Issue 873

K-STATE
Research and Extension

Extension Agronomy

eUpdate

09/16/2021

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.

Subscribe to the eUpdate mailing list: https://listserv.ksu.edu/cgi-bin?SUBED1=EUPDATE&A=1

eUpdate Table of Contents | 09/16/2021 | Issue 873

1. In-furrow fertilizers for wheat

Wheat is considered a highly responsive crop to band-applied fertilizers, particularly phosphorus (P). Application of P as starter fertilizer can be an effective method for part or all the P needs. Wheat plants typically show a significant increase in fall tillers (Figure 1) and better root development with the use of starter fertilizer (P and N). Winterkill can also be reduced with the use of starter fertilizers, particularly in low P testing soils.

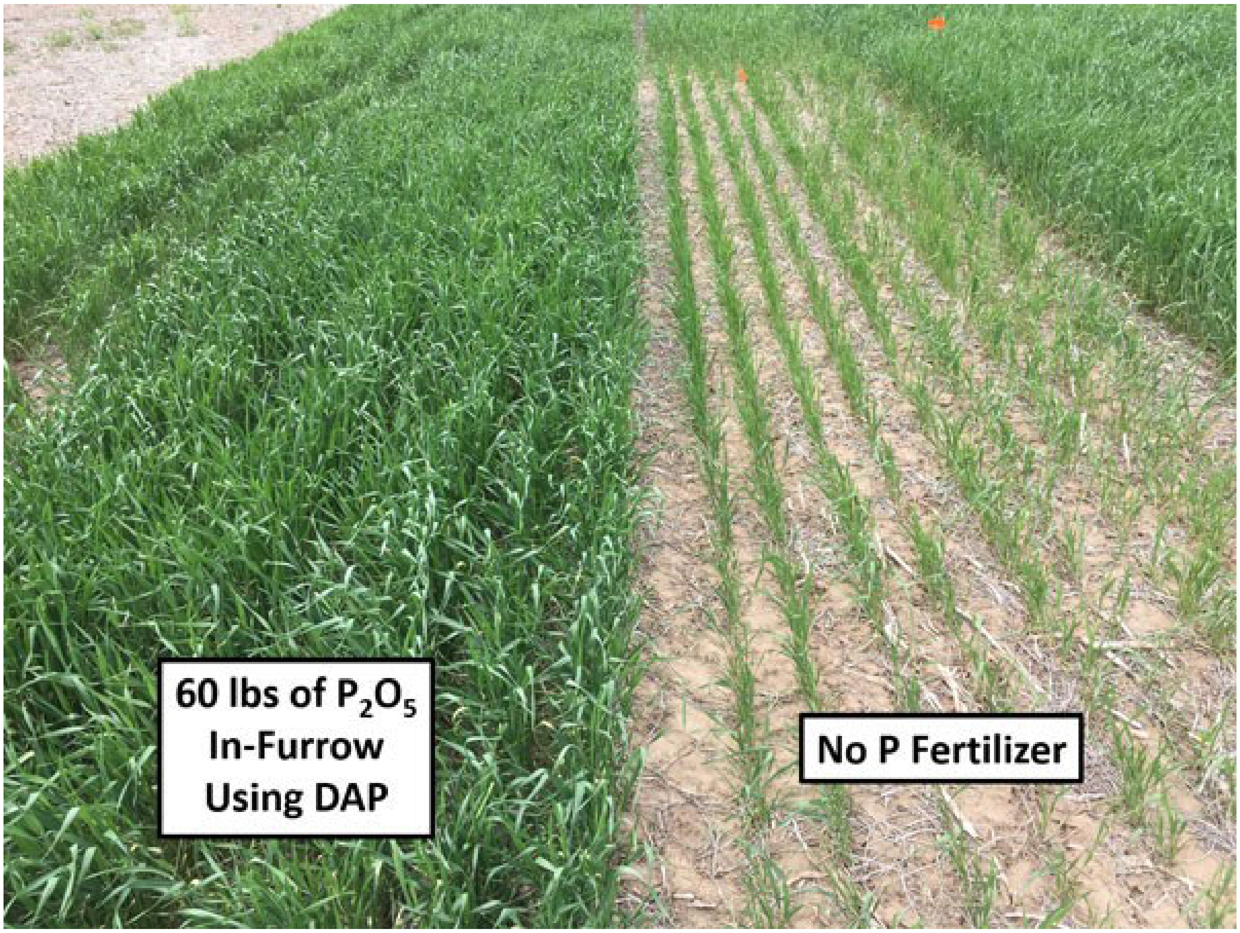

Figure 1. Effects on wheat tillering and early growth with in-furrow P fertilizer on soil testing low in P. Photo taken in 2020 in Manhattan, KS. Photo by Chris Weber, K-State Research and Extension.

In-furrow fertilizer application

Phosphorus fertilizer application can be done through the drill with the seed. In-furrow fertilizer can be applied, depending on the soil test and recommended application rate, either in addition to or instead of, any pre-plant P applications. The use of dry fertilizer sources with air seeders is a very popular and practical option. However, other P sources (including liquid) are agronomically equivalent and decisions should be based on cost and adaptability for each operation.

When applying fertilizer with the seed, rates should be limited to avoid potential toxicity to the seedling. When placing fertilizer in direct contact with wheat seed, producers should use the guidelines in Table 1.

