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1. Crop intensity and selection can increase water use efficiency

(Editor’s Note: This article is an excerpt, slightly modified, from the new K-State publication Efficient Crop Water Use in Kansas, NF-3066, available at: http://www.ksre.ksu.edu/library/crpsl2/mf3066.pdf -- Steve Watson)

A basic principle of efficient crop water use is shifting as much of the total water use, or evapotranspiration (ET), to crop transpiration and away from evaporation. One way to reduce evaporation is to increase and maintain crop residues.

Evaporation also can be minimized by adjusting crop intensity, and by selecting crops and crop management practices that shift timing of crop growth to occupy portions of the growing season that are most susceptible to evaporation; that is, growing a crop when precipitation is greatest.

**Crop intensity**

Increasing crop intensity can reduce evaporation. This can be achieved either by increasing intensity of grain or forage crops or by using cover crops. Either practice can result in greater amounts of residue, helping reduce evaporation.

Increasing crop intensity depends on balancing crop water use with available soil water. In water-limited areas, there is a point where cropping intensity is too great and not enough water can be stored during fallow periods to successfully grow a subsequent crop. A cropping system that is too intense may result in crop failure. A system that is not intense enough results in inefficient water use.

Actual rainfall amount and distribution, as well as experience with particular soils and crops, will influence which crops to plant and in what sequence. This can involve alternating summer and winter crops, or planting a double crop or cover crop between two crops -- such as wheat and corn in a wheat-corn-fallow rotation. Dynamic rotations that base crop selection and management decisions on actual soil water conditions and realistic precipitation expectations have the greatest probability of success, both in terms of profitability and water-use efficiency. This type of crop rotation, often referred to as “opportunistic cropping,” takes maximum advantage of water when the conditions are right for success.
Crop selection

Crops differ in total amount of water use and in their pattern of water use (see table below). For example, sorghum requires less water to produce the first bushel of grain, but corn produces more grain for each additional unit of water after the threshold requirement has been met.

<table>
<thead>
<tr>
<th>Crop characteristics and water use.</th>
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<tbody>
<tr>
<td>Crop</td>
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<tr>
<td>------</td>
</tr>
<tr>
<td>Broccoli</td>
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<tr>
<td>Winter Canola</td>
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<tr>
<td>Cotton</td>
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<tr>
<td>Safflower</td>
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<tr>
<td>Soybean</td>
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<td>Sunflower</td>
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<td>Barley</td>
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<td>Corn</td>
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<tr>
<td>Maize/Soja</td>
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<tr>
<td>Dats</td>
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<tr>
<td>Pearl millet</td>
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<tr>
<td>Proso millet</td>
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</tbody>
</table>

† Threshold ET (evapotranspiration) is an estimate of the minimum amount of water use required to produce some harvestable grain.
‡ Water use efficiency is defined as yield per inch of ET after the threshold ET requirement has been met.
§ Water use values from Dr. Loyd Stone, Kansas State University. others are adapted from scientific literature or estimates based on similar crops.

Within a crop, specific varieties or hybrids will have different water use patterns depending on the length of maturity. For example, a short-season corn hybrid produces a smaller plant, reaches maturity sooner, and uses less total water than a full-season hybrid. This same trend is true for other crops as well.

<table>
<thead>
<tr>
<th>Growth and water use for corn hybrids of different maturities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days to physiological maturity</td>
</tr>
<tr>
<td>Grain yield (bu/acre)</td>
</tr>
<tr>
<td>Biomass yield (tons/acre)</td>
</tr>
<tr>
<td>ET, emergence to physiological maturity (inches)</td>
</tr>
<tr>
<td>WUE (grain), bu/acre/inch of ET</td>
</tr>
</tbody>
</table>

Adapted from Howell et al., 1998, Agron. J. 90:3-9

Crop management

Management factors can also influence the timing of water use and how water use is likely to correspond to water availability during the season. Typically, corn is planted earlier than sorghum or soybeans, shifting key periods of water use earlier in the growing season. Most grain crops are highly sensitive to water deficits at and around the time of pollination, so it is important to match this period of crop growth with water availability. The figure below illustrates that corn pollination typically takes place when expected precipitation and temperatures at slightly more favorable than when sorghum pollination occurs in Manhattan.
The solid bars show the timing of pollination for corn planted April 13 to 23 and grain sorghum planted May 11 to 24. The lines are the normal maximum temperature and normal precipitation amounts for Manhattan.

