Issue 1002

K-STATE Research and Extension

## Extension Agronomy

# eUpdate

*05/02/2024*

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 stripe rust update and fungicide considerations

The wheat crop is ahead of schedule and there is a dramatic difference in yield potential in parts of the state that have received moisture and parts that have not. Here, we review some key wheat fungicide considerations.

As of May 2, stripe rust has been detected in 24 Kansas counties. It's important to note that most of these observations have been at very low or trace levels (Figure 1). You can keep up-to-date with reports here: https://wheat.agpestmonitor.org/. Up until this point, the disease has largely been limited by lack of moisture. Reports in the northwest portion of the state are most concerning, as the crop in this region is still in earlier growth stages, and there is ample time for stripe rust to take hold if the environment stays favorable. There are some counties where stripe rust has been detected on flag leaves at an elevated incidence. These fields should be carefully scouted and may be candidates for fungicide applications.

Because the crop is ahead of schedule, many regions in south and south central Kansas have moved past the window for a fungicide application. As a reminder, fungicides have pre-harvest intervals based on growth stages or the number of days before harvest. This publication lists some common fungicides and their pre-harvest intervals: https://bookstore.ksre.ksu.edu/pubs/ep130.pdf. It is always a good idea to consult the label prior to application.

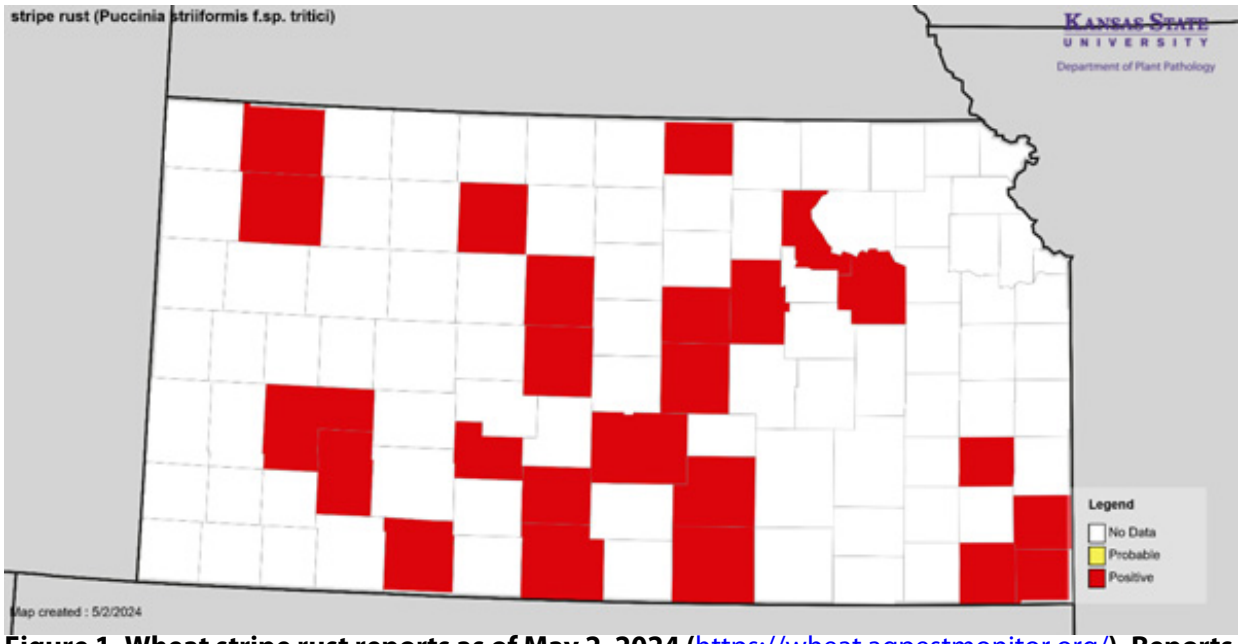


**Figure 1. Wheat stripe rust reports as of May 2, 2024 (https://wheat.agpestmonitor.org/). Reports are a collaborative effort between K-State Research and Extension, crop consultants, industry partners, and producers. Additional reports can be sent to andersenk@ksu.edu.**

We are now fielding questions about the value of a fungicide application in fields that are between flag leaf and flowering growth stages. Here are some factors to consider as we make those decisions:

1. **First and foremost, what variety is planted?** Varieties rated 3 or below will likely have enough genetic resistance and will not benefit from a fungicide application. Check your

variety rating here: https://bookstore.ksre.ksu.edu/pubs/mf991.pdf

2. **Has disease been detected in the field?** If weather conditions are favorable, fields with already established stripe rust are at the highest risk of the disease increasing in the coming days. K-State research demonstrates that if stripe rust is detected on flag leaves at the heading growth stage, there is a 90% chance your fungicide application will pay off. This is a year when scouting will be critical.

3. **What is the crop's yield potential? Does the yield potential justify an application?** K-State research has shown that under moderate to high stripe rust pressure, a fungicide application can provide a 10-15% yield benefit. However, in the absence of disease, we do not expect any economically significant yield benefit from a fungicide application.

4. **What kind of moisture has been received?** As a reminder, it takes about 10 days from the time of infection to symptom development for stripe rust. Areas that have recently received moisture (Figure 2) and are still in the window for a fungicide application (flag leaf to flowering) should be more mindful of scouting over the coming days.

5. **What is the fusarium head scab risk?** Fields approaching early flowering with a history of head scab may be able to use a single application to control both diseases this year. All fungicides that are recommended for head scab are also recommended for stripe rust control. The risk of head scab may be elevated in fields that receive rainfall at or around flowering.

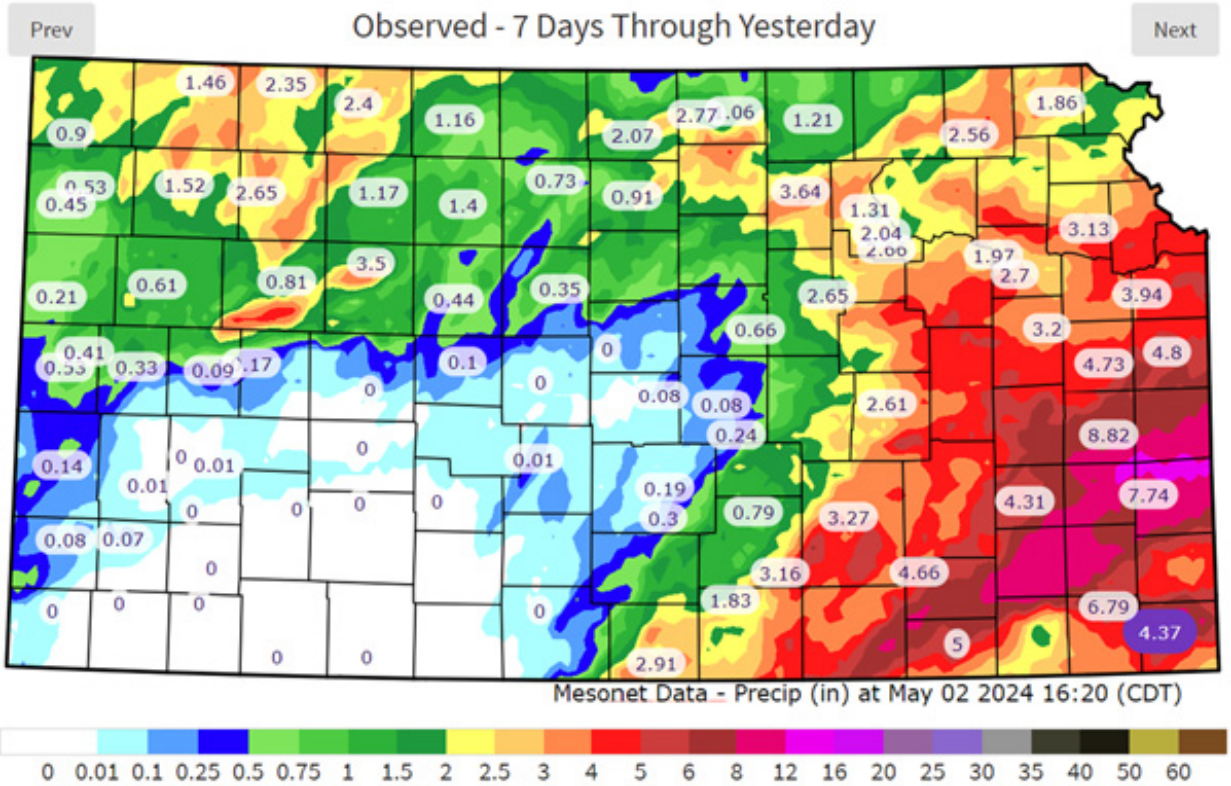


**Figure 2. Precipitation observed over the past 7 days according to the Kansas Mesonet (https://mesonet.k-state.edu/). Areas that have received moisture may be at higher risk of stripe rust developing over the coming week.**

Leaf rust has now been reported in Oklahoma but has not taken hold in Kansas. We will continue to monitor for it over the coming weeks.

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## 2. Pre-harvest weed control in wheat

A warm spring this year has resulted in rapidly maturing wheat. There have been some recent questions about spraying herbicides on wheat that has already headed. Unfortunately, there are few herbicide options to spray after wheat has reached the boot stage, and those products generally require an application either before the flag leaf emerges or before wheat reaches the boot stage. For example, products containing fluroxypyr (Starane, others), bromoxynil (Moxy, others), and Group 27 herbicides (Huskie and Talinor) were discussed in this recent eUpdate article on the control of late-emerging kochia in wheat. Once wheat reaches the boot stage, the next opportunity to apply herbicides comes at the hard dough stage. These would be considered harvest aid applications. The decision to spend resources on a herbicide application that will not directly influence crop yield is difficult; however, pre-harvest applications may be beneficial this year to prevent harvest difficulties, dockage problems, weed seed production, and soil water depletion due to weeds.

Herbicides labeled for use as harvest aids in wheat are listed in Table 1. There are differences in how quickly they act to control the weeds, the interval requirement between application and grain harvest, and the level or length of control achieved. All of them will require thorough spray coverage to be the most effective. Paraquat is sometimes mentioned as a possible herbicide for pre-harvest application but is **not** labeled for pre-harvest treatment in wheat**.** Application of paraquat to wheat is an illegal treatment and can result in quarantine and destruction of the harvested grain, along with severe fines.

