

Extension Agronomy

eUpdate

08/10/2018

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. Final irrigation of the season - Timing is everything

As the growing season wraps up producers have an opportunity to improve their water use efficiency by properly timing their final irrigation application. This is an important decision as an early termination of irrigation can result in reductions in grain yield, primarily through reductions in the kernel weight yield component. Conversely, a late termination of irrigation results in unnecessary pumping, energy consumption, and increasing the risk of soil compaction at harvest due to increased soil moisture and the risk of water loss through drainage.

With the goal of matching available water to crop needs while avoiding excess, it is important to understand crop water use requirements late in the growing season. Anticipated water use from various growth stages until physiological maturity for corn, grain sorghum, and soybeans is shown in Table 1.

Stage of Growth	Approximate number of days to maturity	Water use to maturity (inches)	
Corn			
Blister	45	10.5	
Dough	34 7.5		
Beginning dent	24 5		
Full dent	13	2.5	
Black layer	0	0	
Grain Sorghum			
Mid bloom	34	9	
Soft dough	23	5	
Hard dough	12	2	
Black layer	0	0	
Soybeans			
Full pod	37	9	
Beginning seed	29	6.5	
Full seed	17	3.5	
Full maturity	0	0	
Adapted from K-State	MF2174, Rogers and Sot	hers.	

Table 1. Anticipated water use for corn, grain sorghum, and soybeans at various growth stages.

Research in western Kansas has shown the importance of keeping the management allowable depletion limited to 45% during the post-tassel period. In other words, maintaining available soil water contents above 55%. By knowing anticipated water use from a given growth stage and the remaining soil water in the profile, producers can add just enough irrigation water to meet that

demand and maintain profile available soil water content above 55%.

By closely following the growth and development of the crop, one can know when physiological maturity, i.e. black layer in corn, has been reached and at that point water use for the production of grain yield has ceased and additional irrigation is certainly unnecessary.

Termination Based on Calendar Dates

Traditionally many producers have used a fixed calendar date to determine their final irrigation. Longterm studies conducted at the Northwest Research-Extension Center at Colby show the potential danger in this approach. Table 2 shows silking, maturity, and irrigation termination dates for a long term study in corn. Over the course of this study, the irrigation termination date for maximum grain yield varied from August 12 to September 21. This is a significant departure from a general rule of thumb using Labor Day as a termination date. As shown, the use of a fixed date on the calendar without regard to crop progress, soil water status, or ET demand would have resulted in both forfeited yield and wasteful pumping across this timeframe.

Date of		Date of	Irrigation Season Termination Date For		
Year	Anthesis	s Maturity	80% Max Yield	90% Max Yield	MaxYield
1993	20-Jul	30-Sep	5-Aug	5-Aug	15-Aug
1994	20-Jul	15-Sep	5-Aug	15-Aug	15-Aug
1995	20-Jul	29-Sep	5-Aug	13-Aug	18-Aug
1996	20-Jul	3-Oct	17-Jul	17-Jul	29-Aug
1997	23-Jul	1-Oct	23-Jul	23-Jul	27-Aug
1998	20-Jul	28-Sep	20-Jul	20-Jul	24-Aug
1999	23-Jul	6-Oct	24-Jul	13-Aug	20-Sep
2000	12-Jul	20-Sep	14-Sep	20-Sep	20-Sep
2001	16-Jul	29-Sep	30-Jul	22-Sep	22-Sep
2002	22-Jul	30-Sep	4-Aug	30-Aug	7-Sep
2003	22-Jul	23-Sep	3-Aug	3-Aug	18-Aug
2004	19-Jul	28-Sep	8-Aug	21-Aug	27-Aug
2005	20-Jul	28-Sep	2-Aug	9-Aug	29-Aug
2006	17-Jul	25-Sep	30-Jul	13-Aug	13-Aug
2007	18-Jul	19-Sep	14-Aug	21-Aug	28-Aug
2008	24-Jul	10-Oct	31-Jul	6-Aug	27-Aug
Average	19-Jul	27-Sep	2-Aug	13-Aug	28-Aug
Standard Dev.	3 days	6 days	13 days	19 days	13 days
Earliest	12-Jul	14-Sep	17-Jul	17-Jul	12-Aug
Latest	24-Jul	10-Oct	14-Sep	21-Sep	21-Sep

Table 2. Silking, maturity, and irrigation termination dates for a long-term study in corn.

* Estimated dates are based on the individual irrigation treatment dates from each of the different studies when the specified percentage of yield was exceeded.

Consequences of Excess Late-Season Irrigation

In the silt-loam soil profiles common in western Kansas, water drainage out of the soil profile starts to occur when the profile water content rises above 60% available soil water. The rate of drainage loss increases rapidly with increasing water content. Late-season irrigation in excess of crop water use results in increased accumulation of water in the profile, which is subject to drainage losses. A survey of irrigated corn fields was conducted in 2010 and 2011 (Figure 1). Fields were surveyed after corn harvest across three east-west transects in western Kansas.



Figure 1. Results from 2-year survey of irrigated corn fields. Fields were surveyed after harvest across three east-west transects in western KS.

The line at 9.6 inches of plant-available soil water (PASW) denotes the approximate water content where drainage losses would start to occur. On average, most producer fields were near this level of soil water storage indicating a good management strategy as drainage losses had been minimized while yet maintaining adequate soil water to complete grain fill.

Producer fields near the minimum observed values likely did not have adequate soil water to ensure

maximum grain yields. The most concerning scenario however, are the fields at the upper end of soil water values such as the maximum observation. The red line at 16 inches PASW represents field capacity, the point at which free drainage and significant water losses from the profile would occur. In the wettest producer fields, in all three regions, significant amounts of free drainage and water loss would have been occurring at the time of crop maturation and harvest.

Timing of the final irrigation:

- 1. Determine crop growth stage and anticipated remaining water use
- 2. Determine soil water status in the field by probe or calibrated soil sensor technology
- 3. Determine irrigation strategy necessary to meet remaining crop water use while maintaining soil water content at or above 55% (limit depletion to 45%).
- 4. Be ready to make adjustments based on changes in ET demand, precipitation, etc.

