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These e-Updates are a regular weekly item from K-State Extension Agronomy and Kathy Gehl, Agronomy eUpdate 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 Kathy Gehl, 785-532-3354 kgehl@ksu.edu, or Dalas Peterson, Extension Agronomy State Leader and Weed Management Specialist 785-532-0405 dpeterso@ksu.edu.

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Chloride is taken up by plants as the Cl^- ion. A major function of chloride in plants is as a counter ion for cation (Ca^{+2}, K^+, Mg^{+2}, N_4H^+) transport and as an osmotic solute. In addition, chloride serves an essential role in maintaining cell hydration and turgor. A critical role of chloride is as a cofactor in the oxidation of water in photosynthesis and as an activator of several enzymes.

Physical symptoms of chloride deficiency in plants vary and are not always consistent. In wheat, some varieties show a characteristic leaf spotting, best described as random chlorotic spots on the leaves (Figure 1). The spots resemble tan spot lesions, but are smaller and do not have the characteristic "halo" at the edge of the spot. On low-chloride soils in Kansas, some varieties consistently show the leaf spotting, while other varieties never spot. Other research indicates no obvious visual deficiency symptoms occurred on corn or grain sorghum, even where chloride fertilization increased yields.

Figure 1. Chloride deficiency symptoms in wheat resemble tan spot lesions, some varieties might not show a visual deficiency symptom. Photo by Dorivar Ruiz Diaz, K-State Research and Extension.

Soil considerations

Chloride is normally present in the soil in sizeable quantities, particularly in U.S. coastal areas where chloride deposition is high. Evaluations in Kansas indicates fairly low soil chloride levels. This could be due to low chloride atmospheric deposition due to the distance from oceans and the relatively high indigenous potassium levels of the majority of Kansas soils, which means little potassium chloride (KCl) fertilizer has been applied. Summaries of soil test data in Kansas show a majority of the samples had chloride levels below 40 pounds per acre, with a significant number of samples less than 10 pounds per acre (on 0- to 24-inch samples).

As an anion, a negatively charged ion, chloride is not readily adsorbed on the soils exchange complex and is subsequently not attached. Because of this, chloride moves readily with soil water. Chloride is quite leachable, even more so than nitrate.

Soil testing for chloride

The Kansas State University Soil Testing Laboratory and most commercial labs offer a chloride soil test. Because of the leaching potential of chloride, we recommend sampling to a depth of 24 inches to best assess soil chloride status (just like nitrogen and sulfur). When testing for pH, phosphorus (P), potassium (K), organic matter, and zinc, a 0- to 6-inch sample is recommended. When testing for the mobile nutrients (nitrogen, sulfur, or chloride) a 0- to 24- inch sample is recommended.

Fertilizer considerations

Potassium chloride (KCl) is the most common and readily available chloride-containing fertilizer in Kansas. On an elemental basis, KCl fertilizer is 53 percent potassium and 47 percent chloride. For ease of calculating, assume a ratio of roughly 50 to 50 potassium to chloride. For example, if 50 pounds of KCl fertilizer is applied, about 25 pounds of chloride would be furnished. Since P and K in fertilizer are reported on an oxide basis (P_2O_5 and K_2O), it can be confusing because many fertilizer dealers know potassium chloride as 0-0-60 or 0-0-62. For ease of calculating chloride application, just remember the product is about 50 percent chloride.

Other chloride-containing fertilizers include: ammonium chloride (NH_4Cl), calcium chloride ($CaCl_2$), magnesium chloride (Mg_2Cl), and sodium chloride (NaCl). These fertilizers contain 66 percent, 65 percent, 74 percent, and 60 percent chloride, respectively. Calcium chloride, ammonium chloride, and magnesium chloride are sometimes available as liquid fertilizer. Research in Kansas has evaluated all of these sources of chloride. Results show each of these fertilizers to be equally effective in supplying chloride.

