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These e-Updates are a regular weekly item from K-State Extension Agronomy and Kathy Gehl, Agronomy eUpdate Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have any questions or suggestions for topics you'd like to have us address in this weekly update, contact Kathy Gehl, 785-532-3354 kgehl@ksu.edu, or Dalas Peterson, Extension Agronomy State Leader and Weed Management Specialist 785-532-0405 dpeterso@ksu.edu.

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1. 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 with the higher fertilizer price this year contributing to very tight margins for wheat.

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 P_2O_5 to increase 1 ppm in soil test P; for K is around 8 pounds K_2O 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 the fall. 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 (Cl) 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 (KCl) 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, wheat 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 conditions and 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

2. Estimating soybean yield potential

Many producers like to estimate the yield potential of their soybeans well before reaching the end of the season. In contrast with corn, soybeans can easily compensate for abiotic (e.g., temperature, water) or biotic stresses (e.g., insects, diseases). The final number of pods is not determined near the end of the season (beginning of seed filling). For comparison, in corn, the final kernel number is attained during the 2-week period after flowering. Thus, when estimating soybean yield potential, we have to keep in mind that the estimate could change depending on the growth stage at the time the estimate is complete and weather conditions. For example, wet periods toward the end of the reproductive period can extend the seed-set period, promoting greater pod production and retention, with heavier seed weight.

From a physiological perspective, the main yield driving forces are: **1) plants per acre, 2) pods per area, 3) seeds per pod, and 4) seed size**. Estimating final yield in soybean before harvest can be a very tedious task, but a simplified method can be used for just a basic yield estimate.

When can I start making soybean yield estimates?

There is not a precise time, but as the crop approaches the end of the season (R6, full seed or R7, beginning of maturity) the yield estimate will be more accurate. Still, you can start making soybean yield estimates as soon as the end of the R4 stage, full pod (pods are ¾-inch long on one of the top four nodes), or at the onset of the R5 stage, beginning seed (seeds are 1/8-inch long on one of the top four nodes). Keep in mind that yield prediction is less precise at those early stages.

Is plant variability within the field an issue in soybeans?

Variability between plants relative to the final number of pods and seed size needs to be considered when trying to get an estimation of soybean yields. In addition, variability between areas within the same field needs also to be properly accounted for (e.g. low vs. high areas in the field). Make yield estimations in different areas of the field, at least 6 to 12 different areas. It is important to properly recognize and identify the variation within the field, and then take enough samples from the different areas to fairly represent the entire field. Within each sample section, take consecutive plants within the row to have a good representation.

Conventional approach to estimating soybean yields

In the conventional approach, soybean yield estimates are based on the following components:

- Total number of pods per acre [number of plants per acre x pods per plant] **(1)**
- Total number of seeds per pod **(2)**
- Number of seeds per pound **(3)**
- Total pounds per bushel, or test weight, which for soybeans is 60 lbs/bu **(4)**

The final equation for the estimation of the potential soybean yield is:

[(1) x (2) / (3)] / (4) = Soybean yield in bushels/acre

Simplified approach to estimating soybean yields

The main difference between the "conventional" and "simplified" approaches is that the conventional approach uses the total number of plants per acre in its calculation; while in the simplified approach, a constant row length is utilized to represent 1/10,000th area of an acre (Figure 1).

For the simplified approach, sample 21 inches of row length in a single row if the soybean plants are spaced in 30-inch rows; in 2 rows if the row spacing is 15 inches; and in 4 rows if the row spacing is 7.5 inches.

Figure 1. In the "simplified" approach to estimating yields, sample 21 inches of row length to equal 1/10,000th of an acre. The number of rows to sample will depend on the row spacing. With 30-inch row spacing, sample one row. With 15-inch row spacing, sample two rows. With 7.5-inch row spacing, sample four rows. Photo by Ignacio Ciampitti, K-State Research and Extension.

Repeat this procedure in different sections of the field to properly account for the natural field variability.

What are the driving forces of soybean yield?

1) Total number of pods per acre:

Count the total number of pods (Figure 2) within this constant row length. After counting all the plants within the 21-inch row sections that represent 1/10,000th of an acre, estimate a final pod number per acre. Use a similar procedure in different areas of the field to get a good overall estimate at the field scale. One good criterion is only to consider pod sizes that are larger than ¾ or 1 inch long. Smaller pods can be aborted from this time on in the growing season until harvest.

Figure 2. Total number of pods per plant (only consider the pod sizes larger than ¾ or 1 inch). Photo by Ignacio Ciampitti, K-State Research and Extension.