Additional information, including a step-by-step procedure, can be found in publication MF2174: "Predicting the final irrigation for corn, grain sorghum, and soybeans"; <u>http://www.bookstore.ksre.ksu.edu/pubs/MF2174.pdf</u>

Lucas Haag, Northwest Area Crops and Soils Specialist <u>Ihaag@ksu.edu</u>

Freddie Lamm, Irrigation Engineer, Northwest Research-Extension Center <u>flamm@ksu.edu</u>

2. Estimating corn yield potential

The corn in many areas of Kansas is currently in the reproductive period. From this point until harvest, farmers and consultants can begin to make reasonable estimates of corn yield potential. If no ear formed within a week or two after pollination, that specific corn plant will remain "barren" until the end of the season. In that unfortunate situation, you need to choose whether to harvest it for silage or leave it in place for grazing the residue.

The number of potential kernels per ear can be adversely affected either before silking time (Figures 1 and 2), if no potential ovule develops, or after silking. After silking, kernel numbers are reduced under any or all of the following conditions (Figure 3):

- If the fertilization was not effective (unpollinated ovules).
- If there is abortion of the fertilized ovules.
- If there is abortion of developing kernels (before or at milk stage, R3 stage) (Figure 4).



Figures 1 and 2. Determination of the potential kernel number in corn ears as seen under a microscope (left) and magnifying glass (right). The tip kernels are the first one to start the abortion process under stress. Photos by Ignacio Ciampitti, K-State Research and Extension.



Figure 3. Kernel abortion process and final grain number formation. Photo by Ignacio Ciampitti, K-State Research and Extension.

If ears are present a week or two after silking, producers can get a reasonable yield estimate by the time the corn plants are at the milk or dough stages. Before the milk stage, it is difficult to tell which kernels will develop and which ones will be aborted (Figure 4). The milk stage takes place about 15 to 25 days after flowering, depending on the environmental conditions. We can easily recognize this stage by opening the husk. In the milk stage, a milky white fluid will be evident when the kernels are punctured with a thumbnail (kernel moisture is ~80%) (Figure 5).



Figure 4. Grain abortion at the top of the ear (early abortion) and in the mid-section of the ear (late abortion, brown coloration in right corner picture). Photos by Ignacio Ciampitti, K-State Research and Extension.



Figure 5. Corn at the milk stage (R3 growth stage), a milky white fluid is evident when the kernels are punctured with a thumbnail (kernel moisture is approximately 80%). Photo by Ignacio Ciampitti, K-State Research and Extension.

Farmers can get some estimate of the failure or success of the pollination process by examining several corn ear silks. Pollination is successful when silks turn brown (R2 stage, kernel blister stage) and when they can be easily detached from the ear structure as husks are removed. If the silks remain green and are still attached to the ear after growing several inches in length, pollination has failed (Figure 6). In this situation, the ovules will not be fertilized, and kernels will not develop.

Before estimating corn yields, a few points are noteworthy. Yield estimates are more accurate as the corn is approaching maturity. Also, yield estimates can be accurate as long as the sample areas reflect the "real" variation of corn yield within the field. The precision of the method increases as the number of sample areas increases, properly reflecting the variability within the field.

Yield estimations before harvest can: (1) facilitate the decision of harvest timing, (2) estimate the need for additional inputs before maturity, and (3) serve as a scouting tool since the method of yield estimation involves examining diverse areas of the field.



Figure 6. Unpollinated silks have grown several inches in length. Photos by Ignacio Ciampitti, K-State Research and Extension.

Estimating yields using "yield component method"

The concept of estimating yields using the "yield component method" has advantages and disadvantages. The primary advantage is that it can be used early in the growing season (milk stage, R3). It involves the assumption that the kernel weight is constant. The method only estimates the "potential" yield because the kernel weight component is still unknown until the crop reaches final maturity (R6 stage).

Estimating potential corn yield with this method uses the following elements:

1) Total number of ears (ears per acre): This is determined by counting the number of ears in a known area (Figure 7). With 30-inch rows, 17.4 feet of row = one-thousandth of an acre. This is probably the minimum area that should be used. The number of ears in 17.4 feet of row x 1,000 = the number of ears per acre. Counting a longer length of row is fine, just be sure to convert it to the correct portion of an acre. Make ear counts in 10 to 15 representative parts of the field or management zone to get a good average estimate which fairly represents the field variation. The more ear counts you make, if they are representative of the rest of the field, the more confidence you have in your yield estimate.



Figure 7. Total number of corn ears per unit area. Photo by Ignacio Ciampitti, K-State Research and Extension.

2) Final kernel number per ear: Count the number of rows within each ear and the number of kernels in each row (Figure 8). The final number of kernels per ear is calculated by multiplying the number of rows by the number of kernels within each row. This is just a quick estimation of the potential yield.





Figure 8. Two different size of ears with similar number of rows (16 rows in total) but different kernel number per row and kernel sizes (left). The photo at right shows the determination of rows per ear from a vertical position (20 rows in total). The final number of rows per ear is defined earlier in the season than the number of kernels per row, and can be a function of the hybrid and growing conditions. Photos by Ignacio Ciampitti, K-State Research and Extension.

The number of kernels within each row is not standard and can vary from row to row, depending in part on the number of kernels aborted ("abnormal ears"). Do not count aborted kernels or the kernels on the tip of the ear; count only kernels that are in complete rings around the ear. Do this for every 5th or 6th plant in each of your ear count areas. The more you can count, the more precise will be the estimation. Avoid odd, non-representative ears.

Finally the number of kernels per acre is estimated by multiplying the first and second components.

Kernels per acre = Ears per acre x Kernels per ear

Kernels per bushel: This will be more precisely defined at maturity. For this case, common values range from 75,000 to 80,000 for excellent grain filling conditions; 85,000 to 90,000 for average; and 95,000 to 105,000 for poor conditions. The best you can do at this point is estimate a range of potential yields depending on expectations for the rest of the season.

Example:

For corn in 30-inch rows with an average total number of ears in 12 areas of the field (17.4-foot lengths of row) of:

Number of ears = [(25 + 24 + 22 + 21 + 24 + 26 + 20 + 21 + 22 + 20 + 25 + 26)]/12 = 23 (a)

An average of 23 ears were counted within the 17.4-foot lengths. This can be scaled up to an acre basis by multiplying the number of ears by 1,000 (constant factor if the counts were taken from a 17.4-foot length).

