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Agronomy e-Updates

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1. Will summer crops in Kansas mature before frost?

Relatively cool temperatures in the second half of August and early September may have some producers worried about the chances of their summer crops maturing before frost. Development and maturation of most of our summer crops in Kansas are driven by temperature. Corn and sorghum are especially dependent on temperature, while soybean and cotton flowering and maturation depend on a combination of day length and temperature.

Formulas developed to describe the relationship between temperature and crop growth use the heat unit concept. Growing degree units (GDU) are calculated for each crop based on the sensitivity of that crop to low or high temperatures.

Corn

For corn, the GDU formula is well defined and functions well in most environments:

[(Daytime high + Nighttime low)/2] – 50

In this formula, the high is capped at 86ºF and the low has a floor of 50ºF. Using this formula and daily max/min temperatures from a few locations in Kansas, we can get an idea of how cool it really was in August and early September and what we might expect from here on out. The following table shows the GDU accumulation for August 1 to September 9, 2008, the normal GDU accumulation for those dates, and the normal GDU accumulation from September 10 until the date with a 50% chance of a 28ºF frost for each location. August 1 was chosen because Kansas Agricultural Statistics reported that 94% of the corn crop had silked by August 3.

Corn GDU Calculations

Location	A 2008 Corn GDU Aug. 1 to Sept. 9	B Normal Corn GDU Aug. 1 to Sept. 9	C Normal Corn GDU Sept. 10 to "50% Frost Date"
Colby	752	922	414
Garden City	798	974	520
Scandia	797	1,028	567
Hutchinson	893	1,111	715
Manhattan	824	1,077	675

All of the selected locations accumulated significantly fewer GDU in August and early September of 2008 than normal (columns A and B). A mid-season corn hybrid needs approximately 1,300 GDU from silking until maturity (black layer). Adding the numbers in columns A and C for each location indicates that medium maturity hybrids should reach black layer before frost in most of the state assuming they had silked sometime before August 1. Kansas Agricultural Statistics reported that only 80% of the corn had silked in the west-central crop-reporting district by August 3. A mid to late season hybrid that silked in late July or early August in northwest or west central Kansas may have trouble reaching maturity before frost, even with normal GDU accumulations from now on.

Even if the crop reaches black layer before frost, cool temperatures may slow dry-down and delay harvest. Neither is very attractive given the high cost of drying grain and the increased possibility of lodging the longer the crop stands in the field. The greatest problems are likely to arise in irrigated corn with full-season hybrids, especially if planting was delayed. With the 10-day forecast indicating below-normal temperatures, GDU accumulations are likely to continue lag behind normal. Producers should consider their options for harvesting higher moisture corn or perhaps seeking markets for silage if their corn is not likely to mature before frost.

Grain Sorghum

Grain sorghum develops in response to temperature much like corn, but the relationship between sorghum development and temperature is not so clearly defined as it is in corn. Sorghum development before heading can be slowed in response to moisture deficit regardless of temperature, a fairly common situation in much of the area where sorghum is grown. However, temperature does drive grain maturation from half-bloom until black layer. For sorghum, GDU are figured according to this formula:

[(Daytime high + Nighttime low)/2] – 42

In this formula, there is no cap on the high, but the low has a floor of 42ºF. The following table shows the GDU accumulation for August 16 to September 9, 2008, September 1 to 9, 2008, and the normal GDU accumulation from September 10 until the date with a 50% chance of a 28ºF frost for each location. Kansas Agricultural Statistics reported that 72% of the sorghum crop in

Kansas had headed by August 18 and 86% had headed by September 1. Half bloom usually follows soon after heading.

