1. Late August rains and soybean yield potential

The rain that fell over parts of Kansas on August 24-26 could help the soybean crops in those areas where it rained. The extent of any potential yield increase will depend on the stage of development the soybeans were in and the overall plant health of the crop at the time of the rain. The yield response to this rain could range from negligible to substantial. The crop condition was highly variable prior to the rain.

**Situations in which soybeans are unlikely to respond to the rain**

It is unlikely that plants in very poor condition with dead and yellow leaves throughout the canopy, or with limited vegetative development, will be able to respond to the rain. Plants that have quit flowering and have no pods, or very few pods, will not benefit from the rain. Soybeans that have reached the R7 stage (beginning maturity - leaves start to turn yellow and drop and at least one normal pod on the main stem has reached its mature pod color) will not show a yield response to the rain. The closer the seeds are to R7 -- the more mature the seeds, the less yield response there will be to the rain.

**Situations in which soybeans should respond to the rain**

On the positive side, some of the soybean crop had the potential to benefit from the rainfall. Plant heights and vegetative development varied, but in some areas canopies were still intact and functioning at the time of the rain. Even with functioning canopies, however, plants this year are generally shorter and have fewer nodes than normal. The latest state yield average is forecast at 22 bushels per acre. If you assume 3,000 seeds per pound, an average of 2.2 seeds per pod, and 100,000 plants per acre, 18 pods per plant will produce 22 bushels per acre. A relatively small plant is capable of filling 18 pods.

During reproductive development, the soybean plant can respond to favorable growing conditions by increasing seed size, increasing seed number, or both. By August 24, most of the soybeans in the
state were nearly finished flowering, or had already finished flowering and were in the seed filling stage. The potential to increase seed number is either severely limited or not possible by this time. However, for beans in some stage of pod fill between R3 and R6 the rain can help the plant continue seed fill, minimize pod abortion, and increase seed size. Increasing seed size cannot totally compensate for severe losses in pod set and seed number, but the soybean plant is capable of producing slightly larger seeds (perhaps 10 to 20% larger than average). This can help compensate for some reduction in seed number.

Some soybeans were in the flowering and pod set stage at the time of the rain. For the most part, these are double-cropped or full-season maturity group V varieties. These beans have the potential to respond to the rain by retaining and filling pods, thereby increasing seed number. The question then becomes whether plants that just now set pods will have enough time to develop mature pods before the first hard freeze in the fall. In general, it takes a soybean plant about 50-62 days from pod set (R3) to full maturity (R8). At Parsons, in southeast Kansas, the average first frost date is October 23, if pod set began on August 24, this will provide for about 61 days of pod fill before the average first fall freeze.

Soybeans that did not receive rain on August 24-26

Unfortunately, some areas of Kansas got very little rain on August 24-26. Rain is falling in some of these areas of east central Kansas today, August 31. It may or may not be too late at this point. The potential for plants in these areas to respond to rainfall at this time or in the future will again depend upon the plant health and stage of plant development of the crop.

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2. Soil water and winter wheat prospects

Parts of Kansas received up to 6 inches of rain on August 24-26, while other parts missed most of that rain. All areas remain in a prolonged, severe drought. Where it rained several inches, how deep into the profile will moisture go? Where it did not rain, or did not rain very much, how much precipitation will be needed at this point to provide enough moisture to make a wheat crop.

Filling the profile with water

Most soils in central and western Kansas are loam, silt loam, or silty clay loam in texture. In general, soil profiles of these textures have potential to hold about 2 inches of available water per foot of soil depth. A 4-foot profile will hold about 8 inches of available soil water.

To fill the profile to that depth will take more than 8 inches of rainfall, however. If you follow the math, you might conclude that a 6-inch rain would moisten a loam, silt loam, or silty clay loam soil to a depth of 3 feet. But not all the rain that falls gets into the soil because of runoff. And not all of the rain that infiltrates the soil remains there because of evaporation, transpiration from weeds, or drainage as the profile becomes wetter.

As a general rule, about 80 percent of the first inch of rain gets into the soil and remains there. The next inch of rain in a single rainfall event is a bit less efficient. In a 2-inch rainfall event, about 1.5
inches of water could typically be expected to remain in a silt loam soil – about 75 percent intake efficiency. This is under reasonably good soil surface and rainfall conditions.

Runoff is affected by many conditions such as soil roughness, residue cover, soil surface sealing, rainfall rate and amount, soil slope, soil texture, soil compaction, and initial soil water content. If surface runoff is increased by those negative factors, then the infiltration efficiency would be less than the 75 percent value for the 2-inch rain.

