



Extension Agronomy

eUpdate

06/27/2014

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 cthompso@ksu.edu.

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1. Nutrient deficiencies in soybeans

This time of year, soybeans may begin showing signs of chlorosis or other leaf discoloration in all or parts of the field. There may be many causes of discoloration. Nutrient deficiencies are one possibility.

The following is a brief description of the symptoms of some of the most common nutrient deficiencies in soybeans.

Nutrient deficiency symptoms

Nitrogen. Lower leaves are chlorotic or pale green. Within the plant, any available nitrogen (N) from the soil or from nitrogen fixation within nodules on the roots goes to the new growth first. Soybeans prefer to take up N from the soil solution as much as possible, since this requires less energy than the nitrogen fixation process. Both sources of N are important for soybeans since they are a big user of N.

Iron. Iron chlorosis, occurs in calcareous soils with high soil pH. The classic symptom is chlorosis (yellowing) between the veins of young leaves. Iron is not mobile within the plant. A side effect of iron deficiency can be N deficiency, since iron is necessary for nodule formation and function. If iron is deficient, N fixation rates may be reduced. Iron deficiency occurs on calcareous soils because at high levels of calcium, iron molecules become tightly bound to the soil particle and unavailable for plant uptake. In addition to high pH, plant stress can favor the development of iron chlorosis, and therefore the severity can vary significantly from year to year in the same field.



Figure 1A. Iron chlorosis in soybeans. The upper leaves become chlorotic. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.



Figure 1B. Closeup of iron chlorosis in soybeans. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.

Magnesium. Lower leaves will be pale green, with yellow mottling between the veins. At later stages, leaves may appear to be speckled bronze. This deficiency may occur on very sandy soils.

Manganese. Stunted plants with interveinal chlorosis. Can be a problem in soils with high pH (>7), or on soils that are sandy or with a high organic matter content. Manganese activates enzymes which are important in photosynthesis, as well as nitrogen metabolism and synthesis. Symptoms are hard to distinguish from iron chlorosis.



Figure 2. Manganese deficiency symptoms are similar to symptoms of iron chlorosis in soybeans. Photo by Dave Mengel, K-State Research and Extension.

Molybdenum. Plants turn a light green color due to lack of nitrogen fixation. This deficiency is not common, but can occur on acidic, highly weathered soils.



Figure 3. Molybdenum deficiency in soybeans. Symptoms are similar to nitrogen deficiency. Photo by Dave Mengel, K-State Research and Extension.

Phosphorus. Phosphorus deficiency may cause stunted growth, dark green coloration of the leaves, necrotic spots on the leaves, a purple color to the leaves, and leaf cupping. These symptoms occur first on older leaves. Phosphorus deficiency can also delay blooming and maturity. This deficiency may be noticeable when soils are cool and wet, due to decrease in phosphorus uptake.

Potassium. Soybean typically requires large amounts of potassium. Like phosphorus deficiency, potassium deficiency occurs first on older leaves. Symptoms are chlorosis at the leaf margins and between the veins. In severe cases, all but the very youngest leaves may show symptoms.



Figure 4. Potassium deficiency: chlorosis of the lower leaves. Photo by Dave Mengel, K-State Research and Extension.

Sulfur. Stunted plants, pale green color, similar to nitrogen deficiency except chlorosis may be more apparent on upper leaves. Plant-available sulfur is released from organic matter. Deficiency is most likely during cool wet conditions or on sandy soils with low organic matter content.

General considerations

Mobile Nutrients: These nutrients can be transfer from older tissues to youngest tissues within the plant. Symptoms are noticeable first on lower, oldest leaves.

Nitrogen
Phosphorus
Potassium

Magnesium

Immobile Nutrients: These nutrients are not easily transfer within the plant. Therefore, symptoms occur first on upper, youngest leaves.

Boron

Calcium

Copper

Iron

Manganese

Molybdenum

Sulfur

Zinc

Possible causes of nutrient deficiencies:

1. Low soil levels of the nutrient.
2. Poor inoculation (in the case of nitrogen deficiency).
3. Unusually low or high soil pH levels.
4. Roots are unable to access sufficient amounts of the nutrients. This can be due to poor growing conditions, excessively wet or dry soils, cold weather, or soil compaction.
5. Root injury due to mechanical, insect, disease, or herbicide injury.
6. Genetics of the plant.

For more information, see K-State Research and Extension publication MF-3028, *Diagnosing Nutrient Deficiencies in the Field* at: <http://www.ksre.ksu.edu/bookstore/pubs/MF3028.pdf>

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2. Water quality improvement in Little Arkansas River Watershed

(Note: The following article is based on a news release by Kaitlin Morgan, K-State Research and Extension communications specialist.)

Located in central Kansas, the Little Arkansas River watershed is one of the most intensive agricultural watersheds in the state, with 97 percent of its land area in agricultural production.

Many of these acres are used for either corn or grain sorghum production and a majority of producers in the watershed use atrazine for control of broadleaf weeds and grasses.

Because atrazine is water soluble, atrazine can run off fields during rainfall, sometimes creating a surface water quality issue in the Little Arkansas River watershed and other heavily farmed watersheds.

Spring and early summer are periods of heavy atrazine application due to corn and sorghum planting. As a result, the concentration of atrazine in the surface waters during this season can sometimes rise above the drinking water maximum contaminant level and the aquatic life standards for atrazine set by the U.S. Environmental Protection Agency.

Wichita has an aquifer re-charge project in which they are attempting to capture water during high flow conditions of the Little Arkansas River and inject it back into the groundwater aquifer for later use.

Before it can be injected, the water must meet drinking water standards. However, most municipal water treatment plants do not remove atrazine and other pesticides because it requires an activated carbon treatment system to the treatment process, which increases the cost of the facility and the day-to-day cost of water treatment.

The Little Arkansas Watershed is currently the only one focusing on this in Kansas. Other parts of the state may not be aware of some of the issues with atrazine, but in the Little Arkansas Watershed there is a heightened responsiveness because of the city of Wichita.

Incentive for change

In 2004, a local group of watershed stakeholders developed a plan to restore and protect the surface waters of the Little Arkansas River watershed. The main goal of their Watershed Restoration and Protection Strategy (WRAPS) is to encourage farmers to minimize atrazine loss from crop fields, thereby reducing atrazine runoff to surface waters to levels that meet water quality standards.

The WRAPS team knew atrazine runoff couldn't be totally eliminated, but if atrazine runoff could be kept at a minimum and spikes in atrazine concentration could be prevented, that would be a tremendous benefit to the city of Wichita in terms of the amount of money it spends treating the water.

Our approach with this WRAPS uses best management practices developed to minimize atrazine runoff to establish a cafeteria-style incentive program for producers to select the practices that fit best to their unique operations.

