



## Extension Agronomy

# eUpdate

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*05/03/2019*

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](mailto:kgehl@ksu.edu), or Dalas Peterson, Extension Agronomy State Leader and Weed Management Specialist 785-532-0405 [dpeterso@ksu.edu](mailto:dpeterso@ksu.edu).

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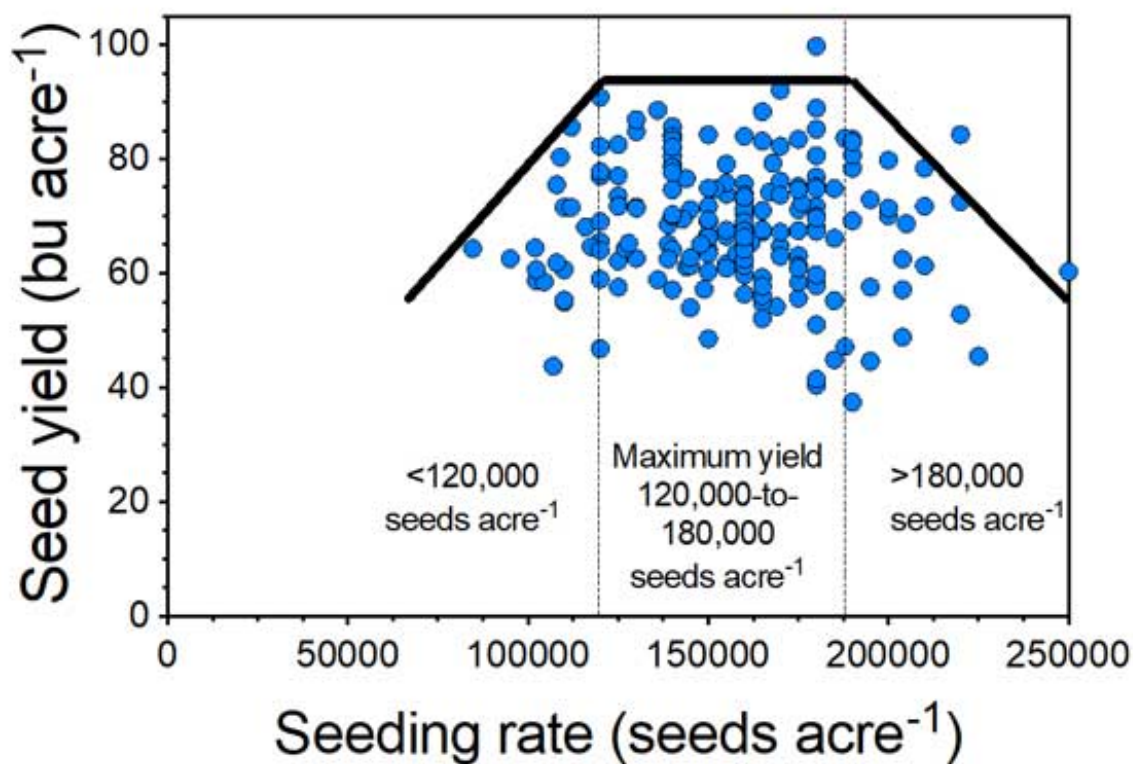
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## 1. Soybean seeding rates and optimum plant populations

The optimum seeding rate is one of the most influential factors for increasing soybean profitability as seed cost is one of the most expensive inputs. Soybean seeding rate, row spacing, and planting date are all tied together. The final number of seeds per linear foot of row decreases as row spacing narrows. For example, at a target population of 105,000 plants per acre and 85 percent germination, 30-inch rows will need twice the number of seeds per linear foot as 15-inch rows (6 vs. 3 seeds per linear foot). Seeding rate will need to increase at later planting dates to compensate for the reduction in the growing season since more plants are needed to increase early light interception and biomass production.

### Seeding rates for high-yielding soybeans: A case study

Information gathered from the Kansas Soybean Yield contest shows that maximum yield (more than 90 bushels per acre) could be achieved with seeding rate ranging from 120,000 to 180,000 seeds per acre (Fig. 1). Note: most of the yields ranged from 60 to 90 bushels per acre.

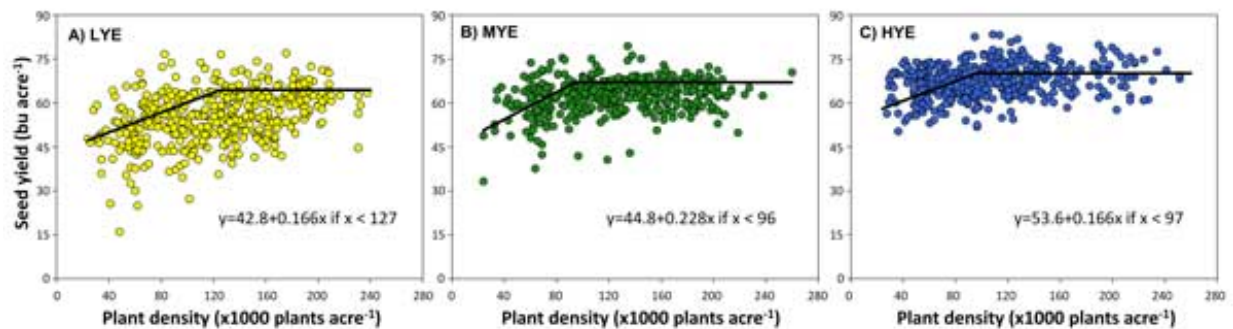


**Figure 1. Relationship of soybean yield versus seeding rate for Kansas Soybean Yield Contest data. Graph by Ignacio Ciampitti, K-State Research and Extension.**

Yield potential for each environment should be considered when deciding soybean seeding rates. Yield potential is primarily defined by weather conditions (before and after planting), genetic potential, soil type, fertility program, and use of best management practices for producing the crop (proper weed, insect, and disease control from planting until harvest). Before deciding the seeding rates, it is necessary to consider potential soil and weather conditions that could affect the success of the final stand establishment, to achieve the proper plant density required for each yield environment (YE).

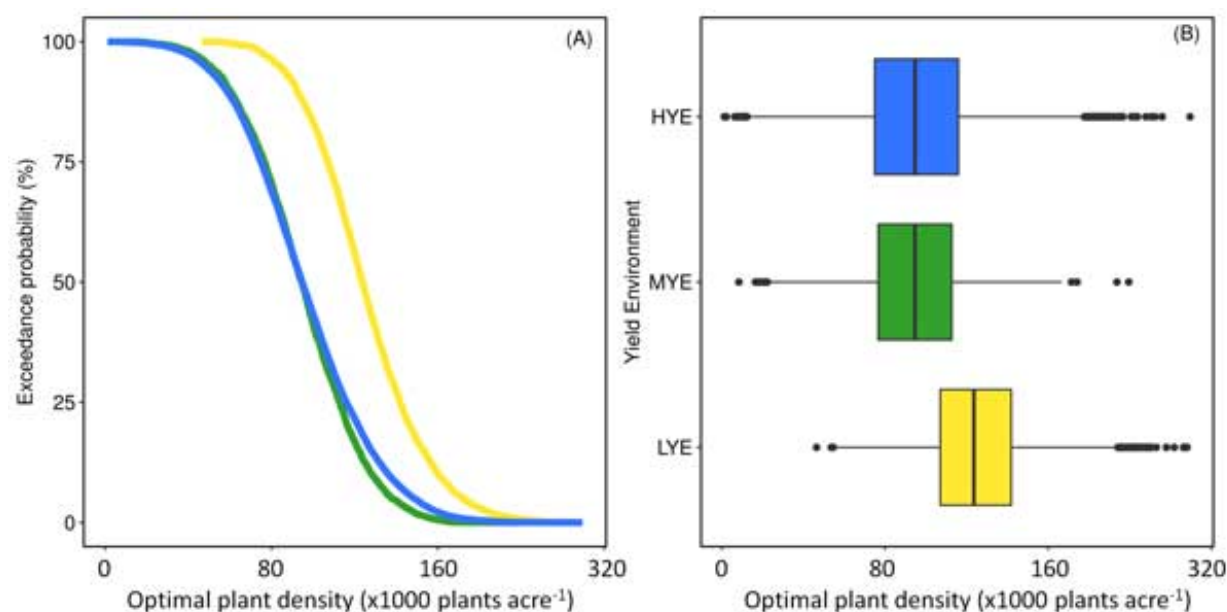
### Summary of a recent plant density study

Recent economic and productive circumstances have caused interest in within-field variation of the agronomic optimal plant density (minimum number of plants in a per-unit-area basis required to maximize yield) for soybean. A recent study by Carciochi, Ciampitti and collaborators from Corteva published in *Agronomy Journal* presented a new insight about the optimal plant density by yield environment. For that study, a soybean database evaluating seeding rates ranging from 69,000 to 271,000 seeds per acre was collected, including final number of plants and seed yield. The data was classified in yield environments: low (LYE, <59.6 bu per acre), medium (MYE, 59.6-64.1 bu per acre), and high (HYE, >64.1 bu per acre). The main outcomes for this study were: i) optimum plant density decreased by 24% from low (127,000 plants per acre) to high (97,000 plants per acre) yield environments (Fig. 2), ii) the optimal density (50% interquantile) ranged between 109,000 - 144,000 plants per acre for the low, from 77,000 to 114,000 plants per acre for the medium, and 76,000 to 117,000 plants per acre for the high yield environment (Fig. 3), iii) greater optimal density for the low yield was not related to a low plant survival rate, iv) less precipitation during the reproductive period was one of the main causes for the need to increase the plant density in low yield environments to overcome a possible reduction in the crop reproductive ability.



**Figure 2. Relationship between seed yield and plant density for low (LYE, <59.6 bushels per acre, A), medium (MYE, 59.6-64.1 bushels per acre, B), and high yield environments (HYE, >64.1 bushels per acre, C). Models were fitted using hierarchical Bayesian models. Graphs by Ignacio Ciampitti, K-State Research and Extension.**

This is valuable information for site-specific management strategies, such as variable seeding rate. Thus, within a field, yield variation could be better related to the adjustment of seeding rate for soybeans, improving both the productivity and net return for farmers.