Evaporation will work to deplete the soil of water after a rainfall event. In the 5 to 7 days after a rainfall event, total evaporation would likely be from about 0.15 to 0.5 inches – with evaporation being increased by certain conditions, such as tillage, reduced residue cover, high temperature and wind speed, and low humidity. If weed growth is present, that will obviously further reduce the stored soil water.

Using those general figures, here’s how much rainfall it would take to fill the profile of a loam, silt loam, or silty clay loam soil that is at the lower limit of available soil water to the 4-foot depth, using an example of 2-inch rains occurring at 5 to 7 day intervals.

* Target amount of available soil water in 4 feet of silt loam soil: 8 inches
* Amount of water infiltrating into the soil profile from a 2-inch rain: 1.5 inches
* Amount of soil water lost to evaporation in the 5 to 7 days after the rain: 0.15 to 0.5 inches
* Net amount of water remaining in soil after a 2-inch rain, followed by 5 to 7 days of no rain: 1.0 inch (if 0.5 inch of evaporation) to 1.35 inch (if 0.15 inch of evaporation)
* Number of 2-inch rainfall events occurring every 5 to 7 days needed to reach the target of 8 inches of available soil water: 6 (if 0.15 inch evaporation) to 8 (if 0.5 inch of evaporation)

**Total amount of rainfall needed to fill the 4-foot profile of a silt loam soil:** 12 to 16 inches, occurring in 2-inch events every 5 to 7 days over a 6-week period (12 inches if 0.15 inch of evaporation per rain or 16 inches if 0.5 inch of evaporation per rain). This assumes a rather optimistic infiltration efficiency of 75 percent. If the heavy rains of August 24-26 fell slowly enough that there was very little runoff, however, the efficiency could be at least that high since the deeper the moisture soaks into the soil, the less likely it is to be lost to evaporation.

Coarser-textured soils that have little to no available water will also need considerable rainfall to fill the profile. A coarser-textured sandy loam soil has a smaller available water holding capacity (about 1.5 inches per foot of depth) than the loam, silt loam, and silty clay loam soils. So it takes less water to fill the profile of a sandy loam soil with available water than it does a silt loam soil. With our example for the silt loam soils, we gained about 1 inch per rainfall event if 0.5 inches of evaporation or about 1.35 inches per rain if 0.15 inches of evaporation. Assuming similar conditions for the sandy loam soil, to fill the sandy loam soil profile to the 4-foot depth would require about 9 inches of rain if 0.15 inches of evaporation after each 2-inch rain or 12 inches of rain if 0.5 inches of evaporation after each 2-inch rain.

**Relative importance of available soil water and in-season precipitation**

A full soil profile at planting time is not required for a decent wheat crop. However, increased available soil water at planting does improve greatly the odds of getting a good wheat crop. In-season precipitation and available soil water at planting are both important in determining the ultimate yield of a wheat crop.
The following table is based on results from 30 years of research data collected at the K-State Southwest Research-Extension Center at Tribune. The wheat yields listed were calculated from equation 3.5, table 3, page 1361 of “Yield—Water Supply Relationships of Grain Sorghum and Winter Wheat”, L.R. Stone and A.J. Schlegel, 2006, Agron. J. 98:1359-1366. Wheat yields were calculated in response to both available soil water at emergence and total in-season precipitation.

<table>
<thead>
<tr>
<th>In-season precipitation (inches)</th>
<th>Available soil water at emergence (inches)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Average wheat grain yield (bushels/acre)</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
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</tr>
<tr>
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<td>40</td>
<td>51</td>
<td>65</td>
<td>81</td>
<td></td>
</tr>
</tbody>
</table>

In the above table, keep in mind that 2 inches of available soil water is equivalent to having moisture to a depth of one foot in a silt loam soil, since a silt loam soil holds about 2 inches of available soil water per foot. Likewise, 4 inches of available soil water means a silt loam soil is moist to a depth of 2 feet. In a sandy loam soil, 2 inches of available soil water would be moisture to a depth of roughly 1.33 feet.

The chart shows the influence of available soil water and in-season precipitation at producing long-term yield results. Having water in the fall is critical for germination, emergence, stand establishment, and vigor. Precipitation during winter is closely related with yield potential, providing for winter survival and increased soil water at the beginning of spring regrowth. Water in spring is normally most effective at increasing wheat yields if received at about boot through head extension, providing for decreased water stress at flowering and grain development.