We don't say "in this field you can't use atrazine." We present producers with a list of things they can do to help reduce runoff, and see if one or two of those practices will fit into their operations.

The flexibility offered by the program is a crucial part of its success and sets it apart from traditional farm programs.

By using a dollar-per-acre figure, producers know up front that what they do will dictate the amount of financial incentive they receive. Producers who stop using atrazine will get the full amount of incentive while those who choose a practice predicted to result in a 50 percent reduction of atrazine runoff will receive 50 percent of the incentive dollars available per acre.

Impact

Over the past 10 years, members of the WRAPS team have made extensive education efforts to reach out to local producers in terms of meetings, letters, one-on-one consultations, farm visits, and newsletters.

In the first few years we learned pretty quickly that crop consultants and chemical dealers were key to the success of the project. We met with those in our area to make sure they know what results we were seeing.

When the incentive program first started in 2006, there were 41 farmers in the program and best management practices were implemented on 4,792 acres of land in committed watersheds. The result was 18 percent less atrazine used. In 2013 the program included 103 farmers, 19,544 acres of land with implemented best management practices, and a 52 percent decrease in the amount of atrazine used.

Water samples taken from a paired watershed monitoring system in the targeted areas have shown dramatic improvements in the amount of atrazine concentration levels in surface water, with the improvement in some years as high as 60 percent.

We've been doing this effort long enough now that some producers are using these practices without any incentives.

The city of Wichita has been happy with the participation rate and the reduced levels of atrazine found in streams and rivers in the area. In 2006, the WRAPS team approached the city of Wichita to ask for financial support and received \$10,000, which was matched by another source. The city's financial donation has grown to \$50,000 for incentives as well as providing all the water analysis needed, representing an estimated total contribution of \$75,000 per year.

For more information, see K-State Research and Extension publication MF-2768, *Atrazine Herbicide Best Management Practices for the Little Arkansas River Watershed* at www.ksre.ksu.edu/bookstore/pubs/MF2768.pdf.

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3. Change in drought status in Kansas

Rainfall continued this week, although amounts were quite varied. Most of the moisture was the result of convective storms, which tended to pop-up and collapse over the same areas. Totals for the week range from 0.03 inches at Glasco in Cloud County to 4.16 inches at Belle Plaine in Sumner County. This has brought most of the state to above-normal precipitation for the month-to-date. The Southwestern Division had the greatest departure from average at 1.60 inches which is 208 percent of normal. Still, the rainfall wasn't evenly distributed across the region. The Southwest Research-Extension Center in Garden City reported 3.33 inches, while Ulysses reported just 0.98 inches. In contrast, the North Central Division had the greatest shortfall from normal precipitation. The average precipitation for the division was just 0.32 inches, which is 36 percent of normal.

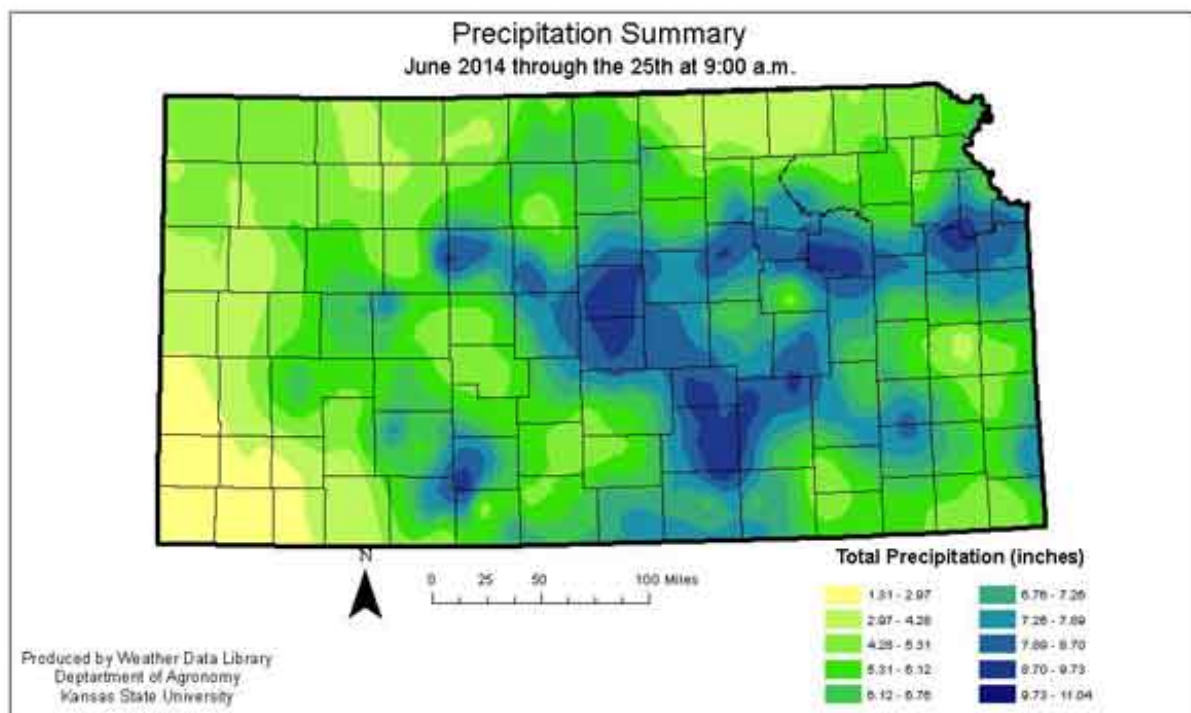


Figure 1. Kansas precipitation summary June 2014 through June 25.

Temperatures were warmer this week, bringing the statewide average to 0.6 degrees above normal. The Northwest Division was the coolest when compared to normal, with an average temperature of 69.7 degrees F, or 0.4 degrees cooler than normal. The Northeastern Division was the warmest, when compared to normal. Temperatures there averaged with the average 73.2 degrees F, or 1.1 degrees warmer than normal.

This combination has resulted in only minor shifts in the U.S. Drought Monitor for Kansas. Much of western Kansas remains in extreme drought. There is also a pocket of extreme drought in Central Kansas. Given the rain that is occurring, that will improve in next week's Monitor. While the rains have

been welcome in western Kansas, it will take a long period of continued normal to above-normal rainfall for major improvement in the drought situation. The Drought Outlook does call for continued improvement statewide. This does not mean that the drought will be over, but does indicate the likelihood of at least 1 category improvement. For western Kansas, this would mean extreme drought might improve to severe drought. In northeast Kansas, the abnormally dry conditions might be replaced by drought-free conditions.