Table 1. Suggested maximum rates of fertilizer to apply directly with the wheat seed

Row spacing (inches)	Pounds N + K_2O (No urea containing fertilizers) Medium-to-fine soil textures	Course textures or dry soils
15	16	11
10	24	17
6-8	30	21

Air seeders that place the starter fertilizer and seed in a 1- to 2-inch band, rather than a narrow seed slot, provide some margin of safety because the concentration of the fertilizer and seed is lower in these diffuse bands. In this scenario, adding a little extra N fertilizer to the starter is less likely to injure the seed - but it is still a risk.

What about blending dry 18-46-0 (DAP) or 11-52-0 (MAP) directly with the seed in the hopper? Will the N in these products hurt the seed?

The N in these fertilizer products is in the ammonium-N form (NH_4^+), not the urea-N form, and is much less likely to injure the wheat seed, even though it is in direct seed contact. As for rates, guidelines provided in the table above should be used. If DAP or MAP is mixed with the seed, the mixture can safely be left in the seed hopper overnight without injuring the seed or gumming up the works. However, it is important to keep the wheat mixed with MAP or DAP in a lower relative humidity. A humidity greater than 70% will result in the fertilizer taking up moisture and will cause gumming or caking within the mixture.

How long can you allow this mixture of seed and fertilizer to set together without seeing any negative effects to crop establishment and yield?

The effects of leaving DAP fertilizer left mixed with wheat seed for various amounts of time is shown in Figure 2. Little to no negative effect was observed (up to 12 days in the K-State study).

