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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. Is There Any Value to Starter Fertilizers 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.

However, with narrow row soybeans, it may not be possible to install fertilizer units for deep banding. In that situation, producers can surface-apply the fertilizer. Fertilizer should not be placed in-furrow in direct seed contact with soybeans because the seed is very sensitive to salt injury.

Soybean seldom responds to nitrogen (N) in the starter fertilizer. However, some research under irrigated, high-yield environments with sandy soils suggests a potential benefit of small amounts of N in starter fertilizer.

Figure 1. Visual differences with starter P fertilizer on low testing soils. Photo by Nathan Mueller, former K-State Agronomy graduate student and current Associate Extension Educator at the University of Nebraska West Central Research & Extension Center.

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2. Interseeding sorghum-sudangrass into perennial cool-season western wheatgrass pasture

Conversion of pastureland into cropland has occurred at a rapid rate in the Great Plains. A reduction in total acreage of pastureland from this conversion has resulted in a decline of total numbers of beef cows in the same region.

One way to mitigate the decline in cow numbers is to increase the carrying capacity of the remaining pastureland acres. One way to do this could be to interseed a warm-season annual grass species into perennial cool-season grass pastures (Figure 1). This could increase dry matter production during the mid-summer time period when perennial cool-season grasses would be most dormant. An increase in production during this time period could result in a significant overall increase in total land area production.

Figure 1. Sorghum-sudangrass approximately 30-45 days following interseeding into western wheatgrass pasture near Hays, KS. Photos by Keith Harmoney, K-State Agricultural Research Center-Hays.

Methods

In 2020 and 2021 we tested this by interseeding sorghum-sudangrass, crabgrass, and teff into a western wheatgrass pasture at the Agricultural Research Center-Hays. First, the western wheatgrass was harvested to a height of 4 inches for forage yield in June. The three summer annual forages were no-till seeded into the plots at three seeding rates (0.5X, 1.0X, and 1.5X), using 12-inch rows. After seeding, 60 lbs N/acre was applied.

The summer annual forages were harvested for forage yield at a 4-inch height 90 days after planting.

The following spring, western wheatgrass was fertilized early with 60 lbs N/acre and was harvested in late spring to see if the summer annual forages had any effect on the subsequent growth of perennial cool-season grass.

Results and Discussion

Following western wheatgrass harvest in June, the soil was dry both years. It didn't rain enough directly after seeding to get good seed germination of all the summer annual forages. The only summer annual forage that established and maintained acceptable stands in either year was sorghum-sudangrass.

Yields of both western wheatgrass and sorghum-sudangrass were higher in 2020 than in the extremely dry season of 2021. This especially reduced sorghum-sudangrass production in the new 2021 interseeding. At 90 days after seeding, sorghum-sudangrass plots averaged 6,600 lbs/acre of additional forage in 2020. The new seeding of sorghum-sudangrass in 2021 produced a little more than 800 lbs/acre of additional forage. Crabgrass and teff resulted in no additional harvestable forage in either year.

Sorghum-sudangrass planted in 2020 reduced western wheatgrass production in the following year by 440 to 730 lbs/acre compared to where no summer annual forages had been interseeded. Western wheatgrass production following the 2021 sorghum-sudangrass seeding will take place yet in spring of 2022. Once that data is available it, along with the 2021 sorghum-sudangrass yield, will be added to the table below.

Implications

Establishing sorghum-sudangrass in cool-season western wheatgrass pasture at the Agricultural Research Center-Hays improved total forage production over two years, 2020-2021. There was a net increase of nearly 3 tons of forage/acre compared to the cool-season grass alone (Figure 2).

Figure 2. Sorghum-sudangrass just before harvest at 90 days after interseeding into western wheatgrass pasture near Hays, KS.

Vast improvements in production on limited cool-season pastureland resources are possible during years of greater precipitation. Alternatively, timely summer rainfall may provide an opportunity for some interseeded summer annual forage growth when early spring precipitation limits cool-season grass production. Greater forage production in turn increases the total number of beef cows the land area could support through grazing or haying.

Table 1. Effect on forage yields in 2020 and 2021when interseeding sorghum-sudangrass into western wheatgrass pasture at, Hays, KS.

	Western wheatgrass yield (lbs/a) before interseeding	Sorghum-sudangrass yield (lbs/a)	Western wheatgrass yield (lbs/a) the year after interseeding	2-yr combined forage yield (lbs/a) following interseeding	2-yr combined forage yield (lbs/a) increase
Sorghum-sudangrass seeding rate	Harvested June 2020	Harvested Sept. 2020	Harvested June 2021		
0 (no interseeding)	2243	--	3170	5413	--
0.5X (20 lbs/a)	2499	7180	2840	12519	7106
1.0X (40 lbs/a)	2262	5950	2520	10732	5319
1.5X (60 lbs/a)	1778	6670	2250	10698	5285
Interseeded Average	2180	6600	2538	11318	5905

The full article on this research can be found in the ARC-Hays Roundup 2022 publication at: https://newprairiepress.org/kaesrr/vol8/iss2/4/

This research is a follow-up to a previous regional study at several locations that is published in Agronomy Journal. The new study published in the Roundup is one of two locations, with the other location being Meade, NE in smooth bromegrass pasture.

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3. Soybean Row Spacing in Kansas

There are still many questions about row spacing for soybean production. In this article we present a summary of recent research from K-State. From 2015 to 2017, a series of six On-Farm experiments were conducted across eastern and central Kansas (**Figure 1**).

For the 2015-16 seasons, four on-farm studies (collaboration between K-State, Kansas Soybean, and the United Soybean Board - USB) were conducted, one each in Franklin County, Hutchinson, Jefferson County, and Manhattan. For the 2017 season, two additional studies (collaboration between K-State, Kansas Soybeans, North Central Soybean Research Program) were conducted in Ashland Bottoms near Manhattan and Franklin County.

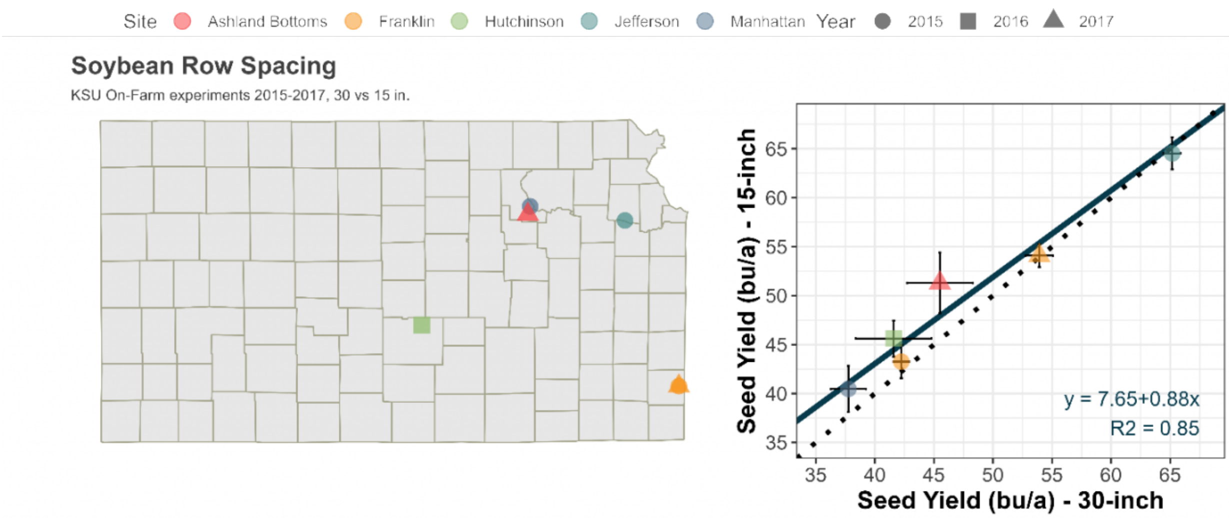

Figure 1. On-farm experiments on soybean row spacing comparing conventional (30-inch) vs. narrow rows (15-inch). Collaborators: Kansas State University, United Soybean Board, North Central Soybean Research Program.