**Figure 1. Weeds in wheat near harvest time. Photo by Dallas Peterson, K-State Research and Extension.**

**Table 1. Herbicides for use a pre-harvest weed control options in wheat.**

| Herbicide and rate | Weeds controlled | Application timing | PHI* (days) | Comments |
|---|---|---|---|---|
| **Metsulfuron (Ally, others) 0.1 oz** | Some broadleaf weeds | Hard dough stage | 10 | • Use 0.25 to 0.5 % v/v nonionic surfactant)<br>• Apply in combination with glyphosate or 2,4-D<br>• Do not use on soils with a pH greater than 7.9<br>• 12- to 34-month rotation interval for soybeans<br>• Kochia, pigweeds, and marestail may be resistant |
| **2,4-D LVE 1 pt of 4lb/gal product or 2/3 pt 6 lb/gal product** | Broadleaf weeds | Hard dough stage | 14 | Weak on kochia and wild buckwheat |
| **Dicamba 0.5 pt** | Broadleaf weeds | Hard dough stage and green color is gone from nodes | 7 | Do not use treated wheat for seed unless a germination test results in 95% or greater seed germination. |
| **Glyphosate 1 qt of 3 lb ae/gal product, 22 fl oz of 4.5 lb ae/gal product** | Grasses and broadleaf weeds | Hard dough stage (30% or less grain moisture) | 7 | • Consult label for recommended adjuvants<br>• Not recommended for wheat harvested for use as seed<br>• Kochia, pigweeds, and marestail may be resistant. |
| **Carfentrazone (Aim EC, others) 1 to 2 fl oz** | Pigweeds, kochia, lambsquarters, Russian thistle, wild buckwheat | | 7 | • Use 1% v/v crop oil concentrate<br>• Acts quickly, usually within 3 days<br>• Regrowth of weeds may occur after 2-3 weeks or more, depending on the rate used. |
| **Saflufenacil (Sharpen) 1 to 2 fl oz** | Broadleaf weeds | Hard dough stage (30% or less grain moisture) | 3 | • Use 1% v/v methylated seed oil + 1 to 2% w/v AMS or 1.25-2.5% v/v UAN<br>• 1-month rotation interval for soybean |

*PHI = Pre-harvest interval, or days required between application and harvest.

For more detailed information, the "2024 Chemical Weed Control for Field Crops, Pastures, and Noncropland" guide is available online at https://www.bookstore.ksre.ksu.edu/pubs/CHEMWEEDGUIDE.pdf or check with your local K-State Research and Extension office for a paper copy.

*The use of trade names is for clarity to readers and does not imply endorsement of a particular product,*

*nor does exclusion imply non-approval. Always consult the herbicide label for the most current use requirements. Users should read and follow all label instructions.*

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## 3. 2024 Kansas Wheat Plot Tours - Updated Schedule

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 14, 2024. 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. Below is a preliminary list of plot tour dates, times, and plot locations/directions. This list will be continuously added to and updated in the coming weeks.

Romulo Lollato, Extension Wheat Specialist
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| Date | Time | County | Location | Directions | Agent/Contact | Speakers |
|---|---|---|---|---|---|---|
| 5/14 | 6:00 PM | Pawnee | Kinsley | Plot Location: Turn north off HWY-156 onto 345th Ave in Burdett, go north on 345th until it curves west for ½ mile, then turn north on 350th Ave. Stay on 350th Ave for 4 miles to T Road, then ½ West. The plot is on the south side of the road. A meeting and meal will follow the Wheat Tour at Rozel Community Center, located at 105 N Main Street, Rozel, KS 67574 | Kyle Grant | Kelsey/ Logan |
| 5/15 | 11:00 AM | Barber | Isabel | Plots are located on the SE side of the intersection between SE 120th St. and Main St. in Isabel. | Matt Rhodes | Kelsey/ Logan |
| 5/15 | 6:00 PM | Pratt | West of Pratt | 0.5 Mile South of Kincheloe's Inc. (Farm Implement Dealer) on the east side of N US Highway 281. | Jenna Fitzsimmons | Kelsey/ Logan |
| ~~5/16~~ | ~~8:30 AM~~ | ~~Barton~~ | ~~Galatia~~ | CANCELED | Stacy Campbell | |
| 5/16 | 11:00 AM | Kingman | Spivey | Conrardy Seeds Test Plot, 7681 SW 80 Ave, Kingman, KS 67068 | Grace Schneider | Kelsey/ Logan |
| 5/16 | 5:00 PM | Comanche | Protection | 5.5 miles north of Protection on Road 4, | Levi Miller | Kelsey/ Logan |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | west side of the road. Supper will follow the plot tour. | | |
| 5/16 | 6:30 PM | Riley | Riley | SAVE Farm: 9680 North 52nd Street, Riley, KS | Gary Fike | Romulo |
| 5/17 | 9:00 AM | McPherson | Marquette | PATRICK PLOT - Marquette. Marquette Rd & Highway 4 | Shad Marston | Romulo/ Kelsey |
| 5/17 | 11:30 AM | McPherson | Moundridge | GALLE PLOT - Moundridge. 1/4 North of Cheyenne Road & 23rd Avenue<br><br>A free lunch sponsored by MKC will be held at MKC Learning Center, 221 W Hirschler Str., Moundridge. | Shad Marston | Romulo/ Kelsey |
| 5/17 | 3:00 PM | McPherson | Inman | SCHROEDER PLOT - Inman. Between 4th & 5th Avenue on Cheyenne Road | Shad Marston | Romulo/ Kelsey |
| 5/20 | 12:00 PM | Harvey | Camp Hawk | Lunch at noon at Camp Hawk. Plot following lunch. From Camp Hawk, go 1.5 miles east to S West Rd, a mile south to 48th St., and turn west and go about 400 yards. The plot is on the south side of the road. | Ryan Flamming | Romulo |
| 5/20 | 6:00 PM | Sumner | Belle Plaine | Belle Plaine- 1/2 south of 90th N and N Woodlawn, or 1 mile east of Belle Plaine and ½ south | Randy Hein | Romulo |
| 5/21 | 8:00 AM | Sedgwick | Andale | 1/2 mile south of intersection 247th St W & 21st St N | Jeff Seiler | Romulo |
| 5/21 | 10:45 AM | Sedgwick | Haysville | 1901 E 95th St S, Haysville, KS 67060 (John C. Pair Center) | Jeff Seiler | Romulo |
| 5/21 | 6:00 PM | Sumner | Caldwell | Caldwell - approximately 2 miles east of Caldwell and ¾ south. or ¾ south of Hwy 81 and S Sumner rd. | Randy Hein | Romulo |
| 5/22 | 10:30 AM | | Jewell | Off of Highway 14 in Jewell County at H Road, then 1 ½ miles west on | Sandra Wick | Romulo/ Kelsey |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | the north side of the road. | | |
| 5/22 | 1:30 PM | | Lincoln | Lunch at 11:30 am at Emerson Lake (Jewell). Plots 3 miles west of Beverly or 8 miles east of Lincoln on Highway 18 on the south side. | Sandra Wick | Lucas |
| 5/22 | 4:30 PM | | Mitchell | South of Beloit on Highway 14 to S Road, then 8 miles west on the north side of the road. | Sandra Wick | Romulo/ Kelsey |
| 5/22 | 1:30 PM | | Osborne | Lunch at noon at the wheat plot. Hwy 24 (east of Jct. 281) to 60 Road, then ½ mile south on east side | Sandra Wick | Lucas |
| 5/22 | 10:00 AM | | Smith Center | Right north of Landmark Implement, Smith Center (west edge) on the north of the road. | Sandra Wick | Lucas |
| 5/23 | 8:00 AM | Phillips | Phillipsburg | From the HWY 36 and East 300 Road Intersection, travel South 1 ½ miles on East 300 Road. Plot is located on the West side of the road. | Cody Miller | Romulo/ Kelsey |
| ~~5/23~~ | ~~5:00 PM~~ | ~~Ellis~~ | ~~Hays~~ | CANCELED | Stacy Campbell | |
| 5/23 | 6:00 PM | Sumner | Conway Springs | Across the road from 922 West 140th Ave North, Conway Springs Ks | Randy Hein | Allan |
| 5/24 | 7:30 AM | Russell | Russell | East of the intersection at E Lucas St & S Front St Russell, KS 67665 | Craig Dinkel | Kelsey |
| 5/24 | 11:30 AM | Ellsworth | Lorraine | 1 1/2 miles west of Lorraine on Ave V on the south side of the road | Craig Dinkel | Allan |
| 5/24 | 8:00 AM | Ottawa | Minneapolis | From K106 highway south of Minneapolis to west on Justice Road, 1.5 miles. | Jay Wisbey | Romulo |
| 5/24 | 11:00 AM | Saline | Solomon | From Old 40 Highway West of Solomon, go South on N Gypsum Valley Road 2.5 Miles and then West ½ mile on E Stimmel Road | Jay Wisbey | Romulo/ Kelsey |
| 5/28 | 5:00 PM | Finney | Garden City | Southwest Research and | Logan Simon | Logan |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Extension Center in Garden City | | |
| 5/28 | 6:00 PM | Kiowa | Mullinville | Junction of State Hwy 54 and 11th Ave (east edge of Mullinville), south 2 miles, intersection of 11th Ave and M street. | Gary Jorgensen (Alliance Ag & Grain) / Mandy Hensen | Romulo |
| 5/29 | 9:30 AM | Rush | LaCrosse | 8 ½ miles straight west of the Casey's located in LaCrosse on Hwy 4. Do not curve north to Hargrave. At 7 miles, continue straight west off of the curve. The plot is south side of the road. | Lacey Noterman | Romulo/ Kelsey |
| 5/29 | 2:00 PM | Ness | Ness City | 17282 T Road. From Ness City, go North on Hwy 283 for 4 miles, then turn east on Rd. 170 for 1 mile, and then turn north on Rd. T. Plot is located north of the scale house on the Nichephor farm. | Lacey Noterman | Romulo/ Kelsey |
| 5/29 | 6:00 PM | Lane | Dighton | 7 miles west of Dighton to Eagle Rd, 2 miles south to West Rd 130, then 200 yards west toward Ehmke farmstead, east of the scale. | Lacey Noterman | Romulo/ Kelsey |

## 4. Sorghum management considerations: Planting practices

There can be considerable environmental variation across Kansas during the growing season of grain sorghum, with a high probability of drought after flowering when moving toward the west. Tailoring the right management strategy to every site is critical to increase productivity and reduce the impact of abiotic stressors. The most critical planting practices affecting yields in sorghum are row spacing, row arrangement, seeding rate/plant population, planting date, and hybrid maturity.