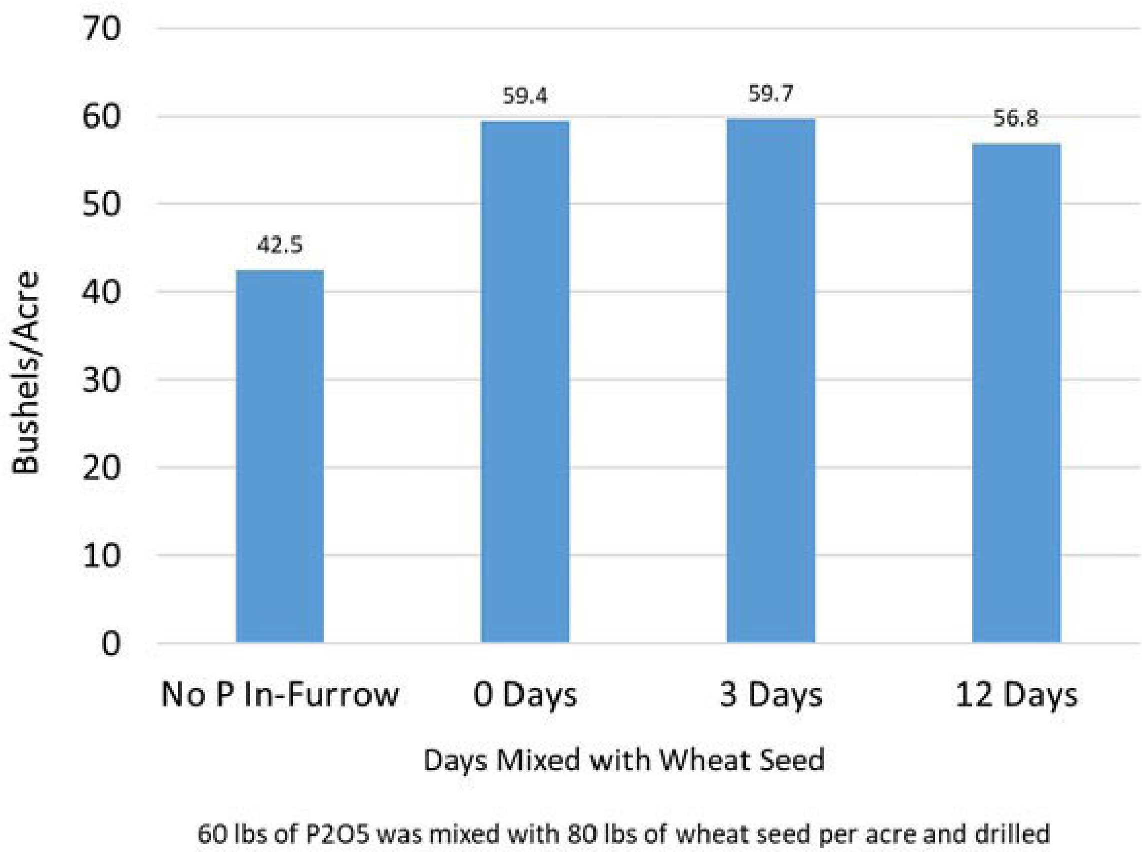

Figure 2. Effects on wheat yield from mixing P fertilizer with the seed. Study conducted in 2019 and 2020 at four sites. Graph by Chris Weber, K-State Research and Extension.

Although the wheat response to these in-furrow fertilizer products is primarily from the P, the small amount of N that is present in DAP, MAP, or 10-34-0 may also be important in some cases. If no pre-plant N was applied, and the soil has little or no carryover N from the previous crop, the N from these fertilizer products could benefit the wheat.

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

Chris Weber, former Graduate Research Assistant, Soil Fertility

2. Weed management practices: Fall scouting for weeds

Weeds that escape control by in-season management practices can cause several problems, including the possibility of reduced harvest efficiency and crop yield. Even if these factors do not justify an herbicide application, it is important to consider the future costs of seeds produced by those escapes – particularly if those escaped weeds produce a lot of seed and/or are herbicide resistant.

Just a few escapes of species such as waterhemp or Palmer amaranth can have a big impact (Figure 1). For example, research conducted in Georgia showed that one female plant in five acres added about two million seeds per acre to the soil. Those seeds can have impacts for many years. It took six years of total Palmer amaranth control to deplete the seedbank by 98% in Texas. In some situations, scouting during the weeks leading up to harvest may provide an opportunity to remove these plants by hand to reduce the number of seeds in the soil.

Figure 1. The waterhemp plants growing between these corn rows may not have reduced grain yield, but they will produce seed that must be controlled in future years. Photo by Sarah Lancaster, K-State Research and Extension.

Fall scouting can help plan for future control

Scouting for weeds at harvest, even if you simply make notes from the combine, is important for planning future weed management.

When scouting, make notes about:

- which weed species are present,
- where weed escapes are present, and
- any changes in the size or location of areas with weed escapes.

Some observations might be the result of soil or environmental conditions, while others might suggest problems with the herbicide selection or application equipment. However, some of these escapes might indicate the presence of herbicide-resistant weeds in your field – especially if the same herbicide program has been used for a number of years. Two examples of observations that might indicate herbicide resistance are 1) a growing patch of a particular species, or 2) herbicide failure on a few plants of a single species that is normally controlled.

