



Extension Agronomy

eUpdate

09/05/2014

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. Late-season rainfall: Moldy corn ears and premature kernel sprouting

The corn growing season is reaching an end, but late-season rains can still have an impact on corn grain quality and test weight. Late-season precipitation can increase fungal colonization of corn ears, increase pre-harvesting sprouting, and reduce final test weight and grain quality.

Moldy ears can occur on corn that died prematurely from stress. Corn in this situation usually has high grain moisture content, which favors fungal colonization (Figure 1). In addition, the wet pattern experienced this past week favors the occurrence of moldy ears. Also, corn ears affected by abiotic or biotic (e.g., insect and bird damage) stress are more susceptible to ear molds.



Figure 1. Moldy corn ears. Photos by Eric Adee and Ignacio A. Ciampitti, K-State Research and Extension.

“Exposed ears” are also more susceptible. Exposed ears occur when the ear keeps elongating beyond the end of the husks. The upper part of the ear becomes partially or completely exposed. The combination of heat and drought early this season, followed by an unusually cool and wet pattern, increased the presence of exposed ears (Figure 2). For more information on this topic and other abnormalities in corn ears, check the new K-State Research and Extension i-book at: <http://www.agronomy.k-state.edu/extension/crop-production/corn/>



Figure 2. “Exposed” corn ears. Photo by Ignacio A. Ciampitti, K-State Research and Extension.

When ears are exposed out of the husks, diverse disease problems are evident. Some of the most common diseases are: *diplodia* ear rot, *aspergillus* ear and kernel rot, *fusarium* ear and kernel rot, *gibberella* ear rot, and blue eye mold, among several other diseases.

Low test weight

The occurrence of moldy ears can affect test weight in corn, resulting in light-weight and chaffy grain. Other causes of low test weight are: 1) higher grain moisture, 2) abiotic stress conditions (e.g., drought and heat), 3) late-season leaf diseases, and 4) below-normal temperatures during the end of the grain filling, which was not the case this year.

Moldy ears can also impact final grain quality through the production of mycotoxins, potentially affecting quality of the grain as an animal feeding source. It can also cause issues for storage and end-use processing (e.g., starch quality and ethanol).

Sprouting

Pre-harvest sprouting is likely to occur when dry grain (less than 20% moisture content) is re-wetted. This situation is particularly associated with late-season rains, warm temperatures, and upright ears. The main result is a sprouted kernel in the lower section of the corn ear (Figure 3). If this is a large-scale problem throughout the field, grain quality can be compromised and cause problems for storage purposes.



Figure 3. Premature corn kernel sprouting in the lower section of the ear. Photo by Eric Adee, K-State Research and Extension.

For more information about the causes of low test weight and premature corn kernel sprouting, see the following articles by Dr. Robert Nielsen of Purdue University:

<http://extension.entm.purdue.edu/pestcrop/2009/issue25/index.html#test>

<http://www.agry.purdue.edu/ext/corn/news/timeless/Vivipary.html>

In summary, these production issues are occurring now in the field in some cases. One the most effective management practices is to scout fields for these issues and estimate the portion of your field affected by moldy ears or pre-harvest sprouting problems. Timely harvest and pre-screening of corn ears can help mitigate these issues and diminish the economic impact.

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2. Method for estimating sorghum yields

The estimation of crop yields before harvest can be erratic, but producers often like to know about the potential yield of their crops. In previous K-State Agronomy eUpdates we discussed the calculation of the potential yield for soybean and corn. These articles are:

- Estimating soybean yields. <http://ksu.ag/1oPgUtP> (August 15, 2014 - eUpdate 470)
- Estimating corn yields. <http://ksu.ag/XpLTak> (August 1, 2014 - eUpdate 468)

This article will discuss how to get simple but fairly good estimates of sorghum yield potential. Similarly to soybean crop, sorghum can also compensate for abiotic or biotic stresses through changes in head sizes (grain number and weight) and number of tillers.

Before going into the procedure to estimate sorghum yields, we need to understand the main plant components of sorghum yield. The main yield-driving forces are:

- Number of plants
- Number of tillers per plant
- Total number of seeds per head
- Seeds per pound

The number of plants and the number of tillers per plant are two of the main components, which are determined well before the end of the crop growing season. Those two yield components are influenced by the initial plant density, planting date, and the environment, among other factors.

Those who want to get right to the formula can skip to the next paragraph, but it will help to know how sorghum yield components develop. Increasing the number of plants per acre potentially increases competition for resources, which can diminish the plant's capacity to produce tillers. In addition, the interaction of planting date with plant density can have a similar effect. As planting date is delayed, the capacity of the plant to produce tillers will be reduced; thus, plant population needs to be increased to compensate for the reduction in the number of tillers. Previous research at K-State showed sorghum produces more tillers when planted early (mid-to-late May) at lower plant populations as compared with late planting dates (mid-to-late June). The environment also plays an important role in the final number of heads per unit area. Heat and drought stress will reduce the plant's ability to produce more tillers, and also could severely reduce the tiller survival rate. The total number of seeds per head will be determined within the one- or two-week period before flowering until milk to soft dough stages (approximately two to three weeks after flowering). Kernel size will be determined close to the end of the season. In the 15 to 25 days after flowering, during the soft dough stage, sorghum grains have already accumulated about 50% of the final dry mass. Thus, the period around flowering is critical for defining not only the final number of grains per head but also the potential maximum kernel size. Final seed weight will be determined when the grains reach physiological maturity (visualized as a "black-layer" near the seed base). From this time until harvest the grains will dry down from approximately 35% to 20% moisture content.

The interaction among all four components will determine the actual yield, but a wide range of variation can be expected in all these main yield driving forces (Figure 1).