Sorghum plants can compensate and adjust to diverse environmental conditions through modifications in the number of tillers, head size, and final seed weight. For sorghum, the final number of seeds per head is the plant component that varies the most; and thus has more room for adjustment than the other plant components (seed weight and number of tillers).

**Seeding rates and plant populations**

Sorghum population recommendations range from a desired stand of 23,000 to more than 100,000 plants per acre depending on average annual rainfall (Table 1).

**Table 1. Grain sorghum recommended seeding rate, plant population, and row spacing based on average annual rainfall. Source: https://www.bookstore.ksre.ksu.edu/pubs/MF3046.pdf**

| | | | Within-row Seed Spacing (70% emergence) | | |
|---|---|---|---|---|---|
| **Avg. Annual Rainfall (inches)** | **Seeding Rate (x1,000 seeds/acre)*** | **Recommended Plant Population (x1,000 plants/acre)** | **10-inch rows** | **20-inch rows** | **30-inch rows** |
| **< 20** | 30-35 | 23-27 | 21-18 | 10-9 | 7-6 |
| **20 to 26** | 35-64 | 25-45 | 18-10 | 9-5 | 6-3 |
| **26 to 32** | 50-80 | 35-55 | 13-8 | 6-4 | 4-3 |
| **> 32** | 70-125 | 50-90 | 9-5 | 4-2 | 3-2 |
| **Irrigated** | 110-150 | 80-110 | 5-4 | 3-2 | 2-1 |

** Assuming 70% field emergence.*

Because of sorghum's ability to respond to the environment, final stands can vary at least 25 percent from the values listed above, depending on expected growing conditions, without significantly affecting yields. Lower seeding rates minimize the risk of crop failure in dry environments. Sorghum can compensate for good growing conditions by adding tillers and adjusting head size, but yields can be reduced in a dry year if populations are too high. For a high-yielding environment (>150 bu/acre), under narrow rows, high plant populations can be a critical factor in improving sorghum yields.

Higher seeding rates should also be used when planting late. Increase rates by 15-20 percent if planting in late June or later. Late planting will restrict the amount of time that sorghum plants have in the season for producing productive tillers, thus decreasing the plant's ability to compensate for inadequate stands.

Recent research in Kansas has confirmed these long-term recommendations. In these studies,

sorghum yields were maximized at 25,000 plants per acre (optimum between 20,000 to 30,000 plants per acre) in western Kansas at 17 inches annual precipitation; 40,000 in central Kansas at 30 inches annual precipitation; and 50,000 in eastern Kansas at 32 inches annual precipitation. For western Kansas, final stands of about 20,000 to 30,000 plants per acre can attain yields of 60 to 80 bushels per acre or more. For central and eastern Kansas, final stands of 50,000 to 70,000 plants per acre can maximize yields, with the final objective of having an average of 1 to 1.5 heads per plant.

Having more than the recommended number of plants per acre results in fewer fertile and productive tillers and thinner stems, reducing yield in drier environments and increasing susceptibility to drought. On the other side, thin stands can compensate for better-than-expected growing conditions somewhat by producing more and/or larger heads. However, under high-yielding environments, a higher final plant population will be needed to increase yields as much as possible (Table 1).

**Planting date**

A summary of research data performed in the last several years has confirmed that the optimum planting date for maximizing yields will be around early June (Figure 1). Still, the decision on the optimum planting date should be timed so plants have the best chance of avoiding hot, dry weather at the flowering stage, but can still have sufficient time to mature before the first frost.

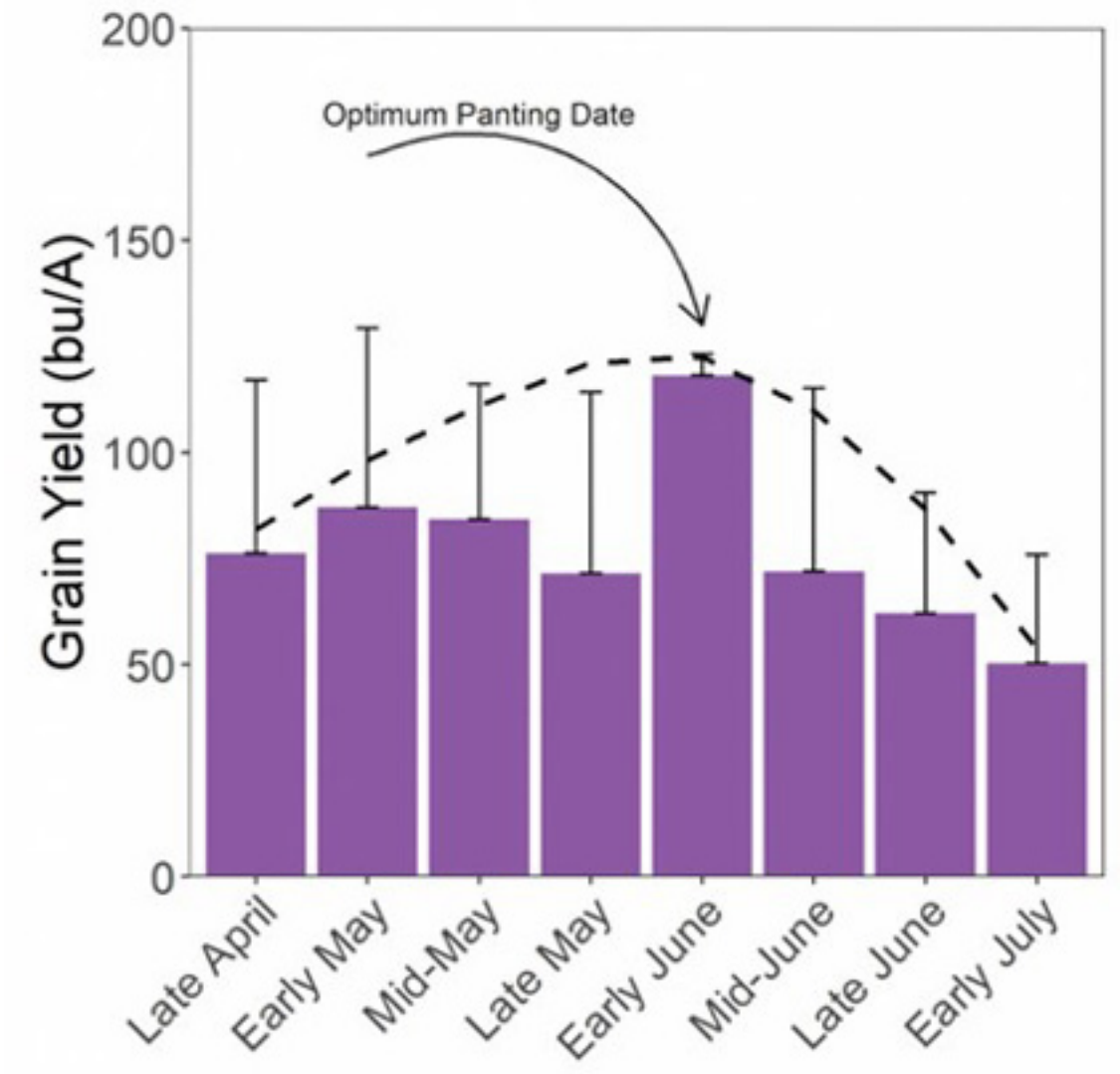


**Figure 1. Planting date effect on final sorghum yields (Tribune/ Hutchinson/ Manhattan, Vanderlip; Scandia 1994-96, Gordon; St. John 1993-95, Martin and Vanderlip; Columbus 2000/03, Kelley). From** Sorghum: State of the Art and Future Perspectives**, Agronomy Monographs 58, chapter "Genotype × Environment × Management Interactions: US Sorghum Cropping Systems" doi:10.2134/agronmonogr58.2014.0067, Ciampitti and Prasad (Eds).**

The planting date has some effect on seeding rates. Sorghum will tiller more readily in cool temperatures and less under warm conditions. As a result, later plantings in warmer weather should be on the high side of the recommended range of seeding rates for each environment since there will be less tillering. The potential for greater tillering with earlier planting dates makes sorghum yields more stable when planted in May and early June compared to planting in late June or July.

**Planting depth**

Seed placement is also a critical factor when planting sorghum. The optimum seed placement for sorghum is about 1-2 inches deep. Shallower or deeper planting depths can affect the time between

planting and emergence, affecting early-season plant uniformity.

**Row spacing**

The other factor that can influence yield is row spacing. A response to narrow row spacing is expected under superior growing environments when water is a non-limiting factor. Narrow rows increase early light interception, provide faster canopy closure, reduce evaporation losses, can improve suppression of late-emerging weeds, and maximize yields.

The comparison between wide (30-inch) vs. narrow (15-inch) row spacing shows an overall yield benefit of 4 bushels per acre with narrow rows. In addition, narrow rows out-yielded wide rows in 71 percent of all observations evaluated (Figure 2).

