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Extension Agronomy

eUpdate

09/14/2018

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. Optimum sowing dates and seeding rates for wheat in Kansas

Ensuring optimum sowing date and seeding rate are two steps needed to ensure that the maximum wheat yield potential can be attained in a given growing season (Figure 1). Sowing date affects yield potential due to stand establishment, soil and air temperatures to which the crop is exposed, tiller formation, disease pressure, etc. Optimum seeding rate depends on sowing date and its adjustment is crucial to ensure the crop will maximize its yield potential.

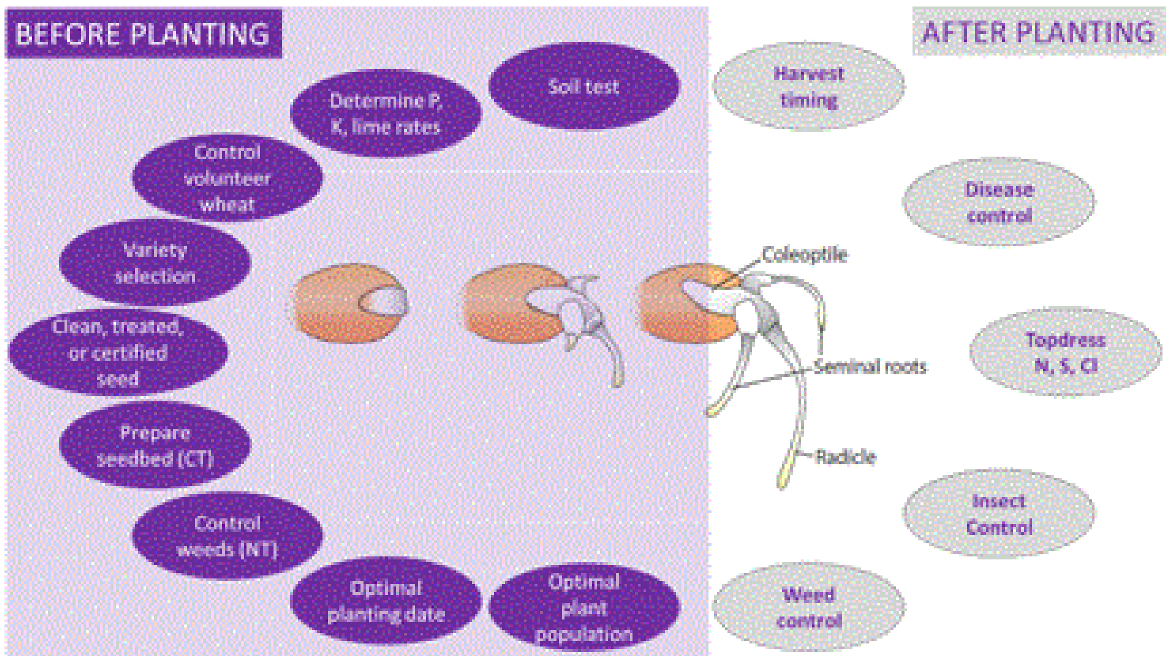

Figure 1. Best management practices before and after sowing to ensure maximum yield potential can be attained in a given growing season. Graphic by Romulo Lollato.

Sowing date

A) K-State recommendations

Optimum sowing date for winter wheat is quickly approaching for a large portion of Kansas (Figure 2). Depending on geographical location, optimum sowing window can start as early as September 10 and last until the end of September (northwest Kansas), or it can start as late as October 5 and last until October 20 (southeast Kansas). This gradient in sowing dates, with earlier dates in the northwest, is a function of temperature. Northern regions with higher elevation will have cooler air and soil temperatures earlier in the year as compared to southern regions.

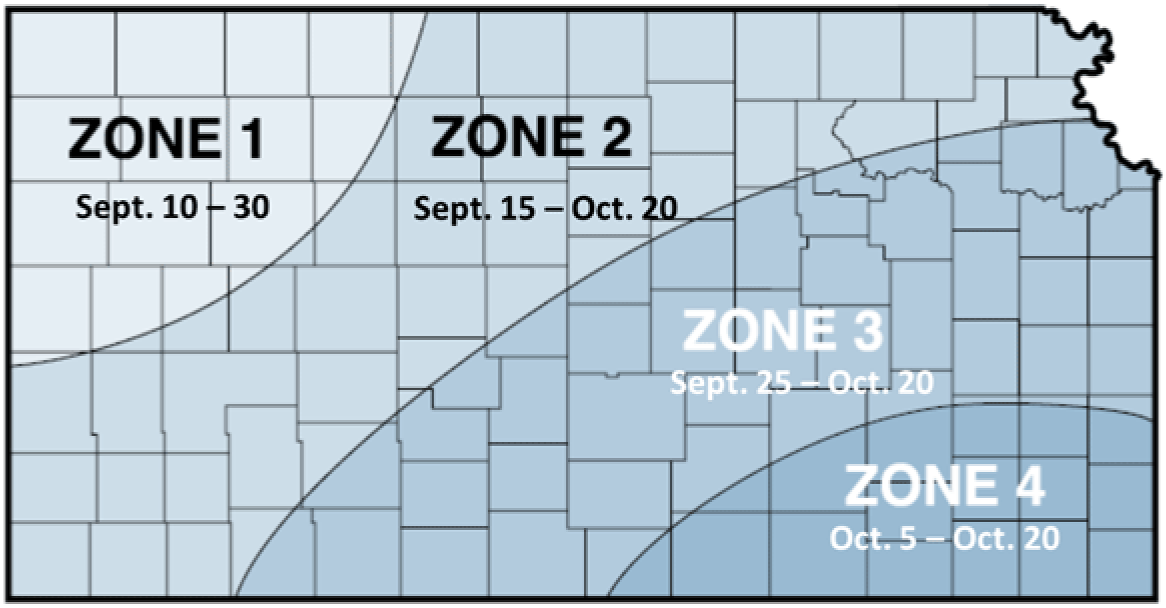

Figure 2. Optimum planting dates for winter wheat according to geographical location within Kansas. Figure adapted from KSRE publication L-818, Kansas Crop Planting Guide.

B) Actual Kansas wheat sowing dates

According to historical data released by the USDA-NASS crop progress reports, on average, producers in Kansas planted approximately 50% of the crop prior to October 4 and about 90% of the crop prior to October 25 during the 1994-2015 period (Figure 3).

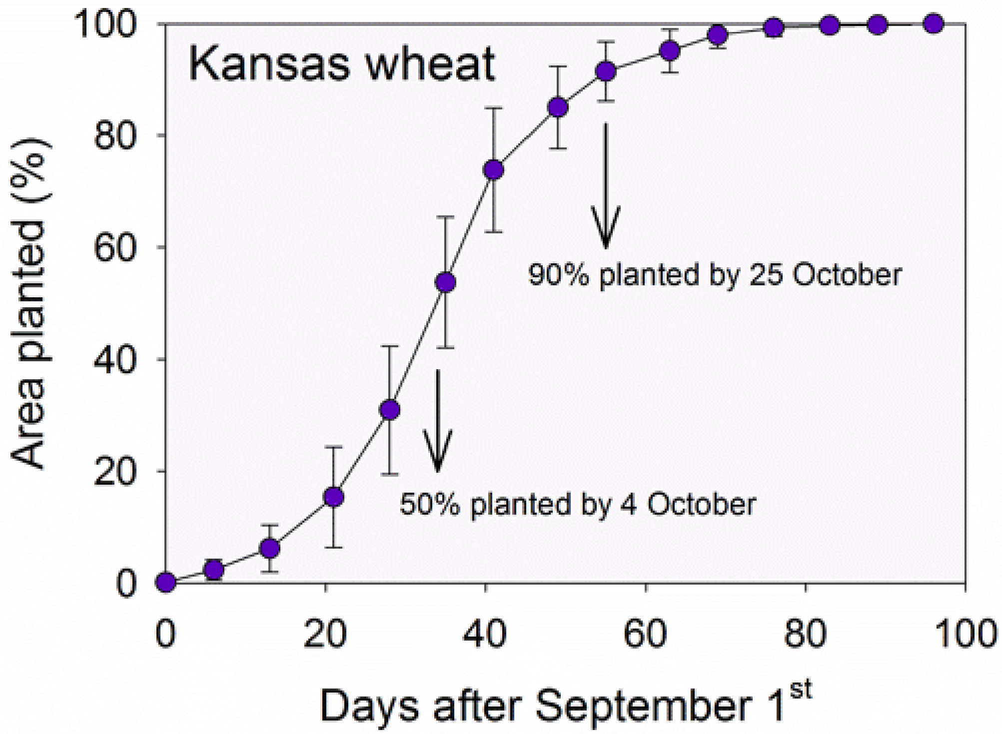

Figure 3. Average percent wheat area planted in Kansas after September 1st. Data represents average and standard deviation for percent planted area during the 1994 – 2015 period as reported by the USDA-NASS Crop Progress Reports (https://www.nass.usda.gov/Publications/National_Crop_Progress/).

Although 50% of the fields are, on average, planted by October 4, there is large year-to-year variability in percent planted area within the aforementioned date range (see error bars on Figure 3). This year-to-year variability is led by sowing conditions as extremely moist or dry soils may keep producers from sowing at the optimum planting date.

The largest variability of area planted in Kansas in the period 1994-2015 occurred between September 20 and October 15. During this period the difference in area planted between the earliest and the latest years on record was above 40% (Figure 4). In other words, while 50% of the wheat area was sown by September 21 in the earliest year on record, only 7% of the area was sown by the same date for the latest year on record. In the latest year, 50% wheat area sown was only achieved October 11. The variability in planted area was lower at earlier planting dates (before September 20), probably because most producers tend to wait until the optimum planting window with a smaller acreage planted early. Year-to-year variability in planted area also decreased towards the late planting window (after October 15), as most of the acreage had been planted by that time in most years.

