Number 345
April 13, 2012

1. Impacts of gypsum as a soil amendment on clayey soils

Some producers have wondered about the potential benefits of gypsum applications to heavy-textured, clayey soils that have slow drainage. The potential benefits of using gypsum (calcium sulfate dihydrate) as a soil amendment on clayey soils include:

- Enhanced soil aggregation
  - Improved infiltration
  - Reduced risk of runoff and erosion
- Reduced aluminum toxicity in acidic soils
- Source of soil calcium (Ca) and sulfur (S)

To test whether gypsum can provide any or all of these potential benefits, a one-year pilot study was recently conducted in Kansas. Similar experiments are underway in other states on clayey soils, and some unpublished data for one 2011 site location has been supplied by a Wisconsin researcher.

Methods

A test was established on an Irwin silty clay loam soil in a producer's field near Marion, Kansas in December 2010. The 2010 crop was conventionally tilled soybeans and the 2011 crop was no-till grain sorghum. The five treatments consisted of applying 0, 0.50, 2.15, 4.30, and 8.60 tons per acre of mined gypsum before planting.

Soil samples were collected prior to gypsum application and were analyzed for background cation concentrations (Table 1). Grain yield and grain nitrogen (N) and sulfur (SO_4-S) content were determined. After harvest, soil samples were taken for wet-aggregate stability analysis and for soil fertility analyses, including: pH, potassium (K), Ca, Mg, sodium (Na) and cation exchange capacity (CEC). Additionally, soil hydraulic conductivity was measured.

Data was also obtained from a similar study conducted in Douglas Co., Wisconsin, near Lake Superior on a clay loam soil with 39% clay using flue gas desulfurization (FGD) gypsum applied at rates of 0, 0.5, 1.0, and 2.0 tons per acre in a tilled corn field. In that study, infiltration tests were conducted and samples were collected for wet aggregate stability and bulk density measurement approximately 12 weeks after gypsum application.

Results

Table 1. Soil test results prior to gypsum application (Kansas).

pH	K (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	CEC meq 100 g^{-1}	Ca:Mg*
6.2	401	2526	1338	84	28	1.1

**The Ca:Mg ratio may look incorrect at first glance, but this ratio should be calculated after converting Ca and Mg concentrations to units of meq per 100 grams. To convert Ca ppm to Ca meq per 100 grams, divide by 200. To convert Mg ppm to Mg meq per 100 grams, divide by 120.*

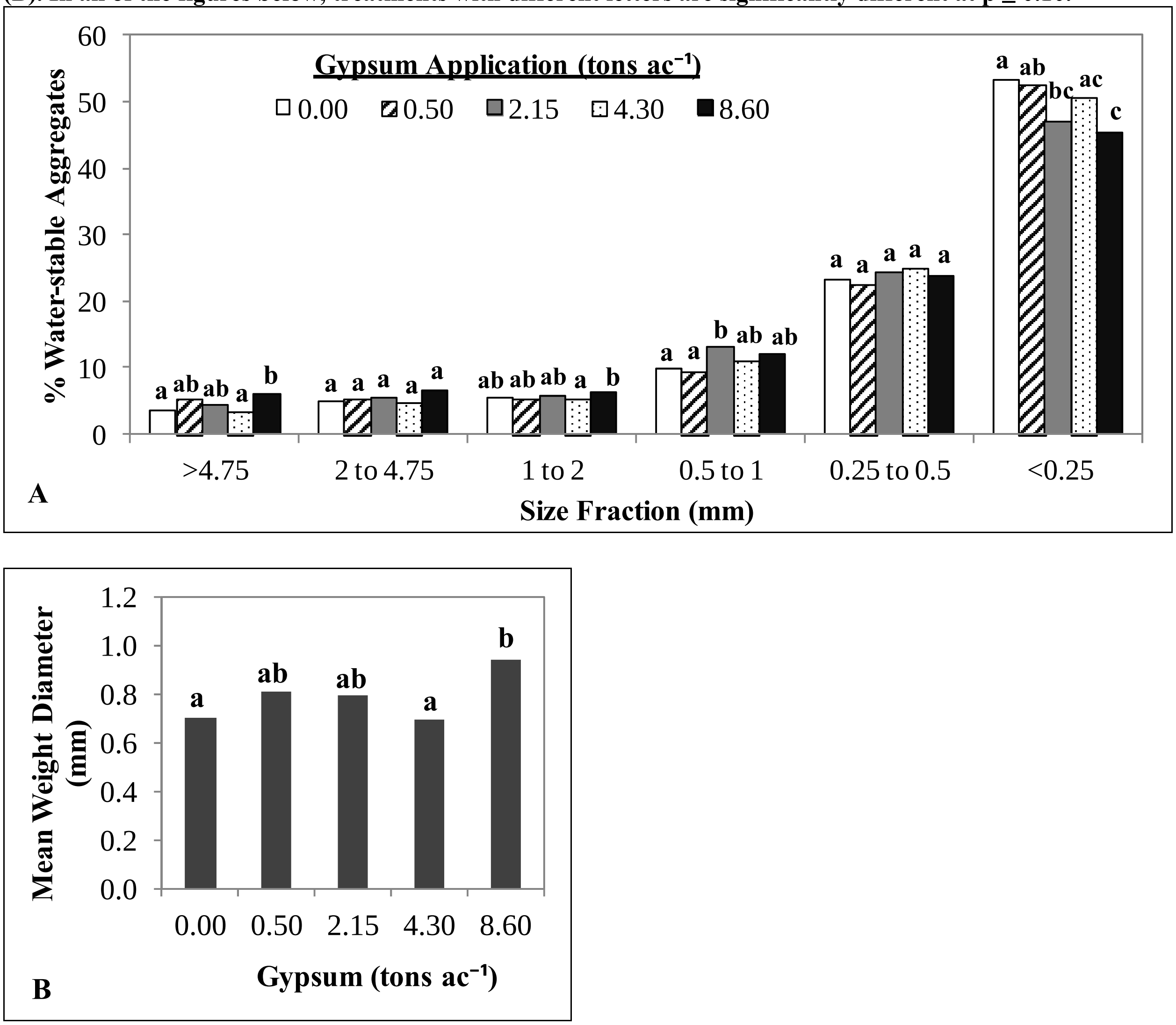
Sorghum yield and nutrient content. In the Kansas tests, no differences in sorghum yield and grain N and S content were observed among gypsum application rates (Table 2).

Table 2. Sorghum yield and nutrient content as impacted by gypsum application rate (Kansas).

Gypsum Application (tons per acre)	Sorghum Yield (bu per acre)	Grain Nitrogen (% N)	Grain Sulfur (% SO_4-S)
0.00	41.3 a	2.06 a	0.108 a
0.50	37.0 a	2.01 a	0.107 a
2.15	32.6 a	2.05 a	0.109 a
4.30	30.2 a	2.09 a	0.119 a
8.60	38.3 a	1.91 a	0.113 a