References: Bagavathiannan and Norsworthy, 2012; Webster and Grey, 2017

Sarah Lancaster, Extension Weed Science Specialist
slancaster@ksu.edu

3. Grain sorghum yield potential: An on-farm calculation

Estimating crop yields before harvest can be variable, but producers often like to know about the potential yield of their crops.

When can I start making sorghum yield estimates?

As the sorghum crop gets closer to full maturity, yield estimates will be more accurate because the seed weight will be closer to being set. Nonetheless, we can start taking yield estimations three to four weeks after flowering (from soft to hard dough stages). At these stages, the final seed number can still change. In addition to the seed number, the seed weight will be only partially determined -- approximately 50 to 75% of dry mass accumulation as compared to the final weight. Each of the main sorghum yield components is discussed in more detail in a companion article in this eUpdate issue, "Grain sorghum yield potential: Understanding the main yield components".

Variability within the field

Variability between plants needs to be properly accounted for when estimating sorghum yields using the on-farm approach (see next section). Another important factor is the variation between different areas in the field. In general, it is recommended to perform yield estimations in at least 5 to 10 sections of the field to account for field variability.

On-farm approach for estimating sorghum yields

The estimation of sorghum yields should consider the main driving forces:

1. Total number of heads per unit area [number of plants per acre x heads per plant] (**1**)
2. Total number of seeds per head (**2**)
3. Number of seeds per pound (**3**)
4. Pounds per bushel, or test weight, which for sorghum is **56 lbs/bushel** (**4**)

The final equation for estimating sorghum yields:

[**1** x **2** ÷ **3**] ÷ **4** = Sorghum yield in bushels/acre

Take the following steps for making sorghum yield estimates:

Step 1. Number of heads per unit area:

For this on-farm approach, start by counting the number of heads from a 17.4-foot length of row when the sorghum is in 30-inch rows. This sample area represents 1/1000th the area of an acre. If the sorghum is in 15-inch rows, then count the number of heads in two rows. For a 7.5-inch spacing, measure four rows. In each of these scenarios, the area counted will be equal to 1/1000th of an acre.

Take head counts in several different areas of the field to properly account for the potential yield variability. If the proportion of smaller heads, < 3 inches in height, is very low (< 5%), these heads could be avoided due to the smaller proportion they will represent when determining the final yield.

Step 2. Estimation of the number of seeds per head:

The seed number is, by far, one of the most complicated yield components that needs to be estimated. The total number of seeds per head can vary from 100 to 5,000 seeds per head, but almost ¾ of the seed number distribution is around 1,500 to 2,500 seeds per head.

A quick method uses an estimate of seed counts per head, we can utilize a very simple association between the yield level, conditions around pollination/grain set time, and the number of grains per heads (Figure 1). The number of seeds per pounds, or seed weight, is also a factor we need to estimate, but this factor is relevant for yield contribution, with a less clear relationship with yield (Figure 1).

This method of estimating seed counts is summarized in Table 1. If conditions were very poor during pollination and grain set and the general yield environment is low, the total number of seeds per head will average around 500-1,000 seeds per head (900; Table 1). If conditions around flowering were very favorable and the general yield environment is very high, then the number of seeds per head could be around 1,500 to 3,500 (2,500). Intermediate yield environment scenarios can occur if a portion of the three-to-four week period around flowering was favorable and part of it was unfavorable. In that case, the number of seeds per head could range from 1,000-3,500, with an average of 1,745 seeds per head.

This information is provided only for general guidance on estimating sorghum yield potential using the on-farm approach.

