1. Herbicide-resistant weeds in Kansas

Herbicide-resistant weed populations have become a problem in almost every crop in Kansas over the past 20 years. Populations of certain weeds have even become resistant to more than one class of herbicide, making them especially challenging to control.

Confirming herbicide resistance in a weed population is actually a long, difficult process. It may seem as if there are more herbicide-resistant weeds than those officially on the list, but that’s because of the time it takes to do all the necessary testing to confirm resistance.

Just because a herbicide application did not control weeds in a given field does not mean the weeds have become resistant to that herbicide, of course. How can you determine whether the weeds are resistant to the herbicide used?

First of all, most herbicide failure is a result of unfavorable environmental conditions, inadequate spray coverage, oversized weed plants at the time of application, or inadequate herbicide rates.

However, herbicide-resistant weeds are a very real cause of poor control in some cases. One of the factors that would indicate the possibility of herbicide resistance is the pattern of weed survival. If the surviving plants (escapes) are in middle of a group of dead plants, you might begin to suspect herbicide resistance. Also, has the same herbicide mode of action been used for several years in a row on that field? If so, that also might make you suspect herbicide resistance. Finally, if the weed control failure involves a weed that is known to have developed resistance to the herbicide that was used, that’s a strong indicator that herbicide resistance could be the problem.

The table below is the most current list of resistant weeds confirmed to exist in Kansas, in chronological order. Most herbicide-resistant weed populations occur only in isolated or scattered areas of the state, and not on all fields. So just because a weed is listed as resistant to a certain class
of herbicide doesn’t mean all populations across the state will have that resistance. But resistant populations of weeds do tend to become more widespread with time once they have developed.

### History of Confirmed Resistant Weeds in Kansas

<table>
<thead>
<tr>
<th>Weed Species</th>
<th>Herbicide Mode of Action</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Bindweed</td>
<td>Synthetic Auxins (2,4-D)</td>
<td>1964</td>
</tr>
<tr>
<td>Kochia</td>
<td>PSII (atrazine)</td>
<td>1976</td>
</tr>
<tr>
<td>Downy brome</td>
<td>PSII (atrazine)</td>
<td>1977</td>
</tr>
<tr>
<td>Kochia</td>
<td>ALS (chlorsulfuron)</td>
<td>1987</td>
</tr>
<tr>
<td>Russian thistle</td>
<td>ALS (chlorsulfuron)</td>
<td>1988</td>
</tr>
<tr>
<td>Palmer amaranth</td>
<td>PSII (atrazine)</td>
<td>1991</td>
</tr>
<tr>
<td>Palmer amaranth</td>
<td>ALS (imazethapyr)</td>
<td>1995</td>
</tr>
<tr>
<td>Redroot pigweed</td>
<td>PSII (Atrazine)</td>
<td>1995</td>
</tr>
<tr>
<td>Waterhemp</td>
<td>ALS (imazethapyr, thifensulfuron)</td>
<td>1995</td>
</tr>
<tr>
<td>Waterhemp</td>
<td>PSII (atrazine)</td>
<td>1995</td>
</tr>
<tr>
<td>Common sunflower</td>
<td>ALS (imazethapyr)</td>
<td>1996</td>
</tr>
<tr>
<td>Shattercane</td>
<td>ALS (nicosulfuron, primisulfuron)</td>
<td>1996</td>
</tr>
<tr>
<td>Common cocklebur</td>
<td>ALS (chlorimuron, imazaquin)</td>
<td>1997</td>
</tr>
<tr>
<td>Waterhemp</td>
<td>PPO (acifluorfen, fomesafen)</td>
<td>2001</td>
</tr>
<tr>
<td>Marestail (horseweed)</td>
<td>ESPS (glyphosate)</td>
<td>2005</td>
</tr>
<tr>
<td>Bushy wallflower/Flixweed</td>
<td>ALS (several)</td>
<td>2005/07</td>
</tr>
<tr>
<td>Waterhemp and Giant ragweed</td>
<td>ESPS (glyphosate)</td>
<td>2006</td>
</tr>
<tr>
<td>Common ragweed and Kochia</td>
<td>ESPS (glyphosate)</td>
<td>2007</td>
</tr>
<tr>
<td>Cheat and Japanese brome</td>
<td>ALS (imazamox, propoxycarbazone,</td>
<td>2007</td>
</tr>
<tr>
<td></td>
<td>pyroxsulam, sulfosulfuron)</td>
<td></td>
</tr>
</tbody>
</table>

Some weeds seem to develop herbicide resistance more readily than others. The table above clearly shows this, as many weeds are listed as resistant to several different herbicide modes of action.

Weed characteristics that favor resistance include:
* Species with broad genetic diversity
  - Species that readily cross pollinate
  - Species that hybridize with related species
* Species with rapid turnover rate
  - High seed production
  - Short seed life

Likewise, some herbicides are more likely to have problems with weed resistance. Glyphosate, atrazine, and the ALS class of herbicides are prime examples. Other herbicides have very few or no problems with weed resistance. Why is that?