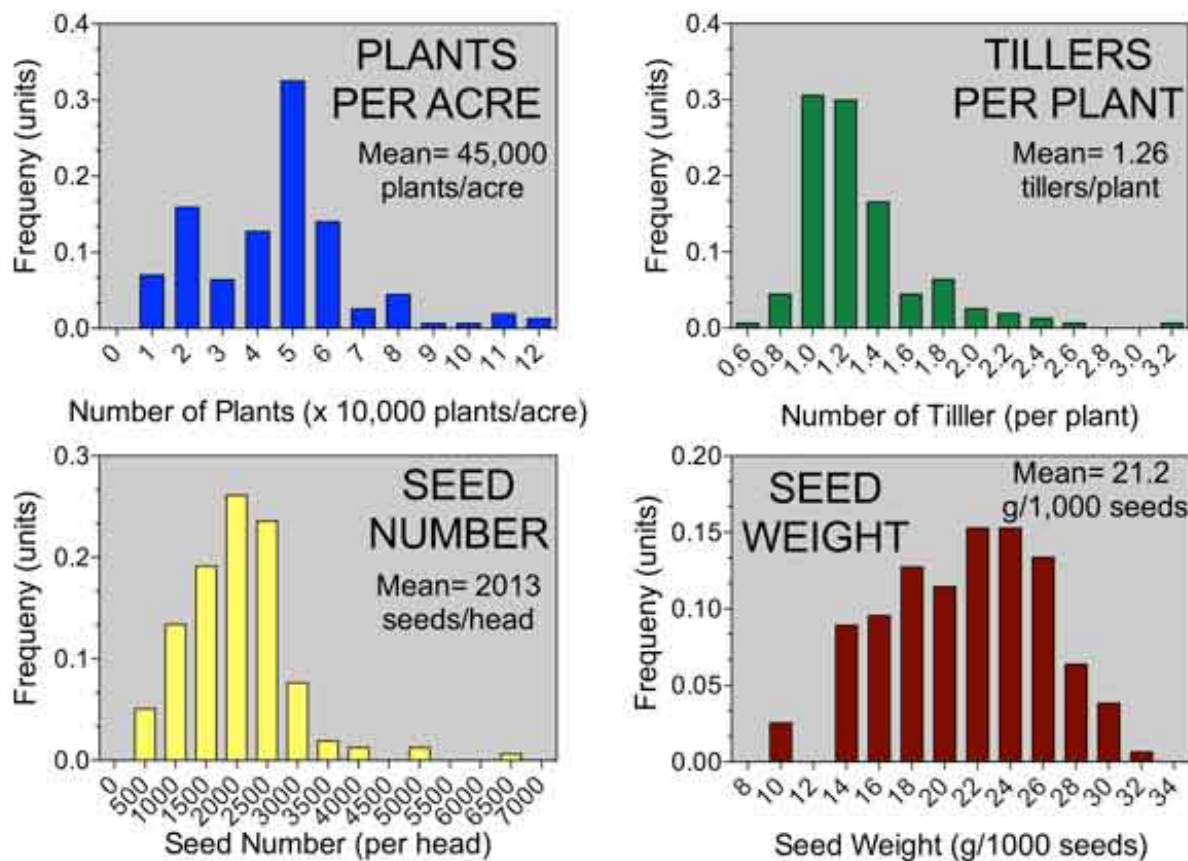


Figure 1. Example of the variation expected to be found in the main sorghum yield components. The number of tillers per plant can also be interpreted as the number of heads per plant, considering that all tillers have one fertile head.

When can I start making sorghum yield estimates?

As the sorghum crop gets closer to full maturity, yield estimates will be more accurate because the kernel weight will be closer to being set. Nonetheless, we can start taking yield estimations three to four weeks after flowering (from soft to hard dough stages). At these stages, the final seed number can still change. In addition to the seed number, the seed weight will be only partially determined -- approximately 50 to 75% of dry mass accumulation as compared to the final weight.

Variability within the field

Variability between plants needs to be properly accounted for when estimating sorghum yields using the on-farm approach (see next section). Another important factor is the variation between different areas in the field. In general, it is recommended to perform yield estimations in at least 5 to 10 sections of the field to account for field variability.

On-farm approach for estimating sorghum yields

The estimation of sorghum yields should consider the main driving forces:

Total number of heads per unit area [number of plants per acre x heads per plant] (1)

Total number of seeds per head (2)

Number of seeds per pound (3)

Pounds per bushel, or test weight, which for sorghum is 56 lbs/bushel (4)

The final equation for estimating sorghum yields:

$$[(1) \times (2) / (3)] / (4) = \text{Sorghum yield in bushels/acre}$$

The following steps should be taken for making sorghum yield estimates:

Step 1 -Number of Heads per Unit Area:

For this on-farm approach, start by counting the number of heads from a 17.4 foot length of row when the sorghum is in 30-inch rows. This sample area represents 1/1000th area of an acre. If the sorghum is in 15-inch rows, then the number of heads in 2 rows should be counted. For a 7.5-inch spacing, 4 rows will be measured. In each of these scenarios, the area counted will be equal to 1/1000th of an acre.

Head counts should be taken in several different areas of the field to properly account for the potential yield variability. If the proportion of smaller heads, less than 3 inches in height, is very low (less than 5%), these heads could be avoided due to the smaller proportion they will represent when determining the final yield.

Step 2 –Estimation of the Number of Seeds per Head:

The seed number is, by far, one of the most complicated yield components that need to be estimated. The total number of seeds per head can vary from 100 to 5,000 seeds per head (Figure 1), but almost $\frac{3}{4}$ of the seed number distribution is around 1,500 to 2,500 seeds per head. A previous report on sorghum yield estimation (Vogel, 1970), suggested as an alternative to estimate the number of nodes, and branches within nodes, for each sample of sorghum heads, and then to count the number of grains in a subsample of nodes and branches.

This approach is still very tedious. A simpler method of estimating the number grains per head would be very helpful.



Figure 2. To estimate the total number of heads per acre, count the number of heads in a sample area 17.4 feet in length, for 30-inch row spacings. Photo by Ignacio Ciampitti, K-State Research and Extension.



Figure 3. There is no easy shortcut yet for counting the number of seeds per head. Photo by Ignacio Ciampitti, K-State Research and Extension.

We are currently processing information from previous and current year, and the method for developing a quick estimation of the grain number will be available soon. The estimation is based on predicting the final head volume. Stay tuned for more details about this project in coming months!

Another quick method uses an estimate of seed counts per head based on determinations of general yield environment conditions. From previously published information from K-State (provided by K-State professors Richard Vanderlip, emeritus, and Kraig Roozeboom), we can utilize a very simple association between the yield level, conditions around pollination/grain set time, and the number of grains per heads (Figure 4). In their work, Vanderlip and Roozeboom counted the average number of seeds per head and average seed weight for different yield environments, after harvest.

We can use this relationship to give us a general idea of the kind of seed count per head we can expect based on the general yield environment, using primarily the environmental conditions during the period of first week before flowering to two to three weeks after flowering, when pollination and grain set are being determined. We can then use that estimated seed count per head, and multiply it by the number of heads per acre. The number of seeds per pounds, or seed weight, is also a factor we need to estimate, but the work by Vanderlip and Roozeboom found that to be much less of a factor in yield than seed count per head.

If conditions were very poor during pollination and grain set, around the first week before and two to three weeks after flowering, and the general yield environment is low then the total number of seeds per head will average around 500-1,000 seeds per head (900; Table 1). On the opposite extreme, if the conditions around flowering were very favorable for good pollination and grain set development, and the general yield environment is very high, then the number of seeds per head could be around 1,500 to 3,500 (2,500; Table 1). Intermediate yield environment scenarios can occur if a portion of the three-to-four week period around flowering was favorable and part of it was unfavorable. In that case, the number of seeds per head could be between 1,000-3,500, with an overall average of around 1,745 seeds per head.

This information is provided only for general guidance on estimating sorghum yield potential using the on-farm approach. Different responses between yield and its components might be expected for the complexity of diverse genotypes, crop production practices, and environments.

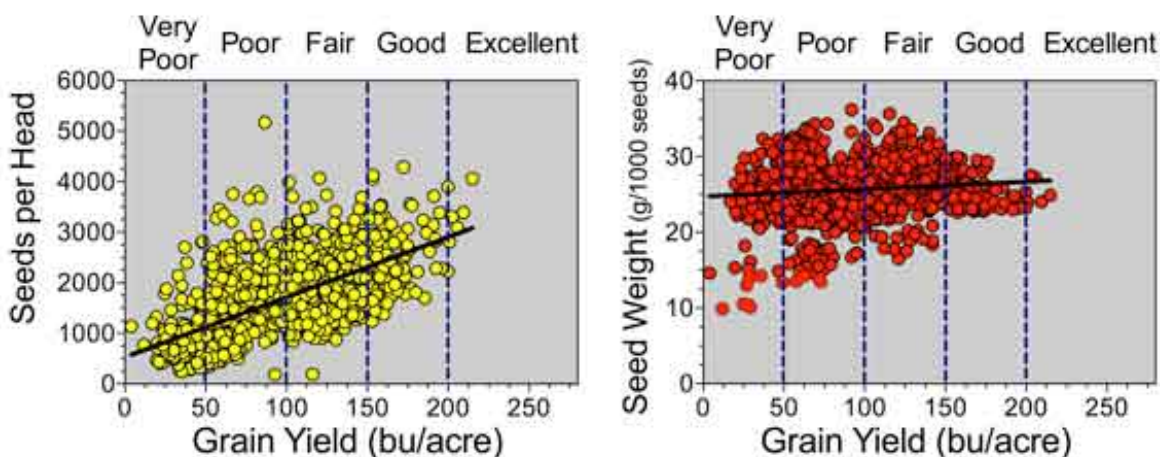


Figure 4. Relationship between grain yield and yield components, seeds per head (yellow points, left panel) and seed weight (red data points, right panel). The number of seeds per head has the most direct relationship with yield.

