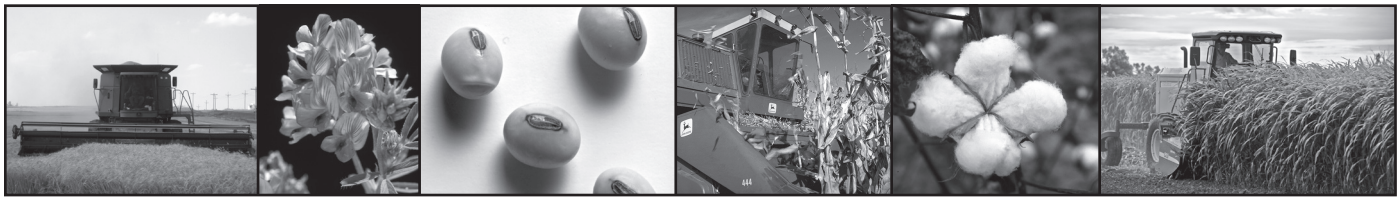


Unit 4) Kansas Crops Up Close

That was Then and This is Now…

Then

Grasshoppers

"The corn I had planted was looking fine, and the potato patch was getting green when on the 10th of May at about 11:30 a.m. we saw a cloud coming across the plain very low, that sounded like wind. Remembering the story I had heard, I put the horses under the wagon cover where we kept our grain, and we all rushed for the house. As the cloud approached the noise increased until we could not hear each other speak, and the light from the sun faded as though night was coming. It was the most awesome and terrifying thing we had ever seen. Then it fell, and for a while we were in almost total darkness. As the light gradually came back, and with the realization that we were safe in the house, we felt thankful, until we looked outside. There we saw a writhing black blanket that seemed to be crawling toward us from every direction. We each grabbed a child and held it to protect it. Soon the sun came out, but the blanket kept rolling and the stench was so appalling it left us trembling.

I have no idea how long it lasted, but it seemed eternal as the man had said... Gradually the blanket lifted, and we could see the damage. Not a stalk of corn was left, nor a blade of grass, even the leaves on the trees were gone... The next day I ran the harrow over the cornfield and began replanting it." [1]

Warren P. Trimm, 1878

Now

"Today was a beautiful, crystal clear late summer day. There was a bite in the air this morning, so I checked the weather forecast on the computer before breakfast. The animated map predicted clear weather with hardly any clouds, so I was able to resume wheat planting.

What a busy day! My Twitter feed told me there were free doughnuts at the grain elevator because of Charlie's birthday. I gave Charlie a hard time while talking to the elevator's grain marketing specialist about taking advantage of next year's wheat prices anyway. I was able to see the prices thanks to the hourly grain price text messages I get.

I saw on Facebook that Dalton bought some distillers grains from the ethanol plant in Oakley through an online broker, and needs someone to help him haul them home. I'll text him to see if I can help him, provided I get my wheat planted in the next few days!

Before I go to bed, I want to post pictures of the planting equipment on my blog today. Aunt Joyce in Tucson always wants to see what we're doing on the farm, and the blog sure works great for that. While I'm at it, I'll show pictures of the soybeans and grain sorghum, as those crops are looking great!"

Bill Spiegel, 10 p.m., September 18, 2010

Continued on next page

Each year, farmers plant more than half of the land in Kansas to agricultural crops, an area about the size of Maine and larger than 11 other states. In Kansas, about 23 million acres are planted to agricultural crops each year.

Year after year, the state of Kansas leads the nation in the production of wheat and grain sorghum, also ranking among the top states in the production of sunflowers, alfalfa, corn, and soybeans. Kansas farmers also plant and harvest a variety of other crops, including cotton, potatoes, pinto beans, and vegetables.

Corn Plants
Credit: USDA

Kansas Crop Fields
Credit: Cindy Baldwin

Soybean Field
Credit: Keith Weller, USDA ARS

Sunflowers
Credit: Bruce Fritz, USDA ARS

What is an Acre?

Acre – a unit of measurement for land.

One acre equals 43,560 square feet (approximately the same size as a high school football field, not including the end zones).

One square mile equals 640 square acres.

Crop Categories
Agricultural crops – crops produced for human food, livestock feed, or consumer and industrial products.
Fiber crops – crops produced for the fiber. Examples: cotton and flax.
Forages – crops harvested for livestock feed. Examples: alfalfa, forage sorghum, and brome.
Grains – crops that produce a small, hard seed.
Horticultural crops – fruits, vegetables, flowers, and ornamental plants; considered agricultural crops.
Row crops – originally used to describe crops planted in a specific way; includes soybeans, corn, grain sorghum, sunflowers, and cotton.
Specialty Crops – a general category that includes horticultural crops, berry and nut crops, herbs and spices, grapes, Christmas trees, turfgrass, and other nursery crops.

Source: Jim Shroyer, Crop Production Specialist, K-State Research and Extension

Crop Categories

Crops are cultivated plants grown on land specifically designated for crops (cropland). Agricultural crops are produced for human food, livestock feed, or processed and sold in a variety of consumer or industrial products. Several terms are used to refer to agricultural crops, including grains, oilseeds, forages, fiber crops, and specialty crops (including horticultural crops). Within those general crop categories, a crop may be described in more than one way.

Grains are crops that produce a small hard seed. Crops can be categorized as coarse grains or small grains. Coarse grains include crops like corn and grain sorghum, whereas small grains include crops like wheat, oats, barley, triticale, rye, and rice.

The broader term "cereal grain" is used to describe crops that produce seeds used as food by people. Cereal grains include wheat, rice, corn, grain sorghum, rye, oats, barley, millet, and triticale. In contrast, "feed grain" describes grain fed to livestock, such as corn and grain sorghum.

Grains – Wheat
Credit: Kansas Wheat Commission

Oilseeds are crops that produce oil for food, consumer, and industrial products. Oilseeds include soybeans, sunflowers, canola, peanuts, cotton, and flax. In addition, cotton and flax are called "fiber crops" because they are also used for the production of fibers.

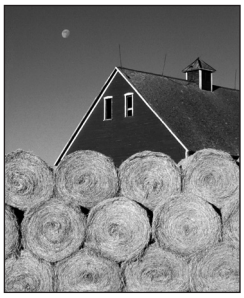
Oilseeds – Sunflowers
Credit: Bruce Fritz, USDA ARS

Grains and Oilseeds

Cereal grains – wheat, rice, corn, grain sorghum, rye, oats, barley, millet, and triticale.
Coarse grains – corn and grain sorghum.
Feed grains – grain fed to livesock; term is often interchanged with coarse grains.
Oilseeds – soybeans, sunflowers, canola, cotton, and flax.
Small grains – wheat, oats, barley, triticale, rye, and rice.

Source: Jim Shroyer, Crop Production Specialist, K-State Research and Extension

Forages are plants grown to provide feed for animals, mainly in the form of leaves and stems. Forage crops include grasses, legumes, and crop residue (stalks and plant material left after harvesting the grain or seeds). Both annual and perennial plants can be used as forage crops. Forage crops may be harvested as pasture, greenchop, silage, or hay.



Forages – Alfalfa Bales
Credit: Scott Bauer, USDA ARS

Horticultural crops include fruits, vegetables, flowers, and ornamental plants. These are considered specialty crops in addition to Christmas trees, turfgrass, berry and nut crops, herbs and spices, grapes, and other miscellaneous crops.

Specialty Crops – Pears
Credit: Keith Weller, USDA ARS

Many variables determine which fields are planted to what crops each year, including individual situations on each farm or field, field and weather conditions, the potential demand for products, and anticipated net returns on the required investments in inputs. These inputs include the seeds, equipment, and labor necessary for planting, growing, and harvesting each crop.

Crops are also planted in planned cycles. In crop rotation, a sequence of crops may be grown on the same land. That sequence may include summer fallow (ecofallow), when the land is left unplanted during at least one growing season.

The wide variety of crops grown in Kansas helps meet the world-wide needs for food, fiber, fuel, and other consumer and industrial products. The predominant agricultural crops grown in Kansas fall into the grain, oilseed, and forage crop categories.

Feeding People

One farm worker produced enough food and fiber to meet the needs of this many people in the United States and around the world:

1861	**< 5 people**
1961	**26 people**
2010	**155 people**

Sources: USDA, American Farm Bureau Federation

The Great Plains

Source: Commission for Environmental Cooperation

Grains

Grasslands are found on every continent except Antarctica. Covering almost half of the earth's land surface, grasslands produce approximately 70 percent of the food consumed by the world's population. Many food-producing crops belong to the grass family of plants, including wheat, rice, corn, and sorghum.