Ears per acre = 23 x 1000 = 23,000 (b)

From those 23 ears, we will take between 2 and 5 ears to calculate the rows per ear and the kernels per row. The average number of rows was 14 with 27 kernels per row.

Kernel number per ear = 14 rows per ear x 27 kernels per row = 378 (c)

The final number of kernels per acre is the outcome of the multiplication of (b) ears per acre and (c) kernel number per ear.

Kernels per acre = 23,000 ears per acre x 378 kernels per ear = 8,694,000 (d)

Kernels per bushel

Under hot, dry conditions, grain filling duration and biomass translocation from the whole plant to the ear (kernels) can be severely affected. Otherwise, a reasonable value to use is about **105,000** kernels per bushel (e).

The final number of kernels per bushel is affected by diverse factors such as genotype, management practices (for example, plant density), and the environment. Plant density can strongly affect the kernel weight and the number of kernels per bushel. Lower plant densities (if growing conditions are optimum) will result in lower values for kernel number per bushel. Also, expect a lower kernel number per bushel as N is more deficient. More information regarding the influence of these management practices on the kernel weight and the number of kernels per bushel is available from an article titled "Corn Grain Yield Estimation: The Kernel Weight Factor" from Dr. Tony Vyn, Purdue University, at: http://extension.entm.purdue.edu/pestcrop/2010/issue22/index.html#corn

Final yield: Calculation of bushels per acre

The final calculation of the potential yield to be obtained at the end of the season is simply the outcome of dividing the component (d) by (e).

Bushels per acre = 8,694,000 kernels per acre ÷ 105,000 kernels per bushel = about 83

In this example, if projected conditions prove to be accurate, the corn should obviously be kept and harvested for grain. From previous experiences, the yield component method of estimating yields often seems to provide optimistic outcomes (slightly overestimation). If the conditions during the reproductive period are predicted to worsen (severe heat stress and lack of precipitation), the kernel weight can be reduced and the number estimated for component (e), kernels per bushel, should be higher. That will reduce the yield expectations.

New technologies for estimating corn yields: App for smartphone or tablet

If you have smartphone or tablet devices, there is a "free" app that can provide assistance in estimating corn yield at on-farm scale. The app, developed by the University of Wisconsin, is named "Crop Calculators for Corn" and can be downloaded at: <u>https://play.google.com/store/apps/details?id=ipcm.calc.cropmanager</u>

The Crop Calculators app has a section for estimating yields: "Grain Yield Estimator." In that section, only four inputs are needed for predicting the final yield: (1) plants per 1000th acre (17.4-feet length of row); (2) rows per ear; (3) kernels per row; and (4) kernel weight, or mass. The last factor refers to the individual kernel weight for corn and it is expressed in mg per kernel. This factor normally varies from 150 to 400 mg per kernel. If conditions will be favorable until harvest, then the "kernel mass" should be higher (e.g., 300 mg per kernel). On the opposite end, unfavorable conditions with a short-grain filling period will produce a lower value (e.g., 180 mg per kernel). This factor will ultimately be defined at maturity, but a projection can be used based on forecasted weather conditions for the remainder of the season.

Links with further discussions on the yield estimation can be found at:

- "Predicting Corn Yields Prior to Harvest" <u>https://agcrops.osu.edu/newsletters/2010/25</u> The Ohio State University
- "Estimating Corn Yields" <u>http://www.ca.uky.edu/agc/pubs/agr/agr187/agr187.pdf</u> University of Kentucky
- "Estimating Corn Grain Yield Prior to Harvest" -<u>http://www.agry.purdue.edu/ext/corn/news/timeless/yldestmethod.html</u> Purdue University
- "Methods for Calculation Corn Yield" <u>http://corn.agronomy.wisc.edu/AA/pdfs/A033.pdf</u> University of Wisconsin

Further details on corn growth and development can be found at: <u>http://www.bookstore.ksre.ksu.edu/pubs/MF3305.pdf</u>

Ignacio Ciampitti, Cropping Systems and Crop Production Specialist

ciampitti@ksu.edu

3. Extreme temperatures: Impact on 2018 corn yields in eastern Kansas

How hot is it really this year? Working day after day in the heat can really get to you. High temperatures also impact crop growth and yield. Corn yields are directly affected by climate and weather (temperature and rainfall).

Growing degree days, or heat units, are a method of estimating the thermal time and can be related to the physiological growth of crops. Growing degree days (GDD) are calculated by subtracting a base or threshold temperature from the average daily temperature. For corn, that base temperature is 50 degrees F. The cumulative GDD50 also show year-to-year variability, but not as extensively as the cumulative rainfall.

Calculated from the corn crop insurance planting date of March 21, the 10-year average GDD50 received at Columbus, KS is 3436. For 110-day corn, it has been estimated to need 2650 GDD50 (Figure 1 top panel, dashed line) to reach black layer (Pioneer Hi-Bred International Sales Literature, 2001). The greater cumulative GDD50 is part of the reason for different rates of maturation of corn from one year to the next, with earlier harvesting in hotter years. Estimated black layer for 110 corn would vary from an early date of July 19 in 2012 to a late date of August 15 in 2014, with an average date around August 3. The cumulative GDD50 in 2018 were initially below average during the early spring growing period, but have since rapidly exceeded average. The cumulative GDD50 was reached on July 29, 2018 in Columbus, KS. Date of planting also impacts the rate of GDD50 accumulation, as later-planted corn will have fewer heat units accumulated than early-planted corn.





Figure 1. Growing degree days (top panel) and rainfall (bottom panel) at Columbus, Kansas.

Temperature determines the rate of physiological growth of corn, but moisture is also very important for determining the yield. Southeast Kansas receives the highest average yearly rainfall in the state, with totals ranging from 40 to 50 inches. About 20 inches of rain are received on average during the corn growing period from March through August (Figure 1, bottom panel), though the amount varies considerably from year to year. This year has been exceptionally dry, with current rainfall totals well below half of the growing-season average. This is comparable to rainfall received in 2014. In contrast to 2014, however, the 2018 spring/summer growing season has been warmer (Figure 1, top panel).