2) Total number of seeds per pod:

Soybean plants will have, on average, 2.5 seeds per pod (ranging from 1 to 4 seeds per pod), primarily regulated by the interaction between the environment and the genotypes (Figure 3). Under severe drought and heat stress, a pessimistic approach would be to consider an average of 1-1.5 seeds per pod. This value is just an approximation of the final number of seeds per pod, and can change from the time of estimation until the end of the growing season.

Figure 3. The number of seeds per pod will vary somewhat, depending on the growing environment and genotype. Photo by Ignacio Ciampitti, K-State Research and Extension.

3) Seed size:

Seed size can range from 2,500 (normal to large seed weight) to 3,500 (small seed size) seeds per pound. This season, conditions are mostly favorable in Kansas for promoting large seed sizes. In more stressful years, such as 2012 and 2011, seed size is normally smaller, meaning a larger number for the seeds per pound (e.g. 3,500 seeds per pound). In the simplified estimation approach published by Dr. Casteel, you do not need to actually measure the number of seeds per pound in order to estimate yields, as is done in the conventional approach. Instead, a seed size conversion factor is used. If the conditions are favorable and large seed size is expected, the conversion is 15 units; while if abiotic or biotic stresses are present during the seed-filling period, a seed size factor of 21 units is used. Further details related to the seed size factor can be found in the link to the Purdue University extension article listed at the end of this article.

Example of the simplified approach for estimating soybean yields:

Say that we have 120,000 plants/acre in a 30-inch row. Then, we should have around 12 plants in 21 inches of row. In those 12 plants, we have measured on average 22 pods per plant, with a total number of 264 pods (22 x 12).

If we assume a "normal" growing season condition, then the final seeds per pod will be around 2.5, and for the seed size factor, we can assume large seeds, and will use a conversion factor of 15 units.

Equation for a “Favorable” Season:

264 pods x 2.5 seeds per pod / 15 = 44 bushels per acre

For a “droughty” (late reproductive, from R2 to R6 stages) growing season, the final seed number and size will be dramatically affected. Thus, even if the pod number is the same as in a normal season, the yield calculation could be:

Equation for a “Drought” or Short Seed-Filling Season:

264 pods x 1.5 seeds per pod / 21 = 19 bushels per acre

Basically, this “simplified approach” relates the total number of pods in a “known” unit area (easily extrapolated to the acre unit), and is affected by the total number of seeds in the pod. This is adjusted by the estimated seed weight, which is affected by two main components: duration of seed fill and rate of dry mass allocation to the seeds.

Ignacio Ciampitti, Farming Systems
ciampitti@ksu.edu

3. Management options for stressed corn

Where dryland corn has been under severe drought and/or heat stress, producers have to decide whether to let it go and hope for some kind of grain yield, salvage the crop for silage or hay, or leave the crop in the field for its residue value.

Economically, should you leave the corn, cut it for silage or hay, or leave it for residue?

The value of the residue for moisture retention, soil quality, and future crop productivity will vary depending on the situation, and can be hard to quantify -- but it is considerable. As for the silage/hay vs. grain decision, if the yield potential is less than 25 bushels per acre, it's probably best to cut it for silage or hay. If the yield potential is 50 bushels or more, it's probably best to harvest it for grain. If the yield potential is between 25 and 50, the decision will depend on the price of corn, the quality of the silage, and on a producer's ability to use or sell the silage.

Of the two options for dryland corn that has limited yield potential – silage or hay -- silage is normally the preferred option. However, you need the facilities to make silage (or sell it to someone who does), and there must be enough moisture in the plants to properly ensile. And where there's no ear at all, silage may not be a good option. Where the ear is very small, or has poor seed set, the silage will have lower energy value (TDN) and lower overall forage quality than normal. Even at normal yield levels, silage quality begins to decline when grain yield drops below roughly 150 bushels per acre, and continues to decrease as grain yields keep going down.

To cut corn for silage, you need 65 to 75 percent moisture in the plant. If plants are suffering from drought, they may have lost some of the bottom leaves. The top leaves may have browned off or turned white. In that case, the plants probably do not have 65 percent moisture, depending on how much moisture is in the stalk. Where that's the case, your only option is probably to chop and graze, or hay the crop like a summer annual forage. The pasture/hay shortage that exists in some areas of the state may make haying the failing corn crop a more desirable option this year.