Herbicide characteristics that favor resistance include:
* Herbicides with a very specific site of action.
* Herbicides that have long residual effects in the soil.
* Herbicides with a high degree of selectivity.

Certain management practices will tend to favor the development of herbicide-resistant weeds. For example, if the producer relies on herbicides alone to control weeds, that will favor resistance. Another practice is the use of herbicides multiple times during the growing season, or the same herbicide or mode of action on the same field for consecutive seasons. Probably the greatest contributing factor for the development of herbicide-resistant weed biotypes is the frequent and exclusive use of one herbicide, or a single herbicide mode of action, over time.
The best way to avoid the development of herbicide-resistant weeds is to:
* Rotate and/or tankmix herbicides with different sites of action, within and across years.
* Use crop rotations.
* Include other control tactics (cultivation, prevention, crop competition, cultural practices).
* Use the proper herbicide rate at the proper time.

-- Dallas Peterson, Weed Management Specialist
dpeterso@ksu.edu

-- Curtis Thompson, Weed Management Specialist
cthompsso@ksu.edu

2. Use of legumes in wheat-bermudagrass pastures

Bermudagrass is a productive forage species when intensively managed. However, it has periods of dormancy and requires proper use to maintain forage quality. Bermudagrass also requires adequate nitrogen (N) fertilizer to optimize forage yield and quality. Interseeding wheat or other small grains can lengthen the grazing season but this requires additional N fertilization.

Legumes in the bermudagrass sward could improve forage quality and reduce fertilizer usage, but legumes are difficult to establish and maintain with the competitive grass. Clovers can maintain summer survival once established in bermudagrass sod and may be productive enough to substitute for some N fertilization.

At the Southeast Agricultural Research Center, we conducted a study to compare dry cow performance on a wheat-bermudagrass pasture system that included summer legumes with a single 50 lb/a N application vs. wheat-bermudagrass with additional N applications of 100 lb/a and no legumes.

**Procedures**

The research was conducted on eight five-acre “Hardie” bermudagrass pastures at the Mound Valley Unit of the Southeast Agricultural Research Center (Parsons silt loam soil). Fuller wheat (90 lb/a) was interseeded (no-till) into bermudagrass sod on September 29, 2009. The next day, 10 lb/acre medium red clover was interseeded into the four pastures assigned to the Legume treatment to supplement stands of white clover. Pastures that received no legumes were fertilized with 50 lb/a N as urea each on February 16 and May 12, 2010. All pastures, both with and without clover, received 50-30-30 of N-P₂O₅-K₂O on July 1.

Thirty-two pregnant fall-calving cows of predominantly Angus breeding were weighed on consecutive days and assigned randomly by weight to pastures on April 1. Cows grazed forage that was primarily wheat for the first six weeks, then bermudagrass, until August 20 (141 days), when they were weighed on consecutive days and removed to begin calving.
Results

Cow gains during the season were similar for both treatments (legumes and fertilizer), averaging 2.92 lb/head per day. Average available forage was higher for the plots with the higher fertilizer rate and no legume than the plots with legumes for three of the mid-season sampling times. However, CP was higher in pastures with legumes during the early part of the grazing season. Hay production was similar for both systems, averaging 4,780 lb/acre.

Summary

Use of legumes in lieu of 100 lb/a of N for wheat-bermudagrass pastures maintained spring and summer cow gains. Although forage availability was sometimes higher for pastures with only N fertilization compared to legume-containing pastures, an indicator of forage quality favored the legume-containing pastures in mid-season.

<table>
<thead>
<tr>
<th>Performance of cows grazing bermudagrass pastures interseeded with wheat and fertilized with nitrogen or interseeded with legumes, Mound Valley Unit, Southeast Agricultural Research Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
</tr>
<tr>
<td>Nitrogen fertilizer (lbs/acre)</td>
</tr>
<tr>
<td>Cow gain (lbs) after 141 days</td>
</tr>
<tr>
<td>Cow daily gain (lbs)</td>
</tr>
<tr>
<td>Cow gain per acre (lbs)</td>
</tr>
<tr>
<td>Hay removed (lbs/acre dry matter)</td>
</tr>
</tbody>
</table>

None of the means within a row were significantly different at P<0.05.


-- Joe Moyer, Forage Agronomist
jmoyer@ksu.edu

-- Lyle Lomas, Head and Animal Scientist
llomas@ksu.edu

The Agricultural Research Center-Hays will hold the Kansas Wheat Day on May 30. The program will take a look at the present and future, as well as honor the past, including recognition of Joe Martin, who retired after 32 years as K-State’s wheat breeder at Hays.

Kansas Wheat Day, which will be held at the center, located at 1232 240 Ave. in Hays, begins with registration at 9 a.m. and the program at 9:30 a.m. The rest of the schedule includes:

10:00 a.m. – Field Plot Tour

11:00 a.m. – Recognition of Joe Martin, KSU wheat breeder

11:30 a.m. – Washington, D.C. Wheat Update – Jane DeMarchi, director of government affairs for research and technology, National Association of Wheat Growers
12:00 p.m. – Lunch – Sponsored by Kansas Wheat Commission  
- Kansas Wheat Innovation Center Update – Aaron Harries, Kansas Wheat Commission

1:00 p.m. – Market Demand for Wheat Quality and Hard White Wheat – Matt Overturf, grain merchandiser, Skyland Grain Co., LLC

Wheat Day will end at 2 p.m.

