Issue 452

K-STATE
Research and Extension

Extension Agronomy

eUpdate

04/18/2014

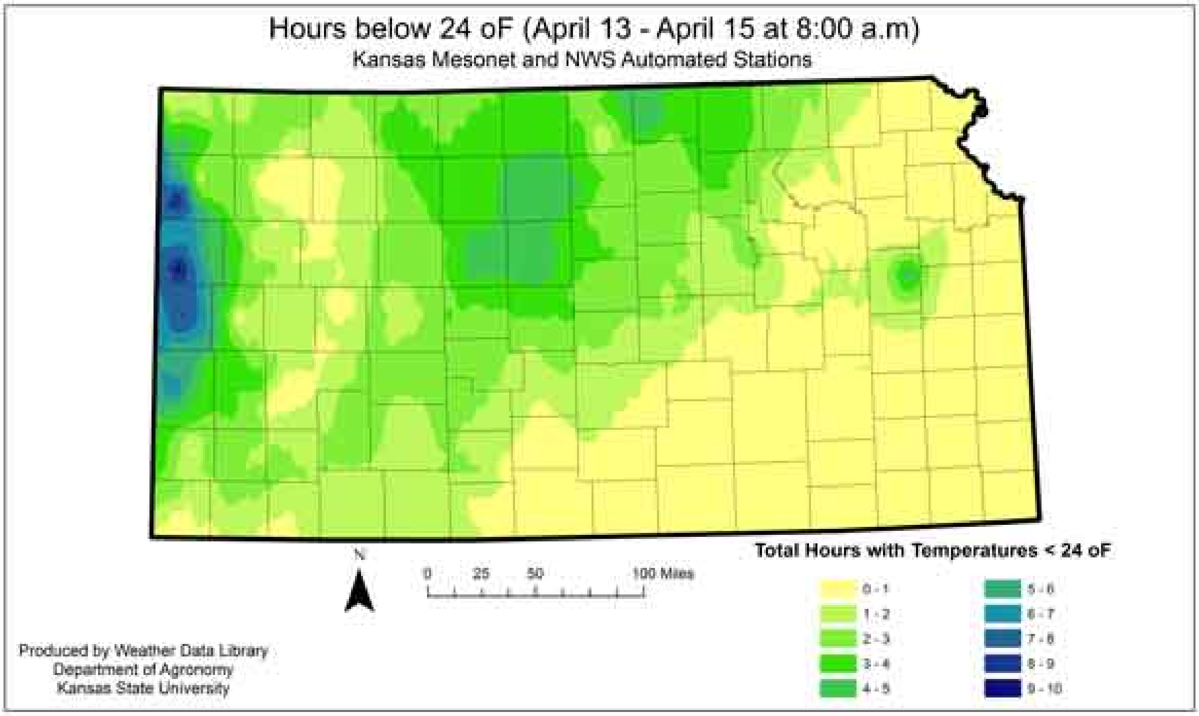
These e-Updates are a regular weekly item from K-State Extension Agronomy and Steve Watson, Agronomy e-Update Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have any questions or suggestions for topics you'd like to have us address 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.

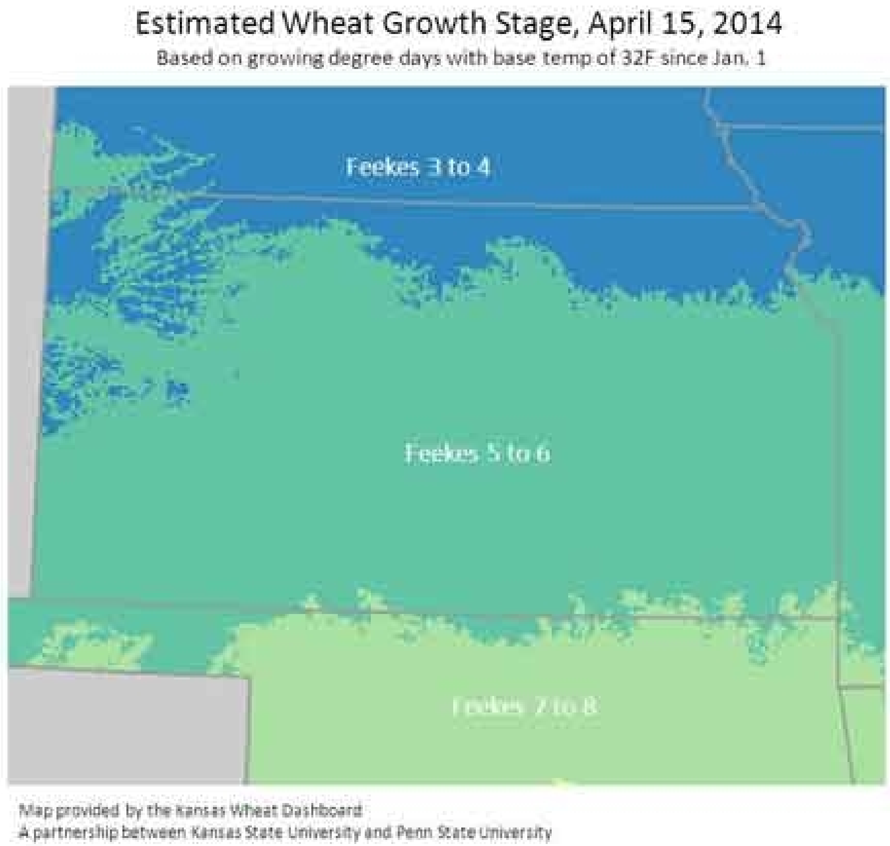
eUpdate Table of Contents | 04/18/2014 | Issue 452

Kansas State University Department of Agronomy
2004 Throckmorton Plant Sciences Center | Manhattan, KS 66506
www.agronomy.ksu.edu | www.facebook.com/KState.Agron | www.twitter.com/KStateAgron

1. Low temperature and growth stage maps for Kansas, April 13-15

The map below shows in graphic form where temperatures were below 24 degrees F on April 13-15. Any wheat in the jointing stage, anywhere in Kansas, should be monitored over the next 2-3 weeks for signs of freeze injury. For details on what to look for, see the special edition eUpdate No. 450 from April 15 at: http://ksu.ag/1t5EVmc





Mary Knapp, Weather Data Library
mknapp@ksu.edu

Erick De Wolf, Extension Plant Pathology
dewolf1@ksu.edu

2. Freeze injury in corn

Plenty of corn acres have been planted in eastern Kansas over the past couple weeks. Many of the seedbeds were dry on the surface with good moisture at seeding depth. The hard freeze, with temperatures into the low-to mid 20's, throughout Kansas overnight on April 14-15, has the potential to cause leaf burn and other kinds of damage to recently planted corn. Leaf burn is largely cosmetic, but other types of injury can be more significant.

Cold temperatures can result in injury to the germinating seed as it is absorbing moisture. When soil temperatures remain at or below 50 degrees F after planting, the damage to germinating seed can be particularly severe.

Soil temperatures at the 4-inch depth during the first 24-72 hours after seeding, when the kernels imbibe water and begin the germination process, are critical. Kernels naturally swell when hydrating. If the cell tissues of the kernel are too cold, they become less elastic and may rupture during the swelling process, resulting in "leaky" cells. Injury symptoms may include swollen kernels that fail to germinate or aborted growth of the radicle and/or coleoptile after germination has begun.