**Figure 3. Cumulative probabilities (%) of agronomic optimal plant density (AOPD, plants per acre) (A) and AOPD range to achieve the maximum yield for the seed yield-to-plant density relationship for the low (LYE, in yellow), medium (MYE, in green), and high yield environment (HYE, in blue) (B). For panel B, box plots portray the 25th (bottom edge of the box) and the 75th (top edge of the box). The solid line within the box represents the median and the circles referred to outliers.**

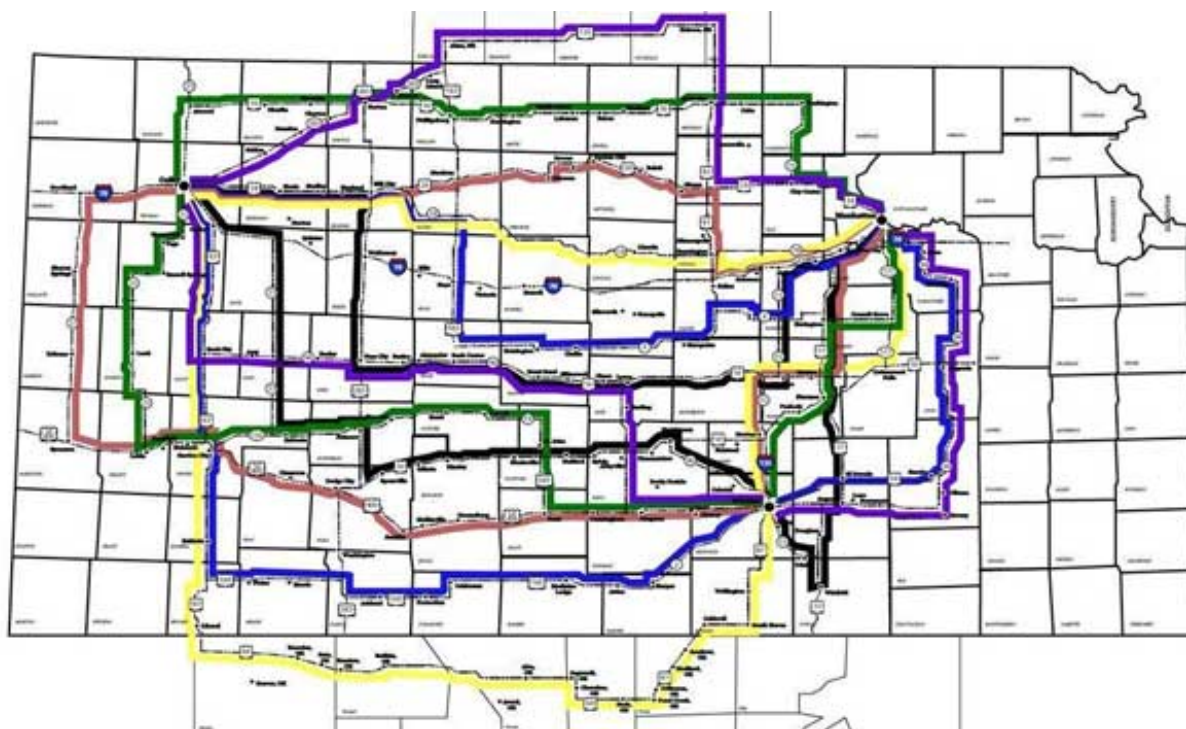
In summary, adjusting seeding rates reduces risks of yield losses due to suboptimal densities in a low yield environment, while limiting higher seed costs due to supra-optimal densities, especially for medium and high yield environments. Moreover, soybean plant density levels above the optimal plant density increase the risk of lodging and disease development without adding a yield benefit.

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## 2. 2019 Kansas Wheat Crop Conditions: A report following the Wheat Quality Tour

The 2019 Wheat Quality Tour took place from April 29 through May 2, 2019. Approximately 75 people actively scouted hundreds of Kansas wheat fields in 20 groups and along six routes (Figure 1). The groups left Manhattan and headed to Colby on the first day, from Colby to Wichita on day 2, and finally from Wichita to Manhattan on day 3.



**Figure 1. Representation of the six routes (purple, green, pink, yellow, blue, and black) explored during the wheat quality tour. Image courtesy of the Wheat Quality Council.**

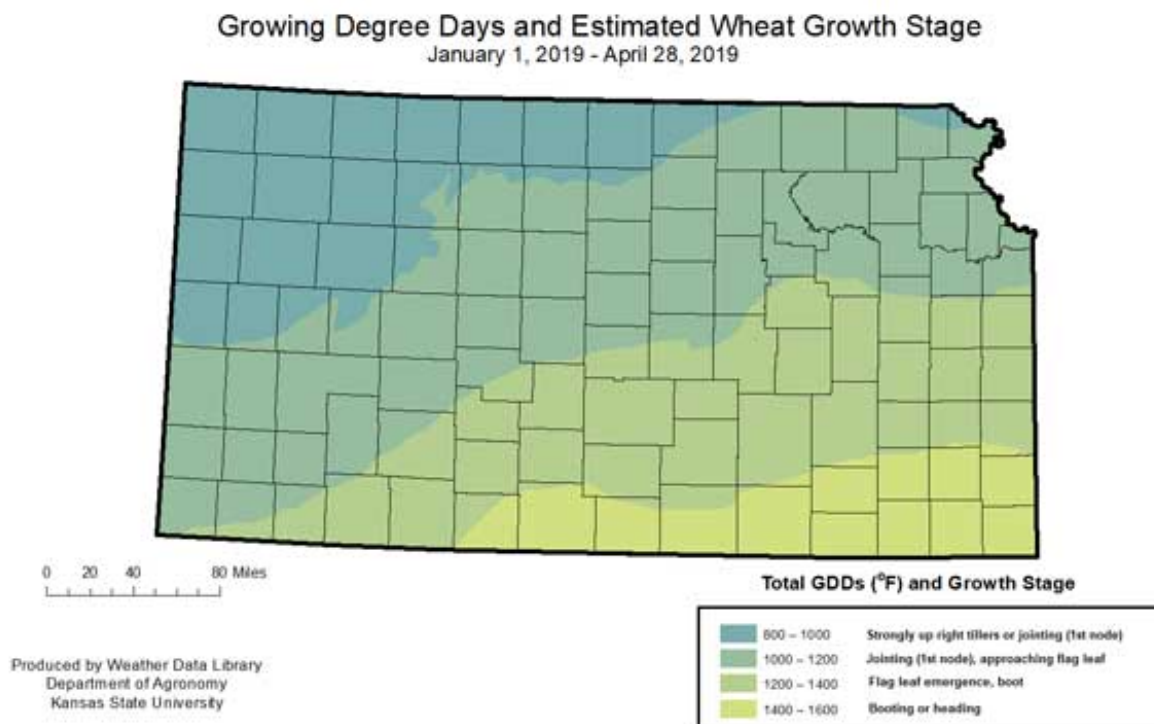
The Kansas wheat crop is overall in good condition; however, there are a few potential challenges. The overall 2019 production estimate for Kansas resulting from the tour was 306 million bushels of wheat, compared to 243 million bushels in 2018 and 282 million bushels in 2017. The current estimate corresponds to a yield of 47 bu/ac and an area abandonment of 6.5%. Weather conditions during the months of May and early June will be crucial in determining where final production will actually land.

### **Delayed development**

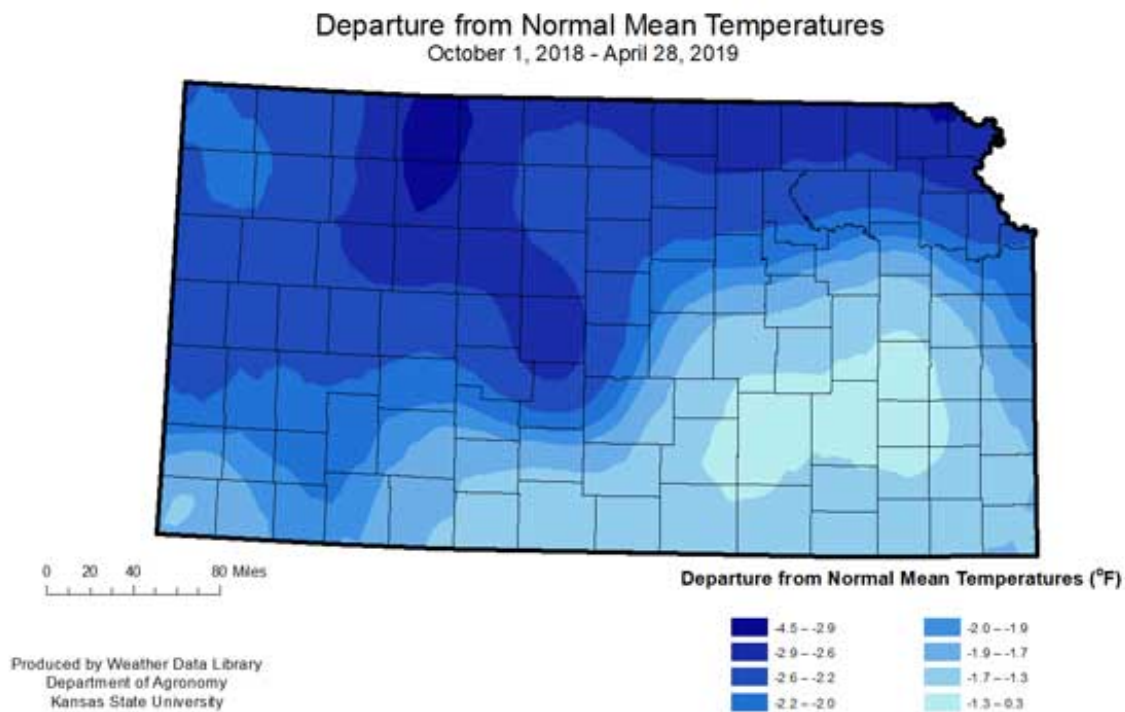
The 2019 Kansas wheat crop is anywhere from two to four weeks behind normal for crop development. For instance, in previous years of the wheat tour, stages of crop development around the state ranged from early grain fill in south central Kansas to boot stage in northwest Kansas. This year, the furthest along fields sampled were in late boot or early heading stages in south central Kansas, and the majority of northwest Kansas is now just jointed (first node) (Figure 2). This delayed development is a consequence of below-average seasonal temperatures, as the departure from normal temperature during the growing season (October 1, 2018 to April 30, 2019) ranged anywhere



from zero to minus 4.5 degrees F across the state (Figure 3).



**Figure 2. Estimated wheat growth stage as of April 28, 2019.**



**Figure 3. Departure from normal mean temperature during the 2019 winter wheat growing season (October 1, 2018 through April 28, 2019). Map from K-State Weather Data Library.**

The consequences of this delayed development will depend on the weather conditions during May and June. If conditions are cool and moist, as Kansas experienced in 2015, 2016, and 2017, the crop might still go through favorable grain fill conditions and produce a decent yield. However, if temperatures are normal or above normal, the crop might go through heat stress during grain fill, which can severely limit grain yield. For fields that are currently at boot stage (south central Kansas), ideal weather conditions would result in as many as 50 days or more until maturity. However, if conditions are warmer and drier-than-normal, the crop might only have about 35 days or less, consequently reducing grain fill duration. Likewise, where the crop is still at the jointing stages of development, ideal conditions would result in as many as 70 days until maturity. However, warmer conditions might reduce this period to 50 days or less, restricting wheat yield. Heat stress during grain fill limits the photosynthetic production of sugars and decrease the accumulation of starch in the grain, reducing grain test weight and grain yield, consequently increasing the percent protein in the grain.