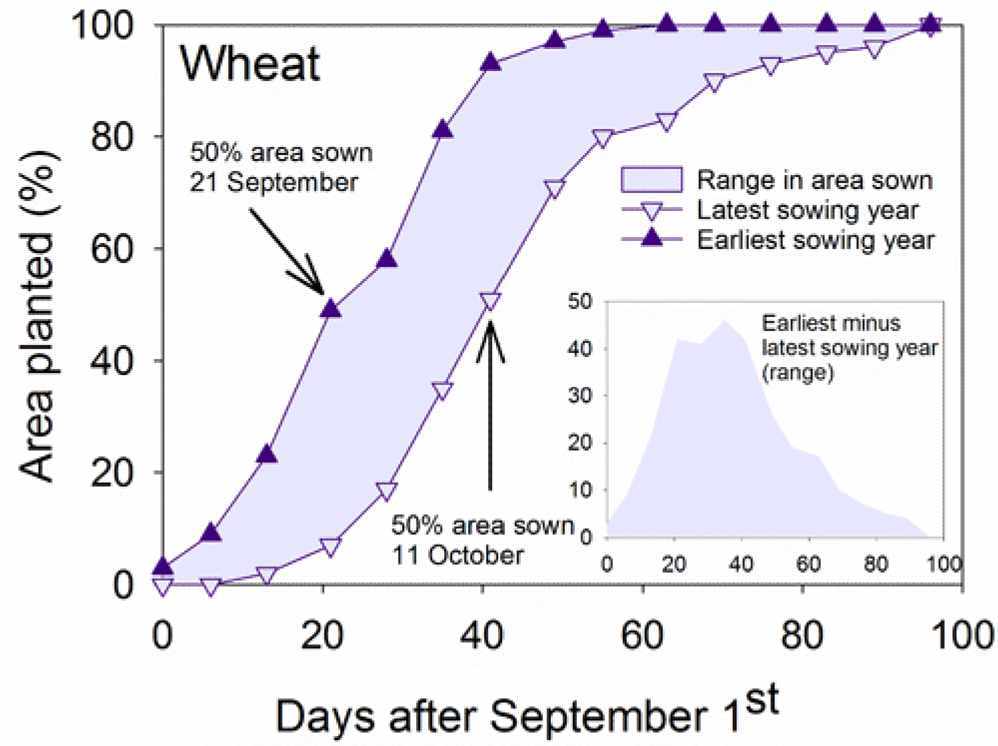

Figure 4. Percent wheat area planted in Kansas after September 1st for the earliest and latest years on record between 1994 and 2015 as reported by the USDA-NASS Crop Progress Reports (https://www.nass.usda.gov/Publications/National_Crop_Progress/**). Range in area sown is shown as light purple area in the main graph. Inset shows the difference in percent area planted between the earliest and the latest sowing years on record.**

C) Considerations of wheat growth affected by sowing date

1. Sowing wheat early: Sowing wheat at an earlier-than-optimal date can result in lush vegetative growth, which will require more water to maintain the canopy later in the growing season. For that reason, producers who graze their wheat are encouraged to plant wheat two or three weeks earlier than the optimal sowing date for grain. Early sowing can also lead to an increased incidence of fall pest infestation, such as Hessian fly, and diseases transmitted by certain vectors more active in warmer temperatures, such as wheat streak mosaic

(transmitted by wheat curl mites) and barley yellow dwarf (transmitted by aphids). The consequences of an earlier-than-optimal sowing date are discussed in [“Early planting of wheat can lead to several problems”]() from eUpdate issue 709 on September 7, 2018.

2. Sowing wheat at the optimal time: The optimal sowing time differs year-to-year due to environmental conditions, such as temperature and precipitation, but the optimal winter wheat sowing range for different regions in Kansas is shown in Figure 2. Sowing wheat at the optimal time stimulates the right amount of fall tiller formation as well as root development to optimize yields while avoiding a lush vegetative growth. Fall-formed tillers contribute more to yield potential than spring-formed tillers, therefore, it is crucial that about 3 to 5 tillers are well established before winter sets in. Additionally, this tiller formation combined with good crown root system development prior to winter dormancy increases winter hardiness of the crop, and consequently the chances of winter survival.

3. Sowing wheat late: Many reasons may lead producers to plant wheat late. Double-cropping wheat following a late-harvested summer crop, such as soybean or sorghum, is common in many regions of Kansas. Delayed planting date due to environmental conditions, such as low or high soil moisture levels, may also occur. When wheat is sown past the optimal window, it is generally sown into colder soils and the crop is exposed to cooler air temperatures during the fall. Sowing into colder soils will delay wheat emergence, so the importance of a seed fungicide treatment increases as planting date is delayed. Additionally, the crop will experience decreased fall tiller formation because wheat development is dependent on temperatures (Figure 5). An increase in seeding rates in these circumstances is warranted.

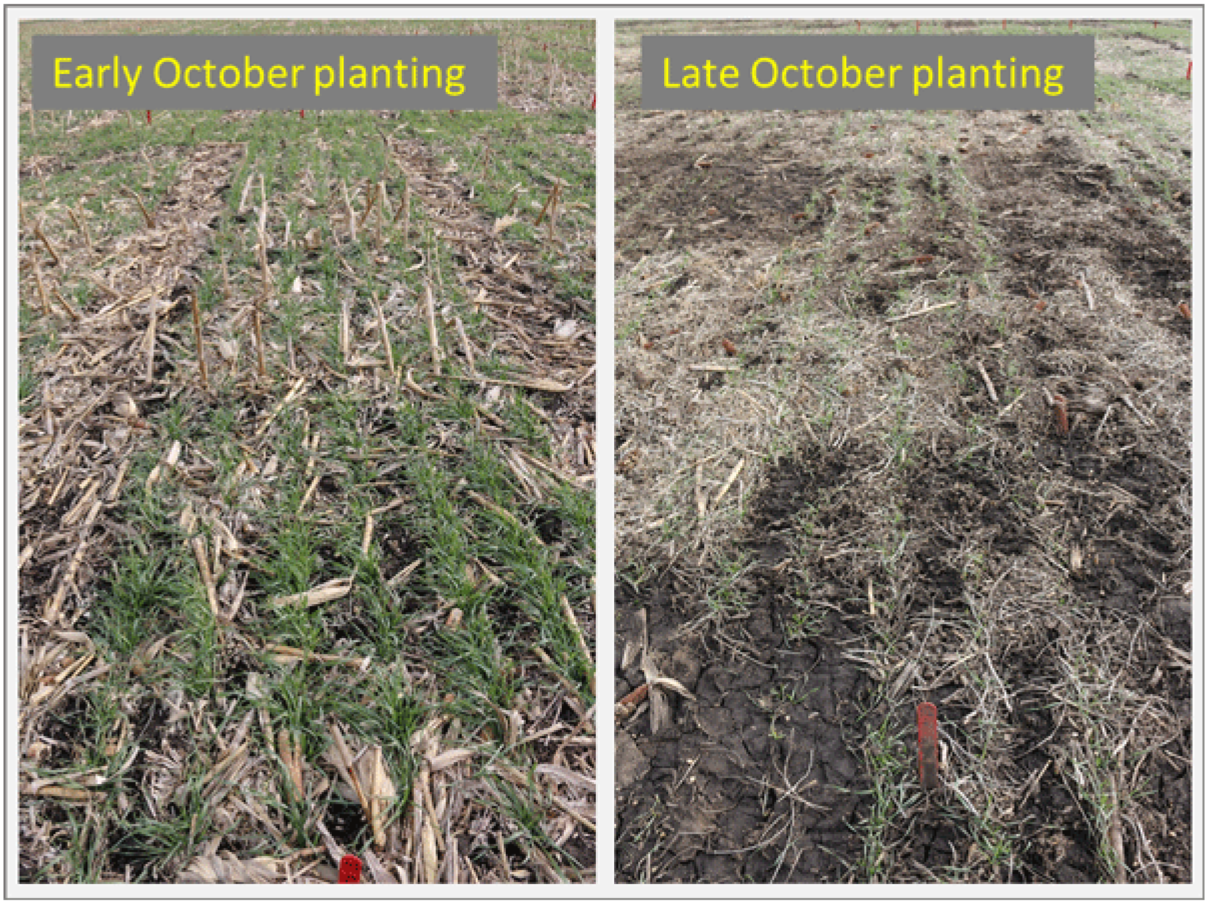

Figure 5. Difference in fall growth due to planting date following summer crops. Photos were taken December 8, 2016 from neighboring fields which were sown in early October in no-till following corn (left photo) or late October no-till following soybeans (right photo). Photos by Romulo Lollato.

Seeding rate

Optimum seeding rate varies with geographical location in Kansas, following the existing east-to-west precipitation gradient. If sown at the optimal date, optimum seeding rate should be about 1,125,000 – 1,350,000 seeds per acre in the eastern portion of the state, where annual precipitation is above 30 inches, or under irrigated conditions (Figure 6). Seeding rate should be decreased to 900,000 – 1,250,000 seeds/acre in the central region, where annual precipitation ranges between 20 and 30 inches. A further decrease in seeding rate should occur in the western third of the state where annual precipitation is less than 20 inches, for a final seeding rate between 750,000 and 900,000 seeds per acre in that region (Figure 6).

Seeding rate should always be discussed along with planting date, and in many times with soil fertility status as well. As mentioned above, later planting dates will decrease the potential number of fall tillers formed and grain yield will be more dependent on the main stem and maybe one or two tillers formed during the fall. Thus, seeding rate should be increased as planting date is delayed (for more information see [“Management adjustments when planting wheat late” in eUpdate Issue 536]). On the other hand, producers with a history of manure application and very high soil phosphorus and organic matter levels have been observing a yield increase from reduced plant populations when sowing towards the early side of the optimum sowing window. The reason behind this response is that high phosphorus levels and increased overall fertility resulting from long-term application of manure, coupled with a slightly early sowing, can increase the wheat tillering potential, decreasing the need for high plant populations.