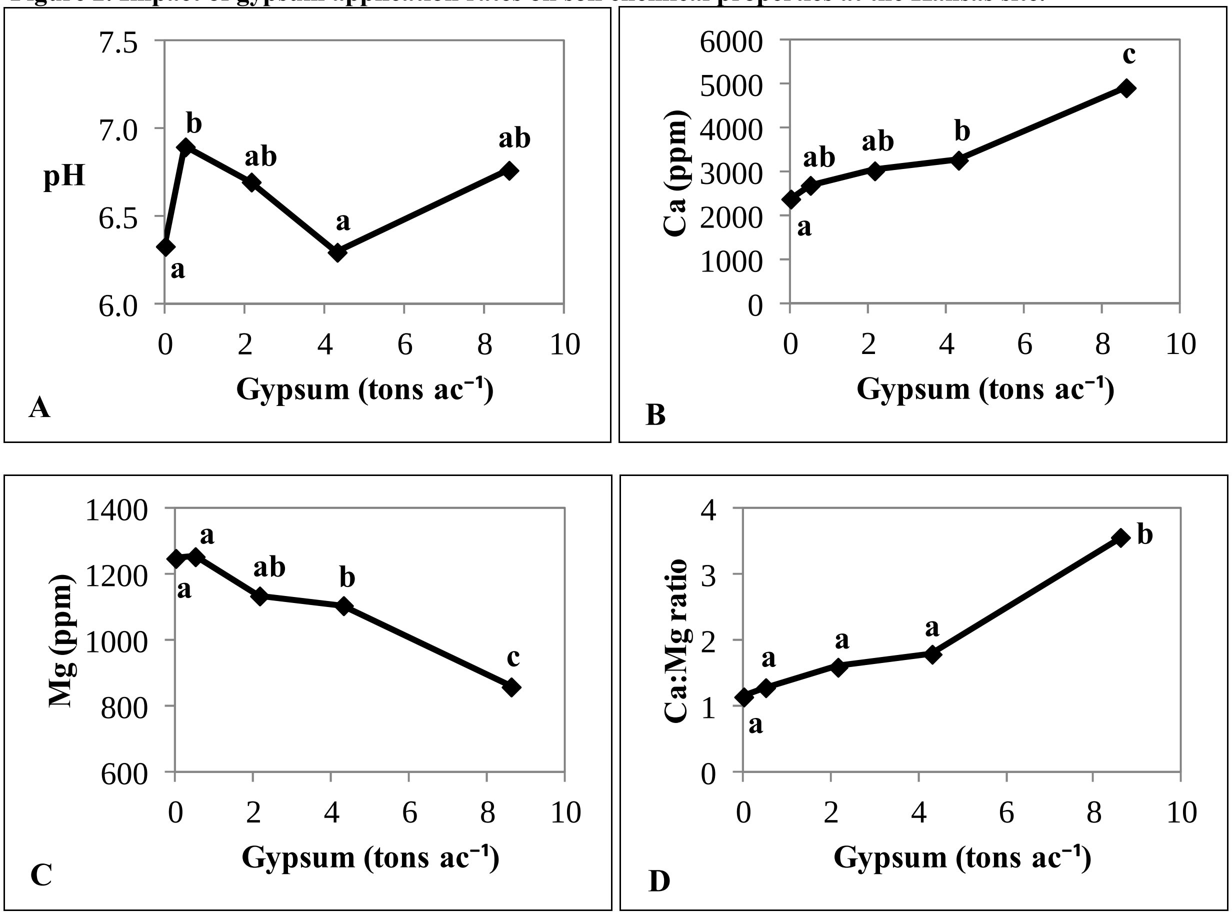
Wet-aggregate stability. Gypsum addition of 8.60 tons per acre resulted in a greater percentage of large aggregates (>4.75 mm) relative to no gypsum application. Lesser percentages of small aggregates (<0.25 mm) were observed with gypsum application rates exceeding 0.50 tons per acre as compared to no gypsum addition (Fig. 1A). Likewise, gypsum application of 8.60 tons per acre increased mean weight diameter (MWD) of water-stable aggregates by 0.23 mm compared to no gypsum application (Fig. 1B).

Figure 1. Effect of gypsum application on percentage of water-stable aggregates by size fraction (A) and MWD (B). In all of the figures below, treatments with different letters are significantly different at p ≤ 0.10.



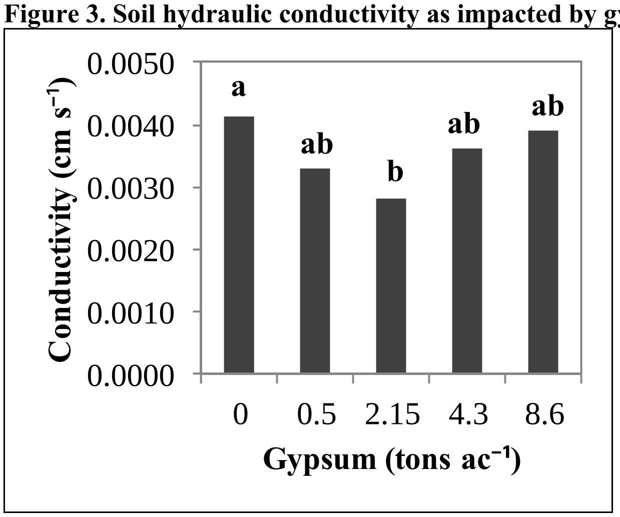
Soil fertility. Unlike lime, gypsum does not impact soil pH. Any differences in soil pH observed in this study are most likely the result of within-field variation (Fig. 2A). Soil Ca increased by 883 ppm at the 4.30 tons per acre gypsum rate and by 2530 ppm at the 8.60 tons per acre application rate compared to no gypsum application (Fig. 2B). This result should be expected as gypsum can be composed of up to 23% Ca. On the other hand, soil Mg decreased by 143 ppm at the 4.30 tons per acre gypsum rate and by 389 ppm at the 8.60 tons per acre application rate compared to no gypsum addition (Fig. 2D).

Figure 2. Impact of gypsum application rates on soil chemical properties at the Kansas site.



Infiltration. Gypsum application rate of 2.15 tons per acre resulted in lower hydraulic conductivity than the control (Fig. 3), however, this difference is most likely the result of inherent, within-field soil variability.

Figure 3. Soil hydraulic conductivity as impacted by gypsum application rate.



Wisconsin Data. Addition of gypsum at this site appeared to improve soil physical properties by reducing bulk density and increasing infiltration and mean weight diameter of water stable aggregates; however, the effect was not found to be significant (data not shown). Additional tests were completed at other sites in watersheds draining to Lake Superior and Lake Michigan and those sites also exhibited no significant treatment effect on soil physical properties in the year of gypsum application. All sites had fine-textured soils that were relatively dense and had been in corn-wheat or corn-soybean rotations under tillage. These soils would be similar to those in Kansas but with a shorter growing season.

Conclusion

While the highest rate of gypsum application in the Marion County, Kansas study (8.60 tons per acre) resulted in increased soil wet-aggregate stability, Ca concentration, and CEC the first year after application, no differences in sorghum grain yield or infiltration were observed. Additionally, gypsum application did not significantly alter soil physical properties in Wisconsin. However, there is the potential that some of the benefits might take longer than one growing season to be seen. To read more about gypsum application rates and gypsum as an amendment, you might be interested in a 2011 publication from Ohio State University by L. Chen and W.A. Dick: *Gypsum as an Agricultural Amendment*, available at: http://ohioline.osu.edu/b945/b945.pdf

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2. Controlling volunteer corn, soybeans, and grain sorghum

Last year's hot, dry weather resulted in widespread failure of dryland corn, soybean, and grain sorghum in much of Kansas south of I-70. As a result, there may be more volunteer corn, soybeans, and grain sorghum than usual this year in fields where the crop formed seed but was either not harvested or was baled for hay due to low grain yield prospects. In most cases where crops are rotated, controlling volunteer plants of these crops should not be too difficult. But control can be challenging in some cases, especially where producers plan to plant the same crop again this year.

Volunteer corn

In stubble fields. If volunteer Roundup Ready corn is emerging in a stubble field that will be planted later to another crop, it can be easily controlled with a grass herbicide such as Poast or Poast Plus, Select or Select Max, or Assure II. Several generics of these grass herbicides exist in the marketplace and could do an excellent job as well. Be sure to check the label for recrop restritions and the appropriate use rate, which can change depending your location in the state. The minimum waiting interval between application and planting corn for these herbicides ranges from a minimum of 6 days for 6 oz of Select Max to 120 days for Assure II. The minimum waiting interval between application and planting sorghum for these herbicides ranges from a minimum of 30 days for Poast Plus to 120 days for Assure II. There is no waiting interval required before planting soybeans. A non-selective herbicide such as Gramoxone could also be used. However, the treated corn plants may recover after treatment because this herbicide is not translocated. If the corn is not Roundup Ready, it can also be controlled with glyphosate. Volunteer corn left uncontrolled in fallow can reduce a subsequent wheat crop yield as reported by John Holman et.al. in K-State publication SRL-141 *Volunteer Corn in Fallow* at: http://www.ksre.ksu.edu/library/crpsl2/srl141.pdf

Within a soybean crop. In most cases, volunteer corn will emerge before soybeans are planted, and can be controlled before planting. If, however, Roundup Ready corn is growing in a field of Roundup Ready soybeans, it can be controlled with Poast or Poast Plus, Select or Select Max, or Assure II., or generics. If the corn is not Roundup Ready but the soybeans are Roundup Ready, the volunteer corn can be controlled with glyphosate.

Within a corn crop. It's important to know which herbicide resistant traits exist in your volunteer corn. Liberty may control conventional or Roundup Ready volunteer corn, but will not be effective if the corn is Liberty Link. Often it will require two applications with Liberty for optimum control. If the volunteer corn contains resistance to both glyphosate and Liberty and emerges within a newly planted field of Roundup Ready corn, the volunteer cannot be controlled. If volunteer densities are low, yields will not be affected. Excessive plants, however, could reduce corn yields and may require row crop cultivation.