Sorghum GDU Calculations

Location	A 2008 Sorghum GDU Aug. 16 to Aug. 31	B 2008 Sorghum GDU Sept. 1 to 9	C Normal Sorghum GDU Sept. 10 to "50% Frost Date"
Colby	451	170	694
Garden City	463	172	832
Scandia	445	177	927
Hutchinson	505	229	1,149
Manhattan	456	193	1,029

Most sorghum hybrids need about 1,500 GDU from half bloom to physiological maturity. Adding columns A, B, and C for each location provides a projection of GDU accumulation between August 16 and the 50% frost date. Adding columns B and C provides a similar projection from September 1 until the 50% frost date. Sorghum in western Kansas will likely not reach maturity before frost if it had not bloomed by the middle of August. If sorghum had not bloomed by September 1 in north central and northeast Kansas, it may not reach maturity before frost. These projections are based on normal temperatures from here on out. If temperatures continue their cool trend, the likelihood of maturing is even less than projected.

See extension publication AF-162, *Probability of Sorghum Maturing Before Freeze,* for a detailed discussion and maps showing probabilities based on several different bloom dates.

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2. New developments in weather data collection in Kansas

The next generation of Kansas weather monitoring has begun. With 14 new and improved weather data collection towers installed by the end of the year, Kansas will benefit from more accurate and detailed weather information. The goal is to locate underrepresented sites for automated weather data collection in Kansas, particularly in the north central area and the Flint Hills of southeast and east central Kansas, and fill in the gaps with improved automated monitoring towers. New 30-foot towers have been installed in Jefferson, Clay, and Washington counties, and plans have been made for Wabaunsee, Cherokee, and other counties.

Led by the Kansas Water Office and funded through the Kansas legislature, the new and improved towers are part of the comprehensive automated weather monitoring project called "Kansas Mesonet," a system of 16 stations across the state that measures surface meteorology information every minute of every day. The data is used primarily to improve the safety of citizens in the state, and to increase the productivity of businesses and producers.

The towers record air temperature and relative humidity (5 feet above ground), wind direction and speed (both at 30 feet and 6 feet), solar radiation, total precipitation (15 inches above ground), and soil temperature and moisture at five different depths (up to 48 inches). Soil temperature and moisture measurements affect everything from crop planting decisions and possible crop freeze injury determinations, to possible damage to building foundations. At most current monitoring sites, soil temperature is only recorded at two- and four-inch depths.

The new towers also have a siphon-heated tipping bucket rain gauge with a wind shield, which allows accurate year-round precipitation readings. Tipping bucket gauges contain a device within a bucket that tips from side to side, with every "tip" representing 1/100th of an inch of rain. Siphon-heated buckets give more sensitive readings, and moisture inside the bucket never freezes to the point of inaccuracy.

The additional monitoring stations in Kansas Mesonet will potentially help conserve the state's natural resource supplies and keep citizens healthy and safe. For instance, better water runoff information would mean better flood forecasting. More detailed weather data would help individuals and businesses determine their energy demands. Wind models would help show how far particulates and smoke from burning will travel. Also, the USDA is looking into the drought/water table response in southwest Kansas, and the towers are expected to assist its research.

Getting funding for the Kansas Mesonet project is difficult, but the information is made publicly available at *www.oznet.ksu.edu/wdl* to help Kansans. Many states have mesonet systems. Oklahoma has one of the most extensive mesonets in the country. The word "mesonet" is a combination of the words "mesoscale" and "network." In meteorology, "mesoscale" refers to weather events that range in size from about one mile to about 150 miles across. Mesoscale events last from several minutes to several hours. Thunderstorms, wind gusts, heatbursts, and drylines are examples of mesoscale events.

The main difference between a mesonet and other weather data collection stations is that a mesonet collects data continuously and with enough stations that mesoscale events can be detected. Most other weather data collection networks either report data less frequently (such as daily instead of every five minutes), or function only in a few localized areas to monitor data for one specific site

Aside from the Kansas Mesonet, there are many other weather data collection stations in Kansas.

* K-State Research and Extension (KSRE) operates 14 agricultural weather stations at its research facilities: Colby, Hays, Hays South, Tribune, Garden City, St. John, Hutchinson,

Hesston, Manhattan, Scandia, Rossville, Silver Lake, Ottawa, and Parsons. These stations are part of the High Plains Regional Climate Center's Automated Weather Data Network (AWDN). KSRE's automated weather stations records hourly data for air temperature and humidity, soil temperature (two- and four-inch depths), wind speed and direction, solar radiation, and precipitation. Reports are made daily. The High Plains Regional Climate Center, based at the University of Nebraska-Lincoln, is part of the National Climatic Data Center, under the umbrella of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). The High Plains Center includes Kansas, Colorado, Nebraska, Wyoming, South Dakota, and North Dakota. The High Plains Regional Climate Center also operates the mesonet stations in each state.