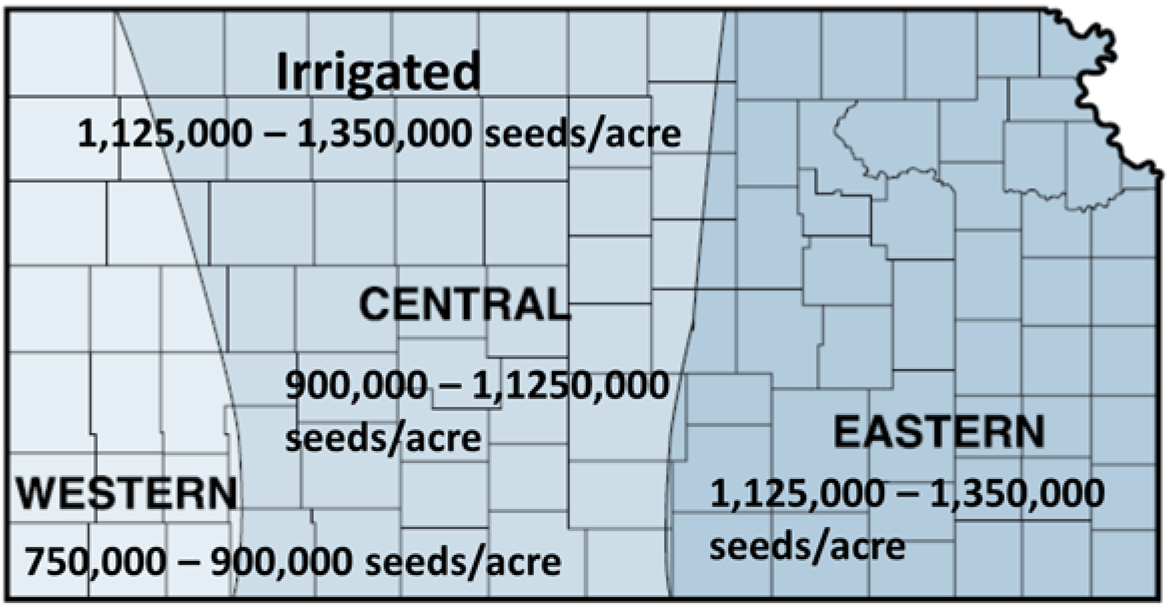

Figure 6. Optimum planting rates for winter wheat according to geographical location within Kansas. Figure adapted from KSRE publication L-818, Kansas Crop Planting Guide.

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2. Evaluate wheat seed size to improve wheat seeding density and final stand

Wheat seeding rate recommendations in Kansas are in pounds of seed per acre and vary according to precipitation zone. However, seed size can have an impact in the final number of seeds actually planted per acre. A variety with larger kernels, when planted in pounds per acre, will result in less seeds planted per acre and possibly thinner stands. If the weather and soil fertility during the growing season are not favorable for fall tiller formation and survival, the thinner stand might reduce grain yields. Examples of varieties with large kernels include WB4458 and Ruby Lee. On the other extreme, a variety with small kernels can result in above-optimal stand establishment, increasing plant-to-plant competition for available resources such as water, nutrients, and incident solar radiation. Additionally, planting in pounds of seeds per acre can reduce seed costs when wheat kernel size is relatively small.

Seed size can be measured in terms of the number of seeds per pound. The "normal" range is about 14-16,000 seeds per pound, but it can range from less than 10,000 seeds per pound to over 18,000 seeds per pound. Although seed size is specific to each individual wheat variety, it can vary within variety depending on seed lot and seed cleaning process. Figure 1 compares three different wheat varieties and the seed size as affected by seed cleaning. For this simple study, the varieties Everest, WB Grainfield, and SY Wolf were evaluated at different times during the seed cleaning process:

- 'Unclean' (harvested seed before cleaning)
- 'Air screened' (seed following air cleaning or the blower)
- 'Mid gravity' (seed from the low end of the gravity table)
- 'Top gravity' (the seed from the top end of the gravity table)

It is clear from Figure 1 that wheat variety plays a major role in determining wheat kernel size as does the quality of seed cleaning. Overall, the number of seeds per pound decreased (or individual seed size increased) as the quality of the seed cleaning process increased.

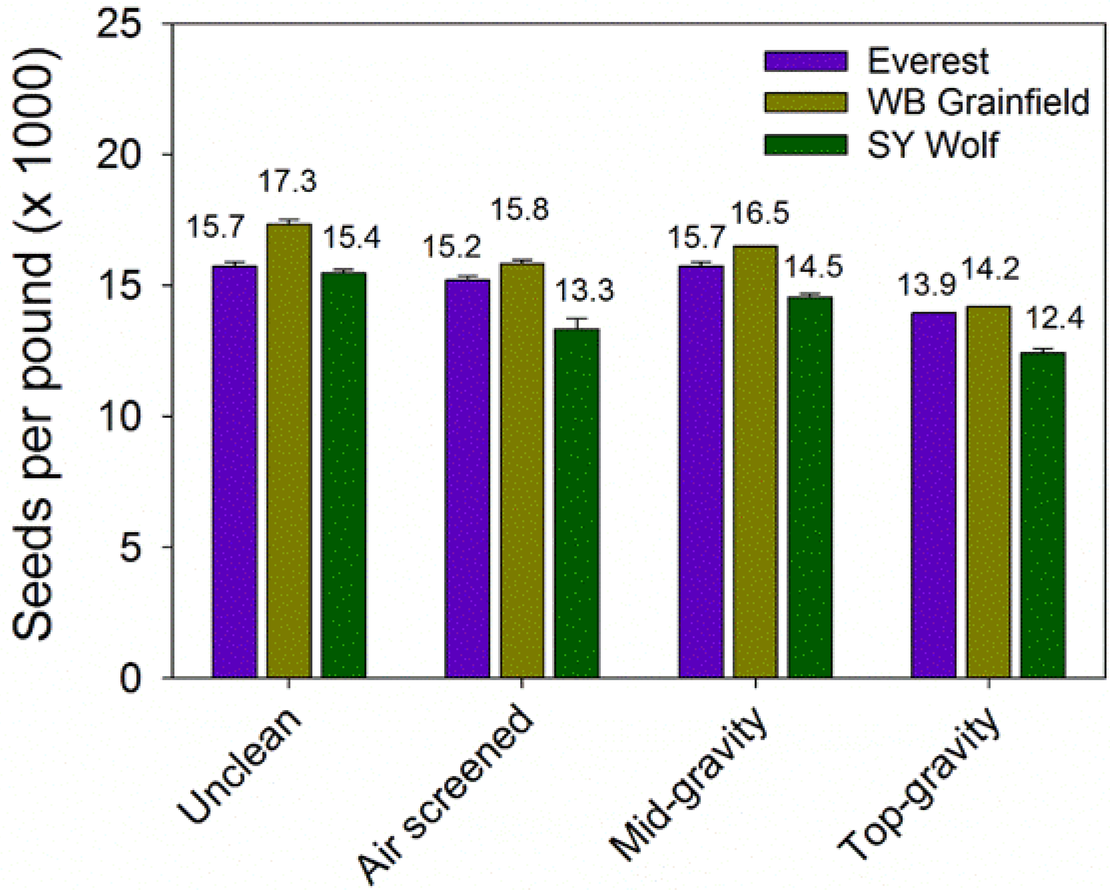

Figure 1. Effects of wheat variety and seed cleaning on final number of seeds per pound. Seed for this research provided by Ohlde seeds, research by Romulo Lollato.

Figure 2 highlights the two most contrasting treatments from the above study, the 'Unclean' WB-Grainfield (top figure, 17,335 seeds per pound) versus the 'Top-gravity' SY Wolf (bottom figure, 12,427 seeds per pound). To achieve the same number of seeds per acre, 'Top-gravity' SY Wolf would require a 39% increase in pounds per acre planted when compared to 'Unclean' WB-Grainfield. In other words, if both varieties are planted at a seeding rate of 75 pounds/acre, final number of seeds planted per acre will be 1.3 million seeds/acre for 'Unclean' WB-Grainfield and 930,000 seeds/acre for 'Top-gravity SY' Wolf. If the goal was to achieve 1.2 million planted seeds per acre, wheat would be over-seeded at about 8% for the smaller seed and under-seeded in about 22.5% for the larger seed. This assumes the same emergence rate for the cleaned and uncleaned seed, which would not necessarily be expected.

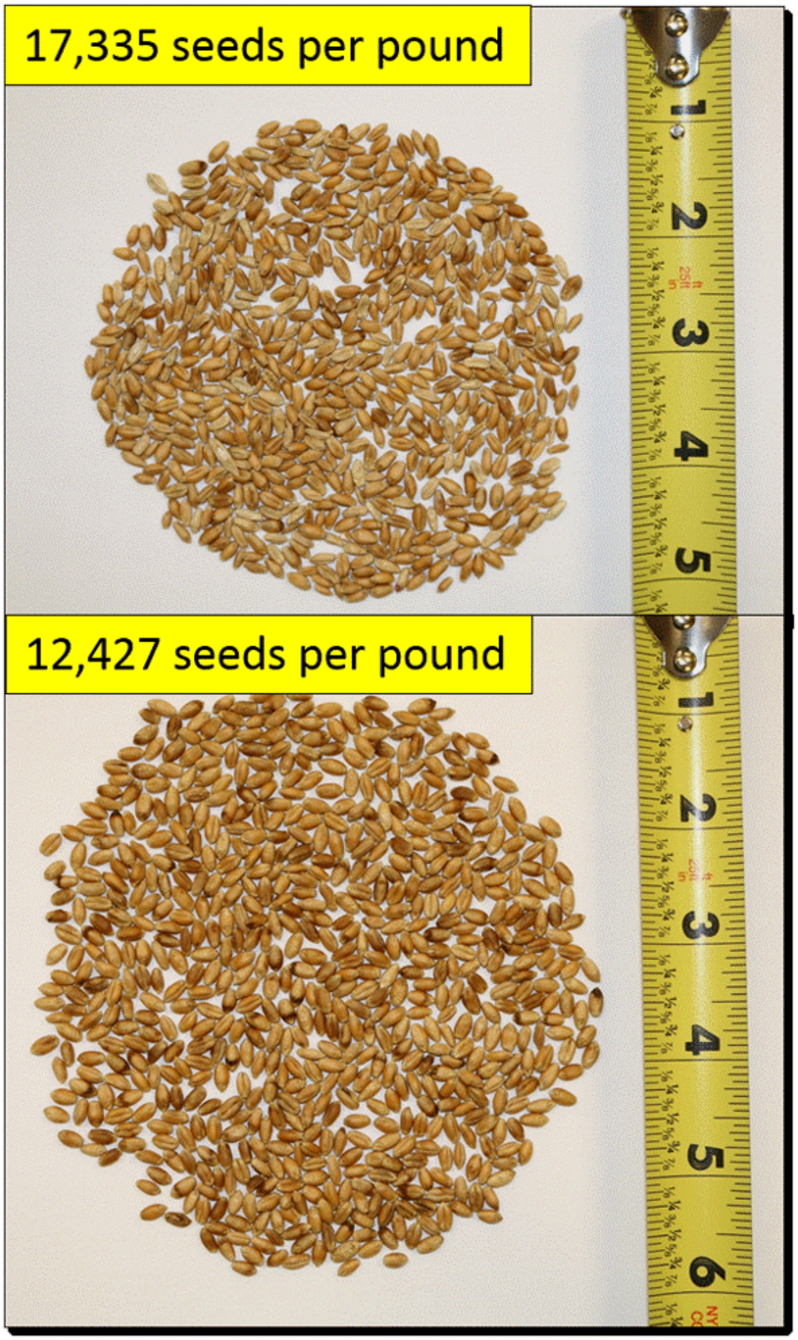

Figure 2. Differences in seed size between treatments 'Unclean' WB-Grainfield (17,335 seeds per pound; top photo) and 'Top-gravity' SY Wolf (12,427 seeds per pound; bottom photo). Photos by Romulo Lollato.