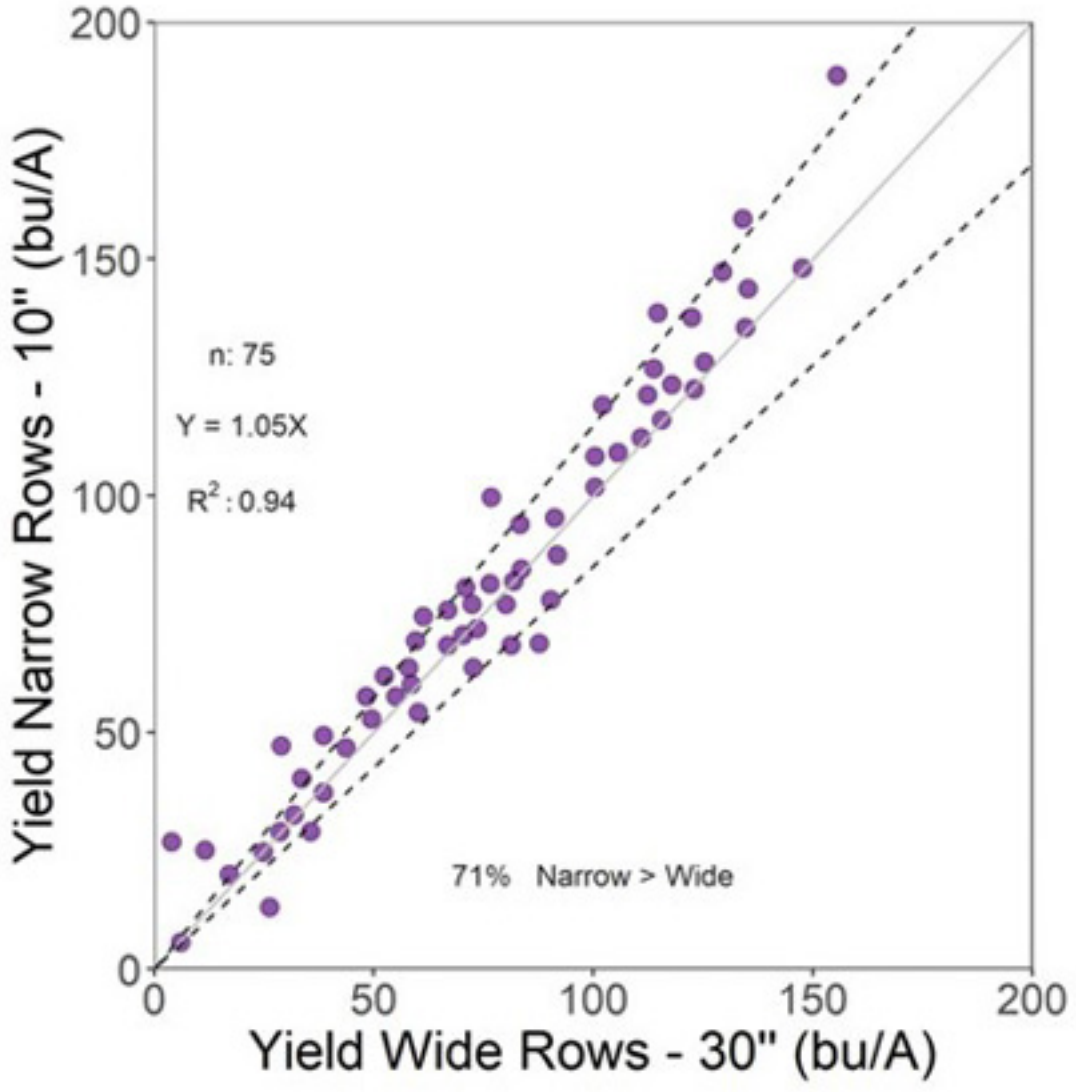


**Figure 2. Yield in narrow rows versus yield in wide rows. From a total number of 75 observations, 71% had a greater yield in narrow as compared to wide row spacing. Partial data presented From** Sorghum: State of the Art and Future Perspectives**, Agronomy Monographs 58, chapter "Genotype × Environment × Management Interactions: US Sorghum Cropping**

Systems" doi:10.2134/agronmonogr58.2014.0067, Ciampitti and Prasad (Eds).

A more consistent response to narrow rows was documented when yields were above 70 bushels per acre, with a greater chance of having higher yields when using narrow rows, but the response is not always consistent. Under low-yielding environments, conventional (30-inch) wide row spacing is the best alternative.

**Should populations be adjusted with narrow rows?**

Research results indicate that the population producing the greatest yield doesn't change with different row spacing, but the magnitude of response to population potentially can be greater with narrower row spacing in high-yielding environments.

**Should row spacing be adjusted for planting dates?**

The planting date seems to have an interaction with row spacing. Over three years at the North Central Experiment Field, there was essentially no difference in yield between 15- and 30-inch rows for late-May plantings, but there was a 10-bushel yield advantage for 15-inch rows for late-June plantings. A similar response was observed in Manhattan in 2009 row spacing had no effect on yields for the May planting, but with the June planting 10-inch rows had an 11-bushel/acre yield advantage over 30-inch rows. In all cases, yields were less with the June planting, but the June plantings at Belleville and Manhattan still averaged more than 115 bushels/acre.

**Hybrid selection**

The selection of sorghum hybrids should be based not only on maturity, but also on other traits such as resistance to pests, stalk strength, head exertion, seeding vigor, and overall performance. The selection of a sorghum hybrid based on its maturity should be strictly related to the planting date, the expected duration of the growing season, and the probability the hybrid will mature before the first freeze event. Shorter-season hybrids might be a better fit for late planting dates (mid-June to July, depending on the regions); a longer-season hybrid is recommended when planting time is early and the growing season is maximized. The goal is to plant a hybrid maturity at each particular site/environment (weather and soil type) so the plants can bloom in favorable conditions and have adequate grain fill duration before the first fall freeze occurs.

**Summary**

- Determine your desired population based on average rainfall and expected growing conditions. There is no need to go overboard.
- Make sure you plant enough seed for your desired plant population. A good general rule is about 65-70 percent field germination.
- Think about using narrower row spacing to close the canopy sooner and potentially capture greater yields in yield environments of 70 bushels per acre or more.
- Planting date and hybrid selection are tied together and related to the expected conditions during late summer. Consider this before deciding your planting time and selecting a hybrid.

**Suggested resources for grain sorghum cropping systems from K-State Research and Extension**

"Kansas Sorghum Management 2022" MF3046
https://bookstore.ksre.ksu.edu/pubs/MF3046.pdf

"Narrow-row Grain Sorghum Production in Kansas" MF2388
https://bookstore.ksre.ksu.edu/pubs/MF2388.pdf

"2023 Kansas Performance Tests with Grain Sorghum Hybrids" SRP1182
https://bookstore.ksre.ksu.edu/pubs/SRP1182.pdf

"Sorghum Growth and Development" poster (updated in 2023)
https://bookstore.ksre.ksu.edu/pubs/MF3234.pdf

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## 5. Metabolic resistance: A pressing threat requiring immediate action

Multiple herbicide-resistant weeds such as Palmer amaranth and kochia are a real threat to growers in Kansas. A Palmer amaranth population from a long-term conservation tillage research project in Kansas, uncontrolled by multiple herbicides commonly used, was confirmed to have evolved 6-way resistance by K-State researchers[1]. This research reported large percentages of survivors to postemergence applications of field recommended rates of:

- Group 2 (chlorsulfuron, thifensulfuron, imazethapyr, and imazamox)
- Group 4 (2,4-D)
- Group 5 (atrazine and metribuzin)
- Group 9 (glyphosate)
- Group 14 (fomesafen and lactofen)
- Group 27 (mesotrione and tembotrione) herbicides
- Tank- or pre-mixture of Group 5 and Group 27 herbicides (atrazine and mesotrione)
- Group 6 and Group 27 herbicides (bromoxynil and pyrasulfotole).

A previous eUpdate article about this population can be found here. https://eupdate.agronomy.ksu.edu/article_new/metabolism-based-herbicide-resistance-in-a-6-way-resistant-palmer-amaranth-425-5

**Figure 1. Palmer amaranth escapes in a soybean field. Photo credit: Sarah Lancaster, K-State Research and Extension.**

Surprisingly, these populations were not repeatedly exposed to some of the herbicides for which they showed control failures, suggesting a predominance of metabolic resistance in that population. The concern, therefore, is that metabolic resistance often confers resistance to herbicides of different chemical groups and sites of action and can extend to new herbicides.

The rapid and widespread evolution of multiple herbicide resistance in weed species due to the increased capacity to degrade (or metabolize) herbicides (metabolic resistance) threatens herbicide sustainability and global food production.

**What is metabolic resistance?**

Metabolic resistance, in the context of herbicide resistance, refers to the ability of weeds to increase their metabolic capacity to detoxify or break down herbicides. This means the weeds are becoming more efficient at converting herbicide molecules into non-lethal metabolites. This process is facilitated by large enzyme families in the weeds, such as cytochrome P450 and glutathione *S* -transferases (GSTs), which are responsible for the breakdown of herbicides.

The following link provides additional details about metabolic resistance.

https://fruit.wisc.edu/2022/09/07/is-metabolic-herbicide-resistance-the-straw-that-will-break-weed-managements-back/.

**Proactive actions**

Effective proactive management strategies, including cultural, mechanical, biological means, and herbicide mixtures, can delay metabolic resistance evolution and enhance crop production (Figure 2).

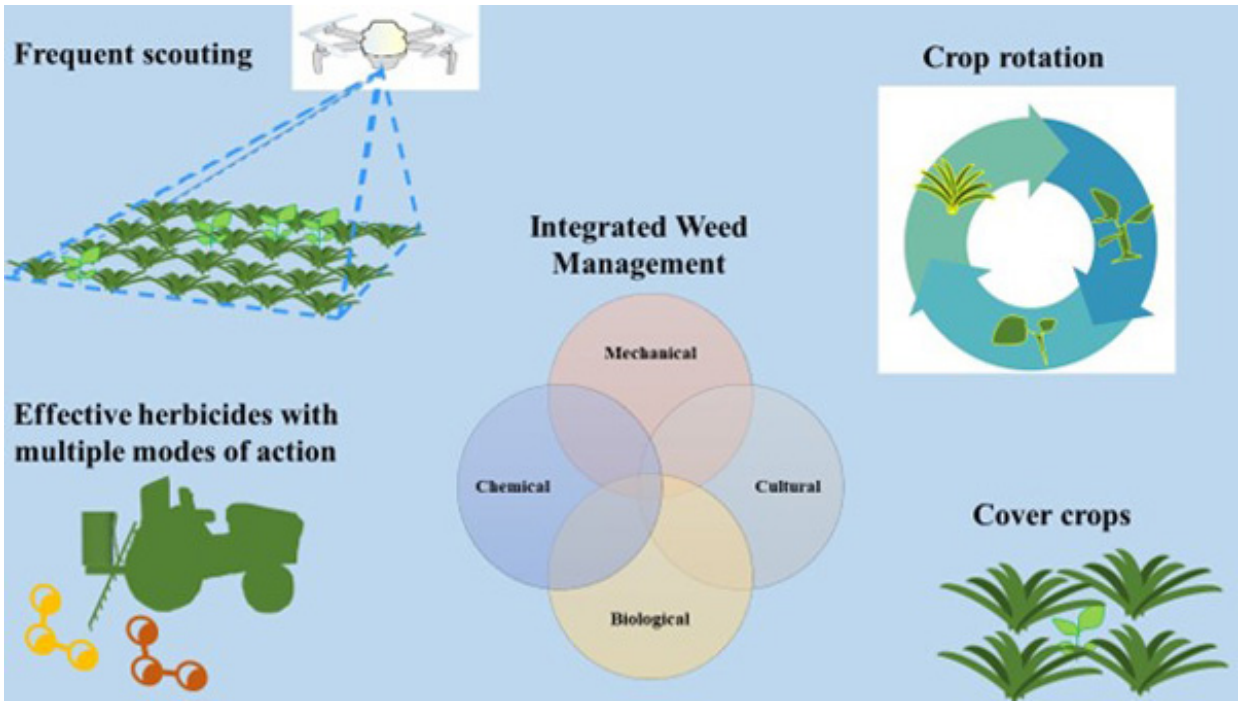


**Figure 2. Integrated weed management approach for delaying and managing metabolic resistance. Graphic adapted from Croplife.**

- **Cultural practices** (cultivar selection, narrow row spacing, high seeding rates, and adjusting planting dates) can help reduce weed emergence and growth and improve crop competitiveness for outcompeting and suppressing weeds.
- **Crop rotation** is helpful for diversifying chemical weed control programs, while cover crop residues can improve weed suppression.
- At the same time, herbicide programs need to be timely and use **multiple, effective modes**

**of action** against the most difficult weeds, which are more likely to evolve resistance.
- **Frequent scouting** is critical for your weed management program to be successful.
- **Harvest weed seed control tactics** (seed destructor, narrow windrow burning, and chaff lining) are helpful in preventing soil seedbank replenishment and can be crucial for managing metabolic resistance by targeting and destroying weed seeds during harvest.