Chloride research in Kansas

Considerable research with chloride fertilization has been conducted in Kansas on wheat, corn, and grain sorghum. Positive yield responses have been noted on these crops. To date, response to chloride fertilization on other crops such as soybean has been limited.

A more detailed research summary, with yield response data, can be found in the recently updated KSRE publication MF2570, "Chloride in Kansas: Plant, Soil, and Fertilizer Considerations": https://www.bookstore.ksre.ksu.edu/pubs/MF2570.pdf

Soil test recommendations and fertilizer recommendations

Research indicates the likelihood of a response to chloride fertilizer is directly related to soil chloride levels. Chloride levels in Kansas soils vary, but levels below 25 pounds per acre are not uncommon, particularly where potassium chloride fertilizer is not normally used. Since most central and western Kansas soils are high in potassium, use of potassium chloride fertilizer has been limited, and low soil-chloride levels are often found. In eastern Kansas, however, where potassium chloride is routinely applied, low soil-chloride levels are not widespread. On soils low in chloride, optimum yields of crops may require addition of chloride fertilizer. The information in Table 1 summarizes our interpretation of soil test chloride information.

Table 1. Soil test chloride interpretation and fertilizer recommendation.

	Soil Chloride*		**Chloride Recommended**
Category	**(pounds per acre)**	**(ppm)**	**(pounds per acre)**
Low	< 30	< 4	20
Medium	30-45	4-6	10
High	> 45	> 6	0
**Interpretations valid for 0-24 inch samples on wheat, corn, and grain sorghum*			

Plant tissue analysis also has proven valuable in assessing a potential need for chloride. Research shows that whenever leaf chloride concentrations are in the 0.10 to 0.12 percent range or less, this is a good indicator of low soil chloride levels. Again, research has been limited to wheat, corn, and grain sorghum. Research with wheat used leaf samples taken at boot stage, while corn and grain sorghum leaf samples were taken at the 6- to 8-leaf stage.

When soil tests indicate a need for chloride, the recommendation is to apply 10 to 20 pounds of actual chloride per acre, depending on soil test chloride level. For example, if potassium chloride is being used, application of 30 pounds per acre of potassium chloride would supply about 15 pounds per acre of actual chloride. Research shows equal performance of chloride applied either pre-plant or topdress (November through early March) for wheat. On corn and grain sorghum, pre-plant or planting time applications are preferred. With the good solubility of all chloride fertilizers, surface broadcast applications work well with sufficient rainfall or irrigation after application.

Remember, response at any given soil chloride level in a specific year may vary with several factors, including variety, disease pressure, timing of moisture or temperature stress relative to the effect of chloride on plant development, and soil chloride distribution relative to crop root distribution.

Summary

Chloride, an often-overlooked nutrient, is essential for plant growth. Deficiencies of this nutrient have been verified in Kansas. Chloride is essential for photosynthesis and serves other critical roles in plants. Plants take up chloride as the Cl^- ion. This ion is very mobile in the soil and is subject to leaching.

Soil testing and plant analyses have proven useful in identifying potential deficiencies of chloride. Recent Kansas research has verified a need for chloride fertilization on some soils. Chloride recommendations are based on soil test chloride levels. If supplemental chloride is needed, several sources of soluble chloride fertilizers are available and agronomically effective.

The entire KSRE publication, MF2570 "Chloride in Kansas: Plant, Soil, and Fertilizer Considerations" is available to download at: https://www.bookstore.ksre.ksu.edu/pubs/MF2570.pdf. Paper copies can be ordered from the KSRE bookstore at www.bookstore.ksre.ksu.edu.

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2. Grazing cover crops: Toxicity considerations

Annual cover crops grown in place of fallow can provide high-quality forage during key production periods and may help reduce soil erosion, suppress weeds, and increase soil nutrient profiles. Traditionally grown for agronomic or soil benefits but not harvested, cover crops are being considered for grazing, haying, or planting as annual forages. They are appealing because of the potential for additional revenue from improved cattle performance combined with the benefits of soil stabilization. Those contemplating this decision should know that plants that work well as cover crops may not be suitable for forage or grazing. In fact, some species can be toxic or fatal to livestock. This article describes popular cover crops and the dangers they present for grazing livestock.