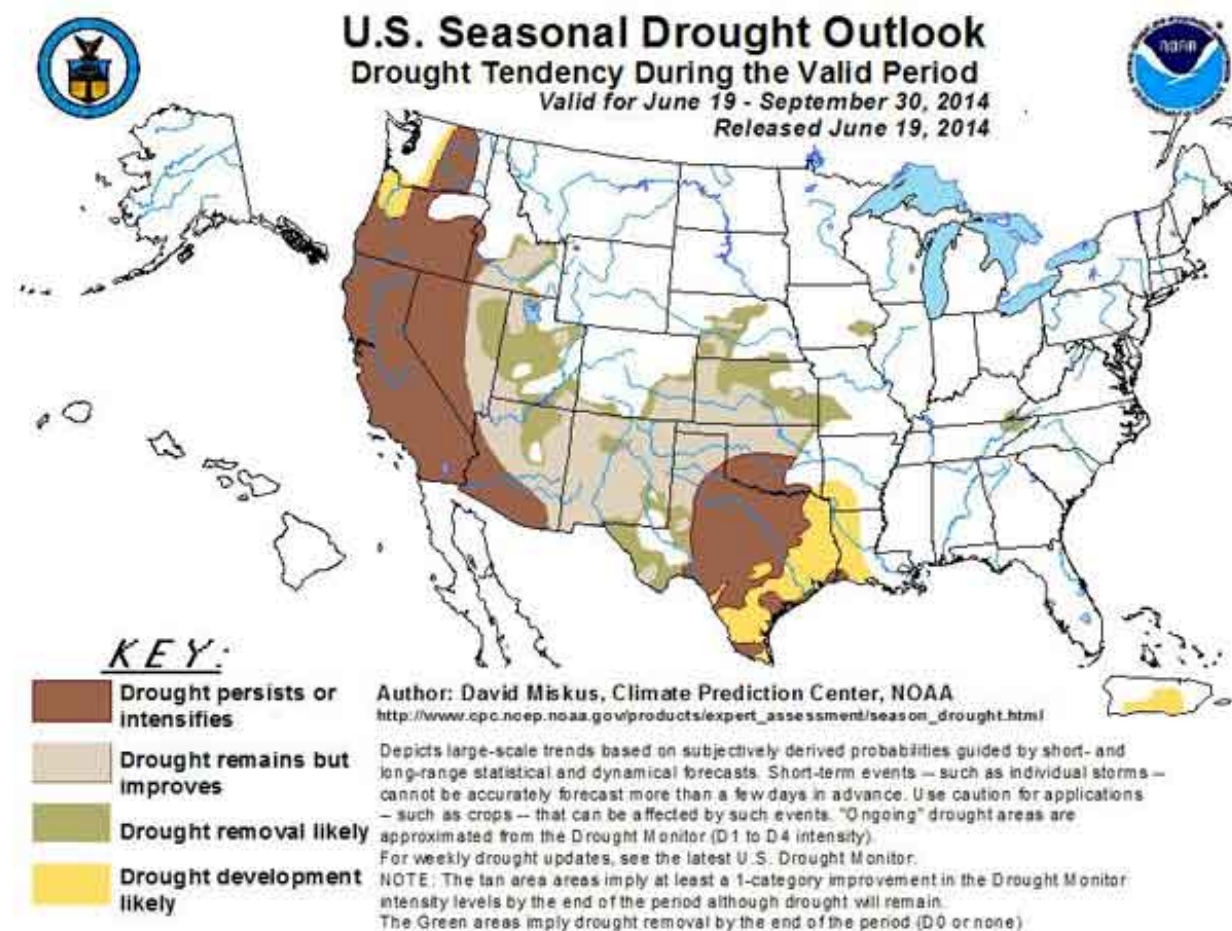


Figure 2. U.S. Seasonal Drought Outlook.

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4. Using plant analysis as a nutrient management tool

Plant analysis is an excellent “quality control” tool for growers interested in high yield crop production. It can be especially valuable for managing secondary and micronutrients, many of which don’t have high quality, reliable soil tests available, and also for providing insight into how efficiently applied nutrients are being used by the plants.

There are two basic ways plant analysis can be used by Kansas farmers: (1) monitoring nutrient levels at the end of vegetative growth as a quality control tool, and (2) collecting comparison samples for diagnostic purposes at any time. Monitoring is generally done at the end of vegetative growth and beginning of reproductive growth or grain fill, since most crops have accumulated the majority of the nutrients they will use at this time. Once grain fill starts, even though the plant may continue to take up nutrients, there will be a net flow of nutrients from the leaves and stem to the developing grain, and the nutrient content of the vegetation will steadily decline. With diagnostics, the absolute level of a given nutrient in the plant is less important, as we are looking for significant differences in nutrient content between good and bad samples from the same field.

Plant analysis for nutrient monitoring

For general monitoring or quality control purposes, plant leaves should be collected as the plant enters reproductive growth. Sampling under severe stress conditions for monitoring purposes can give misleading results, and is not recommended.

In the case of **corn**, 15-20 ear leaves, or first leaf below and opposite the ear should be collected at random from the field at silk emergence, before pollination, and before the silks turning brown.

In **sorghum**, the first or second leaf below the flag leaf at heading should be collected. Again, 15-20 individual leaves should be collected from the field at random.

In **soybeans**, the top, fully develop trifoliolate leaflets should be collected when the first pods are $\frac{3}{4}$ to one inch long. The top fully developed trifoliolate leaflets are normally the third set of leaves below the terminal bud on the main stem of the plant. They should be a dark green, and will likely be positioned at the top of the canopy, while developing/growing leaves will be a lighter green color and generally be below the fully developed leaves in the canopy. Collect 30-40 sets of leaflets at random, removing the petiole, or stem connecting the leaflets to the stem.

In **wheat**, the flag leaf is normally collected at heading. Since the flag leaves are small, 40-50 individual leaves will be needed to have enough dry plant material to have adequate material for analysis. Again, collect the leaves at random from the field or area which is being monitored.

Diagnostic sampling

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, try to take comparison samples from both “good/normal” areas of the field and “bad/problem” spots. Also collect soil samples from the same good and bad areas since physical problems such as soil compaction often limits the uptake of nutrients present in adequate amounts. Don't wait for tasseling or silking to sample. Take these samples as soon as the problems are noticed.

When sampling for diagnostic purposes, collecting specific plant parts is less important than obtaining comparison samples from good and bad areas of the field. As a rule of thumb, if plants are less than 12 inches tall, collect the whole plant, cut off at ground level. If above 12 inches tall, and until reproductive growth begins, collect the top fully developed leaves. In corn or sorghum this would be the top leaves with a visible leaf collar. Once reproductive growth starts, collect the same plant parts indicated for monitoring purposes.

When doing diagnostics, it is also helpful to collect a soil sample from both good and bad areas. Define your areas, and collect both soil and plant tissue from areas which represent good and bad areas of plant growth.

Shipping and handling plant samples

How should you handle samples, and where should you send the samples? The collected 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. Most of the soil testing labs working in the region provide plant analysis services, including the K-State lab. Make sure to label things clearly for the lab.