Results summary

Compared to the conventional 30-inch row spacing, soybeans in narrow rows (15-inch or less) in these tests were likely to show equal or slightly greater yields (**2-12%**), particularly when the yield environment was less than than 50 bushels per acre (**Figure 1**) (regardless of planting date, seeding rate, or maturity). Above this yield threshold level, soybean did not show yield response to changing the row spacing (**Figure 2**). Overall, the common denominator of the response to row spacing is the inconsistency, denoted by the wide error of responses and by the variability between site-years.

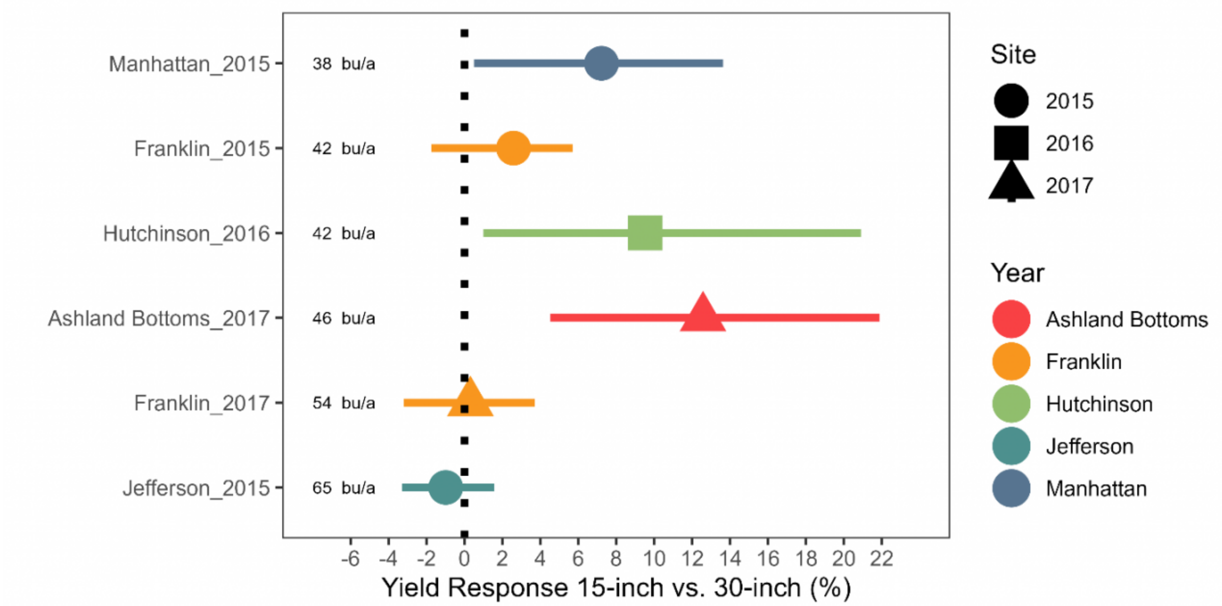

Figure 2. Observed yield response in soybeans to narrow rows (15-inch) compared to conventional spacing (30-inch). Average yield of 30-inch strips is indicated on the left side of the figure (bu/a). At the lowest-yielding site, Manhattan in 2015, sovbeans in 15-inch row spacing had an average of about 6% higher yields than those in 30-inch rows. In the highest yield environments, Jefferson County in 2015 and Franklin County in 2017, there was very little yield difference between 15- and 30-inch rows. On-Farm Experiments (2015-2017). Collaborators: Kansas State University, United Soybean Board, North Central Soybean Research Program.

Final considerations

Some of the benefits of narrow row spacing:

- Early canopy closure favors better light interception,
- Improved weed control, and
- Reduced potential for soil erosion.

On the other hand, some of the disadvantages of narrow rows:

- Potential reductions in final stand at a given seeding rate, linked to equipment and within row compaction.
- In very dry years, narrow row spacing may consume limited soil water earlier in the growing season, reducing the amount of water available for the critical period around pod-setting and seed filling.
- In wet years, too narrow spacing (less than 15-inch) may allow less air flow within the canopy and favor the occurrence of certain diseases, such as white mold.

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4. Spring update on winter canola conditions

The 2021-2022 winter crop season is shaping up to be one to remember for wheat and canola growers. From mounting precipitation concerns to rapidly fluctuating temperatures, one would think that the deck is stacked against this year's winter crops.

Recent observations indicate the majority of the canola crop survived the winter but soil moisture depletion is causing the crop to struggle along. A change in weather systems could breathe new life into the crop but time is of the essence as we move into full flower and pod set.

To better understand how the current drought conditions are impacting canola, we think back to establishment conditions last fall. Low soil moisture in the planting zone made establishment challenging across most of Kansas. Canola is a crop that needs to emerge right away to attain adequate top growth going into the winter. Fortunately, rains in October, coupled with warm temperatures, allowed the crop to emerge somewhat later than normal.

Winter temperatures in 2022 were colder on average in January and February compared to last year. Figure 1 shows the daily low temperatures from October to mid-April for Manhattan the past two growing seasons. We all remember the extreme cold that took place the days surrounding February 16, 2021. One would think that such an event would have a major impact on winter survival. However, last year very little winterkill was observed because the bitter cold happened at a time when the crop was most tolerant to cold and there was light snow cover present. As you can see in Figure 1, there were multiple days with low temperatures reaching the single digits in 2022. The cumulative effect of these lower temperatures had a great impact on the current crop.

