Issue 954

K-STATE Research and Extension

## Extension Agronomy

# eUpdate

*05/04/2023*

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. Inoculating soybeans is a good insurance policy

When planting soybeans in Kansas, it may be a good insurance policy to inoculate the seed. The *Bradyrhizobium* bacteria form 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 soybeans?

1. To promote 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, requiring 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. When well established, the N fixation process can provide 40-80 percent of the plant's N needs for the season. The actual contribution of 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.

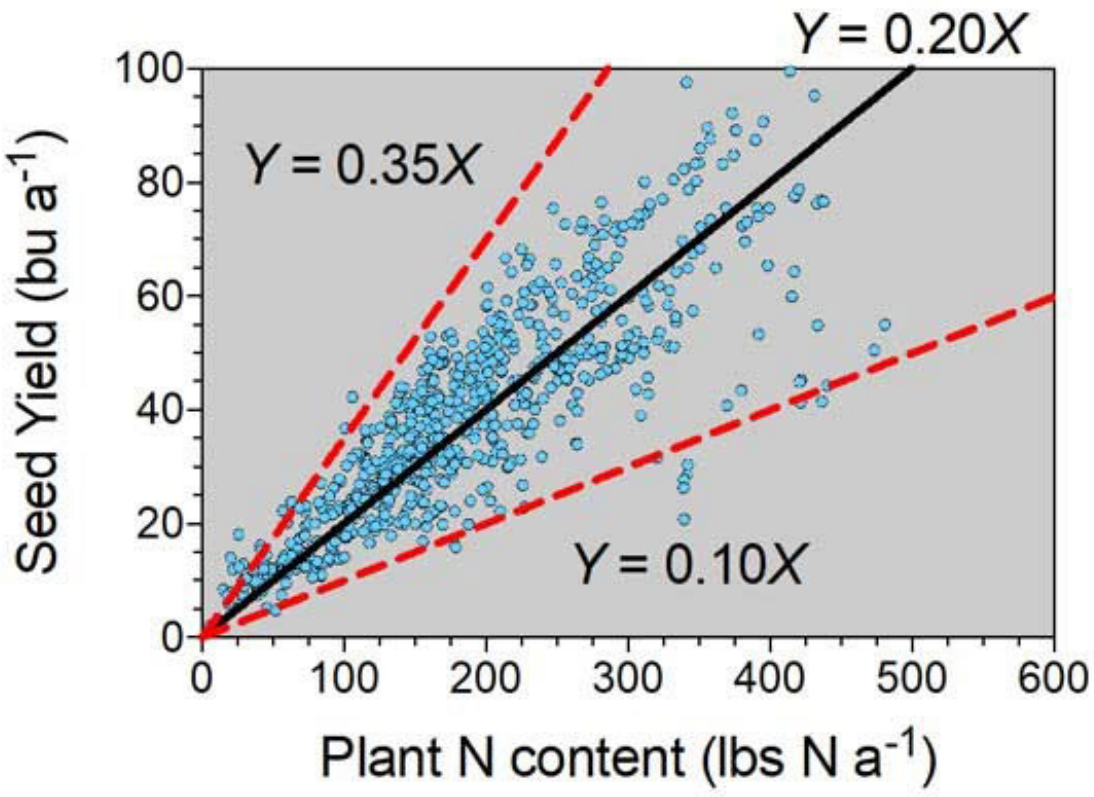


**Figure 1. Soybean yield and plant nitrogen uptake relationship. Data reviewed and synthesized by Dr. Ciampitti, K-State Research and Extension – from Ciampitti and Salvagiotti,**

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. 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 poorly nodulated crop 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 (Figures 2, 3).

**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.**

**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**

| | **Kansas River Valley Experiment Field, Rossville** | **Southwest Research-Extension Center, Garden City** |
|---|---|---|
| **Treatment** | 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.

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 high, poor nodulation could result in a substantial N deficit and reduced yield.

Based on previous information, inoculation is most likely to increase soybean yield when:

1. Soybean has not been planted in the past 3 to 5 years or if it is only the second or third soybean crop on the field, regardless of time since the last soybean crop
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) affect 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. There may be little or no nodulation at very high N levels, such as where the field was fertilized for corn but the producer decided to plant soybeans instead. Depending on soybean yield and amount of residual N, this may be enough to carry the soybean crop for much of the season, but it may end up being N deficient during seed fill. In most cases, up to 40 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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## 2. Several 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**

Assess for root nodules after the V2 stage (second trifoliate) when nodules are first initiated in the roots. Crush or slice nodules from several soybean plants to assess their condition. 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. A few large nodules along the tap root are more effective at fixing N than small nodules along the lateral roots. Nitrogen fixation slows down, and nodules begin to senesce (deteriorate) during seed fill as the plant directs most of its resources to reproduction.