What nutrients should you analyze for?

In Kansas, nitrogen (N), phosphorus (P), potassium (K), sulfur (S), zinc (Zn), chloride (Cl), and iron (Fe) are the nutrients most likely to be deficient. Recently questions have been raised by consultants and others concerning copper (Cu), manganese (Mn), and molybdenum (Mo). Most labs can analyze for most of these. Normally the best values are the "bundles" or "packages" of tests offered through many of the labs. They can be as simple as N, P, and K, or can be all of the 14 mineral elements considered essential to plants. K-State offers a package which includes N, P, K, Ca, Mg, S, Fe, Cu, Zn, and Mn for around \$25.

What will you get back from the lab?

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 or varieties. So a value slightly below the sufficiency range does not always mean the plant is deficient in that nutrient, but 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 a nutrient is significantly below the sufficiency range, then one should ask some serious questions about the availability and supply of that nutrient.

Keep in mind also that any plant stress (drought, heat, soil compaction, etc.) can have a serious

impact on nutrient uptake and plant tissue nutrient concentrations. So a low value in the plant doesn't always mean the nutrient is low in the soil and the plant will respond to fertilizer, rather than the nutrient may not be available to the plant.

Levels above sufficiency can also indicate problems. High values might indicate over fertilization 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. Plants will load up on iron at times in an attempt to compensate for low zinc. 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. This can occur at very low soil pH, generally well below 5.

The following table gives the range of nutrient content considered to be "normal" or "sufficient" for corn at silking, soybeans at pod set, and wheat at heading. Keep in mind that these are the ranges normally found in healthy, productive crops.

Nutrient	Units	Crop		
		Corn: Ear leaf at green silk	Soybeans: Top leaves pod set	Wheat: Flag leaf at boot to heading
Nitrogen	%	2.75-3.50	4.25-5.50	3.5-4.5
Phosphorus	%	0.25-0.45	0.25-0.50	0.3-0.5
Potassium	%	1.75-2.25	1.70-2.50	2.0-3.0
Calcium	%	0.25-0.50	0.35-2.00	0.3-0.5
Magnesium	%	0.16-0.60	0.26-1.00	0.2-0.6
Sulfur	%	0.15-0.50	0.15-0.50	0.15-0.55
Chloride	%	0.18-0.60	--	0.18-0.60
Copper	ppm	5-25	10-30	5-25
Iron	ppm	20-200	50-350	30-200
Manganese	ppm	20-150	20-100	20-150
Zinc	ppm	15-70	20-50	15-70
Boron	ppm	4-25	20-55	1.5-4.0
Molybdenum	ppm	0.1-3.0	1.0-5.0	--
Aluminum	ppm	<200	<200	<200

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

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5. Comparative Vegetation Condition Report: June 10 - 23

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=CRP3Y5Nlggw>

<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 25-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 Nan An at nanan@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 state of photosynthetic activity in Kansas, the Corn Belt, and the continental U.S., with comments from Mary Knapp, service climatologist:

Kansas Vegetation Condition

Period 25: 06/10/2014 - 06/23/2014

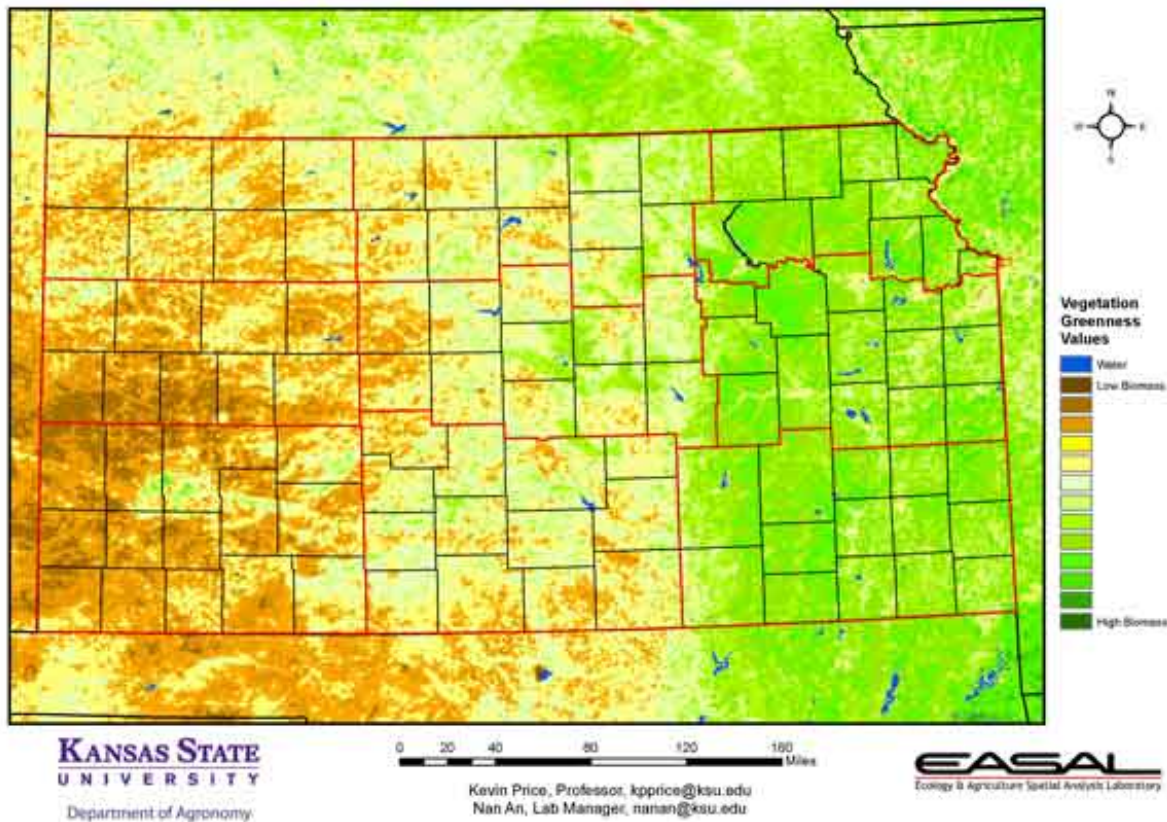


Figure 1. The Vegetation Condition Report for Kansas for June 10 – 23 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that vegetative activity is high in the eastern third of the state, due primary to favorable temperatures and moisture. Increased biomass production can also be seen in the Central Division, particularly in Ellsworth, Saline, and McPherson counties, which have had some of the largest precipitation totals.