Volunteer soybeans

In stubble fields. If volunteer Roundup Ready soybeans are emerging in a stubble field that will be planted later to another crop, it can be easily controlled with a selective herbicide such as dicamba or 2,4-D, or a non-selective herbicide such as Gramoxone. If the soybeans are not Roundup Ready, it can be controlled with glyphosate.

Within a corn or sorghum crop. If volunteer Roundup Ready soybeans are emerging in a field of Roundup Ready corn, the soybeans will probably get shaded out by the corn canopy and not be a problem. Postemergence treatments containing dicamba, Status, Clarity, or atrazine should control emerged soybean plants in corn if necessary. If volunteer Roundup Ready soybeans come up in a field of grain sorghum, the volunteer can be controlled with, Atrazine+COC, dicamba+atrazine, other combinations with atrazine, or Ally+2,4-D.

Within a soybean crop. If volunteer Roundup Ready soybeans have emerged within a newly planted field of Roundup Ready soybeans, the volunteer cannot be controlled, unless the newly planted soybeans are Liberty Link. In that case, the volunteer can be controlled with Liberty. If heavy volunteer densities are anticipated, rotating to a grass crop would be recommended instead of planting soybeans again. If soybeans are planted into a clean seedbed, because of the nature of soybean growth and development, it is unlikely that soybean volunteer in-crop would affect final soybean yield.

Volunteer grain sorghum

In stubble fields. If volunteer grain sorghum is emerging in a stubble field that will be planted later to another crop, it can be easily controlled with glyphosate.

Within a corn or soybean crop. If volunteer sorghum is emerging in a field of Roundup Ready corn, it can be controlled with glyphosate or any other herbicide that would be used to control shattercane. If heavy densities are expected, herbicides such as Corvus or Balance Flexx with atrazine applied preemergence or before the 2-collar stage of corn can have activity on volunteer sorghum. Several preplant or preemergence herbicides used in soybeans have activity on volunteer sorghum and should be used if heavy volunteer sorghum is expected. If volunteer sorghum emerges in Roundup Ready soybeans, it can be controlled with glyphosate or any of the grass herbicides, Poast, Select, Assure II, or generics.

Within a sorghum crop. Herbicides such as Degree Xtra, Lumax, Lexar, or other products containing a chloracetamide herbicide preemergence, may provide some level of control or weaken the volunteer sorghum seedlings because they are not "Concep" treated as is the planted sorghum seed. If seed of last year's crop is present in the soil, volunteer sorghum likely will emerge within a newly planted field of sorghum and can only be controlled between the rows with row crop cultivation. However, as with soybeans, it is unlikely that emerging volunteer in the sorghum crop will have much effect on final sorghum yield unless populations are very high. If high populations of volunteer sorghum are expected, it would be our recommendation to rotate to corn, soybean, or fallow and plant winter wheat this fall depending on your location and soil moisture availability.

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3. Wheat disease update and frequently asked questions about fungicides

The cooler weather the past week to 10 days has slowed down development of the wheat crop, especially in central and eastern Kansas. The crop is still ahead of normal in development, but is not advancing as rapidly as it had been earlier.

We continue to get reports of low levels of stripe rust, leaf rust, Septoria tritici blotch, and tan spot from throughout central Kansas. Most reports indicate that low levels of rust diseases can be found on the top three leaves but is probably most common on the second and third leaf down into the canopy. Infection of the flag leaf by stripe rust has been reported in southeast and south central regions. Tan spot and Septoria tritici blotch are at moderate levels in many fields, with infections commonly occurring on the lower leaves and mid canopy.

The excellent yield potential of many fields and emerging risk of disease has many farmers thinking about fungicides applications. Based on the information I have to date, it appears that most areas of central Kansas are at a moderate risk for disease related yield loss this year. I suggest that farmers scout their fields for disease and carefully evaluate the need for fungicides.

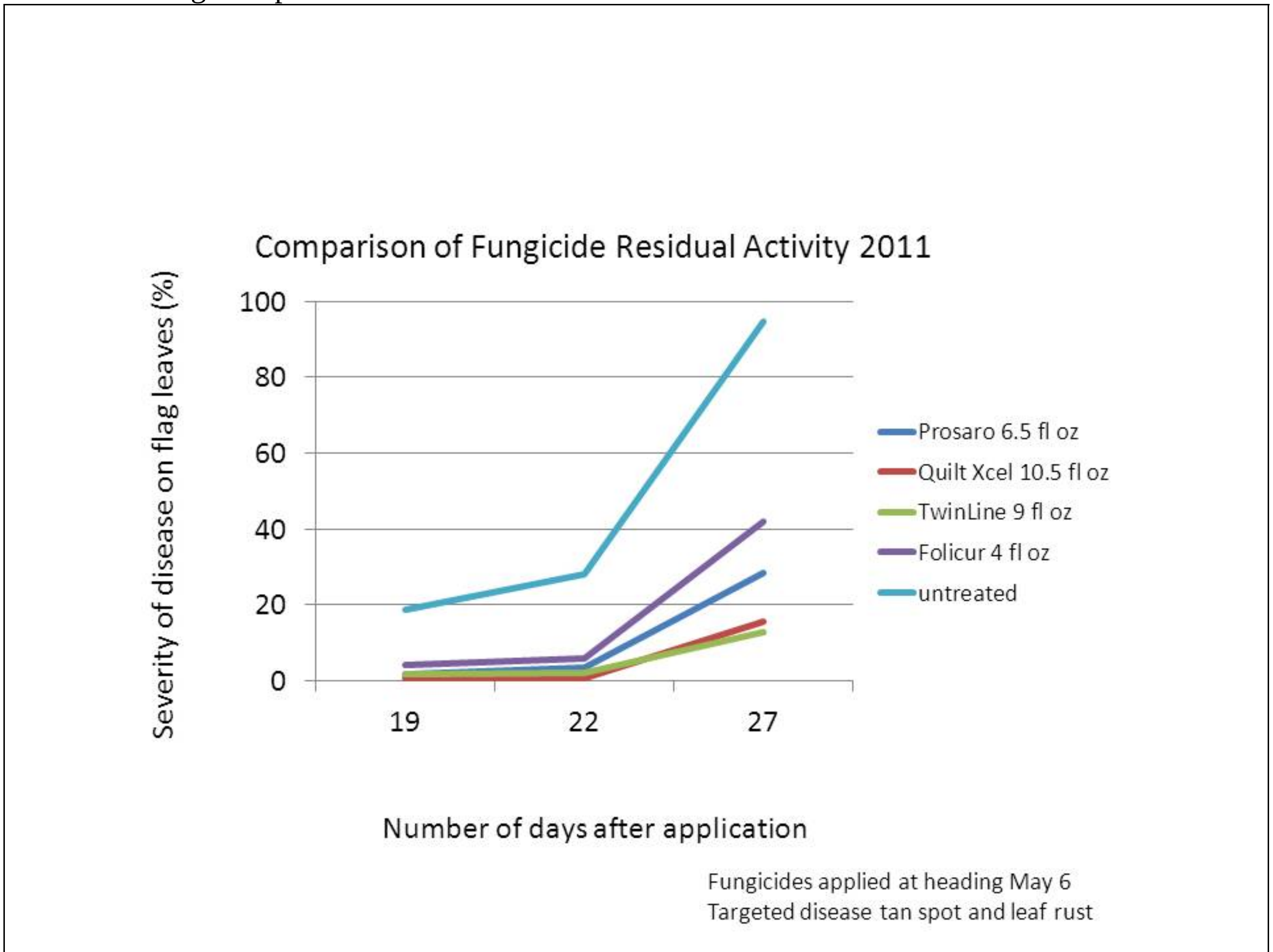
The interest in fungicides has stimulated a lot of questions about the different fungicide products. Below are some of the most common questions and potential misunderstandings from this week.

What type of residual life can I expect from the different fungicide products?

The residual life of the fungicide is influence by many factors, including the rate at which the product is applied, the targeted disease, and the level of disease pressure. Fungicides applied at the full-labeled rate will generally have longer residual life. Fungicides will generally provide longer residual life against rust diseases (often more than 21 days) than leaf spot diseases. Some of the products may provide some additional residual life but this extra residual does not always translate into more grain yield.