### **Limited potential for late-planted fields**

October 2018 was extremely wet, with all parts of the state recording at least  $\frac{3}{4}$  of an inch more than normal. Parts of south central and central Kansas had between 5 and 11 inches greater than average precipitation. This caused the 2019 Kansas wheat crop to be planted either before ~October 5, or towards the end of October and into November. In addition, temperatures during the fall, winter, and early spring were cooler-than-normal, not allowing for much vegetative growth (for more details, see the March 8 eUpdate "[Kansas wheat crop update - March 8, 2019](#)"). This difference in development is being carried over until today, with huge differences in development and yield potential between early- and late-planted fields (Figure 4). The early-planted field in Figure 4 is at the flag leaf stage, while the late-planted field is still at the beginning of stem elongation. These differences in development will cause heading and grain fill to occur later in the small crop, and thus having the potential to expose it to hotter grain fill conditions further limiting its yield potential.





**Figure 4. Differences in development between neighboring fields planted early (upper panel) or late (lower panel) in Hodgeman County, KS. Photos taken May 1, 2019 by Romulo Lollato, K-State Research and Extension.**

## Nitrogen and sulfur deficiencies

One common theme of the 2019 Wheat Quality Tour was nutrient deficiency, specifically nitrogen and sulfur. While the frequency of fields showing nutrient deficiency symptoms was higher in some regions such as Edwards and Stafford counties (Figure 5), nutrient deficiencies were common across the entire state. Some potential explanations are:

- Both N and S are nutrients that are mobile in the soil profile, and therefore the excessive seasonal precipitation might have increased leaching losses (especially in sandier soils).
- Many fields were waterlogged during the fall, winter, and early spring, which might have caused denitrification losses, depending on temperature conditions.
- The cooler temperatures during the entire growing season have likely decreased the rate of organic matter mineralization, which is a very large source of both N and S availability to the crops.
- Low N and S input by producers due to low wheat prices.



**Figure 5. Sulfur deficiency, a common theme of the 2019 Kansas wheat crop. Photo taken in Edwards County, KS, by Romulo Lollato, K-State Research and Extension.**

## Water logging

Central and east-central Kansas are also facing an additional problem of water logging. Many fields in



the region between Stafford and Dickinson counties have extremely moist soil conditions, which are showing symptoms of water logging (Figure 6). Symptoms often consist of portions of the field where the entire wheat plant is dead due to anaerobic conditions (these portions would be white and will not produce grain yield, or plants would be completely absent as in Figure 6). The high incidence of water logged fields is resultant for high total growing season precipitation coupled with poor drainage capacity of soils in the region.



**Figure 6. Water logged conditions leading to plant death due to anaerobic conditions in the lower parts of the fields. Photo taken in Marion County, KS, by Romulo Lollato, K-State Research and Extension.**

### **Lack of uniformity**

Another common theme of fields visited during the 2019 Wheat Quality Tour was the lack of stand uniformity in fields that seemed to be uniform and have a good yield potential from the road (Figure 7). There are many potential causes for lack of stand uniformity and patchy stands, and the actual cause varies field-to-field. Nonetheless, producers are encouraged to inspect their fields closely for stand uniformity and yield potential before further investing in the crop with applications such as foliar fungicide.



**Figure 7. Example of a field that looked uniform and with a high yield potential from the road (upper panel) but showed an extremely variable stand upon close inspection. Photo taken in Gove County, KS, by Romulo Lollato, K-State Research and Extension.**

## Stripe and leaf rusts

On a positive note, the incidence of stripe and leaf rusts in the 2019 tour was very low and mostly in the second day of the tour, when the group scouted south-central Kansas and north central Oklahoma. While at low incidence at this time, stripe rust has been reported in Oklahoma for a few weeks and the recent rainfall events likely brought spores to Kansas fields. It will take approximately two weeks from the time spores are introduced to the fields until the lesions are visible to the naked eye; thus, we advise producers to scout their fields for the disease in the next few days. The majority of the state is still within fungicide application window and in case the disease is present, producers still have the option for spray. This decision should take into account the yield potential of the crop, the crop price, disease incidence, weather conditions, variety susceptibility to the disease, and the costs of product and application.

The above factors are a few of the major challenges that the 2019 Kansas wheat crop is currently facing. While all should contribute to restricted wheat yields to a certain extent, the largest uncertainty when estimating wheat production at the state level is the weather during grain filling. Because the crop is two to four weeks behind in development for the majority of the state, the cool and moist conditions during grain fill are essential to ensure a decent crop. If warm and dry conditions arise, the wheat yield potential can be severely limited.

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### 3. Is there any value to starter fertilizer on soybeans?

Soybean is a crop that can remove significant amounts of nutrients per bushel of grain harvested. Because of this, soybeans can respond to starter fertilizer applications on low-testing soils, particularly phosphorus.

Typically, corn shows a greater response to starter fertilizer than soybean. Part of the reason for that is that soils are generally warmer when soybeans are planted than when corn is planted. The typical response in early growth observed in corn is usually not observed in soybeans. However, yield response to direct soybean fertilization with phosphorus and other nutrients can be expected in low-testing soils.

K-State guidelines for soybeans include taking a soil test for phosphorus (P), potassium (K), sulfur (S), zinc (Zn), and boron (B). If fertilizer is recommended by soil test results, then fertilizer should either be applied directly to the soybeans or indirectly by increasing fertilizer rates to another crop in the rotation by the amount needed for the soybeans.

The most consistent response to starter fertilizer with soybeans would be on soils very deficient in one of the nutrients listed above, or in very high-yield-potential situations where soils have low or medium fertility levels. Furthermore, starter fertilizer in soybeans can be a good way to complement nutrients that may have been removed by high-yielding crops in the rotation, such as corn, and help maintain optimum soil test levels.

Banding fertilizer to the side and below the seed at planting is an efficient application method for soybeans. This method is especially useful in reduced-till or no-till soybeans because P and K have only limited mobility into the soil from surface broadcast applications. Fertilizer should not be placed in-furrow in direct seed contact with soybeans because the soybean seed is very sensitive to salt injury.

Soybean seldom responds to nitrogen (N) in the starter fertilizer, and producers should emphasize adequate seed inoculation to ensure good nodulation and N supply during the growing season.





**Figure 1. Visual differences with starter P fertilizer on low testing soils. Picture by Nathan Mueller, former K-State Agronomy graduate student and current University of Nebraska Cropping Systems Extension.**

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#### 4. Management strategies to minimize iron chlorosis in soybeans

Soybean is one of the most susceptible field crops to iron chlorosis (yellowing), and this problem is not uncommon in Kansas. Iron is a catalyst in the production of chlorophyll, so a deficiency of iron (Fe) displays as a yellowish or pale color in the leaves. Iron is an immobile nutrient in the plant so symptoms first appear on the youngest leaves.

Iron chlorosis is usually caused by a combination of stresses rather than a simple deficiency of available soil Fe. Some of the soil chemical factors that play a role in Fe chlorosis include high pH, high carbonate levels, high salinity (EC), low available iron (DTPA-Fe), and high soil nitrate levels. Other factors that play a role include variety susceptibility and the presence of soybean cyst nematodes and root rotting fungi. Given all these factors, Fe chlorosis is a complex problem and not one that can be determined solely on the basis of a soil Fe test.

One of the factors that can be involved in the development of Fe chlorosis in soybeans is high levels of soil nitrate. Iron is taken up in the ferric form ( $\text{Fe}^{+3}$ ), then is immediately converted within the plant into the ferrous form ( $\text{Fe}^{+2}$ ) (existing in the chlorophyll). High concentrations of nitrate-N seem to inhibit this conversion of  $\text{Fe}^{+3}$  to  $\text{Fe}^{+2}$  in the plant, contributing to Fe deficiencies. It is important remember that high soil nitrate levels alone will not cause iron chlorosis in soybeans, but is simply one additional factor that will magnify the problem.





**Figure 1. Wheel tracks are noticeable with greener plants in this field of soybeans with iron chlorosis. Soil nitrate levels in these wheel tracks are much lower than the rest of the field due to some soil compaction and the subsequent N loss by denitrification. Usually where soil nitrate levels are lower, plants are not as green. But in the case of iron chlorosis, it is actually the opposite because higher nitrate levels make iron chlorosis symptoms worse. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.**

### **Fertilization strategies for iron chlorosis**

Research in Kansas evaluated multiple factors to manage Fe deficiency, including fertilization strategies with Fe fertilizer applied with the seed and foliar, and in combination with variety selection. These studies were established in soils prone to develop Fe deficiency, with soil pH above 7.4.

