

FORAGE CROPS

GRAZING MANAGEMENT: TOXIC PLANTS

A SHORTAGE OF GOOD-QUALITY PASTURE CAN BE A LIMITING FACTOR FOR A CATTLE OPERATION.

Annual forage 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 publication describes popular cover crops and the dangers they present for grazing livestock.

METABOLIC DISORDERS

BLOAT

Frothy bloat refers to a condition that occurs when a ruminant consumes feeds that produce thick, foamy gas that the animal cannot pass by belching. Froth builds in the rumen and causes noticeable discomfort to the animal. It can be deadly if pressure is not alleviated.

Bloat-prevention agents such as ionophores and poloxalene can be added to feed and water to minimize risk. Providing dry roughage before introducing cattle to high-risk forage and delaying turnout until midday may help, too. Grazing grass-legume mixtures is recommended, but producers should avoid pastures containing more than 50% bloat-causing legumes. Risks associated with specific legume varieties are addressed in the legume section.

GLUCOSINOLATES

Glucosinolates are natural compounds that give plants a bitter, “hot” taste. Found in the leaves of certain plants, they are highly concentrated in seed. When consumed by livestock, glucosinolates interfere with thyroid function, cause liver and kidney lesions, and reduce mineral uptake. For livestock, the most serious issue is inhibited iodine uptake which can reduce production of the hormone thyroxine and result in goiters.

GRASS TETANY

Also known as grass staggers or wheat pasture poisoning, grass tetany is a metabolic disorder characterized by low magnesium levels in the blood. Grass tetany mainly affects older lactating cows grazing succulent, immature grass. It can result in uncoordinated gait (staggers), convulsion, coma, and death. To prevent grass tetany, supplement magnesium by offering mineral or high-magnesium feeds when grass is lush. Graze high-risk pastures with steers, heifers, and dry cows that are less susceptible to this disorder.

NITRATE TOXICITY

Ruminants are vulnerable to nitrate toxicity, which occurs when plant nitrate is converted to nitrite in the rumen. From there, nitrite is absorbed into the bloodstream where it binds with hemoglobin to form methemoglobin, a compound that reduces oxygen-carrying capacity. Nitrate toxicity shows up as grayish to brownish discoloration of nonpigmented skin and mucous membranes of the mouth, nose, eyes, and vulva, and discoloration of the blood from bright red to chocolate brown. Animals show symptoms such as staggering gait, rapid pulse, labored breathing, frequent urination, collapse, coma, and death. Pregnant animals may abort. Reduced feed intake may be associated with high nitrate hays.

When diagnosed early, nitrate toxicity can be treated with an intravenous injection of methylene blue. Because this remedy may not be readily available, prevention is recommended. Always test forage before feeding. Talk to your veterinarian or extension professional if you are concerned about nitrate toxicity.

POLIOENCEPHALOMALACIA (PEM)

High levels of dietary sulfur create hydrogen sulfide gas in the rumen and can lead to brain lesions and a disease called polioencephalomalacia (PEM). Clinical signs include muscle incoordination, circling, stupor, blindness, facial tremors, recumbency, convulsions, and death. Guidelines for sulfur concentration in beef cattle diets are based on the amount of forage in the diet. In diets with less than 15% forage, the maximum tolerable amount of sulfur is 0.30%; in diets containing more than 40% forage, the maximum concentration is 0.50%. Although high levels of dietary sulfur may heighten the risk of PEM, a number of factors must converge for the disease to occur. Supportive treatment may include intravenous thiamine injections and dexamethasone, to reduce cerebral edema.

PRUSSIC ACID POISONING

Prussic acid poisoning occurs rapidly on high-risk forages and can result in sudden death. The active compound in prussic acid, hydrocyanic acid (HCN), deprives cells of oxygen and leads to asphyxiation. Poisoning symptoms include staggering, gasping, trembling muscles, convulsions, and respiratory failure. Mucous membranes in the mouth and eyes may turn blue. Prussic acid or hydrogen cyanide poisoning can be diagnosed by bright cherry-red blood at death.

Treatment is sodium nitrite and sodium thiosulfate administered intravenously by a veterinarian. In general, ruminants (cattle and sheep) are more susceptible to poisoning than non-ruminants. Horses and pigs may not be affected. Avoid grazing forages with new growth that produces high levels of prussic acid, or after a light freeze when HCN levels are at their peak.