When chopping or cutting for hay, stalks should be cut at least six to eight inches off the ground to avoid nitrate toxicity that may result when feeding forage made from drought-stressed corn. Under drought conditions, the plant does not grow normally and high levels of nitrate can accumulate, especially in the lower portions of the stalk. You should also have corn hay (or stubble if you plan to graze) tested for nitrates. A forage nitrate test costs only $5-15 and it's the only sure way to make sure the hay is okay to feed to cattle. Ensiling the corn, if possible, is preferred to chopping or grazing because of that potential for nitrate toxicity. For more information on nitrate toxicity please read the companion article, "Nitrate toxicity in drought-stressed corn", available in a recent eUpdate issue.

If you plan to have cattle graze the corn field after it has been chopped or cut for hay or silage, watch for any shattercane or Johnsongrass that comes up after a rain. New regrowth from these sorghum-type plants after a drought can be dangerously high in prussic acid.

How much silage can producers get from drought-stressed corn?

A publication from the University of Wisconsin estimates that for corn that has been stressed, with limited grain yield potential, producers can expect about one ton of silage per acre for every five bushels of grain yield. For corn that is not stressed, producers can get about one ton of silage for each six to seven bushels of grain yield. If little or no grain is expected, a very, very rough pre-harvest estimate of yield can be made by assuming that one ton of silage can be obtained for each foot of plant height, excluding the tassel.

Ignacio Ciampitti, Farming Systems
ciampitti@ksu.edu

4. 2021 Kansas Performance Tests with Winter Wheat Varieties report available online

The *2021 Kansas Performance Tests with Winter Wheat Varieties* report is now online. The Kansas Agricultural Experiment Station annually compares both new and currently grown wheat varieties across different regions in Kansas. These performance tests generate unbiased information designed to help Kansas growers chose the best wheat varieties for their cropping system.

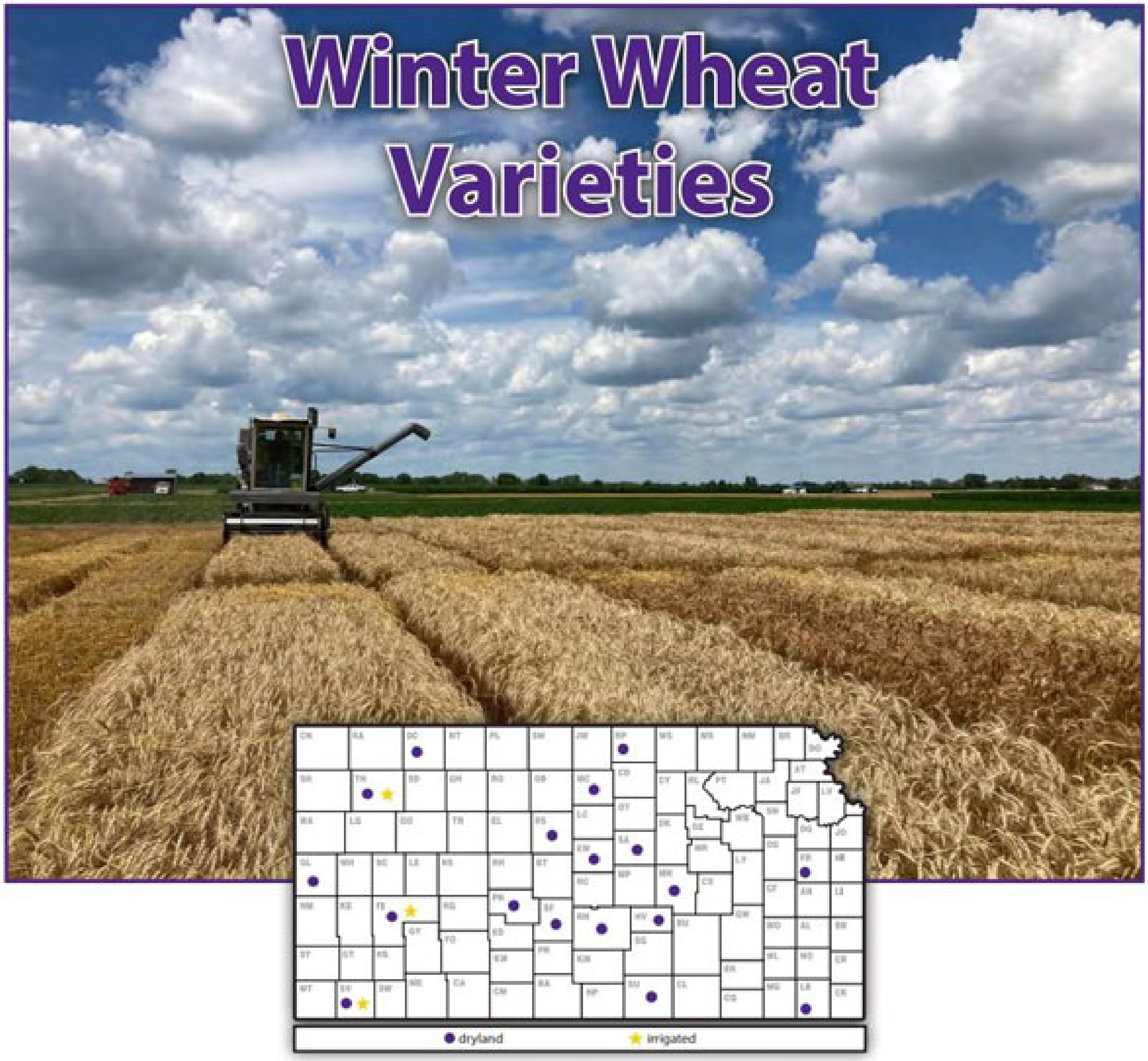
In this report, you will find a recap of the 2020-21 wheat crop, with a detailed discussion of weather conditions that resulted in two very distinct wheat crops going into the winter months. The prolonged winter maintained the wheat crop dormant for a relatively long time. Most of the varieties evaluated in Hutchinson by K-State Research and Extension did not reach the first hollow stem stage of development until March 30, which compare to as early as March 6 in years with a warm winter. A recap of insect pressure and diseases is also included. More importantly, the results of the 2021 wheat variety performance tests are also shown.