Table 1. Total number of seeds per head and seed weight components.

Yield Range (bu/acre)	Crop Condition	Average Seeds per Head	Average Seed Weight (g/1,000)	Number of Observations
<50	Very Poor	900	24.5	154
50-100	Poor	1,500	25.5	391
100-150	Fair	2,000	26.2	495
150-200	Good	2,500	25.6	129
>200	Excellent	3,330	25.5	5

Step 3 –Estimation of the Seed Weight:

A similar procedure can be followed to estimate the seed weight (Table 1). For the seed weight component, the variation documented in the dataset showed a very narrow seed weight variation as compared with the variability found in the seed number component. In general, it seems that lower seed weight is expected at low yield ranges, but the difference among yield levels is negligible. Table 2 shows the conversion from average seed weight to seeds per pound, and from seeds per pound to the seed size factor employed in the examples below for sorghum yield estimation.

Table 2. Seed weight, seeds per pound.

Yield Range (bu/acre)	Crop Condition	Average Seed Weight (g/1,000)	Seeds Per Pound
<50	Very Poor	24.5	18,520
50-100	Poor	25.5	17,793
100-150	Fair	26.2	17,318
150-200	Good	25.6	17,723
>200	Excellent	25.5	17,793

Step 4- Examples of “On-Farm” Yield Estimation Approach:

$[(\text{Heads} \times \text{Seeds per Head}) \times 1,000 \div \text{Seeds per Pound}] \div \text{Pounds per bushel}$

Examples:

A. Good Crop Condition:

Irrigated sorghum with adequate plant density (48,000 plants/acre), average number of tillers per plant of 1.3, and good yield environment with adequate flowering and grain filling periods:

$(48 \text{ plants in } 17.4 \text{ foot} - 1/1000^{\text{th}} \text{ of an acre} - \times 1.3 \text{ fertile tillers per plant}) = 62 \text{ heads}$

Yield Estimation = $[(62 \times 2,500) \times 1,000 \div 17,723] \div 56 = \mathbf{156 \text{ bu/acre}}$

B. Poor to Fair Crop Condition:

Dryland sorghum with adequate plant density (40,000 plants/acre), average number of tillers per plant of 1.3, and poor flowering but fair grain filling period:

$$\text{Yield Estimation} = [(52 * 1,500) * 1,000 \div 17,723] \div 56 = \mathbf{79 \text{ bu/acre}}$$

C. Very Poor Crop Condition:

Dryland sorghum with adequate plant density (40,000 plants/acre), average number of tillers per plant of 1.0, and poor yield environment and growing season (poor flowering and grain filling period):

$$\text{Yield Estimation} = [(40 * 900) * 1,000 \div 18,520] \div 56 = \mathbf{35 \text{ bu/acre}}$$

Summary

Seed number is the main driving force of sorghum yield. On-farm estimations can be roughly based on environmental conditions during the week before and the two- to three-week period after flowering, which is the critical period of pollination and grain set. Actual seed counts per head would make the estimates much more accurate, but requires considerable time and effort. Future work will focus on getting more exact, rapid estimates of the number of seeds per head through the use of pragmatic and simple techniques, which will simplify the “on-farm approach” described in this article.

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3. Fall treatment of *sericea lespedeza*

Recent rains across Kansas have caused *sericea lespedeza* to bloom in many areas. If your area is still dry and *sericea* is not actively blooming, it may be more effective to wait until next year to spray. The late-bud stage through the bloom stage is a good time to spray *sericea lespedeza*. Dense stands of this invasive, noxious weed need be addressed with broadcast or aerial applications of labeled herbicides to start reducing stands. However, scattered or sparse stands can be treated with spot-spraying.



Figure 1. *Sericea lespedeza* in bloom. Photo by Walt Fick, K-State Research and Extension.

Remedy Ultra (triclopyr) and PastureGard (triclopyr + fluroxypyr) can be effective during the early to full bloom stage, but products containing metsulfuron (such as Escort XP, Cimarron Plus, Chaparral etc.) are often more effective as flowering ends and seed pods appear and begin to fill.

Aerial applications

Escort XP (metsulfuron) in the fall should be applied with a minimum of 3 gallons/acre spray solution. Add 0.25% non-ionic surfactant to 0.5 oz product of Escort XP. Chaparral (metsulfuron + aminopyralid) should be applied at 2.5 oz/acre beginning at flower bud initiation through the full bloom stage of growth. Aerial applications of Chaparral should be made with at least 2 gallons/acre spray solution. Dense or tall stands should be treated with 5 gallons/acre spray solution. Add 0.25-0.5% non-ionic surfactant when spraying Chaparral. Smooth brome and tall fescue may be suppressed or stunted by applications of Chaparral. Cimarron Plus (metsulfuron + chlorsulfuron) can

be applied by air in a minimum of 3 gallons/acre spray solution at a rate of 0.625 oz/acre. Add 0.25% non-ionic surfactant and treat sericea lespedeza beginning at flower bud initiation through the full bloom stage of growth.

Ground applications

The same rates of Escort XP (0.5 oz/acre), Chaparral (2.5 oz/acre), and Cimarron Plus (0.625 oz/acre) as applied by air can be applied by ground applications using 10-20 gallon/acre spray solutions. Add a minimum of 0.25% non-ionic surfactant and treat sericea lespedeza through the full bloom growth stage.

Spot applications

Not all labels allow spot spraying. Always check labels for recommended rates and other precautions. For spot spraying, Escort XP can be applied at 1 gram/gallon of water or 1 oz/100 gallons of water. Add a non-ionic surfactant. Established stands of native grasses and smooth brome tolerate Escort XP, but tall fescue can be stunted.

Chaparral can be applied for sericea lespedeza control during the bud to flower stage at a rate of 2.5 oz/100 gallons of water. Add 0.25% non-ionic surfactant to the Chaparral application. As mentioned earlier, cool-season grasses such as smooth brome and tall fescue may be stunted by Chaparral. Spot spraying results in spraying to the point of wetting at about 40-50 gallons/acre.