If planting occurs in seeds per acre instead of pounds per acre, we might see the opposite results where seed cleaning will actually increase stand establishment. The seeds above were no-tilled in heavy corn residue in an experiment during the 2015-16 growing season, with final seeding rate established in seeds per acre. The resulting stand counts are shown in Figure 3. These results indicate that the seed cleaning process increased stand establishment. These results were possibly due to better seed quality as the cleaning process removed small and shriveled grains that may have lower vigor than larger, healthier grains. Regardless of planting in seeds per acre or pounds per acre, these results highlight the importance of measuring wheat seed size before planting to avoid the final amount of seeds planted per acre being too far away from the original target.

Figure 3. Final wheat stand establishment as affected by seed cleaning process. Plots were sown in seeds per acre, and the improved seed quality resultant from the cleaning process increased final stand establishment. Research by Romulo Lollato.

Certified seed, or seed submitted for germination testing, will have seeds per pound information available. However, an easy on-farm method to estimate the average seed weight of a seed lot is to collect several representative 100-seed samples and weight each 100–seed sample in grams. To calculate seeds per pound, divide the conversion factor 45,360 by the average weight the 100-seed samples. Samples should be collected from the lot as is, including large and small kernels in the same proportion as found in the seed lot. The targeted number of seeds per acre is then divided by the number of seeds per pound to determine the number of pounds to be planted per acre. The following table is a quick reference guide to adjust the planting rate in pounds per acre based on seed size and the targeted number of seeds planted per acre:

Table 1: Reference guide to adjust planting rate in pounds per acre

	Target planting rate (seeds per acre)				
	600,000	750,000	900,000	1,200,000	1,500,000
Seeds/lb	**Pounds of seed per acre**				

10,000	60	75	90	120	150
12,000	50	63	75	100	125
14,000	43	54	64	86	107
16,000	38	47	56	75	94
18,000	33	42	50	67	83
20,000	30	38	45	60	75

How to use Table 1:

A dryland wheat producer in western Kansas whose target may be 750,000 seeds per acre has a seed lot with large kernels, averaging 12,000 seeds per pound. Seeding rate in pounds per acre for this seed lot for a final placement of 750,000 seeds per acre should be ~63 lb/ac. The same producer, planting a different lot with smaller seeds averaging of 16,000 seeds per pound, should plant ~47 lb/ac to achieve the same final seed placement of 720,000 seeds per acre.

A wheat producer in eastern Kansas whose target may be 1.2 million seeds per acre has two seed lots, the first averaging 14,000 seeds per pound and the second, with slightly smaller kernels, averaging 16,000 seeds per pound. This producer should use a seeding rate of 86 lb/ac in the first seed lot and 75 lb/ac in the second seed lot to achieve the same final seed placement. In this case, both seed lots were in the "normal" range of about 14,000-16,000 seeds per pound, and a simple ±10% adjustment on the seeding rate should compensate for differences in seed size.

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3. Seed drill calibration to improve wheat seed distribution

Decisions taken prior to wheat planting can account for a large proportion of the success or failure of the wheat crop. These decisions include:

- selecting a variety well adapted to the area and with a good yield stability record
- soil sampling to determine fertility needs
- pre-plant fertilization (N, P, K, lime)
- tillage for weed control and seedbed preparation (or using a contact herbicide in no-till situations)
- proper drill calibration

Proper drill calibration can increase the chances of success of the wheat crop by ensuring the amount of seed planted per acre is close to the target.

There are several methods to calibrate seed drills. In this article, we discuss the stationary method, which is a simple 4-step method to calibrate a wheat drill prior to planting. In stationary drill calibration, a drill operation is simulated by turning the drive wheel freely above ground, weighing the seeds delivered from the drill spouts, and comparing to a targeted seed weight by length of drill-row.

The four steps are:

1. Determine seeding density.

Targeted seeding density varies within the State of Kansas based on annual precipitation. A target range of seeds per acre based on current K-State recommendations is shown in Table 1.

Table 1. Target seeding density based on annual precipitation

Annual precipitation	**Target seeding density** (seeds per acre)
> 20 in	675,000 - 900,000
20 - 30 in	900,000 - 1,125,000
>30 in	1,125,000 - 1,350,000
Irrigated	1,350,000 - 1,800,000

2. Determine the number of seeds in 50 drill-row feet based on row spacing and targeted seeding density.

Determine the number of linear row feet per acre based on the drill's row width (Table 2). Next, estimate the number of seeds to be collected in 50 drill-row feet based on row width and the target seeds per acre. This can be done by dividing the number of target seeds per acre by the number of linear row feet per acre based on row width and multiplying the result by 50. Percent emergence can be accounted for by dividing the result by the fraction of emergence (for example, dividing by 0.85 for 85% emergence). Table 2 shows calculations for selected row widths and targeted number of seeds per acre considering 85% emergence.

After determining the number of seeds to be collected from 50 drill-row feet, weigh the equivalent amount of seed of each variety you intend to plant. For instance, if the target is 675,000 seeds per acre and row width is 12 inches, a total of 775 seeds need to be planted in a 50 drill-row feet. Assuming 85% emergence, this number increases to 912 seeds (Table 2). Count and weigh 912 seeds from each variety. If no scale is available, place the 912 seeds in a clear graduated cylinder (i.e. a rain gauge) and mark the level for each variety.

Table 2. Seeds per 50 drill-row feet as function of row width and target number of seeds per acre. Feet of linear row per acre as a function of row width is also shown.

	Feet of linear row per acre	**Target number of seeds per acre**					
		675,000	750,000	900,000	1,125,000	1,350,000	1,800,000
Row width (inches)		Seeds per 50 drill-row feet					
6	87,120	456	506	608	760	912	1,215
7	74,674	532	591	709	886	1,063	1,418
7.5	69,696	570	633	760	950	1,139	1,519
8	65,340	608	675	810	1,013	1,215	1,620
10	52,272	760	844	1,013	1,266	1,519	2,026
12	43,560	912	1,013	1,215	1,519	1,823	2,431

3. Determine the number of wheel revolutions needed for 50 drill-row ft.

First, attach the seed drill to a tractor and raise the drill off the ground. Measure the drive wheel's circumference using a tape measure, and divide 50 drill-row feet by the length of the circumference to determine how many times the drive wheel needs to be rotated to account for 50 drill-row feet. For example, if the drive wheel's circumference is 7 feet, dividing 50 by 7 indicates that the wheel needs to be rotated 7.15 times to account for 50 drill-row feet. Mark a starting point in the wheel with tape (i.e. duct tape) to facilitate counting how many times the wheel is being turned.

4. Calibrate the drill.

Adjust the seed meter using the rate chart provided by the manufacturer for the desired seeding rate, which should result in a first approximation of final calibration. Add enough seed of the variety to ensure seed cups will remain covered throughout the calibration process. Rotate the wheel the number of revolutions needed to cover 50 drill-row feet as calculated in step 3 and collect the seed from each spout in a bucket or similar container. The more spouts evaluated, the more accurate the calibration. Weigh the collected seed (or pour it in the marked graduated cylinder from step 2) and compare to the target seed per 50 drill-row feet as determined in step 2. If the collected seed weighs too low or too heavy compared to the target, adjust the metering system to deliver more or less seeds, respectively. Keep a record of the different seeding rates achieved at each setting for future reference. Repeat this process until the number of seeds delivered from the drill spouts matches the target established in step 2.

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4. Ongoing research conducted on seeding rates for dryland wheat in western Kansas

Since 2014, a study has been conducted at Garden City, Tribune, and Colby to evaluate wheat yield response to different varieties and seeding rates.

The objective of this study was to address the following questions:

1. Are K-State seeding recommendations appropriate for current varieties?
2. Is there a need for variety specific seeding rates (other than adjusting for seeds per lb)?
3. How region-specific do seeding rate recommendations need to be?

Popular varieties representing a range of tillering potential were selected and seeding rates were selected to represent the range of rates known to be in use by producers. Four wheat varieties (TAM111 in 2016 and 2017, TAM114 in 2017 and 2018, Byrd, T158, and Winterhawk) were seeded at five seeding rates (30, 45, 60, 75, and 90 lbs/ac) at Garden City, Tribune, and Colby into no-till or reduced-till fallow in a wheat-sorghum-fallow rotation. Data were collected from 960 individual plots across 14 site-years throughout the course of the study. The 2014 study was preliminary, subsequently we chose to evaluate a wider range of seeding rates. For the purposes of evaluating seeding rate response curves, only data from 2015-2018 is reported in this article.