Poisonous Plants

Hairy vetch

Hairy vetch is a nitrogen-fixing plant that works well as a cover crop but is not recommended as a forage crop because of toxicity to cattle and horses. Hairy vetch prompts an allergic reaction with symptoms such as subcutaneous swelling, photosensitization, hair matting, skin sloughing, oral ulcers, cough, alopecia, weakness, loss of appetite, diarrhea, decreased milk production, sporadic abortions, red-tinged urine, and death. The mortality rate for affected animals ranges from 50 to 100%, usually as a result of kidney failure. Grazing is risky at any stage of plant growth. Animals with black pigmented skin such as Angus, Angus cross, or Holstein cattle and black horses, are the most susceptible, but Hereford cattle also may be affected. Also cattle that have been exposed regularly to hairy vetch are at a greater chance of hairy vetch toxicosis. Overall toxicosis rates are fairly low in the cattle population, but if it occurs in your operation can be devastating.

Hairy vetch poisoning has been linked to herd genetics, which may explain why livestock deaths associated with this plant tend to cluster within herds. Unfortunately, there is no genetic test to indicate live- stock sensitivity to hairy vetch. Weigh potential benefits and risks when deciding whether to plant hairy vetch as a forage crop.

Lupin

Lupin is a good source of protein and energy in livestock feeds for both ruminants and monogastrics, but use is limited to four nontoxic species: narrowflower lupine *(Lupinus angustifolius)*, white lupine (*L. albus*), European yellow lupine (*L. luteus*), and tarwi (*L. mutabilis*). The lupin grain can be fed and is relatively low in starch, which reduces the likelihood of acidosis. Even though lupin grain is high in protein, when feeding to monogastrics, bear in mind that lupins are low in methionine and lysine.

Six lupin species that are particularly toxic to cattle and sheep are silky lupine (*L. sericeus*), tailcup lupine (*L. caudatus*), velvet lupine (*L. leucophyllus*), silvery lupine (*L. argenteus*), summer lupine (*L. formosus*), and sulfur lupine (*L. sulphureus*). These poisonous plants can kill sheep and may cause cleft palates, crooked legs, distorted and malformed spines, and other birth defects when consumed by pregnant cows.

Amaranth

Amaranth is a bushy plant related to pigweed. Species used for grain production include love-lies-bleeding (*Amaranthus caudatus),* red amaranth *(A. cruentus),* and Prince-of-Wales feather *(A. hypochondriacus)*. The grain from the amaranth plant is marketed to food processors, breakfast cereal companies, and health food stores. Spiny amaranth or spiny pigweed (*Amaranthus spinosus* L.), redroot pigweed (*Amaranthus retroflexus*), and Palmer amaranth (*Amaranthus palmeri*) are examples of amaranth species that are classified as true weeds and hard to control in pastures and crops. Palmer amaranth is consistently high in nitrate and potentially toxic to cattle. Know which amaranth species you are getting before using it as a forage crop for livestock.

Metabolic disorders

Brassicas – Kale, rapeseed, swede, turnip, canola, mustard

Brassicas provide high-quality, high-protein feed for cattle. Aboveground parts provide 20 to 25% crude protein (CP) with 60 to 80% *in vitro* digestible dry matter. Roots are 10 to 14% CP and 80 to 85% digestible. Brassicas are ready for grazing about 75 days after planting. Regrowth is possible if not overgrazed. Palatability increases after a freeze.

Brassicas are high in moisture and low in fiber. Other dry feeds should be offered to maintain a functional ruminal environment. They are low in copper, manganese, and zinc. Plan to supplement with a properly balanced mineral to meet cattle requirements. This is especially important for breeding animals.