Planting dates can be manipulated to shift silking and pollination to a different part of the growing season, when expected precipitation and temperatures may be slightly more or less favorable. The figure below shows that corn silking can take place anywhere from mid-June to mid-August, depending on when the corn was planted. Planting a month later does not result in a month’s delay in silking because corn develops faster when temperatures are higher, reducing the number of days required to reach silking and eventually maturity.

Bars indicate the timing of corn pollination for different planting dates. The lines are the normal maximum temperature and normal precipitation amounts for Hutchinson.

-- Kraig Roozeboom, Cropping Systems Agronomist  
kraig@ksu.edu

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

-- Josh Jennings, CCA – Graduate Research Assistant, Agronomy  
jdj3636@ksu.edu
Wheat replanting decisions

Wheat emergence has been very slow this year in some areas of Kansas because of dry soil conditions. If wheat stands in a field are spotty, it may be necessary to replant some or all of the field, depending on the cause of the poor emergence. Replanting an entire field is expensive and time-consuming, so producers have to make this decision carefully. Even just spot planting a few bare areas can be time-consuming. Nevertheless, replanting any area that truly needs it can pay off.

Stand count determination

The first step is to determine how much below normal the stand count is. To do this, you first have to determine what is normal. This can apply to the entire field or just certain spots that are bare.

If you use a drill with 12-inch row spacings, plants at a 60-pounds-per-acre seeding rate with a variety that has 15,000 seeds per pound, and expects a germination and emergence rate of 75 to 80 percent, there should be 675,000 to 720,000 plants per acre. This amounts to about 15.5 to 16.5 plants per foot of row.

If you planted 60 pounds of seed per acre using 7.5-inch rows, and a germination rate of 75 to 80 percent, that would be about 9 plants per foot or row.

The next step is to determine the average number of plants per foot of row that is present by taking numerous plant counts across the field. This assumes the stand is more or less uniform throughout the field, with no large gaps.

Generally, if the average number of plants is about 50 percent or more of normal, the recommendation is to keep the stand. With less than 40 percent of normal, the recommendation is to replant the field. With a stand that is between 40 and 50 percent of normal, the decision is more difficult.

There are two major concerns to consider other than yield potential in deciding whether to replant: the susceptibility of the ground to wind erosion and the potential for weed and grass infestations. Where stands are less than 40 percent of normal, these become major concerns, even if yield potential is not a concern. In fact, research in western Kansas indicates that 260,000 to 320,000 plants per acre (or about six to seven plants per foot of row) can produce within 90 percent of expected yields – especially if the plants are able to tiller well and the stand is uniform. But if the soil is blowing or weeds and grass infestations become severe, the stand should probably have been replanted and thickened.

Where the stand is 30 to 40 percent of normal, the yield potential will have been reduced enough that replanting will usually pay off. If possible, replanting should be done at a 45 degree angle to the original stand to minimize damage to the existing stand.

Seeding rates when re-seeding

Until the end of October, producers could cross-drill at the rate of 30-40 pounds per acre in western Kansas and 40-60 pounds per acre in central and eastern Kansas, using a double-disc opener drill if at all possible to minimize damage to the existing stand. If the replanting is done in November or later, increase the seeding rates to 60-75 pounds per acre in western Kansas and 75-90 pounds per acre in central Kansas. If stands are less than 30 percent of normal, increase the seeding rates just
mentioned by 20-30 pounds per acre. If a hoe drill is used, the seeding rate should be higher than if a
disc drill is used because the hoe drill will destroy much of the original stand. With a hoe drill, add
about 20-30 pounds per acre to the seeding rates mentioned above.