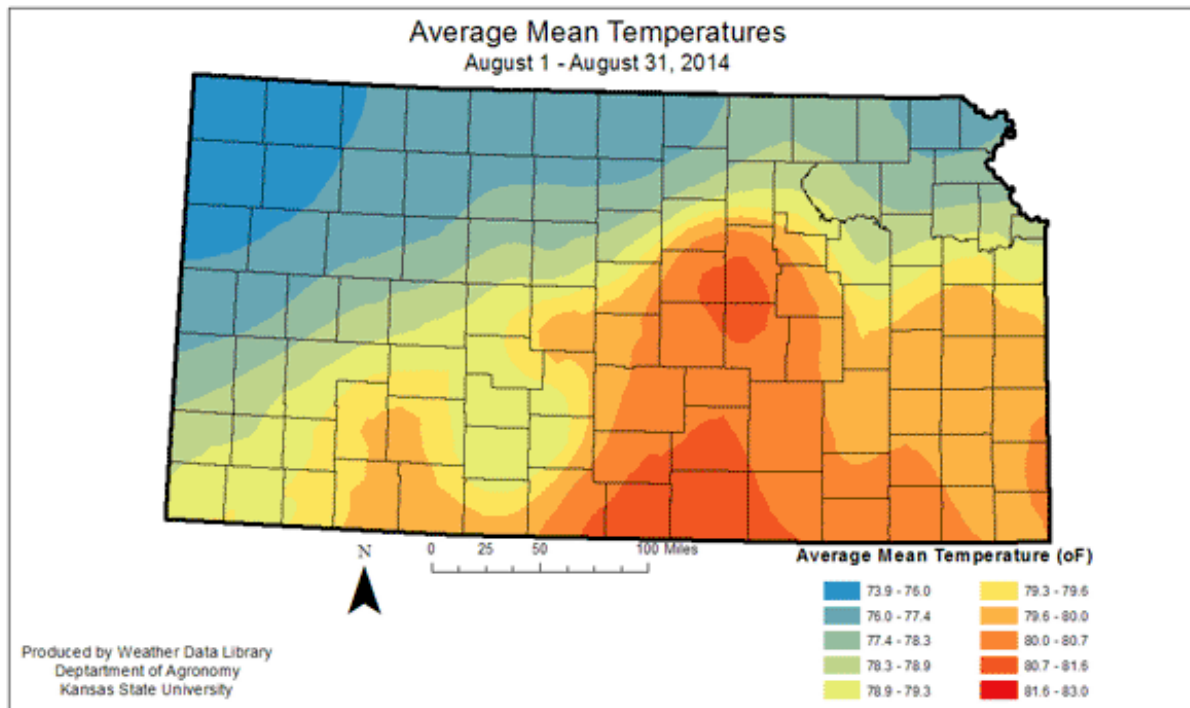
Keep sericea lespedeza from going to seed

Sericea plants can be killed until frost, but if pod fill has begun, viable seed will still be produced. Grasslands with sericea lespedeza infestations should not be grazed or hayed after the sericea has gone to seed. This will only serve to spread the seed to other areas. If at all possible, keep sericea lespedeza from going to seed. Start planning now for follow-up treatment early next summer. Persistence is necessary to keep sericea lespedeza at reduced levels.

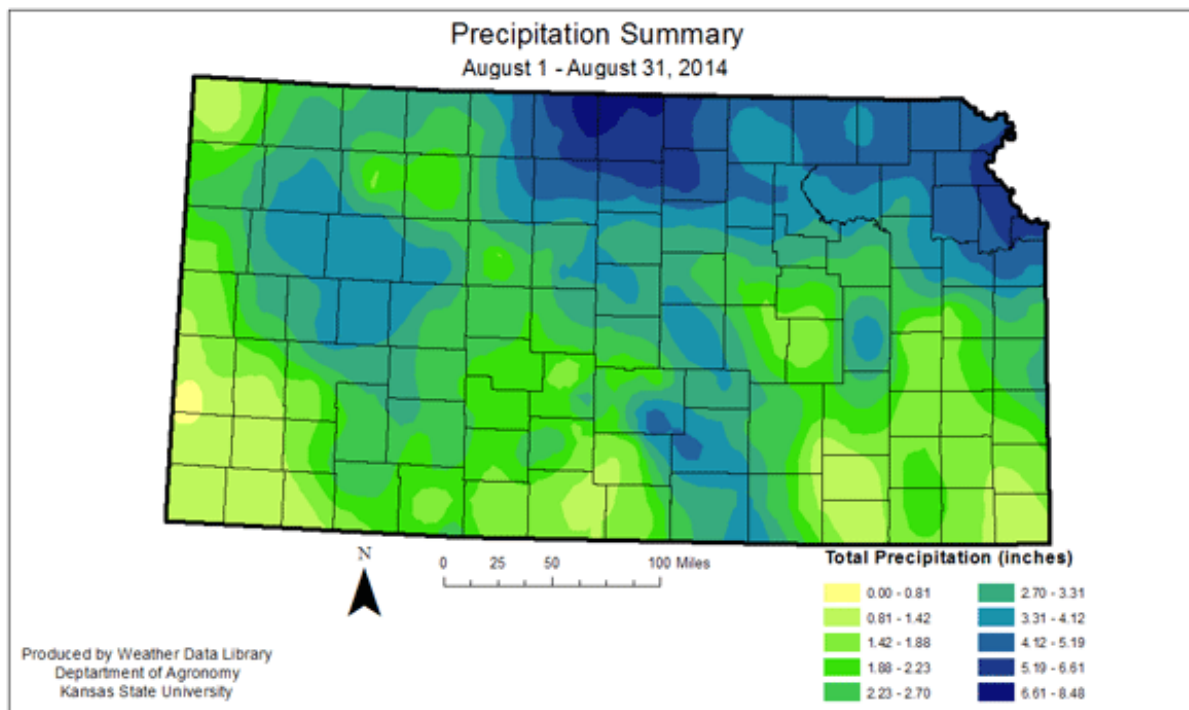
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4. August 2014 weather summary for Kansas: Uneven pattern

In general August was warmer than average and drier than average. There were exceptions to the pattern. The Northwest Division saw the coolest temperatures. It also was the area that saw the coldest reading of the month: 47 degrees F at Brewster. Despite these factors, the division average was 0.9 degrees above normal. All divisions saw temperatures above 100 degrees F during the month. Despite the warm temperatures, no new monthly record high temperatures were set for August, and only three daily records were matched or exceeded. The statewide average temperature for the month was 78.7 degrees F, ranking 37th of 120 years. Much of the warmth was noted in elevated night temperatures, where 35 daily records were met or surpassed.

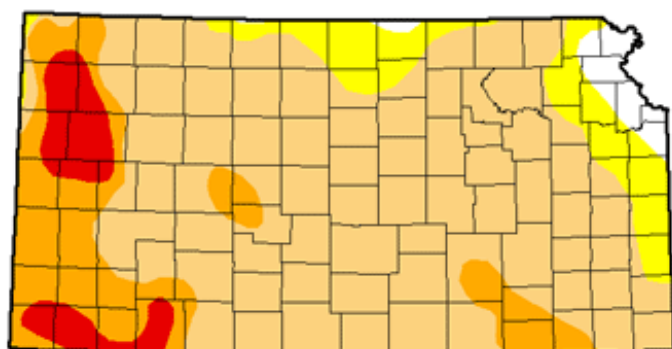


The statewide average precipitation for August was 2.14 inches, which was a 1.18-inch deficit for the month. That is 64 percent of the normal precipitation for the month, and places it as the 30th driest of 120 years. Only the North Central Division averaged normal, with 3.31 inches. It should be noted that this does not include the widespread rain that fell during the afternoon and evening of August 31st. Those totals were reported on the 1st of September, and will be included in next month's summary. Beloit reported the greatest monthly total for a National Weather Service station with 6.47 inches; Lebanon had the greatest monthly total for a CoCoRaHS station at 8.87 inches.



Drought conditions persist across the state, but there was continued improvement in western Kansas. Conditions deteriorated in the central part of the state. Only a tiny sliver of extreme northeast Kansas is in near normal conditions. However, the area of extreme drought has been reduced, particularly in central and south central Kansas. Less than 10 percent of the state is in extreme drought, and an additional 24 percent is in severe drought. The El Niño/Southern Oscillation (ENSO) is still expected to switch to an El Niño event before winter, but it still remains to be seen what impact will be felt. The September temperature outlook is for cooler-than-normal temperatures across most of Kansas, with the southern counties likely to have near-normal temperatures. The precipitation outlook is for above normal from the northwest through the southeast, and neutral for north central and northeast Kansas. This does not indicate how that moisture might be distributed.