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Kansas Vegetation Condition Comparison

Mid-June 2014 compared to the Mid-June 2013

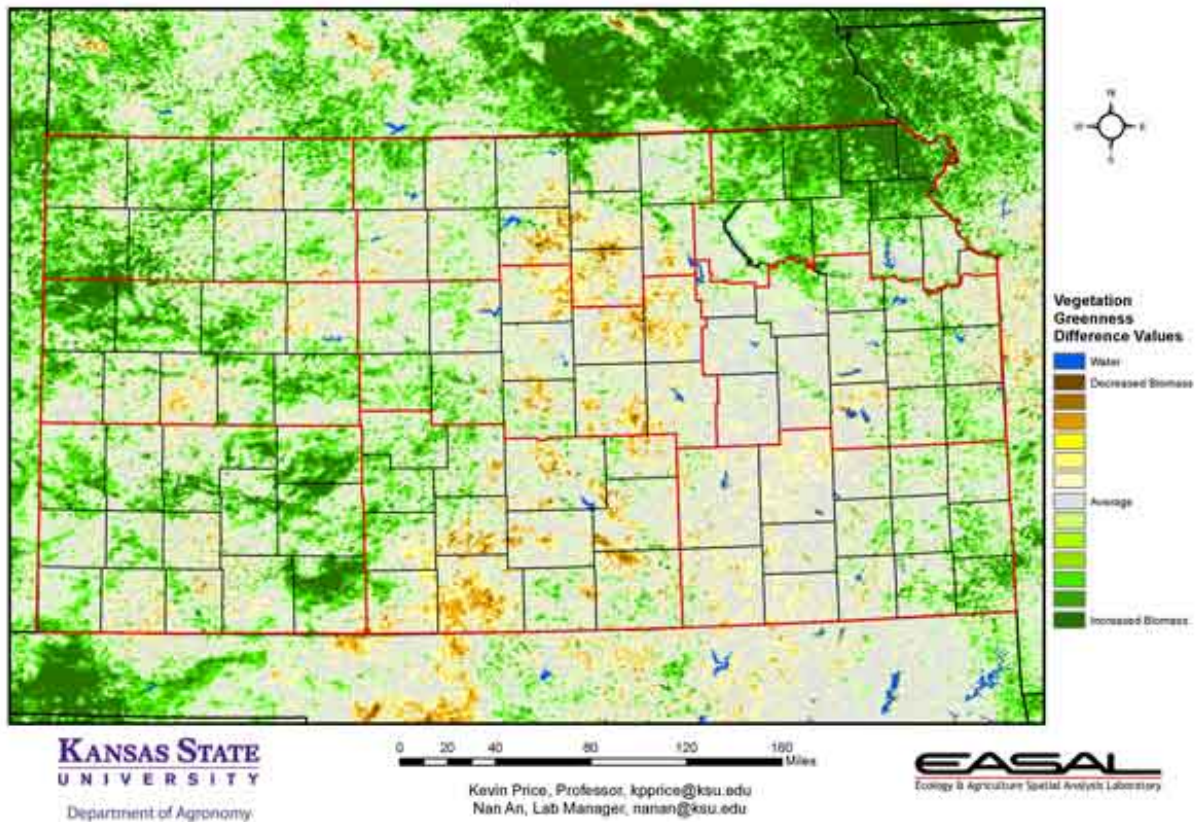


Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for June 10 – 23 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the extreme northeastern area of the state has seen the largest increase in photosynthetic activity. In the west, the increase in biomass production is particularly evident in northern Wallace County and northern Clark County. This increase does not necessarily mean good conditions, as can be seen in the following map, just better than last year.

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Kansas Vegetation Condition Comparison
Mid-June 2014 compared to the 25-Year Average for Mid-June

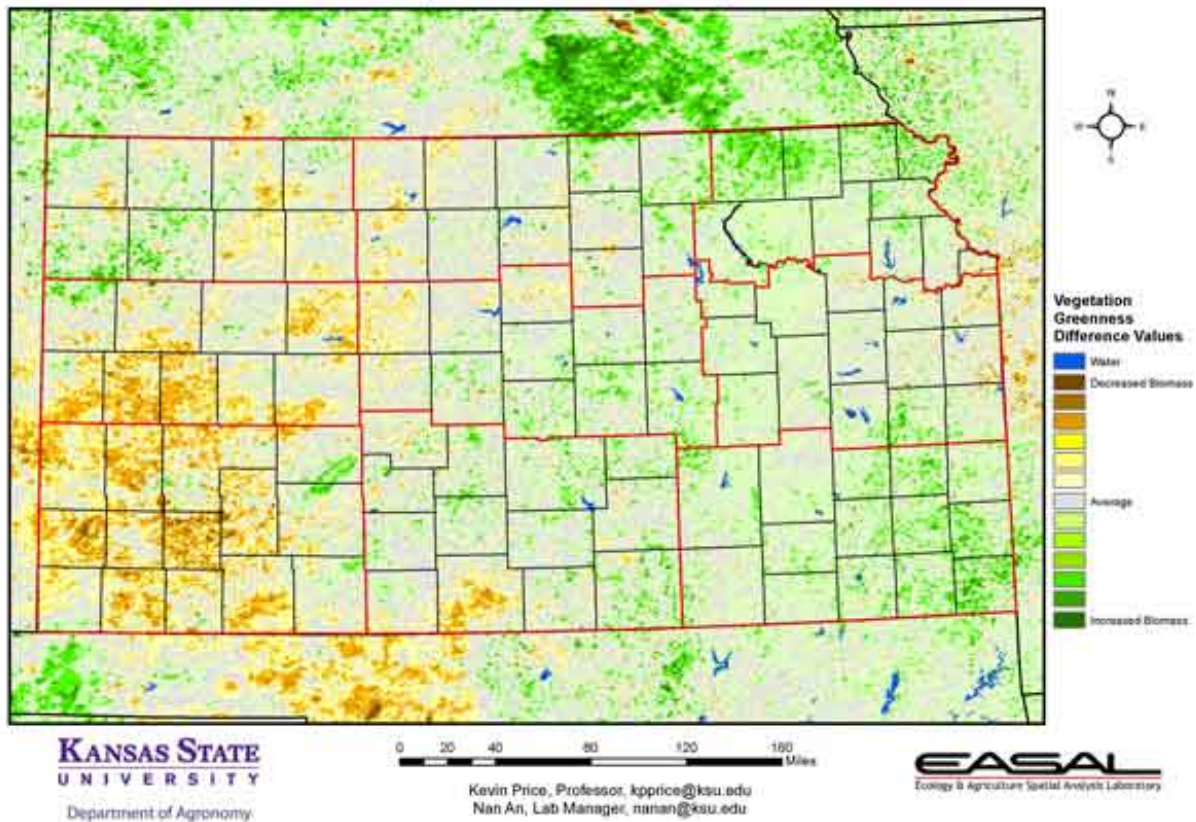


Figure 3. Compared to the 25-year average at this time for Kansas, this year's Vegetation Condition Report for June 10 – 23 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that while the eastern half of the state has close to average biomass production, the West Central and Southwestern Divisions still show below-average photosynthetic activity. Extreme drought is still prevalent in this area of the state.