Chilling injury can also occur following germination as the seedlings enter the emergence process, reducing plant metabolism and vigor, potentially causing stunting or death of the seminal roots, deformed elongation ("corkscrewing") of the mesocotyl, and either delayed or complete failure of emergence, often leafing out underground. Chilled seedlings may also be more sensitive to herbicides and seedling blights.

Figure 1. Leaf burn from freeze damage early after corn emergence. Photo by Ignacio Ciampitti, K-State Research and Extension.

Figure 2. Leaf burn and brown lesion on the upper section of the mesocotyl from freeze damage early after corn emergence. Photo by Ignacio Ciampitti, K-State Research and Extension.

Figure 3. Brown lesions on the first developed leaves from freeze damage early after corn emergence. Photo by Doug Shoup, K-State Research and Extension.

The damage to the corn plant can vary with:

- **Soil type** (as related to water holding capacity) and **soil moisture**. Less freeze injury is expected with wetter soils than dry soils. Dry soils are more sensitive to changes in temperature.

- Residue: The effect of residue is not entirely straightforward. The more surface residue, the more the emerging seed and seedlings will be insulated and protected from temperature fluctuations. However, soils with less residue will warm up faster, resulting in less freeze injury when compared with no-till conditions where more residue is on surface.

- **Duration and intensity of cold weather:** More than 2 to 4 hours of soil temperatures in the mid-to-low 40's could result in some injury. Shorter periods of more intense cold or periods of more than 4 hours of soil temperatures in the mid-40's could be equally damaging.

- Field natural gradient: Low areas are most sensitive to freeze injury.

- **Growth stage**: On newly planted corn, the emergence process could be affected. On newly emerged plants (before V4-V6), the first leaves could be burned but plants can recover as long as the growing point remains below the soil surface.

There was a significant amount of corn that was at the 2- to 3-leaf stage in southeast Kansas when the freeze occurred. Early indications are that most of the growing points are in good shape because the freeze didn't reach very deep in the soil where the crown is forming. However some fields that were planted more shallowly (<1.5") may have been more affected.

Before making any decisions, fields should be scouted 4 to 7 days after the cold weather occurred since the extent of the damage and potential for new growth will be evident during this time.

Early planted corn has the risk of facing cold injury, reducing yield potential. However, if growing conditions are good then a longer growing season and higher yield potential could also be expected from these early planting dates.

Ignacio Ciampitti, Crop Production and Cropping Systems Specialist
ciampitti@ksu.edu

Stu Duncan, Northeast Area Crops and Soils Specialist
sduncan@ksu.edu

Doug Shoup, Southeast Area Crops and Soils Specialist
dshoup@ksu.edu

3. Freeze effects on winter canola

Since canola is a relatively new crop to Kansas, our experiences with late spring freezes on canola are somewhat limited. However, we can draw on our experience with the hard freeze about this same time last year to speculate on how the recent freeze might impact the crop.

Canola recovered from the April 2013 freezes but did suffer a yield penalty in some instances. In other instances, ideal growing conditions in May allowed the crop to produce more seed pods and a yield reduction was not observed. Canola is indeterminate (continues to flower and produce seed pods for an extended period) and because of this has numerous growing points on the plant. These growing points can develop new flowering sites that will compensate for damaged ones when severe stresses occur.

The extent of crop damage will depend on growth stage, and how low and long temperatures dropped. Canola is more susceptible to yield losses later in the growth and development of the plant. This year, the growth stage of canola at the time of the April 15 freeze ranged from rosette/early bolting (northern Kansas and southwest Kansas), bolting/early flower (central Kansas), and mid-bloom (southern Kansas). Canola can recover from freezes in the mid-20s over a 3- to 7-hour time period with little substantive damage at these stages. Temperatures below 20 degrees F can be extremely damaging.

Cosmetic injury will be observed immediately but canola should begin to recovery as soon as temperatures warm up. The time it will take to allow a more realistic estimate of the potential damage and recovery will depend on temperatures and moisture conditions in the short term.

- At the rosette stage, leaf burn will likely be observed. Watch as new leaves start to emerge from the center of the rosette and see whether the crop bolts normally. If the crop turns brown and does not show any new growth as temperatures warm up, then the damage was likely severe and a yield reduction can be expected.
- At the bolting stage, some discoloration, or bleaching, will likely be evident on leaf and stem tissue. The main stem and flower buds may turn white or a shade of purple, which is just a symptom of cold temperatures and does not necessarily indicate tissue damage. Stem splitting may be observed, but the canola should continue to grow normally. Again, if stem and leaf tissues turn brown and flowering does not follow, then damage was likely severe and a yield reduction can be expected.
- At the flowering stage, we often see bleaching of leaves and a bend or crook in the stem and flowering racemes. Often, these bends may take the flowering racemes to the ground; however, we have seen plants straighten and continue flowering normally. The only problem may be that the racemes set seed below the main canopy of pods, potentially creating problems at harvest. This is the most common damage being reported in southern Kansas into Oklahoma following the latest freeze.
- Unopened buds should produce flowers and growing pods should produce viable seed. The open flowers will be lost and permanent bends in racemes will be observed. In severe cases, we have seen the main raceme and some secondary branches completely freeze off and die. As the plant continues to flower, these damaged plant parts will turn brown. The crop can compensate for the losses with secondary branching.
- Stem splitting and cracking are often observed following April freezes in flowering canola. Canola will continue to grow even if the stem is split wide open; however, these splits cause concern for lodging as the crop produces pods and seeds. Cracks are usually cosmetic, but do

provide an entry point for fungi that could cause the stem to rot.
- Splitting occurs when the stem fills up with ice and ruptures. This year, some plants with translucent, mushy stems were observed the morning of the hard freeze. It is too early to determine if this was severe enough to cause a reduction in yield potential.

Longer durations of temperatures in the mid-20s may increase the severity of damage. The extent of damage and potential yield loss relative to how long it stays this cold is somewhat of an unknown. But as long as the plants show normal growth in the upcoming weeks, reasonable yields can be expected. With dry conditions in the region, it is also unknown whether the freeze effects will be more severe on the already drought-stricken crop.

Longer-term effects on the plant include delayed maturity and reduced plant height. Delaying crop maturity results in flowering and filling grain during a warmer period which can reduce yield if temperatures are above 90. If temperatures remain cool during flowering and early grain fill, yield reductions should be minimized. Reduced plant height doesn't necessarily result in reduced yield as was seen following the 2013 freezes.

The indeterminate growth habit still gives canola an opportunity to compensate for lost yield. How well the crop yields will be a function of the weather over the next few weeks.

Figure 1. Canola plant bent over from the 2014 freeze. Note the translucent looking stem. Photo courtesy of Josh Bushong, Oklahoma State University Canola Extension Specialist. Used with permission.

Figure 2. An example of severe stem splitting following the 2013 freeze. Note the plant is not lost but this does cause concern for future lodging. Photo courtesy of Jay Smith, Crop Quest Agronomist. Used with permission.

Figure 3. Stem cracking following the 2013 freeze. Photo by Mike Stamm, K-State Research and Extension.

Mike Stamm, Canola Breeder
mjstamm@ksu.edu

4. Identifying wheat streak mosaic and barley yellow dwarf symptoms

The wheat in most parts of the state will be moving through the jointing stages of growth during the next few weeks. Symptoms of barley yellow dwarf and wheat streak mosaic often become more evident during this period of rapid growth than at earlier growth stages. In general, these diseases cause a yellow discoloration of plants that can be confused with nutrient deficiency or environmental injury. The distribution of the affected plants within a field, the position of the discolored leaves on plants, and patterns of symptoms on the leaves can help distinguish these diseases from other disorders.