Where there was no emergence in all or parts of the field, producers would have to use a slightly
higher seeding rate than used initially -- 75 to 90 pounds per acre in western Kansas and 100 to 120
pounds in eastern and central Kansas, using the higher end of those ranges when planting in
November or later.

Seeding rates on non-irrigated fields should not be higher than 90 lbs/acre in western Kansas or 120
lbs/acre in central and eastern Kansas. Under irrigation, seeding rates should never be higher than
150 lbs/acre.

Causes of poor emergence

Before replanting, producers should dig through the soil crust to determine why the seed did not
emerge. The most common emergence problems are dry soils, crusting, poor quality seed, seedling
rot diseases, and wireworms.

If dry soils are the cause of the problem, which is the most likely situation this year, replanting will
do no good unless the seed has partially germinated and stalled out before emerging. If the seed are
still hard and viable, or have a very short coleoptile emerging from the seed, the best advice is to
leave the field alone and wait for rain.

Where crusting has occurred, producers should determine whether the seeds or seedlings are still
viable or the coleoptiles have become bent or crinkled due to the crusting. Sometimes a light rain on
crusted soil will soften the crust so seedlings can emerge. Otherwise, a rotary hoe will break up the
crust, allowing them to emerge.

If there has been adequate moisture and no crusting, but little or no emergence, poor quality seed,
seedling rot diseases, or soil insects are possible causes of the problem. In this case, the field will
need to be replanted with good quality, treated seed.

-- Jim Shroyer, Crop Production Specialist
jshroyer@ksu.edu

3. Tillering potential of wheat covered with soil

High winds and blowing soil can cause soil to pile up in unwanted places, including in the furrows
created by hoe drills. If this happens shortly after emergence, the crown of the seedlings will get buried
to some extent under an unexpected layer of soil. Hopefully there will still be leaves sticking up out of
the soil. But even if leaves are visible, the crown will be positioned deeper underground that normal.

This raises a few questions:

* Will this wheat still be able to tiller? Yes, but there may be fewer tillers than normal. Most tillers
form in the axils of leaves, which will be down at the crown level. The crown normally establishes
about a half-inch below the soil surface, regardless of how deeply the seed was planted. When the
crown is deeper in the soil, it will be cooler and this can reduce the level of tiller initiation activity going on near the crown.

Once a wheat plant has three leaves, the first tiller will begin growing in the axil of the first leaf. If the seedling has been covered with soil, this tiller will have to push through more than the usual half-inch of soil to emerge. This takes a little extra effort, but is certainly not impossible. After the next leaf forms, a second tiller will start growing – this time from the axis of the second leaf. This will still be at the crown, however, and so the second tiller will also be starting out under more soil than normal. It’s hard to say how many of these tillers will actually make it through the soil.

There can also be “coleoptilar” tillers, which form at the base of the coleoptile – near the seed and below the crown. When the seed furrow fills in with soil after emergence, the seeds will be so deep that it’s unlikely any coleoptilar tillers will be able to emerge.

* Will the main shoot and leaves continue to grow normally? Yes, if three or more leaves are present above the soil surface. Any shoots and leaves that make it above the soil surface will grow normally. Potential head size will not be affected by this. If only one leaf is sticking out of the ground (or not at all), however, the plants cannot be expected to develop normally.

* Should the field be replanted? If the stand is good and there are three or more leaves visible above the soil surface, then there’s probably no need to replant. You can probably expect fewer tillers per plant, depending on how deep the crown has been buried and the firmness of the soil. That may reduce yield potential somewhat – but not enough to justify replanting. If the stand has been thinned out, however, or if the plants are buried so that no leaves or only one leaf is visible, replanting may be a good idea (see article above).