U.S. Corn Belt Vegetation Condition

Period 25: 06/10/2014 - 06/23/2014

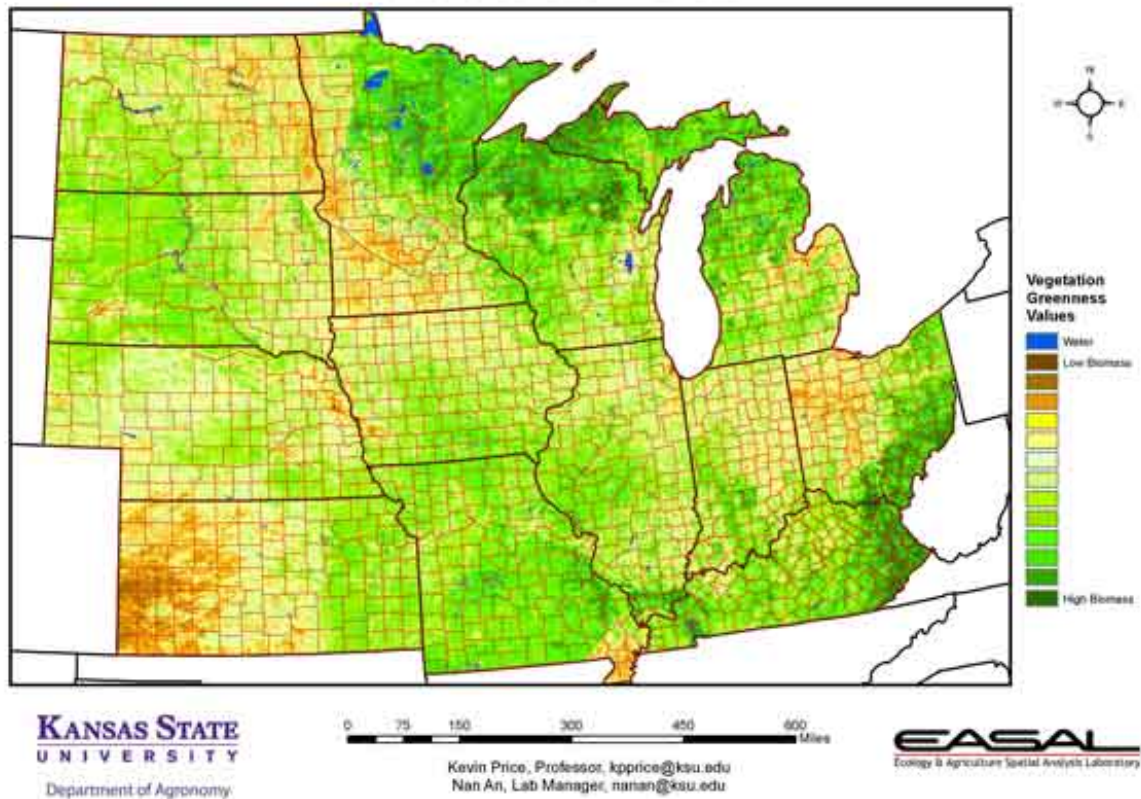


Figure 4. The Vegetation Condition Report for the Corn Belt for June 10 – 23 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the highest photosynthetic activity is concentrated in the northern and eastern portions of the region. Parts of the upper Missouri River Basin continue to have excessive soil moisture, which has limited plant development. The southwestern region of Kansas still continues to show extreme drought.

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U.S. Corn Belt Vegetation Condition Comparison
 Mid-June 2014 Compared to Mid-June 2013

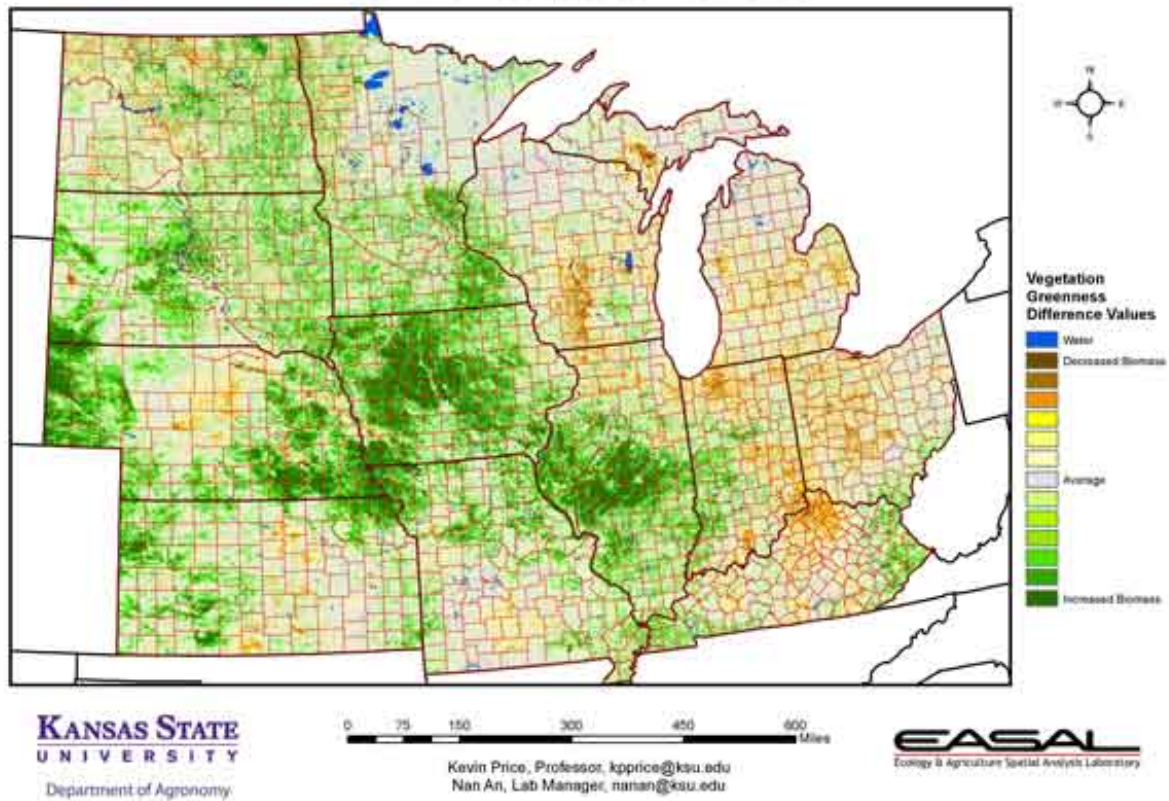


Figure 5. The comparison to last year in the Corn Belt for the period June 10 – 23 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that much of the region has higher biomass production this year. This is particularly true in northern Iowa and southeastern Nebraska. In Iowa, 70 percent of the corn is reported in good to excellent condition.