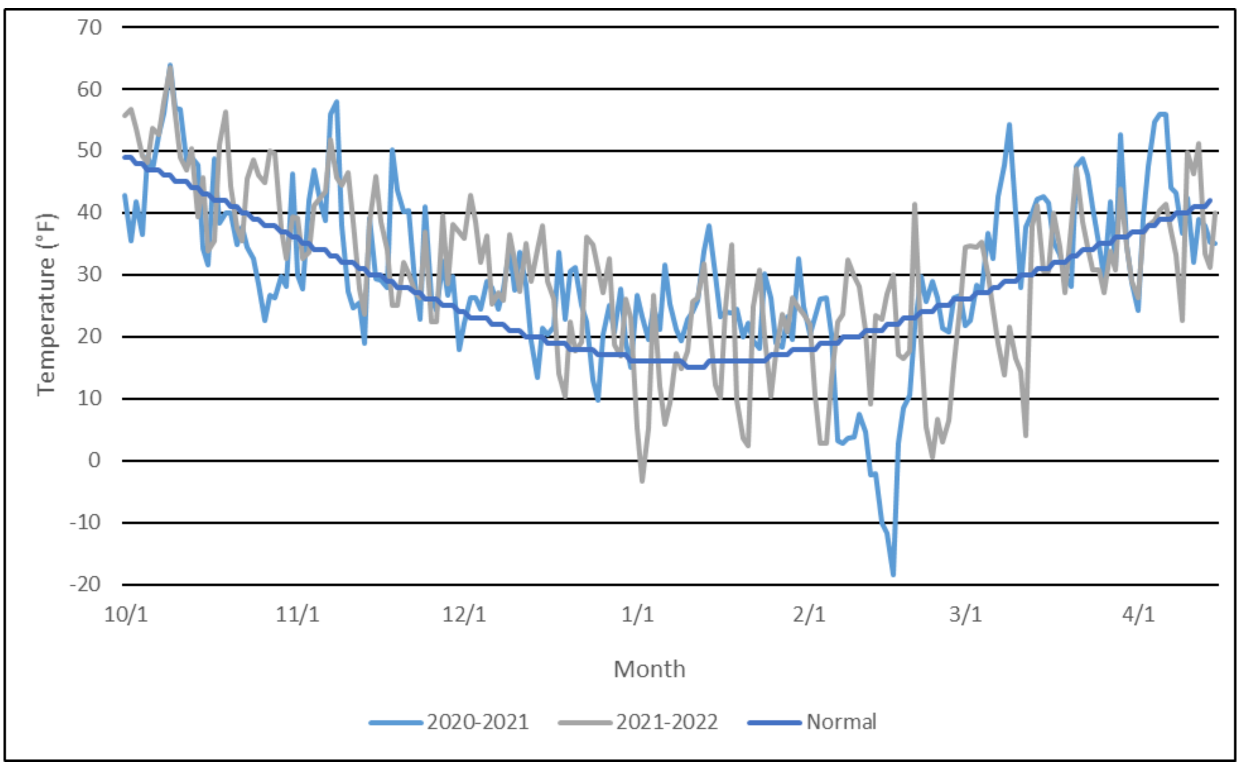

Figure 1. Low temperatures near Manhattan, KS for the fall and winter months of the 2020-2021 and 2021-2022 growing seasons. Data courtesy of the Kansas Mesonet.

What was the effect? These low temperature caused a significant reduction in the amount of above ground biomass. Figure 2 illustrates this loss of leaf area. In simple terms, canola yield and leaf area work hand-in-hand. Typically, in the years where we carry the most leaf area through the winter we see potential for higher yields. In the years where we lose most of the fall leaf area we can often see lower yields. The drought on top of this has not helped the situation. We didn't see much recovery of leaf area this spring as the crop jumped into survival mode, meaning it rapidly moved to bolting to attempt to survive the current dry conditions.

Figure 2. Winter canola variety trial near Caldwell, KS. The top photo was taken December 13, 2021 and the bottom photo was taken March 29, 2022. The leaf area in the bottom photo is all newly developed. Photos by Mike Stamm, K-State Research and Extension.

Figure 3 shows drought-stricken plots near Manhattan. The plants on the front and the back ends of the plots have much more leaf area compared to the plants within the plots. This is a result of there being less competition next to the alley. This "saddling" effect is quite common in drought years. Plants in the center of the plots lack adequate biomass and have lower yield potential.

Figure 3. Winter canola variety trial near Manhattan, KS showing effects of current drought conditions. The photo was taken April 15, 2022. Photo by Mike Stamm K-State Research and Extension.

Canola has entered the time of peak water demand, which is flowering through early pod fill. What might happen if conditions improve? Since winter canola is an indeterminate crop, adequate precipitation may induce budding at growing points along the main stem. If time allows for these buds to produce viable flowers and pods, then yield recovery could be expected. However, if we find ourselves deep into pod fill and the crop begins to mature, late rains may induce a secondary bloom, which we don't want. Producers familiar with canola may remember a similar situation in the mid-2000s where late rainfall caused a secondary bloom on drought stricken canola. Having a crop at two different growth stages (mature and flowering) can make harvest timing more challenging.

One positive through the spring is that we have not seen winter decline syndrome become a widespread problem. This happens when the crown is damaged overwinter and internal decay causes the main stem to weaken at the soil surface. The symptoms of winter decline syndrome (lodging, rotten stems, wilted plants) have only been observed sparingly, providing good indication that stem damage may not have been prevalent even though conditions were favorable for its development this year. Lodging is the primary concern for a weakened canola stem.

Only time will tell how well the current canola crop will yield. We've seen the resiliency of canola carry it through challenging weather conditions before, and one significant rainfall event can change the narrative rather quickly.

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5. 2022 Blowing in the Wind

While drought has deepened across the Plains, persistent winds have also been an issue. Measuring the drought is difficult and measuring wind can be even more challenging. Wind is often hard to reasonably sample because small changes in terrain/obstacles significantly influence measurements. However, we can all agree it has FELT windy but how windy has it been?

Climatology

Unsurprisingly, spring is the windiest season on the Great Plains. When warm air from the south begins pushing northward, clashing with colder air masses, it creates windy conditions due to increasing pressure differences. In addition, these winds are not uniform across the terrain. Western Kansas has fewer terrain changes and obstructions and typically averages more wind than areas farther east. April is the peak month for winds in all regions of the state despite (Figure 1).

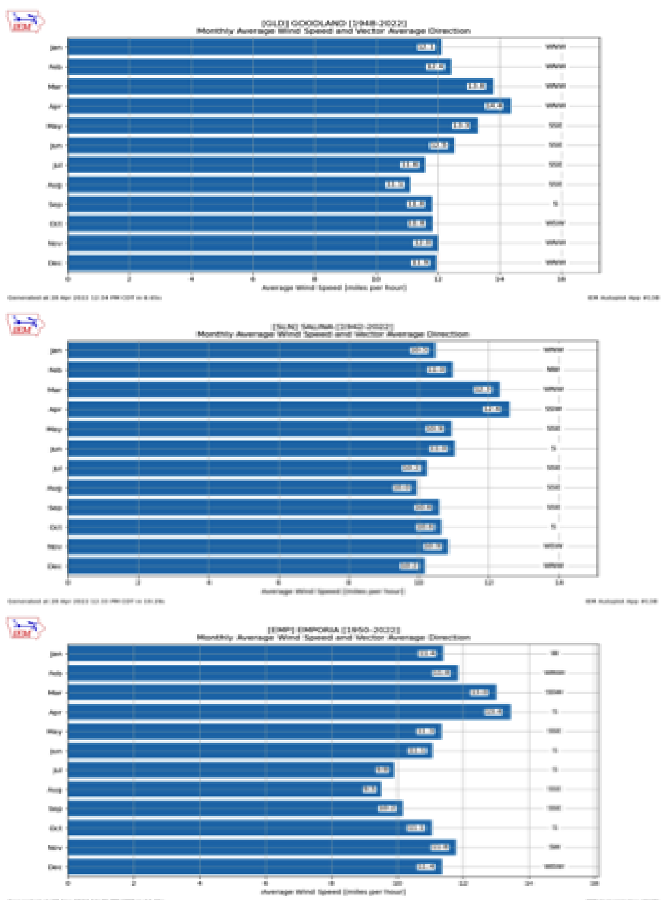

Figure 1. Average sustained wind speed and direction at Goodland (left), Salina (center), and Emporia (right) by month of the year. Source: Iowa Environmental Mesonet.

Magnitude of 2022 Wind

There are many ways to sample and observe wind, and then to calculate averages for specific locations and regions. There are few locations that have adequate climatology data to compare to normal. However, some airports have fairly reliable data and that was used in Figure 1. Using those same locations, let's look at average sustained wind speeds over a period of time. This does not consider gusts, which are the daily maximum wind speeds (we will look at those next). Daily average sustained wind speed doesn't consider just the afternoon readings (typically the windiest time of day) but also averages in the overnight speeds (typically the least windy time of day). Therefore, the final average wind speed may underplay the gusty afternoon winds that are moving much of the soil.