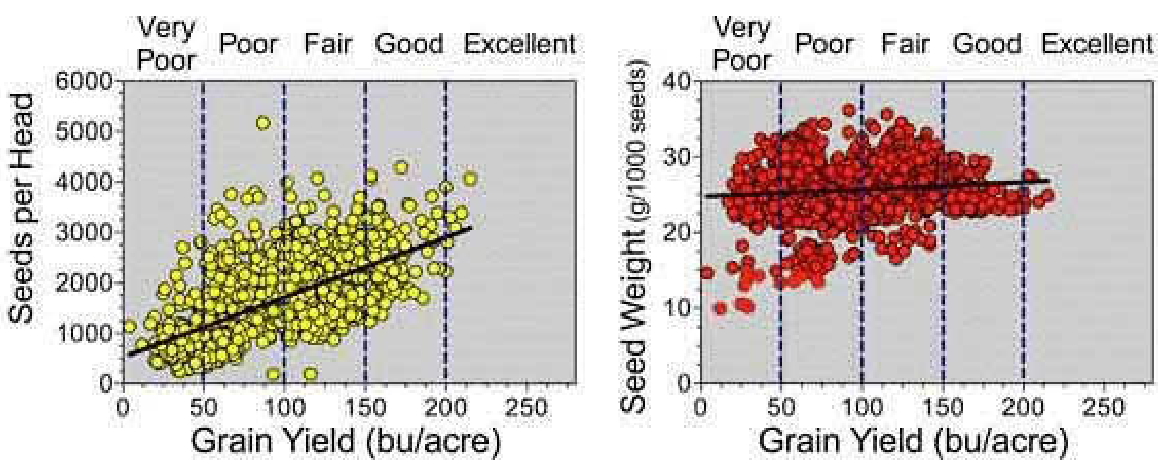

Figure 1. Relationship between grain yield and yield components, seeds per head (yellow points, left panel) and seed weight (red data points, right panel). The number of seeds per head has the most direct relationship with yield.

Table 1. Total number of seeds per head and seed weight components.

Yield Range (bu/acre)	Crop Condition	Average Seeds per Head	Average Seed Weight (g/1,000)	Number of Observations
<50	Very Poor	900	24.5	154
50-100	Poor	1,500	25.5	391
100-150	Fair	2,000	26.2	495
150-200	Good	2,500	25.6	129
>200	Excellent	3,330	25.5	5

Step 3. Estimation of the Seed Weight:

A similar procedure can be followed to estimate the seed weight (Table 1). For the seed weight component, the variation documented in the dataset showed a very narrow seed weight variation as compared with the variability found in the seed number component. In general, it seems that lower seed weight is expected at low yield ranges, but the difference among yield levels is negligible. Table 2 shows the conversion from average seed weight to seeds per pound, and from seeds per pound to the seed size factor employed in the examples below for sorghum yield estimation.

Table 2. Seed weight, seeds per pound.

Yield Range (bu/acre)	Crop Condition	Average Seed Weight (g/1,000)	Seeds Per Pound
<50	Very Poor	24.5	18,520
50-100	Poor	25.5	17,793
100-150	Fair	26.2	17,318
150-200	Good	25.6	17,723
>200	Excellent	25.5	17,793

Step 4. Final calculation using "On-Farm" Yield Estimation Approach:

[(Heads x Seeds per Head) x 1,000 ÷ Seeds per Pound] ÷ Pounds per bushel

<u>Example A. Good Crop Condition:</u>

Irrigated sorghum with adequate plant density (48,000 plants/acre), average number of tillers per plant of 1.3, and good yield environment with adequate flowering and grain filling periods:

(48 plants in 17.4 foot -1/1000th of an acre- x 1.3 fertile tillers per plant) = 62 heads

Yield Estimation = [(62 x 2,500) x 1,000 ÷ 17,723] ÷ 56 = **156 bu/acre**

Example B. Poor to Fair Crop Condition:

Dryland sorghum with adequate plant density (40,000 plants/acre), average number of tillers per plant of 1.3, and poor flowering but fair grain filling period:

Yield Estimation = [(52 x 1,500) x 1,000 ÷ 17,723] ÷ 56 = **79 bu/acre**

Example C. Very Poor Crop Condition:

Dryland sorghum with adequate plant density (40,000 plants/acre), average number of tillers per plant of 1.0, and poor yield environment and growing season (poor flowering and grain filling period):

Yield Estimation = [(40 x 900) x 1,000 ÷ 18,520] ÷ 56 = **35 bu/acre**

Ignacio A. Ciampitti, Farming Systems
ciampitti@ksu.edu

4. Grain sorghum yield potential: Understanding the main yield components

In order to best estimate the yield potential of grain sorghum, we need to understand the main plant components of sorghum yield. The main yield-driving factors are:

- number of plants,
- number of tillers per plant,
- total number of seeds per head, and
- seeds per pound.