SWEETCLOVER POISONING

Sweetclover poisoning is associated with coumarin, a substance that is converted to dicoumarin in spoiled or damaged sweetclover. Dicoumarin interferes with vitamin K metabolism and blood clotting and may



Hairy vetch.

result in hemorrhaging. Poisoning usually occurs when feeding moldy sweetclover hay and rarely when cattle are grazing. Minimize risks by planting low-coumarin clover varieties. Treat with intravenous injections of vitamin K or whole blood. Prevention is discussed in the legume section.

POISONOUS PLANTS

HAIRY VETCH

Hairy vetch is a nitrogen-fixing plant that works well as a cover crop but is not recommended as a stock 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.

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 livestock 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* S. Watson) 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), nitrate poisoning, 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.

Nitrate toxicity is possible with brassicas. Test forage before turnout to determine if it is safe based on laboratory results. In general, the more mature the



Turnip growing in residue.

plant, the lower the nitrate concentration. If nitrate value is high early in the season, it may be suitable for grazing at a later date. Introduce animals to the brassica diet over 5 to 7 days. Do not turn out hungry animals. Make sure they are full of hay first.

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 of sweetclover, yellow clover, and white clover, as well as the low-coumarin varieties such as red clover and Banat sweetclover (*Melilotus dentatus*) does not lead to sweetclover poisoning in cattle. 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 medicants are not as risky as barrel and naturalized medicants.

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-sudan-grass 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 (Figure 1). 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 lathrogenic 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.

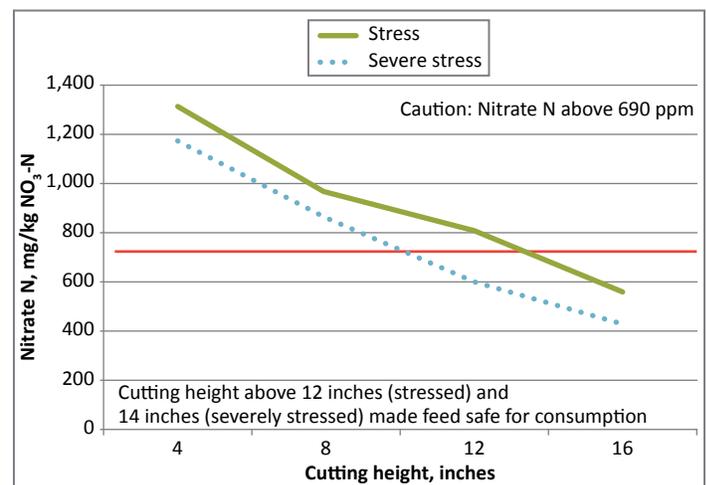


Figure 1. Effect of cutting height on nitrate-N level in forage sorghum that was either stressed or severely drought-stressed within the same field near Garden City, Kansas, in 2010. Holman, J. 2010.

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.

AUTHORS

Jaymelynn Farney, *Beef Systems Specialist*

Doug Shoup, *Agronomist*

Dave Rethorst, *DVM, College of Veterinary Medicine*

Dale Blasi, *Beef Stocker Management Specialist*

John Holman, *Agronomist, Cropping Systems*

THIS MATERIAL IS BASED UPON WORK SUPPORTED BY:

U.S. Department of Agriculture, Project Nos. 2013-69002-23146 through the National Institute for Food and Agriculture's Agriculture and Food Research Initiative, Regional Approaches for Adaptation to and Mitigation of Climate Variability and Change. Great Plains Grazing is a group of research scientists, Extension specialists, and consumer experts from Kansas State University, Oklahoma State University, University of Oklahoma, Tarleton State University, Samuel Roberts Noble Foundation, and the USDA's Agricultural Research Service working together to improve and promote regional beef production while mitigating its environmental footprint.

K-STATE
Research and Extension

Publications from Kansas State University are available at www.bookstore.ksre.ksu.edu

Publications are reviewed or revised annually by appropriate faculty to reflect current research and practice. Date shown is that of publication or last revision. Contents of this publication may be freely reproduced for educational purposes. All other rights reserved. In each case, credit Jaymelynn Farney et al., *Forage Crops: Grazing Management: Toxic Plants*, Kansas State University, April 2018.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

K-State Research and Extension is an equal opportunity provider and employer. Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, Extension Districts, and United States Department of Agriculture Cooperating, John D. Floros, Director.

MF3244 April 2018