DUAL-PURPOSE WHEAT

IMPROVING GRAZING MANAGEMENT USING A SMARTPHONE APP

In much of the southern Great Plains, where conditions allow winter grazing, wheat is managed as a forage and grain crop. A combination of favorable temperatures for wheat growth during winter months and few snow-covered days allows wheat to be used as forage when other forages are limited. Winter wheat offers high-quality forage during the winter in addition to grain at the end of the growing season. The dual-purpose system includes about half of the wheat acreage in Oklahoma and a significant portion of wheat grown in northern Texas and southern Kansas.

In dual-purpose wheat systems, management recommendations for cattle-stocking density are based on the amount of forage needed to sustain cattle weight gains. Fall and winter stocking rates often range from 1 to 2 acres per stocker, depending on weight, while spring stocking rates usually range from 0.75 to 1.3 acres per stocker. Despite being the recommended practice, managing stocking density based on the forage supply and animal weight does not consider the amount of wheat defoliation allowable at the end of grazing to maintain optimum grain yield. Overgrazing wheat pastures increases the risk of reduced grain yield.

The percentage of remaining green canopy cover can be used to help decide when to end in-season grazing. This variable complements forage supply and animal weight while minimizing the risk of overgrazing. The percentage of green canopy cover is simply the proportion of a given ground area covered by green, live vegetation. Green canopy cover affects light interception and the plant's ability to produce carbohydrates. The more leaf area that is present at grazing termination, the greater the opportunity for the wheat crop to recover from grazing.

THRESHOLD GREEN CANOPY COVER TO SUSTAIN MAXIMUM RELATIVE WHEAT GRAIN YIELD

A recent study (Butchee and Edwards, 2013) shows that producers can use the percentage of green canopy cover to monitor wheat pastures from the end of fall growth to grazing termination in late winter (late February or early March) to make in-season adjustments to cattle stocking density to prevent overgrazing. The study compared two winter wheat varieties (Overley and Fuller) subjected to three different simulated grazing intensities and a nongrazed control treatment (Figure 1). The study was conducted during three growing seasons in two locations in north central Oklahoma and had an intensive, an average, and a low grazing intensity treatment. Simulated

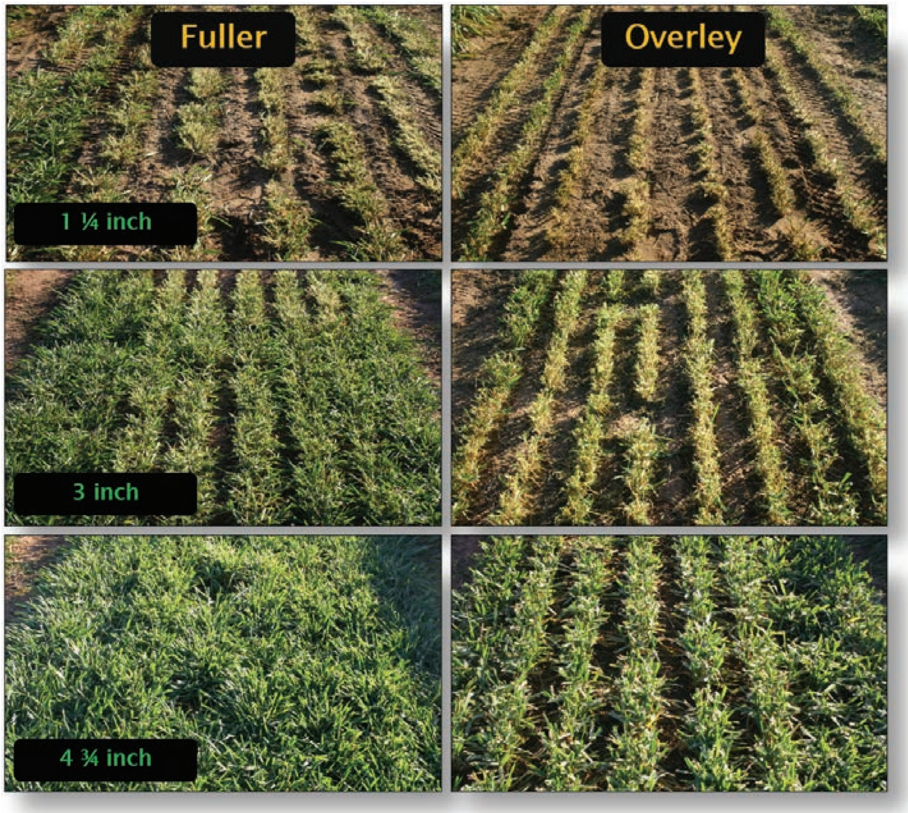

Figure 1. Winter wheat varieties Fuller (left) and Overley (right) following simulated grazing at 1¼, 3, or 4¾ inches mowing height at Lahoma, OK. Photo courtesy of Dillon Butchee, former M.S. student with Oklahoma State University.

grazing was performed when regrowth achieved approximately 2 inches and was terminated at first hollow stem in all site-years.