**Reference**

[1]Shyam et al. (2021)

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## 6. Spring 2024 precipitation in Kansas: A tale of two extremes

Meteorological spring began on March 1. Since that date, the last two months have featured a sharp contrast in precipitation amounts across Kansas. In the east, precipitation has been plentiful, particularly in the past month. Meanwhile, southwest Kansas has seen very little in the way of moisture. As a result, drought conditions have improved or maintained the status quo in the wetter areas but have notably worsened in the state's driest parts. In this report, we take a closer look at where precipitation totals and drought conditions stand across Kansas through the first two months of spring.

Bourbon County is the precipitation "winner" so far this spring (Table 1, Figure 1). The CoCoRaHS observer in Devon, northwest of Fort Scott, has recorded the most precipitation in the state: 16.58" since March 1. Of that total, 13.71" fell in April. Devon's two highest daily amounts occurred just this past week: 6.88" on April 28th and 3.82" on April 26th. Extreme as the 6.88" amount is, there were even higher amounts on the 28th. The maximum 1-day total was 8.10" in Humboldt (Allen County, COOP observer). This amount is historic; in the 42-year history of the Humboldt site, this is their highest single-day precipitation total on record. Close behind was 7.94" in Wilson County, a CoCoRaHS report from north-northeast of Altoona. Amounts over 7" were also recorded by CoCoRaHS observers in Neosho (7.37" in Erie), Cowley (7.34" south-southeast of Dexter) and Bourbon (7.32" in Fort Scott) Counties, and by co-operative observers in Wilson (7.43", Neodesha 3NE) and Allen (7.28", Moran) Counties. These extreme totals resulted from multiple rounds of thunderstorms training over the same areas, the second of two heavy rain events in the past week. Severe weather accompanied these storms, including tornadoes, large hail, and high winds.

**Table 1. Highest precipitation amounts across Kansas since March 1.**

| Location | Network | County | Amount (in.) |
|---|---|---|---|
| **Devon 0.1 SE** | CoCoRaHS | Bourbon | 16.58 |
| **Fort Scott 0.6 SW** | CoCoRaHS | Bourbon | 15.13 |
| **Humboldt** | COOP | Allen | 15.01 |
| **Fort Scott 9.3 NNE** | CoCoRaHS | Bourbon | 14.97 |
| **Mound City 1SSW** | COOP | Linn | 14.80 |
| **Moran** | COOP | Allen | 14.34 |
| **Fort Scott 0.6 W** | CoCoRaHS | Bourbon | 14.22 |
| **Savonburg 4.1 ESE** | CoCoRaHS | Bourbon | 14.01 |
| **Longton** | COOP | Elk | 13.63 |
| **Colony** | COOP | Anderson | 13.40 |
| **Altoona 7.2 NNE** | CoCoRaHS | Wilson | 13.08 |
| **Erie 0.4 NNW** | CoCoRaHS | Neosho | 12.72 |
| **Neodesha 3NE** | COOP | Wilson | 12.50 |
| **Iola 2.7 SSE** | CoCoRaHS | Allen | 12.36 |

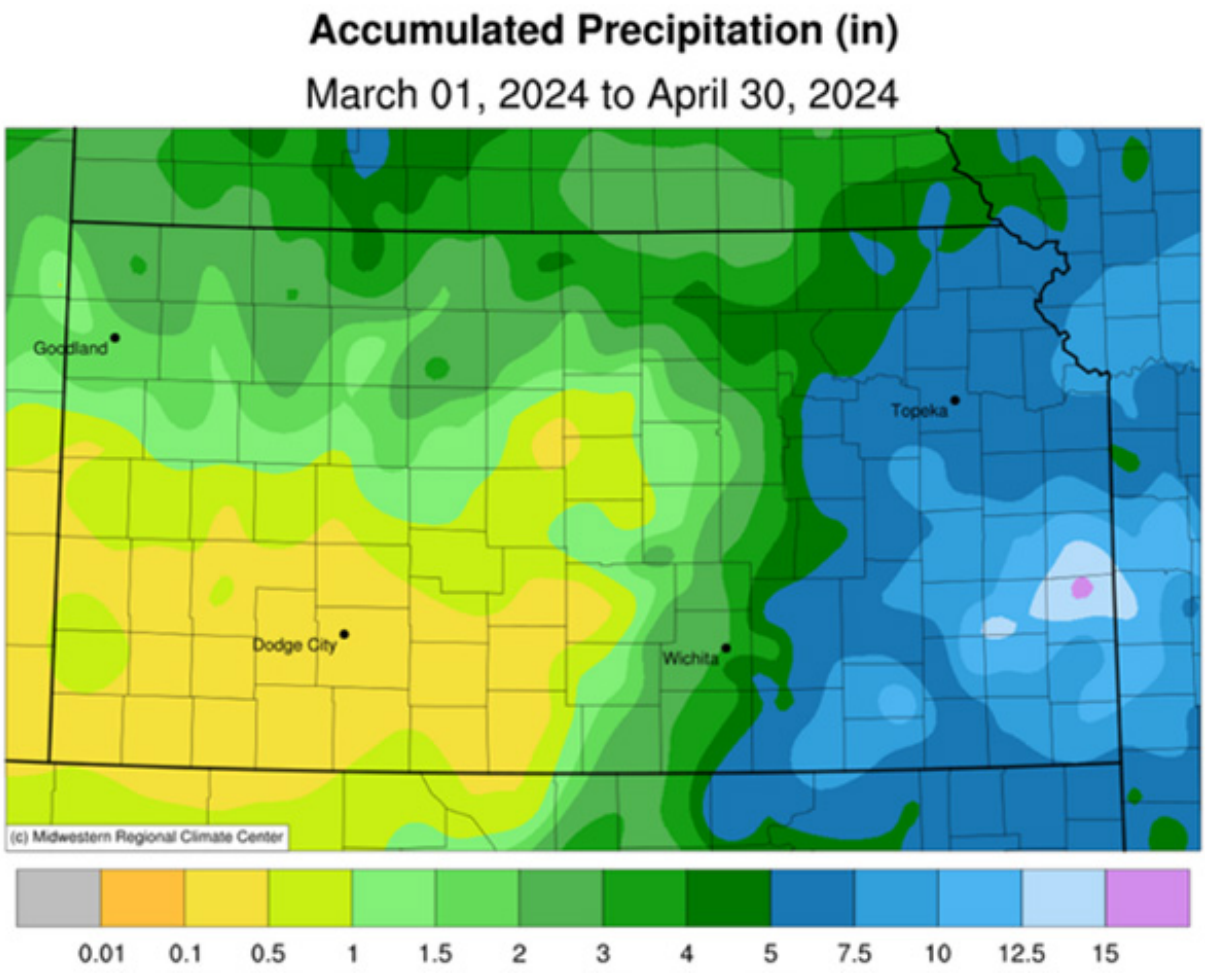


**Figure 1. Total precipitation across Kansas since March 1, 2024. Source: Midwest Regional Climate Center (mrcc.purdue.edu).**

On the dry side, many locations in southwest Kansas have had less than half an inch of precipitation since March 1. The lowest total in the state is in Gray County, where a CoCoRaHS observer in Montezuma has measured only a trace of precipitation since March 1 (Table 2). It fell on April 20, the first precipitation since a trace was reported back on February 18th, 62 days earlier. The last time measurable precipitation fell there was on February 12, when 0.01" was recorded. Parts of Meade and Ford Counties have also had less than one-tenth of an inch of precipitation. It's important also to consider the departures from normal precipitation that has fallen in the state (Figure 2). While there are some areas of above-normal precipitation in eastern Kansas, the majority of the state has had below-normal precipitation since March 1st. The most below-normal areas in Kansas are not in southwest Kansas, where the lowest totals are, but in south-central Kansas. Parts of this division are more than 4 inches below normal since March 1. The result of these deficits is evident on the US Drought Monitor change map (Figure 3), where three-category degradations have occurred in parts of south central and southwest Kansas. As of April 30, 27% of Kansas is in D2 status (Figure 4). This is the largest amount in almost five months. Fortunately, no areas are in D3 or worse status yet. If precipitation continues to miss the parched areas in the southwest in the coming weeks, worsening conditions are likely. The recent heavy rains in southeast Kansas have resulted in this area having better drought conditions than two months ago, with 16% of the state now drought-free.