Viral diseases, such as barley yellow dwarf and wheat streak mosaic, tend to occur in patches within affected fields. Barley yellow dwarf is most commonly found in small patches randomly scattered within a field. Wheat streak mosaic often is more severe on the edges of a field closest to volunteer wheat. The size and distribution of these diseases are ultimately determined by the feeding activity of the vectors (aphids or mites) that spread the viruses.

The symptoms of barley yellow dwarf and wheat streak mosaic are most intense on the upper leaves of infected plants. In contrast, nitrogen deficiency symptoms are more severe on the lower leaves and sulfur deficiency symptoms occur uniformly throughout the plants. The upper leaves of plants infected with barley yellow dwarf are normally bright yellow (Figure 1), but some varieties may also have a red discoloration. This discoloration is more intense near the tip of the leaf than at the base, giving the leaves a flame-like appearance. Plants infected early in their development are often slightly shorter than healthy plants.

Wheat streak mosaic also causes a yellow discoloration of the upper leaves but the affected leaves have a more streaked or blotchy appearance (Figure 2). Plants infected with wheat streak mosaic may be dramatically shorter than healthy plants and often have a more prostrate growth pattern.

The diagnosis of these viral diseases can be a challenge in the field, but they can be reliably distinguished by laboratory testing. You can get help with the diagnosis by sending suspect plants to the Plant Disease Diagnostic Lab at Kansas State University. Your county Extension office can help you send plants to the diagnostic lab, or you can send them directly to the lab yourself. Instructions for sample submission can be found online at: http://www.plantpath.ksu.edu/p.aspx?tabid=725

Figure 1. Wheat with symptoms of barley yellow dwarf. Photo by Erick DeWolf, K-State Research and Extension.

Figure 2. Wheat with symptoms of wheat streak mosaic. Photo by Erick DeWolf, K-State Research and Extension.

Erick DeWolf, Extension Plant Pathology
dewolf1@ksu.edu

5. Gardening on contaminated urban soils

Gardening on vacant lots in urban and suburban areas is becoming more and more popular. There are many benefits to this, provided some basic precautions are taken. Those who raise food on these soils would be well advised to have the soil tested for potentially harmful contaminants. If any contaminants are found, we must find ways to minimize any potential health concerns.

What are the potential contamination problems? Urban soils have sometimes been found to contain toxic levels of heavy metals including lead, arsenic, cadmium, mercury, zinc, nickel, and copper. Contamination may have come from paint, gas or oil, waste incineration, lead pipes, specific industries, and so forth.

It would be helpful to know what practices could be used to minimize potential health risks posed by contamination of garden produce on these soils.

To address this problem, in 2009 we studied lead uptake by several types of vegetables at an urban garden site in Kansas City with "average" levels of lead. In 2010, we tested at a different area on this same site known to have high levels of lead. Lead is one of the more common contamination problems on urban soils, and a contaminant that can cause serious health concerns if levels are too high.

We studied two general approaches to minimizing lead contamination at this site: soil treatments (to reduce plant uptake) and food preparation methods.

Figure 1. Chammi Attanayake, Agronomy graduate student, at the urban garden site in the Washington Wheatley area of Kansas City. Photo courtesy of Ganga Hettiarachchi, K-State Research and Extension.

Soil amendment treatments

One of the most readily available organic amendments for urban gardeners is leaf compost. We tested the effect of compost as a soil treatment on the bioavailability of lead in this soil. Compost was added at 28 kg per square meter and mixed with the top 15 cm of soil, representing a compost:soil ratio of approximately 1:3 (v/v). Control plots with no compost were maintained. Soil pH in compost-added and no-compost-added soils was in the neutral range; furthermore, compost addition improved the concentration of soil organic carbon and cation exchange capacity.

A leafy vegetable, a fruiting vegetable, and a tuber/root vegetable were grown to assess lead uptake of vegetables in the presence and absence of compost treatment. In 2009, Swiss chard, tomatoes, and sweet potatoes were grown. In 2010, Swiss chard, tomatoes, and carrots were grown.

In plants, lead tends to be held in roots. It transfers only slowly to shoots or fruits. As a result, root vegetables such as carrots or sweet potatoes could potentially have the highest concentrations of lead. Leafy vegetables, such as Swiss chard, are next. Fruits such as tomatoes are the least likely to contain lead absorbed from the soil.

To determine lead concentrations in the vegetables we tested, the edible portions of the plants were harvested as each plant type reached maturity at the end of the growing season. Also, representative soil samples were collected before adding compost, at planting, and at harvesting from each plot.

Our study found that adding compost at the rate we used diluted the overall lead concentration in the soil by anywhere from 29 to 52 percent. This reduced the amount of lead absorbed by the vegetables. Also, the phosphorus in compost (and iron oxides in some compost materials) can help hold lead in the soil, which reduces its availability to plants. Finally, compost increased the soil fertility and resulted in larger vegetables, diluting the concentration of lead in them.

In analyzing the edible portions of the vegetables (using the laboratory washing method described below), we found no relation between the concentration of lead in the soil and the concentration of lead in the vegetables.

In 2009, on the soil with relatively low levels of lead, the addition of compost had no effect on the lead concentrations in either Swiss chart, tomatoes, or sweet potatoes. This is most likely because the lead concentration in the produce samples was low, close to the background lead concentration levels.

In 2010, on the soil the relatively high levels of lead, the addition of compost reduced the lead concentration in Swiss chard by 59 percent and in carrots by 20 percent. Since the lead concentration in the soil and produce was high enough in this situation, we could see the compost treatment effectiveness. On the other hand, the lead concentration in tomatoes was unaffected by the addition of compost, even at this location. Fruits, such as tomatoes, have very low lead concentrations under almost any conditions, so it is not surprising that the compost treatment did not affect lead uptake in tomatoes.

The concentration of lead in the vegetables does not necessarily reflect total lead uptake by that vegetable. In 2010, one of the main reasons for the lower concentration of lead in Swiss chard and carrots in the compost-treated soil is that the vegetables were much larger in the treated soils. This diluted the concentration of lead in the vegetables, while the absolute amount of lead in the vegetables was not significantly different between the compost-treated and untreated soils.

This result indicates that an increase of total biomass of vegetables could be an effective means of reducing potential lead transfer to humans.

Vegetable cleaning methods

We tested the effect three methods of cleaning vegetables on lead concentrations in 2010.

1. Laboratory cleaning. Vegetables were rinsed with tap water, then rinsed with deionized water, then with sodium lauryl sulfate solution, and finally rinsed again with deionized water. The objective was to remove all soil particles from produce surfaces.
2. Kitchen cleaning. Vegetables were rinsed only with tap water, to mimic the washing procedure in a home kitchen. This removed all visible soil particles from the produce.
3. Peeling. After kitchen cleaning, a portion of the carrots were peeled.

The various cleaning methods made a significant difference in lead concentrations of Swiss chard and tomatoes but not for carrots. Swiss chard cleaned with the kitchen cleaning method contained 2.6 to 4.6 times greater lead concentrations than that cleaned with the lab cleaning method. Similarly, kitchen-cleaned tomatoes had 3.0 times greater lead concentrations than lab-cleaned tomatoes.