Grain Foods
Credit: Scott Bauer, USDA ARS

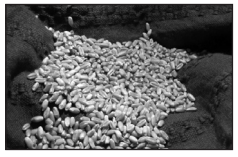
Early explorers like Lt. Zebulon Pike described the Great Plains as "the Great American Desert" because the prairie grasslands were so different from the forested areas of the eastern United States that were more familiar to them. Despite those differences, the soils and climate that produced the prairie grasses in states like Kansas have proven ideal for growing grains.

Wheat

More foods are made with wheat than any other cereal grain. In fact, about 75 percent of all U.S. grain food products are made with wheat flour. Nonfood uses, including livestock feed and seed, account for less than 15 percent of the wheat produced in the United States.

Wheat
Credit: Bill Spiegel, Kansas Wheat Commission

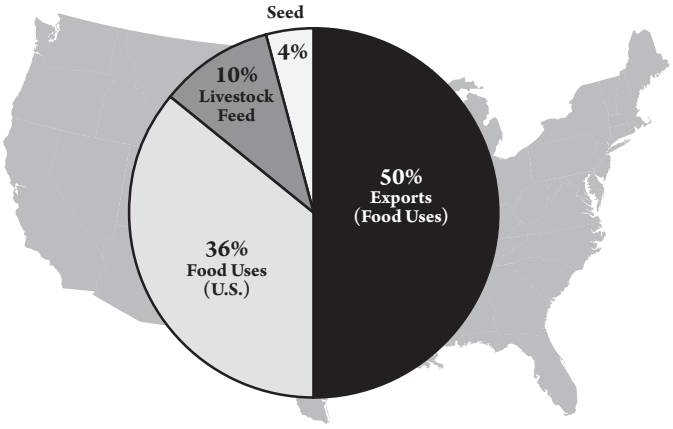
Nearly every year, Kansas produces more wheat than any other state. In fact, Kansas farmers produce 20 percent of all the wheat grown in the United States. Kansas also mills more wheat flour and produces more wheat gluten than any other state.



Wheat Kernels
Credit: Mary Anne Stoskopf

Wheat Flour
Credit: Wheat Foods Council

U.S. Wheat Uses



Source: Kansas Wheat Commission

Wheat History

Wheat is a member of the grass family of plants that produces a dry one-seeded fruit, commonly called a kernel. Wheat originated nearly 10,000 years ago in the "cradle of civilization," a geographical area that is now Iraq, eastern Syria, southwestern Iran, and southeastern Turkey. Wheat's earliest ancestors – wild einkorn and emmer – were among the first plants cultivated by people. In fact, the ability to cultivate grain and harvest seeds marked the beginning of civilization because people were able to grow their own food and live in one place, rather than having to move from place to place in order to gather enough food to survive.

However, it was not until much later that wheat was brought to North America. It was Christopher Columbus who introduced wheat into the New World, taking it to the West Indies (where the first wheat crop was grown in 1492). In the early 1500s, Spaniards then took wheat to Mexico, and its cultivation spread from there into what is now the southwestern United States. Other explorers took grains of wheat on their expeditions to the eastern coast of the United States, where settlers grew wheat as a crop in the early 1600s.

The first record of a wheat crop in Kansas was produced at the Shawnee Methodist Mission in 1839 (located in what is now Johnson County). Settlers coming to Kansas brought small quantities of wheat seed with them. However, those wheat varieties grew poorly in the Kansas environment, because they were developed in milder climates in the eastern United States or Europe.

Over time, different wheat varieties more suited to Kansas conditions were developed, especially after German Mennonites from the Ukraine introduced Turkey Red hard red winter wheat in south-central Kansas. The first crop of this variety was planted in Marion County in 1873 and harvested in 1874. By 1919, more than 82 percent of the wheat acreage in Kansas and about 30 percent of the wheat acreage in the United States was planted to the Turkey Red wheat variety. It remained the most popular wheat variety in Kansas until 1939 and was the most popular wheat variety in the United States until 1944. [2] According to the Kansas Wheat Commission, modern varieties of winter wheat in Kansas contain, on average, about 50 percent of Turkey Red hard red winter wheat in their pedigrees.

However, today's wheat varieties are very different from the older varieties. Modern varieties produce more grain, grow shorter stronger stalks, mature earlier, are resistant to specific pests and diseases, and produce better quality grain for bread and other wheat foods.

Wheat Field
Credit: Mary Anne Stoskopf

Hard white wheat was introduced in Kansas in the 1980s, and Kansas researchers continue to develop varieties that will produce well under typical Kansas growing conditions.

Winter Wheat

Almost all of the wheat grown in Kansas is winter wheat. Winter wheat is a cool-season plant that is able to withstand both cold and hot weather. It is planted in the fall, sprouts, and begins growing. Then, during the winter, the plants go dormant. During the period of dormancy, the plant conserves energy by temporarily slowing down or stopping growth and development. In the spring, as the soil and air temperatures rise, the wheat plants begin growing again.

Winter Wheat (Fall)
Credit: Mary Anne Stoskopf

Winter Wheat (Winter)
Credit: Mary Anne Stoskopf

Mesopotamia – Cradle of Civilization

Mesopotamia ("land between two rivers") refers to the basins of the Tigris and Euphrates rivers and the geographical area watered by these two rivers. Today, this region includes Iraq, eastern Syria, southeastern Turkey, and southwestern Iran.

Mesopotamia is called the "Cradle of Civilization" because the first literate societies developed in this region. The people of Mesopotamia adopted food production innovations, such as irrigation and using plows to soften the soil before planting. They also adopted other early technologies, including metalworking (copper, bronze, gold, and iron), glassmaking, textile weaving, and water storage and control using dams and aqueducts. Mathematical systems that originated in this region are the source of today's 60-minute hour, 24-hour day, 360-degree circle, and weeks of seven days each. Mesopotamian astronomers also worked on a 12-month calendar based on the cycles of the moon.

Plant Varieties

A variety is a plant with specific genetic characteristics that make it different from other plants of the same species. The selected variety is usually one that makes full use of available rainfall, soil fertility, and the growing season. Farmers also select varieties based on insect and pest resistance, soil conditions, climatic conditions (like wind, low rainfall, or a shortened growing season), and anticipated end uses.

Wheat Head (Green)
Credit: Peggy Greb, USDA ARS

Wheat Head (Ripe)
Credit: Kansas Wheat Commission

Bread
Credit: Wheat Foods Council

In addition to the main stem, a wheat plant's root system can produce many secondary tillers (side shoots), each of which may develop into a stem with a seed head at the tip. A head of wheat grows six to 12 V-shaped rows called spikelets. Each spikelet is self-pollinating, producing two to three kernels (seeds) per spikelet. The beards are slender stiff, bristle-like extensions that protect the kernels. Long after the plant's lower leaves begin to die, photosynthesis continues in the beards, which extend beyond the kernels. This allows the kernels to continue growing and gaining weight as temperatures rise and moisture levels in the plant decrease.

During the winter and spring seasons, Kansas normally receives precipitation (either as snow or rain) that is needed by the growing wheat plants. As the growing plants produce seed, warmer temperatures and summer sunshine ripen the wheat, and the plants begin to dry out and stop providing nutrients to the seeds. The grain is ready to harvest when the seeds are mature and capable of producing the next crop of wheat and the stalks of the plants have dried down and can easily be cut, usually in June or July.

There are three classes of winter wheat produced in Kansas: hard red winter wheat, hard white wheat, and soft red winter wheat. Hard red winter wheat accounts for about 40 percent of the wheat grown in the United States and 95 percent of the wheat grown in Kansas. This wheat makes high-quality yeast breads and rolls. In contrast, only 4 percent of the wheat grown in Kansas is hard white wheat, a winter wheat that is used primarily for tortillas, hard rolls, noodles, and yeast breads. About 1 percent of the wheat grown in Kansas is soft red winter wheat. This wheat is grown in the eastern part of the state and used to make cakes, crackers, flat breads, and pastries.

Corn

Although Kansas is called the "Wheat State," Kansas farmers produce more bushels of corn than wheat each year. Like wheat, corn is a member of the grass family of plants. It is the most widely distributed crop in the world, grown on every continent except Antarctica.

An extremely versatile grain, corn can grow in tropical climates that receive up to 400 inches of rainfall a year or in areas that receive only 12 inches of rain annually. It can also grow in high altitudes or at sea level.

In the United States, corn is the number one crop, both in the number of acres planted and the cash value of the crop produced. Kansas is among the top 10 corn-producing states, but Kansas only accounts for less than 4 percent of the corn produced for grain in the United States.

Corn Kernels
Credit: Tim McCabe, USDA NRCS

Corn Plant
Credit: Rich Sanders, USDA NRCS

Wheat Classes

Although there are about 30,000 wheat varieties, all varieties are divided into six official classes of wheat. Class is determined by hardness, color of kernels, and by planting time. Each class of wheat has its own relatively uniform characteristics related to milling, baking, or other food uses.