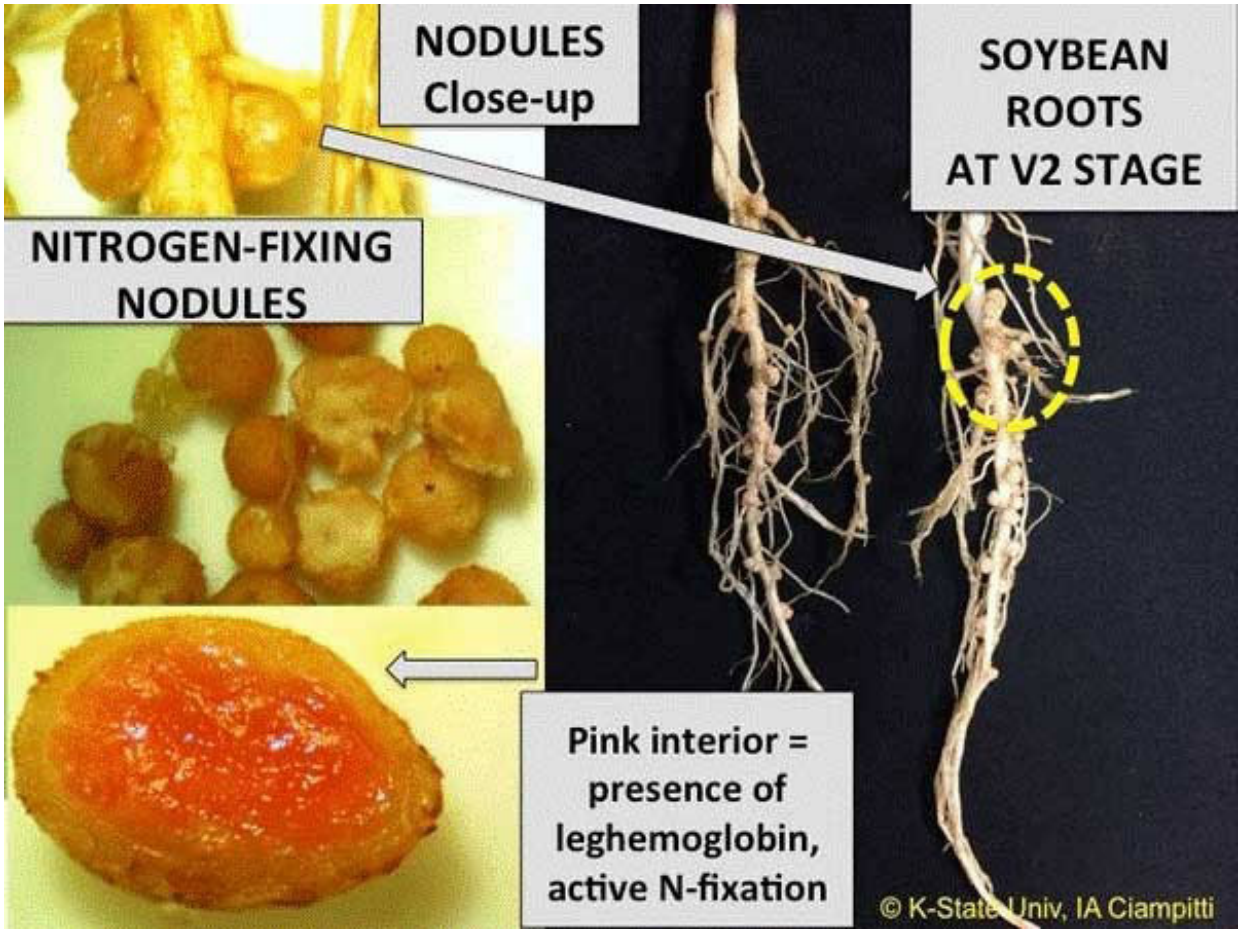


**Figure 1. Close-up of soybean nitrogen-fixing nodules. Photos by Ignacio Ciampitti, K-State Research and Extension.**

**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 *Bradyrhizobium* strain compared to the indigenous *Rhizobia strains*.
4. Lack of persistence in the soil: The introduced *Bradyrhizobium* should be able to grow and remain viable in the soil between soybean crops without undergoing mutation.
5. Low soil phosphorus (P): Legumes need adequate P for proper growth and 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 seed 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 *Bradyrhizobium* 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 *Bradyrhizobium* 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. Stresses such as drought, waterlogging, or heat 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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## 3. Proper pesticide use: Why should an applicator care?