Maladies associated with improper grazing include polioencephalomalacia, hemolytic anemia (abnormal breakdown of red blood cells, mainly an issue with kale), pulmonary emphysema (a permanent accumulation of air in lungs), bloat (especially with canola), and metabolic problems associated with glucosinolates. Photosensitivity may be observed in sheep. Polioencephalomalacia (PEM), anemia, and emphysema are normally found when the cattle diet consists solely of brassicas. Brassicas should comprise no more than 75% of the total diet. An iodized mineral pack should be offered to counter negative effects of glucosinolates on iodine uptake.

Canola is high in sulfur, increasing the risk of PEM. Test sulfur levels in the canola plant and water source to minimize toxicity concerns. Sulfur may inhibit absorption of minerals and particularly copper and selenium. Provide a trace mineralized salt and mineral supplement to cattle grazing canola.

Flax

Grazing flax is not recommended because of the potential for prussic acid poisoning. Avoid grazing green flax straw, in particular, and especially right after a freeze when risk is higher. On the other hand, harvested flax seed is a good high-protein feed. In addition to 35% CP, it offers a unique fatty acid profile, making it desirable as a dietary supplement for horses. After seed harvest, flax straw's high cellulose and lignin content makes it a poor-quality forage. Despite desirability as feed, flax is not recommended for grazing or haying.

Small grains – Barley, Oats, Rye, Ryegrass, Wheat, Triticale

Rapidly growing, lush grasses can lead to grass tetany in grazing cattle. Grass tetany is more common in the spring but can occur with the cool-season growth of small grains in the fall and winter. High-protein grasses may contribute to bloat.

To manage grass tetany, provide magnesium to lactating cows, preferably a free-choice mineral containing 8 to 12% magnesium. Begin supplementation before turnout, making sure the mineral is palatable to ensure adequate intake. Increasing legumes to 30% of the pasture may reduce risk of grass tetany.

Nitrate toxicity risk increases with heavy nitrogen fertilization of cool-season grasses. Nitrate can accumulate, reaching dangerous levels on cool, cloudy days, during periods of drought or under environmental conditions that slow grass growth and metabolism.

Legumes

Grazing either yellow or white sweetclover, is not a risk for cattle, however moldy hay puts cattle at risk for sweetclover poisoning. Low-coumarin varieties such as red clover and Banat sweetclover (*Melilotus dentate)* are exceptions. Yellow (*M. officinalis)* and white (*M. albus)* sweetclover varieties contain the most coumarin. Avoid feeding moldy sweetclover hay to cows within 2 weeks of calving to reduce the risk of abortion.

Bloat is another concern when grazing clovers and legumes. Forage with less than 50% clovers is less problematic. Never give hungry animals access to lush clover stands, and provide dry hay to reduce bloat. Clovers are less likely to cause bloat than alfalfa. Annual lespedeza, birdsfoot trefoil, and sainfoin are not known to cause bloat, but certain birdsfoot trefoil species may contain high levels of prussic acid.

Cattle will consume lablab, cowpea, sunhemp, mungbean, and soybean, which are suitable for grazing. Bloat can be an issue as with other legumes, but the risk is fairly low. Sheep are less tolerant of these crops than cattle. A small percentage, usually crossbred sheep, may show photosensitivity around the face and ears while consuming cowpea. This is rare with lablab or soybean. Sheep grazing rain-damaged mature soybean crops may become ill if exposed to the fungus *Phomopsis* and toxins that cause lupinosis-like symptoms. Lupinosis causes acute liver atrophy and may lead to death.

Medics are legumes that are recommended as forage because of their high biomass production. Black medic is not palatable to cattle, but animals may consume other varieties. These plants may cause bloat in cattle and sheep to a lesser extent. Snail medics are not as risky as barrel and naturalized medics.

Sorghum, Sudans, Millets, and Corn

Sorghums and millets are warm-season, drought-tolerant crops that grow in above-average temperatures. Four main categories are grain sorghum, forage sorghum, sudangrass, and sorghum-sudangrass hybrids. Cattle grazing on any of these are at risk for prussic acid HCN poisoning. Sudangrass, with low levels of HCN, is the least toxic and rarely kills animals. Sorghum-sudangrasses pose an intermediate threat, and sorghum, with the highest levels of HCN, is potentially the most toxic to livestock.