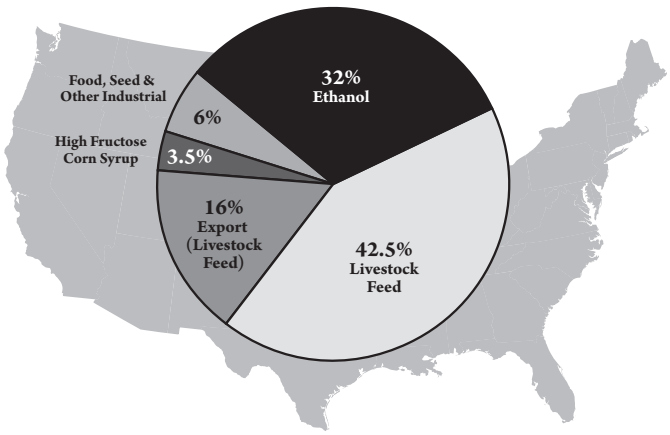
The six official classes of wheat are: Hard Red Winter, Hard Red Spring, Soft Red Winter, Durum, Hard White, and Soft White.

Source: Kansas Wheat

One Bushel Weighs

Corn	56 pounds	Wheat	60 pounds
Grain Sorghum	56 pounds	Oats	38 pounds
Soybeans	60 pounds	Barley	48 pounds
Sunflowers	27 pounds		

U.S. Corn Uses



Source: 2010 World of Corn, National Corn Growers Association

Corn is considered a "coarse grain" or a "feed grain" because more than 50 percent of the corn produced in the United States is fed to livestock. Although less than 9 percent of the U.S. corn crop is used for direct human consumption, thousands of food items contain corn or are made using some component of the corn kernel. For example, nearly 4 percent of the corn produced in the United States is made into high fructose corn syrup. Ethanol production now represents the largest industrial use of corn in the United States.

Corn History

Corn developed from a wild grass in central Mexico more than 7,000 years ago. Until American Indians shared their corn with Christopher Columbus, it grew only on the American continents. In fact, Columbus took corn kernels back to Europe with him when he returned to Spain.

The American Indians referred to corn as "maize," and relied on this crop as their main food. In fact, some tribes considered corn one of the "three sisters," along with beans and squash. As a result, many American Indian ceremonies and traditions emphasize the importance of corn.

Corn played a vital role for European settlers. In 1621, the Pilgrims at Plymouth Rock would have starved if the American Indians had not taught them how to grow corn. Corn became so valuable that early settlers traded corn with the American Indians for food and furs.

Understanding Maize

The scientific name for the plant commonly referred to as corn is *Zea mays*.

The term "maize" was first used by American Indians, and it is still used in many countries today, including the United Kingdom and Ireland.

Historically, the English used the term "corn" for any cereal crop, including wheat. Thus items crafted from wheat straw, known as wheat weavings in the United States, are known as "corn dollies" in England.

In the United States, some early varieties of grain sorghum were named "milo maize."

Corn was also the principal crop of early pioneers in Kansas. But after the development of horse-drawn machinery in the 1870s, which allowed the machine operator to ride rather than walk, growing wheat increased in popularity. At the time, corn still had to be picked by hand, while machines could cut, bundle, and thresh wheat.

Corn Harvest, Sheridan County, 1939

Source: Library of Congress; Russell Lee, photographer

Hybrid Seed

Hybrid seed is produced by controlling pollination and allowing only specific genes to be transferred to seed-producing plants. The result is a plant with specific characteristics, which is unable to produce seed for future plants with the same exact characteristics. Therefore, each planting requires the purchase of new seed.

Hybrid seed produces a crop that grows and matures at a uniform rate. Researchers have developed hybrids that are resistant to pests and diseases, use nutrients more efficiently, and produce more grain or plant material.

Between 1930 and 1945, corn production in the United States changed dramatically with the development of machinery that could harvest corn. At the same time, the development of hybrid seed corn made it possible to increase production while reducing the number of planted acres. According to the Kansas Agricultural Statistics Service, Kansas farmers went from producing 67 million bushels of corn on 7.1 million acres of land in 1930 to producing 95 million bushels of corn on 1.5 million acres in 1969.

Today, according to the U.S. Grains Council, the United States produces more than 40 percent of the world's corn crop. Corn production continues to grow to meet food and other consumer and industrial demands. Common items like toothpaste and windshield washer fluid use corn or corn components. Products made from cornstarch are also used in pharmaceutical and pet products, corn-based plastics and textiles, and food packaging materials.

Corn Harvest

Credit: USDA

Field Corn

The term "field corn" is used to describe corn grown for optimal kernel production. In Kansas, field corn is planted early in the spring (late March to mid-May). A corn plant grows a single stem, which is seven to 10 feet tall and topped by a tassel. The tassel produces pollen, caught by the silks on each potential kernel in each ear. While genetics usually determine the number of rows on each ear of corn, growing conditions determine the number of kernels in each row. On average, each corn plant produces one or two ears that have 16 rows with 800 kernels in each ear. Between 50 to 60 days after pollination, the kernels will have filled and the grain and plants begin to lose moisture and dry down to an acceptable moisture

Corn Field
Credit: Mary Anne Stoskopf

Corn Tassel
Credit: USDA

Pollen on Corn Tassel
Credit: National Corn Growers Association

level for harvest. In Kansas, corn harvest usually begins in August and may continue into October or November.

Field corn may be harvested as corn silage, a process during which the whole corn plant is cut and chopped into small pieces while it is still growing, then packed tightly in a storage area where the plant materials ensile (ferment) and produce a sweet-tasting, easily digestible livestock feed.

Developing Corn Ears
Credit: Mary Anne Stoskopf

Dent corn is the most important commercial corn grown in the United States. Dent corn is characterized by distinctive indentations on both sides of the kernels, which form when the corn is mature and ready for harvest. Although the kernels have a hard seed coat (outer layer), the inner starchy layer (endosperm) is relatively soft and easily grinds into a powder.

Yellow dent corn is the principal type of corn grown in the United States. This grain is rich in nutrients, containing high amounts of carotene (vitamin A). Most of the corn grown in Kansas is yellow dent corn, although some white dent corn is also grown here, primarily for food uses. Other types of corn grown in Kansas include sweet corn and popcorn, but both are considered specialty food crops rather than grains.

Corn Ears (Harvested)
Credit: Alice Welch, USDA

Silage

To produce silage, corn or sorghum plants are harvested while the plants are immature (still growing). During the harvesting process, whole plants are chopped into small pieces, then transported to a storage area where they are packed tightly so that the plant material will ensile (ferment). The result is a sweet-tasting, easily digested livestock feed.

Grain Sorghum

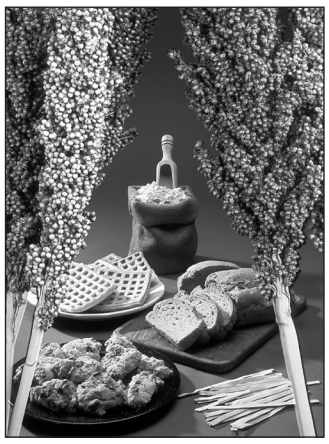
In 1942, sorghum was considered the Kansas crop best suited to meet the state's needs for feed and grain. Today, the largest producer of grain sorghum in the world is the United States, and Kansas alone produces about 50 percent of the U.S. grain sorghum crop. In the United States, grain sorghum, also called milo, is primarily a feed grain. For many years, more than 80 percent of the grain sorghum produced in Kansas was fed to livestock because its feed value is similar to that of corn. Grain sorghum has more protein and fat than corn, but is lower in carotene (vitamin A).

However, in many other countries, grain sorghum is considered a cereal grain. Grain sorghum is the fifth most important cereal grain in the world behind rice, wheat, corn, and barley. Worldwide, people and livestock consume nearly equal amounts of grain sorghum. Food sorghums (for human consumption) are specific varieties of grain sorghum that produce a white berry used to make white flour. In contrast, the red, bronze, and yellow grain sorghums commonly grown in Kansas and some varieties of cream-colored grain sorghums are considered feed grains rather than food-grade sorghums.

Industrial uses of grain sorghum, especially ethanol production, continue to rise. According to the United Sorghum Checkoff Program, 30 to 35 percent of the grain sorghum produced in the United States in 2010 will be used to produce ethanol. [3]

Grain Sorghum Plants
Credit: High Plains Journal

Grain Sorghum Seeds
Credit: Stephen Ausmus, USDA ARS

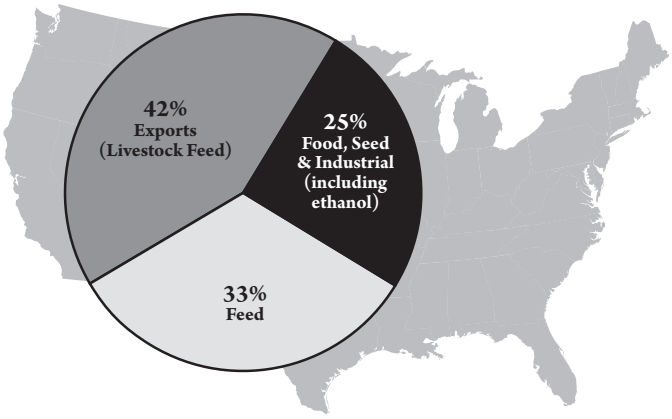


Grain Sorghum Foods
Credit: Stephen Ausmus, USDA ARS

Gluten-free

Because grain sorghum does not contain gluten, sorghum food products can play an important role in the diets of people who cannot eat foods containing gluten.