Not only the amount, but the timing of rainfall is important for optimal corn production. Corn is a determinate crop that flowers only once. The strong determinate nature of corn makes the flowering period (tasseling) very sensitive to environmental conditions during that one growth period, as the plants cannot flower again if flowering fails due to an adverse environmental period. Poor environmental conditions, especially low rainfall, can reduce the fertilization of ovules, resulting in unfertilized ovules (Figure 2). If adverse weather conditions continue, fertilized ovules may be aborted. High temperatures also limit grain filling (see "Effect of high night temperatures on corn yield" article from Issue 701).



Figure 2. Corn fertilization and grain filling are dependent on temperature and moisture. Low moisture during tasseling reduces the fertilization. Inadequate moisture and/or high temperatures impairs kernel development and grain filling. Photo by Gretchen Sassenrath, K-State Research and Extension.

The period of highest potential rainfall in southeast Kansas coincides roughly with the corn pollination window from mid-May to mid-June (Figure 3). Interestingly, although the total rainfall received in 2018 is well below average, the rainfall received during the critical corn pollination window from May 10 until June 20 was 4.23 inches in 2018, substantially more than was received during the drought year of 2012, which totaled only 1.01 inches. The second lowest rainfall year, 2014, received 5.6 inches of rain during this period. This timely rain, together with the mild temperatures, resulted in good corn yield in 2014.



Figure 3. Statistical rainfall probability for corn growing season in southeast Kansas. Graph from Xiaomao Lin, K-State Research and Extension.

Corn development and grain filling are especially sensitive to temperatures above 86 degrees F. As the number of days that the maximum temperature exceeds 90 degrees F increases, corn yield decreases (Figure 4). Comparing the number of days above 90 degrees F maximum temperature, 2018 is similar to the drought year of 2012 (Figure 5a). In contrast, the number of days that temperatures exceeded 95 degrees F in 2018 are nearly normal. So yes, it is a hot year, but not THAT hot!



Figure 4. Corn yield decreases as the number of days that temperatures exceeded 90 degrees F increases. Graph from Gretchen Sassenrath, K-State Research and Extension.



Figure 5. The number of days in 2018 that temperatures exceeded 90 degrees F (top graph) and 95 degrees (bottom graph). Data from K-State Mesonet.

This is how temperature and moisture both work to grow a crop.

Xiaomao Lin, State Climatologist xlin@ksu.edu

Gretchen Sassenrath, Crop Production Agronomist <u>gsassenrath@ksu.edu</u>

Ignacio Ciampitti, Crop Production and Cropping Systems Specialist ciampitti@ksu.edu

4. Controlling tall, thick stands of weeds in wheat stubble

Weeds in wheat stubble continue to be an increasing problem, especially in fields that had thin wheat stands and abundant rain this summer. Weeds in dry areas can be especially difficult to control.

Because of this, it may be unreasonable to expect complete control of many of these populations. A more realistic approach might consider management to reduce seed production and facilitate moisture conservation.



Figure 1. Kochia and pigweeds in August, in a field to be planted to wheat. Photo by Curtis Thompson, K-State Research and Extension.

Weeds grow rapidly this time of year, and some of the broadleaf weeds will have flowered and formed seed by now, which will make chemical control more difficult. Another potential problem for chemical control will be getting the spray down through the canopy to get complete coverage and reach any weeds or grasses underneath the taller weeds.

The standard treatment over the years to control weeds and volunteer wheat in wheat stubble has been glyphosate plus 2,4-D LVE. If kochia was present, we may have added some dicamba. Where susceptible crops are nearby, it is especially important to manage spray drift, both droplet drift and

vapor drift. Keep in mind, when adding ammonium sulfate (AMS) to a herbicide mixture containing dicamba, volatility of the dicamba increases greatly. This is true for all formulations of dicamba. If a crop sensitive to 2,4-D is adjacent to the weedy field, 2,4-D amine should be used instead of 2,4-D LVE to minimize the potential for damaging volatility drift. 2,4-D amine may not be safe around cotton fields.

Glyphosate plus 2,4-D and/or dicamba remain a primary option for weed control in stubble, but with the development of glyphosate-resistant weeds, these options certainly don't work as well or quickly as they used to. Glyphosate used to be foolproof, even on big weeds, but that is no longer the case. Dicamba and 2,4-D probably were not contributing as much to the weed control in those tank mixes as we may have thought, so now we are struggling with acceptable control. Timing and weed size is much more critical with almost all other herbicides than it has been with glyphosate. Consequently, it is very important to try to apply those treatments before the weeds exceed 4 to 6 inches tall, but that often does not happen.

Higher rates of the 2,4-D and dicamba may improve control, but in most cases we probably do not want to exceed 1 qt/acre of 2,4-D or a pint/acre of dicamba. Sharpen is another herbicide tank-mix partner that may help with control of the pigweeds and provide some residual control. Sharpen works best with the addition of methylated seed oil plus an ammonium source such as AMS or urea ammonium nitrate (UAN) and can provide some good burndown on smaller weeds. If the weeds are very big, Sharpen tends to burn the tops and plants eventually resume growth. Sharpen requires complete coverage so using 15 to 20 gallons/acre spray solution is important.

One herbicide alternative to glyphosate that has worked pretty well on pigweed and kochia the last couple of years is paraquat. Paraquat is a contact herbicide, so spray coverage is critical. Spray volumes of 20 gallons/acre or higher are preferred, especially on larger and thicker weeds. It is recommended to apply at least of 0.75 pounds ai/ac of paraquat, especially when trying to control think stands of pigweed or kochia. Recent research has revealed that pigweed control with paraquat is optimized when paraquat is applied through a nozzle and pressure combination that delivers a medium to coarse spray droplet classification (Figure 2). While control did not differ between the treatment produced fine and medium spray droplets, the potential for herbicide drift with the fine droplet size was much greater; therefore, a medium to coarse droplet size should be utilized.



D_{vso} (μm)ASABE
Classification200Fine300Medium450Very Coarse600Extremely
Coarse750Ultra Coarse900Ultra Coarse

Figure 2. Palmer amaranth control two weeks after treatment in a Sedgewick County stubble field in 2017. Control was influenced by different spray droplet classifications of paraquat applied at 20 GPA with 0.25% v/v NIS. Treatments with different letters indicate a significant different $\alpha = 0.05$. D_{v50} (µm) can be linked to spray droplet classifications in the right side of the figure that would be found in a nozzle selection book. Adapted from Hay et al. 2017.

