1. Method for estimating wheat yields

By mid-May, producers often want to know what kind of wheat yield to expect. This is a very difficult question to answer since it depends on the weather conditions and diseases from now through June.

Still, there are a couple of methods we can use to make some rough yield estimates. These methods are used by the estimators on the Wheat Quality Council’s annual Hard Winter Wheat Evaluation Tour.

The methods to use in estimating yields depend on whether most of the tillers have headed out yet. These are two distinct situations.

* Wheat has not yet headed out on most or all tillers.

\[ \text{Yield} = \left( \frac{(\text{No. of heads/ft}) \times (\text{Average wt/head}) \times 19.213}{\text{Row space in inches}} \right) \]

The calculations for No. of head/ft and Average wt/head vary by area of the state.

<table>
<thead>
<tr>
<th></th>
<th>Western</th>
<th>Central</th>
<th>Eastern</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of heads/ft</td>
<td>([(\text{No. stalks} \times (.512)) + 10.8])</td>
<td>([(\text{No. stalks} \times (.529)) + 7.5])</td>
<td>([(\text{No. stalks} \times (.518)) + 10.1])</td>
</tr>
<tr>
<td>Average wt/head</td>
<td>0.556</td>
<td>0.645</td>
<td>0.659</td>
</tr>
</tbody>
</table>

Two examples:

a. Western Kansas. There are an average of 50 stalks per foot in 10-inch rows.
Yield = \( \left( \left( 50 \text{ stalks/ft} \times 0.512 \right) + 10.8 \right) \times 0.556 \times 19.213 = 38.9 \text{ bu/acre} \)

b. Central Kansas. There are an average of 30 stalks per foot in 7.5-inch rows.

Yield = \( \left( \left( 30 \text{ stalks/ft} \times 0.529 \right) + 7.5 \right) \times 0.645 \times 19.213 = 38.6 \text{ bu/acre} \)

NOTE: If the primary tillers were killed by freeze and the crop is coming back from secondary or even tertiary tillers, then this formula may overestimate yields.

* Wheat has headed out on most or all tillers.

It’s a little easier to get an accurate yield estimate after most or all of the crop has headed, but it’s still far from certain.

Yield = \( \left( \text{No. heads/ft} \right) \times \left( \text{No. spikelets/hd} \right) \times \left( \text{No. kernels/spikelet} \right) \times 0.48 \)

Row space in inches

Two examples:

a. Western Kansas. There are an average of 20 heads per foot in 10-inch rows.

Yield = \( \left( 20 \text{ heads/ft} \right) \times \left( 12 \text{ spikelets/hd} \right) \times \left( 2 \text{ kernels/spikelet} \right) \times 0.48 = 23.0 \text{ bu/a} \)

b. Central Kansas. There are an average of 30 heads per foot in 7.5-inch rows.

Yield = \( \left( 30 \text{ heads/ft} \right) \times \left( 12 \text{ spikelets/hd} \right) \times \left( 2 \text{ kernels/spikelet} \right) \times 0.48 = 46.2 \text{ bu/a} \)

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2. Plant analysis for wheat: Optimum sampling time is near

Plant analysis is an excellent “quality control” tool for wheat growers interested in high yield wheat management, and one that most growers can take advantage of yet this year.

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 wheat growth that often occurs this time of year.

Keep in mind however that any plant stress (drought, heat, frost, 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 advisable.

**When and what to Sample:** For monitoring purposes, 40-50 flag leaves should be collected at random at the late boot to initial heading stage of growth. Once the plant pollinates and kernel development begins, nutrients start to flow from the stem and leaves to the developing grain. For this reason, sampling flag leaves for nutrient monitoring purposes is not recommended once the plant begins to shed pollen. The leaves should be allowed to wilt over night 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.

**Interpretation of plant analysis data:** The data returned from the lab will be reported as the concentration of nutrient elements, including potentially toxic elements, in the plants. 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 varieties or hybrids. So a value slightly below the sufficiency range in a certain nutrient does not always mean the plant is deficient in that nutrient. It is just an indication that the nutrient is relatively low. 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 that are too much above the sufficiency range can also indicate problems. High values might indicate over-fertilization and luxury consumption. 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 which can be toxic when present in excess.