Vegetables can be contaminated with lead not only because of absorption by roots, but also by surface contamination where lead-contaminated soil particles become attached to the plant surface or get embedded in the waxy outer layer of plants. The sodium lauryl sulfate used in the lab cleaning method is an anionic surfactant that can solubilize a large portion of the cuticle barrier on these plant parts. As a result, the lab cleaning methods may have effectively removed particles embedded in the plant surface by solubilizing the cutin lipid cover. That's one reason the lab-cleaned tomatoes and Swiss chard showed lower lead concentrations.

In contrast, cleaning methods did not significantly affect lead concentrations in carrots. This can be explained by the absence of cuticle lipid layer on the roots. Peeling also did not statistically change lead concentrations in carrots. When peeling, we removed a very thin outer layer of the carrots. Synchrotron-based X-ray fluorescence mapping has shown that the concentrations of lead in the peel and the phloem of the carrot are low compared with the concentration of lead in the xylem.

Bioaccessibility of lead in soils

Ingestion of lead directly from contaminated soil and dust is considered as one of the major exposure pathways of lead for children. What percentage of the lead in soil and dust is "bioaccessible" -- meaning soluble in the simulated gastrointestinal (GI) environment and available for absorption by humans?

In this study we measured the level of bioaccessible lead in the soil to understand the direct ingestion risk. Bioaccessible lead in our soil was low (<10% of total lead). This indicates that the potential for lead absorption on this site through direct ingestion of soil or dust would be low. The addition of compost further reduced the concentration of bioaccessible lead in the soil, mainly through dilution.

Summary

Urban and suburban soils should be tested often for nutrient and pH levels. Testing for micronutrients and heavy metals, such as lead, might also be advisable in any circumstance in which contamination may have occurred. One example is soil close to an older house where flakes of lead-based paint may have contaminated the soil.

If the soil test does indicate lead contamination, it might be a good idea to avoid growing root crops such as carrots in the garden. For leafy vegetables, remove the lower or outer leaves since they will be the leaves most likely to be contaminated with soil particles.

Also, if necessary apply lime to keep the soil close to neutral in pH, or possible slightly alkaline. Lead becomes more available for plant absorption under acidic soil conditions.

Be sure to wash vegetables thoroughly with high-quality water and soap. If soil particles are hard to wash off, peel the vegetables or remove the parts contaminated with soil.

Adding leaf compost to the soil may be a good idea as well, as long as the compost does not itself contain high levels of heavy metals. In our study, the addition of compost diluted initial total soil lead concentrations, indicating that the continuous addition of compost would lower total lead concentration in soils significantly. Compost addition also plant lead concentration and bioavailable lead concentrations in the soil.

In addition, compost addition helps maintain good soil nutrient status in soils. Maintaining good soil fertility and thereby increasing biomass production diluted lead concentrations in the vegetables. The highest concentrations of lead in edible portions were found in root/tuber crops, followed by leafy and fruiting vegetables.

In our study, lead concentrations of the edible portions of vegetables, except carrot, were below the maximum allowable limits of lead established by the Food and Agriculture Organization and the World Health Organization.

The abstract of this study published in the Journal of Environmental Quality is online at: http://dx.doi.org/doi:10.2134/jeq2013.07.0273

Ganga Hettiarachchi, Associate Professor, Soil Chemistry
ganga@ksu.edu

Chammi Attanayake, Agronomy Graduate Student
chammi@ksu.edu

6. Comparative Vegetation Condition Report: April 1 - 14

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 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:

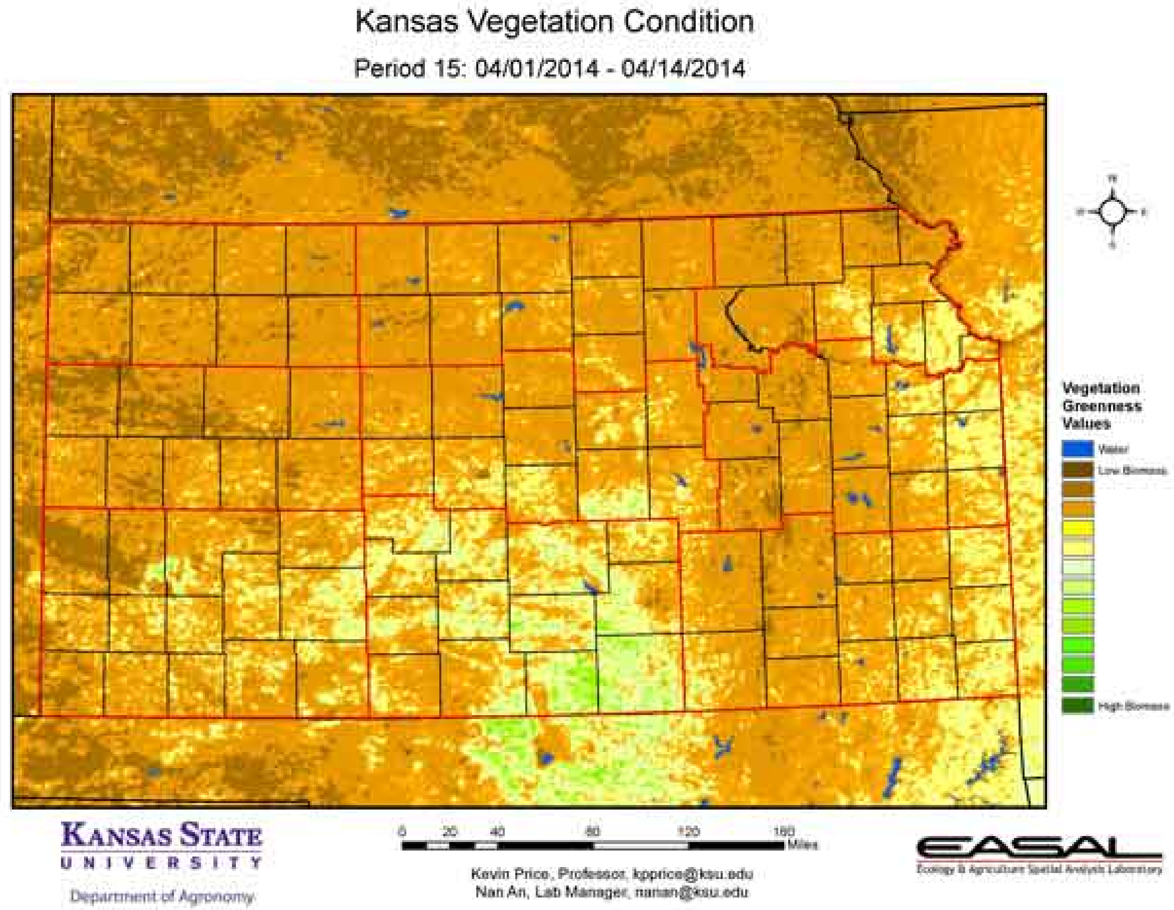


Figure 1. The Vegetation Condition Report for Kansas for April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that vegetative activity is greatest in the South Central Division, where slightly warmer temperatures have resulted in further progress in the winter wheat. Low vegetative activity is particularly noticeable in parts of western Kansas, especially in the area from Wallace to Trego counties and in Hamilton County. This is due to a combination of dry conditions and the cooler temperatures.