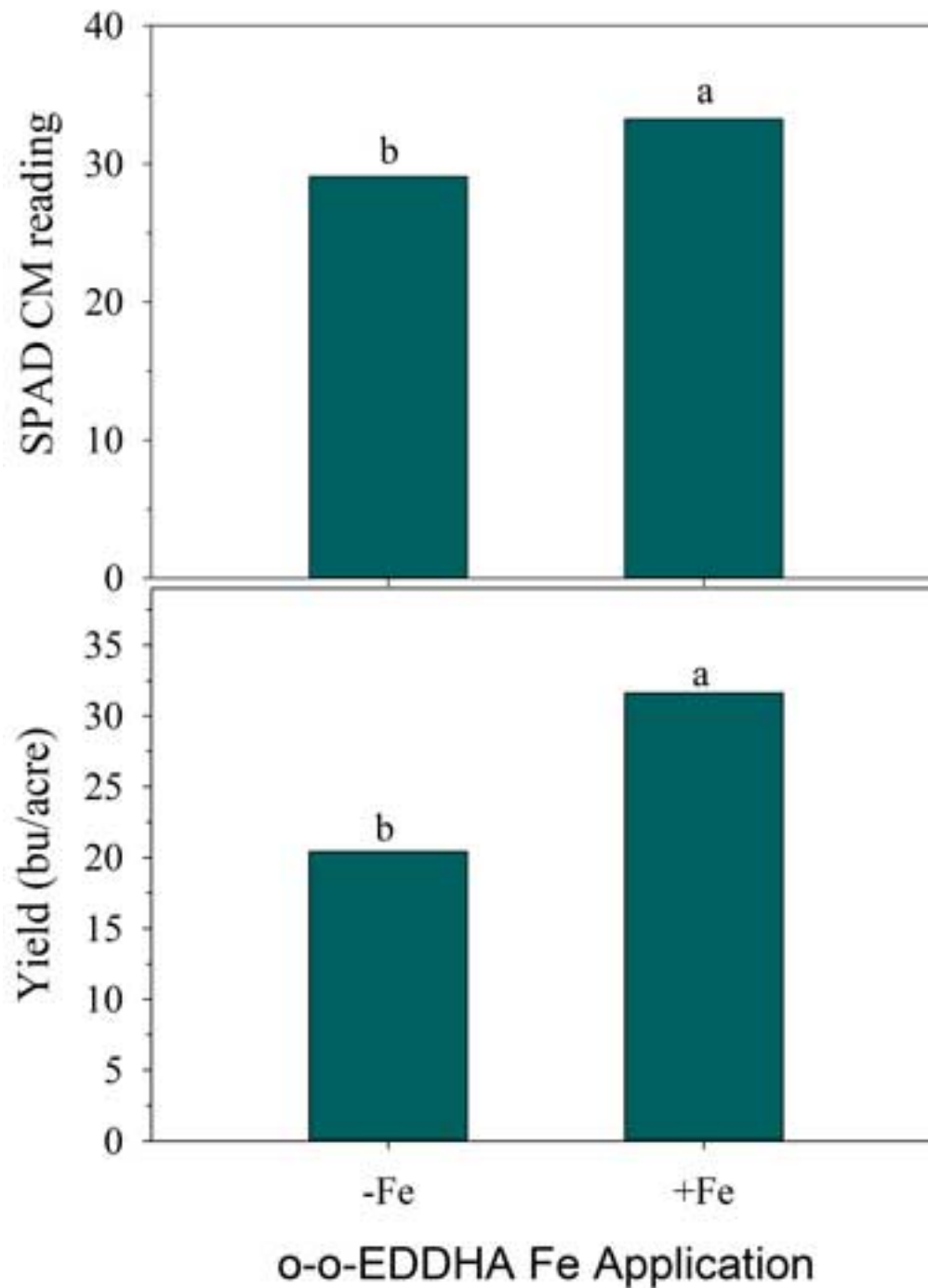


**Figure 2. Soybean response to seed-applied chelated iron fertilizer EDDHA Fe (6%). Photos by Dorivar Ruiz Diaz, K-State Research and Extension.**

**Greenness.** The seed-applied Fe treatment had a significant effect in improving the greenness of the foliage, as shown by the chlorophyll meter reading results (Figure 3). Overall, the greening response was greater than the response to foliar Fe applications, suggesting less benefit from foliar applied Fe fertilizer. The variety most susceptible to Fe chlorosis greened up in response to the seed-applied Fe much more than the variety more tolerant to Fe chlorosis, even though there is also increase in greenness with the tolerant variety. This indicates that the tolerant variety stayed greener during the growing season but still showed additional benefit from the seed-applied Fe treatment.

**Yield.** Both the tolerant and susceptible varieties also had a good yield response to the seed-applied Fe fertilizer, and no significant yield response to the foliar Fe chelate treatments (Figure 3). Average

yield increase was approximately 10 bushel per acre, while yield increase in the tolerant variety was approximately 15-20 bushels per acre. Previous studies suggested that tolerant varieties tend to utilize Fe fertilizer sources more efficiently, which would explain these results in plant response observed in our study.



**Figure 3. Average chlorophyll meter reading and yield. Under these conditions favorable to iron chlorosis, an iron chelate fertilizer improved greenness readings and yield.**

## Summary

- Fe deficiency potential cannot be explained well by any single soil parameter.
- Foliar Fe treatments to soybeans with Fe chlorosis seem to increase the “greenness” effectively but results suggest an inconsistent yield response.
- A seed-applied iron chelate provides significant yield increases to soybeans under conditions favorable to Fe chlorosis. The seed contact with the fertilizer source seems to be particularly important for reducing Fe chlorosis symptoms, and the fertilizer placement should be in-furrow. Also, in very high soil pH conditions, chelated Fe sources such as o-o-EDDHA (used in our study) are more stable and can provide better results.
- If Fe chlorosis has been a common problem in the past, producers should select a soybean variety that is tolerant to Fe chlorosis. It may also pay to use a chelated Fe fertilizer in-furrow.
- Producers should avoid excessive application of N fertilizer to the crop that precedes soybeans in the rotation. In fields with some risk of Fe chlorosis, the high levels of soil nitrate may be a complicating factor.

This study was supported by the Kansas Soybean Commission.

Additional information can be found in: <https://store.extension.iastate.edu/product/Micronutrients-for-Soybean-Production-in-the-North-Central-Region>

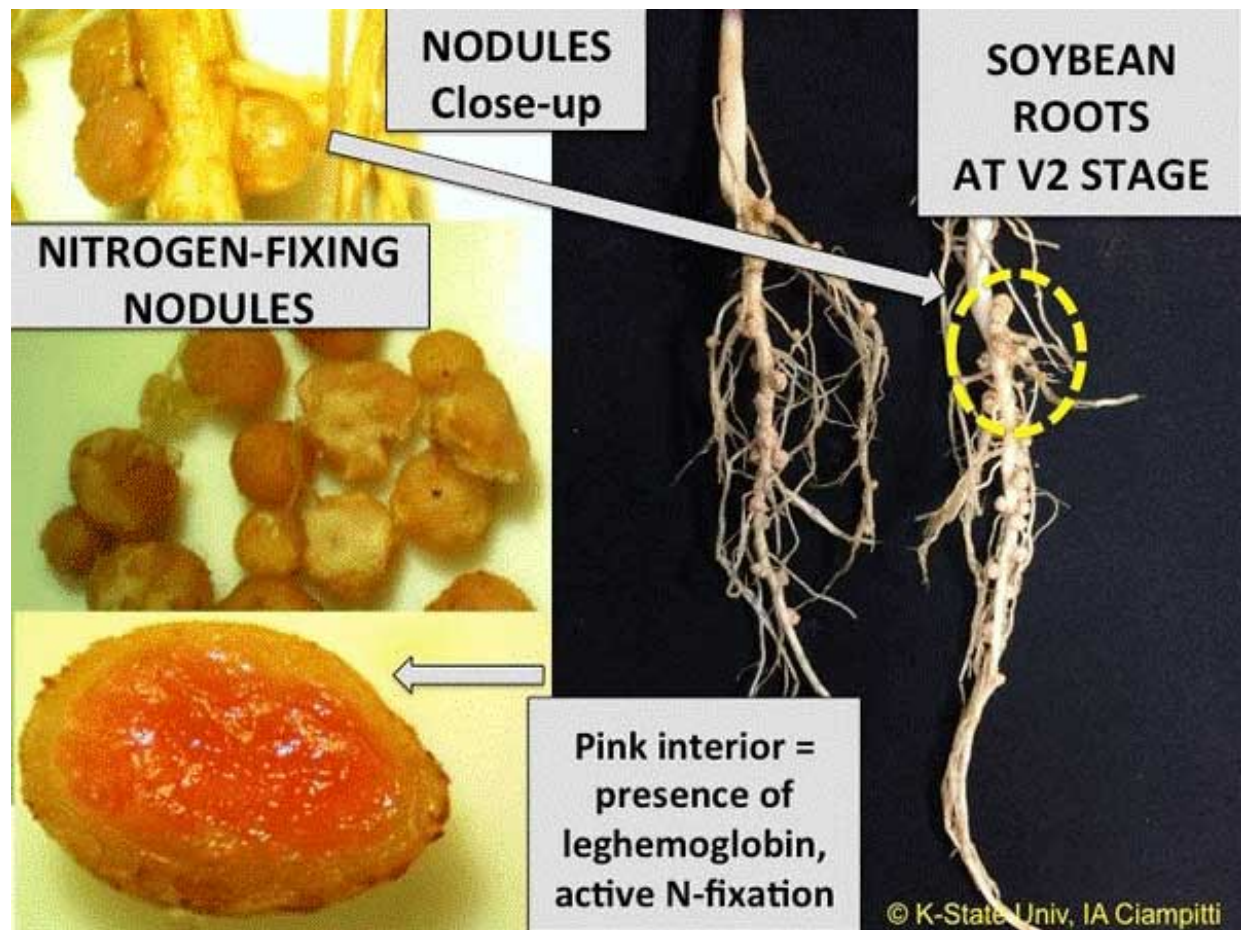
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## 5. What factors affect successful soybean inoculation and nodulation?

If soybean plants are chlorotic (yellow) and nitrogen (N) deficient despite being inoculated, that probably indicates the inoculant has failed.

### Assessing nodulation in the field

In the field, nodules from some soybean plants can be crushed to assess their internal color. In general, a pink or reddish internal color indicates the rhizobia is actively fixing N. On the other hand, a dark gray or whitish color indicates the rhizobia is not effectively fixing N. This color will be difficult to see in very young or very old nodules. Nitrogen fixation slows down, and nodules begin to senesce (deteriorate) during seed fill as the plant directs most of its resources to reproduction.



**Figure 1. Close-up of soybean nitrogen-fixing nodules. Photos by Ignacio Ciampitti, K-State Research and Extension.**



## What factors affect inoculation response?

Several factors can result in poor nodulation or failure of inoculation:

1. Poor or inadequate coverage of the seeds by the inoculum during inoculation.
2. Contamination of inoculant with foreign materials.
3. Lack of competitiveness of the introduced *Rhizobia* strain compared to the indigenous *Rhizobia*.
4. Lack of persistence in the soil: The introduced *Rhizobia* should be able to grow and remain viable in the soil and in between crops without undergoing mutation.
5. Low soil phosphorus (P): Legumes need adequate P for proper growth and pod development. Low P can result in poor nodulation and reduced N fixation. Phosphorus deficiency can negatively affect seed development and pod formation leading to low yield.
6. Soil pH: This is an important environmental factor. Most legumes grow and nodulate well at pH 5.6 to 6.7. The best soil pH for *Rhizobium* lies between pH 6 to 7. Low pH soils require liming. In general, legume responds well to liming. Low pH (< 5) causes aluminum (Al) and manganese (Mn) toxicity, and results in P deficiency.
7. Soil nitrate and ammonium levels: High inorganic N (ammonium and nitrate) levels in the soil inhibit nodulation and N fixation. The effectiveness and competitiveness of *Rhizobia* are negatively affected by high inorganic nitrogen.
8. Molybdenum (Mo): Soils deficient in Mo can have reduced nitrogen fixation. Mo, an essential micronutrient, is needed for the formation and function of the nitrogenase enzymes. Legumes also need other micronutrients such as iron, boron, and copper.
9. Stress, either in the form of drought, excessive soil moisture, and high temperatures can reduce nodulation.

If the inoculation has failed, producers may need to apply N to their soybean crop. Depending on the projected yield potential, producers may need to apply as much as 120-180 lbs N/acre.