Paraquat also needs to be applied with a nonionic surfactant at 0.25% v/v to enhance surface coverage of the plant foliage. Research has not been able to demonstrate the value of adding an ammonium source to enhance paraquat activity. A tank mix with a photosystem II-inhibiting herbicide such as atrazine, metribuzin, or linuron will enhance paraquat control and could provide some residual weed control. Because most of these herbicides are lipophilic, nonionic surfactant should be substituted with crop oil concentrate at 1 pt/ac when tank mixed with paraquat. Special consideration should be given to rotational restrictions of tank mix partners. If winter wheat is to be planted this fall, atrazine, metribuzin, and linuron should not be applied this summer. Atrazine is an option if planning to plant corn or sorghum next spring. Likewise, metribuzin can be tank-mixed with paraquat if rotating to soybean to enhance control and provide some residual. Paraquat generally provides poor control of grass weeds in stubble situations; therefore, if applying paraquat to control pigweed or kochia, it would be better to make a sequential application of glyphosate to control grass weeds. Research at K-State has shown that tank mixing glyphosate with paraquat produces an antagonistic response and should be avoided (see Table 1).

Herbicide	Control (%)
Paraquat	53
Glyphosate	99
Paraquat + glyphosate	58
Glyphosate fb paraquat	99
LSD a = 0.05	14

Table 1. Large crabgrass control three weeks after treatment.

Different paraquat combinations were applied to 4-inch tall large crabgrass in Kingman County in 2017 (Table 1). Treatments were visually evaluated 3 weeks after application. Paraquat alone provided poor control of the large crabgrass while glyphosate alone provided excellent control. These types of responses are what we would expect from paraquat and glyphosate. An antagonistic response (58% control) was observed when glyphosate was combined with paraquat. To contrast, when glyphosate and paraquat were split-applied with the glyphosate applied 24 hours in advance of the paraquat, excellent control was observed. While the exact mechanism is unknown, it is likely due to a chemical or physiological incompatibility between paraquat and glyphosate. Table 1 adapted from Hay and Peterson, 2018.

If planting wheat this fall, a tank mix with Sharpen is an option to provide some residual broadleaf control, especially if more than 1 oz/ac is applied. Using nozzles and application pressures resulting in uniform droplet sizes that provide sufficient coverage while minimizing the number of fine droplets can provide good control and reduce the potential for off-target movement. Keep in mind that flat fan nozzles and high pressure produce fine droplet sizes which are prone to move off target

and can cause very striking paraquat injury wherever the droplet lands. On the other hand, spray tips that produce very coarse or larger droplets, like those required for application of the new dicamba products, will not provide thorough enough coverage for good weed control.

Producers should not expect perfect control of weeds and grasses from any treatments if the stands are unusually tall and thick, or if many of the weeds have flowered or formed seed. Burndown treatments probably will not affect the viability of weeds seeds that are already mature at the time of application. Producers should also be prepared for a second flush of weeds, and possibly volunteer wheat, once the main canopy is killed, so follow up treatments may be required.

Using a sulfonylurea herbicide such as Finesse or Rave could improve control of certain broadleaf weeds and provide some residual control if planting wheat this fall, but will limit recropping options to sorghum or ALS-tolerant soybeans next spring. Many pigweed and kochia populations are ALS-resistant and may not be controlled by the ALS herbicides.

An additional option that has become more common again due to the increase in glyphosate resistance has been the use of tillage to control thick stands of pigweed or kochia. While the use of tillage can cause additional concerns (i.e., water conservation, soil erosion, loss of organic matter, etc.), tillage could be an integral part of an integrated weed management plan that would reduce the selection pressure for herbicide resistance with late-season herbicide applications.

Dallas Peterson, Weed Management Specialist <u>dpeterso@ksu.edu</u>

Marshall Hay, Weed Science Graduate Research Assistant mmhay@ksu.edu

References:

Hay MM and DE Peterson (2018). Interactions of tank-mix partners with paraquat for enhanced grass control. Weed Science Society of America Annual Meeting. *In Proceedings* 58:158.

Hay MM, DE Peterson, GR Kruger, T Butts (2017). Paraquat efficacy as influenced by spray droplet size for Palmer Amaranth Control. North Central Weed Science Society Annual Meeting. *In Proceedings* 72:149.

5. Planning your wheat fertility program: Start now by soil testing

Wheat planting is just a month or so away in parts of Kansas, so now is the time to get your soil sampling done to have good information on which to base your fertilizer inputs. This is particularly important since wheat prices continue at lower than most of us would like and efficiency in production will be critical.

Which nutrients should be tested?

The most important tests and nutrients to focus on this year depends in part on where you are located, the choices you make when applying N, and your tillage system. The nutrients for which wheat is most likely to show responses statewide are nitrogen (N) and phosphorus (P). Wheat is the most P-responsive crop we grow in Kansas, and while P removal with wheat may be less than with corn or soybeans, the relative yield response is often the highest. Therefore, knowledge of P soil test levels and fertilizer needs will be valuable. In addition, low soil pH is becoming a problem, especially fields with a history of high rates of N application and relatively low cation exchange capacity.



In addition to the "Big 3" (pH, N, and P), potassium (K) deficiency in wheat can also be found in some areas of southeast and south central Kansas. Wheat is generally less prone to K deficiency than many of the rotation crops commonly grown, such as corn, soybeans or grain sorghum. Generally, the focus of a K fertilization program is with the rotation crops, and meeting the higher K needs of corn and soybeans minimizes the chance of a K deficiency in wheat.

The 0-6 inch soil sample

A standard 0-6 inch surface sample is normally used to test for pH and the non-mobile nutrients such as P and K. Phosphorus and K are buffered processes in our Kansas soils. This simply means that the soil contains significant quantities of these nutrients, and the soil tests we commonly use provide an index value of the amounts available to the plant, not a true quantitative measure of the amounts present. In the case of P, most Kansas soils require about 18 pounds of P₂O₅ to increase 1 ppm in soil test P; for K is around 8 pounds K₂O to increase 1 ppm K soil test.