U.S. Drought Monitor Kansas



Author:
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Western Regional Climate Center



<http://droughtmonitor.unl.edu/>

August 26, 2014

(Released Thursday, Aug. 28, 2014)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0	D1	D2	D3	D4
Current	2.73	9.35	67.69	14.66	5.58	0.00
Last Week 8/19/2014	2.73	9.41	67.71	14.58	5.58	0.00
3 Months Ago 5/27/2014	0.00	1.16	18.03	32.50	45.23	3.09
Start of Calendar Year 1/1/2014	4.71	48.37	13.04	28.30	5.58	0.00
Start of Winter Year 10/1/2013	46.14	13.58	8.35	27.98	3.96	0.00
One Year Ago 8/27/2013	45.00	11.41	4.45	8.59	21.71	8.83

Intensity:

D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought
D2 Severe Drought	

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Aug 2014

Kansas Climate Division Summary

Precipitation (inches)						Temperature (°F)				
Aug 2014			2014 Jan. through Aug.			Monthly Extremes				
Division	Total	Dep. ¹	% Normal	Total	Dep. ¹	% Normal	Ave	Dep. ¹	Max	Min
Northwest	1.76	-0.97	64	12.05	-4.84	70	75.6	0.9	103	47
West Central	2.44	-0.17	92	14.97	-1.32	90	76.8	1.3	102	54
Southwest	1.27	-1.44	45	12.90	-2.54	81	79.5	2.3	104	56
North Central	3.31	0.03	100	16.06	-5.23	75	78.0	0.9	102	52
Central	2.38	-1.19	67	17.58	-4.90	78	80.4	2.2	103	52

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South Central	1.73	-1.71	49	18.99	-4.48	81	80.1	0.9	103	51
Northeast	3.31	-0.59	85	19.16	-6.50	74	78.0	1.7	103	50
East Central	2.00	-2.09	48	17.52	-10.09	63	79.5	2.4	104	53
Southeast	1.84	-1.90	49	18.64	-10.77	63	80.0	1.5	101	51
STATE	2.14	-1.18	64	16.40	-5.60	75	78.7	1.6	104	47

1. Departure from 1981-2010 normal value

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5. Comparative Vegetation Condition Report: August 19 - September 1

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 35: 08/19/2014 - 09/01/2014

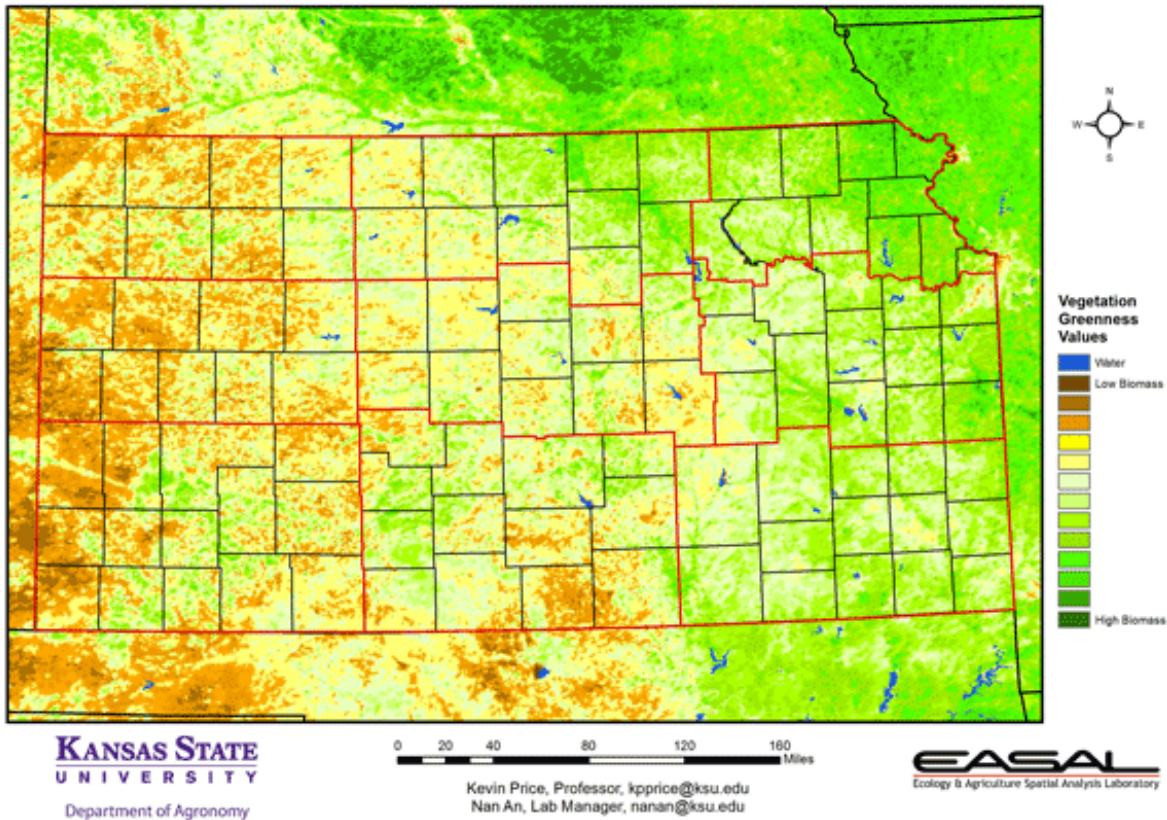


Figure 1. The Vegetation Condition Report for Kansas for August 19 – September 1 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that northeast Kansas has the highest biomass production. The Republican River Valley region of north central Kansas also shows high NDVI values for the period. The largest areas of low biomass production continue to be in western Kansas, where severe to extreme drought is still widespread.

Kansas Vegetation Condition Comparison
Late-August 2014 compared to the Late-August 2013