The research that I have reviewed indicates that fungicides listed in the publication *Foliar Fungicide Efficacy Ratings for Wheat Disease Management, 2012,* EP130, will generally provide 21 days of solid protection against fungal diseases. This includes products with the active ingredient tebuconazole that is listed in the table as the product Folicur but is also marketed in a number of generic formulations. This publication can be found at:
http://www.ksre.ksu.edu/library/plant2/ep130.pdf

The chart below is just one example of the type of data that supports the 21-day residual activity for the various fungicide products.



What about the different level of curative and preventive activity of the fungicides?

Based on the questions I have been getting this week, it appears that there is some confusion about the preventative and curative activity various fungicides. All the fungicides listed in the *Foliar Fungicide Efficacy Ratings for Wheat Disease Management* publication mentioned above are best applied when the disease is at low levels. The triazole fungicides are generally considered to provide some limited curative activity. This means that they can stop the development of fungi already inside the plant. The triazole-only fungicides include products such as Prosaro, Carmaba, Tilt, and Folicur. Triazole fungicides are also included in mixed mode-of-action products such as Quilt Xcel, Stratego

YLD, and TwinLine. Both the triazole and strobilurin fungicides provide excellent protection against new infections that is often considered "preventive" activity.

It would be an error to think that a triazole fungicide does not provide preventive activity simply because it also has curative activity. The curative activity is good thing, especially with a disease such as stripe rust where the fungus grows within the plant to cause additional expansion of the stripes.

The bottom line is that producers have a lot of excellent fungicide options. In my experience, based on the all the data I have seen in research trials in Kansas and other states, the importance of correctly identifying situations where fungicides are needed or not needed is far greater than the choice of fungicide product.

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4. Disease prediction system for Fusarium head scab on wheat

A disease prediction system is currently available to help farmers evaluate the risk of Fusarium head scab in their area. The prediction system summarizes the weather conditions over the last 7 days and provides a daily estimate of disease risk. The risk of disease is presented in a map-based format where colors represent the chance of a scab epidemic (green = low risk, yellow = moderate, and red = high risk).

I suggest that growers access the site frequently during the next few weeks to monitor the risk of disease as they approach flowering. The prediction tool can be found at:
http://www.wheatscab.psu.edu/

Here's how to use this tool.

* Click on the link called "Risk Map Tool"
* When the next window appears, first click on a date on the calendar on the left side of the page. Then click on the big "OK" in the center box.
* The next box to appear is "Choose Model." Click on winter wheat, then "OK."
* On the large map of the U.S., click on the state of Kansas.
* This bring ups a large map of Kansas. The colors on the background of the map (not the round or square dots) indicate the relative risk of a severe outbreak of scab (green=low risk, yellow=moderate risk, red=high risk).
* Buttons in the upper left corner marked 24, 48 and 72 ask the system to provide estimates of disease risk based on forecasted weather information.
* The dots on the maps indicate specific weather stations. Click on a weather station to request more detailed information for that location.
* After clicking on one of the station dots, you'll see along the lower third of the page, on the left side, the current risk assessment for that location. In the lower right of the page is a link called "Commentary" which will give you a little more information on current conditions and FHB.

If the factors indicate a moderate to high risk of head scab when the wheat is fully headed, a fungicide may be needed to help suppress the disease. Selection of an appropriate fungicide is important for head scab. The fungicides in the strobilurin class are not recommended for control of head scab. The triazole fungicides Folicur (and generic tebuconazole), Prosaro, Proline, and Caramba are available for use in Kansas and can help suppress disease development. The fungicides must be applied to the heads to have any activity against scab, and they should be applied as close to flowering as possible. These products have a 30 pre-harvest interval.

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5. The role of fungicides in controlling Fusarium head scab in wheat

There are certain fungicides on the market now that can provide some degree of control of Fusarium head scab in wheat: Caramba, Folicur (and generic tebuconazole), Proline, and Prosaro. In 2011, we tested these fungicides for control of Fusarium head scab on several wheat varieties with varying degrees of resistance.

This was a field trial near Manhattan. The plots were inoculated by spreading corn grain colonized by Fusarium on the soil surface in three separate applications about two weeks apart beginning four weeks prior to heading. During heading and flowering, plots were sprinkler irrigated during the overnight hours. The fungicides were applied at Feekes Growth Stage 10.5 (fully headed) in 20 gallons of water per acre.

Effect of Foliar Fungicides on Fusarium Head Blight: Manhattan, 2011

Variety (and Fusarium head scab rating: 1=Best, 10=Worst)	Fungicide	Rate (oz/acre)	Avg. % diseased spikelets (May 30-June 9)	Grain yield (bu/acre)	DON (ppm)
Everest (4)	None	--	15	59	2.0
	Prosaro	6.5	11	62	1.7
Art (6)	None	--	29	32	5.5
	Prosaro	6.5	20	34	5.1
Karl 92 (6)	None	--	23	41	2.8
	Prosaro	6.5	17	43	2.2
Fuller (7)	None	--	29	40	5.9
	Caramba	13.5	22	39	4.9
	Folicur	4	19	44	4.5
	Proline	5	21	42	6.7
	Prosaro	6.5	22	39	5.1
	TopGuard	14	22	42	5.9
Santa Fe (7)	None	--	29	52	3.8
	Prosaro	6.5	23	57	2.4
Overley (9)	None	--	44	47	9.4
	Prosaro	6.5	35	49	10.1
LSD (P=0.05)			4	7	3.0

The inoculation of this plot resulted in a moderate Fusarium head scab infection. The fungicides were able to significantly reduce the % diseased spikelets in all varieties. The fungicides did not significantly increase grain yields in any varieties, in part because leaf diseases were not present.

In terms of reducing DON (deoxynivalenol) concentrations in grain to acceptable levels, the fungicides were not quite as effective. Applying Prosaro to Overley, for example, did not reduce the DON concentration. The acceptable level of DON is 2 ppm.

These results demonstrate that management of head scab is difficult with fungicides. Most fungicide labels only list suppression of this disease. Data from other years in Kansas and other states indicate that the best available fungicides (Prosaro, Proline, and Caramba) generally provide approximately 40-50% suppression of disease and DON. Products containing tebuconazole (Folicur and other generics) provide about 30-40% suppression of the head scab and DON.

Based on these and other past years' results, it takes a combination of fungicides and more resistant varieties to reduce DON concentrations to acceptable levels. More resistant varieties seem to show higher benefits from fungicide application for Fusarium head scab than susceptible varieties, in terms of DON reductions.

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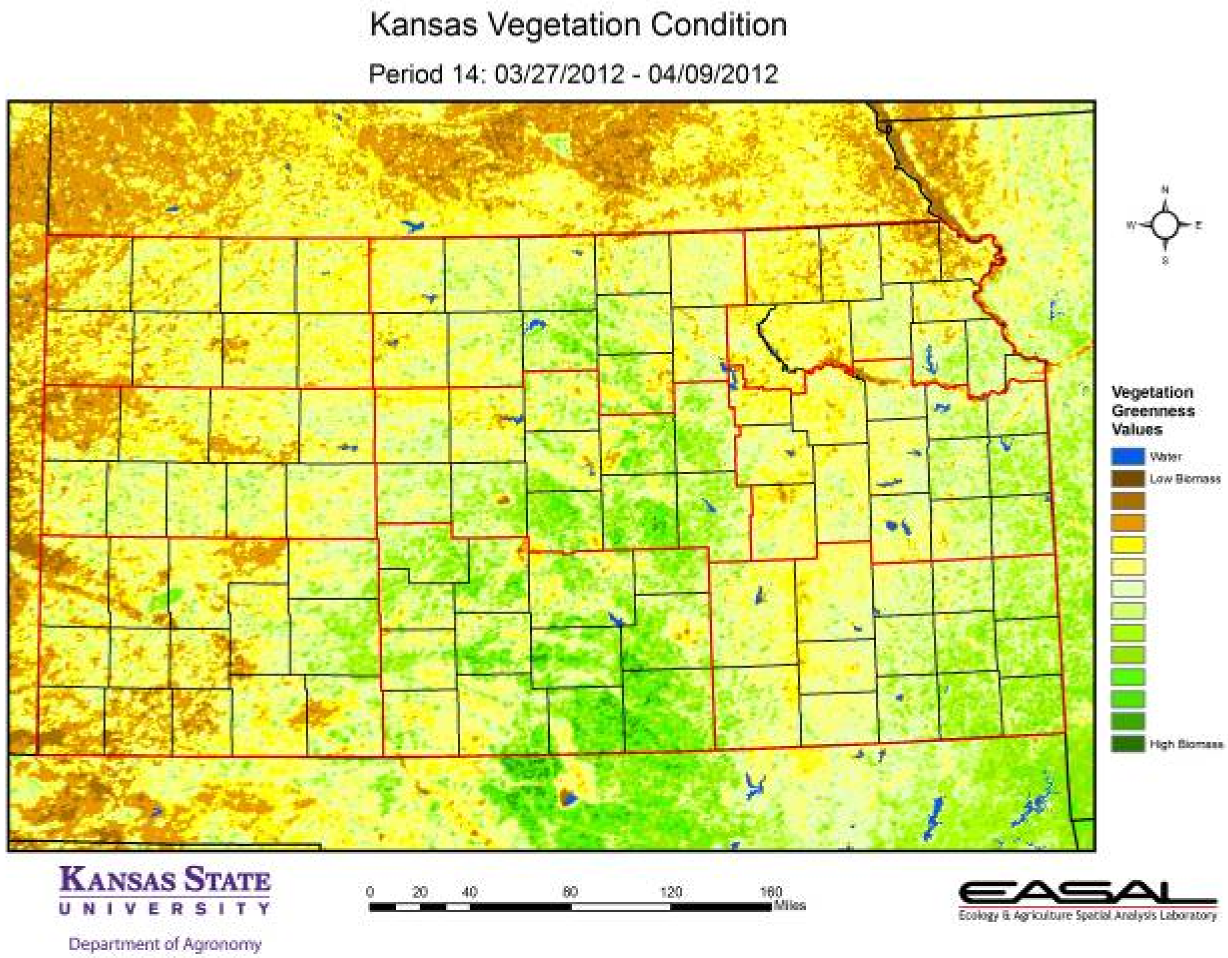
6. Comparative Vegetation Condition Report: March 27 – April 9