Corn does not raise prussic acid concerns, but cattle are at greater risk for prussic acid poisoning than sheep. Sorghums and corn have been associated with nitrate toxicity. Test forage before grazing or haying.

Graze sorghum when the plant is 18 inches or higher. HCN levels are highest when the plant is young and growing, after a drought breaks, during regrowth, and immediately following a freeze. A rotational system should be used if grazing sorghums during summer. Briefly, turn cattle into the paddock when plants exceed 18 inches. To keep cattle from consuming regrowth, do not graze the paddock for more than 5 days. Although appetizing, new shoots may be high in HCN. HCN levels tend to increase following a light frost and peak after a killing frost. Wait 10 days after a killing frost to graze or feed sorghums and delay grazing sorghum stalks until after a killing freeze. Prussic acid is not a concern with baled hay because HCN evaporates as the hay dries.

Nitrates are the biggest threat when harvesting sorghum for hay. Although curing removes prussic acid, which is volatile, nitrates remain in the hay. Test plants for nitrate before harvest and raise cutting height, leaving the bottom one-third of the stalk where nitrate concentrations are highest. If the test is high, delay harvest to allow plants to grow and metabolize more of the nitrates.

With millet (pearl or foxtail), nitrate toxicity may be a problem but not prussic acid. These grasses are recommended for horses. Sorghum is not recommended because it contains lathyrogenic nitriles such as β-cyanoalanine, cyanogenic glycosides, which may cause cystitis. Symptoms include urinary incontinence, posterior ataxia or incoordination, and less frequently death and late-term abortion. Mold is a problem with high-tonnage crops such as millet or sorghum hay. Poorly cured hay can cause respiratory problems in horses, and cattle may refuse to eat it.

In Mississippi, researchers studying the effects of cattle grazing on corn reported steer gains of 1.9 to 2.0 pounds per day. Experiments involved turning cattle onto corn after ears developed as plants dried for winter feed. Cattle graze selectively in corn fields, which can lead to acidosis and founder. The Mississippi steers also grazed selectively, consuming leaves, tops, ears, and then stalks when that was all that was left. In a similar Canadian study, cows grazed ears, leaves, tops, then the stalk, in that order.

Corn grazing may lead to nitrate toxicity in cattle. To prevent this and to maintain an optimal rumen microbial environment, strip graze the corn and allow cattle to graze for 2 to 3 days per paddock. Reduce daily corn consumption to decrease the risk of acidosis and founder. Strip grazing also increases forage utilization, even if cattle are only grazing stalks.

These recommendations are based on current information. Consult your veterinarian before grazing or feeding any of the plants discussed. To select forage crops suitable for your operation, consult your area livestock extension specialist and veterinarian.