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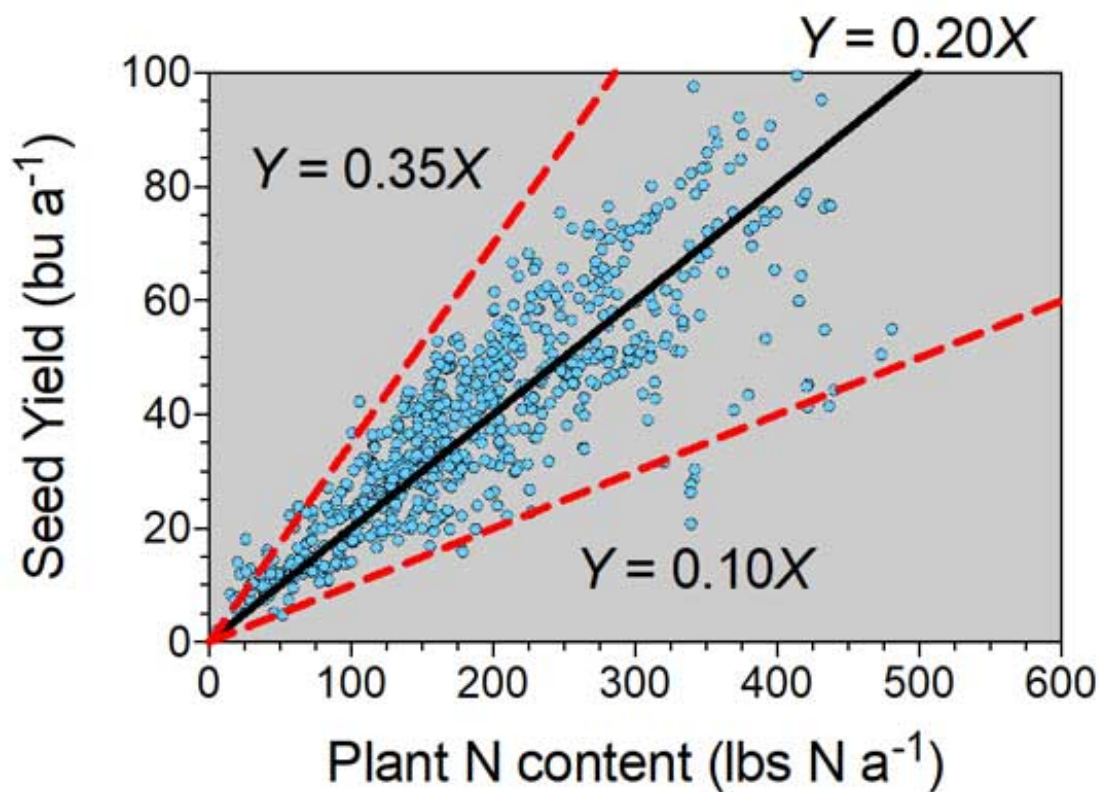
## 6. Inoculation of soybeans: A good insurance policy

When planting soybeans in Kansas, it may be a good insurance policy to inoculate the seed. The *Bradyrhizobium* bacteria forms nodules on soybean roots, and these nodules fix nitrogen from the atmosphere and supply it to the plants. Neither soybeans nor *Bradyrhizobium japonicum* are native to the United States, so there will be no *Bradyrhizobium japonicum* in the soil unless it was introduced at some time in the past by inoculated soybean seed.

Why do we need to inoculate soybean?

1. To enhance good nodulation
2. To improve nitrogen (N) fixation
3. To help ensure a stable yield

Soybeans are big users of nitrogen. For example, a soybean yield of 60 bushels per acre requires 300 lbs N per acre in the plants, removing about 3-4 lbs of N per bushel of seed (Figure 1). Most of the N required by a soybean plant is supplied via biological nitrogen fixation that takes place in nodules on the soybean roots. The nodules, when well established, can provide from 40-80 percent of the soybean plant's N needs for the year. The actual contribution of biological N fixation to the N requirement of soybeans can be influenced dramatically by the amount of residual or mineralized N available in the soil profile or by stress conditions affecting the plant such as drought and heat, inhibiting N fixation due to the cost of maintaining the N fixation process.



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**Figure 1. Soybean yield and plant nitrogen uptake relationship. Data reviewed and synthesized by Dr. Ciampitti, K-State Research and Extension – from Ciampitti and Salvagiotti, 2018, Agronomy Journal.**

Yield responses to inoculation have been quite variable in Kansas and other surrounding states. However, the cost of buying pre-inoculated seed, or inoculating the seed or soil yourself, is low and the potential yield loss from poor inoculation can be significant unless available soil N levels are high.



**Figure 2. The soybeans in the part of the field at left in this photo had good nodulation. The area of the field on the right had poor nodulation and exhibited nitrogen deficiency symptoms. Photo by Tom Maxwell, K-State Research and Extension.**



**Figure 3. Well-nodulated soybean plants (left) compared to plants without nodulation. Photo by Kraig Roozeboom, K-State Research and Extension.**

Soybeans that are poorly nodulated will have to take up most of the N they need from the soil, just like corn, sorghum, wheat, or any non-legume crop. Because N fertilizer is generally not applied for soybeans, a crop that is poorly nodulated will quickly use up the available N in the soil and become chlorotic (yellow) from N deficiency. For poorly nodulated soybeans, N deficiency is usually evident later in the growing season as the nutrient demand increases.

### **Why is the yield response to inoculation so variable?**

There are several reasons for the variability in yield response to inoculation. For one thing, if soybeans have been grown on the field in previous years, there may be enough *Bradyrhizobium* bacteria in the soil to nodulate the soybeans adequately, in which case an inoculant may not benefit the crop. But if there is not enough *Bradyrhizobium* in the soil, the inoculant may increase yields by 2 bushels per acre or more on fields that have had soybeans in the recent past. On fields where soybeans have never been grown, the inoculant can often increase yields by 10 bushels per acre or more (Table 1).

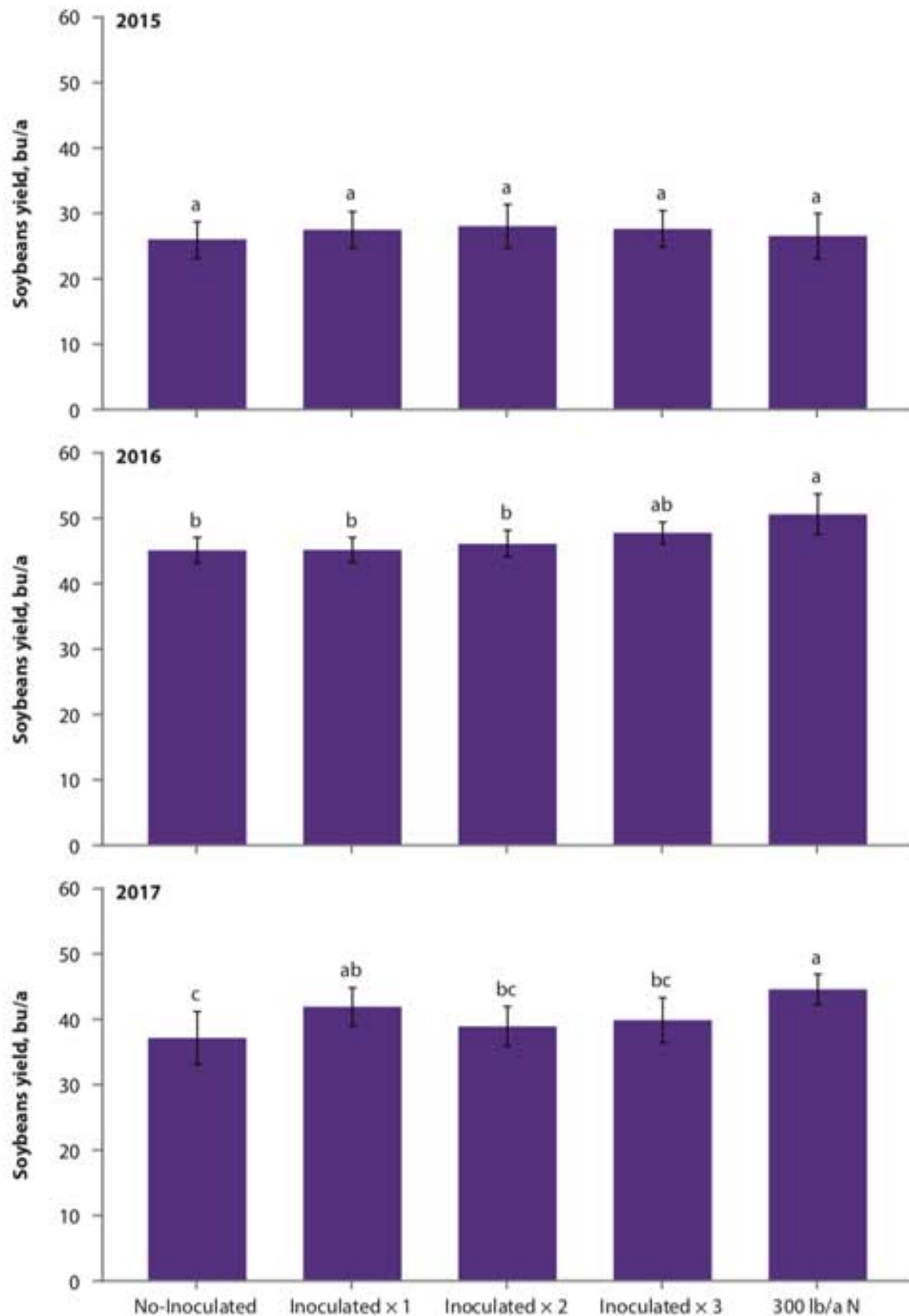
**Table 1. Effect of soybean inoculant on land with no prior history of soybeans**

	<b>Kansas River Valley Experiment Field, Rossville</b>	<b>Southwest Research-Extension Center, Garden City</b>
<b>Treatment</b>	Soybean yield (bu/acre)	
None	56.9	33.9
Seedbox inoculant	57.8	39.6
Seed-applied inoculant	66.4	43.5
LSD (.05)	9.8	3.6

Source: C.W. Rice and L.D. Maddux, Kansas Fertilizer Research 1992, K-State Report of Progress 670;  
C.W. Rice and M. Witt, Kansas Fertilizer Research 1991, K-State Report of Progress 647.

Even on fields with no history of soybean production, inoculation may increase nodulation but still have no effect on yields – especially if the yield environment is low and soils have enough available N to supply the crop's needs (Figures 4 and 5).