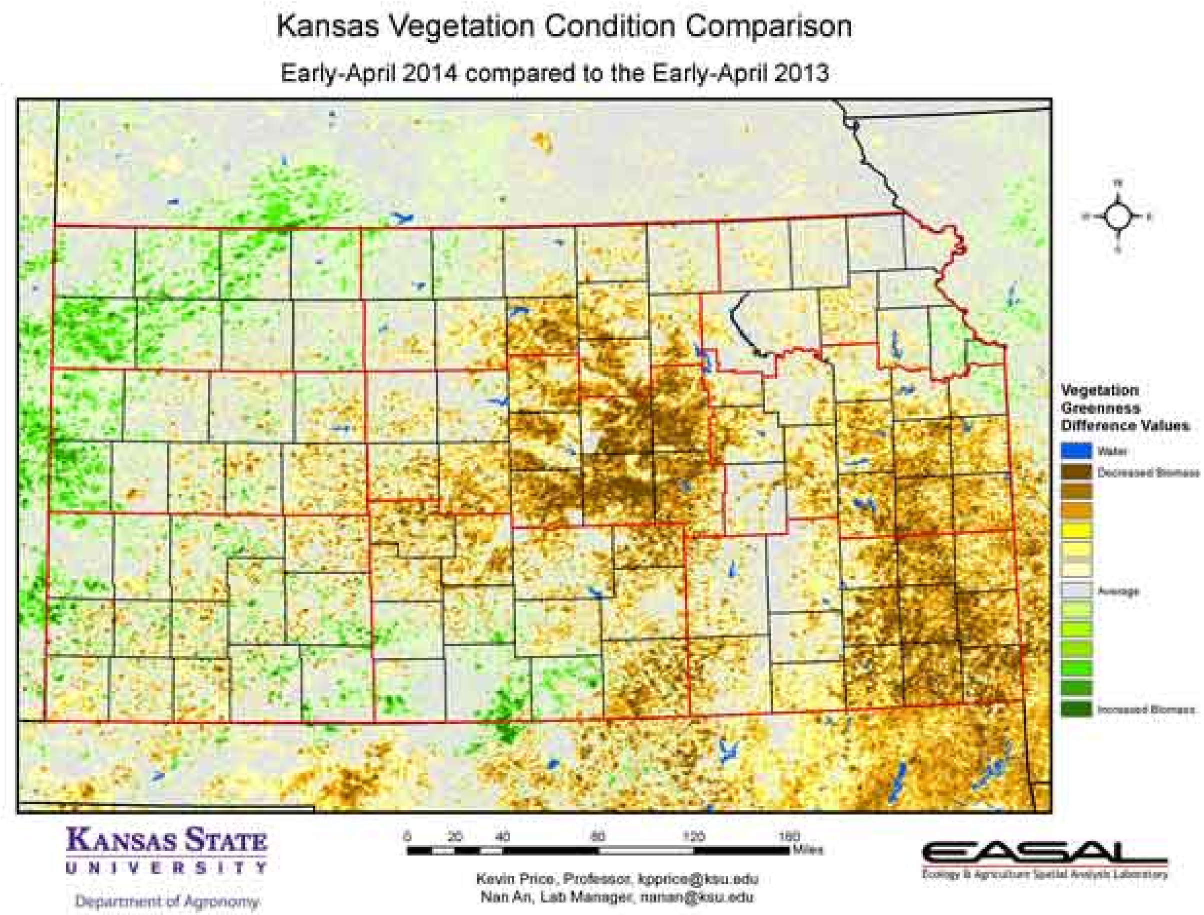


Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows the greatest decrease in vegetative activity in the Central, East Central, and Southeastern Divisions. Northwest and west central Kansas have increased vegetative activity. For the west, this does not signal excessive plant activity; it is simply the fact that vegetative activity last year was extremely limited.

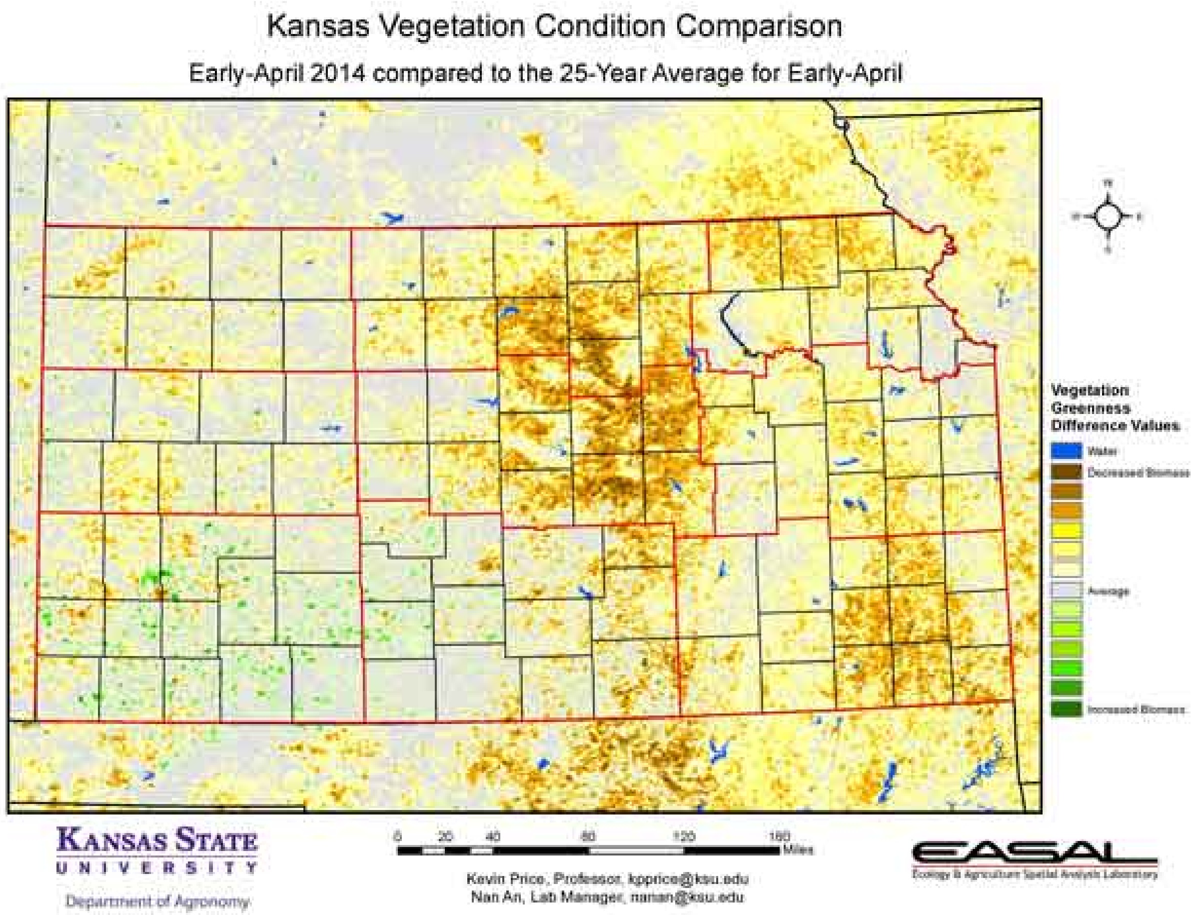


Figure 3. Compared to the 25-year average at this time for Kansas, this year's Vegetation Condition Report for April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows the biggest area of below-average vegetative activity is in the North Central and Central Divisions. In North central Kansas, cooler temperatures have delayed plant development. In the Central Division, the cooler temperatures are compounded with extremely dry conditions.