The label is the law - most pesticide applicators are familiar with that phrase. Yet, pesticides are sometimes used in ways that are inconsistent with product labels. Examples may include using a product on a site that is not labeled, using a rate greater than labeled, using an application method that is not labeled, and many others. Sometimes, pesticides have similar active ingredients, but different formulations. Using a formulation that is not labeled for a particular site is also a misuse. Even though the off-label practice seems harmless at the time, doing so may have unintended consequences, including additional limitations on pesticides. The pesticide toxicity and amount of exposure affect the amount of risk to human health. Remember pesticides are designed to kill certain organisms (insects, weeds, and diseases) and therefore have a degree of toxicity that could cause harm to humans. Label directions are written to minimize risks for applicators, bystanders, and the environment. The following information will explain why applicators should prioritize reading and following pesticide labels.

**Instructions ensure the health and safety of applicators, handlers, and others.** Pesticides can enter the body through ingestion, inhalation, or absorption through the skin. It is important to use personal protective equipment to limit exposure to applicators and handlers, as well as others with whom they come in contact. Sanitation practices, such as washing your hands after an application are also important to reduce exposure to others.

**Instructions ensure food and feed products are safe for use.** Pesticides are extensively tested to determine the amount of exposure that is safe for consumers. Pesticides applied to a site not listed on the label can result in residues on our food, crops, air, and water. Also, applying pesticides before labeled harvest intervals or crop rotation intervals could result in pesticide residues at harvest that are not safe for consumers. If pesticide residues are detected at levels that are too great, or if they are detected on crops for which the product is not labeled, economic losses and stricter regulations could occur.

**Instructions ensure protection for the environment.** Misapplications can increase the amount of pesticides in the environment, negatively affecting non-target organisms, such as plants, insects, reptiles, birds, fish, and mammals, which alters food webs and other aspects of ecosystems. It is important to follow label requirements that limit water contamination and other forms of off-target movement because pesticide detections in environmental samples could result in additional regulations in the future. These types of restrictions are likely to increase as the Environmental Protection Agency begins to comply with the requirements of the Endangered Species Act.

**Instructions ensure agronomic and economic success.** It can be tempting to increase pesticide rates, but applying rates that are greater than labeled increases costs, as well as the risk of crop injury. Instructions for things like application timing, adjuvant selection, tank-mix partners, and mixing order are intended to make sure applications do not have negative consequences such as incompatibility in the spray tank, crop injury, or carryover. Instructions about weather or equipment restrictions are often intended to reduce off-target movement, which can negatively affect the environment, as discussed in the previous paragraph, but can also cause injury to neighboring crops. In addition, labels include instructions to help manage pesticide resistance. These are critically

important to ensure the effectiveness of products in the future.

The agrichemical industry spends hundreds of millions of dollars to develop pesticides and the data to prove they can be used safely. It is the users' responsibility to follow label directions and take care to handle products in ways that ensure safe use. This is one of the most important steps to take to protect the well-being of our families and communities and ensure access to pesticides in the future.

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## 4. 2023 Wheat Plot Tours - May 10 through May 26

The Department of Agronomy and K-State Research and Extension will host several winter wheat variety plot tours in different regions of the state, starting May 10, 2023. Make plans to attend a plot tour near you to see and learn about the newest available and upcoming wheat varieties, their agronomics, and their disease reactions. A preliminary list of plot tour dates, time, and directions was published in a previous eUpdate. This article contains the upcoming plot tours for May 10 through May 26. Plots highlighted in red are still tentative. This list will be continuously updated in the coming weeks.