Forage Crop Characteristics and Toxicities

Plant	C[1]	G[2]	W[3]	S[4]	TDN[5]	CP[6]	Toxicities	Livestock affected
Amaranth	B	A	L	W	68	13-18	Some species OK, some poisonous	
Beet (bulb)	B	B	H	C	75-79	7-11	Choking	All livestock species
Beet (tops)	B	B	H	C	58-61	15-17		
Brassica hybrid	B			C	67-70	15-16	Nitrate, polioencephalomalacia, anemia, emphysema	All cattle
Buckwheat[7]	B	A	M	W	62-75	3-25	Photosensitive dermatitis	Horses
Canola	B	A/B	M	C	62-65	13-16	Nitrate toxicity, bloat, polioencephalomalacia	All cattle
Carrot (root)	B	A/B	H	C	83	10	Scouring	Cattle
Carrot (top)	B	A/B	H	C	73	13	Nitrate	
Chicory leaves	B	P		W	67	8		
Chicory roots	B	P		W	89	4		
Flax[8]	B	A	M	C			Prussic acid (green flax), seeds SAFE	All cattle
Kale	B	A	M	C	69	22	Nitrate,polioencephalomalacia, anemia, emphysema	All cattle
Mustard[9]	B	A/P	H	C	53	10	Glucosinolate toxicity	All livestock species
Phacelia	B	A	L	C	56	15		
Radish	B	A	H	C	66	20	Nitrate, polioencephalomalacia, anemia, emphysema	All cattle
Rapeseed	B	A/B		C	70	17	Nitrate, polioencephalomalacia, anemia, emphysema	All cattle
Safflower	B	A	H	W	55-58	10-13		
Spinach[10]	B	A	M	C	51	31		
Squash[10]	B	A		W	54	26		
Sunflower[11]	B	A	H	W	55	10-12	Nitrate	All cattle
Turnip	B	B	H	C	67	16	Nitrate, polioencephalomalacia, anemia, emphysema	All cattle
Barley[12]	G	A	L	C	62-66	9-11	Grass tetany, bloat	All cattle, lactating cows
Cereal rye[12]	G	A	H	C	48-52	7-9	Grass tetany, bloat	All cattle, lactating cows
Corn	G	A	H	W	70	8.1	Nitrate, acidosis, founder	All cattle
Crabgrass	G	A		W	60-64	15-21		
Forage sorghum	G			W	58	6	Nitrate, prussic acid	All cattle and sheep
Foxtail millet	G	A	L	W	57	15	Nitrate, prussic acid	
Grain sorghum	G	A	M	W	60	7.5	Nitrate, prussic acid	All cattle and sheep
Oats[12]	G	A	M	C	54-58	8-10	Grass tetany, bloat	All cattle, lactating cows
Pearl millet	G	A	L	W	57	13	Nitrate	
Proso millet	G	A	M	W	56	10	Nitrate, prussic acid	
Ryegrass[12]	G	A/P	M	C	60	16	Grass tetany	All cattle, lactating cows

continued

Forage Crop Characteristics and Toxicities								
Plant	C[1]	G[2]	W[3]	S[4]	TDN[5]	CP[6]	Toxicities	Livestock affected
Sorghum-Sudan grass	G			W	56	6-8	Prussic acid	All cattle and sheep
Sudan grass	G	A	M	W	70	17	Minimal chance of prussic acid poisoning	All cattle and sheep
Teff	G	A	M	W	55-64	9-14		
Triticale[12]	G	A	H	C	52-54	8-10	Grass tetany, bloat	All cattle, lactating cows
Wheat[12]	G	A	M	C	55-60	8-10	Grass tetany, bloat	All cattle, lactating cows
Alfalfa	L	P	H	C	51-63	14-22	Bloat	All cattle
Berseem clover	L	A	L	C	56-71	18-23		
Birdsfoot trefoil	L	P	M	C	58-66	15-20		
Chickpea[13]	L	A	L	W				
Cowpea	L	A	L	W	65	18	Minimal chance of bloat, photosensitivity in sheep	Cattle and sheep
Field Pea	L	A	L	C	67	17	Bloat	Cattle
Forage lespedeza	L	A		W	71	18	Milk decrease	Lactating dairy cows after plant blooms
Guar	L	A	L	W	81	19	Bloat	
Hairy vetch[14]	L	A/B	M	C	NG	NG	Poisonous, allergy	Cattle, horses
Lablab	L	A/P		W	56	18	Minimal chance of bloat	Cattle and sheep
Lentil[11]	L	A	L	C	56	15		
Lupin	L	A	L	C	63	32-44	Some species OK, some poisonous	Cattle and sheep
Medic[15]	L	A/P	L	C	54-58	7-8.5	Bloat	
Mung bean	L	A		W	78	15		
Red clover	L	B/P	L	C	70	20	Bloat	All cattle
Sainfoin	L	P	H	C	52	17		
Soybean	L	A		W	58	15	Minimal chance of bloat, potential for lupinosis in sheep	Cattle and sheep
Sweetclover	L	A/B	M	C	54	16	Bloat, "sweet clover poisoning", vitamin K interference	All cattle
White clover	L	P	L	C	80	25	Bloat, "sweet clover poisoning", vitamin K interference	All cattle