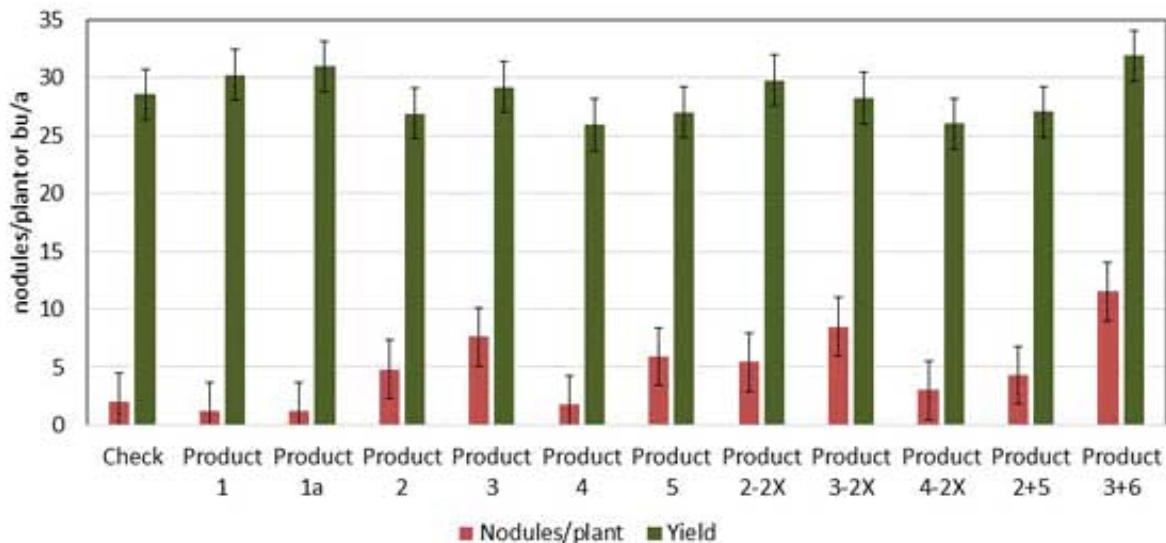






**Figure 4. Soybean yield at East Central Experiment Field, 2015, 2016, and 2017 years. Treatments include inoculation at normal, 2X, and 3X rates; and 300 lbs/acre of N. Data from K-State agronomists Ignacio Ciampitti, Eric Adee, Jim Kimball et al**  
: <https://newprairiepress.org/cgi/viewcontent.cgi?article=7608&context=kaesrr>

Nodule count and yield of soybeans treated with different inoculant products and product combinations in 2011 and 2012 at six locations in Kansas that had not had soybeans in 15 years or more.



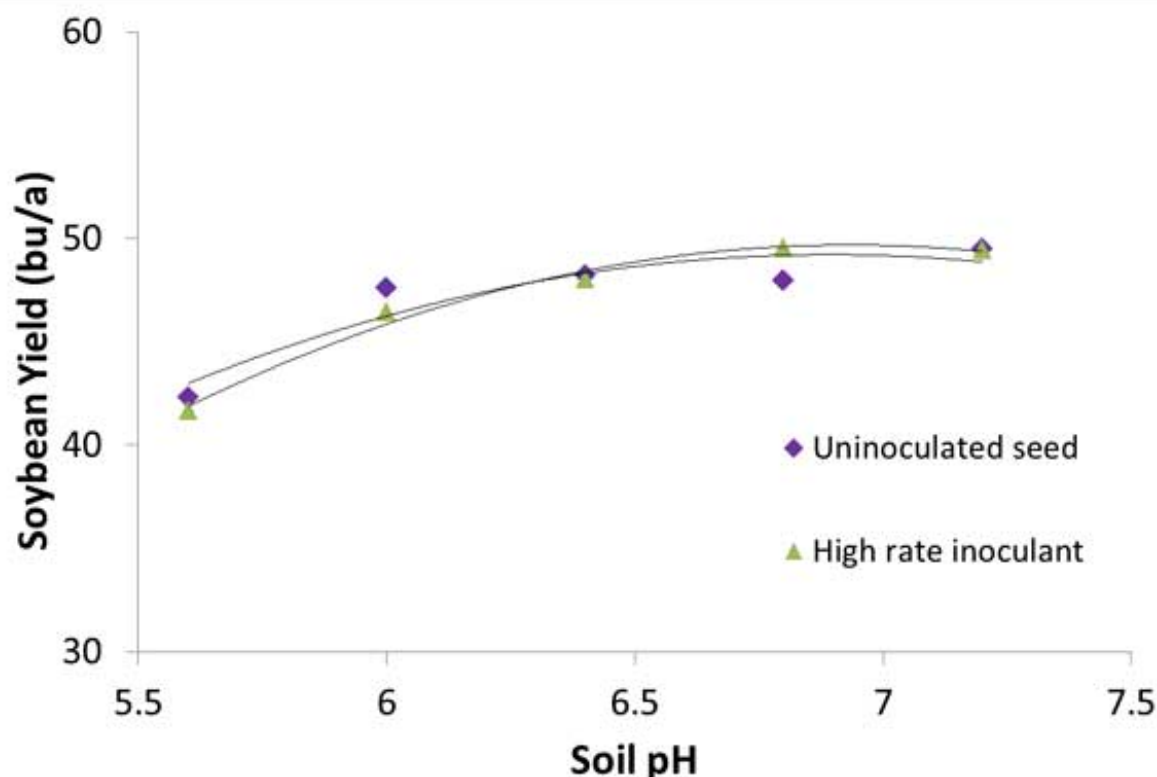
**Figure 5. Research by K-State agronomists Kim Larson, Kraig Roozeboom, and Chuck Rice.** <http://krex.k-state.edu/dspace/handle/2097/16303>

Yield response to inoculants can also depend on soil pH, environmental conditions, and other factors. For instance, if lack of precipitation limits yields to less than 30 bushels per acre, poor nodulation may not impact yield. However, if rainfall is favorable, and yield potential is greater than 90 bushels per acre, poor nodulation could result in a substantial N deficit and reduced yield.

Soybeans should be inoculated in the following circumstances:

- Where the field has not been planted to soybeans for the past four years or more: *Bradyrhizobium japonicum* do not compete especially well with other soil microbes over time, and their numbers often gradually decline unless a host plant (soybeans) is grown every few years or new populations of the bacteria are introduced regularly from inoculated seed.
- Where the soil pH is less than 5.5 or greater than 8.75: *Bradyrhizobium japonicum* does not survive well in the soil under these pH extremes, and good soybean nodulation is unlikely unless the seed is inoculated. At more normal pH levels, from pH 5.5 to 7.5, the effect of inoculation will vary with the other conditions mentioned above. However, soybean yields

will be reduced at pH levels below 6.0 regardless of inoculation (Figure 6).



**Figure 6. Lower pH levels reduced soybean yields in this research by K-State agronomists Doug Shoup, Dan Sweeney, and Ignacio Ciampitti. In this research, inoculation had no significant effect on yields. This field has beans in the rotation every other year, so a response to inoculation isn't necessarily expected.**

- Where soil erosion has occurred since the last time soybeans were grown: If some of the topsoil has been lost, the remaining topsoil will need to be replenished with *Bradyrhizobium japonicum* from the seed inoculant.
- Where soil organic matter levels are less than 1 percent: Soils with low organic matter levels have less *Bradyrhizobium japonicum* and need to be replenished with new sources from the seed inoculant.
- Where there has been severe drought or flooding: Severe drought and flooding reduce *Bradyrhizobium japonicum* populations in the soil. Just a couple days of saturated soils, however, should not adversely affect *Bradyrhizobium japonicum* populations in the soil.

Based on previous information, inoculation is usually effective when:

1. Soybean has not been planted in the past 3 to 5 years
2. Soil pH is below 6.0
3. Soil has a high sand content

4. Field has been flooded for more than a week, creating anaerobic conditions, when nodulation was supposed to become established
5. Early-season stress conditions (e.g. heat) affects plant-bacteria establishment

Producers should be aware that inorganic soil N will reduce nodulation and N fixation by *Bradyrhizobium japonicum* bacteria. Where soil N levels are 40-60 lbs per acre or more, soybean plants may look fine, yet have reduced nodulation. At very high N levels, such as where the field was fertilized for corn but the producer decided to plant soybeans instead, there may be little or no nodulation. Depending on soybean yield and amount of residual N, this may be enough to carry the soybean crop for much of the seasons, but it may end up being N deficient during seed fill. In most cases, up to 20 lbs N per acre can be applied as a starter fertilizer to help get the soybeans started without having any detrimental effect on nodulation during the growing season (unless the upper layer of soil is already rich in inorganic N at planting time).

Soybean inoculation is basically “cheap insurance” against a potential N deficiency problem. Even if soybeans have been planted in the field recently, it doesn’t cost much to inoculate the seed.

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## 7. Risk of Fusarium head blight suggests potential problems in southeast Kansas

Frequent rainfall and extended periods of high relative humidity create an ideal environment for many wheat diseases. When these weather conditions occur around the flowering time for wheat, it increases the risk for Fusarium head blight. This fungal disease reproduces on crop residues from previous corn and wheat crops. Wet weather as wheat is heading stimulates the fungus to reproduce and release spores. These spores are moved by wind to developing wheat with infection taking place during flowering or early stages of grain fill. The resulting symptoms include large tan lesions that encompass one or more spikelet's, or in some cases, can damage the entire head (Figure 1).



