1. Low test weights in wheat: Causes and utilization

Wheat test weights are low in some cases this year. Possible causes include drought stress, heat stress, wheat streak mosaic damage, and rainy weather at harvest.

Drought stress is probably the main cause overall. Wheat under drought stress reacts in several ways. The plants will normally allocate most of the available nutrients and water to the first kernel or two in the mesh. These kernels may be small, but often have high protein and adequate test weight. The remaining kernels will be denied the necessary nutrients and water, however. If these flowers or kernels were not aborted, then they will be shriveled and have low test weight.

Heat stress during grain fill can cause the plants to shut down the nutrient flow to grain, which can result in low test weights in most kernels on the head. It may even result in premature death of the plant, before the grain has filled. Heat stress would have to occur for several days in a row during early- to mid-grain fill to shut down the plants and reduce test weights significantly. If the period of extreme heat lasts for only 1-3 days, it’s unlikely to permanently reduce test weight. Premature death due to heat stress is one of the most common reasons for low test weights in late-maturing varieties in Kansas.

A fall infection of wheat streak mosaic can also reduce test weight, by causing a season-long disruption of nutrient flow to the kernels. This year, many fields in western Kansas were affected by a combination of drought stress and wheat streak mosaic, resulting in low test weights.
In other years, leaf rust and stripe rust have caused test weight reductions. When diseases, in combination with drought some years, cause premature death of the flag leaf at or before the soft dough stage, this often results in shriveled grain and low test weight. When premature death of the flag leaf occurs later, in the hard dough stage, there is usually little or no effect on test weight.

In some cases, the test weights at maturity were fine this year, but rains at harvest time lowered the test weights by 2-3 points or more almost overnight. In this case, the reason for the low test weight is that the rain causes the wheat kernels to swell – something like puffed wheat cereal. Test weight is a measure of how much grain weight can be placed in a given volume. Prior to the rain, the wheat kernels could be packed well into a bushel. When it rains, kernels swell and upon drying, the kernels do not shrink back to their original volume, shape, and smoothness. This results in more space between kernels, and they will not pack into a bushel as well as they did before the rain. The result is a lower test weight. But this does not reduce the total number of pounds of grain produced per acre. There is no real grain yield loss – the number of bushels per acre will be increased but the weight per bushel will be reduced.

Whatever the cause, if test weights are low enough, the wheat may be unacceptable for milling, leaving its primary use as livestock feed. Many studies have been conducted on feeding wheat to livestock, and most report excellent animal performance when the wheat-containing diet is managed correctly.

Livestock feeders, particularly cattle feeders, should consider taking advantage of price discounts when low-test-weight or damaged wheat is available. Regardless of wheat’s test weight and condition, it should be processed by grinding, dry rolling, or steam flaking to disturb its hard seed coat. This will increase the energy digestibility of the wheat kernel.

Even with wheat’s attributes as a feed ingredient, there are things livestock producers should be aware of. Wheat is low in fiber content and high in starch, making it more difficult to feed than other grains in ruminant rations. Wheat starch can support fast fermentation rates within the rumen, which can cause digestive upsets that lead to poor animal performance and even death.

Generally, wheat should be restricted to 30 to 50 percent of the complete diet for finishing cattle. Adapting fed cattle to diets with high wheat content may take 20 to 30 days. Stocker cattle consuming silage or hay diets can also be fed damaged, low-test weight wheat. Wheat should be limited to one percent or less of the animal’s body weight for growing cattle. It is imperative that the protein content of the diet is formulated to meet the animal and rumen microbial requirements. Wheat usually contains less than 14 percent protein, which limits its use in most low-quality forage diets fed to mature beef cattle. Protein supplements used in such situations usually contain 20 to 40 percent protein.
Producers should feed by weight not volume -- large cattle with greater gut capacity can utilize low-test-weight wheat more readily than younger, light-weight cattle and non-ruminants. The price of low-test-weight wheat can be calculated from corn and soybean meal prices. For example, 100 pounds of wheat has about the same economic value (based on protein and energy content) as 92 pounds of corn and 8 pounds of soybean meal.

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2. Evaluating hail and storm damage to corn

Strong thunderstorms bringing hail and high winds have moved through Kansas in recent weeks. Damage to uncut wheat fields is readily apparent as many fields were laid flat. However, will corn yields also be dramatically reduced? As seen in Figure 1, corn leaves can be shredded to the point that stalks are all that is left in a field. In the photo below, high winds overturned a section of this center pivot system in Sheridan County on June 18th.
To evaluate the effect of hail damage, research was conducted at the Southwest Research-Extension Center near Garden City. Corn at the 15-leaf growth stage, 10 to 15 days from silking, had 80 percent of its leaf area removed. It yielded 36 to 38.5 percent less than nondefoliated corn. Although there was a reduction, a sizeable percentage of the potential yield was harvested by allowing the corn to continue to grow.