Goodland and other locations in western Kansas have been the target of the strongest winds observed this spring. In April, of the 27 days completed at the time of this writing, 17 days had at- or above-normal sustained winds (Figure 2). Farther east, Salina has measured 16 days of at/above-normal wind (Figure 3) and Emporia only 10 (Figure 4). From this information it is safe to say it has been windier than normal for over half the days in central/west Kansas. It has also been less windy farther east. Unfortunately, this doesn't portray the magnitude of the strongest winds.

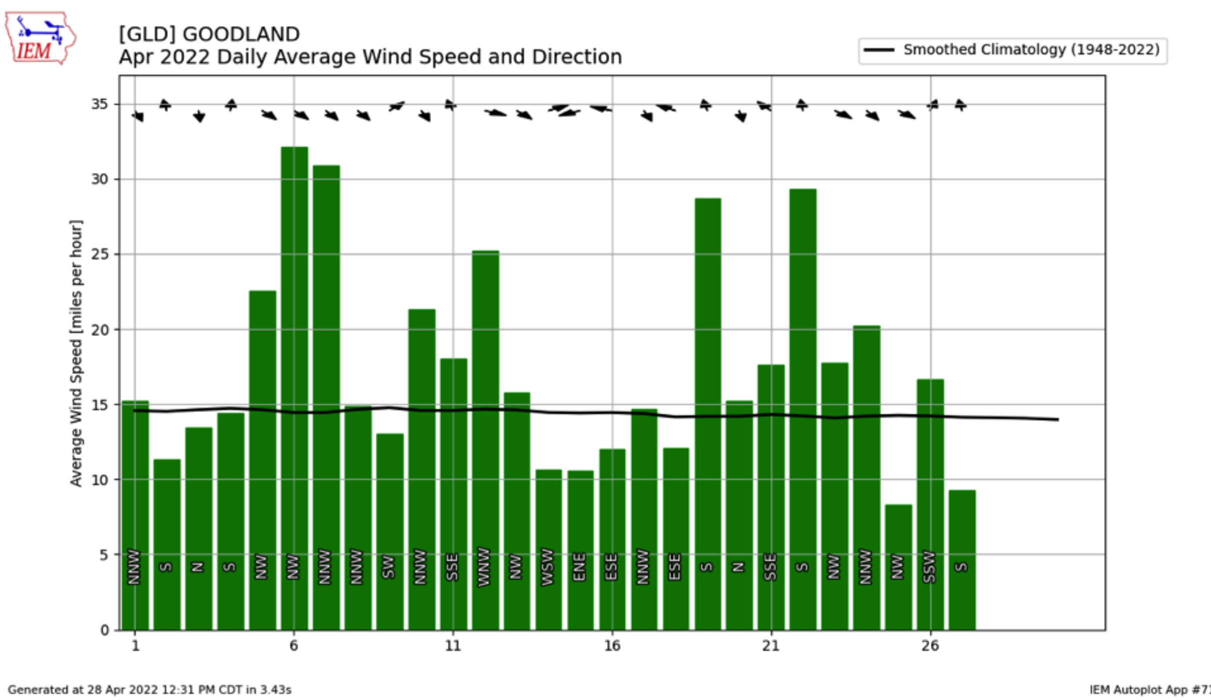

Figure 2. Daily sustained wind as observed at Goodland compared to average daily climatology. Source: Iowa Environmental Mesonet.

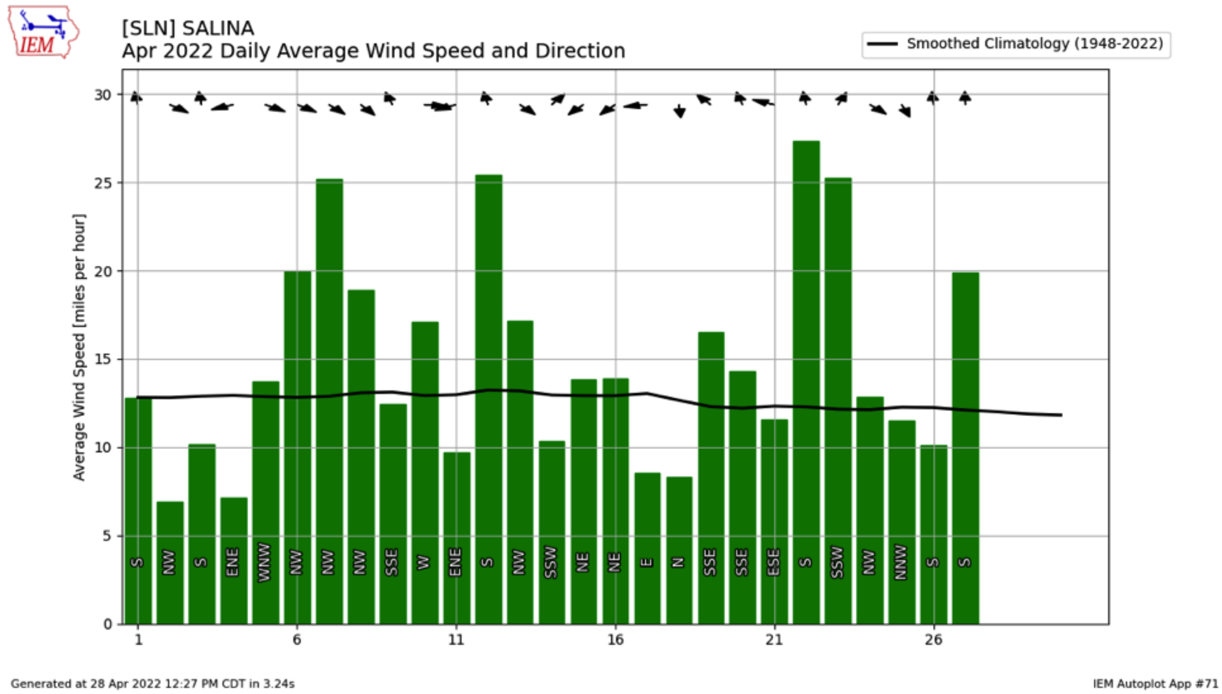

Figure 3. Daily sustained wind as observed at Salina compared to average daily climatology. Source: Iowa Environmental Mesonet.