* The Groundwater Management Districts in Kansas operate 21 automated stations in Kansas to collect data used to calculate evapotranspiration rates for irrigation water management. The districts measure water levels in sample wells along with the data that KSRE records. KSRE now operates eight of these ET stations in southwest Kansas, formerly managed by the Southwest Kansas Groundwater Management District.

* The most extensive system of weather data collection is the National Weather Service Cooperative Observer Program (NWS COOP program), with 300 stations in Kansas. The COOP program consists largely of volunteers who collect data from non-automated instruments in a manner that hasn't changed much over the years. Daily NWS COOP weather data includes evaporation, high temperature, low temperature, precipitation, and snowfall for first order (NWS forecast offices) and second order (cooperative observer network) sites.

* There are 25 automated weather stations maintained by either the National Weather Service or Federal Aviation Administration for collection of weather data related to aviation. These are Automated Surface Observing Systems (ASOS) and Automated Weather Observing System (AWOS) stations and are usually located near airports. In addition to collecting standard weather data, these stations also collect information on cloud height and coverage, visibility, altimeter setting, and lightning and thunderstorms.

* The Kansas Department of Transportation operates 53 automated weather stations in Kansas in a network called the Road Weather Information System (RWIS). These stations collect the standard weather data, along with data on pavement and bridge deck temperatures for ice estimations.

* The USDA-NRCS is developing the Soil Climate Analysis Network (SCAN), with three locations in Kansas – Cowley, Nemaha, and Phillips counties. SCAN is designed to gather historic and real-time climate and soil condition information.

* CoCoRaHS (Community Collaborative Rain, Hail and Snow Network) is a grassroots volunteer network of backyard weather observers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow) in their local communities. By using low-cost measurement tools, stressing training and education, and utilizing an interactive Web site, its aim is to provide data for natural resource, education, and research applications. There are currently about 744 observing sites in Kansas, and participation changes as new people join.

* There are a few localized monitoring systems that collect an extensive amount of data, but only for a specific location and often in support of a research project. For example, The Kansas Biological Survey has an automated weather station at its field location in Douglas County. Also, the national program called the Climate Reference Network has two benchmark monitoring sites in Kansas – one is at Konza Prairie, the other at the Cimarron Grasslands in Morton County.

* There are almost 1,000 locations in Kansas that record precipitation in its various forms. Of those locations, 20 are "centennial locations," which have 100 years or more of data. The centennial locations are operated by the NWS COOP program. People studying climate change find these sites useful, especially when they are concerned about major cropping districts.

* Another useful KSRE resource is the daily calculation of heat units. These are calculated using an equation that involves the high and low temperatures during the day. Heat units help determine when crop will mature, and which insects might be damaging to crops that season.

Automated Weather Data Collection Stations in Kansas		
Source/Owner	Frequency of data reporting	Type of data collected
Kansas Mesonet	Once per minute	Air temperature, relative humidity, wind direction and speed, solar radiation, total precipitation, and soil temperature and moisture
KSRE	Daily	Air temperature, humidity, soil temperature, wind direction and speed, solar radiation, and precipitation
GWMD	Daily	Air temperature, humidity, soil temperature, wind direction and speed, solar radiation, precipitation, water levels
NWS/FAA	Hourly	Air temperature, precipitation, relative humidity, wind direction and speed, barometric pressure, visibility

The Kansas Weather Data Library at K-State collects a wide range of weather data, mainly from the Kansas Mesonet and KSRE stations. We are working on incorporating NWS ASOS data from Hill City, Emporia, Salina, Russell, Medicine Lodge, and Olathe onto the site as well. We are also considering the addition of USDA-NRCS site data. Our Web site, *www.oznet.ksu.edu/wdl*, is an invaluable resource for a wide range of weather data. Producers, students, professors, aviators, and wind turbine companies are just a few examples of our customers.