U.S. Corn Belt Vegetation Condition Comparison
Mid-June 2014 Compared to the 25-Year Average for Mid-June

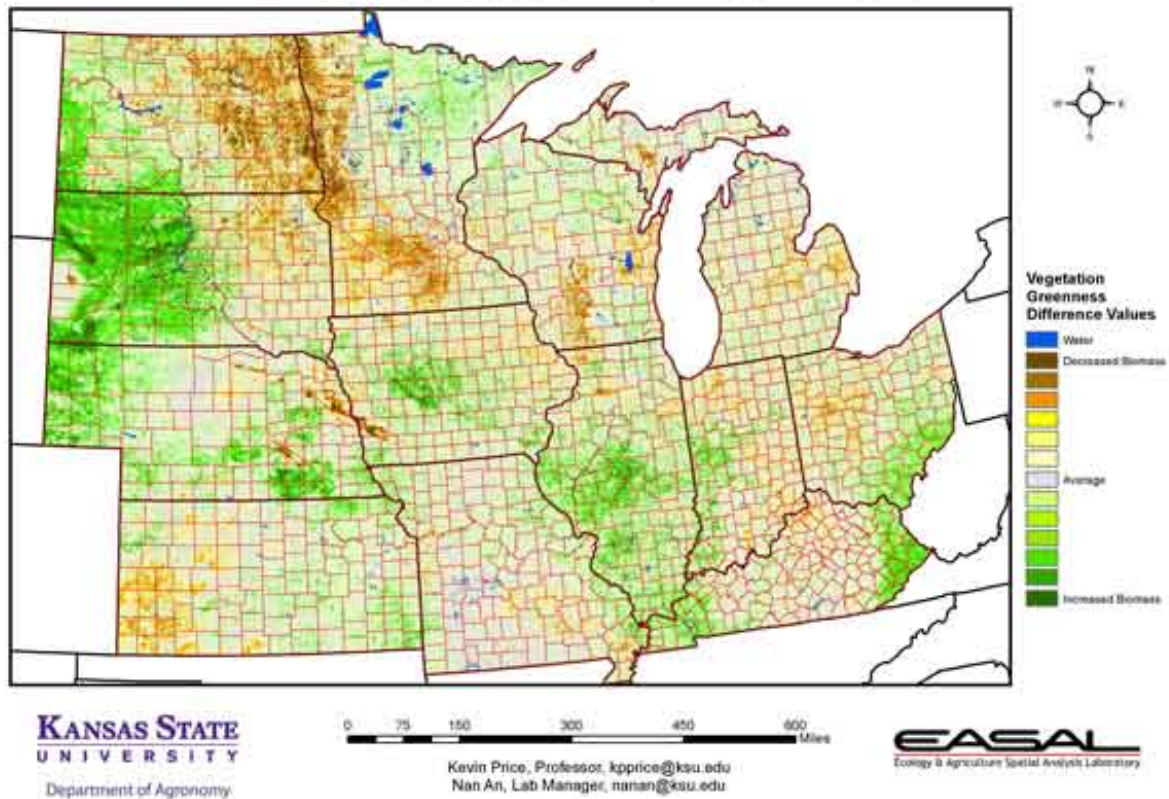


Figure 6. Compared to the 25-year average at this time for the Corn Belt, this year's Vegetation Condition Report for June 10 – 23 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that the biggest differences are in the northern and western parts of the region. In western South Dakota, favorable temperatures and moisture have resulted in above-average plant productivity. In eastern North Dakota and western Minnesota, the below-average activity is due to excessive moisture. Some locations in the region are approaching record rainfall totals for June.

Continental U.S. Vegetation Condition

Period 25: 06/10/2014 - 06/23/2014

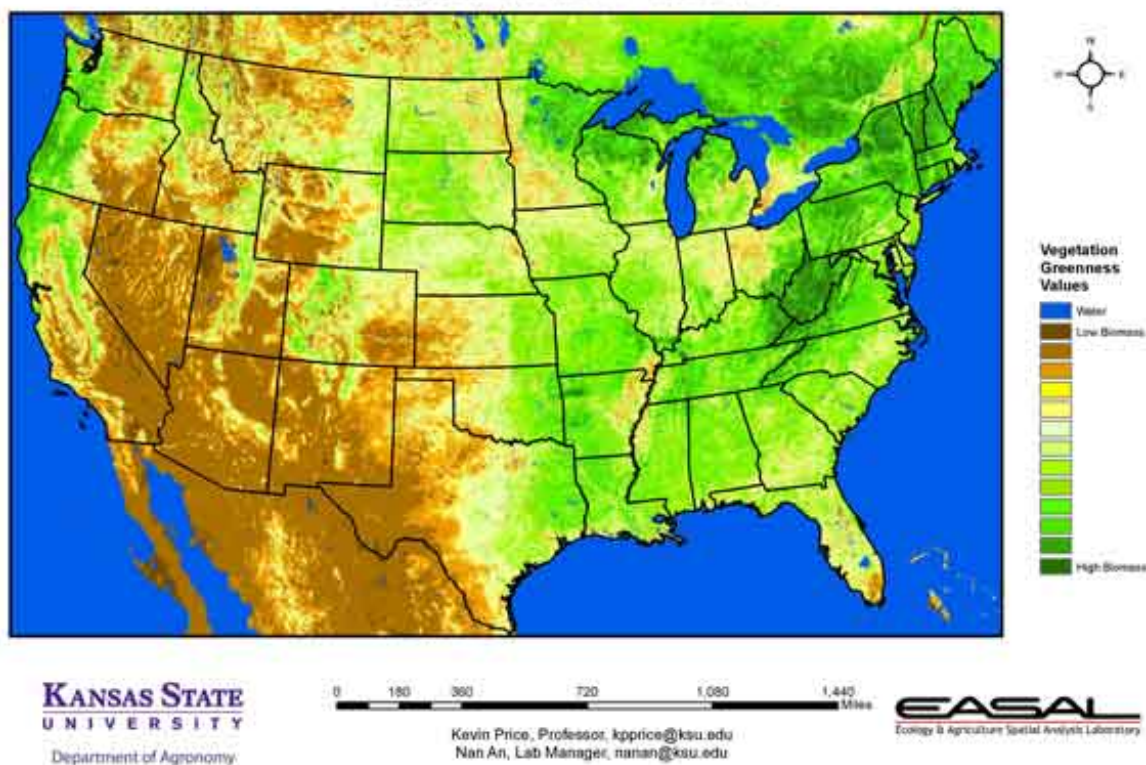


Figure 7. The Vegetation Condition Report for the U.S. for June 10 – 23 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that there is a typical east/west divide in biomass production. The highest levels are in the eastern U.S., particularly in West Virginia and central New England.