The effect of variety and seeding rate on grain yield is shown in Table 1 for each site-year, along with the interaction of both variables. A value less than 0.05 (shown in bold) represents a significant effect on yield. A significant variety x seeding rate interaction means that the optimal seeding rate depended on the variety. As expected, variety selection is important as it significantly affected grain yield in all 14 site-years. Similarly, yields responded to changes in seeding rate in 13 of 14 site-years (over a wide range of seeding rates we would typically expect a yield response). However, optimal seeding rate depended on the variety used in just two site-years. These two site-years (Tribune 2015 and Garden City 2015) were during stripe-rust outbreaks and the plots were unable to be sprayed with fungicide. At these two site-years, higher seeding rates of the stripe rust-susceptible varieties were able to partially compensate for the effects of the rust, resulting in different yield responses to seeding rate. In summary, varieties responded similarly to seeding rate in 12 of the 14 site-years.

Table 1. Effect of wheat variety, seeding rate, and their interaction on grain yield at three locations in western Kansas. Data is presented for 14 site-years.

		P > F		
Location	**Year**	**Variety**	**Seeding Rate**	**Variety x Seeding Rate**
Tribune	2014	**<0.0001**	**0.0020**	0.1761
Tribune	2015	**<0.0001**	**<0.0001**	**0.0458**
Tribune	2016	**<0.0001**	**<0.0001**	0.3607
Tribune	2017	**0.0135**	**<0.0001**	0.9101
Tribune	2018	**<0.0001**	**0.0048**	0.9073
Garden City	2014	**0.0084**	**0.0095**	0.2444
Garden City	2015	**<0.0001**	**<0.0001**	**0.0006**

Garden City	2016	**<0.0001**	0.2051	0.9986
Garden City	2017	**<0.0001**	**<0.0001**	0.3760
Garden City	2018	**<0.0001**	**<0.0001**	0.1187
Colby	2015	**<0.0001**	**<0.0001**	0.7308
Colby	2016	**0.0286**	**<0.0001**	0.1901
Colby	2017	**<0.0001**	**<0.0001**	0.2852
Colby	2018	**<0.0001**	**<0.0001**	0.0754
No. of Significant Site-Years		**14/14**	**13/14**	**2/14**

Effect of Location

While location affected the overall yield level, with yields increasing in the order of Garden City < Tribune < Colby, location did not affect the overall yield response to seeding rate. As shown in Figure 1, the seeding rate response curve is similarly shaped for all locations when averaged across years and varieties.

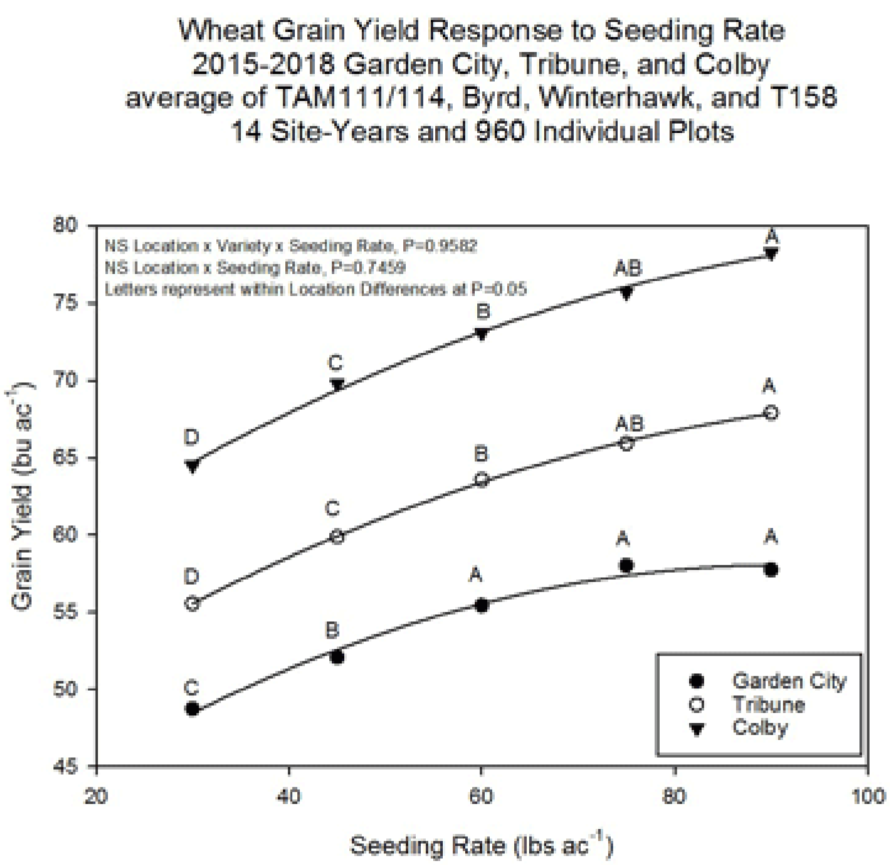

Figure 1. Seeding rate response by location.

In Figure 1, data points within a location that have the same letter are not statistically different. For example, at Garden City there was no difference between the 60, 75, or 90 lb/ac rates, while all three of those rates were higher yielding than the 45 lb/ac rate, which was higher yielding than the 30 lb/ac rate. At Tribune and Colby, there was no significant difference in grain yield between the 60 and 75 lb/ac rates, however the 90 lb/ac rate was significantly higher than the 60 lb/ac rate. With location and variety selection not playing a significant role in optimal seeding rate, all data were then combined to look at the overall response to seeding rate (Figure 2.)

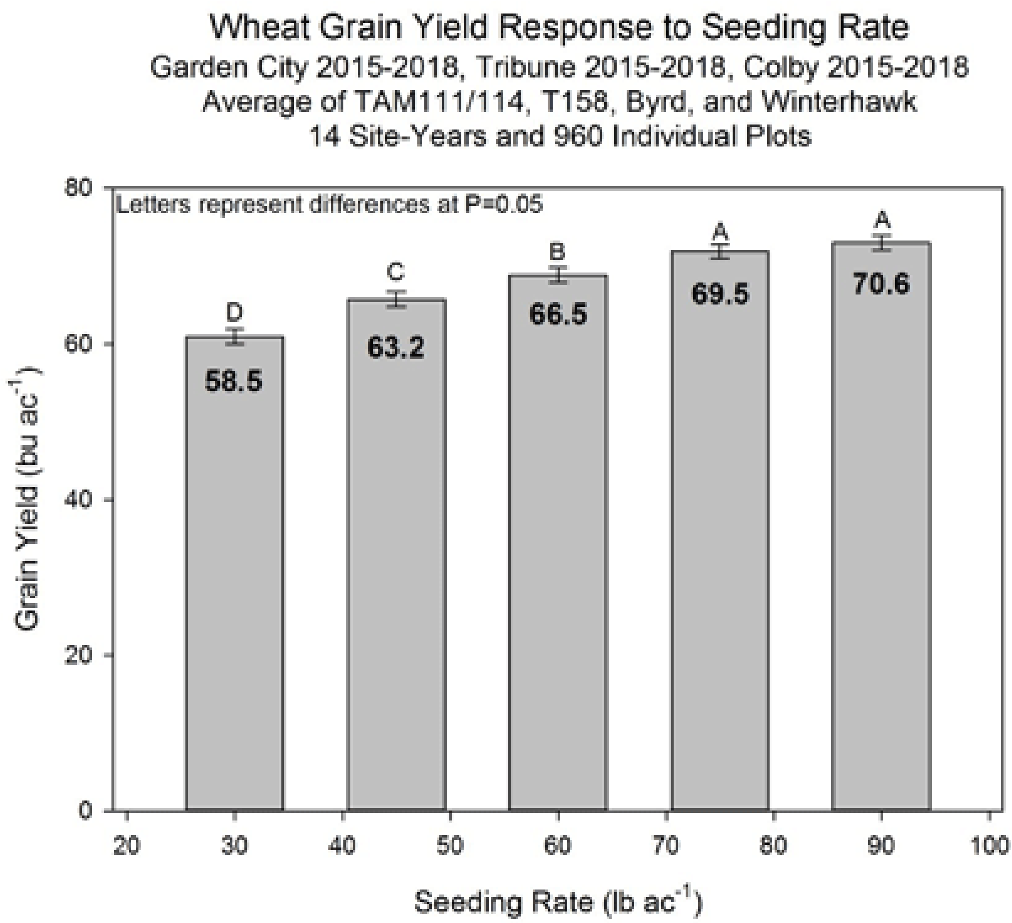

Figure 2 - Effect of seeding rate on grain yield, averaged across varieties and site-years.

When the response to seeding rate was evaluated (Figure 2), grain yield significantly increased with increasing seeding rate up through the 75 lb/ac seeding rate. Yield between the 90 and 75 lb/ac rate were not significantly different. When translated into a seeds/ac basis, these seeding rates would have been 452,000, 678,000, 903,000, 1.13 million, and 1.36 million on average.

Important points to keep in mind

1. This study was conducted on a lb/acre basis. However, the range in seed size was modest (an average seed size of 15,056 +/- 19%) when compared to the differences between seeding

rates. Conducting the study on a seeds/ac basis would not have significantly changed the shape of the overall seeding rate response curve.

2. The fields used in this study are managed to be non-fertility limiting, however they are not excessive in their fertility and have no history of manure or compost application. Fields with excessive soil test phosphorus levels will likely result in additional fall tillering and thus satisfactory performance might be obtained from seeding rates lower than what these results suggest are optimal. Differences in soil fertility levels, the use of replicated trials, and perhaps planting date are likely factors in lower optimal seeding rates reported by others.
3. Due to the dry seeding conditions experienced during the course of this study, seed was often dusted in, or planting was delayed until a rain. Therefore, emergence was often later than what would be obtained from planting on the optimal planting date into good moisture. Previous work by K-State in Colby has shown the importance of increasing seeding rates as planting is delayed due to reduced opportunity for tillering. This may be why the distinction between the 60 and 75 lb/ac or the 90 lb/ac rate is not clear cut.