U.S. Grain Sorghum Uses



Source: USDA Economic Research Service

Sorghum History

Sorghum is a grassy plant native to Africa. From there, sorghum plants spread into India, China, and eventually Australia. Sorghum was brought to the United States in the late 1700s but sorghum production was not widespread in the United States until the 1850s. At that time, the U.S. government imported sorghum seeds from France and South Africa to support research into sweet sorghum as an alternative source of sweetener. By the 1950s, however, most of the sweet sorghum grown in the United States was grown for forage (livestock feed).

Kafir Corn, 1938
Source: Library of Congress; Russell Lee, photographer

Grain sorghum has been called by many names, none of which are commonly used today: African millet, Egyptian corn, milo maize, durra, kafir corn, rice corn, and Jerusalem corn.

In the early 1900s, the Agricultural Experiment Station at Hays, now known as the Kansas State University Agricultural Research Center – Hays, was the leader in grain sorghum research in Kansas. The first grain sorghum variety developed at the Hays Experiment Station was Pink kafir, which was sold to growers beginning in 1909 and was one of the most valuable grain sorghum varieties for many years.

Beginning around 1920, researchers responded to changes in harvesting equipment by developing shorter plants that could be harvested by combines, rather than by the earlier labor-intensive techniques of cutting, bundling into shocks, and threshing or feeding later. The development of hybrid seed resulted in hundreds of hybrid grain sorghum varieties with improved yields, disease resistance, pest resistance, and stronger, shorter stalks. Research has also produced grain sorghum varieties with different rates of maturity, especially important in Kansas because the average length of the growing season varies greatly from one side of the state to the other.

Sorghum Shocks, 1938
Source: Library of Congress; John Vachon, photographer

Ethanol Facts

Grain sorghum and corn are interchangeable in the production of ethanol.

One bushel of grain sorghum will produce as much ethanol as one bushel of corn.

Approximately one-third of the grain used in ethanol is later used as distillers grains, a high-nutrient livestock feed.

Grain Sorghum

Grain sorghum is one of the most important dryland crops grown in the area stretching from Texas to South Dakota. Individual grain sorghum plants have a unique ability to "wait" for precipitation. In other words, as the soil dries out and the plant does not have access to water, a sorghum plant will begin to shut down growth and seed production. Once it rains, the plant will jump-start its growth and seed production cycle. This characteristic is especially important in areas where rainfall is low or erratic.

In Kansas, grain sorghum is planted in late May or early June. A single plant can produce more than one stalk. Each stalk produces a single head, and 750 to 1,250 seeds form on the head. When the seeds ripen and turn hard, the grain is ready to harvest. In Kansas, grain sorghum is harvested in the fall, between September and the end of November. However, grain sorghum is a perennial plant, meaning the plant remains green and alive after producing grain until it is killed by freezing temperatures, tillage, or herbicides.

Grain Sorghum Head
Credit: High Plains Journal

Although grain sorghum is the predominant sorghum grown in Kansas, the state also produces other types of sorghum. Grassy sorghums, like sudangrass, are grown for feed and hay. In contrast, sweet sorghums are grown to make sorghum syrup and molasses. Yet another type of sorghum, broomcorn, is grown for the branches and fibers of the seed clusters.

Grain Sorghum Field
Credit: High Plains Journal

Kansas Broomcorn

In the late 1800s and early 1900s, broomcorn was a very important crop in Kansas. In fact, Kansas broomcorn was shipped all over the world. Some years, Kansas produced more than twice as much broomcorn as any other state. Liberal, Kansas was even considered the largest broomcorn market in the United States.

Broomcorn
Source: Library of Congress; Russell Lee, photographer

Groat

The inner kernel of an oat seed is called the groat.

Oat and Barley Foods
Credit: Peggy Greb, USDA ARS

Oats

Oats, another grain that is a member of the grass family of plants, are grown in nearly every state in the United States. In states like Kansas, oats are usually grown as a feed grain (typically swathed and baled) or as forage (grazed directly by livestock). Food uses consume less than 5 percent of the oats produced in the United States.

Oats are thought to have originated in Asia, but much later than wheat. In the 1600s, European colonists brought oat seeds to North America, where it became an important agricultural crop. By 1887, more than one million acres of oats were planted and harvested in Kansas. However, after tractors and mechanized equipment were introduced, farmers moved away from horse-drawn machinery. As a result, the need for oats to use as horse feed was greatly reduced. In fact, 1957 was the last year Kansas producers planted or harvested more than one million acres of oats.

Oat Foods
Credit: Peggy Greb, USDA ARS

Typically, the Kansas oat crop accounts for less than 0.2 percent of the harvested acres in Kansas. Even so, the Kansas oat crop was valued at $3.8 million in 2009. [4]

Spring Oats

Oats are best adapted for cool, moist climates. In both the United States and Kansas, spring oats are the most common type grown. Spring oats are planted from late February through April because the plants need to mature early enough to produce grain before summer. Growing between two and four feet tall, oat plants produce a large, loose branching pyramid-shaped cluster of flowers at the tips of the multiple stems. The seeds grow along the branches of these flower clusters and are high in minerals and several vitamins.

Oat Plant
Credit: Doug Wilson, USDA ARS

Barley

Like other cereal grains, barley is an annual plant belonging to the grass family.

Barley is one of the world's leading cereal grains, ranking only behind rice, wheat, and corn. Today, according to the U.S. Grains Council, 66 percent of the barley produced in the United States is consumed in food and industrial uses, primarily the production of malt beverages. In the United States, as a feed grain, barley ranks third behind only corn and grain sorghum. [5]

Barley Plants
Credit: Jack Dykinga, USDA ARS

There are three types of barley: spring, winter, and malting. Winter barley requires cold weather to produce a head that fills with grain. Winter barley matures earlier in the spring than spring barley, which may not mature before the weather turns hot and dry in Kansas. Malting barley, a type of barley used for brewing

The Fertile Crescent

The Fertile Crescent was an area of land suitable for growing crops that stretched from the southeastern coast of the Mediterranean Sea around the Syrian Desert north of the Arabian Peninsula to the Persian Gulf.

The rich soil and half-moon shape of the area led to the name "Fertile Crescent." The climate encouraged the domestication of plants and animals, a key step in the development of human civilization. This agricultural revolution made it possible to increase food supplies and allowed nomads and cave dwellers to become farmers and herders. Cattle, goats, sheep, and swine – four of the most important species of domesticated animals – originated in the Fertile Crescent. The direct ancestors of eight plants – emmer wheat, einkorn, barley, flax, chickpea, pea, lentil, and bitter vetch – also originated in the Fertile Crescent.

The Fertile Crescent included two geographical areas: Mesopotamia on the east and the Mediterranean on the west.

Barley Heads
Credit: Doug Wilson, USDA ARS

Grains of Rice
Credit: Keith Weller, USDA ARS

Rice
Credit: USDA NRCS

beverages such as beer and whiskey and in certain food products like cake mixes and breads, requires cooler temperatures and bright sunshine to produce high quality grain. In Kansas, the weather rarely allows the production of high quality malting barley.

Barley is one of the world's oldest cultivated cereal grains. Wild barley was domesticated in the "Fertile Crescent" about the same time as wheat – around 10,000 years ago. Barley was introduced in North America in the 1600s by colonists on the East Coast, as well as in the southwest by Spanish missionaries.

Historically, most of the barley grown in the United States was used as animal feed. Today, most of the barley grown in the United States is grown as malt barley, mainly used to produce beer.

Winter Barley

Barley is classified according to the number of rows of grain on each head. The most commonly grown barley in Kansas is six-row winter barley.

At first glance, a field of barley resembles a field of wheat. As a feed grain, winter barley is planted from September through mid-October and harvested the following summer, similar to winter wheat. The stages of plant development in barley are similar to those of wheat and other cereal grains. However, there are differences. Barley can be grown in soils with a higher soil pH than wheat will tolerate. Barley can also grow with less moisture than wheat, but it is less tolerant of winter conditions than wheat. Barley plants are also more prone to lodging (stalks falling over) than wheat. Additionally, barley seeds are larger than wheat seeds but weigh less. These hard seeds must be cracked or ground before they can be fed to livestock.