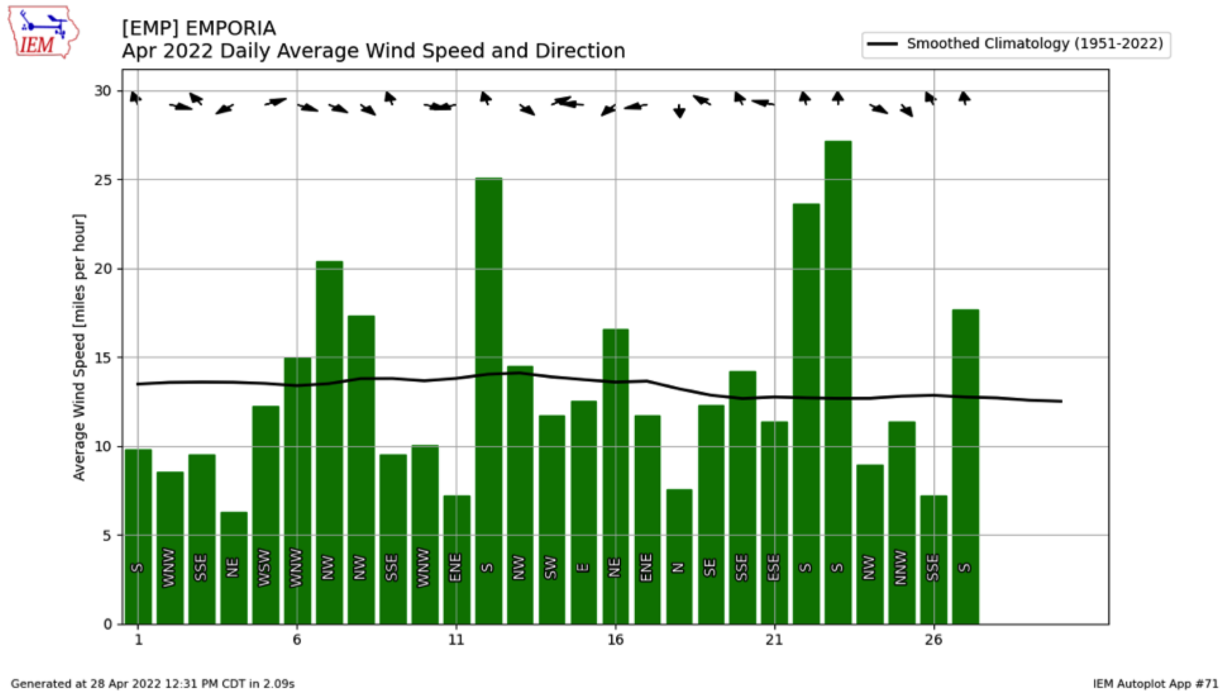

Figure 4. Daily sustained wind as observed at Emporia compared to average daily climatology. Source: Iowa Environmental Mesonet.

All About the Gusts

Gusts typically are measured as the fastest three- or five-second wind speeds measured through the day. Often these occur in the afternoon and get mixed out with averaging of sustained wind. Evaluating the Kansas Mesonet (mesonet.ksu.edu) wind data for the months of March through April, the average of the strongest gusts (at 30 feet, similar to the airport stations used above) for the period are above 20mph at all stations with maximum averages of 30-40 mph occurring in western Kansas (Figure 5). The maximum measured gusts reached as high as 73.9 mph at Colby on April 23rd. One third of the 57 tower stations in Kansas have measured gusts over 60mph since March 1st. This is the strong wind that many are referencing and are responsible for much of the blowing dust and wildfire concerns.

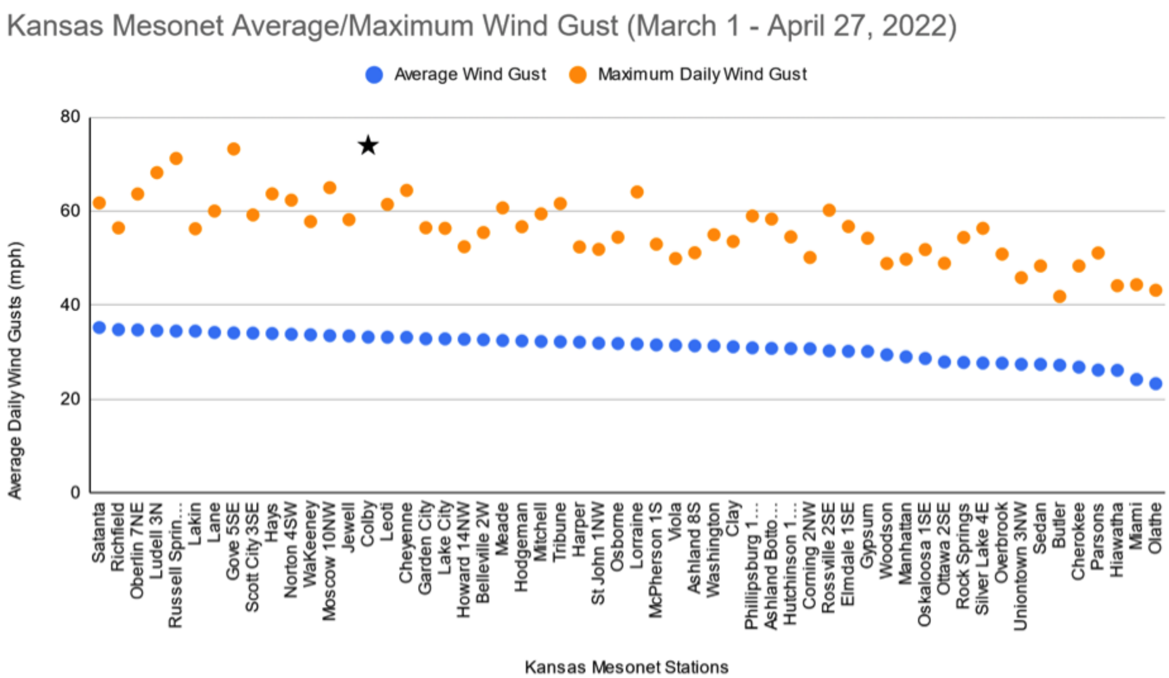

Figure 5. Average of daily wind gusts and the maximum wind gusts measured from March 1 through April 27, 2022 on the Kansas Mesonet. The strongest wind gust, 73.9 mph at Colby on April 23rd is starred. Source: Kansas Mesonet.

Drought Connection

A popular question of late has been if there is a connection between drought and the winds across the region. This question is a bit hard to answer as many environmental connections of drought are hard to measure. The first most obvious connection has been with the persistent La Nina. This combined with other oscillations have contributed to persistent northwest flow of wind. While this has kept temperatures cooler and drier than normal (and led to drought), it has also provided frequent storm systems and associated cold fronts. Frequent cold frontal passages result in enhanced pressure gradients leading to our persistent gusty winds. It has also shunted chances of moisture off to our south and east.

So what about the drought? Drought is not just limited to Kansas. Much of the western U.S. is gripped in severe or worse drought, resulting in drier air masses. This drier air is moved over Kansas with westerly flow in the northern hemisphere. As a result, drier atmospheric air leads to fewer clouds in the sky and increased solar radiation. Using Salina as a center point in Kansas (Figure 6), observed only 19% of April afternoon (2pm) days have reported overcast conditions compared to the normal of 31% (approximately nine days). This is below average and has resulted in much more sun in the afternoon compared to normal.

Solar radiation in the afternoon means warmer surface soil temperatures. This in turn creates more mixing in the lower atmosphere, bringing stronger mid-level winds down to the surface and stronger surface winds!

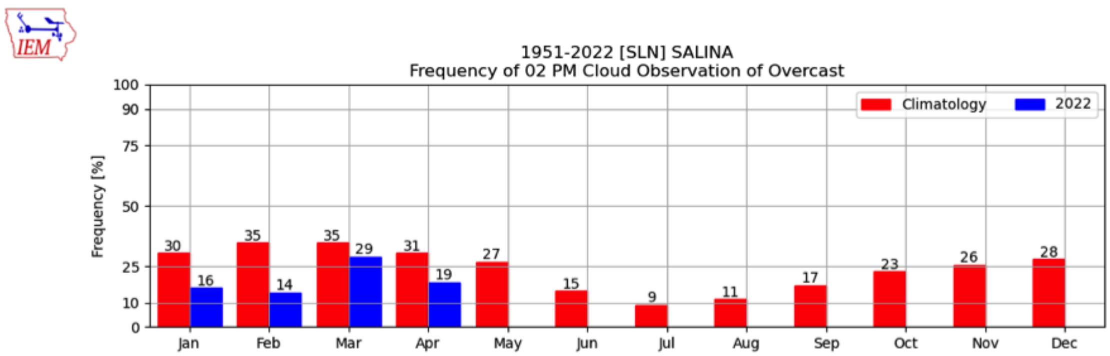

Figure 6. Afternoon (2pm CT) observations of cloud cover at Salina compared to climatology. Source: Iowa Environmental Mesonet.