NG=data not given
[1] C=Class of plants: G=grass; B=broadleaf; L=legume
[2] G=Growth pattern: A=annual; B=biennial; P=perennial
[3] W=Plant water use: H=high; M=medium; L=low
[4] S=Season: W=warm; C=cool
[5] TDN=total digestible nutrients, measure of energy, % of dry matter
[6] CP=crude protein, % of dry matter
[7] Buckwheat grain TDN=86.6 and CP=13; buckwheat straw TDN=42 and CP=5
[8] Flax seed TDN=110 and CP=23; Flax straw TDN=38 and CP=4
[9] Values for TDN and CP are based on mustard hay values for tame species.
[10] Values adapted as the vegetable from Dairy One Feed Library as reported by Davis et al. (2012). Utilization of cull vegetables as feedstuffs for cattle. Values do not estimate grazing quality (no leaf portion).
[11] Values for TDN and CP are based on silage estimates.
[12] Values at boot stage, change through growth stage.
[13] Chickpea TDN=89 and CP=22; Chickpea straw TDN=45 and CP=6
[14] Values for TDN and CP are not reported because this is not recommended as a livestock feed.
[15] TDN and CP ranges are based on different varieties.

This eUpdate article is a slightly edited excerpt from the K-State Research and Extension Publication MF3244, "Forage Crops Grazing Management: Toxic Plants". The full publication can be viewed at https://www.bookstore.ksre.ksu.edu/pubs/MF3244.pdf.

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3. Prescribed burning workshops scheduled for 2019

Several prescribed burning workshops have been scheduled for the months of February and March, with more in the planning stages. Partners involved include K-State Research & Extension, Kansas Forest Service, USDA-NRCS, USDA-FSA, Kansas Conservation Districts, Department of Wildlife, Parks & Tourism, the National Weather Service, Local Fire Departments and Emergency Management Personnel, Pheasants Forever, The Wildlife Society – Kansas Chapter, and Great Plains Fire Science Exchange.

Each workshop lasts about 4-5 hours and includes topics on reasons for burning, regulations, weather considerations, liability, burn contractors, equipment and crew, hazards, fuels, firebreaks, fire types and behavior, ignition techniques, and burn plans.

Contact Walt Fick at 785-532-7223 or whfick@ksu.edu if you have any questions regarding a prescribed burning workshop. Be sure to contact the host to register for a workshop.

Date	**County/City**	**Host/ Contact**	***Agency***	**Phone**	**e-mail**
Feb. 20	Russell/ Russell	Clint Laflin	KSRE	785-483-3157	cllaflin@ksu.edu
Feb. 21	Wilson/ Fredonia	Pamela Walker	CD	620-378-2866	pamela.walker@ks.nacdnet.net
Feb. 25	Washington/ Barnes	Brett Melton	KSRE	785-243-8185	bmelton@ksu.edu
Feb. 27	Cowley/ Winfield	Elizabeth Espino	KSRE	620-221-5450	eespino@ksu.edu
Feb. 28	Lincoln/ Sylvan Grove	Barrett Simon	KSRE	785-378-3174	barrett8@ksu.edu
Mar. 1	Atchison/ Effingham	Tiffany Hoffman	CD	913-833-5740 ext 333	Tiffany.Hoffman@ks.nacdnet.net
Mar. 6	Franklin/ Ottawa	Keri Harris	CD	785-241-7201	frco.conservation@gmail.com
Mar. 8	Logan/Oakley	Dana Charles	CD	785-672-3841	dana.charles@ks.nacdnet.net
Mar. 18	Johnson/ Olathe	Jessica Barnett	KSRE	913-715-7000	jessica.barnett@jocogov.org