In Kansas, winter barley is also grown for silage or for late fall or early spring pasture. As pasture, barley should be grazed before the seed heads emerge as some barley varieties have sharp, stiff pointed bristles (awns) at the tips of the seeds that can cause sores in an animal's mouth or digestive tract.

Winter Barley
Credit: Bill Scruggs, USDA ARS

Rice

After wheat, rice is the most widely consumed cereal grain in the world. More than 3 billion people rely on rice as their major source of food, according to the International Rice Research Institute.

Most cultivated varieties of rice belong to a species of rice with origins at the feet of the Himalayan Mountains. Today, 90 percent of the world's rice is produced and consumed in Asia. [6] In the United States, six states are the main rice producers: Arkansas, Texas, Louisiana, Mississippi, Missouri, and California.

Rice is a semiaquatic member of the grass family of plants, typically grown as an annual plant. A flowering head grows on each main upright stem, and the grains of rice grow on bunch-like spikes that arch and hang down. Because the seedlings grow while submerged in water, rice requires more water to produce than other grains. In tropical climates, rice may be harvested two to four times a year, but in the United States, producers plant and harvest only one crop each year.

Biotech Rice

Rice was the first crop to have its entire genetic code sequenced (mapped). This genetic map allows researchers to develop new rice varieties quicker, including varieties adapted to produce high yields under harsh growing conditions in places like Africa. It also allows researchers to add genes to rice to increase levels of nutrients like beta-carotene in order to address major health issues, especially for poor children in developing countries. For example, 125 million children worldwide suffer from vitamin A deficiency, the leading cause of preventable blindness in children. Because the human body converts beta-carotene into vitamin A, researchers have developed a variety of rice called "Golden Rice," that produces beta-carotene and stores it in the grain's endosperm. After more than a decade of research, the Golden Rice variety will be released for planting in 2011.

The second leading cause of death in children worldwide is diarrhea, contributing to two million deaths each year. However, new rice research may have a solution. Under strict regulation by the U.S. Department of Agriculture, a new bioprocessing facility for plant-made pharmaceuticals is using rice plants as biofactories to produce proteins that can be extracted and used to treat infants with diarrhea. This project is based out of Junction City, Kansas.

Golden Rice

The Golden Rice variety of rice will be released for planting in 2011 after more than a decade of research by the inventors – Ingo Potrykus, Swiss Federal Institute of Technology, Zurich, and Professor Peter Beyer, University of Freiburg, Germany. This rice variety produces beta-carotene in the grain's endosperm, which the human body then converts into vitamin A.

Worldwide, vitamin A deficiency is the leading cause of preventable blindness in children. Since rice is the major source of food for more than 3 billion people, researchers anticipate that fewer children will become blind once Golden Rice is produced around the world.

Golden Rice Research
Credit: Michael A. Grusak, USDA ARS

Source: Golden Rice Humanitarian Board

Oilseeds

Sunflower Head
Credit: National Sunflower Association

Many plants produce seeds that are rich in oil, an energy source that nourishes plant seedlings in early stages of growth. These plants are called oilseeds because the oil is extracted primarily from the seeds, rather than other parts of the plant. The most important oilseeds worldwide include soybeans, rapeseed, cottonseed, peanuts, sunflower seeds, coconut, and palm kernel. In some crops, such as corn, cotton, and flax, the oil produced by the seeds may be a coproduct of processing, but the oil is not the main reason for growing the crop.

Oilseeds produce both edible and inedible oils, although almost all crude oil extracted from oilseeds must be processed in some way before it can be considered edible. Oils are consumed directly, used as ingredients in food, and heated to cook other foods.

Sunflower Oil
Credit: National Sunflower Association

Extraction, or crushing, is the process by which oil is obtained from a seed. Mechanical extraction involves physically squeezing oil out of intact (whole) seeds that have been heated or cooked. In contrast, solvent extraction starts with removing the hulls from the seeds. Then, the meat of the seeds is flaked, or heated and softened before passing through pairs of rollers that flatten it down a uniform thickness of 10-12/thousandths of an inch. Next, an organic solvent percolates through the seed "flakes," producing an oil-solvent solution. Finally, the solvent is removed from the solution, leaving behind the end product – oil. Solvent extraction is particularly useful for extracting oil from seeds with a low oil content (less than 20 percent).

A high-protein residue called "meal" also remains after oil is extracted from oilseeds. This coproduct is a valuable livestock feed.

Oils from different plants have different characteristics that help determine their uses. For example, corn oil is one of the most common and inexpensive cooking oils, while cottonseed is a major food oil used in industrial food processing. By using the term "vegetable oil" on a product label, a food manufacturer can substitute or combine oils without having to change the label.

Oils vs. Fats

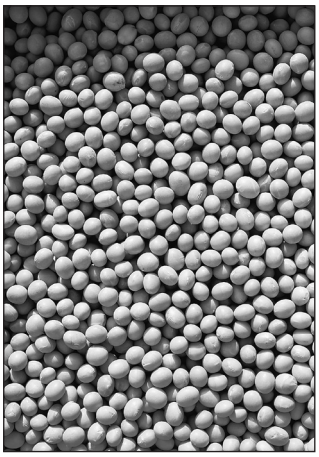
One difference between oils and fats is that oils remain liquid at room temperature, while fats are generally solid at room temperature.

Soybeans

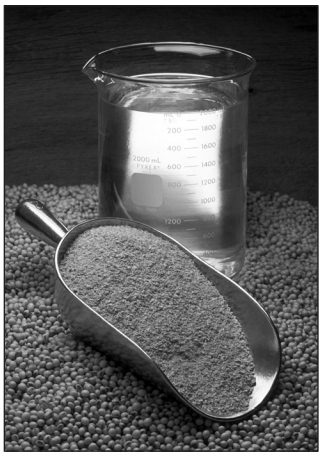
The United States leads the world in both soybean and soybean oil production. In all, soybeans account for about one-half of the world's edible oil production.

In the United States, the soybean processing industry began mechanically extracting oil from soybeans in the early 1900s, but moved to the solvent extraction process in the late 1940s and early 1950s. Today, solvent extraction is used to extract the oil in nearly all the soybeans processed in the United States.

Soybean oil (soy oil) is the most widely used vegetable oil in the world. Nearly all of the soy oil produced in the United States is used in salad and cooking oil, bakery shortening, frying fat, and margarine. Soy oil is also used in plastics, printing inks, lubricants, solvents, crayons, textiles, and biodiesel. In the United States, soybeans are grown in more than 30 states, including Kansas.

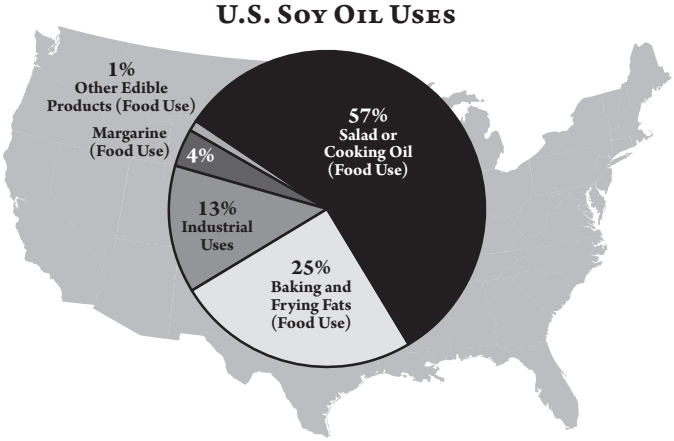


Soybeans
Credit: Lynn Betts, USDA NRCS



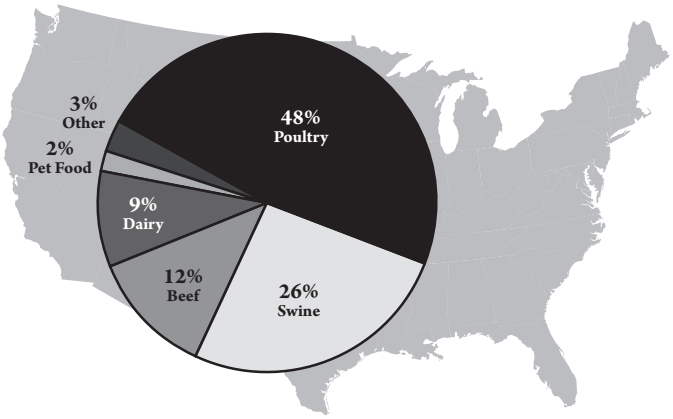
Soy Oil
Credit: Kansas Soybean Commission

U.S. Soy Oil Uses



Source: American Soybean Association

U.S. Soybean Uses for Animal Feed



Source: American Soybean Association

Soybean History

Soybean plants were likely domesticated somewhere in northern China, possibly during the Shang dynasty (1500-1100 B.C.). Chinese records suggest that Chinese emperors sowed soybeans yearly during ceremonies. These were such significant events that poets wrote about the importance of the crop to Chinese civilization. From there, trade missions spread the seeds throughout China and Asia, establishing soybeans as an important crop in other Asian countries, like Japan, as well.