**As a diagnostic tool:** Plant analysis is also an excellent diagnostic tool to help understand some of the variation seen in the field. When using plant analysis to diagnose field problems, producers should take comparison samples from both good/normal areas of the field, and problem spots. Collecting soil samples from the same good and bad areas is also a good idea. Don't wait for the boot stage to take diagnostic samples. Early in the season (prior to stem elongation), growers should collect whole plants from 20-30
different places in their sampling area. Later in the season, producers should take the uppermost, fully developed leaves (those with leaf collars visible). Handle the samples the same as those for monitoring.

**Sufficiency ranges:** The following table gives broad sufficiency ranges for wheat early in the season, prior to jointing (Feekes 4-6), and later in the season at boot to early heading (Feekes 9-10). Keep in mind that these are the ranges normally found in healthy, productive wheat, and values can vary widely between varieties, with increased maturity and due to soil variability across a field.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Unit</th>
<th>Whole plant at tillering-jointing</th>
<th>Flag leaf at boot to heading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>%</td>
<td>3.5-4.5</td>
<td>3.5-4.5</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>%</td>
<td>0.3-0.5</td>
<td>0.3-0.5</td>
</tr>
<tr>
<td>Potassium</td>
<td>%</td>
<td>2.5-4.0</td>
<td>2.0-3.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>%</td>
<td>0.2-0.5</td>
<td>0.3-0.5</td>
</tr>
<tr>
<td>Magnesium</td>
<td>%</td>
<td>0.15-0.5</td>
<td>0.2-0.6</td>
</tr>
<tr>
<td>Sulfur</td>
<td>%</td>
<td>0.19-0.55</td>
<td>0.15-0.55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Unit</th>
<th>Growth stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>ppm</td>
<td>Tillering-jointing</td>
</tr>
<tr>
<td>Manganese</td>
<td>ppm</td>
<td>Boot</td>
</tr>
<tr>
<td>Zinc</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Boron</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Plant analysis is an excellent tool to monitor the effectiveness of your fertilizer and lime program, and a very effective diagnostic tool. Producers should consider adding this to their toolbox.

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3. Site-specific weed management

Weeds are almost never distributed evenly in fields – they grow better in certain areas. We are researching site-specific weed management, with the goal of making postemergence herbicide applications only in areas where weeds are present instead of
the entire field, while maintaining crop yields. This implies less herbicide use, lower cost, and less impact on the surrounding environment.

In 2003-2004, we started researching variable rate spraying across fields. Many times, spraying the full rate of herbicide in high-density weed areas and spraying a lower rate in less-dense areas was sufficient to maintain crop yields. In some cases, spraying was not needed in sections of fields where weeds were absent. Currently, we are expanding on this research to include more weed species and a larger variety of herbicides. By determining the number of weeds and the variety of species in a field, we can predict yield loss and evaluate the cost-effectiveness of implementing variable rate spraying. Costs include the herbicide itself, but can also include hiring a crop specialist, buying a GPS system and variable rate sprayer, and so forth.

Making a map of where the weeds grow is one of the biggest challenges in site-specific weed management. Most growers are familiar with their fields and where the weeds tend to grow, but for greater accuracy, a crop specialist can be hired to scout the field. GPS (global positioning systems) and scouting software can be particularly useful when scouting a field, because time and money isn’t wasted converting hand-drawn maps to a computer.

Other site-specific weed management practices are also being examined. Variable-rate preemergence herbicide applications are being investigated in other states. Different soil types support different weed densities and may interact with herbicide rates and chemistries, so a variable rate of herbicide can be applied according to soil type. On-the-go tools have been developed to measure different soil textures while driving across a field.

Another up-and-coming technology is the WeedSeeker. This is also an on-the-go machine connected to a hooded sprayer. When a weed passes through an optical sensor under the hood, it prompts the nozzles to spray the herbicide.

Eventually, satellite sensing could determine weed patterns and densities in the field. Satellite measurements create a color signature for weeds. This could help with mapping challenges.

In addition to herbicide applications, narrowing rows and/or increasing the crop seeding rate in weed-prone areas could also prove to be effective weed control measures. Dense crop planting in weedy areas could choke and shade out weeds. In that way, variable-rate planters could be used for site-specific weed management.

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These e-Updates are a regular weekly item from K-State Extension Agronomy and Steve Watson, Agronomy e-Update 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 Steve Watson, 785-532-7105 swatson@ksu.edu, or Jim Shroyer, Research and Extension Crop Production Specialist and State Extension Agronomy Leader 785-532-0397 jshroyer@ksu.edu