Another point to keep in mind is that the hail will cause bruising on the stalk of the plant. This bruising can provide an entry site for diseases and insects. This may cause additional yield loss over and above the loss already caused by the hail storm. If the corn stalk is snapped off or a hail storm occurs when the corn ears and tassels are out, then the potential yield will drastically be reduced.

To conclude, a corn field may look bad after a hail storm. However, give it a few weeks. As long as new green leaves are emerging from the whorl, the corn will continue to progress to harvest. There may be a yield reduction, but not as much as one would suspect when first evaluating the field.

To review the effect of simulated hail damage, please visit the Web site: [http://www.oznet.ksu.edu/library/crpsl2/SRL127.pdf](http://www.oznet.ksu.edu/library/crpsl2/SRL127.pdf).

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3. Causes of dark heads in wheat this year

Dark heads in wheat were common in many areas of Kansas this year, especially in areas that were under drought stress. The dark heads would often appear scattered throughout a field, not necessarily in any pattern. What’s going on?

In most cases, the dark heads appear to be a physiological response to the extreme stress this year. The stress was primarily from drought, combined with stress from periods of unusually high heat and wheat streak mosaic disease.

Under stress, the wheat plants in many cases filled the kernels in the main tillers, and had to abandon the other tillers that may have formed. If these tillers were aborted early enough, they would never develop and the wheat would appear very thin with low tiller counts. But the secondary tillers may have already headed out and begun to flower when the plants had to abandon them due to stress. In that case, the heads would still be present but poorly filled or blank, and the glumes may be dark. These dark, poorly filled heads
would often be lower in the canopy than the heads on main tillers that had better grain fill.

In some cases, the heads that have died prematurely have been infected with a saprophytic fungus. There have been reports from the Plant Diagnostic Lab this year of saprophytic fungi on dark heads of wheat plants that had already senesced. The saprophytic fungus infection occurred after the tissue had already died, and would not be the cause of the problem.

There are a few diseases that can cause dark heads, too. Barley yellow dwarf can cause dark heads, although not all plants infected with barley yellow dwarf will necessarily have dark heads. Glume blotch can turn the glumes dark, although this disease normally occurs under good moisture conditions. The K-State Plant Diagnostic Lab only had two cases of glume blotch submitted this year. Loose smut will turn heads dark. With this disease, the glumes and kernels are converted to masses of smut spores that eventually leave the rachis bare. The symptoms of loose smut are easily distinguished from other factors that cause glumes to turn dark.

The most common cause of dark heads in wheat in Kansas this year is environmental stress.

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4. Update on Clearfield wheat

Two weeks ago we had a report on Clearfield wheat in the Agronomy e-Update, and the new herbicide option (ClearMax) from BASF. We now have a little more information and clarification on ClearMax plans, following a meeting with BASF representatives.

For the coming year, both Beyond and ClearMax will be available in Kansas for use on Clearfield wheat. Earlier indications were that ClearMax would be replacing Beyond for the coming season. ClearMax is a combination of Beyond and MCPA. The MCPA will enhance general broadleaf weed control and help control ALS-resistant broadleaf weeds compared to Beyond alone.

The price of Beyond and ClearMax will be comparable for this season. Earlier indications were that ClearMax would have a lower price, and that may eventually be the case, but as
of now the pricing will be similar. The cost for both products will be less than in previous years, due to a larger rebate program.

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5. Plant analysis for corn

Plant analysis is an excellent “quality control” tool for growers interested in high-yield corn production. There are two primary ways plant analysis can be used: as a routine monitoring tool to ensure nutrient levels are adequate, and as a diagnostic tool to help explain some of the variability in corn growth we see in fields. Keep in mind, however, that any plant stress (drought, heat, soil compaction, etc.) can have a serious impact on nutrient uptake and plant tissue nutrient concentrations. Sampling under stress conditions for monitoring purposes can give misleading results, and is not recommended.

For monitoring purposes, 15-20 ear leaves (the leaf below and opposite the ear), should be collected at random from the field at silk emergence, before pollination, and before the silks turn brown. The leaves should be allowed to wilt overnight to remove excess moisture, placed in a paper bag or mailing envelope, and shipped to a lab for analysis. Do not place the leaves in a plastic bag or other tightly sealed container, as they will begin to rot and decompose during transport, and the sample won’t be usable.