Key Results

1. The data collected is not supportive of variety-specific seeding rates (other than adjusting for seeds/lb which remains a K-State recommendation).
2. The seeding rate response curve was similar across varieties and locations for three sites in western Kansas.
3. Across all site-years, 75 lb/ac (an average of 1.13 million seeds/ac) was sufficient to maximize grain yields. When broken down by location, 60 lb/ac (an average of 903,000 seeds/acre) was sufficient to maximize grain yields at Garden City, while at Tribune and Colby the optimal rate appears to lie near 75 lb/ac.

Producers are often worried about having stands that are too thick, thus an excessive use of soil water in the fall. This is a very valid concern. However, one must also be aware of the two-edged sword. If good growing conditions occur in the spring, there are physical limits to how many kernels per head can be set and maximum kernel weight. If there is a shortage of heads/acre due to an insufficient stand and/or lack of fall tillering, yield will be left on the table in a good year.

Note: Expenses for this study at Colby were funded by the Cover Your Acres Winter Conference.

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5. Pre-harvest glyphosate treatment on sorghum in a no-till system

Producers who would like to facilitate a timely sorghum harvest may be thinking of applying glyphosate as a desiccant. Will this affect standability or yield of the sorghum crop?

The answer to the question about standability is "yes," applying glyphosate as a desiccant to sorghum can affect the stalk quality and standability of sorghum in some cases. Unlike corn, grain sorghum is a perennial plant and remains alive until it is killed by a hard freeze. Killing the plants before a freeze can affect the integrity of the stalks. For that reason, inspect sorghum field for existing stalk issues prior to applying the glyphosate. If stalk rots are present, applying glyphosate may increase the chance of plant lodging if not harvested in a timely manner.

Conditions this year, especially in south central Kansas, have been favorable for the development of Fusarium stalk rot. Although we have not received any samples to date, checking for stalk rot prior to desiccant usage might be particularly important this year. We have also had reports of grain mold development on the heads in the Reno County area due to recent wet weather. If conditions stay humid and wet, grain molds will continue to develop in the field and therefore, early harvest could reduce grain losses or dockage at the elevator for poor quality grain.

The answer to the second question about the effect of a desiccant on sorghum yields is not as straightforward. It depends of the timing of the desiccant application.

Most glyphosate labels require that applications be made to the sorghum crop when grain moisture is at 30% or less to minimize any possible yield reductions. In addition, there is a seven-day period between time of application and harvest.

Sorghum response to pre-harvest glyphosate treatments

If glyphosate is applied at the correct time, K-State research in 2011 and 2012 by former Agronomy graduate student Josh Jennings found that using a desiccant did not affect sorghum yields.

From 2011 to 2013, he established six field trials to test the effect of pre-harvest glyphosate treatments on sorghum. In 2011 to 2012, field trials were conducted at Belleville, Manhattan, and Ottawa. In 2012 to 2013, field trials were located in Belleville, Manhattan, and Hutchinson (yield not collected in 2012).

Table 1 summarizes the effect of the pre-harvest treatments on grain sorghum. The response was similar in all harvested experiments, so the data below is averaged across the five field trials over the two-year period.

Table 1. Effect of pre-harvest glyphosate applications on grain sorghum (averaged across five sites in 2011 and 2012).

	Glyphosate	No glyphosate
Yield (bu/acre)	98	99
Grain moisture (%)	12.1	12.3
Test weight (lbs/bu)	60.4	60.2
Seed size (300 seeds, grams)*	5.81	5.90
* 2011 only		

Glyphosate was applied to the sorghum crop when grain moisture was approximately 18-22%. Grain harvest occurred 8-11 days following the application. Average yield reduction to the sorghum crop when sprayed with glyphosate was about 1 bushel or roughly 1% less than untreated.

Another factor is whether the presence of aphids, headworms, or other insect pests in the head should make any difference in the decision to use desiccants. There is no research on this, but by the time a desiccant is applied, the grain fill period is complete and these insects can really do no more damage than they have already done. As a result, the presence of insects at this late stage of development should not play any role in the decision of whether to use a desiccant.

Wheat response to pre-harvest glyphosate treatments to sorghum

In addition to getting the sorghum crop ready for harvest earlier than normal, desiccants can be helpful in cropping systems where wheat is planted directly after sorghum harvest. Killing the sorghum plants early can help save soil moisture for the wheat crop.

The research mentioned above also tested the effect of using a sorghum desiccant on the yield of wheat planted directly after sorghum harvest. Wheat yield responses varied across field trials over both years, so the data in Table 2 includes wheat yields within each field trial over both years of the experiment.

Table 2. Mean winter wheat yields following treated and untreated sorghum.

	Location and year					
Sorghum pre-harvest treatment	Belleville (2011-2012)	Manhattan (2011-2012)	Ottawa (2011-2012)	Belleville (2012-2013)	Manhattan (2012-2013)	Hutchinson (2012-2013)
	Yield (bu/acre)					
Glyphosate	40	45	54	39	51	34
No glyphosate	38	36	51	38	49	35

Averaged over all three locations in 2011-2012, when glyphosate was applied to the sorghum pre-harvest, wheat yielded 12-13% more on average than wheat following untreated sorghum. This is equivalent to an average increase of about 5-6 bushels/acre. Averaged over all three locations in 2012-2013, wheat yields following grain sorghum treated with pre-harvest glyphosate were increased by only 1%, or less than a bushel.

In 2011, applications of glyphosate, on average, were applied 22 days earlier than glyphosate treatments in 2012. The first freeze date was also 12 days later in 2011 than in 2012. As a result, the pre-harvest applications of glyphosate were applied, on average, 38 days prior to the first freeze in

2011 and only 6 days prior to the first freeze in 2012. A hard freeze soon after a pre-harvest glyphosate application to sorghum essentially negated the effect of the glyphosate application.

Summary

The use of glyphosate as a pre-harvest desiccant on grain sorghum will reduce the moisture level of grain sorghum and may allow producers to harvest the crop earlier than normal. However, care must be taken to ensure the crop is harvested in a timely manner. If not, the desiccant could increase lodging potential. If applied at the proper time (after physiological maturity - formation of black layer at the bottom of the sorghum grains), a desiccant will probably have little or no effect on sorghum yields.

Applications of glyphosate to grain sorghum prior to fall harvest can also help improve the performance of the following wheat crop if applied early enough in the late summer/early fall. Wheat yields following glyphosate-treated grain sorghum, on average, were 6% greater in 2011-2012 compared to 2012-2013 when glyphosate treatments were made at least 38 days prior to the first freeze date. When pre-harvest glyphosate is applied to the grain sorghum crop later than that, response of wheat yields following treated sorghum may be minimal.

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6. New eUpdate series on agriculture, climate, and change - Part 1

A new series of articles will be featured in the eUpdate in coming weeks. The theme of the series centers on agriculture, climate, and change. Dr. Xiaomao Lin, State Climatologist, and Dr. Rob Aiken, Crops Research Scientist, are the contributing authors on this 4-part series.

Is Kansas agriculture likely to be affected by a changing climate? If so, are there ways to adapt?

In the semi-arid Central High Plains, crop systems contend with heat stress, desiccating winds, lack of rainfall, flood-generating rains, and unexpected arctic air masses, inducing winter-kill or bringing the season to a chilling conclusion. Are producers in Kansas adapting to these changes? In a sense, we prepare by helping farmers adjust to the challenges of the current growing season.

Our growers recognize long-term warming trends and shifts of weather patterns. A recent report (1), prepared by the State Climatologists of Texas, Oklahoma and Kansas, indicates climate change has been written into the historical weather record.

"Both temperature and precipitation have increased across the Southern Plains since the beginning of the 20th century. Temperature increases so far have averaged about 1.5 degrees F over the 20th century, and precipitation has increased by as much as 5%, albeit with large variations from year-to-year and decade-to-decade. Heavy rainfall events have increased in frequency and magnitude. Historical data for tornadoes and hail are not reliable enough to be used to determine whether a trend is present in these types of severe weather."

"Variations in drought conditions from year-to-year and decade-to-decade are triggered by changes in sea surface temperature patterns in the Pacific and Atlantic oceans. The Dust Bowl drought is thought to have been exacerbated by poor land use practices, while precipitation may have been enhanced in recent decades by growth in irrigated agriculture and surface water."

"It is clear that temperatures will continue rising over the long term, as carbon dioxide and other greenhouse gases continue to become more plentiful in the atmosphere. By the middle of the 21st century, typical temperatures in the Southern Plains are likely to be 4 to 6 degrees F warmer than the 20th century average, making for milder winters (with less snow and freezing rain), longer growing seasons, and hotter summers. Rainfall trends are much less certain. The majority of climate models favor a long-term decrease, but most projected changes are small compared to natural variability. Extreme rainfall is expected to continue to become more intense and frequent."

Specific concerns that come from these warming trends include:

- Declining yield potential as a consequence of increased night temperatures
- Diminished photo-protection systems of plants under persistent heat stress
- Increased risk of reproductive failure with heat stress at critical development stages
- Increased crop water requirements
- Degradation of soil with intensive rainfall events
- Increased potential for large-scale methane emissions unleashed by thawing permafrost (2)

These concerns emerge as potential climate change impacts.

Crop productivity is expected to benefit from historic and on-going annual increases in global CO_2 concentrations. Assimilation rates can be maintained with modestly reduced crop water requirements. Cool-season grass crops and broadleaf crops will likely gain photosynthetic efficiencies. However, warming trends can detract from the beneficial effects of elevated CO_2 levels.

"When elevated temperatures exceed optimal conditions for assimilation, stress responses can include damage to the light-harvesting complex of leaves, impaired carbon-fixing enzymes, thereby reducing components of yield including seed potential, seed set, grain fill rate and grain fill duration. Field studies conducted under conditions of elevated CO_2 indicate that benefits of elevated CO_2 are reduced by heat-induced stress responses (3)".

Warmer temperatures, the most reliable feature of climate change, can extend the growing season, but also impair plant productivity. Persistent heat stress pushes plant metabolism to the edge of toleration. The complexity of plant metabolic processes can be astounding. Many of these processes are temperature-sensitive, with optimum temperatures for photosynthesis ranging from 77 to 86 degrees F for winter wheat (4), up to 90 degrees F for soybean (5), and up to 100 degrees F for corn (6). Chronic heat stress, with daily temperatures exceeding this range, can accelerate breakdown of protective mechanisms and can result in permanent damage to crop canopies.