**Table 2. Lowest precipitation amounts across Kansas since March 1.**

| Location | Network | County | Amount (in.) |
|---|---|---|---|
| **Montezuma 0.2 SE** | CoCoRaHS | Gray | Trace |
| **Meade 12.4 NW** | CoCoRaHS | Meade | 0.05 |
| **Montezuma** | COOP | Gray | 0.07 |
| **Bucklin 0.2 N** | CoCoRaHS | Ford | 0.08 |
| **Spearville 5.4 SW** | CoCoRaHS | Ford | 0.08 |
| **Dodge City 9.1 WNW** | CoCoRaHS | Ford | 0.09 |
| **Pratt 3.1 N** | CoCoRaHS | Pratt | 0.09 |
| **Dodge City 11.0 SSE** | CoCoRaHS | Ford | 0.09 |
| **Syracuse 19 NNW** | CoCoRaHS | Hamilton | 0.10 |
| **Greensburg 8.7 SSW** | CoCoRaHS | Kiowa | 0.14 |
| **Haviland 7.4 WNW** | CoCoRaHS | Kiowa | 0.15 |
| **Jetmore 14.9 WSW** | CoCoRaHS | Hodgeman | 0.15 |
| **Wilson 2.8 W** | CoCoRaHS | Russell | 0.15 |
| **Garden City Airport** | WBAN | Finney | 0.17 |

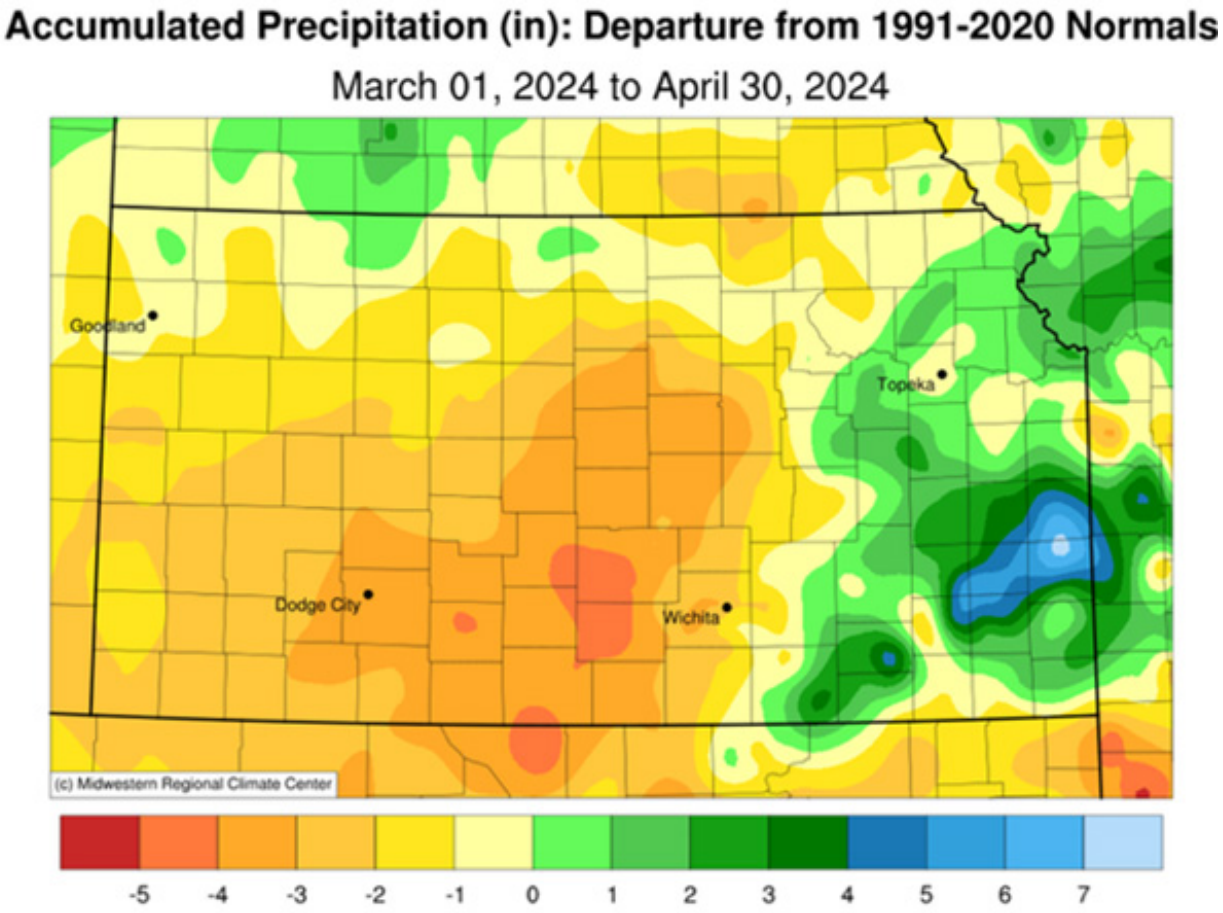


**Figure 2. Departure from normal precipitation across Kansas since March 1, 2024. Source: Midwest Regional Climate Center (mrcc.purdue.edu).**

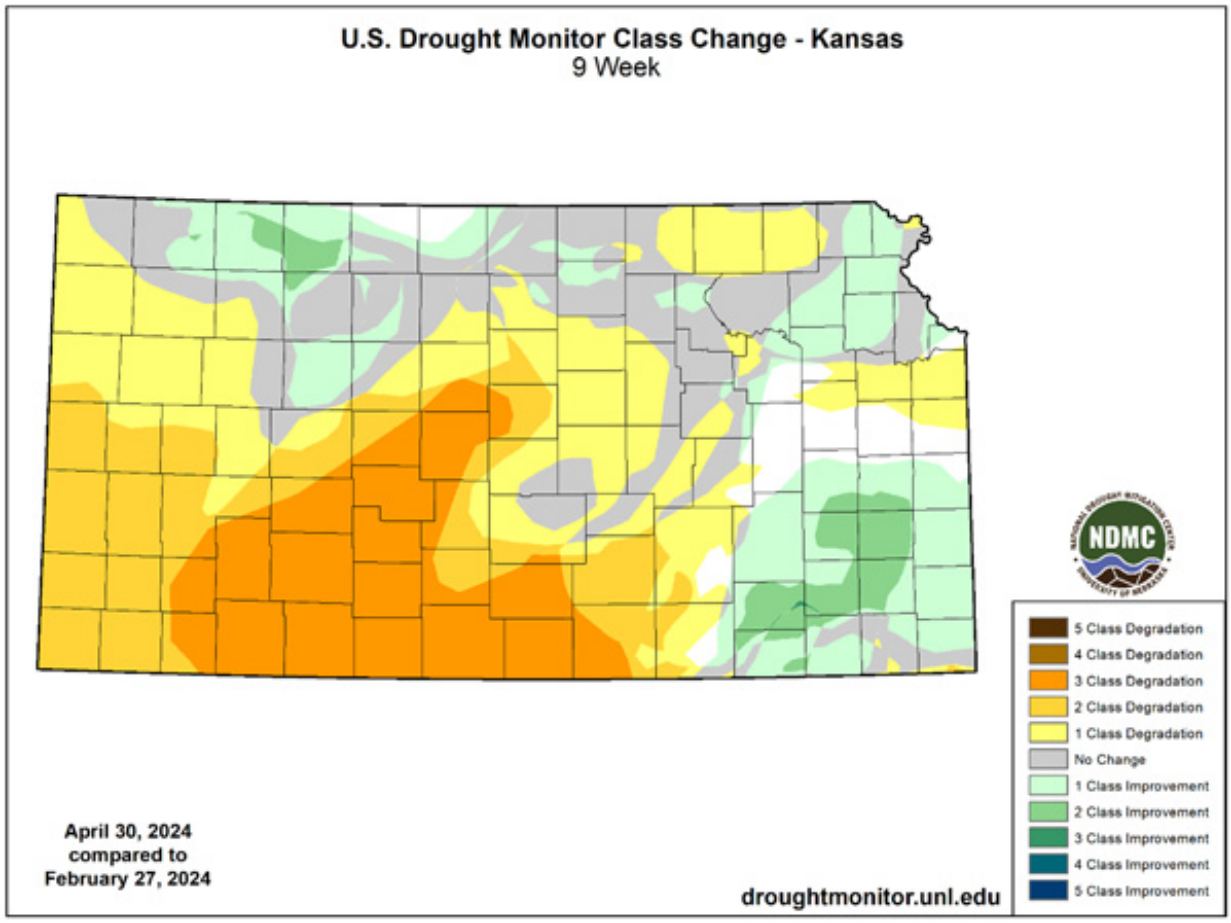


**Figure 3. Change in the US Drought Monitor category across Kansas since February 27, 2024. Source: droughtmonitor.unl.edu.**

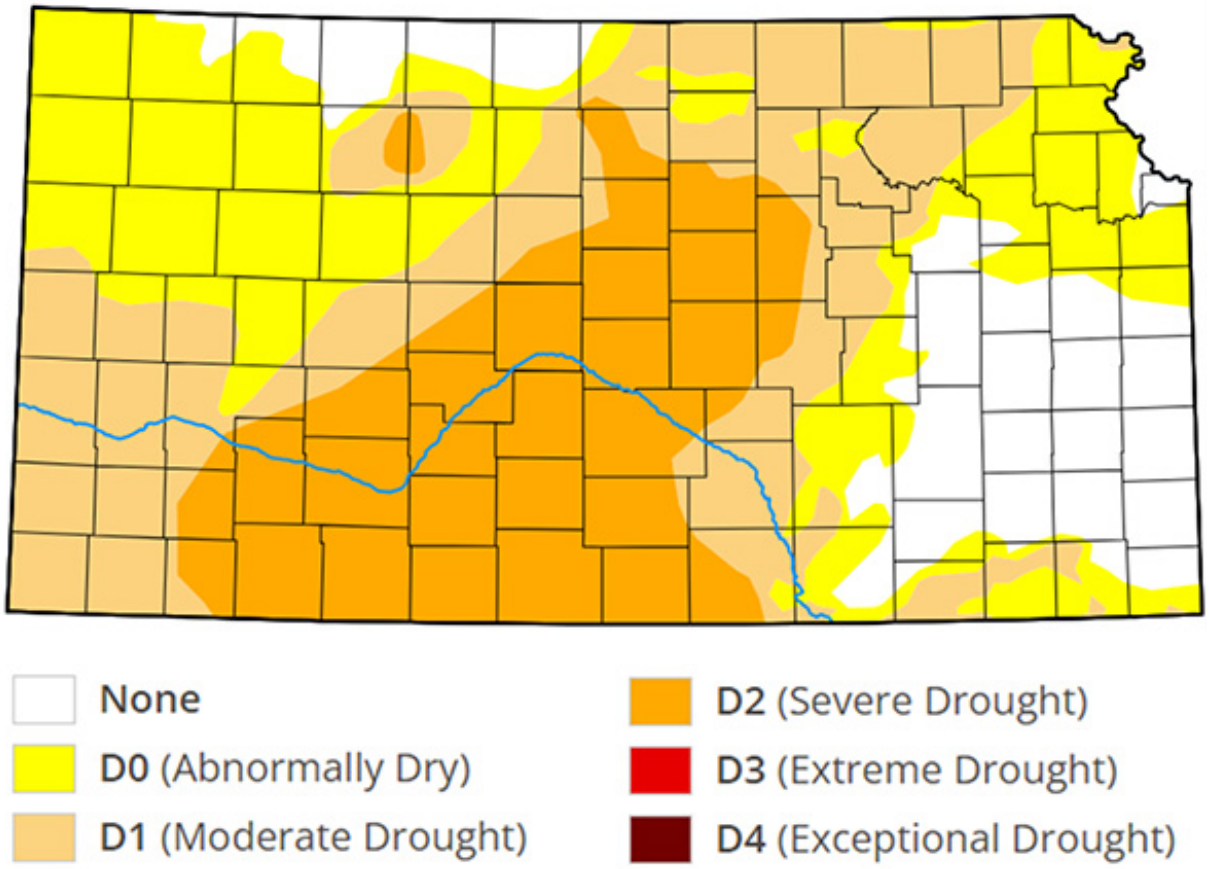


**Figure 4. US Drought Monitor category map for Kansas as of April 30, 2024. Source: droughtmonitor.unl.edu.**

The good news is that we are entering what are traditionally the wettest months of the year in Kansas. Depending on location, from 43 to 63% of annual precipitation falls on average between May 1 and August 31 (source: National Centers for Environmental Information). Every part of the state averages at least 10 inches of precipitation during this 4-month period. We're entering "prime time" for heavy rainfall and also for severe weather. Rainfall totals in the past week are potentially a sneak preview of what's yet to come. A companion article in this eUpdate goes into more detail about the weather outlook for Kansas in the coming weeks.