The data returned from the lab will be reported as the concentration of nutrient elements, or potentially toxic elements in the plants. Units reported will normally be in percent for the primary and secondary nutrients (N, P, K, Ca, Mg, S, and Cl) and ppm or parts per million, for the micronutrients (Zn, Cu, Fe, Mn, B, Mo, and Al). Most labs/agronomists compare plant nutrient concentrations to published sufficiency ranges. A sufficiency range is simply the range of concentrations normally found in healthy, productive plants during surveys. It can be thought of as the range of values optimum for plant growth. The medical profession uses a similar range of normal values to evaluate blood work. The sufficiency ranges change with plant age (generally being higher in young plants), vary between plant parts, and can differ between hybrids. So a value slightly below the sufficiency range does not always mean the plant is deficient in that nutrient -- it is just an indication that the nutrient is relatively low. Values on the low end of the range are common in extremely high-yielding crops. However, if that nutrient is significantly below the sufficiency range, then one should ask some serious questions about the availability and supply of that nutrient.

Levels above sufficiency can also indicate problems. High values might indicate overfertilization and luxury consumption of nutrients. Plants will also sometimes try to compensate for a shortage of one nutrient by loading up on another. This occurs at times with nutrients such as iron, zinc, and manganese. In some situations very high levels of a
required nutrient can lead to toxicity. Manganese is an example of an essential nutrient that can be toxic when present in excess.

Plant analysis is an excellent diagnostic tool to help understand some of the variation seen in the field. When using plant analysis to diagnose field problems, try to take comparison samples from both good/normal areas of the field, and problem spots. Collect soil samples from the same good and bad areas. Don't wait for tasseling or silking to sample. Early in the season (prior to the eighth leaf or roughly knee high) collect whole plants from 15 to 20 different places in your sampling area. Later in the season, but prior to tasseling, collect 15-20 top, fully developed leaves (those with leaf collars visible). Handle the samples the same as if they were sampled for monitoring (described above), allowing them to wilt to remove excess moisture and avoiding mailing in plastic bags.

The following table gives the range of nutrient content considered to be "normal" or "sufficient" for corn early in the season (less than 12" tall) and later in the season, at silking. Keep in mind that these are the ranges normally found in healthy, productive corn.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Units</th>
<th>Whole plant, less than 12” tall</th>
<th>Ear leaf at green silk stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>%</td>
<td>3.5-5.0</td>
<td>2.75-3.50</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>%</td>
<td>0.3-0.5</td>
<td>0.25-0.45</td>
</tr>
<tr>
<td>Potassium</td>
<td>%</td>
<td>2.5-4.0</td>
<td>1.75-2.25</td>
</tr>
<tr>
<td>Calcium</td>
<td>%</td>
<td>0.3-0.7</td>
<td>0.25-0.50</td>
</tr>
<tr>
<td>Magnesium</td>
<td>%</td>
<td>0.15-0.45</td>
<td>0.16-0.60</td>
</tr>
<tr>
<td>Sulfur</td>
<td>%</td>
<td>0.20-0.50</td>
<td>0.15-0.50</td>
</tr>
<tr>
<td>Chloride</td>
<td>%</td>
<td>not established</td>
<td>0.18-0.60</td>
</tr>
<tr>
<td>Copper</td>
<td>ppm</td>
<td>5-20</td>
<td>5-25</td>
</tr>
<tr>
<td>Iron</td>
<td>ppm</td>
<td>50-250</td>
<td>30-200</td>
</tr>
<tr>
<td>Manganese</td>
<td>ppm</td>
<td>20-150</td>
<td>20-150</td>
</tr>
<tr>
<td>Zinc</td>
<td>ppm</td>
<td>20-60</td>
<td>15-70</td>
</tr>
<tr>
<td>Boron</td>
<td>ppm</td>
<td>5-25</td>
<td>4.0-25</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>ppm</td>
<td>0.1-10</td>
<td>0.1-3.0</td>
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<tr>
<td>Aluminum</td>
<td>ppm</td>
<td>&lt;400</td>
<td>&lt;200</td>
</tr>
</tbody>
</table>

In summary, plant analysis is a good tool to monitor the effectiveness of a fertilizer and lime program, and a very effective diagnostic tool. Producers should consider adding this to their toolbox.

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These e-Updates are a regular weekly item from K-State Extension Agronomy. 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 Jim Shroyer, Research and Extension Crop Production Specialist and State Extension Agronomy Leader
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