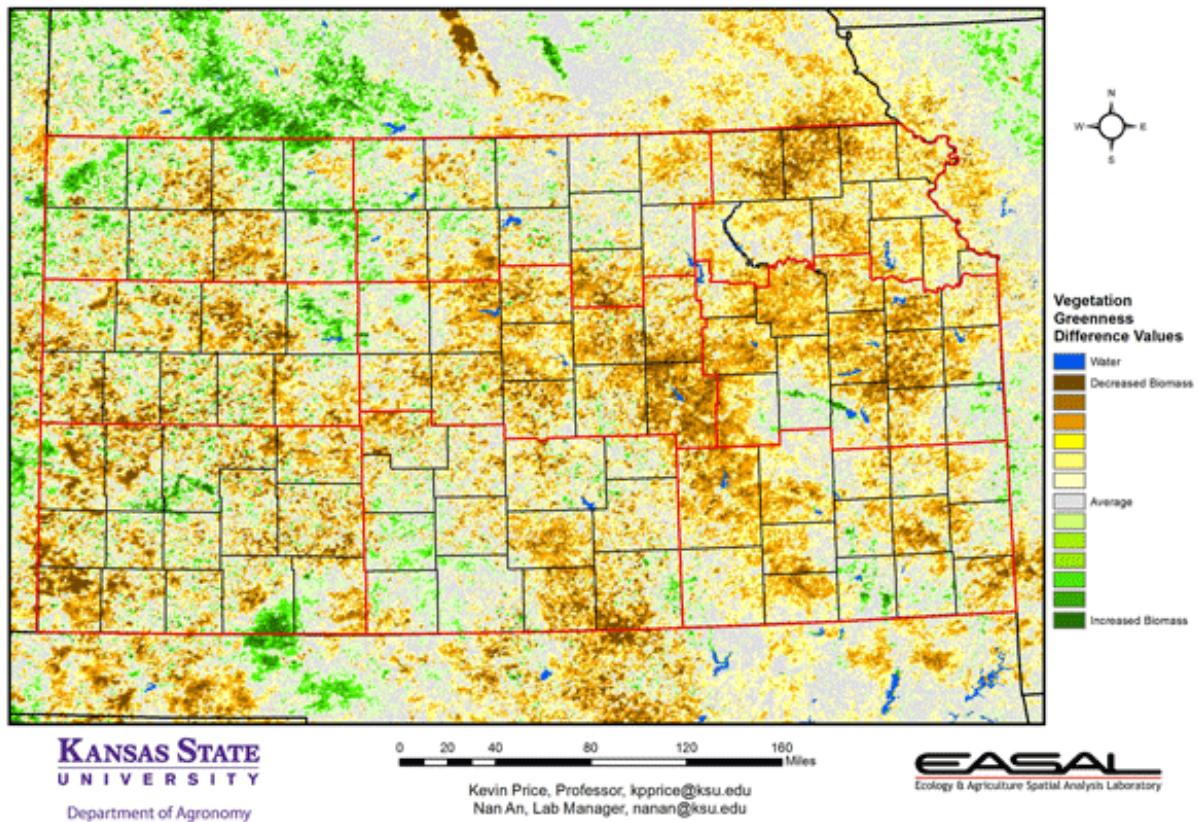


Figure 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for August 19 – September 1 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that NDVI values are lower across much of the state. Crop progress for corn, soybeans, and sorghum was ahead of last year. For example, corn harvest was reported as 7 percent complete, where last year zero percent of the crop had been harvested at this time.

Kansas Vegetation Condition Comparison
Late-August 2014 compared to the 25-Year Average for Late-August

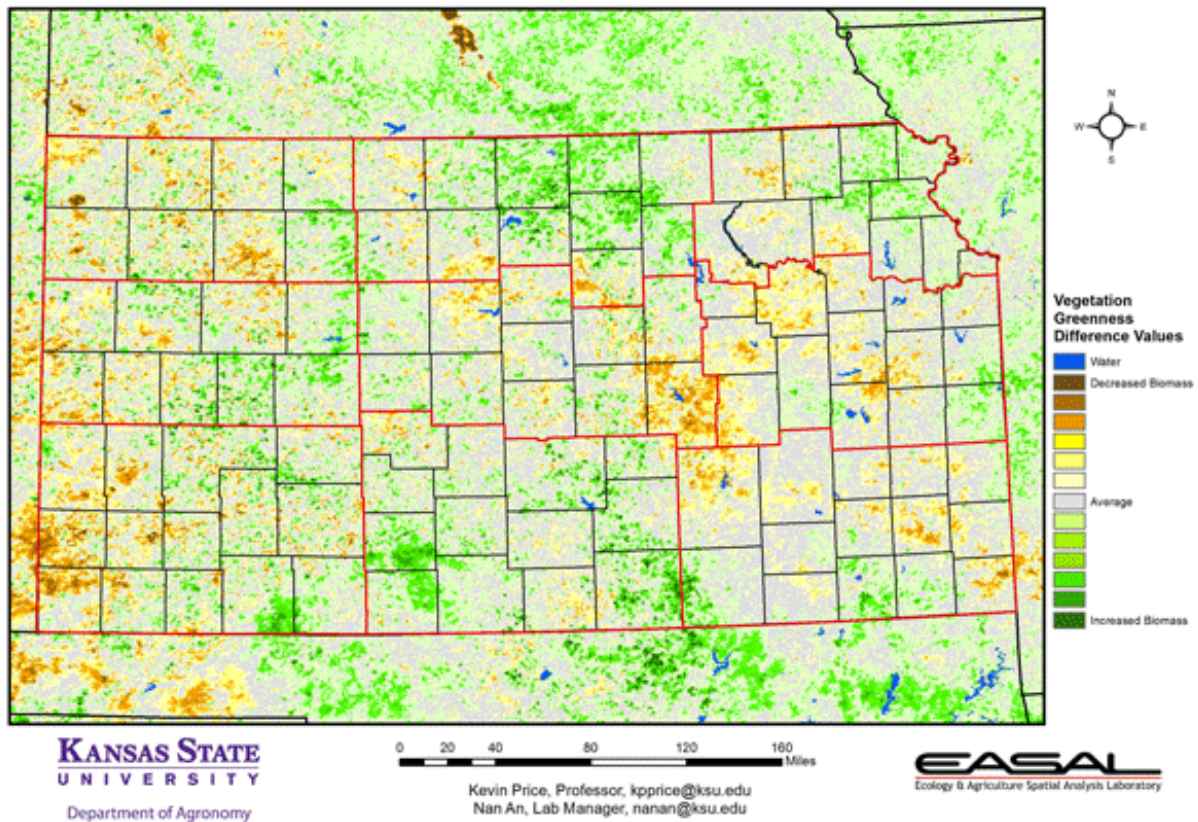


Figure 3. Compared to the 25-year average at this time for Kansas, this year's Vegetation Condition Report for August 19 – September 1 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows most of the state is close to average in biomass production. The exceptions are Stanton County in southwest Kansas and Marion County in central Kansas.