Soybean Seedlings
Credit: Tim McCabe, USDA NRCS

In the United States, the first soybeans were planted in 1765 on a plantation in Georgia. At first, the soybean plants were harvested for hay and the remaining crop residue was tilled into the soil for use as fertilizer for future crops. The colonists did experiment with soy products, even exporting soy sauce and soy noodles to England prior to the Revolutionary War.

Soybean Plants
Credit: Tim McCabe, USDA NRCS

In the Midwest, the first soybeans were planted in gardens rather than crop fields. In 1851, soybeans were first planted in gardens in Illinois, followed by plantings in Ohio and Iowa in 1852. In the late 1800s, soybeans became popular as a forage crop for livestock. Then, in the early 1900s, George Washington Carver discovered that soybeans were a rich source of protein and oil. Carver researched potential food and industrial products using soy protein and soy oil, including a biodiesel fuel product.

Soybeans became popular in the southern states as a crop alternative to cotton. In 1904, the crop was introduced in Kansas when the Kansas State Agricultural College Experiment Station in Manhattan offered free soybean seed to farmers. [7] However, the Kansas State Board of Agriculture did not begin tracking the state's soybean production until 1924.

During World War II, U.S. food processors were forced to rely on domestically-produced soy oil after imports of other edible fats and oils were disrupted. In the early 1950s, the availability of soybean meal as a low-cost, high-protein feed ingredient triggered an expansion in livestock and poultry production. Today, the U.S. poultry industry consumes nearly 50 percent of all the soybean meal produced in this country.

The Soybean Plant

The soybean plant grows in a bushy shape, rather than with straight stalks like wheat, corn, or grain sorghum. The soybean plant is a legume, which means the growing plant produces and deposits nitrogen into the soil through its root system. The next crop in the same field can use this stored nitrogen when it begins growing.

Soybean Field
Credit: Dave Warren, USDA

Soybeans are usually planted in late spring, although planting soybeans into wheat stubble immediately following wheat harvest is a common practice in Kansas. Over the summer, each soybean plant can produce 60 to 80 pods, and each pod holds three seeds (soybeans). Inside the soybean pods, seeds develop as green seeds, but as the soybeans mature, both the soybeans and the pods change in color to cream or light brown. As the plant nears harvest, the leaves dry up and drop off. In Kansas, soybeans are harvested between September and November.

No-till Soybeans in Wheat Stubble
Credit: USDA NRCS

Soybeans Ready for Harvest
Credit: Scott Bauer, USDA ARS

Soybean Size

An individual soybean is slightly larger than a pea.

Soybean Pods
Credit: Minnesota Soybean

Soybeans
Credit: Minesota Soybean

Pod with Soybeans
Credit: Scott Bauer, USDA ARS

Soybean plants are sensitive to changes in day length, which determines when the plants transition into the reproductive phase and begin producing seed. During the summer, horizontal bands (regions) with similar day length run east to west across the United States. Each band is about 100 to 150 miles in width (north to south). Soybean varieties are assigned a maturity group number corresponding to a particular region (horizontal band), ranging from 00 (northernmost North Dakota and Minnesota) to VIII (southernmost Florida). Soybeans planted in Kansas typically correspond to one of three maturity groups: III (northern Kansas and irrigated cropland throughout the state), IV (the southern two-thirds of the state), and V (southeastern Kansas).

Sunflowers

Sunflower Kernels
Credit: National Sunflower Association

Although the United States does not lead the world in sunflower or sunflower oil production, sunflowers are still an important agricultural crop both in the United States and in Kansas. North Dakota and South Dakota are the leading sunflower-producing states, followed by Kansas. Russia, Ukraine, the European Union, and Argentina lead the world in the production of both sunflower seeds and sunflower oil.

There are two types of sunflowers: oilseed and non-oil (confection). Oilseed sunflowers, which account for about 97 percent of the sunflowers grown in Kansas, produce seeds that are shiny, black, and smaller than the seeds of non-oil sunflowers. Non-oil sunflowers produce black-colored seeds with white stripes that are approximately five-eighths of an inch long. The largest non-oil seeds are sold intact for sunflower seeds, an American original! The hulls (shells) are usually removed from the medium-sized seeds, which are sold as sunflower kernels and used in food products ranging from snacks to breads. The smallest seeds are sold for birdseed and pet food.

Sunflower Seeds

Oilseed sunflowers – small, shiny black seeds; produce oil for baking, frying, and food products.

Non-oil (confection) sunflowers – black-colored seeds with white stripes, approximately 5/8 inch long; produce seeds for baking, eating, birdseed, and pet food.

Seed Comparison:

(left) Non-oil seeds
(right) Oilseeds
Source: National Sunflower Association

Sunflower
Credit: National Sunflower Association

Non-oil Sunflower Seeds
Credit: National Sunflower Association

Sunflower History

Sunflowers are native to Central America, where the sunflower held a place of honor in the Aztec culture. From Central America, the domestication of sunflowers spread north and east. American Indians grew and used sunflowers in many ways – for food, dyes, building materials, and medicinal purposes.

In the 1500s, Spanish explorers carried sunflower seeds back to Europe, where the sunflower became an ornamental garden plant.

Native Sunflower
Credit: Kansas Wheat Commission

The State Flower of Kansas

An act of the Kansas legislature, approved by Governor Bailey on March 12, 1903, named the sunflower as the official state flower.

73-1801. State flower and floral emblem. WHEREAS, Kansas has a native wild flower common throughout her borders, hardy and conspicuous, of definite, unvarying and striking shape, easily sketched, moulded, and carved, having armorial capacities, ideally adapted for artistic reproduction, with its strong, distinct disk and its golden circle of clear glowing rays -- a flower that a child can draw on a slate, a woman can work in silk, or a man can carve on stone or fashion in clay; and

WHEREAS, This flower has to all Kansans a historic symbolism which speaks of frontier days, winding trails, pathless prairies, and is full of the life and glory of the past, the pride of the present, and richly emblematic of the majesty of a golden future, and is a flower which has given Kansas the world-wide name, "the sunflower state": therefore,

Be it enacted by the Legislature of the State of Kansas: That the helianthus or wild native sunflower is hereby made, designated and declared to be the state flower and floral emblem of the state of Kansas.

State Flower Credit: Kendra Goering

Source: Kansas Statutes

Although some experimentation with oil extraction took place in England in the 1700s, the sunflower was not recognized as a food plant until it reached Russia, sometime before 1800. By 1830, sunflower oil was being commercially manufactured in Russia. When the Russian Orthodox Church left sunflower oil off the list of foods prohibited from being consumed during Lent, sunflower oil became even more popular. Plant breeders in Russia developed the first sunflower hybrids, which produced single-headed sunflower plants with large heads.

Following the Sun

Heliotropism – the action of plants, such as sunflowers, following the sun from east to west during the day and returning to the east each morning.

Opening Sunflower
Credit: National Sunflower Assn.

Argentina started producing sunflowers in the 1870s and became the world's second largest producer of sunflower oil after the Spanish Civil War of the 1930s created a shortage of olive oil imports.

The sunflower industry in North America took longer to develop. Canada started an official government sunflower breeding program in 1930. In the United States, farmers in North Dakota and Minnesota began growing sunflowers in the 1950s.

Russian and German immigrants probably carried sunflower seeds into states like Kansas when those states were opened for settlement in the 1800s. However, sunflowers did not become a major agricultural crop in Kansas until the late 1970s. At that time, the demand for sunflower oil in Europe exceeded the available supply from the traditional supplier, Russia. As a result, agricultural producers in the United States, including Kansas, expanded sunflower production and exported the additional sunflower oil to Europe.

Today, among the 50 states, Kansas ranks third in the production of sunflowers, acres of sunflowers harvested, pounds of oilseed sunflowers produced, and acres of oilseed sunflowers harvested. Kansas also ranks sixth in the pounds of non-oil sunflowers produced.

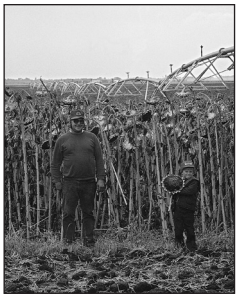
The Sunflower Plant

Native Kansas Sunflowers
Credit: Douglas S. Helmke, KRWA

Sunflowers are unusual because the plants follow the sun as it moves across the sky from east to west each day and return to the east each morning, an action called heliotropism. This activity continues until the growth stages where the closed buds open up, the "flowers" appear, and pollination takes place. Then the stems stiffen and the sunflower heads always face east. Eventually, the sunflower heads become heavy as the seeds fill. As a result, the heads may turn so that they face the ground.