The number of plants and the number of tillers per plant are two of the main components and are determined well before the end of the growing season. The initial plant density, planting date, and the environment, among other factors, influence those two yield components. To learn more about an on-farm approach for calculating sorghum grain yield potential before harvest, please see the companion eUpdate article in this issue, "Grain sorghum yield potential: An on-farm calculation".

Understanding sorghum yield components

Increasing the number of plants per acre potentially increases competition for resources, which can diminish the plant's capacity to produce tillers. In addition, the interaction of planting date with plant density can have a similar effect. As planting date is delayed, the capacity of the plant to produce tillers will be reduced; thus, plant population needs to be increased to compensate for the reduction in the number of tillers. Previous research at K-State showed sorghum produces more tillers when planted early (mid-to-late May) at lower plant populations as compared with late planting dates (mid-to-late June).

The environment also plays an important role in the final number of heads per unit area. Heat and drought stress will reduce the plant's ability to produce more tillers and could severely reduce the tiller survival rate. The total number of seeds per head will be determined within the one- or two-week period before flowering until milk to soft dough stages (approximately two to three weeks after flowering).

Seed size will be determined close to the end of the season. In the 15 to 25 days after flowering, during the soft dough stage, sorghum grains have already accumulated about 50% of the final dry mass. Thus, the period around flowering is critical for defining not only the final number of grains per head but also the potential maximum kernel size. Final seed weight will be determined when the grains reach physiological maturity (visualized as a "black-layer" near the seed base). From this time until harvest, the grains will dry down from approximately 35% to 20% moisture content.

The interaction among all four components will determine the actual yield, but a wide range of variation can be expected in all these main yield-driving forces (Figure 1).