The results of the study show that yield losses associated with overgrazing can be minimized if the percent of green canopy cover is maintained above 53 percent at the end of the fall, before winter dormancy (Figure 2). It also revealed that a minimum of 62 percent green canopy cover was necessary at grazing termination to maintain 95 percent of the potential grain yield (Figure 2). The research highlights the importance of periodically monitoring green canopy cover during the fall and spring to ensure that the levels of green canopy cover are maintained above the critical thresholds, thus avoiding yield penalties relative to a grain-only wheat system.

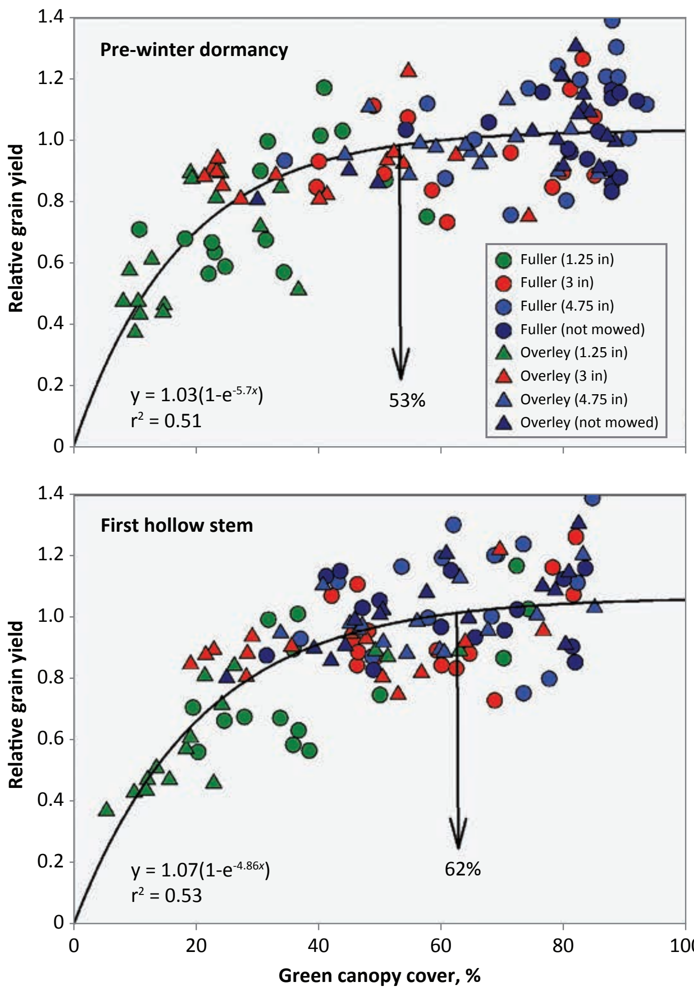

Figure 2. The minimum percentage of green canopy cover of 53 percent before winter dormancy (upper panel) and 62 percent at grazing termination or first hollow stem (lower panel) was needed to ensure maximum wheat grain yield relative to an ungrazed control. Figure adapted from Butchee and Edwards, 2013.

ESTIMATING GREEN COVER USING THE CANOPEO SMARTPHONE APPLICATION

Canopeo is a rapid and accurate green canopy cover measurement tool developed at Oklahoma State University. Canopeo is available as an application for both Android and iOS devices and enables the user to measure the percentage of green canopy cover in real time. This allows users to make informed management decisions while in the field.

STEPS TO USE THE CANOPEO APP:

- Search for and download the Canopeo app from either the App Store or GooglePlay store. For more information, visit the official website at www.canopeoapp.com.

Figure 3. User of the Canopeo mobile app measuring percentage of green canopy cover of winter wheat at the Oklahoma State University Research Station near Marshall, OK. Arms should be extended to the side to avoid including shoes in the photo, and the camera should be held parallel to the ground at least 2 feet (60 cm) above the crop canopy. Photo by Todd Johnson.

- Create an account and accept the permissions requested by the app.
- In the field, open the app in your smartphone and extend your arm to the side so your shoes are not included in the picture. Hold the camera parallel to the ground at least 2 feet (60 cm) from the top of the canopy (Figure 3).
- Snap a photo and continue to next screen.
- A black and white image is displayed, showing the classified green canopy cover in white pixels and the background (soil, plant residue, etc.) represented by black pixels (Figure 4).
- The default settings usually provide excellent approximation, but take a moment to compare whether the white pixels in the processed image match the green pixels in the original image. If you are not satisfied, adjust the slider to better represent the field condition.
- Include additional information with your image.
- Hit "Submit" if using Android or the right-pointing arrow if using an iPhone. Canopeo automatically saves the date, time, and location of each submitted image.

KEY POINTS

- Managing cattle-stocking density based on green canopy cover using the Canopeo app can decrease the risks of wheat grain yield losses associated with overgrazing.
- A minimum green canopy cover of about 53 percent should be maintained before winter dormancy (mid-December) and about 62 percent should be maintained at grazing termination (first hollow stem, late February through March) to minimize grain yield reductions.
- A minimum of six to 12 pictures should be used to determine the average green cover of a given field, depending on field uniformity.