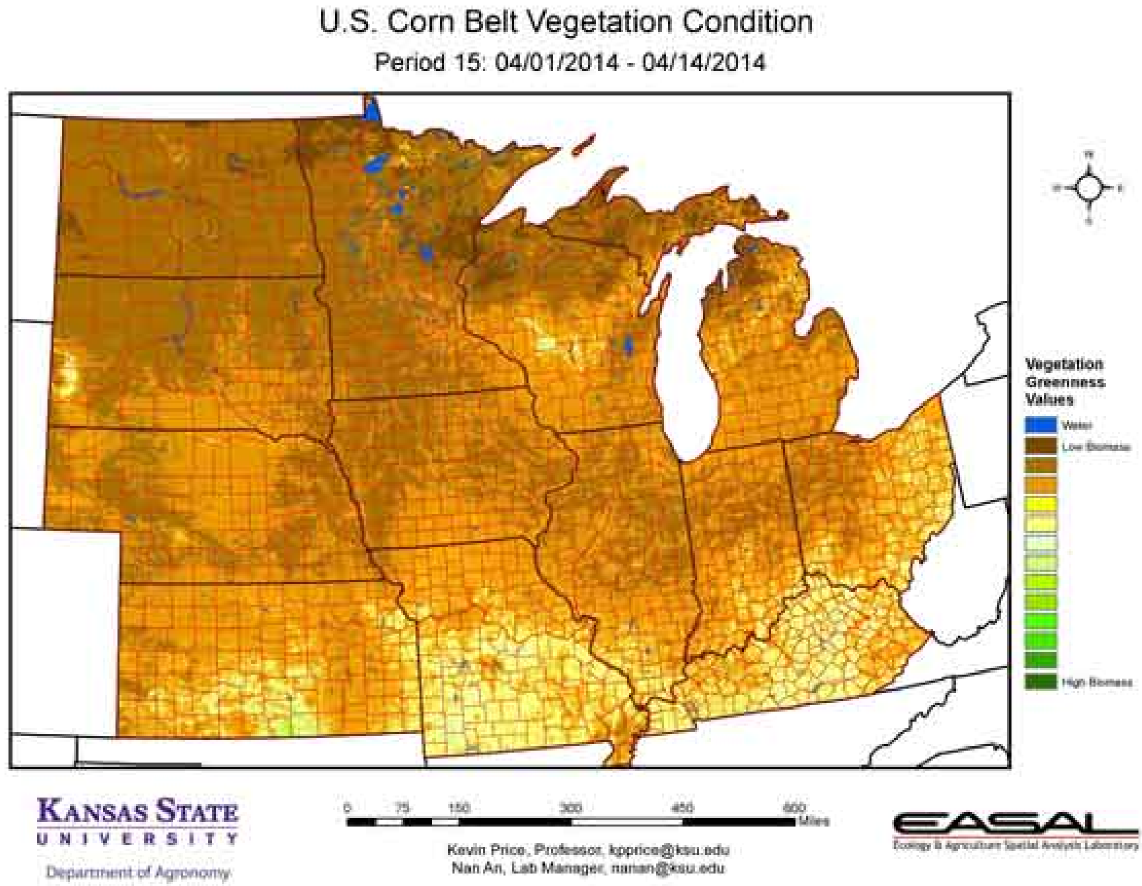


Figure 4. The Vegetation Condition Report for the Corn Belt for April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that the area of lowest vegetative activity is slowly moving northward, as the snow pack retreats. Cold temperatures have delayed field activities in the northern areas of the Corn Belt.

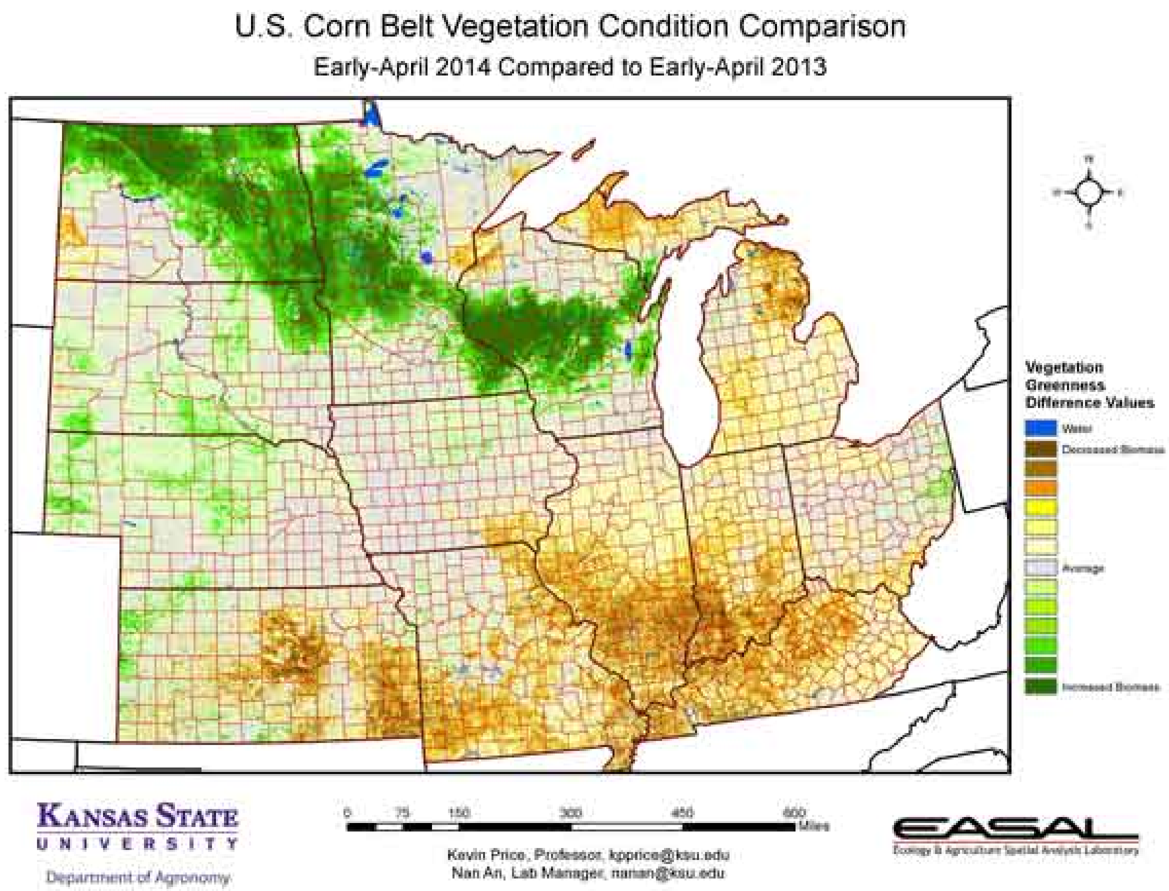


Figure 5. The comparison to last year in the Corn Belt for the period April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows much greater vegetative activity in parts of North Dakota, Minnesota, and Wisconsin. This is due mainly to the lower snow pack this year. In contrast, lower NDVI values are seen in the southern areas of region, due mainly to cooler-than-average temperatures.