Producers and crop consultants can use this resource to help select wheat varieties for their operation by checking for varieties that show a consistently good performance in their region. Be sure to keep extenuating environmental conditions in mind when examining test results.

The online version of the 2021 variety performance report is available here: https://bookstore.ksre.ksu.edu/pubs/SRP1165.pdf.

Performance test results from previous years are available at http://www.agronomy.k-state.edu/services/crop-performance-tests/winter-wheat/index.html

2021 Kansas Performance Tests with



Kansas State University Department of Agronomy
2004 Throckmorton Plant Sciences Center | Manhattan, KS 66506
www.agronomy.ksu.edu | www.facebook.com/KState.Agron | www.twitter.com/KStateAgron

5. 2020 Kansas Summer Annual Forage Hay and Silage Variety Trial final report

In 2020, summer annual forage variety trials were conducted across Kansas near Garden City, Hays, and Scandia. All sites evaluated hay and silage entries. Companies were able to enter varieties into any possible combinations of research sites, so not all sites had all varieties. Across the sites, a total of 98 hay varieties, 78 sorghum silage varieties, and 11 dual-purpose sorghum silage varieties were evaluated (Table 1). The full 2020 Kansas Forage Report can be accessed online at https://newprairiepress.org/kaesrr/vol7/iss6/.

Table 1. Number of hay and silage entries for each location

Location	Hay	Silage	Grain
Garden City	34	29	6
Hays	40	24	5
Scandia	24	25	0
Total	98	78	11

Introduction

In Kansas, there were 2,400,000 acres of hay and haylage harvested with an average yield of 2.24 dry matter tons per acre. Of this total, 650,000 acres were alfalfa with an average yield of 3.72 dry matter tons per acre, and 1,770,000 acres were crops other than alfalfa with an average yield of 1.69 dry matter tons/a. Kansas ranked 6th in the U.S. for hay and haylage production. This largely supports the state dairy (ranked 19th in the U.S. and valued at $483,000,000) and cattle (feedlot, background, and cow/calf) industries (ranked second in the U.S. and valued at $10,200,000,000). Dairy and beef cattle represented 58% of the total agricultural product of Kansas. Hay and grain commodities that support these two industries are critical for the state.

Study Objectives

The objectives of the Kansas Summer Annual Forage Hay and Silage Variety Trial are to evaluate the performance of released and experimental varieties, determine where these varieties are best adapted, and increase the visibility of summer annual forages in Kansas. Breeders, marketers, and producers use data collected from the trials to make informed variety selections. The Summer Annual Forage Trial is planted at locations across Kansas based on the interest of those entering varieties into the test.

This work was funded in part by the Kansas Agricultural Experiment Station and seed suppliers. Sincere appreciation is expressed to all participating researchers and seed suppliers who have a vested interest in expanding and promoting annual forage production in the U.S.

Inestimable differences in soil type, weather, and environmental conditions play a part in increasing experimental error, therefore one should use more than one location and one year of data to make an informed variety selection. Please refer to previous years' forage reports to see how a variety performed across years.

John Holman, Cropping Systems Agronomist, Southwest Research-Extension Center
jholman@ksu.edu

Augustine Obour, Agricultural Research Center – Hays
aobour@ksu.edu