Hot conditions prior to and during flowering can result in crop failure. Grain production requires effective pollination of ovules for 'seed set', followed by development and growth of the kernels, harvested as grain. Excessive temperatures (i.e., daily mean temperatures > 77 degrees F for grain sorghum (7) and wheat (8)) for a few days in the approximate 15 day period around flowering can decrease yield potential due to impaired pollination and seed-set; complete failure can occur with daily mean temperatures of 95 degrees F wheat or 99 degrees F sorghum.

Night temperatures drive the metabolic rates of plants. In a sense, plant respiration depletes the supply of carbohydrates available for plant growth and development (9, 10). As a long-term trend, warmer night temperatures can reduce crop productivity.

In summary, chronic high temperatures add to the evaporative demand on crop systems. This increases the water requirement for crop growth. Warmer temperatures can reduce yield potential by impairing heat-tolerance protective mechanisms; by shortening the duration of grain-filling; and by increasing the respiratory cost, the water requirement for growth, and the risk of reproductive failure of cereal crops. Warmer temperatures carry a complex drumbeat of warnings for crop productivity. Needed research is underway to adapt crop cultural practices to avoid heat stress; and to seek genetic advances for crop varieties that are capable of tolerating or resisting effects of warming temperatures.

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7. Kansas Mesonet continues to grow and improve

New stations

The Kansas Mesonet has two new stations in operation – Elmdale 1SE in Chase County, and Belleville 1W, in Republic County. The Elmdale station provides coverage in an area that was severely lacking weather-monitoring equipment (Figure 1).

Figure 1. Elmdale 1SE station (via mesonet.ksu.edu/metadata)

The Belleville station represents an upgrade for the Scandia Experiment Field tripod installation. The new tower, located on the Belleville site, adds an additional upper level (30-feet) wind and temperature information (Figure 2). An additional temperature sensor at a higher height provides data for inversion monitoring. The Belleville station also adds a dual rain gauge and soil moisture measurements compared to the previous Scandia station – matching the other Mesonet towers located through the state. At the end of this growing season, the Scandia Mesonet station will be discontinued.

Figure 2. Belleville 2W station (via mesonet.ksu.edu/metadata)

Additional stations will be available in the coming months. A station has been installed in Clark County and is the next one scheduled to come on-line.

Station metadata

The Mesonet station metadata webpage has also been enhanced. The intent of this update is to provide context to help users further understand the influences and history of the meteorological observations.

All stations are under stringent citing requirements via the World Meteorological Organization standards. However, minor influences such as ground cover type, distant obstructions, and changes over time are hard to disseminate with a few details. Therefore, we have added an interactive map, additional instrumentation details, and photos (Figure 3).

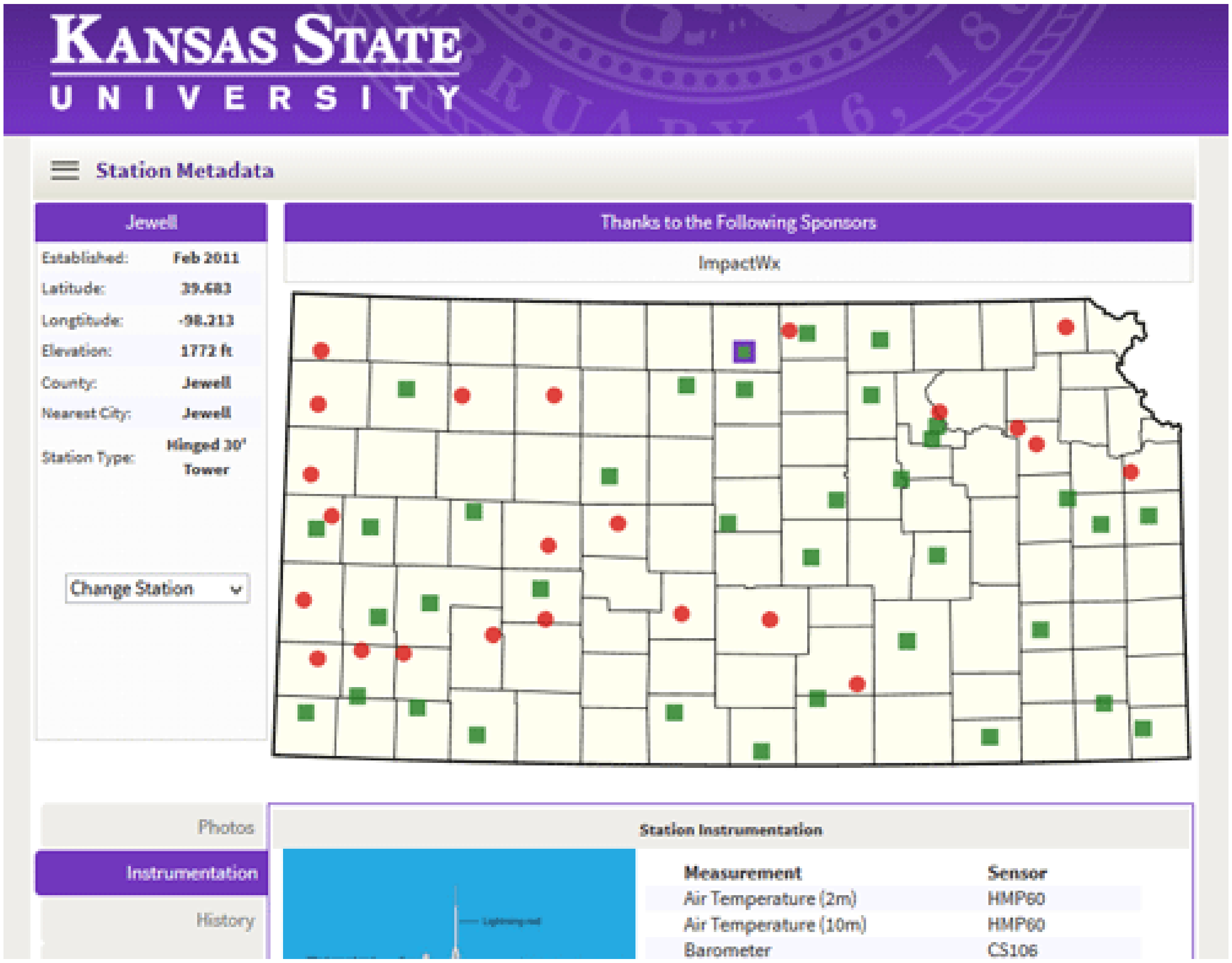

Figure 3. New metadata webpage found at mesonet.ksu.edu/metadata.

With photos being the biggest descriptor, the technician is required to take a minimum of four photos each station visit. The user can select previous trips and see the changes with seasonal and historical changes.

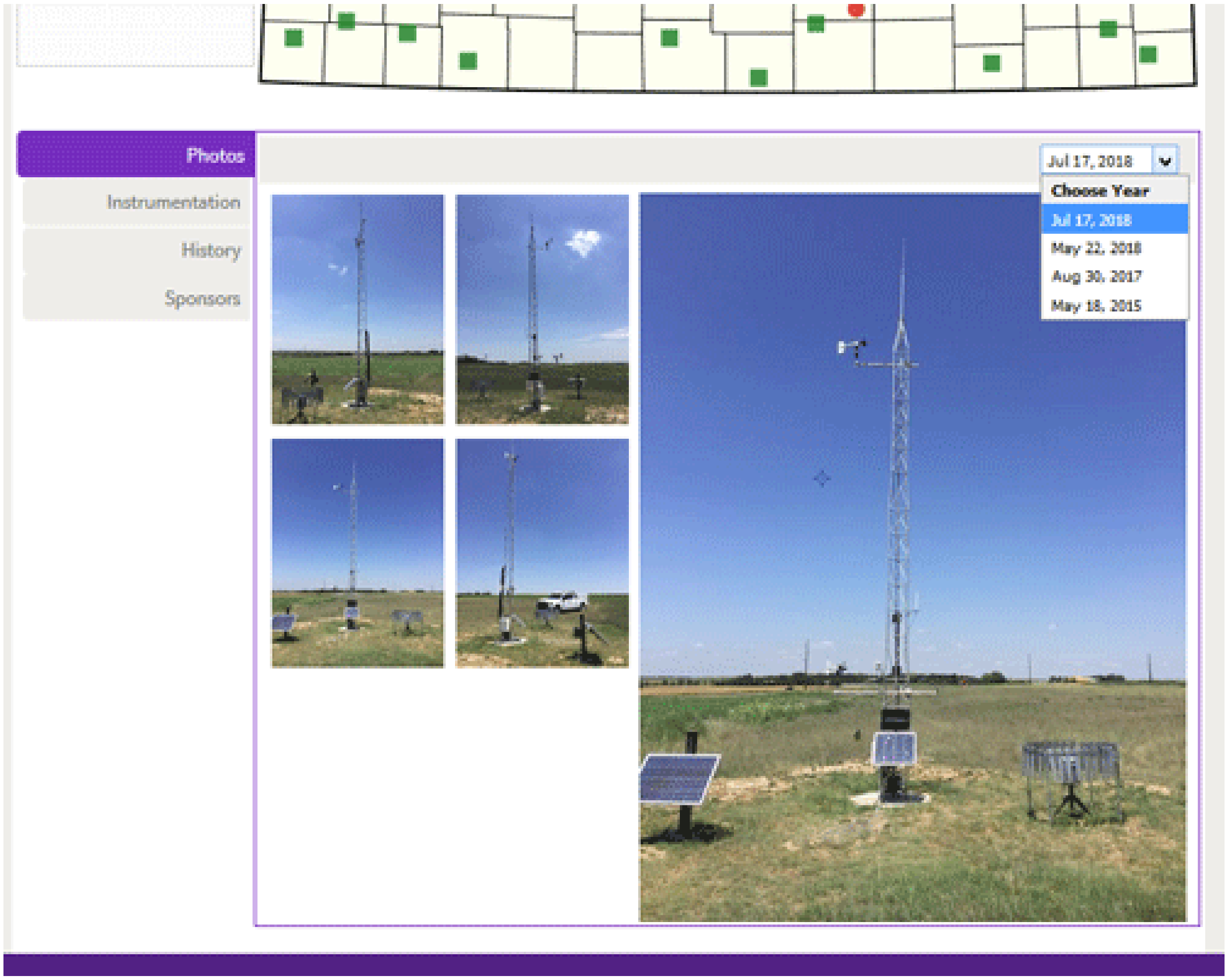

Figure 4. Photos are provided looking towards each cardinal direction and selectable by visit in the top right of the screen. Metadata page can be found at mesonet.ksu.edu/metadata.