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| Date | Time | County | Location | Directions | Agent/Contact |
|---|---|---|---|---|---|
| 5/10 | CANCELED | Comanche | | CANCELED (crop termination) | Levi Miller |
| 5/10 | 11:00 AM | Barber | Isabel | K42 and Main St | Justin Goodno |
| 5/10 | 5:30 PM | Barber | Kiowa | Plots grazed out, tour at 126 S. 7th St., Kiowa | Justin Goodno |
| 5/11 | 7:30 AM | Harper | Danville | 3/4 mile south of Danville (East side) | Jenni Carr |
| 5/11 | 5:00 PM | Pawnee | Rozel | Go on Highway 1-56 go past Rozel to the last turn by Blattner Manufacturing turn right head north for a mile, the Pawnee County Wheat Plot is located on the west side of the road across from the Rozel Cemetery Legal NE Quarter of 28-21-19 in Grant Township. A meeting and meal will follow the Wheat Tour at Rozel Community Center which is located at 105 N Main Street, Rozel, KS 67574. | Kyle Grant |
| 5/12 | 8:00 AM | Edwards | Belpre | Junction of Hwy 50 and Hwy 19, 1/4 mile south on 270th Ave. | Marty Gleason/Jean Huntley |
| 5/12 | 12:00 PM | Kingman | Kingman | 7681 SW 80 Ave, Kingman, KS 67068 | Melissa Thimesch |
| 5/15 | | | | Wheat Quality Tour | |
| 5/16 | | | | Wheat Quality Tour | |
| 5/17 | | | | Wheat Quality Tour | |
| 5/18 | 8:30 AM | Barton | Hoisington | 525 NW 190 Rd | Stacy Campbell |
| 5/18 | 5:00 PM | Sumner | Conway Springs | Plot directions: 1/4 mile east of Tom Pauly Seeds (922 140th Ave N) on SE corner of intersection. Meal to follow the plot at the headquarters. | Randy Hein |
| 5/19 | 9:00 AM | McPherson | Marquette | Patrick Plot- north side of Highway #4 in Marquette Rd at 10:00am | Shad Marston |

| | | | | | |
|---|---|---|---|---|---|
| 5/19 | 12:00 PM | McPherson | Moundridge | Lunch sponsored by MKC held at noon at the Black Kettle Park in Moundridge. Galle Plot at 1:00pm just west of the corner of 23rd and Cheyenne. | Shad Marston |
| 5/19 | 3:30 PM | McPherson | Inman | Schroeder Farm test plot between 5th and 4th Ave on Cheyenne Road. | Shad Marston |
| 5/23 | 8:00 AM | Labette | Parsons | Southeast Extension-Research Center - Parsons | James Coover |
| 5/23 | 8:15 AM | Sedgwick | Andale | 1/2 mile south of intersection 247th St W & 21st St N | Jeff Seiler |
| 5/23 | 10:30 AM | Sedgwick | Clearwater | South of Clearwater 1 mile west of 151st St W on 119th St S. | Jeff Seiler |
| 5/23 | 5:00 PM | Sumner | Belle Plaine | Program to follow meal. Meal location—1459 E. 60th Avenue North Southeast of Belle Plaine. Plot location— 1/2 mile east from meal. | Randy Hein |
| 5/23 | 9:00 AM | Walnut Creek | Rush Co (LaCrosse) | | Lacey Noterman |
| 5/23 | 11:00 AM | Walnut Creek | Ness (Ness City) | | Lacey Noterman |
| 5/23 | 5:00 PM | Walnut Creek | Lane (Dighton) | | Lacey Noterman |
| 5/24 | 12:00 PM | Harvey | Newton | Lunch at Camp Hawk. From camp hawk the plot is 1.5 miles west on SW 36th St. It is at the corner of s west rd. and SW 36th street. | Ryan Flaming |
| 5/24 | 5:00 PM | Sumner | Caldwell | Program to follow meal. Meal Location—South side of highway from plot. Plot Location — From Caldwell, 1 1/2 miles East of Railroad Tracks, on Highway 81, North side of the road | Randy Hein |
| 5/24 | 6:30 PM | Riley | Manhattan | SAVE Farm (9680 N. 52nd Street, Manhattan, KS 66503) | Greg McClure |
| 5/25 | 9:30 AM | Ellis | Hays | Wheat Rx Field day at the K-State's Agricultural Research Center (1232 240th Ave, Hays, KS 67601). RSVP Required. | Romulo Lollato |
| 5/25 | CANCELED | Ellsworth | Lorraine | CANCELED (crop termination) | Craig Dinkel |
| 5/25 | CANCELED | Russell | Russell | CANCELED (crop termination) | Craig Dinkel |
| 5/26 | 8:30 AM | Saline | Solomon | Ryan family farm: 3 miles west of Solomon on Old Hwy 40 and 2.5 miles S on Gypsum Valley Road | Jay Wisbey |
| 5/26 | 11:00 AM | Saline | Mentor | Isaacson Family Farm, West of Mentor on Old 81 Highway | Jay Wisbey |
| 5/26 | 3:00 PM | Cloud | Minneapolis | Tim and Ryan Myers, 1.5 Miles West of K-106 Highway on Justice Road | Jay Wisbey |

## 5. 2023 Research Report for the Southeast Research and Extension Center is online

The latest Kansas Agricultural Experiment Station Research Report is now available online. This report includes preliminary results of research conducted on field production and management practices for crops in southeast Kansas. These field studies are conducted in Parsons and nearby areas.