Continental U.S. Vegetation Condition Comparison
Mid-June 2014 Compared to Mid-June 2013

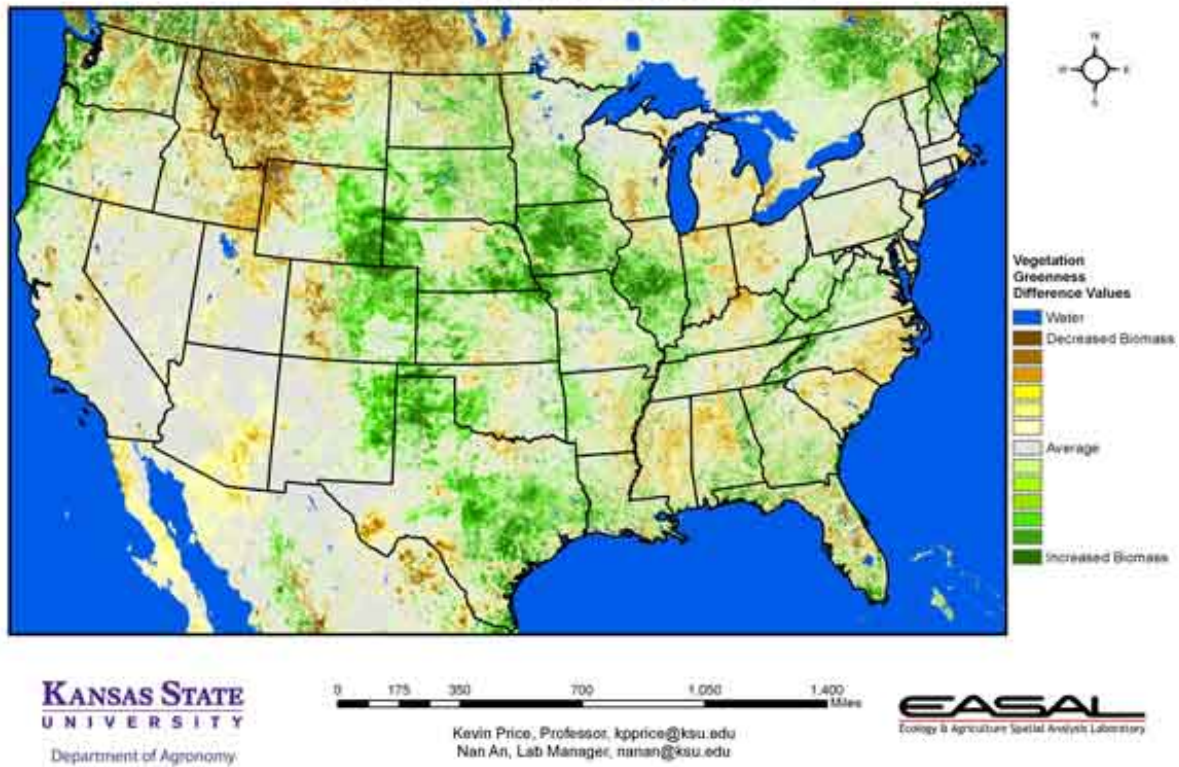


Figure 8. The U.S. comparison to last year at this time for the period June 10 – 23 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the biggest increase in productivity is in the central U.S. This is particularly true in eastern Wyoming and in Iowa. Last year, eastern Wyoming was in extreme drought; this year it is drought-free.

Continental U.S. Vegetation Condition Comparison
Mid-June 2014 Compared to 25-year Average for Mid-June

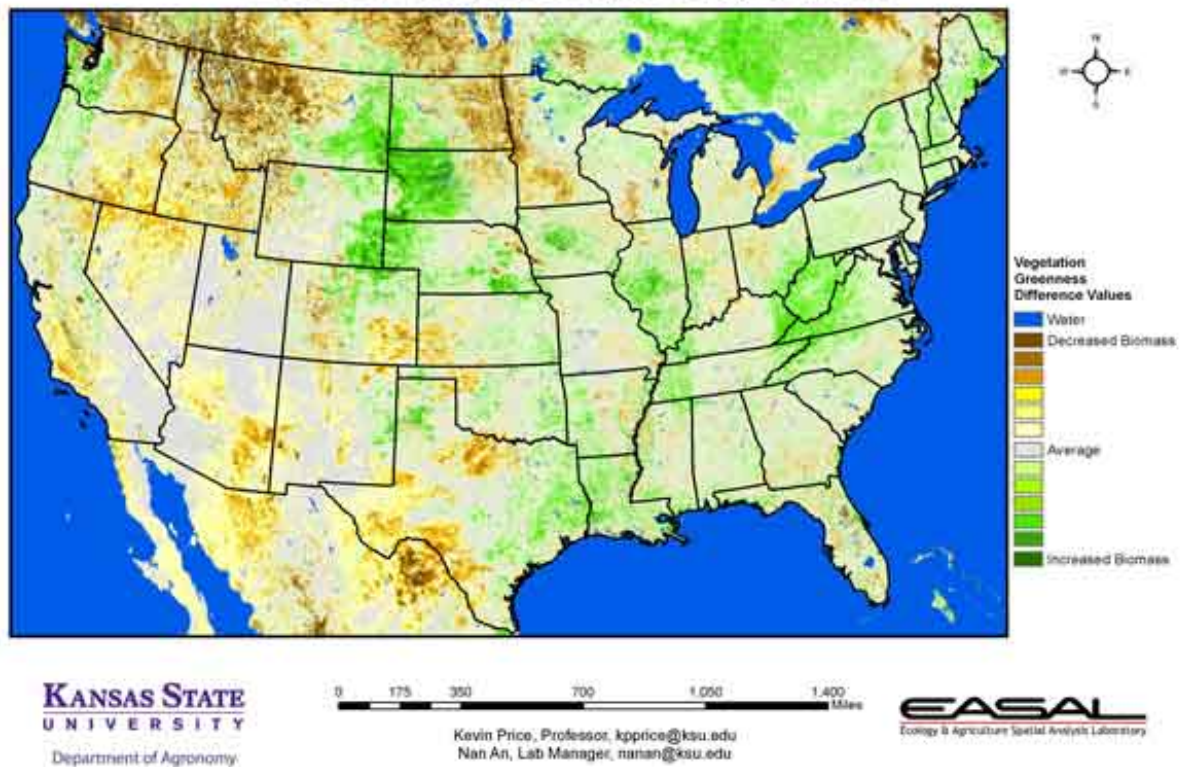


Figure 9. The U.S. comparison to the 25-year average for the period June 10 – 23 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the biggest departures are in the northern Plains. Higher-than-average photosynthetic activity is evident in western South Dakota, while lower-than-average values are present in western Montana and eastern North Dakota.

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