Today's cultivated sunflower plants are generations removed from native sunflower plants that produce multiple heads but do have similar drought and heat tolerances. Cultivated sunflowers are grown from hybrid seed that must be purchased each year. Each seed grows a single stalk with one sunflower head. In Kansas, sunflowers are planted in late May or early June and harvested in September or October. Once the sunflower seeds are mature, a chemical may be applied to the plants to remove the moisture from the stalks and leaves in a process known as desiccation.

Cultivated Sunflowers
Credit: Edward McCain, USDA ARS



Mature Sunflower Crop
Credit: National Sunflower Association

Harvesting Sunflowers
Credit: National Sunflower Association

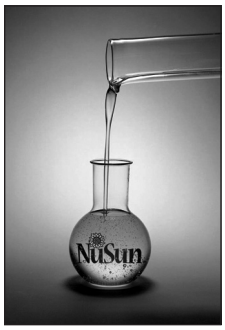
Sunflower Head
Credit: Bruce Fritz, USDA ARS

Oilseed Sunflowers

Over the years, sunflower research programs developed single-headed, large-seeded plants and varieties with high oil content. Today, the oil content of an intact oilseed sunflower seed is more than 42 percent. There are five sunflower crushing plants in the United States, including one in Goodland, Kansas, that uses both mechanical and solvent extraction processes to produce sunflower oil.

There are three different kinds of oilseed sunflowers, each producing an oil with distinctive qualities. According to the National Sunflower Association, 85 to 90 percent of the oilseed sunflowers planted in the United States are NuSun® varieties. Sunflowers producing lineoleic sunflower oil (the traditional sunflower oil) and high-oleic sunflowers (usually grown only as needed by specific customers) split the remaining sunflower production in the United States.

NuSun® varieties were developed through an initiative to change the chemical structure of sunflower oil to produce oil lower in saturated fats. This allows food processors to produce fried foods with better flavor and a longer shelf life. NuSun® varieties produce oil that does not require hydrogenation, meaning no trans fatty acids (trans fat) are produced. Current dietary guidelines recommend keeping the consumption of trans fat, often found in fried or processed foods, as low as possible, and the U.S. Food and Drug Administration requires trans fat content to be listed on nutrition facts labels for food products.



Sunflower Oil
Credit: National Sunflower Association

Hydrogenation

Hydrogenation is a process used in food processing to convert liquid oils into solid or semi-solid fats, like those present in margarine or shortening. One result of this process is an alteration in the molecular structure and the physical properties of the fat, such as the melting point or mixing properties.

Partially hydrogenated fats are the predominant fats used in most commercial baked goods.

Cotton

China, the United States, India, and Pakistan are the leading producers of the world's cotton, which is a perennial plant in its native tropical habitat. In the United States, cotton is grown as an annual plant in the Cotton Belt, the name given to the southern tier of states where cotton is grown. Kansas is one of the17 states in the Cotton Belt that stretches from Virginia to California, but production in Kansas is limited to the lower third of the state.

Raw Cotton
Credit: Peggy Greb, USDA ARS

Cotton Field
Credit: David Nance, USDA ARS

Cotton and soybeans compete for crop acreage in many states. In 2009, higher anticipated economic returns for soybeans led to the lowest number of acres planted to cotton in the United States since 1983.

Cotton History

Evidence exists that cotton was cultivated in both the Western and Eastern hemispheres around the same time period, roughly 5,000 to 7,000 years ago. Around 800 A.D., Arabian merchants introduced cotton to Europe. However, wool and flax remained the chief fabrics in Europe and the Western world until the 1780s, mostly because only the wealthiest people could afford cotton fabrics imported from India. Also, at one time, it was against the law to import or manufacture cloth made from cotton fibers in an effort to protect the wool industry in England.

Cotton Plant
Credit: Scott Bauer, USDA ARS

Upland cotton is native to Mexico and Central America. In the early 1500s, two Spanish explorers found cotton growing in the New World – Hernando Cortez in Mexico and Christopher Columbus in the West Indies. Additionally, Coronado observed American Indians growing cotton in the 1540s, during his two-year expedition that crossed Kansas.

In 1607, early colonists in Jamestown, Virginia planted cotton. The American colonists could grow cotton, but lacked the machinery and skills to process the fibers into cloth until the late 1700s. Even after the American Revolution, England controlled the textile industry. That country went so far as to prohibit anyone from England familiar with textile machinery from moving to another country. However, Samuel Slater disguised himself as a farmer in 1793, came to the United States, and built the machinery for the first successful cotton yarn mill in this country from memory. Also in 1793, Eli Whitney invented the cotton gin, the first machine to mechanically separate the cotton fibers from the cottonseed. By the 1850s, the United States was producing three-quarters of the world's supply of cotton, most of which was shipped to the New England states or England to be turned into cloth. [8]

Cottonseed and Lint
Credit: K-State Research and Extension

Until 1857, cottonseed was an undesirable coproduct of the cotton ginning process. One reason was because of the linters, the short fibers that remain attached to the seed after ginning. The invention of machinery that removed linters and hulls from the seed kernels finally made processing cottonseed economically feasible.

Cotton was harvested by hand until a picking device was patented in 1850. An experienced picker could pick about 450 pounds of cotton a day. However, in the early 1930s, a mechanical cotton picker was invented that could pick approximately 8,000 pounds of cotton a day.

Kansas settlers were experimenting with growing cotton when the Civil War disrupted cotton production in the traditional cotton-growing states. Then, cotton production dropped from the 200,000 acres harvested in Kansas in 1888 to only three acres in 1910. As a result, the Kansas State Board of Agriculture stopped tracking cotton production. In 1982, cotton made a comeback in Kansas. In fact, four cotton gins have been built in Kansas at Winfield, Anthony, Cullison, and Moscow since 1998.

The Cotton Plant

As a perennial plant, cotton produces vegetation (leaves) and fruiting structures (fruiting branches, flower buds, blossoms, and bolls) at the same time. A cotton plant has one main stem from which the branches develop. The flower buds, called squares, develop into self-pollinating blossoms that wither and fall off the plant's branches as the bolls, which look like green pods, develop. Inside the bolls, the newly fertilized seeds begin to produce fibers called lint, which lengthen and thicken over time.

No-till Cotton Plant
Credit: Larry Rana, USDA

Cotton Plant Flower
Credit: USDA NRCS

Cotton Boll
Credit: USDA NRCS

Cotton Square
Credit: USDA NRCS

Once the cotton boll is mature, it begins to dry out and the green exterior coat of the boll cracks open, exposing white puffy fibers.

Each boll contains about 32 seeds, from which the cotton fibers grow. One pound of cotton can contain 100 million or more individual fibers. Even so, a cotton plant produces more cottonseed than it does fiber – twice as much!

Cotton Oil
Credit: National Cottonseed Products Assn.

Three products are produced from cottonseed – oil, meal, and hulls. The most valuable of these three products is cottonseed oil. In fact, cottonseed oil dominated the U.S. market for vegetable oil until the 1940s, when World War II caused domestic cottonseed oil shortages. As a result, food processors turned to soy oil instead. Today, one-third of the cottonseed oil supply in the United States goes into snack food production, used in preparation of crackers, cookies, chips, and other snack foods.

The growing season for cotton in Kansas is relatively short. Cotton is planted in May or early June. Early maturing varieties, reaching maturity in 120 days rather than the 180 to 200 days common in more southern states, have been developed for areas like Kansas where an early freeze is not uncommon during the fall.

Unlike many Kansas crops, cotton may be left standing in the field for weeks without being damaged before it is harvested. Cotton is harvested by machines that cut down the entire plant and separate the cottonseeds from other plant materials or by machines that strip (pull) the bolls from the plants. The cotton is collected and compressed into large blocks, called modules, covered with tarps, and stored at the edge of the field until the modules can be transported to a cotton gin. At the cotton gin, the lint is separated from the cottonseed, cleaned, and packed into bales.

Two types of cotton are grown in the United States: Pima cotton and upland cotton (also known as American upland cotton).

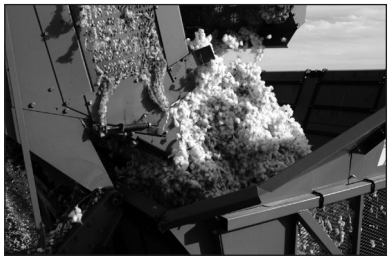
Cotton Facts

One pound of cotton can contain more than 100 million individual fibers.

A cotton plant produces more cottonseed than it does fiber – twice as much!