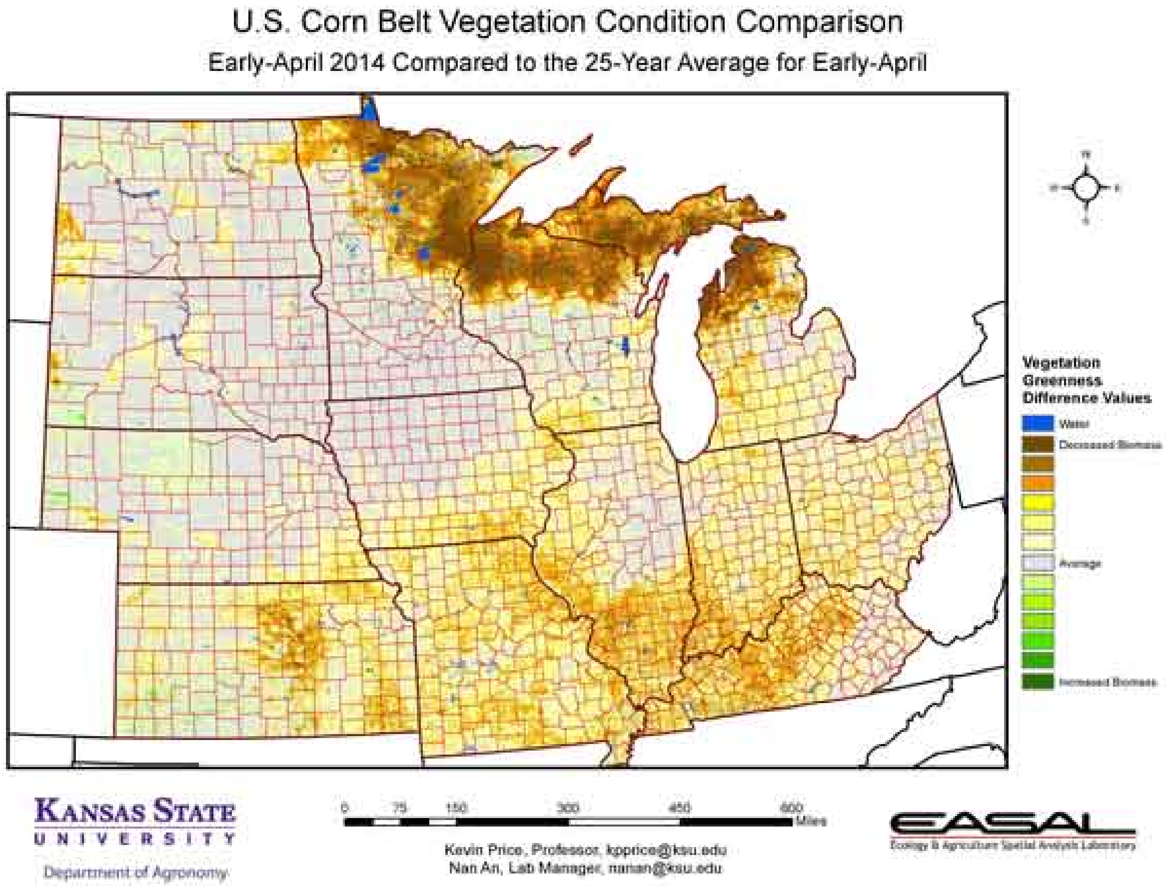


Figure 6. Compared to the 25-year average at this time for the Corn Belt, this year's Vegetation Condition Report for April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that the greatest departure is along the northern Great Lakes, where lingering snow cover continues to delay development. Slighter decreases are seen in the southern portions of the region, where cooler air temperatures are the major influence. Impacts from the freezing temperatures during the April 13-15th period won't be visible for several weeks.

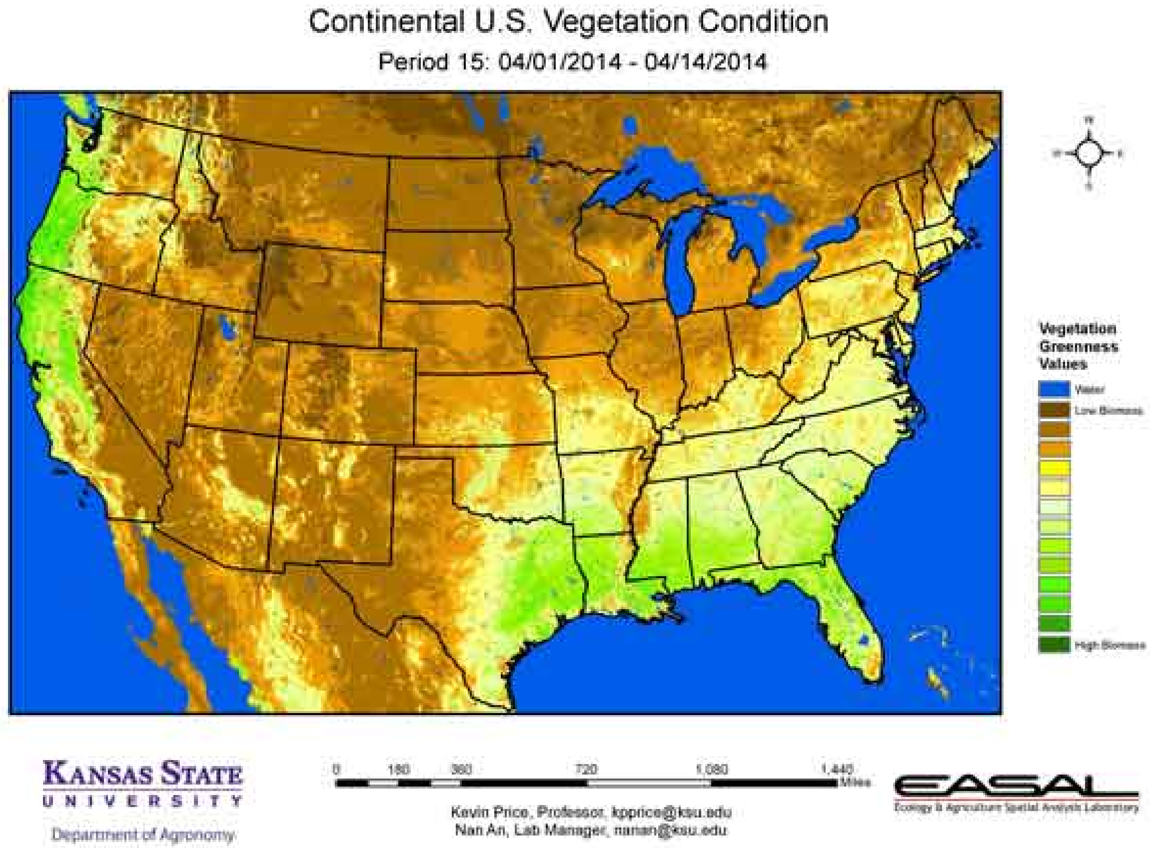


Figure 7. The Vegetation Condition Report for the U.S. for April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that the greatest vegetative activity is along the Gulf Coast and the Pacific Northwest. For the Gulf Coast, the combination of favorable temperatures and moisture has fueled plant development. Along the Pacific Northwest, especially into northern California, the lack of snow is evident in the higher NDVI values. In contrast, in areas of western Wyoming and central Colorado where snow cover is greater, low NDVI values are seen.