Lastly, another possible local effect of the high winds may be the delayed green-up. Cooler temperatures and lack of moisture have quelled the initiation of tree budding, cool-season grass growth, and even wheat development. This has kept the surface of the earth across Kansas browner than normal. A darker surface absorbs more sunshine and heats up more effectively (especially with dry soils) than an active growing green surface. As a result, this warms the air more (relative to the surrounding air above it) and forces stronger mixing into the mid-levels of the atmosphere, bringing stronger winds to the surface.

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6. Management following a wildfire

The dry conditions throughout much of Kansas have led to an increased danger of wildfires. This is normally the time of year for prescribed burns on warm-season rangeland in eastern Kansas, so a wildfire at this time will not permanently harm the quality of vegetation on this kind of grazing land. However, a wildfire may act differently than a carefully planned prescribed burn. Should it produce enough heat it could cause damage, especially to bunch grasses, potentially resulting in a decline in productivity for a year or two. The best general advice for now on burned rangeland is to just wait and see how well it recovers. There are multiple management considerations for burned cropland depending on current or intended crop and other factors (Figure 1). There have also been questions about the effect of the wildfire or super-heated winds on soil quality and soil erodibility.

Figure 1. Wildfires can have many management implications for rangeland, cropland, and soil. Photos by Lucas Haag, K-State Research and Extension.

I. Effects on Rangeland and Management Strategies

Where a wildfire occurs, the ability of rangeland or tamegrass pastures to regenerate forage depends on precipitation amounts, the time of year that the fire occurs, the water infiltration ability of the soil, and management factors following the fire. Most of the soils in western Kansas were very dry going into the winter. The topsoil was generally quite dry at the time of the fire, and subsoil moisture was minimal. This will slow grass recovery and may take a few years to fully recover, depending on moisture during the growing season.

A previous wildfire in central Kansas that occurred in mid-March in a dry year on shortgrass rangelands reduced forage production 65% the year of the burn and 39% the following year. This shortgrass rangeland consisted primarily of blue grama, buffalograss, and western wheatgrass. In mixed prairie grassland, bunchgrasses such as little bluestem with large accumulations of dead plant material may be damaged as the passing fire ignites the dry material and generates increased temperatures at the soil surface for a period of time. If this occurs, forage production may be reduced by about 10-20 percent.

Wildfires tend to move rapidly, typically the result of high winds, low relative humidity, and warm air temperatures. Movement through rangeland grasses, especially those with rhizomes, is normally quick with reduced residence time. Therefore, there is an expectation that grasses should recover in time. Wildfires can also reduce stored carbohydrate reserves for grass plants, reduce moisture infiltration, increase evaporation and runoff, lead to erosion, create grazing distribution problems, and lead to an infestation of noxious weeds.

The crowns of grass plants often survive a wildfire and will regrow, but some can be damaged if the fire occurs when soil and air conditions are extremely dry. If plant litter remains after the fire, less damage will have occurred to the plant crowns, and soil conditions will be better. Evaporation and runoff may be increased if the fire occurs when the grasses are not actively growing. Bare soil may lose at least one-half inch of moisture per week through evaporation. The higher the clay content of the soil, the greater the potential for puddling and runoff.

Trees can burn quite hot, and for an extended period of time, if they catch fire. Eastern red cedar trees, among others, may be killed by a wildfire. On rangeland, this would normally be considered a good thing.

Good precipitation during the early growing season following the wildfire will hasten recovery and lessen the immediate impact of the fire.

A. Native warm-season grass rangeland

Between mid-March and June, wildfires generally do not reduce forage production as much as fires later in the year. However, if conditions are dry, regrowth will not occur and stocking rate must be reduced. Wildfires at this time may change plant composition of the grazing land.

When wildfires occur between late June and frost, the major consideration is to protect the plants from overuse. Immediate removal of the grazing animals is usually necessary. This will permit regrowth and allow plants to accumulate food reserves before winter. Wildfires occurring between fall and mid-March leave the soil bare until spring growth. Forage yields will be reduced, and a reduction is stocking rate is advised.

On sandy soils, blowouts (eroded areas) should be controlled as soon as possible. Mulching with manure, straw, or hay free of noxious weeds, along with reseeding can stabilize the blowout area. Fencing of blowouts will restrict livestock traffic and speed recovery.

Several grazing management options exist after a wildfire. If a wildfire occurs where prescribed burning is generally practiced, burn the areas that were untouched by the wildfire in late spring, when the desirable grass species have 1 to 1.5 inches of new growth. This will encourage grazing of the entire pasture. Observe where the animals are grazing, and use grazing distribution tools such as salt, mineral, and oilers to attract cattle to underutilized areas.

For forage plants to recover, it usually will be necessary to reduce stocking rates on the burned area.

Area	Year after wildfire	Stock at:
Flint Hills and East	1	75-85%
	2	Normal
Central Kansas	1	65-75%
	2	90-100%
	3	Normal
Western Kansas	1	50%
	2	75%
	3	Normal

Note: During lengthy droughts, use lower stocking rates than those listed in the chart. The main concern is the inability of the plants to regrow. The plants must be given the opportunity for regrowth during drought.

If a wildfire occurs where prescribed burning is not practiced, management decisions should be based on when the grassland was burned, how much of it was burned, and where livestock water is located.

Example 1: If there is a livestock-watering source in both the burned and unburned portions of the grassland, divide the burned and unburned areas (using an electric fence, for example) and reduce the stocking rate in the burned area.

Example 2: If there is only one livestock-watering source in the grassland area, the decision is whether to manage the burned or the unburned area. If the unburned area is larger, separate the two areas with an electric fence and stock the unburned area at the normal rate. If the burned area is larger, either manage only the burned part by reducing the stocking rate or establish an alternate water source, fence the area, and reduce the stocking rate on the burned portion. If the sole watering source is in the burned portion, the unburned portion would not be utilized unless the area was fenced and another water source established or a lane is fenced off to allow watering from the unburned area.

Example 3: If only a small portion of the grassland is burned, fence it off and reduce the stocking rate on the unburned portion accordingly.

Example 4: In areas where prescribed burning is commonly practiced, a partial burn of one-third of the pasture may provide an opportunity to try patch-burn grazing. Livestock will concentrate on the recently burned area, but the next year a different third of the pasture is burned and the livestock will change their grazing habits. Patch-burn grazing will result in rotational grazing without using a fence.

Mowing unburned areas in the early spring can encourage livestock to move from the burned area. However, don't mow in August or September. Early intensive grazing is another option for burned areas. Removing all livestock from the grassland by mid-July provides late-season rest and time for the desirable grasses to replenish root reserves.

B. Tamegrass hay meadows

Hay meadows burned by wildfires will probably produce less hay. To return hay meadows to their former production, cut the meadow in early to mid-July to allow regrowth and replenishment of root reserves.