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3. Nutrient management after a failed corn or sorghum crop

Where the corn or sorghum crop failed in 2012, farmers are asking questions on the best ways to handle their nutrient management programs for 2013. In most cases, the vast majority of the fertilizer that was applied to unharvested, failed corn or sorghum should still be there in 2013 – either in the soil or in the crop residue. Farmers will need to do some soil testing to know for sure the nutrient status of fields with failed corn or sorghum. Farmers will also want to have some idea of the amount of nutrients present in the residue remaining, and how quickly those nutrients will become available to crops.
There are a number of potential sources of nutrients other than applied fertilizers that could contribute to a 2013 wheat, corn, sorghum, or soybean crop. These include:

- Nitrate, sulfate, and chloride in the soil profile
- Phosphorus, potassium, and zinc in the surface soil
- Nutrients in crop residues

The first category consists of mobile nutrients, and the second category consists of immobile nutrients. The difference is important. Mobile nutrients are able to dissolve in soil water and can move through the soil in water, while immobile nutrients generally stay where applied. Of the 14 essential mineral elements, the common mobile nutrients we apply as fertilizer are N, S, and Cl, and the common immobile nutrients we apply as fertilizer are P, K, and Zn.

**Mobile nutrients in the soil after failed corn and/or sorghum**

A very large portion of those mobile nutrients that were not taken up by the 2012 corn and/or sorghum crops are likely still present in the top foot or two of soil. With the low rainfall in most of the state, very little of the N will have been lost, even after the heavy rains many areas received on August 24-26 this year. In the K-State Soil Testing Lab, we are already seeing higher-than-normal soil test levels for N, reflecting an accumulation of unused nitrate N in the soil. Any unused sulfur (S) or chloride (Cl) would also be present in that top foot or two of the soil profile.

So the first tool a farmer should think about when planning his 2013 fertilizer program is a deep profile soil test for N, S, and Cl.

**Immobile nutrients in the soil after failed corn and/or sorghum**

What about P, K, or Zn? Where these nutrients were applied to the 2012 corn or sorghum crop, will they still be available for crops in 2013? When immobile nutrients such as P, K, and Zn are applied to the soil, they interact with different portions of the soil and are retained. Note the word “retained,” not “fixed.”

*Phosphorus.* Phosphorus reacts with the clay surfaces and the iron and aluminum coatings found on the soil particles, and is sorbed to those surfaces. Sorption reactions occur in stages, and the initial stages are highly reversible. Sorbed phosphorus can be desorbed and go into soil solution, replacing the P taken up by plants. This is a buffering system that maintains a constant small quantity of P in the soil solution and supplies the P needed for good crop growth. This is how we store P in the soil and build soil test values, with little worry about that P being lost.

Sorbed P is the primary P fraction in soils measured by a soil test. But the soil test only reflects a fraction of the total P present in the soil. In most Kansas soils, we have an 18:1 buffer factor. If we add 18 pounds of P₂O₅ and it reacts with the soil, becoming sorbed to the clays and other minerals present, the soil test will increase 1 ppm. If we remove 18 pounds P₂O₅ through crop uptake, the soil test value will drop 1 ppm.

So how does this relate to planning for 2013? Any P applied in 2011 or 2012 for this year’s crop that was not taken up by the plants was sorbed onto clays and other minerals. This creates a new equilibrium in the soil, and will increase the soil test values for P. The higher soil test values will result in a lower P fertilizer recommendation.
Potassium. Potassium is a charged cation, K⁺, which is attracted to and retained on the soil’s cation exchange capacity (CEC). Like sorbed P, exchangeable K maintains a constant supply of K in the soil solution to support plant growth. Also like P, this exchangeable K can be measured by a soil test, and it is a highly buffered system. With K, every 4-8 pounds K₂O added will increase the soil test 1 ppm, and every 4-8 pounds removed will lower the soil test 1 ppm.

The buffer factor is a function of CEC and soil minerals present. On low-CEC sandy soils this factor is closer to 4, while on high-CEC silty clay loams the value will be closer to 8. Any K applied and not taken up by the 2012 corn or sorghum crop would have been retained on the CEC in the surface soil and remains available for 2013. And, the higher K soil test values will result in lower K fertilizer recommendations for 2013.

Zinc. With zinc, a third mechanism, chelation, occurs and retains applied zinc. Soil organic matter is a strong natural chelating agent, much like some of the synthetic compounds we buy as fertilizer sources. Zinc sulfate added to soil slowly dissolves. A portion reacts with the organic matter and is retained in soluble, natural organic matter chelates. The vast majority of the zinc that moves to plant roots for uptake is present as a natural soil organic matter chelate. Again, this can be measured by a soil test, and there is a common buffer factor of about 10:1 with our DTPA soil test. If we add 1 pound of Zn, the DTPA soil test value will increase by about 0.1 ppm.