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.

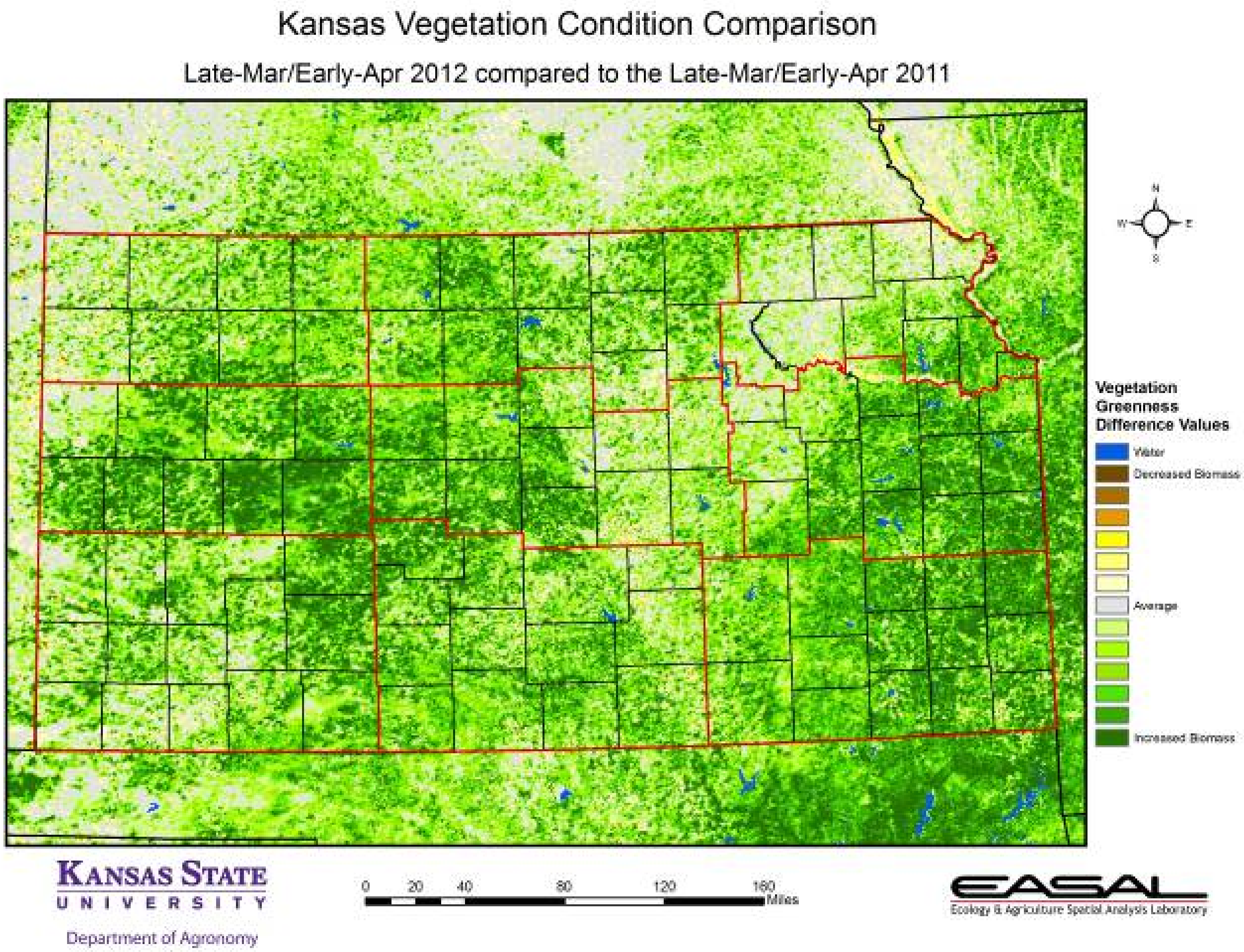
Two short videos of Dr. Kevin Price explaining the development of these maps can be viewed on YouTube at:
http://www.youtube.com/watch?v=CRP3Y5NIggw
http://www.youtube.com/watch?v=tUdOK94efxc

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.

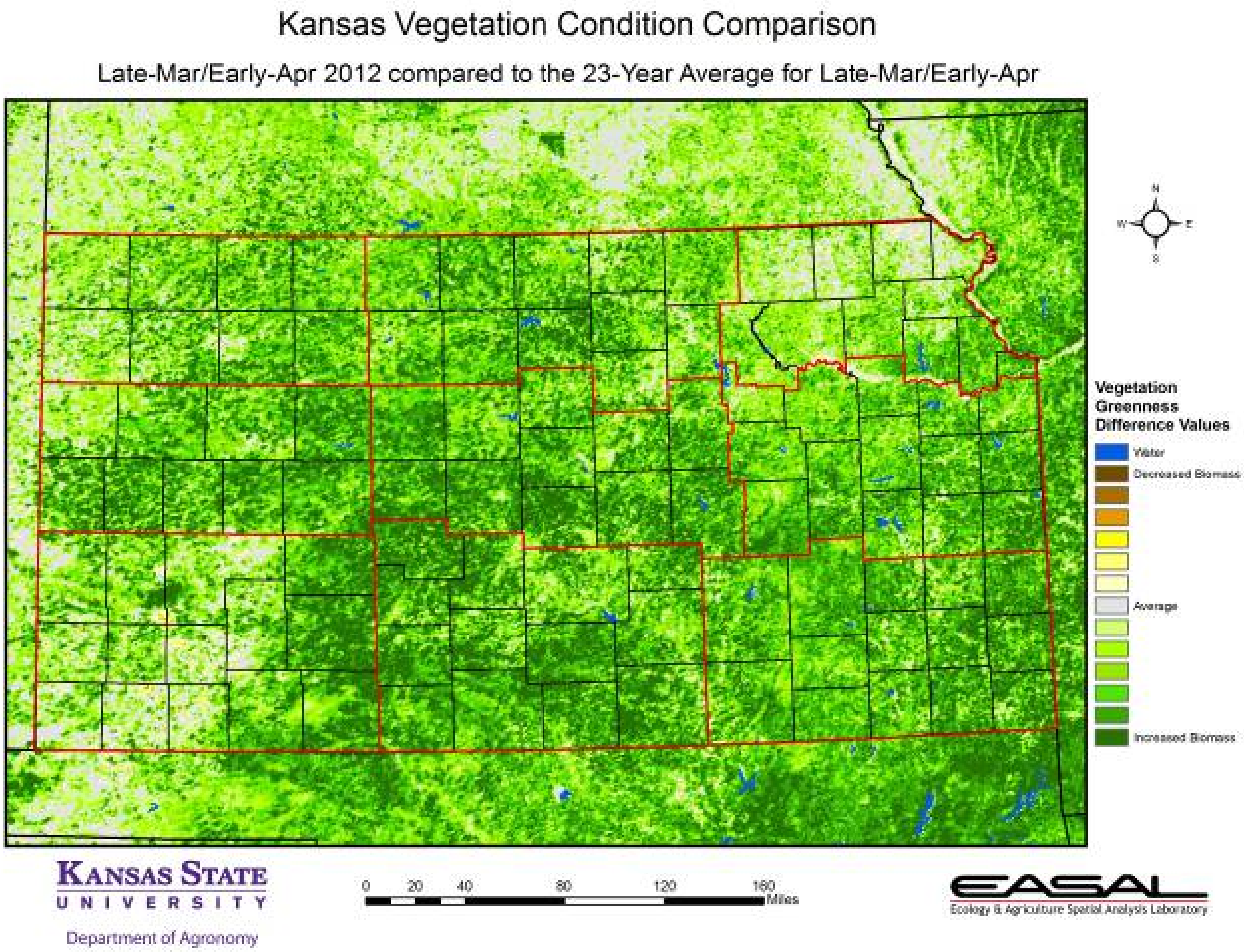
The maps below show the current vegetation conditions in Kansas, the Corn Belt, and the continental U.S, with comments from Mary Knapp, state climatologist:



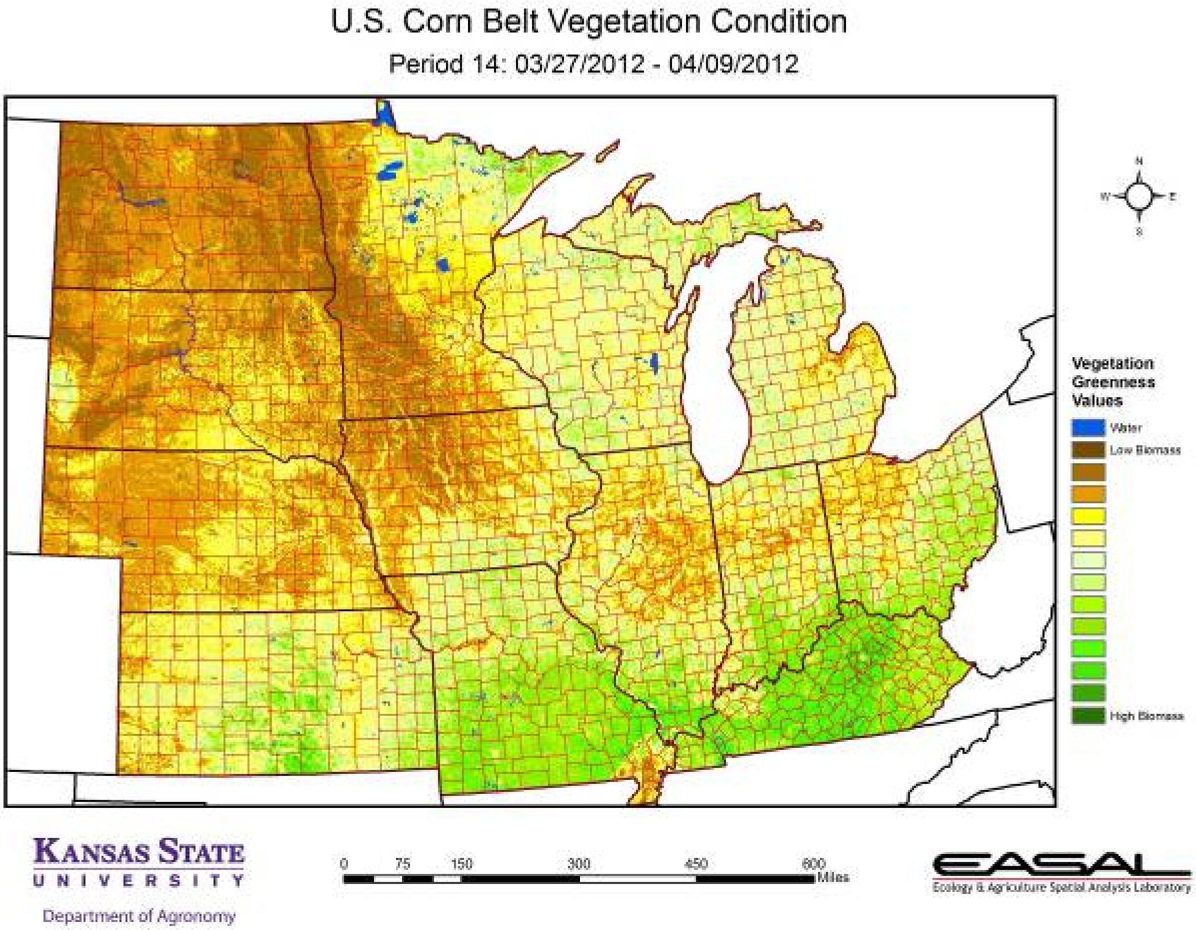
Map 1. The Vegetation Condition Report for Kansas for March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows increased photosynthetic activity continues to spread northward, particularly in the central and eastern portions of the state. Less photosynthetic activity is seen in the Flint Hills, and the High Plains of western Kansas.



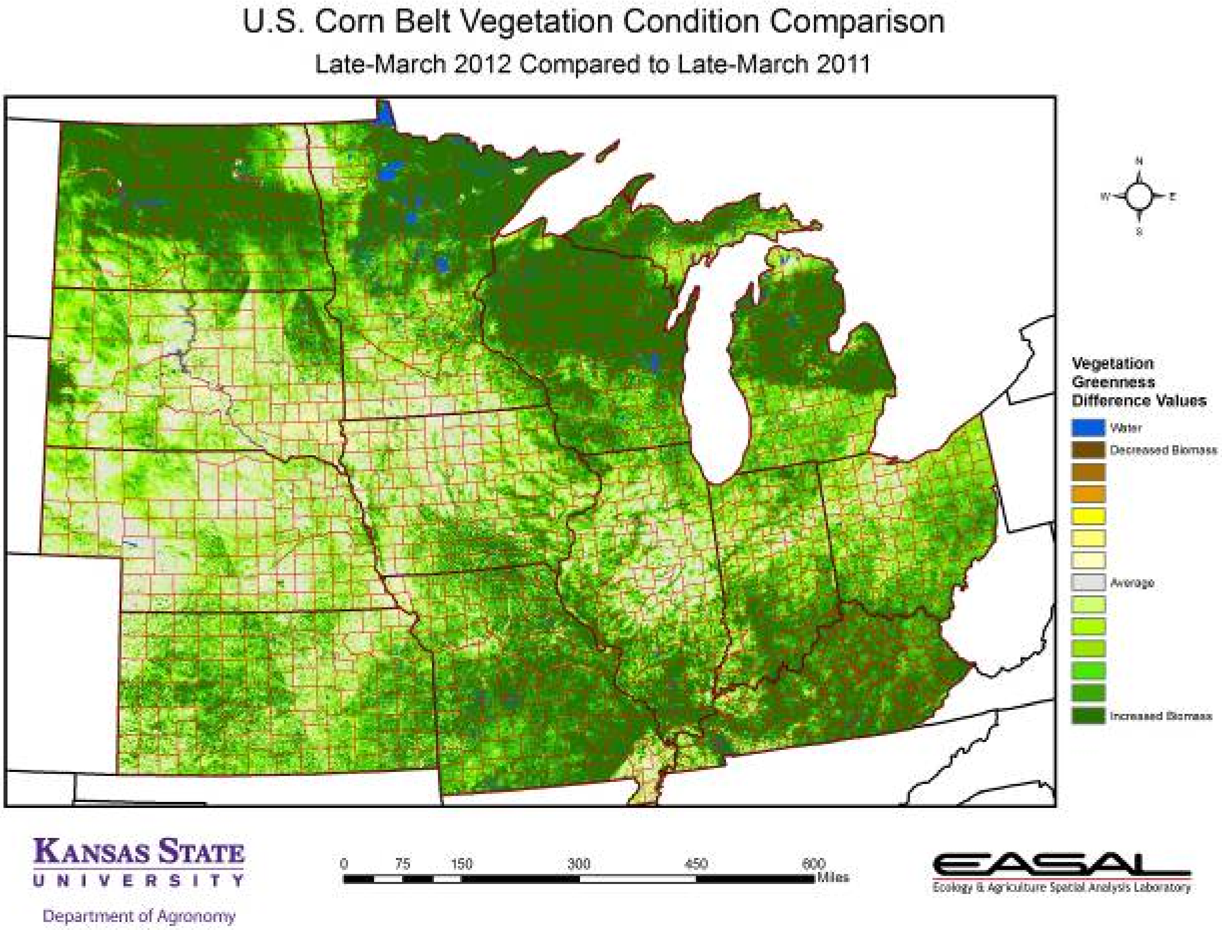
Map 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows much higher NDVI values across the state. Warmer temperatures and more abundant moisture have resulted in much greater photosynthetic activity. This trend is particularly evident in west central Kansas.



