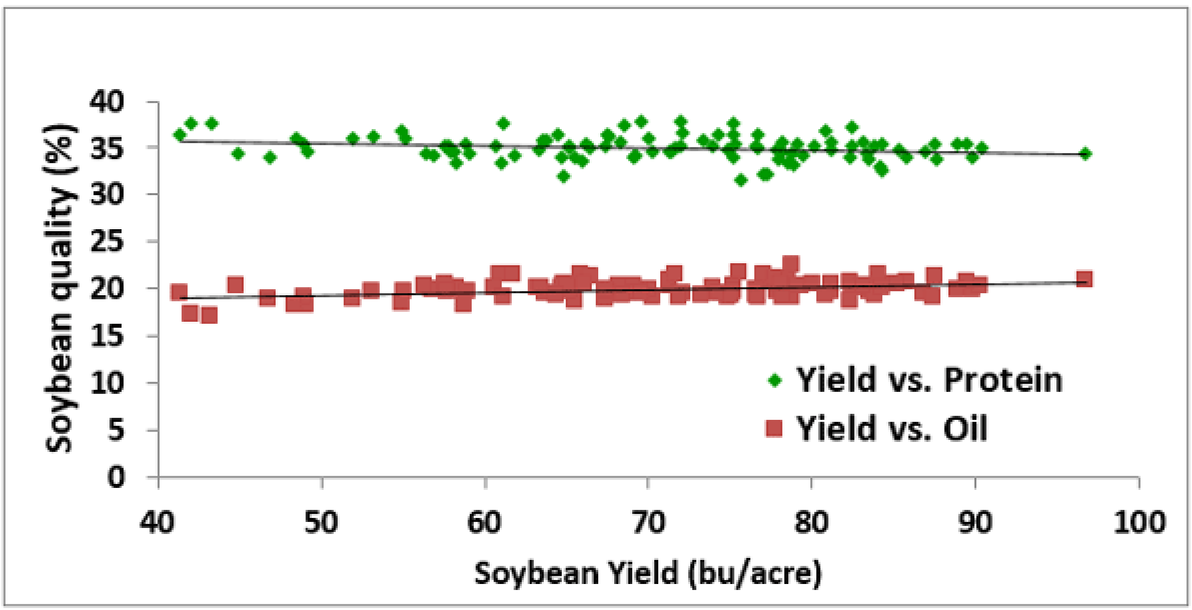

Figure 4. Relationship between soybean oil and protein vs. soybean yield for 100 entries in the Kansas Soybean Value Contest, more than 10 years data.

If a producer has interest in submitting an entry in the Kansas Soybean Yield Contest, they need:

1. A minimum of 5 contiguous acres of soybean
2. To contact their County Extension Agent for witnessing the harvest
3. Have the entry postmarked by December 1, 2018

The Soybean Yield and Value Contest is free to producers. One does not have to enter the Yield contest to enter the Soybean Value Contest, just fill out the entry form and mail a 20-ounce soybean sample to the Kansas Soybean Office by December 1, 2018. The contest winners will be announced at the Kansas Soybean Expo on January 9, 2019 in Topeka. To find complete rules and the entry form, visit http://kansassoybeans.org/association/contests/

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