The buffering value for both P and K varies based on soil cation exchange capacity (CEC) and the soil test levels. On high CEC soils, especially those soils with high clay content, the buffering capacity goes up, so the soil test levels will change more slowly. However, on low CEC soils, the buffering capacity can be much lower, and soil test levels can change rapidly. The same situation occurs with soil test levels. On soils with low soil test P or K levels, it will require more P or K to raise the soil test than at high soil test levels.

In addition to requesting the standard soil tests of pH, P, and K from the 0-6 inch surface sample, producers might also want to monitor soil organic matter levels and micronutrients such as zinc (Zn). Zinc is not a nutrient commonly found deficient in wheat production. However, it is important for corn and grain sorghum. Thus including it in your sample package would be helpful for planning for these rotation crops.

Soil organic matter (SOM) is an important source of nutrients such as N and sulfur (S). When calculating the fertilizer needs for both these nutrients, SOM is taken into consideration. For wheat production, 10 pounds of available N and 2.5 pounds of S is credited for every 1% SOM in the soil.

The 0-24 inch soil sample

In addition to pH, SOM, P, K, and Zn -- all of which are non-mobile in soils and accumulate in the surface – the mobile nutrients N, S, and chloride can provide significant yield responses when deficient in soils. Since all three of these nutrients are mobile in soils and tend to accumulate in the subsoil, we strongly recommend the use of a 24-inch profile soil sample prior to growing wheat, corn, or grain sorghum.

Nitrogen is a nutrient likely to provide yield response statewide. One common misconception is that the accumulation of N in the soil profile only occurs in the drier, western half of the state. However, with our dry winters, N can accumulate in the soil statewide. Rainfall tends to peak in Kansas in June and July, with a rapid decrease in monthly precipitation in August and September. Rainfall totals are generally lowest in December and January. Wheat takes up the majority of its N prior to flowering. In southeast Kansas that is in April, and in north central Kansas it is in early May most years.

In many years, especially following dry summers, significant amounts of N can be present in soils at wheat planting. On the other hand, after good yields, the residual N levels may be lower than the commonly used "default" value, and N fertilizer rates would need to be adjusted accordingly.

Sulfur deficiency is increasing across the state in wheat production also. There are two primary causes: the reduction in sulfur deposition from the atmosphere seen over the past 2-3 decades, and the reduction in S content in many P fertilizers. While not as soluble as nitrate, S is also a relatively mobile nutrient which accumulates in the subsoil. The S profile soil test is a good way to determine S

needs.

Chloride (CI) is the third essential mobile element to be considered for wheat production with profile soil testing. Chloride deficiency is normally found in the eastern half of the state on soils that do not have a history of potash (KCI) application. In general, this includes many areas in eastern Kansas, north of the Kansas River, and the central corridor of wheat production. Chloride deficiency is associated with grass crops, wheat, corn, and grain sorghum, and is correlated with the plants ability to resist plant disease. Again, the profile soil test for chloride is well calibrated in Kansas and should be considered.

Summary

In summary, crop producers in Kansas should consider soil testing to help in making accurate fertilizer decisions. Accurate decisions are especially important during years with low grain prices and tight budgets. Furthermore, after variable yield levels across the state, fertilizer needs may require adjustments based on soil test. Wheat producers specifically, should use surface 0-6 inch samples to determine the need for lime on low pH soils, P, K, Zn, and soil organic matter. They also should be using 24-inch profile soil tests for N, S, and Cl. Now is the time to get those samples taken, to ensure there will be enough time to consider those test results when planning your fall fertilizer programs.

Dorivar Ruiz Diaz, Nutrient Management Specialist ruizdiaz@ksu.edu

6. Correlation of soil test nitrate level and wheat yields

Taking 24-inch soil profile-N samples in the fall has been a recommended practice for making an N recommendation for winter wheat for many years. However, due to the mobility of nitrate-N in the soil, soil test values observed in the fall may be completely different from values observed in the spring, particularly on soils prone to leaching. Because many producers wait until spring greenup to make their N application, does soil sampling in the fall for nitrate-N really provide useful information for N management in wheat? That is a legitimate question.

Analysis of yields taken from K-State research plots that received no N fertilizer shows a strong positive relationship with fall soil profile nitrate-N (Figure 1). Wheat yields increased rapidly as soil N levels increased to about 80 pounds soil N per acre, and then leveled off.



Fall Residual Soil Nitrate (lb/ac)

Figure 1. Relationship between fall soil profile nitrate-N level and wheat yield with no N fertilizer applied.

We found that at low soil nitrate levels, wheat yields responded well to applied fertilizer. We also found that when fall soil profile nitrate-N levels are greater than 80 to 100 lb/acre, it is unlikely the site will respond to additional fertilizer N applied in the spring.

In short, a strong relationship was found between wheat yield and fall nitrate-N levels from 24-inch profile soil test analyses when no N fertilizer was applied. Although new practices have been developed to improve N management in winter wheat, soil sampling in the fall for nitrate-N remains

an important practice to manage N efficiently and can result in considerable savings for producers.

When soil sampling for N is not done, the K-State fertilizer recommendation formula defaults to a standard value of 30 lb/acre available N. In this particular dataset, the average profile N level was 39 lb N/acre. However, the N level at individual sites ranged from 11 to 197 lbs N/acre. Most recommendation systems default to a standardized set of N recommendations based on yield goal and/or the cost of N. Without sampling for N or using some alternative method of measuring the soil's ability to supply N to a crop, such as crop sensing, the recommendations made for N will be inaccurate, resulting in a reduction in yield or profit per acre and increased environmental impact.

Failure to account for the N present in the soil wastes a valuable resource and can result in excess foliage, increased plant disease, inefficient use of soil water, and reduced yield. Soil sampling in fall for nitrate-N can have a significant impact on N recommendations for winter wheat, thus improving N management, and is strongly recommended.

Dorivar Ruiz Diaz, Nutrient Management Specialist ruizdiaz@ksu.edu

7. Update on insect activity in grain sorghum - August 10, 2018

Chinch bug activity

Chinch bug populations continue to increase dramatically throughout north central Kansas. Adults are still active, mating, and ovipositing (laying eggs) in both the developing heads and around the base of plants. There are also large numbers of nymphs, mainly feeding in and around the base of plants, but some are on the developing kernels. The significant populations of chinch bugs, along with continued hot and dry conditions, are causing some plants to lodge as the stalks dry down prematurely.