-- Jim Shroyer, Crop Production Specialist
jshroyer@ksu.edu

4. FDA approves blending of corn containing aflatoxin

Earlier this month, the U.S. Food and Drug Administration (FDA) approved the Kansas Department of Agriculture’s (KDA) request to allow corn containing more than 20 parts per billion (ppb) of aflatoxin to be blended with corn with lower levels or no aflatoxin to be used for animal feed in accordance with FDA guidelines.

Certain procedures must be followed in the blending process. Prior to blending, the blending firm must file a compliance certification form and submit the completed form to KDA. By filing the certificate the blending firm certifies that it shall comply with the following conditions when blending corn containing aflatoxin in concentrations of higher than 20 ppb (parts per billion) and less than 500 ppb with other corn containing aflatoxin and/or corn free of aflatoxin for animal feed:

a. Corn contaminated with aflatoxin above 20 ppb may be blended with other corn to the extent that the resulting product is below the appropriate aflatoxin action level in corn used as or in animal feed. The blended corn will be used, sold, or shipped in interstate commerce or for use as or in feed for mature poultry, breeding swine and finishing swine over 100 pounds, breeding cattle and finishing (feedlot) cattle as long as the aflatoxin levels are below the action levels set forth in FDA Guidance Document, Compliance Policy Guide- Section 683.100, “Action Levels for Aflatoxin in Animal Feeds.”
b. Once the blending operation is completed, each batch of blended corn will be analyzed to determine its aflatoxin level. Samples will be analyzed by the Kansas Grain Inspection Service with results reported to the blending firm and the Kansas Department of Agriculture. The analysis shall be performed using U.S. Department of Agriculture Grain Inspection Packers and Stockyards Administration (GIPSA) approved sampling and analysis protocols and testing procedures. Prior to the use of the blended corn and before shipment in interstate commerce, the seller will certify that the aflatoxin level of the blended batch does not exceed the action level for the appropriate intended species. The GIPSA protocol can be found at: http://www.gipsa.usda.gov/publications/fgis/handbooks/grain-insp/grbook1/bk1ch2.pdf

c. The seller of corn blended pursuant to this process will provide the purchaser with a copy of the analytical results generated from the process described in subparagraph “b.” In addition, the seller will obtain written assurance from the purchaser that blended corn will be used only as described in subparagraph “a.”

d. The blended corn will be clearly identified and labeled for animal feed use only.

e. Corn containing aflatoxin levels greater than 500 ppb cannot be blended.

Grain handlers need to be aware that aflatoxin levels can potentially increase in storage. Aflatoxin contaminated corn held in storage should be cooled as quickly as possible to below 50° F and the moisture of the grain should be reduced to less than 15%. Grain should be checked frequently and any out of condition grain should be handled in an appropriate manner. In the spring, raise grain temperature gradually so as to minimize condensation on the grain.

-- Doug Jardine, Extension Plant Pathologist
jardine@ksu.edu

5. Comparative Vegetation Condition Report: October 9 – 22

K-State’s Ecology and Agriculture Spatial Analysis Laboratory (EASAL) produces weekly Vegetation Condition Report maps. These maps can be a valuable tool for making crop selection and marketing decisions.

Two short videos of Dr. Kevin Price explaining the development of these maps can be viewed on YouTube at: http://www.youtube.com/watch?v=CRP3Y5NIggw http://www.youtube.com/watch?v=tUdOK94efxc

The objective of these reports is to provide users with a means of assessing the relative condition of crops and grassland. The maps can be used to assess current plant growth rates, as well as comparisons to the previous year and relative to the 21-year average. The report is used by individual farmers and ranchers, the commodities market, and political leaders for assessing factors such as production potential and drought impact across their state.