II. Effects on Cropland and Management Strategies

A. Growing wheat

Wheat in the jointing stage or beyond can be injured by fire or super-heated air. This injury will be most severe on the edge of the field closest to the fire or super-heated air. It is not uncommon to have some injury to growing wheat on the edge of a field if the field is adjacent to a prescribed burn. The injury symptoms may be bleached or scorched leaves and possibly damaged growing points. The extent of injury from a wildfire depends on how quickly the fire moved through the field or around the field.

Research has found that the lethal high temperature for wheat is about 120 degrees F (J. Exp. Bot. *(1984) 35 (11): 1603-1608. doi: 10.1093/jxb/35.11.1603 http://jxb.oxfordjournals.org/content/35/11/1603.short)*.

A wildfire can easily heat the air or the plants themselves to well over those temperatures, depending on the distance of the fire from the wheat, possibly resulting in irrecoverable damage to the affected plants.

Wildfire injury to wheat will most likely be quite variable through the field. The only way to accurately assess any possible injury is to slice open the stems and examine the growing points 10-14 days after the fire. As with freeze damage, if the growing point is green and turgid (crisp) and light green, it is fine. If it is white, off-white or yellowing and soft, it is damaged. If there was extensive damage, the ability of the wheat to recover will be similar to the ability to recover from spring freeze injury.

B. Fields where wheat stubble or row-crop residue has been burned off

In many instances, fields of wheat or row-crop residue that were to be seeded are left barren after a wildfire event. There are many considerations and options for how to manage these fields moving forward. The first consideration should be how to protect the field from potential wind and water erosion through the use of emergency tillage (details are presented later in this article).

Farmers generally have several options:
1. Summer-fallow the land until seeding of the winter wheat crop

2. Plant a summer cash crop

3. Plant a cover crop. Options may be limited by timing and amount of precipitation received after the wildfire.

Summer-Fallow: Summer-fallowing the land is a straight forward option, but with zero residue present to buffer erosion by wind and water, care should be taken to use tillage operations that maintain surface roughness as long as possible up until seeding time.

Planting a summer cash crop: As wildfires typically follow long periods without precipitation, it's likely that little soil water exists in the profile. While profile water at planting is important, data from long-term rotation studies at Tribune have consistently shown that surface residue plays a very important role in maximizing the utilization of in-season precipitation. The reduced precipitation use efficiency combined with low levels of profile water make cropping with a summer cash crop a particularly risky option. The larger challenge then becomes if the cash crop fails without producing much above-ground biomass, the producer is then entering the typically dry, windy winter quite vulnerable to further wind erosion.

Planting a cover crop: If sufficient precipitation is received to establish a stand, a producer may consider a cover crop to grow some biomass as soon as possible and potentially serve as a feed resource if enough growth occurs. In general, a farmer should select species that offer the highest amounts of biomass production per inch of water consumed. For cool-season species, this would include triticale and cereal rye. Millets and sorghums are warm-season species. In the early spring, a producer may want to plant a blend of a cool-season and warm-season species to get some cover more quickly from the cool-season crop, followed by higher amounts and more durable residue from the subsequent warm-season crop.

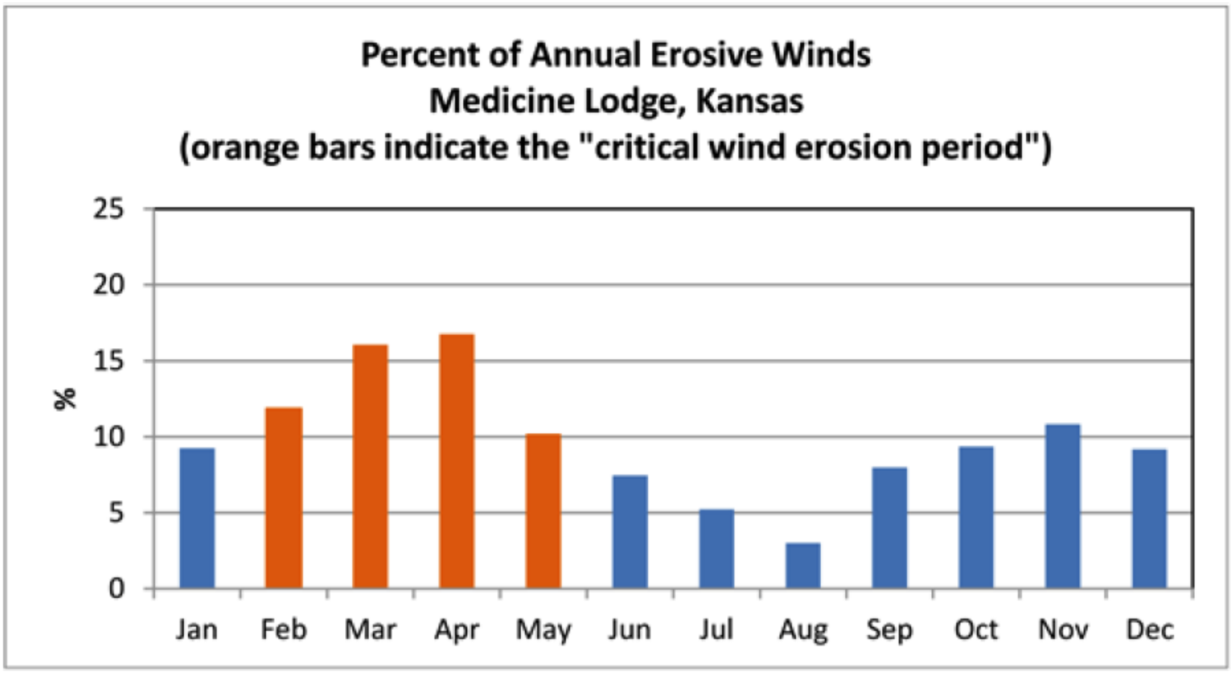
Keep in mind that soil temperatures will be warmer with no residue, so millets and sorghums will generally germinate earlier than what is considered normal at a typical planting date. If planting a blend, it's important to select a planting depth that both places the seed into moisture, but also is an acceptable depth for the species selected. Some potential cover crops such as oats and some millets will require shallower seeding than other potential species. At the time of this writing, most producers should consider moving towards seeding warm-season covers. If a producer has access to a hoe-drill, that method of seeding may offer some benefits for erosion reduction, protection of the emerging cover crop, and -- if done on the contour of sloping land -- reduction of soil erosion by runoff.

Nutrient considerations: About half of the nitrogen, and sulfur in the crop residues are lost to combustion during a fire. In extremely hot fires (the occurrence of white ash is an indicator) more than 25% of the phosphorus in the residue may be lost. Remaining nutrients would be in the ash, which can easily be lost from the field by wind or runoff. If nitrogen had been surface applied and was not yet incorporated by precipitation or tillage it is likely a significant portion will have been lost. It will take time for nutrient cycling to regain its normal function. It's recommended that proper soil sampling be conducted prior to the next cash crop and thereafter so that deficiencies may be detected and addressed.

III. Effects on Soil

The number one issue regarding the impact of a wildfire on soil quality is going to be susceptibility to erosion from water or wind. Past research, mainly on forest soils after a fire, indicate there is nothing to worry about as far as long-lasting chemical or biological effects in the soil from a fire. Managers and landowners may notice a hardening of the soil surface, but there is no reason to be concerned that the fire will cause the soils to become hydrophobic. That can happen in forest soils, but is unlikely grassland soils. Any surface hardening caused by the wildfire will likely be shallow and temporary.

If the vegetative cover on the surface of the soil was completely burned off, this increases the potential for wind erosion during the early spring months, when wind erosion rates are often at their highest.