WHAT INFORMATION FROM THE APP IS NEEDED TO MAKE INFORMED DECISIONS?

The percentage of green canopy cover is a valuable piece of information to make in-season grazing management decisions based on knowledge from Figure 2. The expected effect of different ranges of green canopy cover on wheat grain yield differs depending on the growing season stage, and are as follows:

LATE FALL, BEFORE WINTER DORMANCY:

60-100% Optimal	Low risk of grazing affecting grain yield.
40-60% Caution	Moderate risk of grazing affecting grain yield.
0-40% Danger	High risk of grazing affecting grain yield.

LATE WINTER, AT FIRST HOLLOW STEM:

70-100% Optimal	Low risk of grazing affecting grain yield.
50-70% Caution	Moderate risk of grazing affecting grain yield.
0-50% Danger	High risk of grazing affecting grain yield.

HOW MANY IMAGES ARE NEEDED IN EACH FIELD OR MANAGEMENT ZONE?

The number of images needed for accurate calculation of green canopy cover of a given wheat field depends on the spatial variability of green canopy cover in that particular field (Figure 5). In a case study near Stillwater, Oklahoma, several pictures were taken randomly from two grazed wheat pastures, one where grazing was well managed and another with intensive grazing. Average percentages of green cover in the fields were 61 percent and 15 percent, and canopy cover variability was 14 and 73 percent coefficient of variation, respectively. The minimum number of images included in the mean calculation to achieve an acceptable estimation of the wheat field's green canopy cover with error lower than 5 percent was 6 images for the well-managed field and 12 images for the intensively grazed field (Figure 5). Because the Canopeo app gives the percent of green canopy cover in real time, several measurements can be made quickly.

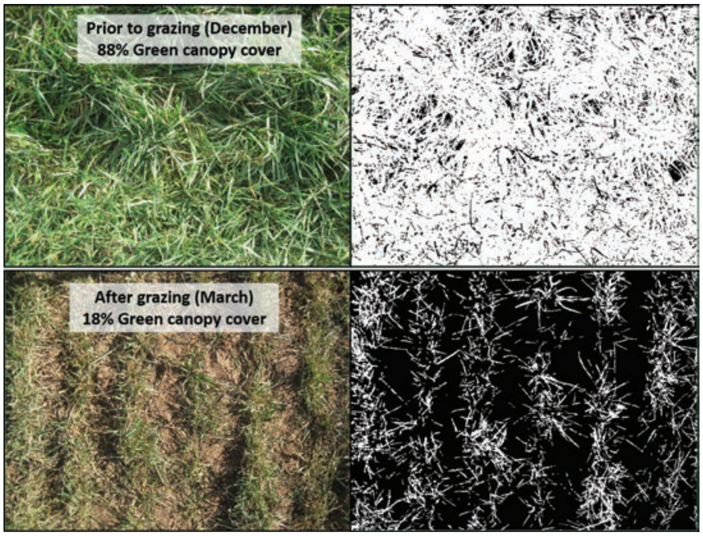

Figure 4. Evaluation of the percentage of green canopy cover before (top, Dec. 2014) and after (bottom, Jan. 2015) cattle grazing at Marshall, OK, using the Canopeo app. The top image presents some freeze damage (see some necrotic leaves) and several dark spots usually ignored on traditional visual quantifications. The bottom image shows excessive defoliation, indicating high risk of affecting grain yield. Notice the green cover is greater than 18 percent, but many leaves are necrotic. Photo courtesy of Andres Patrignani, Assistant Professor, Kansas State University.

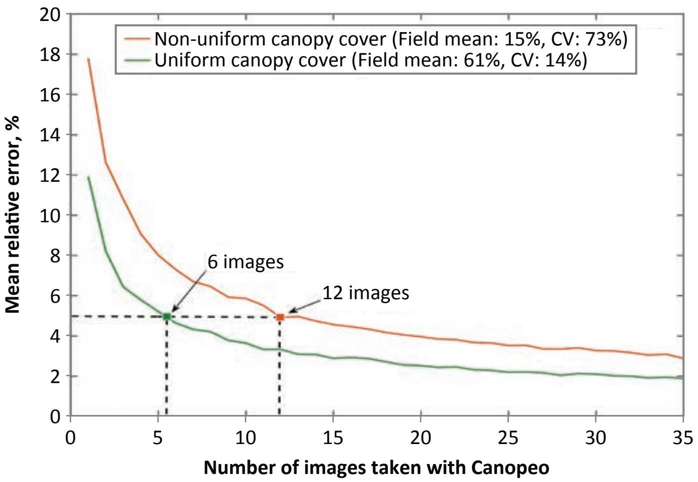

Figure 5. The minimum number of canopy cover pictures included in the estimation of green canopy cover to represent a wheat field with less than 5 percent relative mean error is about 6 for a uniform canopy and 12 for a non-uniform canopy. Relative mean error is the absolute difference between the estimated green canopy cover using the number of images indicated in the x-axis and the overall field mean canopy cover, divided by the actual field mean canopy cover. CV stands for coefficient of variation.

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