"Headworm" activity

'Headworms', both fall armyworms and corn earworms, are also very common in all the fields we sampled that were in the flowering stages. On August 6th, there were all different sizes of larvae detected in heads. Many fields throughout north central Kansas are just starting to reach the reproductive stages, so these 'headworms' will continue to be problematic in any field that is in the flowering to soft dough stage. Past research has indicted that 'headworms' may cause approximately 5% loss/worm/head. It is important to sample in a timely manner to detect these pests while they are still small, before most of the feeding damage has been done.



Corn leaf aphid activity

Corn leaf aphids (CLA) continue to cause considerable concern throughout north central Kansas as these populations are still very widespread and become more apparent as the heads start to extend out of the whorl. However, there are many beneficials present as well (see lady bug photo below). CLA should have little to no negative impact on plant development or yield other than potentially a few individual plants.





For more information relative to sorghum insect management, please see the 2018 Sorghum Insect Management Guide: <u>https://www.bookstore.ksre.ksu.edu/pubs/mf742.pdf</u>

Jeff Whitworth, Extension Entomologist jwhitwor@ksu.edu

Holly Davis, Extension Entomology Research Associate holly3@ksu.edu

8. Dryland Ag Day planned in Southwest Kansas, August 21

Against the backdrop of a diminishing Ogallala Aquifer, dryland farming is increasingly moving into sharper focus. A Kansas State University field day planned in Tribune will feature research related to growing dryland crops in western Kansas.

The **Dryland Ag Day** will be **August 21** at K-State's Southwest Research-Extension Center, one mile west of Tribune on Kansas Highway 96.

Registration and refreshments are available at 8:30 a.m. MDT, followed by field tours, indoor seminars, and a lunch sponsored by TBK Bank.

Field tours starting at 9 a.m. MDT include:

- Dryland corn planting date x maturity
- Tillage vs. no-till in dryland systems
- Dryland crop rotations
- Weed control in fallow and row crop

Indoor seminar topics beginning at 11:15 a.m. MDT include:

- Economics of dryland tillage systems
- Managing iron chlorosis in grain sorghum
- Production of annual forages

Presenters at the field day include:

- Lucas Haag, Northwest Area Agronomist, Colby
- John Holman, Cropping Systems Agronomist, Garden City
- Augustine Obour, Soil Scientist, Western KS Research Center, Hays
- Curtis Thompson, Weed Scientist
- Monte Vandeveer, Southwest Research-Extension Center, Garden City
- Alan Schlegel, Southwest Research-Extension Center, Tribune

More information is available by calling 620-376-4761.

9. Corn Production and Technology Field Day, August 16

K-State Research and Extension and the Central Kansas Extension District are hosting a field day on August 16 highlighting variable rate corn seeding, satellite imagery, high-speed planters, mobile devices, and myFields as well as other topics of interest to corn growers.

The field day will be held at Knopf Farms located at 6229 S. Kipp Rd, which is 1 mile west and 1 mile north of Gypsum, KS. The field day will start at 9:00 a.m. and conclude at noon with a meal sponsored by Kansas Corn. Participants should RSVP by August 13 for the meal by calling the CKD-Salina office at 785-309-5850 or e-mail <u>tmaxwell@ksu.edu</u>.

Speakers include K-State Research and Extension agronomists Ignacio Ciampitti and Stu Duncan; Brian McCornack, Extension entomologist; Ajay Sharda, Extension agriculture engineer; cooperators Justin Knopf and Garrett Kennedy, as well as representatives from Kansas Corn.

All producers, consultants, and agri-business representatives are encouraged to attend this educational event. For more information about the field day, contact Tom Maxwell, Crop Production Agent at the CKD-Salina office (contact info listed above).

10. North Central Experiment Fall Field Day, August 21 in Belleville

All crop producers are invited to attend the **2018 North Central Experiment Field Day** on **Tuesday**, **August 21**, **at 6:00 p.m**. The event will be held at the Belleville experiment field located approximately two miles west of Belleville on Hwy. 36 on the north side of the road.

This is a free event and no pre-registration is required. There will be a catered meal at the end of the program. Topics and speakers will include:

- Mesonet 101 and the new weather station Christopher "Chip" Redmond, KSU Mesonet Manager
- Re-visiting summer row crop seeding recommendations (corn, soybean, and sorghum) – Ignacio Ciampitti, Crop Production and Cropping Systems Specialist
- Dicamba/Round-up Ready Sentinel plot and season review Andrew Esser, Agronomistin-charge, North Central Kansas Experiment Field



August 21, 2018 KSU Experiment Field Belleville Location 2 miles west of Belleville on Hwy 36 6:00 P.M. Sharp

Tour Topics: -Mesonet 101 and the New Weather Station at the Field Christopher "Chip" Redmond, KSU Weather Data Library/Mesonet

Manager

-Re-visiting Summer Row Crop (corn, soybean, and sorghum) Seeding Rate Recommendations

Dr. Ignacio Ciampitti, Cropping Systems Professor K-State

-Dicamba/RR Sentinal Plot and Season Review Andrew Esser, Agronomist-in-Charge NCK-Exp. Fields

Free Event

No registration required Catered Dinner to Follow Program Questions Call: 785-335-2836 Andrew Esser, Agronomist-in-Charge

Meeting sponsored by:



Kanasa State University is committed to making its services, activities and programs accessible to all participants. If you have special requirements due to a physical, vision, or hearing dasheldy, contact John Frentee, Director, River Valley Extension District 49, 322 Genet Aresse, Clay Center, KE 67432. Phone 785-632-5335 Kansasa State University Agricultural Experiment Station and Cooperative Extension Service K-State Extends and Extension is an equil-opportantly provider and employer.

11. Winter Canola Preplant School, August 28 in Wichita

Winter canola yields in Kansas were down in 2018 yet better than expected in some areas. On August 28, producers can learn more about how canola performed in 2018 and what it takes to raise a successful crop.

A winter canola preplant school will be held in Wichita at the Sedgwick County Extension Education Center, 7001 W. 21st Street N., beginning at 10:00 a.m. The event is free but those interested in attending should RSVP by calling 316-660-0143 or <u>jfees@ksu.edu</u> by Friday, August 24 so that an accurate count can be made for lunch.