Source: John Tatarko, USDA-ARS Agricultural Systems Research Unit, Ft. Collins, Colo.

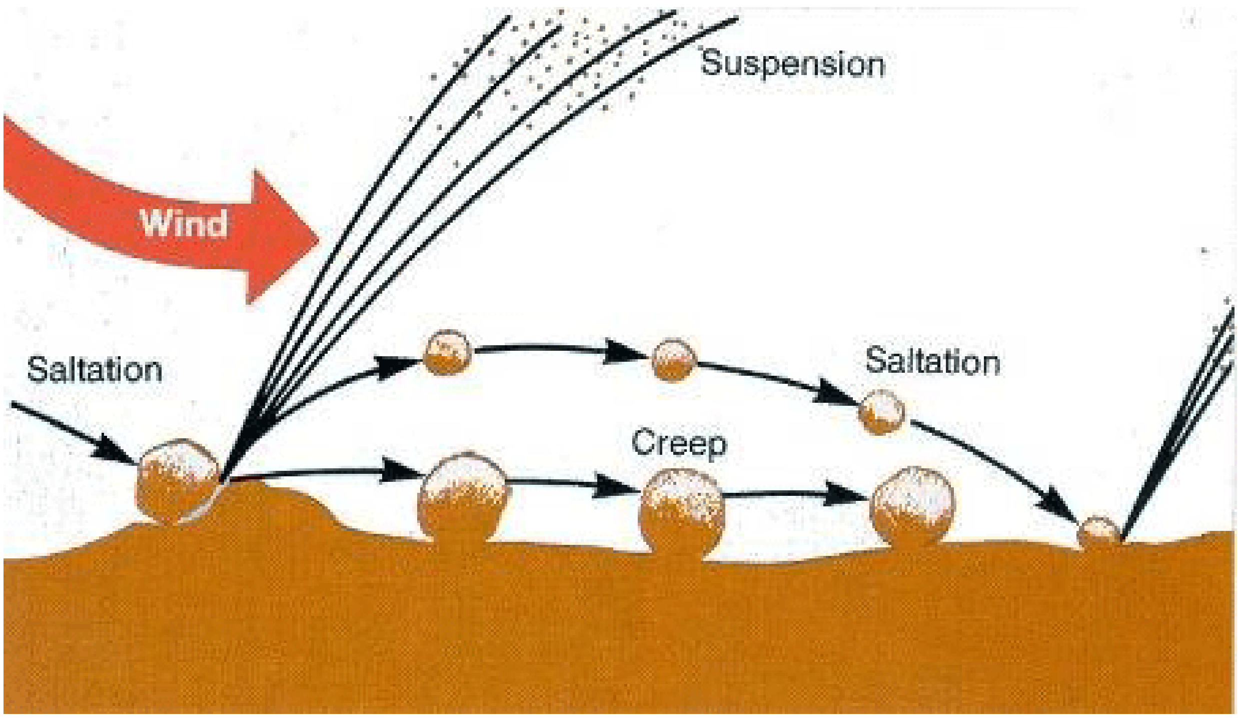
If the vegetation begins to regrow within a week or two, which may well occur on warm-season grasslands, this will reduce the potential for erosion problems. When vegetation or residue cover is insufficient, ridges and large soil clods (or aggregates) are frequently the only means of controlling erosion on large areas. In grasslands, seeding a temporary cover crop is another option for small areas, if the permanent grasses and forbs do not seem to be growing back two or three weeks after receiving some moisture. If there is no soil moisture, however, planting a cover crop will likely fail under this scenario.

Another option for cropland and smaller tracts of grassland left bare of vegetation or residue by the wildfire is to roughen the land surface with ridges and clods. This reduces the wind velocity and traps drifting soils. While this is not practical to do on large acreages of rangeland, it can be an effective practice on smaller acreages, and on cropland ground. A cloddy soil surface will absorb more wind energy than a flat, smooth surface. Better yet, a soil surface that is both ridged and cloddy will absorb even more wind energy and be even more effective in reducing the potential for wind erosion.

Crosswind ridges are formed by tilling or planting across the prevailing wind erosion direction. If erosive winds show no seasonal or annual prevailing direction, this practice has limited protective value. In Kansas, the prevailing winds in early spring the prevailing winds are from the south. Crosswind ridges at this time of year, therefore, should be in an east-west direction to protect from both northerly and southerly winds.

When cropland and grasslands were both burned and border each other, it's useful to create ridges along the field boundaries, to help prevent the drifting of soil into the fencerow area or adjoining road ditches. In sloping fields with contour conservation terraces, continuous east-west or southeast-northwest passes may not be possible. In these cases, a farmer may consider using tillage to roughen the terrace faces that have the greatest exposure to predominant winds with additional tillage passes on the contour in-between terraces if blowing continues. Additionally, contour tillage on terrace backsides and in-between terraces may reduce potential soil movement due to precipitation run-off until surface residues can be regrown.

Tillage implements can form ridges and depressions that alter wind velocity. The depressions also trap saltating soil particles and stop avalanching of eroding material downwind.



Source: Principles of Wind Erosion and Its Control, K-State Research and Extension publication MF-2860: http://www.bookstore.ksre.ksu.edu/pubs/MF2860.pdf

However, soil ridges protrude higher into the turbulent wind layer and are subject to greater wind forces. Therefore, it is important that cloddiness on top on the ridge is sufficient to withstand the added wind force, otherwise they will quickly erode, and the beneficial effects will be lost. Ridging sandy soils, for example, is of little value because the ridges of sand are erodible and soon leveled by the wind.

Clod-forming tillage produces aggregates or clods that are large enough to resist the wind force and trap smaller moving particles. They are also stable enough to resist breakdown by abrasion throughout the wind erosion season.

If clods are large and stable enough, as smaller particles are removed or trapped, the surface becomes stable or "armored" against erosive action. The duration of protection depends on the resistance of the clods to abrasion or changes in the wind direction.

Of the factors that affect the size and stability of soil aggregates, most notable is soil texture. Sandy or coarse-textured soils lack sufficient amounts of silt and clay to bind particles together to form aggregates. Such soils form a single-grain structure or weakly cemented clods, a condition that is quite susceptible to erosion by wind. Loams, silt loams, and clay loams tend to consolidate and form stable aggregates that are more resistant to erosive winds. Clays and silty clays are subject to fine granulation and more subject to erosion. Another factor is moisture; if a soil is totally dry, there may not be enough moisture for clod-forming tillage, or you may need to go deeper.

Selection of the proper tillage implement for emergency tillage is critical to produce meaningful and lasting effects. Chisels, aggressive rippers, and listers are useful implements when they can be ran deep enough to bring large clods to the surface. Any type of rolling basket or firming wheels on a ripper or harrows on a chisel, should be completely raised to maximize surface roughness. Sweep (blade) plows, field conditioners, discs, and vertical tillage machines are not useful in reducing wind erosion and in many instances can make the situation worse by exposing even more fine, erodible, soil particles than would be exposed on a post-fire soil surface.

For more information, see:

Rangeland Management Following Wildfire, K-State Research and Extension publication L-514 at: https://bookstore.ksre.ksu.edu/Item.aspx?catId=364&pubId=385

Principles of Wind Erosion and Its Control, K-State Research and Extension publication MF-2860 at: http://www.bookstore.ksre.ksu.edu/pubs/MF2860.pdf

Emergency Wind Erosion Control, K-State Research and Extension Publication MF-2206 at: https://bookstore.ksre.ksu.edu/pubs/mf2206.pdf

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