In addition, the High Plains Regional Climate Center's Web site includes current data from both NWS COOP and its own AWDN stations (including KSRE stations) at: *http://www.hprcc.unl.edu/data/*.

Questions about the Kansas Mesonet can be directed to me through the Web site by clicking Ask WxWonders, or at the email address below. Any questions about weather data, such as yesterday's precipitation, low temperatures for the past week, or heat units (also called degree days) can be found on the Web site. Call or email me if you have trouble finding information.

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3. Cool weather raises the potential for sorghum ergot

The honeydew could begin dripping from grain sorghum and forage sorghum heads in Kansas this year. The cause: sorghum ergot. This disease first showed up in the U.S. in 1997, and has occasionally caused problems on very late-maturing grain sorghum and on male-sterile forage sorghum in the Central Plains since that time.

Why this year? It's the combination of cool nighttime temperatures and late-flowering sorghum. Cool nighttime temperatures inhibit pollination and create an avenue of infection for the organism.

Sorghum ergot is a disease caused by a fungus (*Claviceps africana*) that infects the ovaries of sorghum flowers and often converts them into a white, fungal mass. The most obvious external symptom of infection is the sticky honeydew which often drips onto the leaves and soil. Spores of the fungus are contained within the honeydew. Wind rapidly spreads these secondary spores over long distances. The fungus also can be spread by seed contaminated with the honeydew.

Sorghum ergot infects only unfertilized ovaries. Once fertilized, an ovary becomes resistant to infection. Any condition that prevents or delays fertilization increases the risk of ergot. Sorghum plants with inherent male sterility or with pollination difficulties caused by cool temperatures are most severely affected by ergot.

Grain sorghum is a self-fertilized crop, and flowers rarely remain unfertilized and susceptible to sorghum ergot infection for long. Unless, that is, cool temperatures predispose the flower to infection. There are two situations that can lead to sorghum ergot infections:

* Cool temperatures (average daily minimum below 55 degrees F) occurring 3 to 4 weeks before flowering. This can inhibit pollen development.

* Cool temperatures occurring at flowering and for the following 5 days. This can delay fertilization by slowing pollen tube growth.

This means that grain sorghum maturing during the cooler temperatures of autumn is at greater risk of ergot than sorghum maturing during summer months.

Once an infection has occurred, there's nothing producers can do to cure the disease. To minimize the development of ergot and limit its impact, producers should try to avoid late planting. The goal is to avoid low evening temperatures (below 55 degrees F) during the period 3 to 4 weeks prior to flowering and from flowering to 5 days thereafter. Fields that bloom in July and August seldom, if ever, have problems with ergot.

Sorghum ergot lowers grain/seed quality, makes threshing difficult, reduces germination and seedling emergence, and predisposes seedlings to other disease. It also reduces grain yield because infected flowers do not produce grain. The honeydew can coat the surfaces of harvest and handling equipment, making them unusable at best, or causing mechanical damage in the worst case scenarios. As an example, we have had reports of auger motors burning up trying to push through infected grain. Infected grain left in a truck or grain cart overnight can often end up looking like a Rice Krispie treat.

Evidence to date suggests that sorghum grain contaminated with sorghum ergot sclerotia has little, if any, implication for animal health. In the past, growers have been successful in harvesting a field almost immediately after a hard rain that washes away most of the sticky residue. Unfortunately, that residue will reappear again within a few days of the rainfall. Others have tried to swath and bale it. Some producers have turned cattle out to graze it off and still others have tried to harvest the grain while it is frozen. If the option is available, ethanol plants may take the grain.

Where sorghum ergot occurs, the panicles left in the field after harvest may still have honeydew and fungal spores on them. It's very unlikely this infected residue would cause a re-infection problem next fall.

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4. Factors that determine soil infiltration rate

"Infiltration" is the name of the game when talking about capturing moisture for crops or preventing runoff-induced erosion. Several factors determine how fast a soil can absorb rainfall.