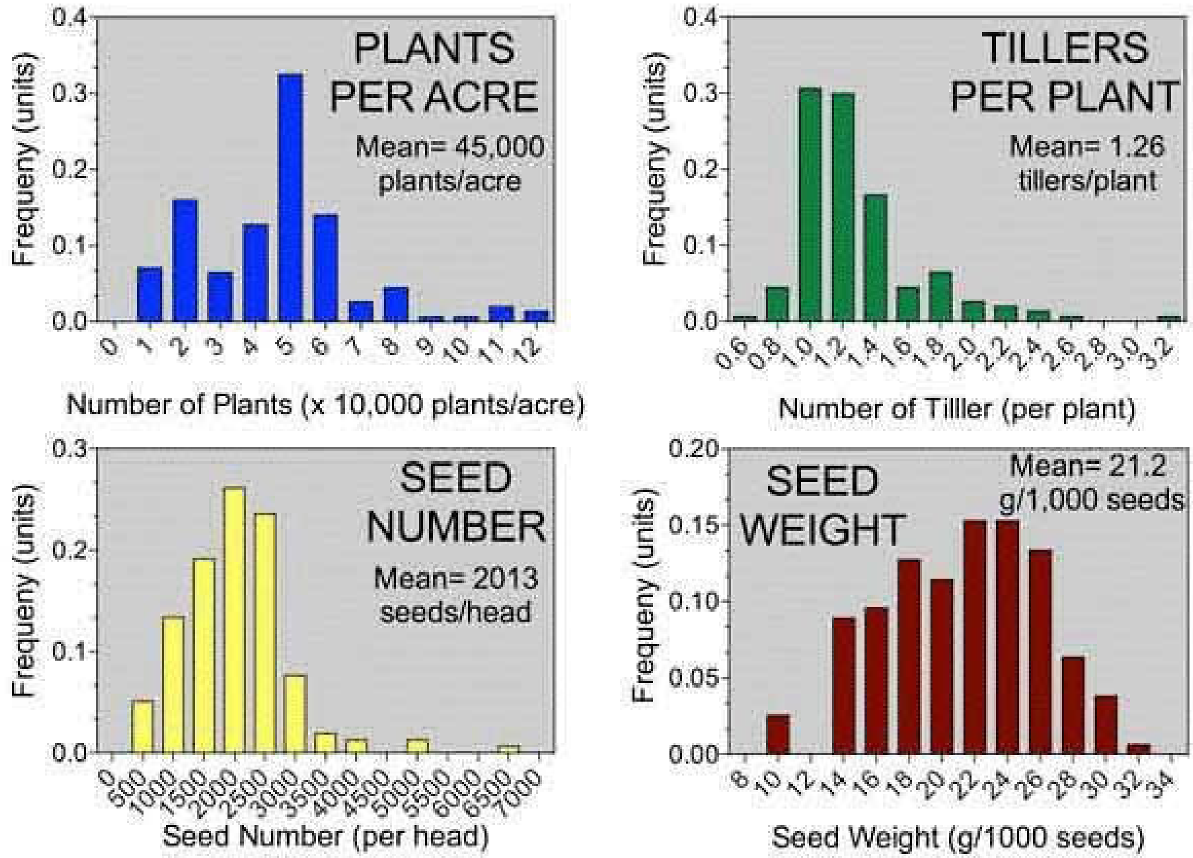

Figure 1. Example of the variation expected to be found in the main sorghum yield components. The number of tillers per plant can also be interpreted as the number of heads per plant, considering that all tillers have one fertile head.

Seed number is the main driving force of sorghum yield. Actual seed counts per head would make the estimates more accurate but requires considerable time and effort.

Ignacio A. Ciampitti, Farming Systems
ciampitti@ksu.edu

5. Insect update: The Year of the Worm

We might end up remembering 2021 as the "Year of the Worm". Starting in late winter 2020/early spring 2021, there was considerable activity by army cutworms. Most of the problem was caused by the larvae decimating thin stands of wheat and/or alfalfa. Then, in late spring/early summer, a combination of armyworms and fall armyworms caused serious concern and damage in lawns, pastures, and alfalfa fields throughout about the eastern two-thirds of the state.

Army cutworms spend the summer in the Rocky Mountains but start to migrate back into Kansas in early fall every year. The larvae may feed on just about any plants but mostly affect wheat and alfalfa as these are usually the only plants actively growing this time of year.

Armyworms, probably more so than fall armyworms, may continue to cycle through another generation, or even two, as they overwinter in Kansas. Ultimately it will probably take a hard frost or freeze to stop them. Fall armyworms, since they don't usually overwinter in Kansas, may migrate south after this generation matures into adults, but there could be another, or at least, partial generation.

Armyworms infest primarily grasses (sorghum, corn, brome pastures, lawns, etc.) and often this time of year, wheat, but occasionally alfalfa. Thus, if armyworms are the problem, they could be around through another generation or maybe even two depending upon the weather. If armyworms are relatively small (Figure 1), they will probably feed for another 10-14 days, then pupate (stop feeding). If they are relatively large however (Figure 2), they will probably pupate in the next 3-7 days. There will probably be at least one more generation of armyworms. Fall armyworms (Figure 3) have a little wider host range which includes alfalfa, soybeans, corn, sorghum, and wheat, but don't usually overwinter in Kansas. Hopefully, they will be heading south after these larvae finish feeding and become moths. Also, in the next 30-60 days army cutworm moths should have returned from their summer Rocky Mountain retreat to deposit eggs throughout at least the western two/thirds of the state and thus, these tiny worms will start feeding on wheat and/or alfalfa all winter.

Figure 1: Small armyworm. Photo by Cayden Wyckoff, K-State Research and Extension.

Figure 2: Larger armyworm. Photo by Cayden Wyckoff, K-State Research and Extension.

Figure 3: Fall armyworms. Photo by Jay Wisbey, K-State Research and Extension.

Jeff Whitworth, Extension Entomology Specialist
jwhitwor@ksu.edu