Testing for soil nutrients

The bottom line for soil nutrients is that any N, P, K, S, Zn, and Cl added as fertilizer and not taken up by crops is still likely there, and can be measured by soil tests. The mobile nutrients (N, S and Cl) will need to be measured using a deep profile test, while the immobile nutrients (P, K, and Zn) can be measured using a surface sample.

What about the nutrients taken up by the 2012 crop?

Based on sampling data on drought-stressed corn from 2011, you can probably anticipate that severely stunted plants (3 to 4 feet tall) that did not form any grain will have high nutrient concentrations but very low total nutrient uptake per acre because of the low level of dry matter produced. In those fields a large portion of the applied nutrients will likely still be present in the soil, and potentially available for the 2013 crop.

On fields where plants grew to more normal height but had very poor grain yields because of heat and drought stress, there will likely be near-normal nutrient uptake per acre, since most nutrients are first taken into the vegetation and used or stored, and then translocated to developing grain. In this situation, residual nutrients in the soil will likely be higher than normal, but not to the degree found in the more extreme drought situations.

The majority of the nitrogen, phosphorus, and sulfur in plant material is present as protein and other organic compounds. For these nutrients to become available to plants, these compounds must be broken down and the N and P mineralized. This process will normally take three or more years to run to completion, with the C:N ratio being the primary factor controlling the rate of release. Corn stalks normally have a very high C:N ratio -- about 60:1. In high C:N materials, very little net N mineralization will occur until the organisms utilizing this material as a food stuff reduce the carbon content of the residue to a C:N ratio of roughly 25:1.
In severely drought-damaged crops, the N content is much higher than normal, since there is little or no grain present. The C:N ratio in many of these severely damaged crops is less than 35:1. As a result, net mineralization will occur much more quickly -- a matter of months rather than years. In this situation, roughly half of the N, P, and S is likely to be available for a summer crop planted next spring. In the fields with more normal vegetation but little or no grain yield, the N will remain in the vegetation and enhance decomposition -- but likely not as quickly as where vegetative growth was more severely damaged by drought.

Potassium and chloride exist in plant cells as free ions. When the plant dies and those cells rupture, the K and Cl rapidly leach from the crop residues and return to the soil to be “recycled” in the next crop. These two nutrients will likely be available quickly for the 2013 crop and can be measured by soil tests later this winter and next spring. If the corn or sorghum crop was taken off for silage or forage, these nutrients will have been removed.

Wheat planted this fall into these residues will not benefit nearly as much from the N, P, and S present in the corn vegetation as will next summer’s corn or sorghum crops. With wheat, there is not as much time for soil organisms to break down the residues and mineralize these nutrients.

Measuring nutrient levels on fields of failed corn and/or sorghum

For those planting wheat this fall in failed crop fields, a profile soil test for N, S, and Cl is a must. P and K applications should also be made based on a surface soil sample. For those planting corn or sorghum next spring, it would be best to wait until late winter or early spring to take the profile sample to get a better feel for the amount of the residual N which will be remaining in the soil. Mobile N can be moved below the root zone, especially in sandy soils if we get a wet winter.

Another potentially valuable tool to consider is the use of a crop sensor to help estimate the amount of the N being mineralized from the 2012 crop residues. Kansas has good recommendation systems for both wheat and sorghum to help interpret sensor data. The rate of mineralization will depend greatly on soil moisture and soil temperatures during March through June. A sensor-based N management system can help take some of the risk out trying to take credit for mineralized N.

This spring, we found that in many wheat fields planted following a failed 2011 corn crop, little fertilizer N was needed, and adding additional N to wheat resulted in lodging. This was especially common in southeast Kansas, where N is normally not considered to carry over due to high spring rainfall. But the spring of 2012 was dry, and the N did carry over. We are already seeing soil tests from this area in the lab with enough nitrate-N in the soil that no N fertilizer is being recommended.

Summary

A significant amount of residual nutrients will be present in many fields where this year’s crops failed. In severe situations, only a fraction of the nutrients applied were actually taken up by this year’s crop. Many of the nutrients remain in the soil and can be measured using soil tests. This is especially true for the mobile nutrients such as N, S, and Cl. But to get a good estimate of the amounts present, a profile soil test to a depth of 24 inches will be required.