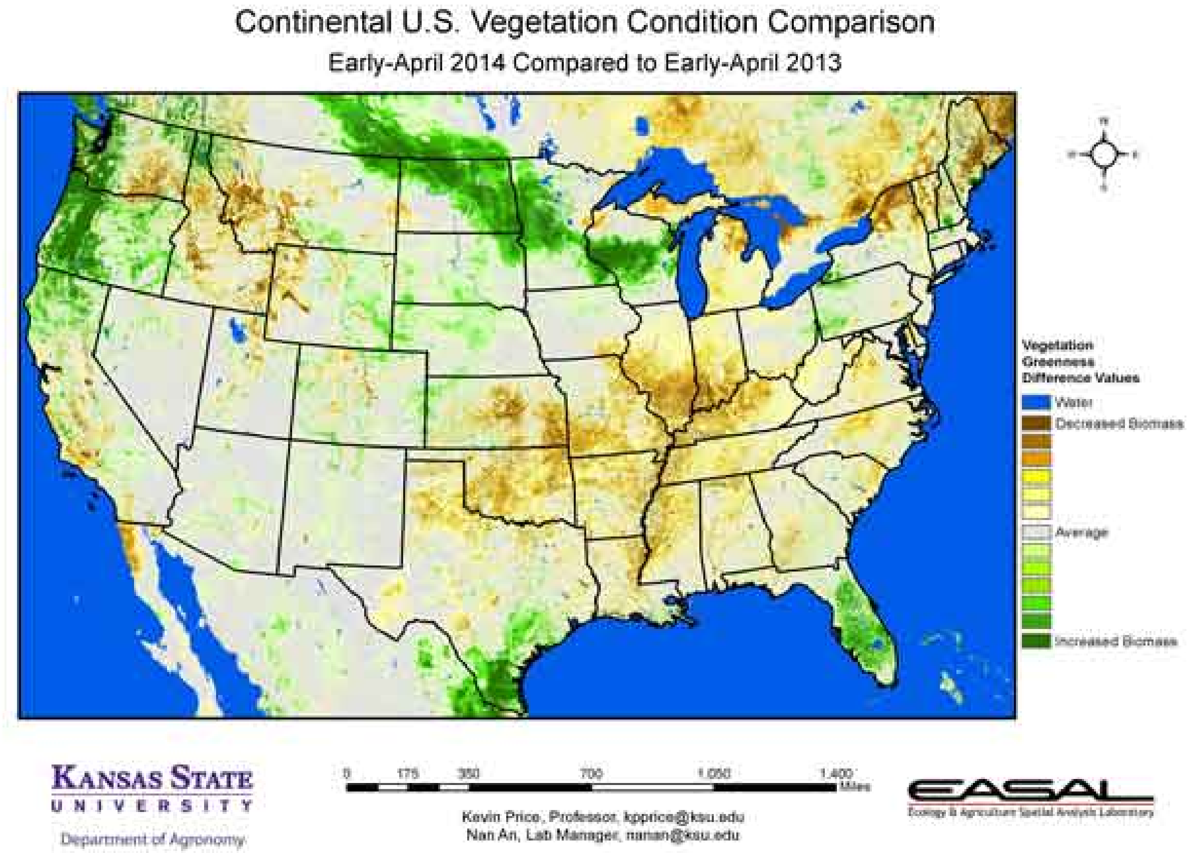


Figure 8. The U.S. comparison to last year at this time for the period April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that the greatest increase in biomass activity is in the northern Plains and the Pacific Northwest. This is due primarily to decreased snow cover this year. For example, Itasca, ND reported no snow on the ground on the 13th of April this year. Last year, it reported 13 inches on the ground.

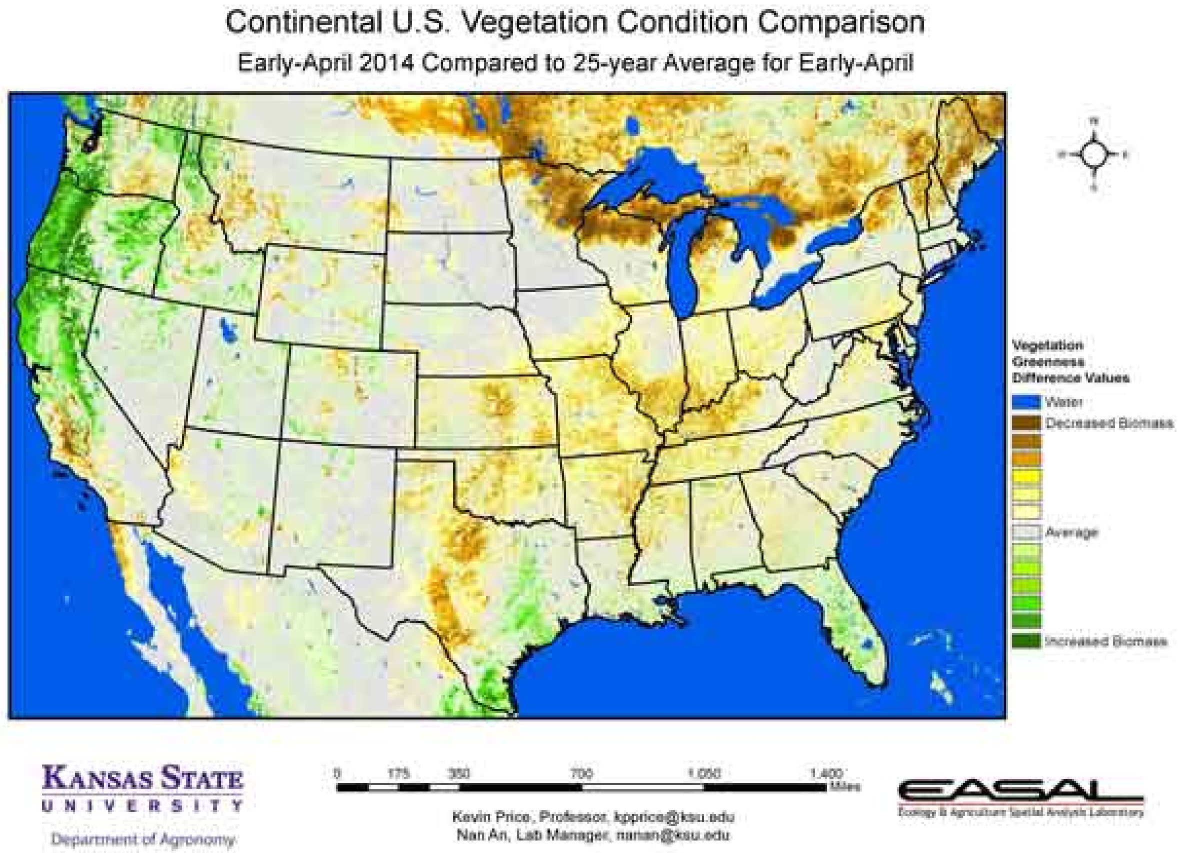


Figure 9. The U.S. comparison to the 25-year average for the period April 1 – 14 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows that the contrast of winters continues to be visible in the northern parts of the country, with delayed vegetative activity in the east, and reduced snow cover in the west. In Texas, the contrast of areas that have had moisture versus those that haven't is evident. Coriscana, southeast of Dallas, has seen 0.83 inches in April; Abilene, southwest of Dallas, has seen just 0.26 inches.

Mary Knapp, Agronomy, Weather Data Library
mknapp@ksu.edu

Kevin Price, Professor Emeritus, Agronomy and Geography, Remote Sensing, GIS
kpprice@ksu.edu

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