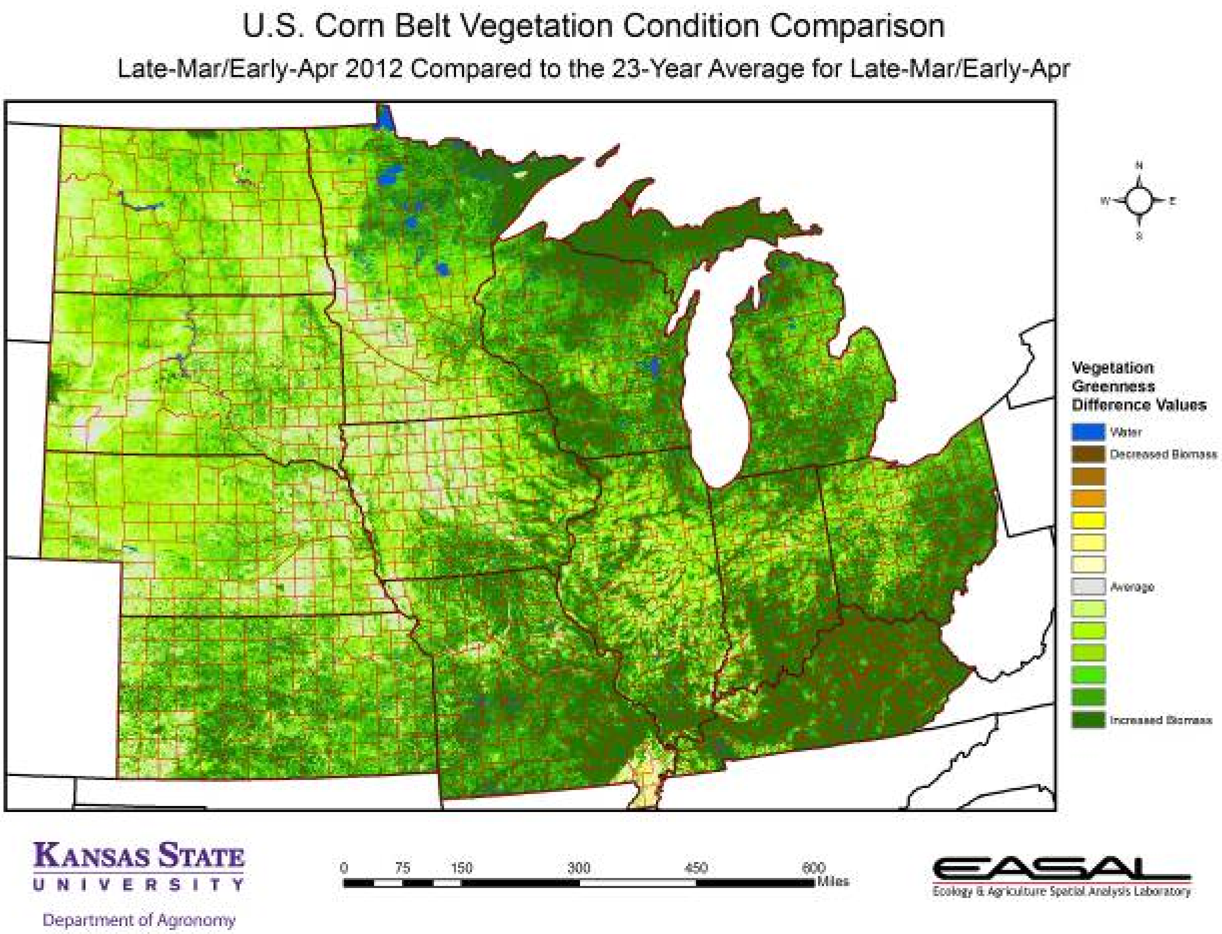
Map 3. Compared to the 23-year average at this time for Kansas, this year's Vegetation Condition Report for March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that NDVI values are much higher than average. Lowest values are seen in the extreme northeastern counties, as well as the extreme southwestern Kansas. In the northeastern counties, temperatures have been slightly cooler than the rest of the state. In the southwest, moderate to severe drought is still present with the resulting delay in photosynthetic activity.



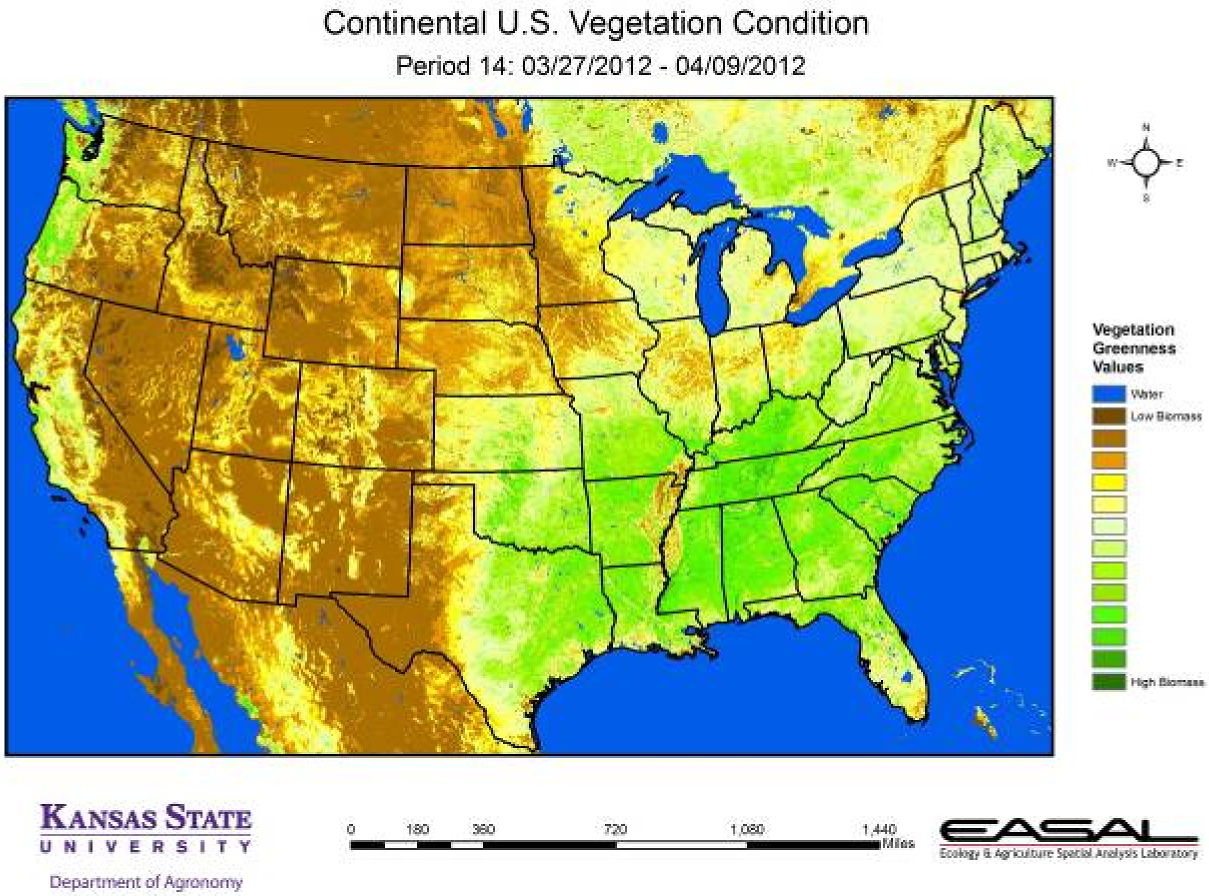
Map 4. The Vegetation Condition Report for the Corn Belt for March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that biomass production has continued to increase along the southern reaches of the Corn Belt. Limited photosynthetic activity can be seen in the northeastern region of the Corn Belt, while very little activity has yet to develop in the western portions of the region. Abnormally dry conditions are present in North Dakota, while moderate to severe drought is present from Minnesota to northern Iowa and eastward into Wisconsin.