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## 7. Looking ahead - Weather outlooks for Kansas

**The current weather pattern**

With the localized heavy moisture in the east, this was well forecasted with some lingering El Niño influence. An enhanced subtropical jet stream has kept enhanced upper-level winds over the region. This, combined with a favorable overall stalling of the weather pattern with low pressure over the Rockies and high pressure in the southeast (Figure 1), allows for frequent thunderstorms and heavy rain episodes. Unfortunately, it keeps them persistent over the same locations. Dry air is able to push east/northeast into the High Plains, keeping most of southwest/south central Kansas precipitation-free. This pattern of the enhanced El Niño subtropical jet stream separated from the northern jet stream (called split flow) is again similar to what we had in February and April. It results in continuous repetitive patterns with little in the way of substantial cold or warm episodes. Therefore, we don't have a few massive storm systems that are driven by temperature contrasts. Rather, we have weak and frequent storm systems that result in modified cold air and a quick return to warmer conditions post-cold front. Until this pattern breaks, much of the Plains will see continuing severe weather with rainfall misplaced, favoring the same areas. A companion article in this eUpdate details the rainfall for March and April across Kansas and an update on drought conditions.

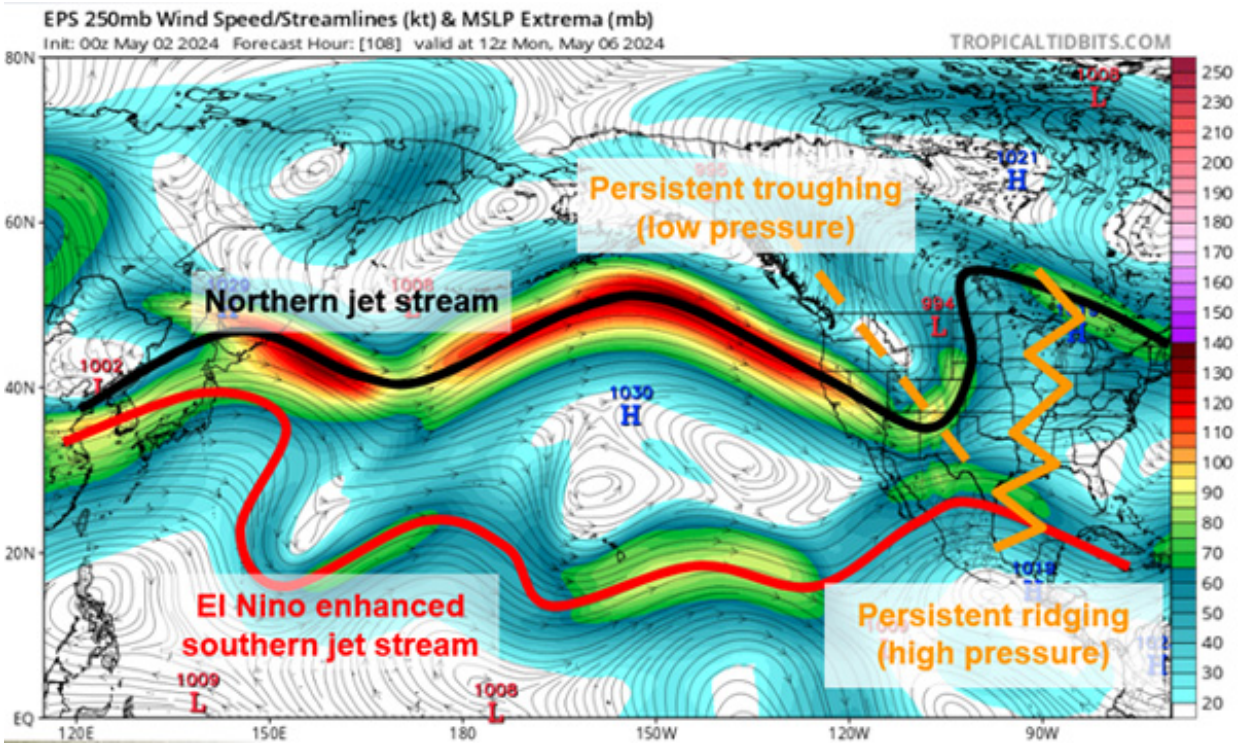


**Figure 1. Upper-level winds as depicted by the EPS model of the current weather pattern across the US and Pacific next Monday morning. Source: tropicaltidbits.com, annotated by the author.**

Another item of interest is the Madden-Julian Oscillation (MJO). It has remained weak, with no tropical activity around the low latitudes. These can propagate eastward around the globe, and the influx of moisture to particular areas can help break these stagnant patterns. The current weak status has aided the stagnant pattern to remain, keeping moisture favoring the same locations. We need the MJO to become more active and start moving eastward to bring more widespread moisture for

those who have missed out thus far. It would also provide a brief reprieve for those who have observed way too much moisture over the last week.

**Looking to the future**

While it hasn't been impactful as of late, there is some suggestion that MJO may begin to strengthen and move eastward by mid-May. This could yield a brief reprieve in the pattern with the potentially limited window for more widespread moisture. However, models aren't overly confident at this point. Much of the wheat crop in both southwest and south-central Kansas is close, if not already, at its demise from flash drought stress. This period of moisture would be beneficial to corn and other early-planted crops.

This brief window of hope is even more concerning when we examine the continued projection for summer in Kansas. With the projection of El Niño to potentially La Niña by mid-to-late summer (Figure 2), May remains the primary transition month. Therefore, we continue to maintain increased confidence in several Kansas impacts. Severe weather is expected to continue to be above normal. These transition periods are the focus for an increase in tornado outbreaks. Over the last two weeks, we have seen that in Kansas and Central Plains. This has increased psychological stress as we are following several very quiet severe weather seasons. It will also lead to areas seeing repeated severe storms multiple times over with damage potential. However, that would continue to provide at least precipitation chances for the short term into mid-to-late May (Figure 3).

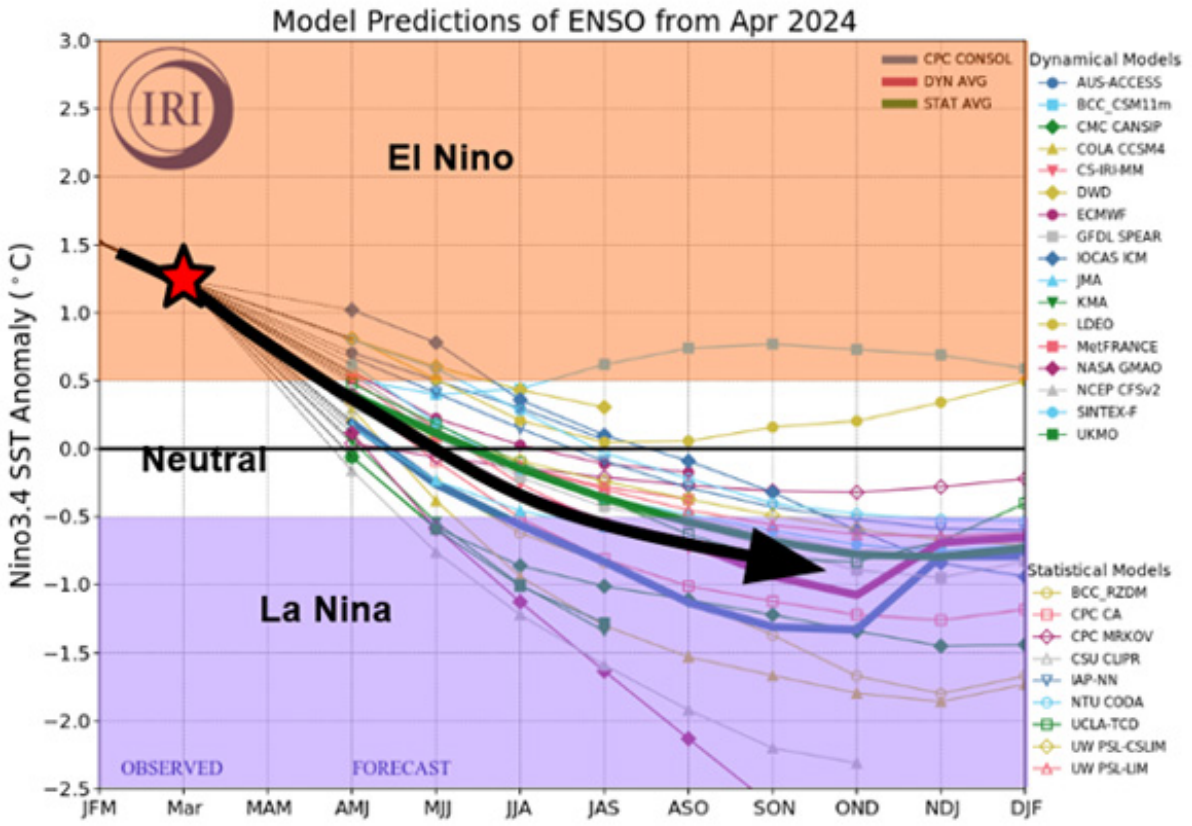


**Figure 2. The current El Niño Southern Oscillation (ENSO) status is highlighted by the red star with projection into the coming months from forecast models. The overall trend is represented by the black arrow. Graphic from https://iri.columbia.edu, annotations by the author.**