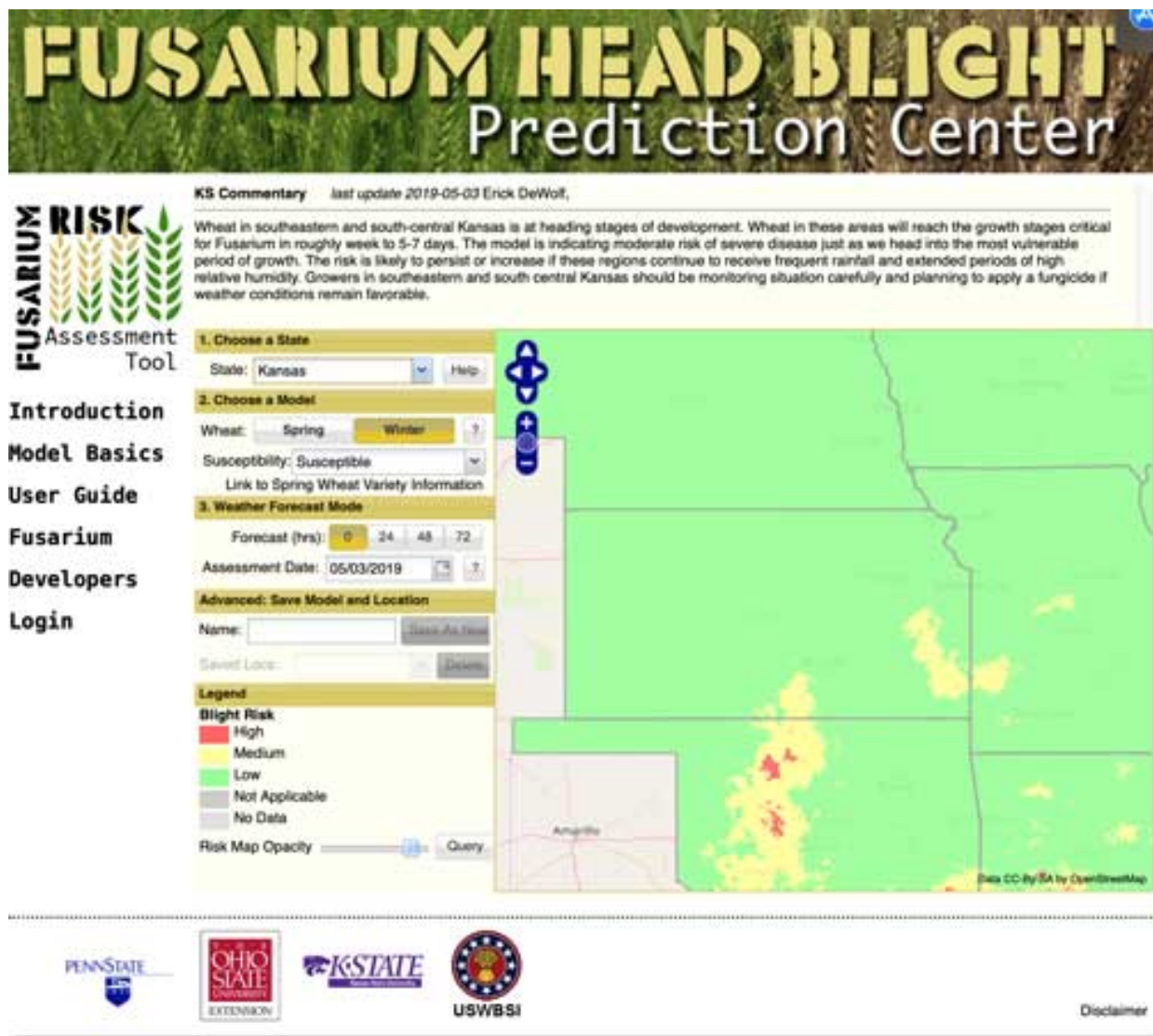
**Figure 1. Wheat with symptoms of Fusarium head blight. Photo provided by Erick DeWolf, K-State Research and Extension.**

Fungicide applications of products such as Prosaro, Caramba, or Miravis Ace provide the best available disease suppression. These fungicides are most effective when applied at the start of anthesis or within a few days after flowering is completed. Given the current low grain prices, it may be even more important to only apply fungicides when they are most needed.

Fortunately, there is a prediction effort designed to help growers evaluate the need for fungicides to suppress Fusarium head blight. These models target the past 2 weeks of observed weather and are most accurate as the crop approaches flowering when the fungicide decision must be made. The current risk map indicates that some areas of southeast and south central Kansas may be at risk for severe disease problems (Figure 2). The current prediction is most relevant for fields that are currently heading or flowering. With more wet weather forecasted for next week, growers in these areas should be monitoring the weather and disease predictions. Fungicides may be needed if the risk persists or increase over the next week.

The predictive models for Fusarium can be found on-line at: <http://www.wheatcab.psu.edu>





**Figure 2. Screenshot of the current risk of Fusarium head blight in KS as estimated by the Fusarium Head Blight Prediction Center (<http://www.wheatcab.psu.edu>).**

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[dewolf1@ksu.edu](mailto:dewolf1@ksu.edu)

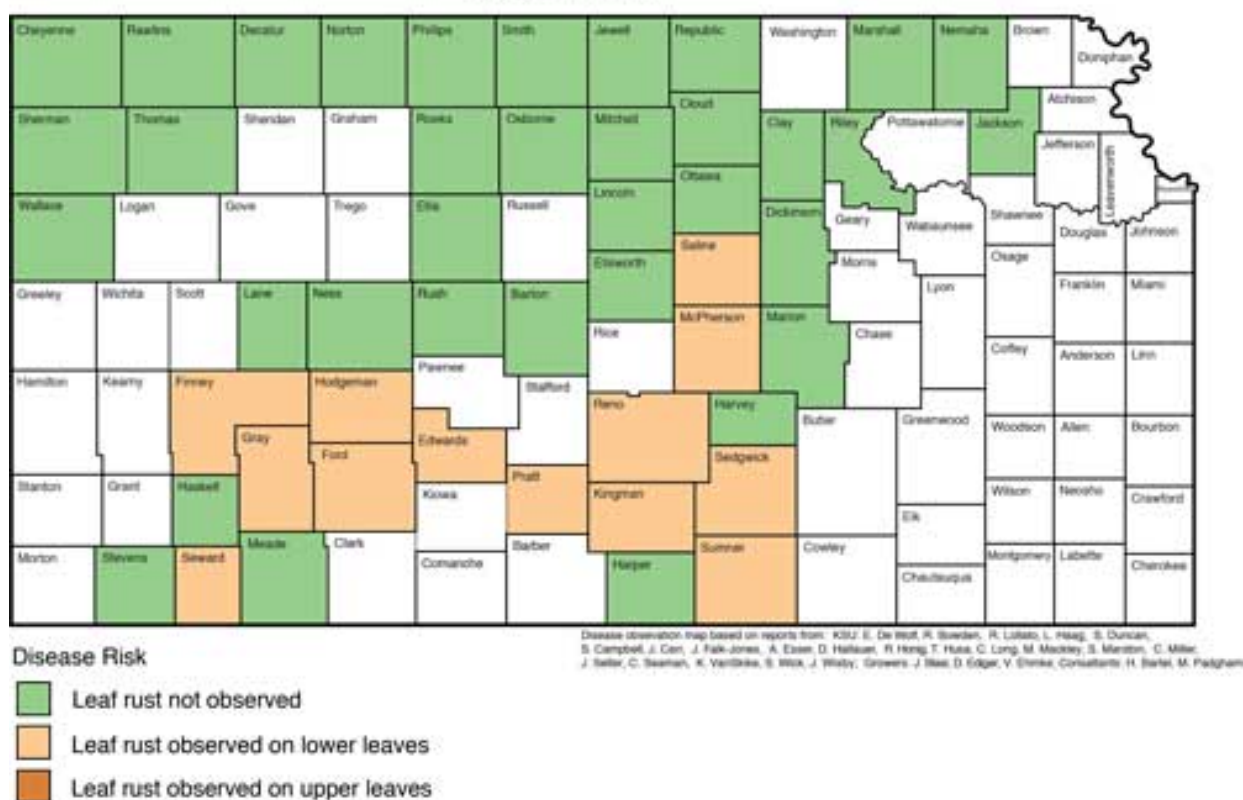


## 8. Decision time on foliar fungicides for wheat producers in southern Kansas

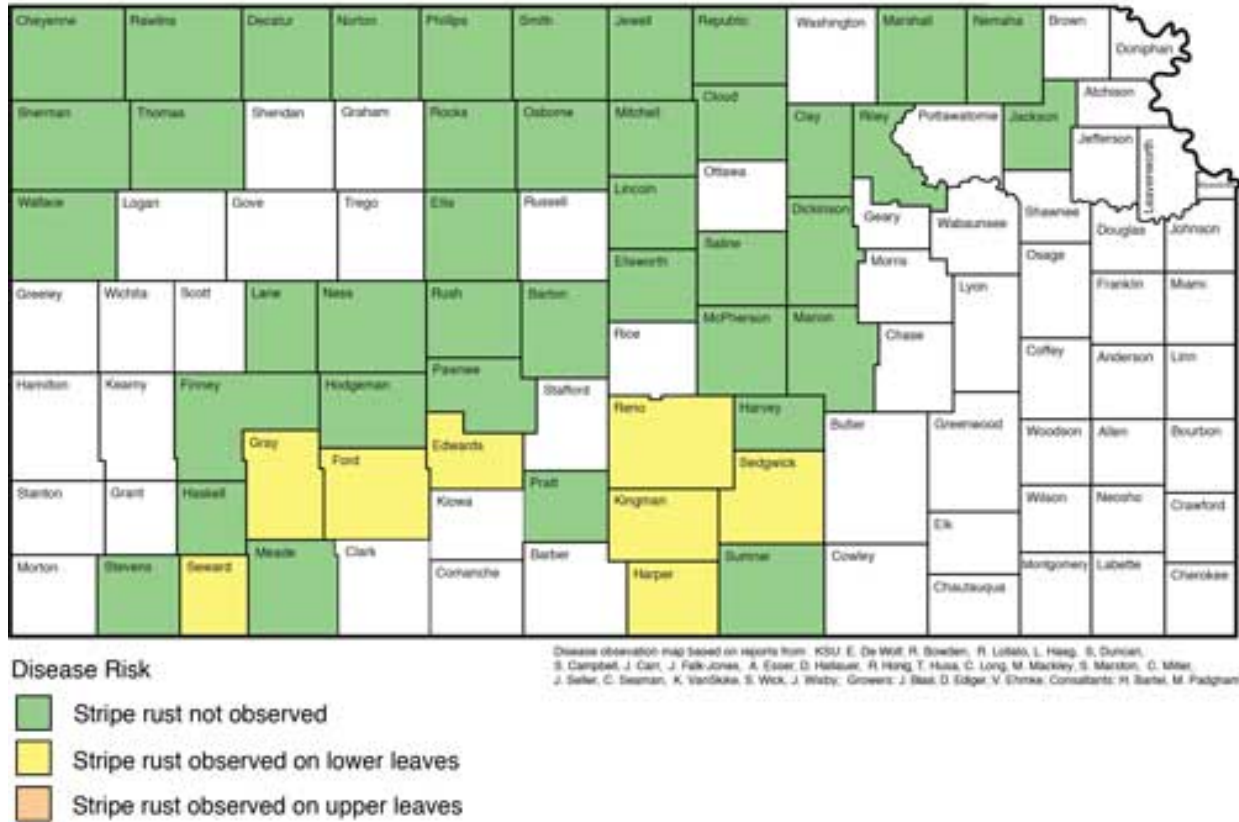
Wheat in many areas of central Kansas is at flag leaf emergence with many fields in the southeastern and south central region at the boot or heading stages of growth.

Monitoring over the past two weeks indicates that leaf rust, stripe rust, and septoria leaf blotch are all active in the state (Figure 1). In most situations, it appears these diseases are still at low levels giving growers some time to evaluate their situation and make final decisions about fungicide applications to help maintain the yield potential of the crop.