Ongoing research has shown ways in which producers can be more cost efficient in canola production. K-State has been working diligently to better understand seeding rate and row spacing questions. In addition, varieties continue to change rapidly and we are excited about some of the newest commercial varieties available to growers.

There have been some ups and downs in the industry recently, but through these experiences we have come to understand a great deal about why we still need canola in our rotations.

Topics for discussion at the preplant school include what to do -- and what not to do -- in canola production, seeding rates and row spacing, variety and hybrid performance, winter survival, and economics. Information on marketing the crop will also be available.

Mike Stamm, Canola Breeder mjstamm@ksu.edu Kansas State University's Southwest Research-Extension Center will host its Field Day 2018 on Thursday, Aug. 23 at 4500 E. Mary St. in Garden City. The day features field tours, indoor seminars, and seed, implement and farm supply company displays.

Registration and vendor exhibits open at 8 a.m. with the program highlighting K-State research updates at 9:15 a.m. A complimentary lunch will be provided.

Field tours include:

- Weed control in irrigated corn Randall Currie
- Weed control in irrigated grain sorghum Vipan Kumar and Randall Currie
- Update on mobile drip irrigation Jonathan Aguilar
- Diversified annual forage crop rotations John Holman
- Perspectives on forbs in Kansas grasslands: Who they are, what they do, and why they are important Bob Gillen and Anthony Zukoff

Seminars include:

- Insect research update Sarah Zukoff
- Pesticide safety update Sarah Zukoff
- Core hour for commercial pesticide license Shawn Rich, Kansas Dept. of Ag.

More information is available at <u>www.southwest.k-state.edu</u> or email <u>rscurrie@ksu.edu</u>.

K-STATE Southwest Research-Extension Center FIELD DAY 2018

Thursday, August 23, 2018 4500 E. Mary St. • Garden City, KS Registration 8:00 a.m., Program 9:15 a.m. Lunch Provided

Field Tours

Weed Control in Irrigated Corn Randall Currie Weed Control in Irrigated Grain Sorghum Vipan Kumar and Randall Currie Update on Mobile Drip Irrigation Jonathan Aguilar Diversified Annual Forage Crop Rotations John Holman Perspectives on Forbs in Kansas Grasslands: Who they are, what they do, and why they're important Bob Gillen and Anthony Zukoff

Seminars

Insect Research Update Sarah Zukoff Pesticide Safety Update Sarah Zukoff Core Hour for Commercial Pesticide License Shawn Rich with the Kansas Department of Agriculture

Displays

Local Seed, Implement, and Farm Supply Representatives

For More Information Contact rscurrie@ksu.edu

K-STATE Research and Extension

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All crop producers are invited to attend the **2018 Kansas River Valley Experiment Field Day** on **Tuesday, August 14 at 5:00 p.m**. The field day will be held at the Rossville field located 1 mile east of Rossville on Hwy. 24 on the south side of the road.

This is free event for all and will included a barbeque meal sponsored by Wilbur-Ellis. Presentations will be geared to having a more profitable and efficient crop production operation. Topics and speakers will include:

- Dr. Anita Dille Integrating cover crops into your weed management plans
- Dr. Nathan Nelson Utilizing cover crops for erosion control
- Dr. Stu Duncan Early weed control strategies in corn and soybeans
- Dr. Ignacio Ciampitti Evolution of production management practices for corn and soybeans

To pre-register for the catered meal, please call Michelle Wilson at the Shawnee County Extension office at 785-232-0062, Ext. 100, by **5:00 p.m. on Monday, August 13**. Additional field day sponsorship includes the Kansas Corn Commission. Certified Crop Advisor and Commercial Pesticide Applicator credits have been applied for.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service. K-State Research and Extension is an equal opportunity provider and employer. Kansas State University is committed to making its services, activities and programs accessible to all participants. If you have special requirements due to a physical, vision, or hearing disability, or a dietary restriction please contact Leroy Russell at 785-232-0062, ext. 108.



Kansas River Valley Experiment Field 2018 Fall Field Day

Tuesday, August 14 - 5:00 p.m. Sharp!

Rossville Field — 1 mile east of Rossville on U.S. Highway 24 on the south side of the road

Dr. Anita Dille – Integrating cover crop into your weed management plans

Dr. Nathan Nelson - Utilizing cover crops for erosion control.

Dr. Stewart Duncan--Early weed control strategies in corn & soybeans.

Dr. Ignacio Ciampitti – Evolution of production management practices for corn & soybean crops.

To pre-register for the catered BBQ meal sponsored by Wilbur-Ellis, call Michelle Wilson at the Shawnee County Extension Office at 785-232-0062 — Ext. 100 by 5:00 p.m. on Monday, August 13. Additional Field Day sponsorship in-part by the Kansas Corn Commission. Certified Crop Advisor and Commercial Pesticide Applicator Credits have been applied for.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service. K-State Research and Extension is an equal opportunity provider and employer. Kansas State University is committed to making its services, activities and programs accessible to all participants. If you have special requirements due to a physical, vision, or hearing disability, or a detary restriction please contact Leroy Russell at 785-232-0062, ext. 108.

The East Central Experiment Field in Ottawa will host its fall field day on **Wednesday, August 15**. The event will begin at 9:00 a.m. with registration, coffee, and doughnuts. The field day program will begin at 9:30 a.m. A complimentary lunch will be served at noon to conclude the event.

Field day topics and speakers include:

- Dr. Anita Dille Integrating cover crops into your weed management plans
- Dr. Nathan Nelson Utilizing cover crops for erosion control
- Dr. Stu Duncan Early weed control strategies in corn and soybeans
- Dr. Ignacio Ciampitti Evolution of production management practices for corn and soybeans

The field day is located at the East-Central Experiment field near Ottawa. From I-35 at the Ottawa exit, go south 1.7 miles on Hwy 59, then east 1 mile, and south 0.75 mile.

Certified Crop Advisor and Commercial Pesticide Applicator credits have been applied for. Please contact the East-Central Research Station at 785-242-5616 at least two days prior to the event if accommodations are needed for persons with disabilities or special requirements. The field day is sponsored in part by the Kansas Corn Commission.