More information is available by calling the K-State Western Kansas Agricultural Research Center-Hays at 785-625-3425.

-- Mary Lou Peter, K-State Research and Extension News  
mlpeter@ksu.edu

4. Southwest Research-Extension Center, Tribune spring wheat tour, May 31

The Southwest Research-Extension Center at Tribune will hold its spring wheat tour May 31 at the center, located at 1474 Kansas Highway 96 (1 mile west of Tribune). The tour begins at 8 a.m. MDT.

Topics and K-State speakers at the field day include:
* Wheat Varieties – Jim Shroyer
* Wheat Diseases – Erick DeWolf
* Wheat Breeding Program – Guorong Zhang

More information is available by calling the center at 620-376-4761.

-- Steve Watson, Agronomy e-Update Editor  
swatson@ksu.edu

5. North Central Kansas Experiment Field spring wheat tour, June 6

The North Central Kansas Experiment Field will hold its spring wheat tour on June 6. The program will start at 7:30 a.m.

Topics at the field day include:
* Wheat Varieties and Diseases
* Canola Production
* Cover Crop Options Following Wheat

Juice and rolls will be provided.

The North Central Kansas Experiment Field is about 2 miles west of Belleville on U.S. Highway 36. More information is available by calling Randall Nelson at 785-335-2836.

-- Steve Watson, Agronomy e-Update Editor  
swatson@ksu.edu
6. Comparative Vegetation Condition Report: May 8 – 21

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

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

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

The maps below show the current vegetation conditions in Kansas, the Corn Belt, and the continental U.S, with comments from Mary Knapp, state climatologist:
Map 1. The Vegetation Condition Report for Kansas for May 8 – 21 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that photosynthetic activity is moderate. There is a distinct splice line in western Kansas, where cloud cover has been an issue during this two-week composite period. Unfortunately, that has not translated to actual rainfall. Statewide precipitation is averaging just 11 percent of normal.
Map 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for May 8 – 21 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that vegetative activity continues to be ahead of last year’s level. Most plant material is still three weeks ahead of normal development, due to the milder-than-normal winter conditions.
Map 3. Compared to the 23-year average at this time for Kansas, this year’s Vegetation Condition Report for May 8 – 21 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows the beginning impacts of the dry May, particularly in the central divisions. Areas that saw some of the scattered rainfall events are faring better than those that missed the precipitation. Also, the Flint Hills region continues to show greater-than-average photosynthetic activity. The deeper root system of the prairie grasses provides a buffer against the rainfall deficit of May.
Map 4. The Vegetation Condition Report for the Corn Belt for May 8 – 21 from K-State's Ecology and Agriculture Spatial Analysis Laboratory shows slow progression of crop development northward. The Boot Heel of Missouri continues to suffer from moderate drought. Meanwhile northern Minnesota and Wisconsin are showing high biomass productivity in response to warm temperatures.
Map 5. The comparison to last year in the Corn Belt for the period May 8 – 21 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that most of the region is at or above last year’s level of biomass productivity. The increasing drought conditions in southern Illinois, western Kentucky, and eastern Missouri are showing as lower productivity than during this same two-week period last year.
Map 6. Compared to the 23-year average at this time for the Corn Belt, this year’s Vegetation Condition Report for May 8 – 21 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows the northern areas have the greatest departure from average. This is due mainly to the warmer-than-normal conditions that have prevailed this spring. Below-average productivity is seen in the southern Illinois, western Kentucky, and eastern Missouri regions as drought conditions continue to worsen.
Map 7. The Vegetation Condition Report for the U.S. for May 8 – 21 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that much of the U.S. has high biomass production. Activity in the central Corn Belt is slow, as plants begin to emerge. In Illinois, almost 100 percent of the corn has been planted and 58 percent of the soybeans.
Map 8. The U.S. comparison to last year at this time for the period May 8 – 21 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that low snow cover in the western mountains has resulted in more photosynthetic activity in those regions. In the Southeast drier-than-normal conditions have slowed biomass productivity from last year at this time.
Map 9. The U.S. comparison to the 23-year average for the period May 8 – 21 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows while much of Texas has benefited from recent rainfalls, there is a persistent area of extreme drought in north central Texas, the Texas Panhandle, and southwestern Oklahoma. These areas continue to have below-average photosynthetic activity. Likewise, areas of eastern Wyoming into the Panhandle of Nebraska are showing lower-than-average photosynthetic activity as moderate drought conditions continue to develop.

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

-- Mary Knapp, State Climatologist
mknapp@ksu.edu

-- Kevin Price, Agronomy and Geography, Remote Sensing, Natural Resources, GIS
kpprice@ksu.edu

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

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