Lastly, we also added an opportunity to recognize groups/individuals that have provided yearly maintenance funding for a particular station. These "sponsors" help make the data possible over the years and we are always looking for more!

Improvements to the main page

The main page (mesonet.k-state.edu) provides the entrance point to all of our resources. Clicking on the "24-hr Precip" tab now shows not only station observations, but also an overlay of estimated rainfall for the past 24 hours. This gives a sense of rainfall in areas not covered by our stations, as well as some context for those times when nearby stations have very different measurements. The overlay comes from the National Weather Service Quantitative Precipitation Estimates and is calculated from radar data. Click the "About Map" button to get the time of update and find a link to the national precipitation map (Figure 5).

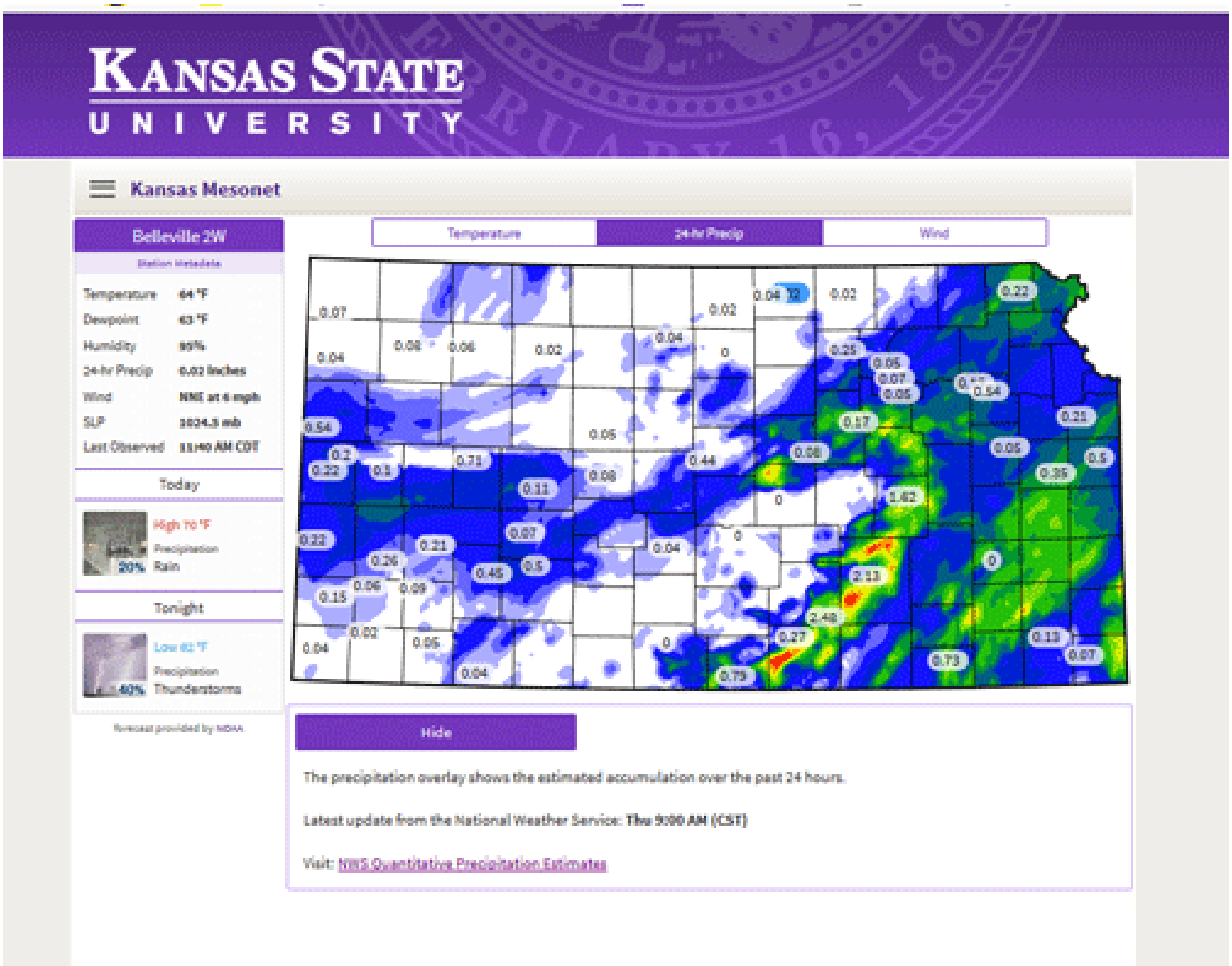

Figure 5. Precipitation overlay (mesonet.ksu.edu)

If you do not see anything as an overlay, it is because the precipitation was too little to be captured by the model. You can click on the "About this map" tab and follow the links to the national product. This will allow you to see what areas of the country did have precipitation.

Interactive wind barb feature

The "Wind" map shows the current wind speed and direction in a "wind barb". If you have been wondering how to read this symbol, we have a new link to our Wind Barbs page. Below the map, click "About This Map" and then "Interactive Wind Barbs Page". You can use the inputs to change wind direction or speed and see how the barb reacts (Figure 6).

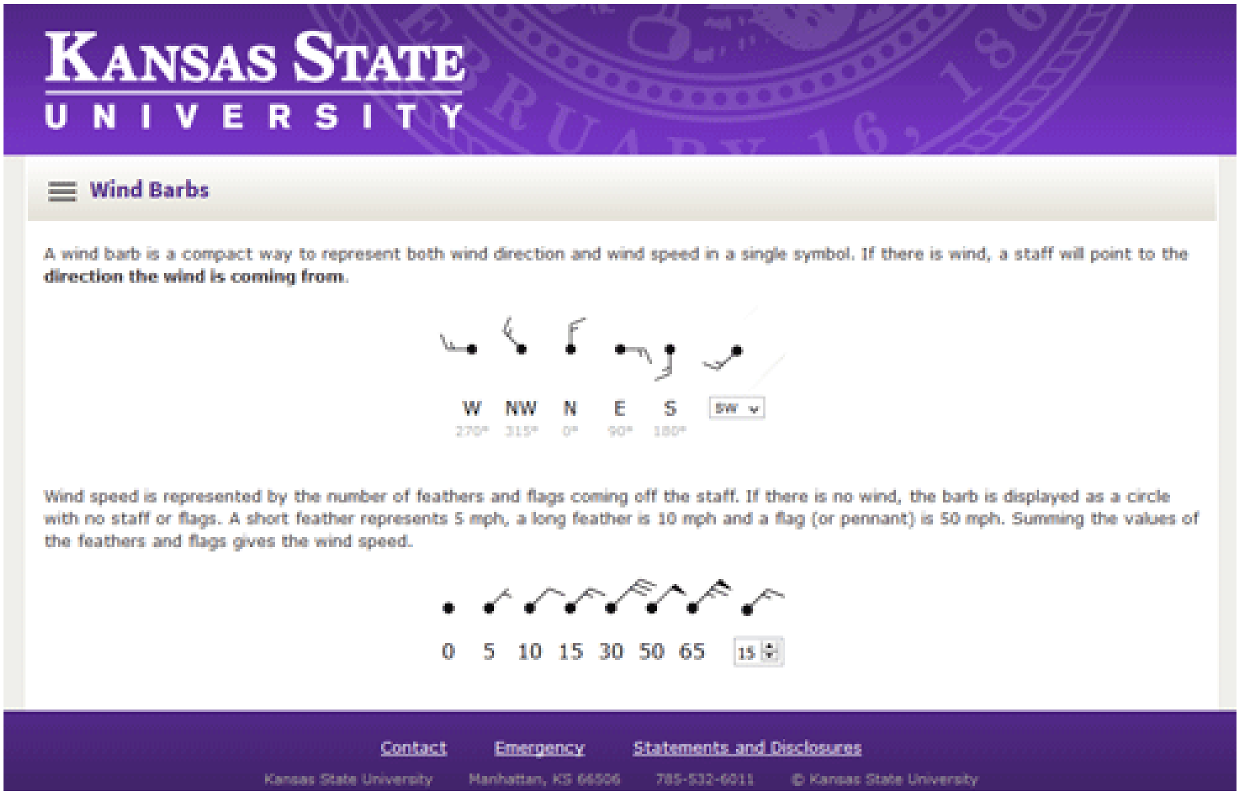

Figure 6. Interactive Wind Bar (http://mesonet.k-state.edu/about/windbarbs/)

Questions? Problems? Please let us know at kansas-wdl@k-state.edu or contact one of us directly.

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8. Kansas Bankers Association Awards nominations due by November 5

Nominate a deserving Kansas producer or landowner for the 2018 Kansas Bankers Association Conservation Awards Program. This year, the Kansas Bankers Association, K-State Research and Extension, and the Kansas Department of Wildlife, Parks, and Tourism have announced six award categories:

- Energy Conservation
- Water Quality
- Water Conservation
- Soil Conservation
- Windbreaks
- Wildlife Habitat

The purpose of this program is to stimulate a greater interest in the conservation of the agricultural and natural resources of Kansas by giving recognition to those farmers and landowners who have made outstanding progress in practicing conservation on their farms. Last year 185 Kansas producers and landowners were recognized through this program.

Nominations can be made by any person in the county. They should be sent to the County Extension Agricultural Agent or the Kansas Department of Wildlife, Parks, and Tourism District Biologist by November 5, 2018.

The K-State Extension agent for Agriculture and Natural Resources, or the Extension Coordinator, is designated Chairperson of the committee to select persons to receive awards.

For more information, see:
http://www.agronomy.k-state.edu/extension/kansasbankersaward/kansas-bankers-awards.html

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