### Distribution of Wheat Leaf Rust May 3, 2019



## May 3, 2019



### Figure 1. Current distribution of leaf and stripe rust on wheat in Kansas

The frequent rainfall and extended periods of high humidity this past week were very conducive for disease development. However, it may take several weeks for the infections occurring now to become visible as disease symptoms. Given the recent weather and the current distribution of disease, growers concerned about leaf rust, stripe rust, and other foliar diseases should be moving ahead with plans to apply fungicides. Growers still have time to gather more information from areas of the state where the diseases are not active and/or the wheat crop has not reached flag leaf emergence.

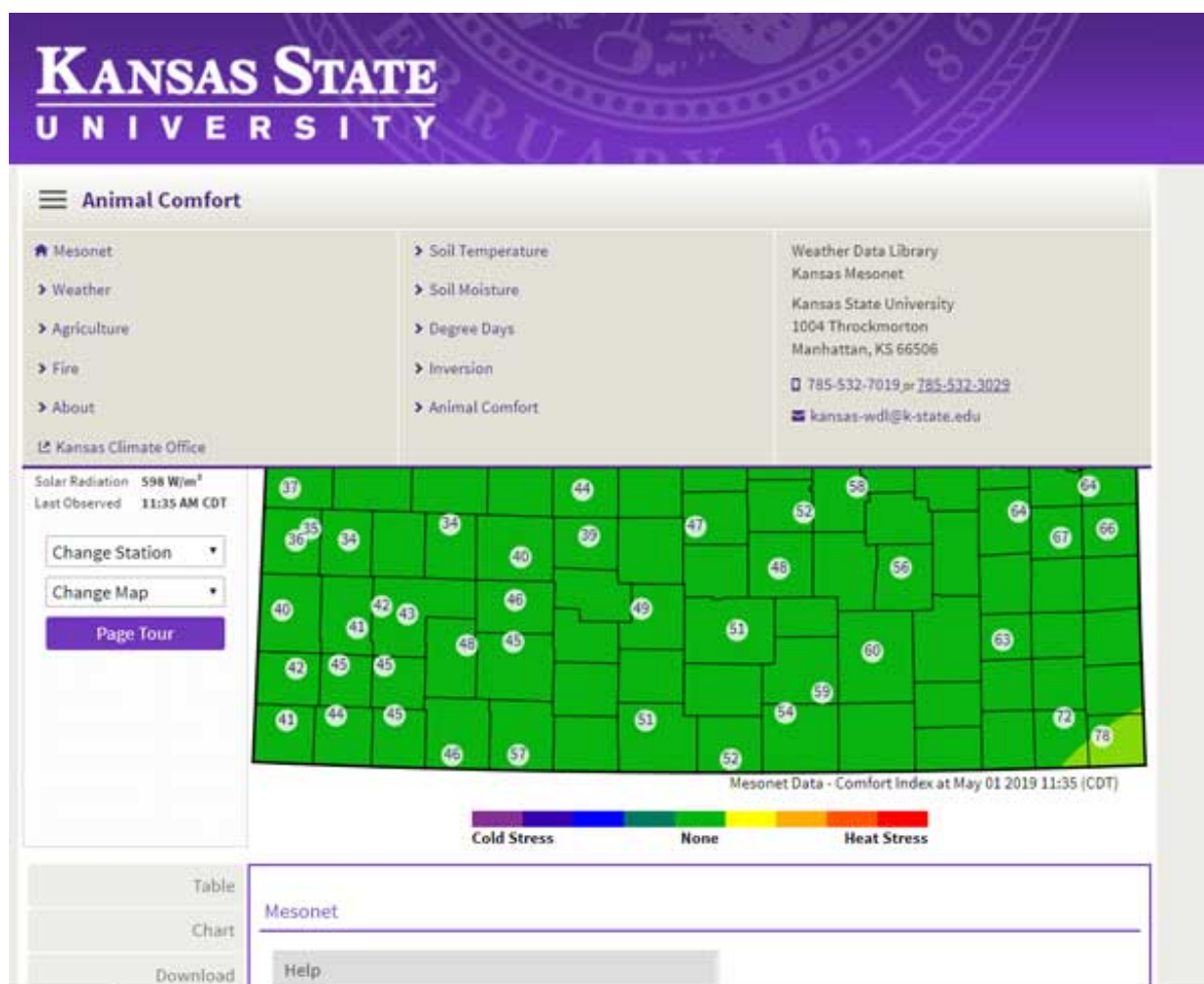
Erick DeWolf, Extension Plant Pathology  
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## 9. Kansas Mesonet launches cattle comfort tool

The Kansas Mesonet is launching a new tool: cattle comfort index. The harsh conditions this winter resulted in negative impacts on cattle, particularly calves. One symptom of the problems was the large number of requests for Mesonet data to document losses under the Livestock Indemnity Program. A comprehensive tool on the weather impacts should prove useful for future events. Negative impacts are not limited to winter conditions. This tool also helps assess the response to excessive heat and humidity.

Actual animal response to temperature stress will be dependent on a number of factors not accounted for in the index. Those include, but are not limited to: age, hair coat (winter vs summer; wet vs dry), health, body condition, micro-environment, and acclimatization.

Users can access this new tool from either the main Mesonet page by selecting from the drop down menu, Agriculture, then Comfort Index (Figure 1); or directly from this link: <http://mesonet.k-state.edu/agriculture/animal/>



**Figure 1. Screenshot of the menu path to the new Comfort Index page on the Kansas Mesonet.**

## Comfort Index

Building on the Comprehensive Comfort Index, produced at University of Nebraska, the tool illustrates the impact of both extremes of hot and cold. The index is unique in that it includes, in addition to air temperature and relative humidity, effects of wind speed and solar radiation. Development and validation of the index used data from beef and dairy cattle. The map indicates where current conditions fit on the scale. On the about page, there is a description of the values on the scale and their potential impact (Figure 2).

Heat and cold stress level categories for the cattle comfort advisor:

Comfort level	Map indicator	Index Value, °F	General Interpretation
Heat Danger		> 105	Animal deaths may exceed 5%
Heat Caution		> 95 to 105	Decreased production, 20% or more Reduced conception , as low as 0%
Heat Caution		> 85 to 95	Decreased production, 20% or more Reduced conception , as low as 0%
Comfortable		77 to 85	
Comfortable		32 to 77	
Comfortable		15 to 32	
Cold Caution		< 15 to -20	18 to 36% increase in dry matter intake
Cold Danger		< -20 to -40	
Cold Danger		< -40	

**Figure 2. Cattle comfort ranges. Graphic from Kansas Mesonet.**

## Understanding the Webpage

The “About” section contains information about the comfort index. There is also a link to the publications used to produce page. For more information on navigating this resource, users can select a page tour from the main soil moisture page located at the top of the featured map.





**Figure 3. Cattle on a pasture near the Sedan Mesonet station. Photo by Chip Redmond, K-State Research and Extension.**

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## 10. Kansas Composting Operators' School, June 11-12 in Manhattan

The Kansas Composting Operators' School provides hands-on training in municipal, agricultural, and commercial large-scale composting for operators and managers of compost facilities who want to gain knowledge and experience in composting. The school will take place on June 11-12 at Pottorf Hall on the Riley County Fairgrounds, 1710 Avery Ave, Manhattan, 66503.

The program includes classroom and laboratory instruction along with field activities. Field activities will include a demonstration of composting equipment such as a turner, and collection of compost samples for testing for maturity as well as chemical and physical properties.

Instructors for this year will be DeAnn Presley, K-State Agronomy Department and Emery Wiens, Kansas Department of Health and Environment.

Training topics will include:

- Composting science and methods
- Compost biology
- Compost feedstocks
- Food waste composting
- Determining compost mixes
- Permit and legal requirements
- Site design and maintenance
- Compost equipment
- Windrow construction and aeration
- Compost moisture
- Field and laboratory monitoring
- Learn to measure moisture, temperature, pH, soluble salts, maturity, and interpreting lab data
- Compost quality and use
- Methods of composting: static vs. active

Registration is due by **June 3** and class size is limited to 20 people. The registration fee (\$195) will include lunches, breaks, and training materials. Participants are responsible for travel and lodging. Payment (payable to KSU Agronomy) must accompany registration. Mail payment and the registration portion on the flyer included below to: Extension Agronomy, 2014 Throckmorton Plant Sciences Center, Kansas State University, Manhattan, KS 66506. Online registration is available for credit card payment (additional fees apply): <http://www.agronomy.k-state.edu/extension/soil-management/>.

DeAnn Presley, Soil Management Specialist  
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# Kansas Composting Operators' School



**June 11-12, 2019**

Pottorf Hall, Riley County Fairgrounds  
1710 Avery Ave, Manhattan, KS 66503



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- ✓ Learn to measure moisture, temperature, pH, soluble salts, maturity, interpreting laboratory data
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- ✓ Methods of composting: static versus active



## Instructors

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Email: [deann@ksu.edu](mailto:deann@ksu.edu)

Emery Wiens  
Kansas Department of Health & Environment  
Email: [emery.wiens@ks.gov](mailto:emery.wiens@ks.gov)

## REGISTRATION: Kansas Composting Operators' School

Name \_\_\_\_\_ Company or Employer \_\_\_\_\_

Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

Phone \_\_\_\_\_ E-Mail \_\_\_\_\_

Company/Agency: \_\_\_\_\_

Please mention any mobility issues or dietary preferences here: \_\_\_\_\_

**Fee: \$195** – Includes lunches, breaks, and training materials. Participants are responsible for travel and lodging. Payment (payable to KSU Agronomy) must accompany registration. Mail to: Extension Agronomy, 2014 Throckmorton Plant Sciences Center, Kansas State University, Manhattan, KS 66506. Online registration available for those who want to pay with a credit card (additional fees apply), <http://www.agronomy.k-state.edu/extension/soil-management/>. Registration due by June 3, 2019. Class size is limited to 20 people.

## 11. Pesticide recordkeeping survey - Applicator feedback requested

Private applicators are required to keep records of their restricted use pesticide (RUP) applications. The classification on several commonly used herbicides to restricted use means more private applicators are in need of an improved mechanism to keep these records.

The Kansas State Pesticide Safety program is trying to collect some data on what producers are wanting/needing to be able to keep more accurate, efficient records. The program has developed a short survey consisting of 7 questions and wants to obtain feedback from across the state. The purpose of this survey is to gather your perceptions related to the use of pesticide recordkeeping books/apps and what you would most likely use. The information you provide will aid us in determining the need and content of a newly developed pesticide recordkeeping book to assist in tracking pesticide application and/or use.

Please go to: [https://kstate.qualtrics.com/jfe/form/SV\\_86r84iID5huDIUZ](https://kstate.qualtrics.com/jfe/form/SV_86r84iID5huDIUZ) to complete the survey and give us your feedback.

Frannie Miller, Pesticide Safety and IPM Coordinator  
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