U.S. Corn Belt Vegetation Condition

Period 35: 08/19/2014 - 09/01/2014

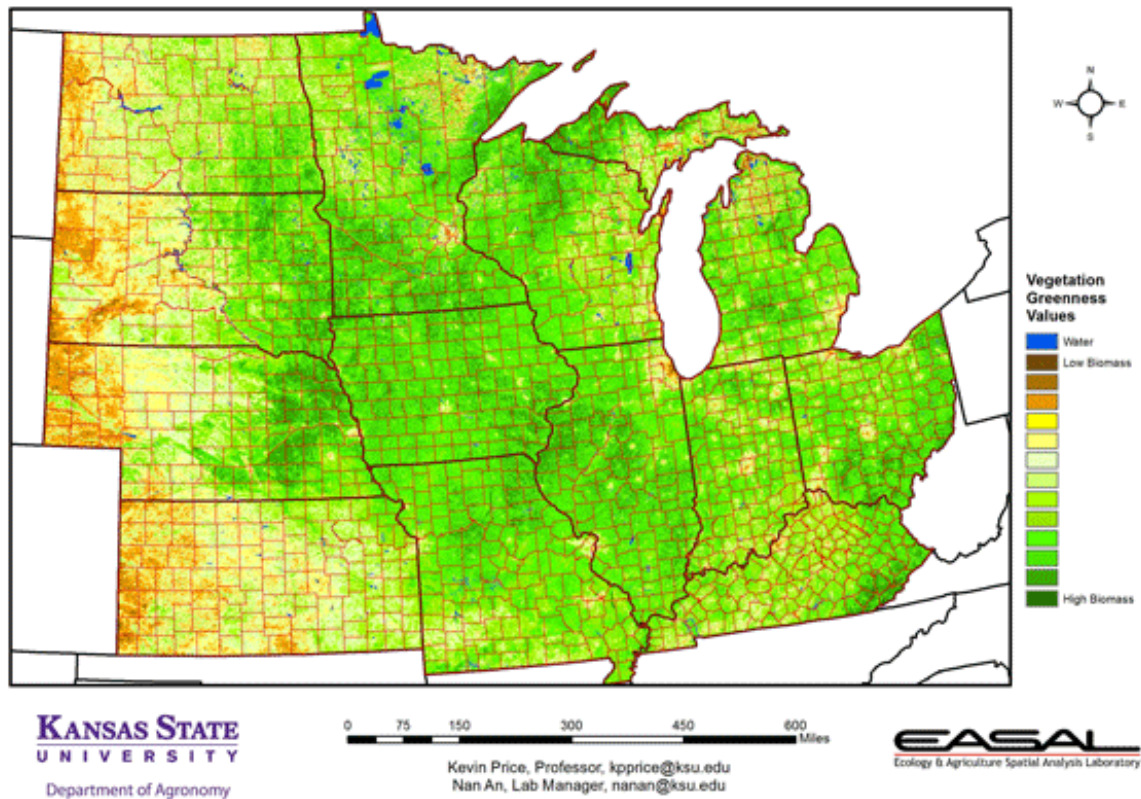


Figure 4. The Vegetation Condition Report for the Corn Belt for August 19 – September 1 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that most of the region has a high level of biomass production. The lowest values continue to be in the western portions of the region, although pockets of low production are showing throughout the region. In Minnesota, for example, rains generally were beneficial but there were some reports of poor hay and wheat conditions due to excessive moisture.

U.S. Corn Belt Vegetation Condition Comparison
Late-August 2014 Compared to Late-August 2013

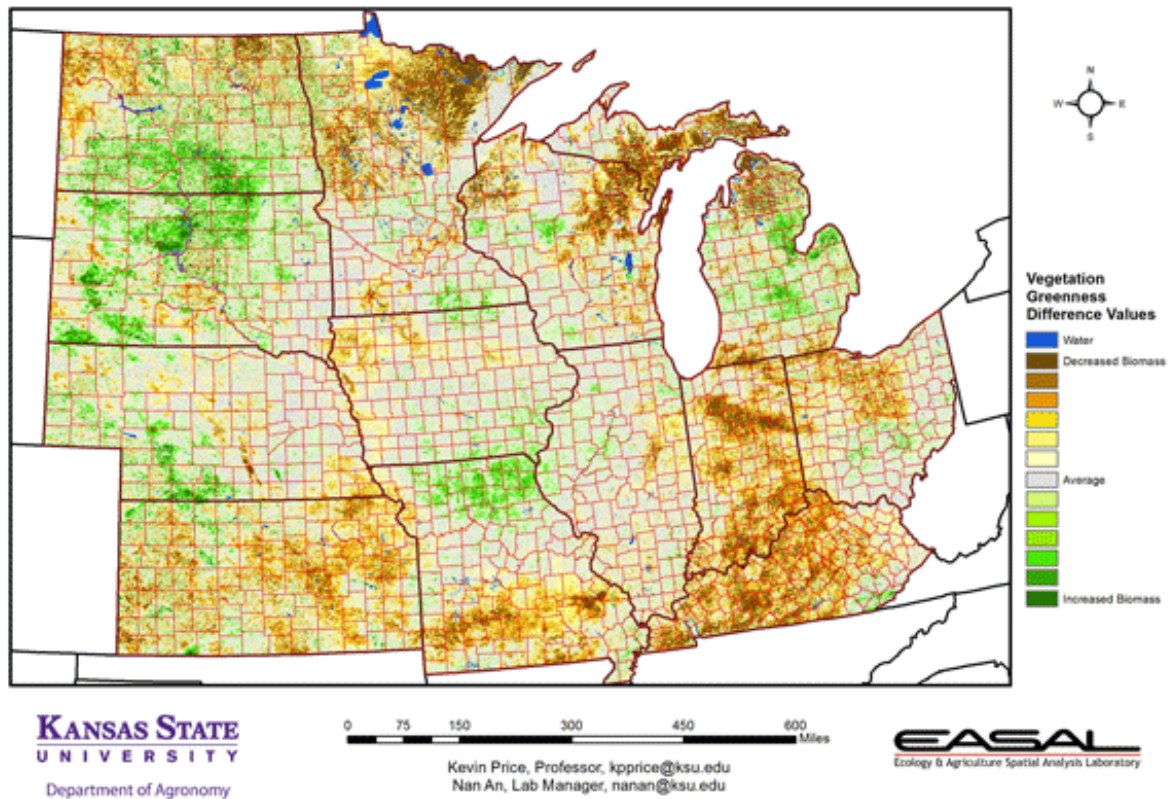


Figure 5. The comparison to last year in the Corn Belt for the period August 19 – September 1 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that biomass production was much lower in northern Minnesota and Michigan, as well as in parts of Indiana and Kentucky. On the northern edge, cool wet weather has hindered crop development. In contrast, a recent heat wave in Kentucky has decreased crop conditions. During the same 2013 period, 85 percent of the corn was in good to excellent condition. This year only 60 percent of the corn is in good to excellent condition.

Vegetation Greenness Difference Values

- Water
- Decreased Biomass
- Average
- Increased Biomass

0 75 150 300 450 600 Miles

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Continental U.S. Vegetation Condition

Period 35: 08/19/2014 - 09/01/2014

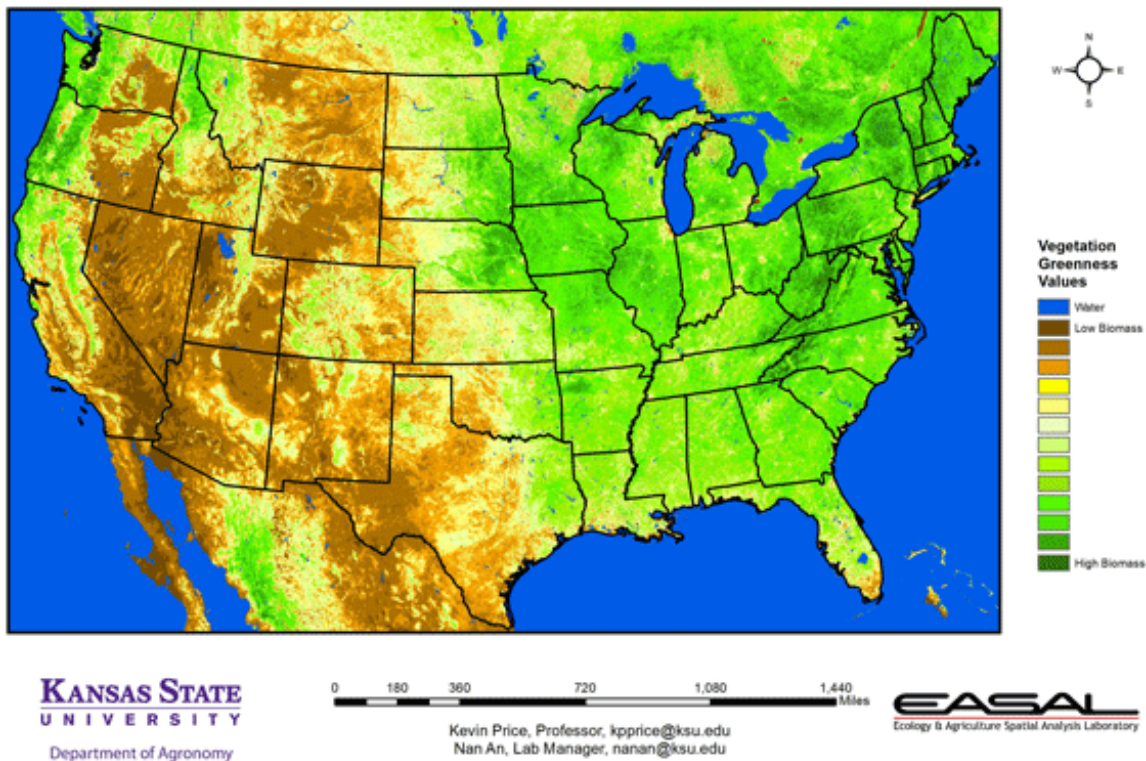


Figure 7. The Vegetation Condition Report for the U.S. for August 19 – September 1 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the highest NDVI values are in the eastern U.S., particularly along the Appalachians. The Upper Missouri River basin also continues to show high biomass production.