NOTE TO READERS: The maps below represent a subset of the maps available from the EASAL group. If you’d like digital copies of the entire map series please contact Kevin Price at kpprice@ksu.edu and we can place you on our email list to receive the entire dataset each week as
they are produced. The maps are normally first available on Wednesday of each week, unless there is a delay in the posting of the data by EROS Data Center where we obtain the raw data used to make the maps. These maps are provided for free as a service of the Department of Agronomy and K-State Research and Extension.

The maps in this issue of the newsletter show the current vegetation conditions in Kansas, the Corn Belt, and the continental U.S, with comments from Mary Knapp, state climatologist:

Map 1. The Vegetation Condition Report for Kansas for October 9 – 22 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the greatest photosynthetic activity is in the eastern areas of the state, where warmer temperatures and more favorable precipitation have continued. The Northwest and West Central Divisions have very low biomass, as do parts of south central Kansas, particularly Comanche and Barber counties.
Map 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for September October 9 – 22 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows areas of Finney, Hodgeman, and Ness counties have much greater photosynthetic activity than last year. Similarly, Miami, Linn, and Bourbon counties are showing greater productivity at this time. Both of these regions benefited from late September/early October rains that missed neighboring areas.
Map 3. Compared to the 23-year average at this time for Kansas, this year’s Vegetation Condition Report for October 9 – 22 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that greatest positive departure from average is in Ness and Hodgeman counties. The eastern Kansas counties that had the recent moisture are only slightly ahead of average productivity.
Map 4. The Vegetation Condition Report for the Corn Belt for October 9 – 22 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the northern and western areas of the region continue to have low productivity values. There is a small area of western South Dakota, near the Black Hills, that has slightly higher photosynthetic activity than the rest of the state. Drought conditions in that area still are in the extreme category. Drought conditions have improved slightly in the eastern portions, but western Iowa north to western Minnesota, and areas west of there, continue to experience severe to exceptional drought. Areas of North Dakota, where drought conditions have improved, won’t see much increase in biomass production as we are now in the dormant period.
Map 5. The comparison to last year in the Corn Belt for the period October 9 – 22 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that most of the region has much lower productivity. Minnesota and North Dakota have the biggest decrease, as these areas were the last to be influenced by the movement of the 2011 drought conditions northward.
Map 6. Compared to the 23-year average at this time for the Corn Belt, this year’s Vegetation Condition Report for October 9 – 22 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that much of the northern region has well-below-normal productivity. The greatest departures are concentrated in Nebraska and South Dakota, which matches the areas of exceptional drought conditions as well.
Map 7. The Vegetation Condition Report for the U.S. for October 9 – 22 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that high NDVI values are seen along the Pacific Northwest and down along the mountains of California. This is due primarily to good moisture in these areas. Shortly, the NDVI readings may be affected by snow cover. Snow cover will produce lower NDVI values, due to the covering of photosynthetically active plant material by the snow. In November, we will begin to apply the snow cover overlay to delineate areas of snow cover.
Map 8. The U.S. comparison to last year at this time for the period October 9 – 22 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows the reverse of the drought pattern. Last year, the drought was centered in Texas. This year, the center is in Nebraska. The exception is along the Texas-Louisiana Gulf Coast, which had begun to emerge from the drought earlier than the rest of the region.
Map 9. The U.S. comparison to the 23-year average for the period October 9 – 22 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that much of the continental U.S. is close to normal. Along the Texas Gulf Coast, lingering impacts from earlier flooding continue to be visible.

-- Mary Knapp, State Climatologist
mknapp@ksu.edu

-- Kevin Price, Agronomy and Geography, Remote Sensing, Natural Resources, GIS
kpprice@ksu.edu

-- Nan An, Graduate Research Assistant, Ecology & Agriculture Spatial Analysis Laboratory (EASAL) nanan@ksu.edu

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, Jim Shroyer, Crop Production Specialist 785-532-0397 jshroyer@ksu.edu, or Curtis Thompson, Extension Agronomy State Leader and Weed Management Specialist 785-532-3444 cthomps@ksu.edu.