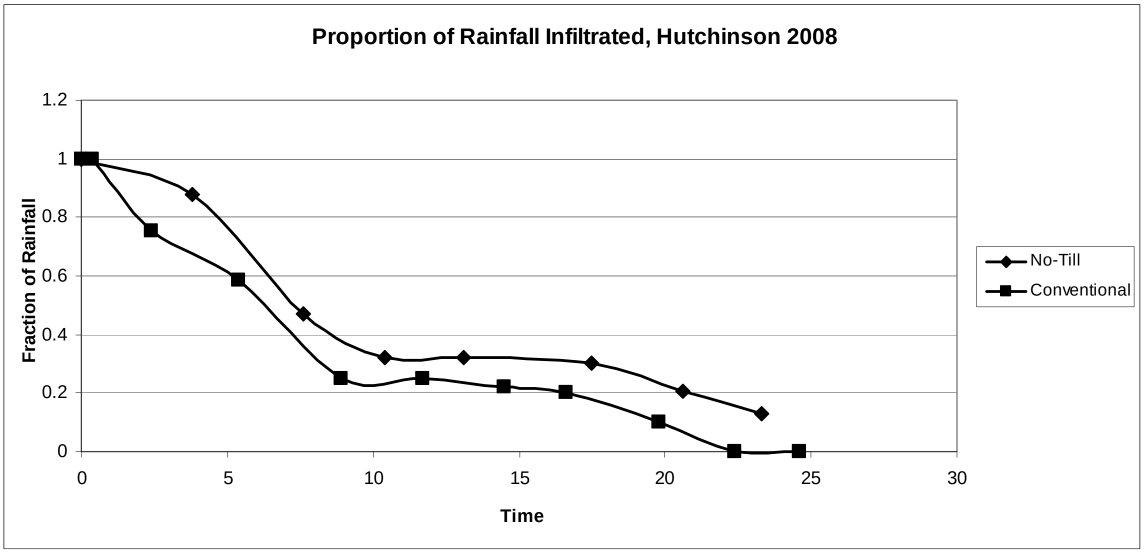
*** The length of time from the start of the rain event**
Infiltration is usually high at first, decreasing gradually, and eventually reaching a steady-state of slow infiltration as the soil profile fills with moisture. No-till soils usually have a higher infiltration rate at the start of the rain event. But at steady-state, their infiltration rate is often the same as tilled soils. Runoff begins when the precipitation rate exceeds the infiltration rate.

*** The water content of the soil when rainfall starts**
Soils have a lower infiltration rate when they are wet than they are dry.

*** The hydraulic conductivity of the soil**
Soil texture (the percent sand, silt, and clay) will affect infiltration, as will soil structure. Soils with well-defined structure, stable aggregates, more pores, and higher organic matter content are better able to conduct water through the soil. The structural characteristics are somewhat dependent upon tillage. Tillage breaks down the soil structure and decreases initial infiltration rates throughout the soil profile. Raindrop impacts also break down aggregates during a rain event. Soils that are not tilled gain some benefit from slightly higher levels of organic matter, but their real benefit is the much greater stability of aggregates.

*** The condition of the soil surface**
Large soil pores (macropores) such as old root channels or other cracks that extend from the surface well into the soil profile allow for moisture infiltration. Residue lying on the surface slows running water giving it more time to infiltrate, and protects the soil surface from the impact of falling raindrops. Partly buried residue that creates new flow paths into the soil can also aid infiltration. Each of these features are characteristic of no-till soils.

*** The depth and layering of the soil profile**
When there are different types of soil structure, texture, and original parent material within the soil profile, that can affect the rate of infiltration. Tillage and heavy loads can also change the profile by creating either a subsurface plowpan or a surface crust that will inhibit water movement. Surface crusts can be broken up with freezing and thawing, but plowpans are not. Plowpans may persist in soils for many years and are very difficult to address once present.



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These e-Updates are a regular weekly item from K-State Extension Agronomy and Steve Watson, Agronomy e-Update 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 Steve Watson, 785-532-7105 swatson@ksu.edu, or Jim Shroyer, Research and Extension Crop Production Specialist and State Extension Agronomy Leader 785-532-0397 jshroyer@ksu.edu