An overview of agronomy-related research topics for this year's report is listed below. You can access and view the 2023 Southeast Research and Extension Center Agricultural Research Report here: https://newprairiepress.org/kaesrr/vol9/iss2/

**Cropping Systems**

Fungicide Efficacy on Fusarium Head Blight of Hard Red Winter Wheat in Parsons, KS

Early Soybean Planting in a Water-Limited Growing Season

Climate Long-Term Trends Impacting Wheat Production Systems in Kansas

Wheat Variety Test Results for South Central Kansas - 2022

Corn and Soybean Production – 2022 Summary

Hard Red and Soft Red Winter Wheat Variety Testing - 2023

Control of Soil-Borne Disease of Soybean

Critical Soil Health Parameters to Improve Crop Production

Improving Resilience of Corn to Weather through Improved Fertilizer Efficiency

**Forage Crops**

Yield and Forage Quality on Native Meadows as Affected by Burn and Fertilization Management

Impact of Stubble Heights on Native Hay Meadows in Southeast Kansas

Impact of Lime, Phosphorus, and Potassium on Yield and Forage Quality on Native Hay Meadows in Southeast Kansas

Nutrient Management Strategies to Control Broomsedge Infestation and Improve Yield and Quality of Tall Fescue Hayfields

**Weather**

Annual Summary of Weather Data for Parsons – 2022

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## 6. Spring Crops Field Day in Parsons on May 23

K-State Research and Extension will host its Spring Crops Field Day Tuesday, May 23 at the Southeast Research and Extension Center, 25092 Ness Road in Parsons.

Registration is 8:30 a.m. with the program starting at 9:00 a.m.

Speakers and topics include:

- Tour of wheat variety plots – Alan Fritz, Wheat Breeding Specialist
- Corn fungicide management – Rodrigo Onofre, Row Crop Pathologist
- Planting with technology that grows – Gaurav Jha, Precision Agriculture Specialist
- Growing profitable crops – Josh Barnaby and Bryan Berggren, PrairieLand Partners

Lunch will be served after the field tours and is sponsored by PrairieLand Partners.

To register for this event, please call (620) 331-2690 or email James Coover at jcoover@ksu.edu


**Tuesday, May 23 | K-State Southeast Research and Extension Center**
25092 Ness Road, Parsons

## Schedule

| | |
|---|---|
| 8:30 am | Registration Check In |
| 9:00 am | Tour of Wheat Variety Plots |
| 10:00 am | Corn Fungicide Management |
| 10:45 am | --break-- |
| 11:00 am | Planting with Technology that Grows |
| 11:50 am | Growing Profitable Crops |

-- Lunch provided by PrairieLand Partners --

## Program Speakers


To register for this event, call (620) 331 - 2690 or email jcoover@ksu.edu

K-STATE Research and Extension Wildcat District

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K-State Research and Extension is an equal opportunity provider and employer.

## 7. Save the date - 2023 In-Depth Wheat Diagnostic School

The Department of Agronomy and K-State Research and Extension will host an In-Depth Wheat Diagnostic School on June 2 from 8:00 am to 3:50 pm at the K-State North Central Experiment Field (2 miles west of Belleville on Hwy 36).

This event will offer six CEU CCA and two 1A PM credits by providing hands-on training on diagnosing wheat production problems in a number of different areas listed below.

- Wheat Growth and Development (Romulo Lollato)
- Wheat Diseases ID and Management (Kelsey Andersen Onofre)
- Diagnosing Wheat Fertility Problems (Dorivar Ruiz Diaz and Nathan Mueller)
- Weed Control and Application Problems (Sarah Lancaster)
- Forage and Cover Crop Options (John Holman)
- Wheat breeding technologies (Allan Fritz)

The cost to attend this training is $90 before May 19 and $120 after, including walk-ins. A light breakfast and lunch are included with registration.

Register online: https://commerce.cashnet.com/AGRONKSU

For program or registration questions, please contact Romulo Lollato at lollato@ksu.edu or 785-477-4644.