Continental U.S. Vegetation Condition Comparison
Late-August 2014 Compared to Late-August 2013

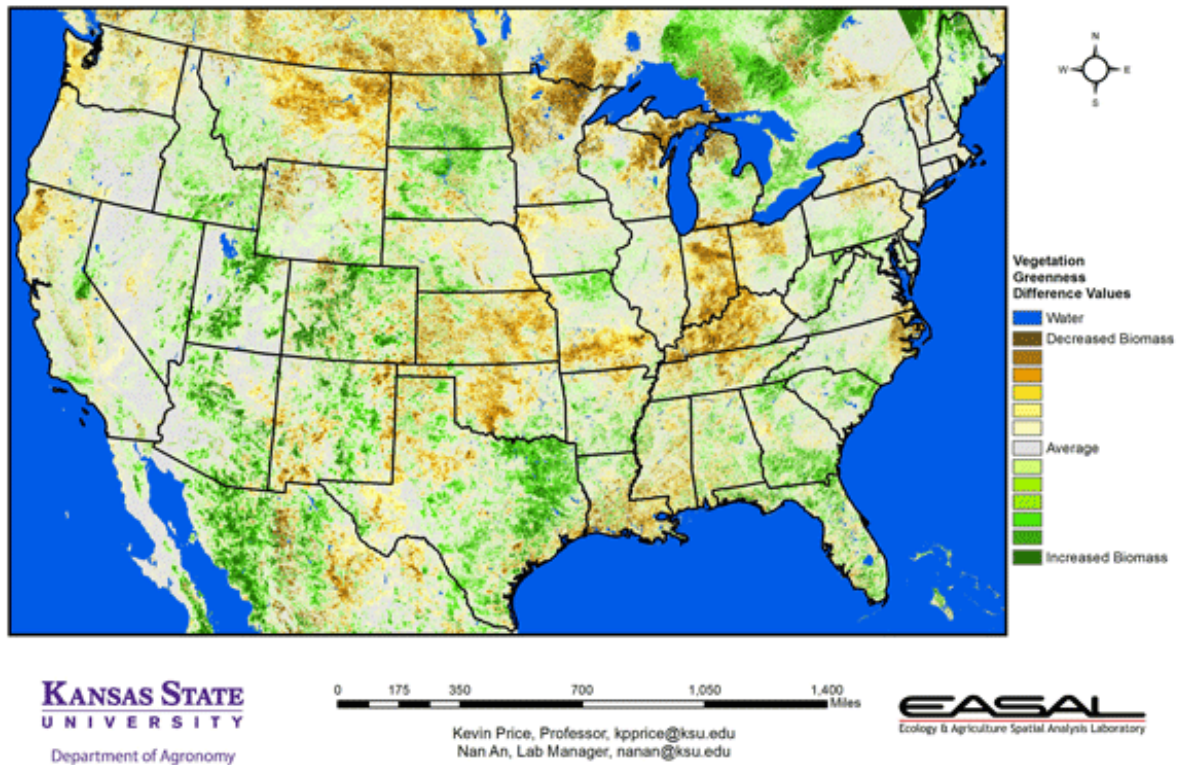


Figure 8. The U.S. comparison to last year at this time for the period August 19 – September 1 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the desert Southwest has generally higher biomass production. The active monsoon this year has favored plant development. According to the U.S. Drought Monitor, 63 percent of Colorado is drought free. Last year, less than two percent of Colorado fell in that category.

Continental U.S. Vegetation Condition Comparison
Late-August 2014 Compared to 25-year Average for Late-August

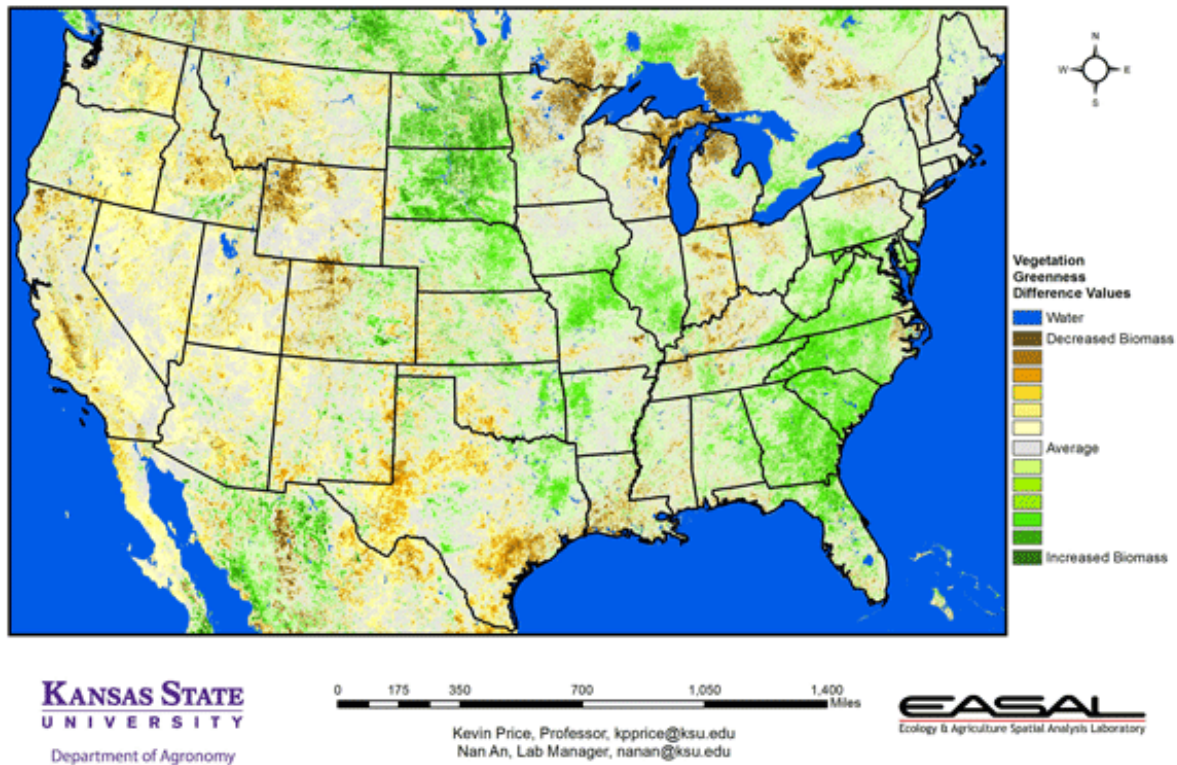


Figure 9. The U.S. comparison to the 25-year average for the period August 19 – September 1 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the Northern Plains and the Atlantic Seaboard areas have the largest increase in biomass activity. The most notable areas of below-average productivity are in northwestern Wyoming and the northern Great Lakes region. Plant development was delayed by cooler-than-average temperatures in both regions. In Yellowstone (northwestern Wyoming), temperatures in August averaged 3 degrees cooler than normal, and the precipitation total of 4.29 inches was the wettest August on record.

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