Many of the nutrients taken up by this year’s crop will also be available for future crops, especially the K and Cl which are not incorporated into organic compounds. However the N, P, and S must be
mineralized as the vegetation decays. This process will be likely be faster than normal in the residue from this year’s failed crops, and this will increase the availability of these nutrients. But the exact rate of mineralization will depend on the weather, and is difficult to estimate. Crop sensors can help take some of the risk out of crediting these mineralized nutrients.

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4. Fall treatment of sericea lespedeza

Late summer/fall can be an excellent time to spray sericea lespedeza. Despite the dry summer, recent rains in parts of Kansas may be enough to stimulate flowering in sericea lespedeza. Flowering is a visual signal that sericea is actively growing. Past research has demonstrated that control is much better if the plants are actively growing. PastureGard and Escort XP were more effective in 2010, when September precipitation was above normal, than in 2004 when September precipitation was below normal (Table 1).

Remedy Ultra and PastureGard 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. Check labels for recommended rates and other precautions.

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.

Sericea lespedeza in bloom. Photo by Walt Fick, K-State Research and Extension.
Table 1. Percent control of sericea lespedeza 1 year after treatment.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Rate</th>
<th>Sept. 16, 2004</th>
<th>Sept. 17, 2010</th>
</tr>
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<tbody>
<tr>
<td>Remedy</td>
<td>1 pt/A</td>
<td>84</td>
<td>80</td>
</tr>
<tr>
<td>Excort XP</td>
<td>0.5 oz/A</td>
<td>70</td>
<td>96</td>
</tr>
<tr>
<td>PastureGard</td>
<td>2 pt/A</td>
<td>77</td>
<td>97</td>
</tr>
</tbody>
</table>

*September 2004 precipitation was 2.7 inches below normal; September 2010 precipitation was 3.1 inches above normal.

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5. Comparative Vegetation Condition Report: August 14 – 27

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

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

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

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

The maps in this issue of the newsletter show the current vegetation conditions in Kansas, the Corn Belt, and the continental U.S, with comments from Mary Knapp, state climatologist:
Map 1. The Vegetation Condition Report for Kansas for August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that greatest biomass productivity is along the Republican River basin, where some rain fell during this two-week composite period, and soil moisture levels tend to be a little higher. This moderate productivity can also be seen in extreme northeast Kansas, particularly in Brown and Doniphan counties which have some carryover from excessive moisture last year.
Map 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows only portions of southwest Kansas have better conditions. Again, this is due to the extremely poor vegetative conditions that prevailed last year, rather than any particularly good conditions this year.
Map 3. Compared to the 23-year average at this time for Kansas, this year’s Vegetation Condition Report for August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that only a very small portion of Jewell County has slightly above-average vegetative conditions. Timely rainfall has allowed the vegetation in this area to maintain normal productivity.
Map 4. The Vegetation Condition Report for the Corn Belt for August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that greatest photosynthetic activity is concentrated in northern Wisconsin and the upper Peninsula of Michigan. Decreasing photosynthetic activity can be seen in the Ohio River Valley as the intense drought takes a toll on productivity.
Map 5. The comparison to last year in the Corn Belt for the period August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that generally poorer conditions prevail across most of the region. Only a very small portion of southeastern North Dakota is faring better this year. Last year, flood conditions hampered production in that region.
Map 6. Compared to the 23-year average at this time for the Corn Belt, this year’s Vegetation Condition Report for August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the greatest area of above-average productivity extends from western Minnesota into eastern North and South Dakota. Crop progress is not as advanced there as in the eastern regions of the Corn Belt, and growing conditions have been more favorable than in most of the rest of the region.
Map 7. The Vegetation Condition Report for the U.S. for August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that low photosynthetic activity is dominating the High Plains. High productivity can be seen in the Pacific Northwest, through northern Idaho and into western Montana.
Map 8. The U.S. comparison to last year at this time for the period August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows a general reversal of conditions from last year. The most intense decrease in conditions is concentrated in the center of the country. For example, this year in Nebraska only 13 percent of the sorghum is rated good to excellent while last year 80 percent of the crop was good to excellent. Similar patterns hold true for soybeans and alfalfa.
Map 9. The U.S. comparison to the 23-year average for the period August 14 – 27 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the center of the country is generally below average in productivity, with the biggest departures in the Flint Hills region from east central Kansas into northern Oklahoma.

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These e-Updates are a regular weekly item from K-State Extension Agronomy and Steve Watson, Agronomy e-Update Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have questions or suggestions for topics you’d like to have addressed in the weekly updates, contact Steve Watson, 785-532-7105 swatson@ksu.edu, or Jim Shroyer, Research and Extension Crop Production Specialist and State Extension Agronomy Leader 785-532-0397 jshroyer@ksu.edu