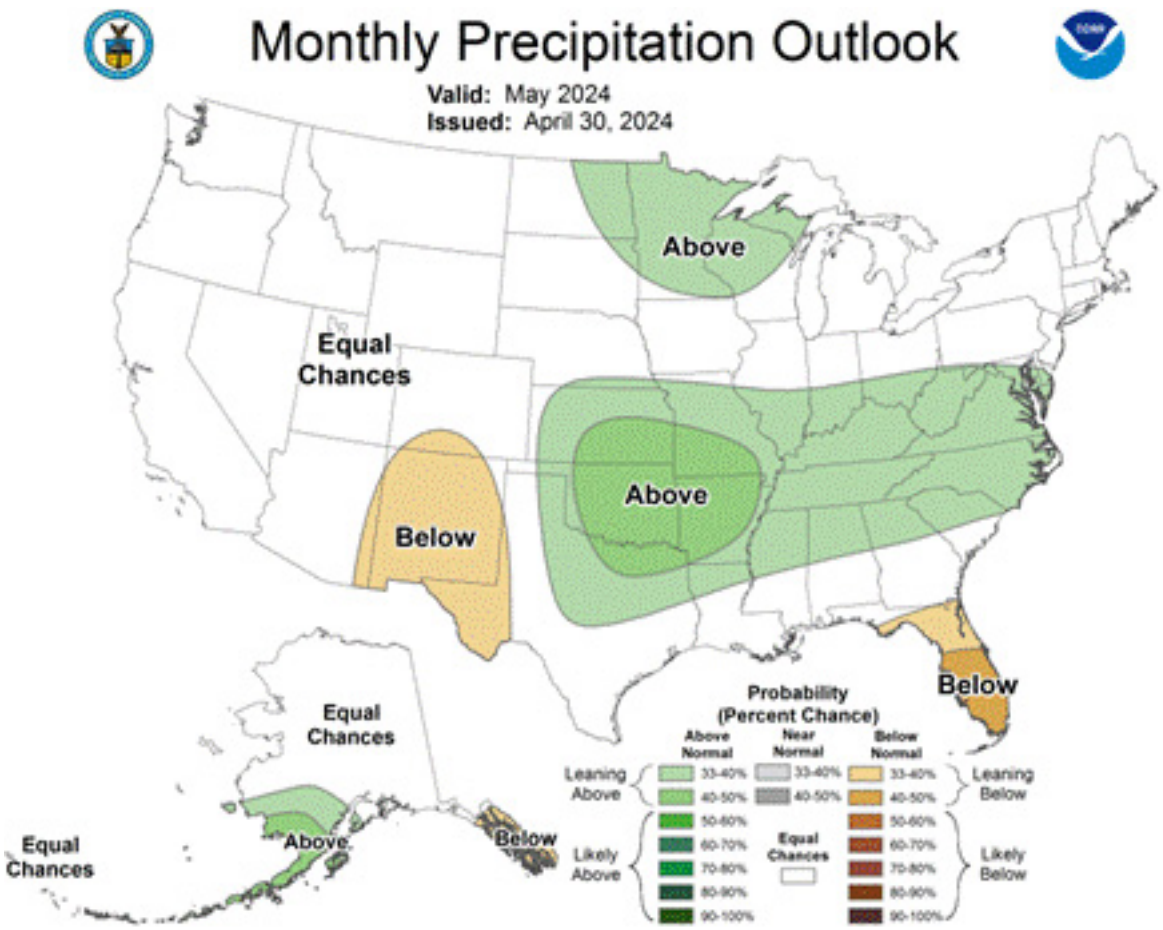


**Figure 3. The May 2024 precipitation outlook for the US favors normal moisture with the highest probabilities in the southeast. Source: cpc.ncep.noaa.gov**

Unfortunately, with this transition, Kansas is favored for warmer and drier-than-normal conditions this summer (Figure 4). With the current flash drought that has emerged in southwest/south-central Kansas and further south/west into Texas and New Mexico, there is potential for a negative feedback cycle. Dry conditions tend to yield drier conditions as we go into the summer. This doesn't mean it will be completely dry, as some precipitation events will still occur. However, the overall expansion of southwest flow enhanced by La Niña (assuming it develops) will expand these dry conditions further north and east during the summer months. This will trend measured precipitation below normal, and drought will be a challenge most of the summer. While we haven't seen it with the wheat crop, timely rains, despite dry conditions, could be a saving grace. However, summer precipitation tends to be much more isolated and spotty due to thunderstorms. Widespread precipitation is usually less common, with the haves and have-nots often being very localized.

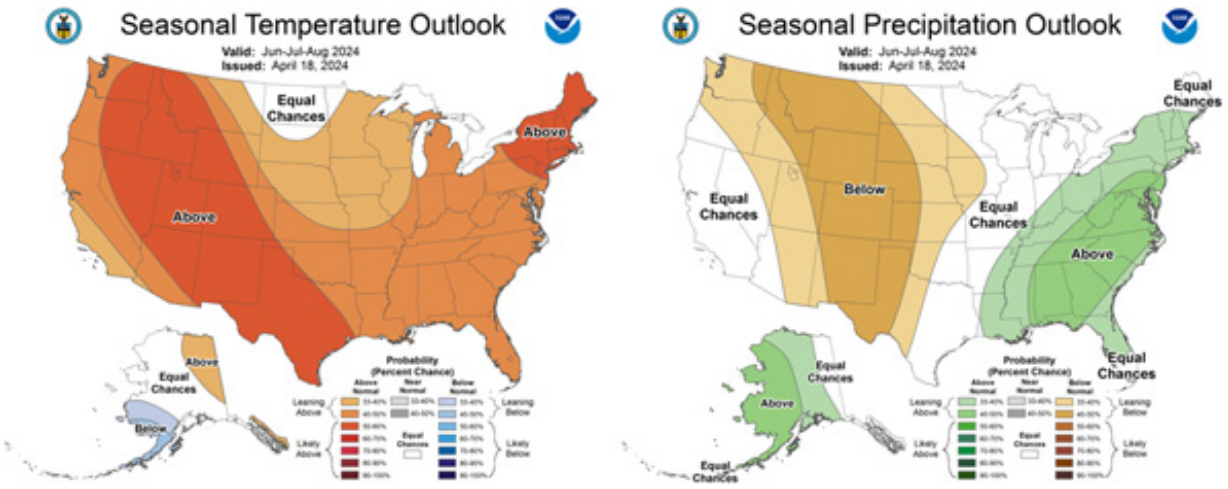


**Figure 4. The June, July, and August temperature (left) and precipitation (right) outlooks from the Climate Prediction Center. Outlooks favor warmer-than-normal and drier-than-normal conditions for most of the state. Source: cpc.ncep.noaa.gov**

**Concluding Thoughts**

A challenging spring and summer are expected. While no season/year is "normal," the extremes are going to provide struggles for agriculture and potentially public safety. This is especially so where the drought has been expanding in the last few weeks (southwest and south-central) and where flooding has been occurring (southeast). Severe weather is going to be above normal into mid-May. This is peak severe weather season to begin with. Therefore, review your plans, have a way to receive warnings, and be prepared to shelter if necessary. With the state so split with current precipitation anomalies – make sure you utilize the current conditions. If you are seriously wet – it is a good time to make plans, train, and work on relationships. If you are seriously dry – work on digging out ponds, get field work done, and be prepared for when the rains (likely heavy) come. These challenges can be difficult both mentally and financially. Talk to your friends and family and help each other.

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## 8. War Against Weeds podcast is looking for your feedback

Have you been keeping up with the "**War Against Weeds**" podcast? Over 100 full-length episodes are posted at https://waragainstweeds.libsyn.com/ and available on Spotify and iTunes. For those not familiar with this podcast, it is an outreach effort from Sarah Lancaster, K-State Extension Weed Science Specialist, Mandy Bish, Extension Weed Scientist at the University of Missouri, and Joe Ikely, Extension Weed Scientist at North Dakota State.

The War Against Weeds team is conducting a survey to improve the podcast. We'd love to hear from you! Please consider participating in this survey. You can access it by clicking this link: https://kstate.qualtrics.com/jfe/form/SV_9NtoPCcnBGAAEBw or scanning the QR code below. The survey will take under 5 minutes to complete.


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## 9. Winter Canola Field Day set for May 16 near Hutchinson

Kansas State University, the Great Plains Canola Association, and Scoular will host a field day at the South Central Experiment Field southwest of Hutchinson on May 16 to highlight winter canola variety development, research, and marketing.

K-State canola breeder Mike Stamm said the field day is an opportunity to see winter canola variety trials in the field and learn about current and future varieties. Management decisions to ensure a successful harvest will be discussed. Questions related to marketing of the crop are still a critical topic. Although the winter was relatively mild, the crop endured a number of stresses. Great establishment of the crop last fall enabled optimum overwintering, although differences among varieties were noted. We will be very interested to harvest and learn from these variety trials.

"Scoular is excited that our oilseed crush facility in Goodland, which will begin operations in October 2024, is creating renewed interest in planting canola," said Jeff Frazier, the market development manager for Scoular. "It's important to give producers an opportunity to get their marketing questions answered. We want to help producers grow canola with confidence and put everyone in the best position possible to harvest and market a successful crop this summer."

The field day will be held at the South Central Experiment Field southwest of Hutchinson, beginning at 10 a.m. From the US-50 and S Dean Road intersection west of Hutchinson, drive south 4 ½ miles on S Dean Rd. The experiment field address is 10620 S. Dean Rd.

The Great Plains Canola Association will provide an update and sponsor a free noon meal.

To RSVP for the catered meal, please contact the K-State agronomy extension office at sprite@ksu.edu or 785-532-5776. More information also is available from Mike Stamm at 785-532-3871 or mjstamm@ksu.edu.

## 10. Save the Dates for Western Kansas Fall Field Days

Join K-State agronomists and extension specialists at one or more of the Western Kansas Fall Field Days. As your calendars begin to fill up, we encourage you to save the dates for these events. As the time draws closer, more information about each event will be shared in the eUpdate. Stay tuned!

**August 27 – Hays**

**August 28 – Tribune**

**August 29 – Garden City**

**September 5 – Colby**


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