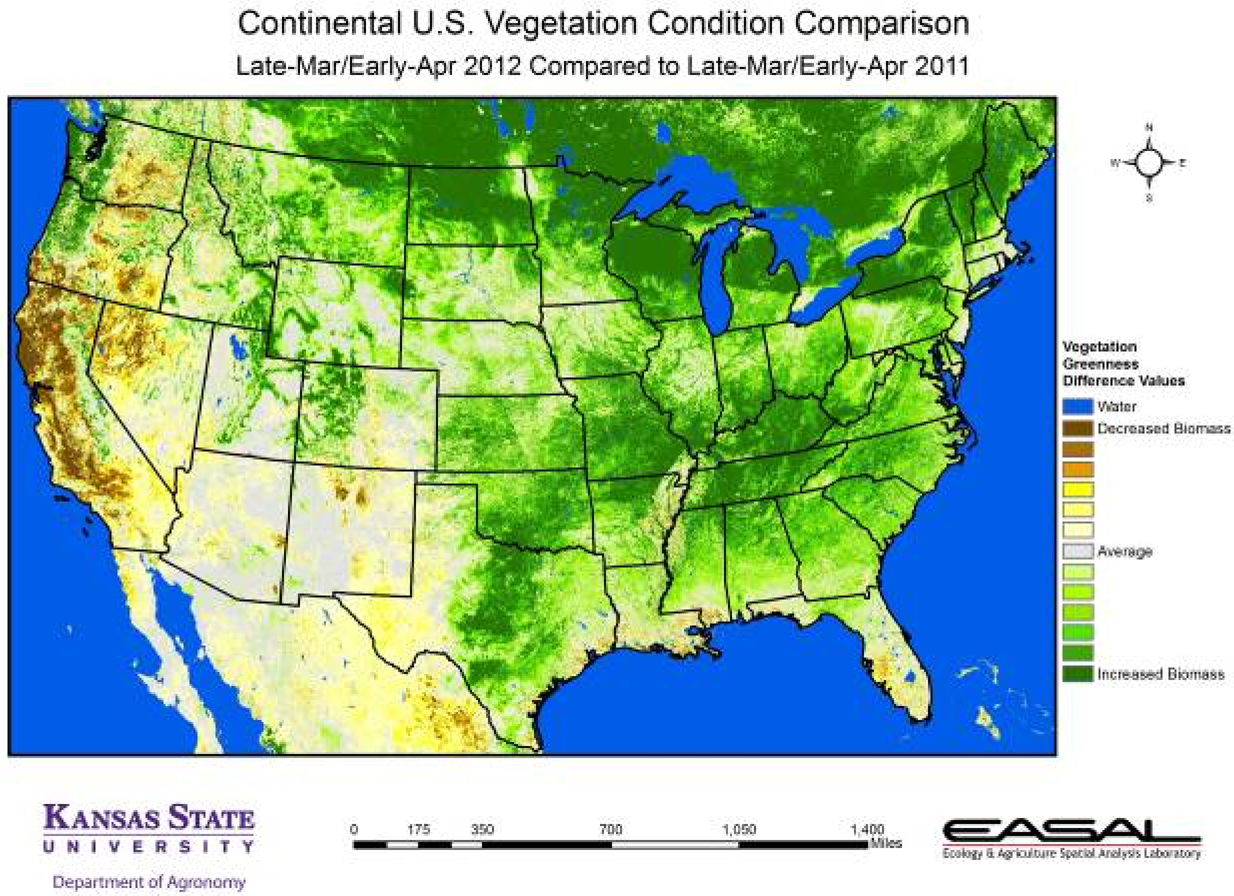
Map 5. The comparison to last year in the Corn Belt for the period March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that the seasonal difference in snow pack continues to result in increased NDVI values in the northern portions of region, despite the dry conditions in these areas. For the rest of the region, warmer-than-normal temperatures have resulted in much greater photosynthetic activity than last year at this time.



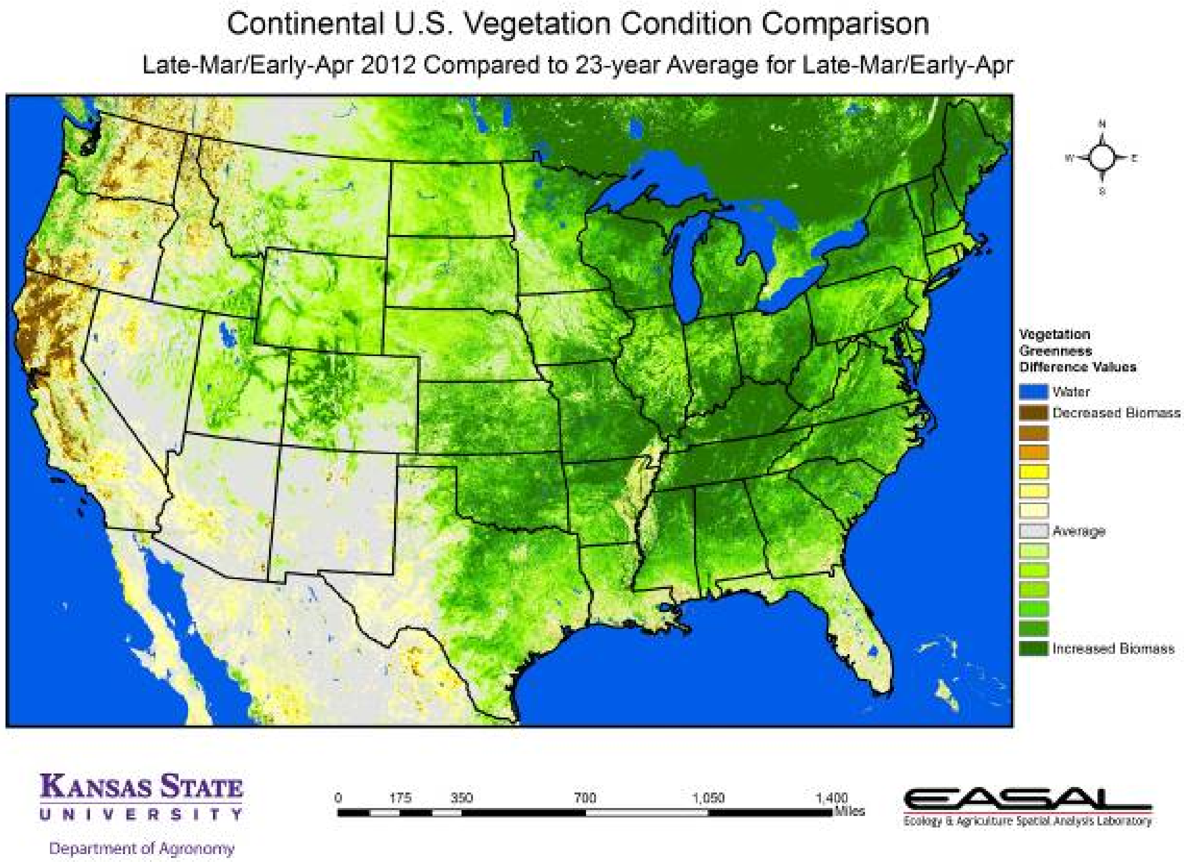
Map 6. Compared to the 23-year average at this time for the Corn Belt, this year's Vegetation Condition Report for March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows greater photosynthetic activity across the region, to varying degrees. Increased activity was limited in the western areas of the region by cooler temperatures and drier soil conditions.



Map 7. The Vegetation Condition Report for the U.S. for March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that photosynthetic activity is highest in the southeastern U.S. into the eastern portions of the High Plains. Vegetative development is limited in west Texas, where extreme to severe drought conditions persist.



Map 8. The U.S. comparison to last year at this time for the period March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that the lower-than-average snowpack has resulted in higher NDVI values in the northern areas and into Mountain West. This does not indicate particularly high biomass productivity, just greater activity than last year at this time. Central Texas and Oklahoma continue to stand out for the much greater photosynthetic activity than last year.



Map 9. The U.S. comparison to the 23-year average for the period March 27 – April 9 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows continued warmth in the eastern half of the U.S. has resulted in much greater photosynthetic activity. This early development has increased concerns for potential freeze damage and higher water use. This is an increasing concern from areas of Wisconsin, Northern Iowa, and Minnesota westward into North Dakota as well as New England. In these areas, low winter moisture has contributed to increasing drought conditions.

Note to readers: The maps above represent a subset of the maps available from the EASAL group. If you'd like digital copies of the entire map series please contact us 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.

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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
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