Kansas Cotton Harvest

Stripper Harvester
Credit: Tom Morton



Dumping Cotton into Boll Buggy
Credit: Tom Morton

From Boll Buggy into Module Builder
Credit: Tom Morton

Building a Cotton Module
Credit: Tom Morton

New Cotton Module (above)
Credit: Tom Morton

Tarped Cotton Module
Credit: Gary Kramer, USDA NRCS

Raw and Ginned Cotton
Credit: USDA ARS

Kansas Cotton
Credit: Tom Morton

Bale of Cotton

Each cotton bale weighs 480 pounds. It takes about 2,350 pounds of cotton to produce a 480-pound bale of cotton lint (long cotton fibers).

Credit: Ken Hammond, USDA

Source: National Cottonseed Products Association

Upland Cotton

Upland cotton, the type of cotton grown in Kansas, accounts for about 96 percent of all cotton production in the United States. The variety determines the thickness of each seed's coat (hull) and the strength of the fiber's attachment to the seed's coat. Today's upland cotton varieties produce fibers that are longer, whiter, finer, and stronger than in past years. For example, upland cotton fibers range in length from 7/8 to 1 5/16 inches, while Pima cotton fibers range from 1 1/4 to 1 9/16 inches long.

The petals of the flower blossoms that form on upland cotton are white or cream-colored, rather than yellow like Pima cotton blossoms. After upland cotton blossoms are pollinated and the seeds are fertilized, the flower petals briefly turn pink before falling off the plant.

Biotech Cotton

Modern technology allows plant breeders to make precise genetic changes to address disease, insect, or environmental challenges more rapidly than traditional plant breeding methods. The technology used by plant breeders to add beneficial traits to plants is called agricultural biotechnology, or biotech. Biotech cotton varieties fall into two categories: insect resistant and herbicide tolerant. Both traits improve yields, while addressing environmental concerns. According to the U.S. Department of Agriculture's Economic Research Service, 88 percent of the cotton grown in the United States in 2009 had biotech traits.

Biotech cotton first became available for cotton production in

Cotton Bollworm
Credit: Scott Bauer, USDA ARS

the United States in 1995. Some biotech cotton varieties protect cotton plants from specific harmful insects, reducing the need for insecticides and benefiting both agricultural producers and the environment. For example, a protein from a common soil microorganism, *Bacillus thuringiensis*, is toxic to specific caterpillars that harm or kill cotton plants. The gene responsible for producing the toxin can be inserted into the genes of cotton, corn, or soybean seeds – protecting the plants from damage by those specific caterpillars without otherwise altering the plants.

Agricultural biotechnology has produced other cotton varieties that are resistant to herbicides, allowing cotton producers to eliminate weeds without harming the cotton plants. This reduces the amount of trash – stems, leaves, or weed seeds – in harvested cotton, making the cotton fibers easier to clean during processing (ginning) at the cotton gin. Clean cotton is worth more per pound than trashy cotton.

Canola

Canola is a specific oilseed plant developed by researchers in Canada from another plant – rapeseed. Both canola and rapeseed are members of the mustard family of plants.

Canola Seeds
Copyright: Monsanto Company

North Dakota produces more than 90 percent of the canola oil produced in the United States. More than 80 percent of the canola oil consumed in the United States is actually imported from Canada and Europe, according to K-State Research and Extension.

Canola Plants
Credit: Bob Nichols, USDA

The first true canola variety was released in 1974. The U.S. Food and Drug Administration approved canola varieties meeting specific requirements for human consumption in 1985. In the United States, as Americans were urged to lower their intake of saturated fat, the demand for canola oil increased due to its low levels of saturated fat and use as a trans fat-free cooking oil. Additionally, canola oil contains vitamins E and K.

Winter Canola

The development of winter varieties of canola is leading to increased canola acreage in Kansas. These varieties are planted in the fall, similar to winter wheat, and harvested in the summer, just prior to winter wheat. The plants grow four to five feet tall, producing bright yellow flowers in the spring. Approximately half of the flowers develop into pods, which contain the seeds.

Canola Flower
Copyright: Monsanto Company

Canola seeds are tiny and change in color from green to purple as they mature. With an oil content of about 40 percent, the seeds are crushed to produce canola oil. Currently, however, there are no canola oil processing facilities in Kansas.

Peanut

While not grown as an agricultural crop in Kansas, peanut ranks fifth in vegetable oil production worldwide. China and India are the largest producers of peanuts, which are also known as "groundnuts." Worldwide, two-thirds of the peanut crop is processed for oil. However, about two-thirds of all peanuts produced in the United States are used for food instead of oil. Peanut production is generally limited to the southeastern United States, although Texas and Oklahoma do produce peanut as an agricultural crop.

Peanuts
Credit: Stephen Ausmus, USDA ARS

The peanut plant is a member of the pea family. It is an annual legume that requires warm temperatures and a longer growing season, generally four to five months. The plants grow 18 inches tall, but the pods, containing one to three seeds, only develop underground and grow horizontal to the soil's surface.

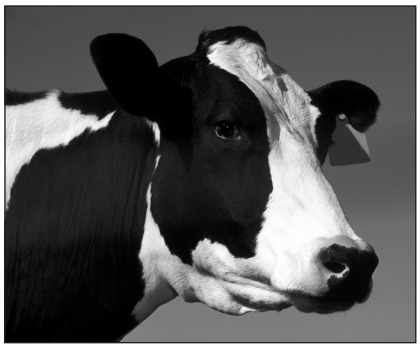
Two processes are used to harvest the seeds (peanuts): digging and combining. Digging cuts the peanut plant's taproot; then lifts the plant from the ground and gently shakes the soil loose from the peanuts before laying the plant upside down in narrow rows (windrows). After two to three days of drying in the sun, the windrows are picked up by a combine, which separates the peanuts from the vines.

Peanuts have an oil content of about 50 percent. Peanut oil is low in saturated fat and trans fat-free, so it is used for frying and cooking at home and in food processing.

Peanut Pods
Credit: Paxton Payton, USDA ARS

Peanuts in Shells
Credit: Jack Dykinga, USDA ARS

Beef Cow
Credit: Meghan Blythe



Dairy Cow
Credit: Peggy Greb, USDA ARS

Sheep
Credit: USDA NRCS

Forages

Forage crops allow people to feed animals year-round, especially important in states like Kansas where the supply of green growing plants is limited during certain seasons. Forages also provide the nutrition needed to support an animal's health, including the production of meat, milk, and wool.

Forages include pastures, greenchop, silage, and hay. Pastures, or areas with fenced perimeters, are harvested by grazing animals. Greenchop is similar to intensively grazing a pasture, because the freshly cut high-moisture plant material is fed to livestock immediately after it is chopped into small pieces in the field. Silage is a sweet-tasting livestock feed that can be stored and fed later. Silage is made by finely chopping green plant material into pieces one-half to three-fourths of an inch long, then packing the chopped plant material tightly together and allowing it to ensile (ferment). To make hay, plants are cut, allowed to dry, and baled (collected and compacted into manageable units for transportation and feeding). The low water content of the bales prevents the growth of mold and bacteria, so hay can be stored for longer periods.

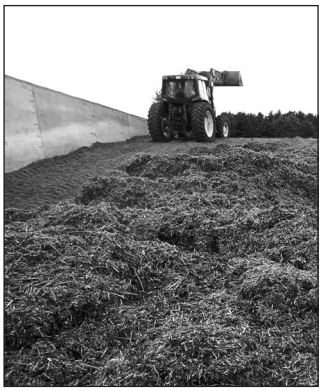
Forage quality is greatly affected by factors generally beyond the control of agricultural producers, such as rainfall, day length, and temperature. Long days and warm temperatures promote growth, which increases fiber content rather than protein content. Higher protein levels provide more energy to animals, while higher fiber content requires that animals use more energy to digest the feed. Drought conditions stunt plant growth, which limits fiber content but also limits the amount of plant material available to harvest as feed.

Forage Types
Greenchop – high-moisture plant material chopped into small pieces in the field and immediately fed to livestock.
Hay – dried plant material collected and compacted into manageable units for transportation and feeding.
Pasture – an area with a fenced perimeter harvested by grazing animals.
Silage – a sweet-tasting livestock feed made by chopping green plant material into fine pieces, packing the chopped plant materials tightly together, and allowing them to ensile (ferment) while the silage is being stored and before it is fed to livestock.

Agricultural producers select plant varieties best suited to their soils and other production factors, work to control pests (weeds and insects), and provide the nutrients needed by the plants to increase yields and provide higher quality feed. However, the most important factor influencing feed quality that can be controlled is the timing of when the plants are harvested. Farmers must make harvesting decisions based on the risks of rain damage, especially for those crops that have an extended drying time, because it may affect the quality of the feed. In addition, as forage crops mature, the quality of the feed steadily decreases. However, it is important to note that this inverse relationship does not have as big an impact on the quality of silage as it does on hay.

Many different plants are grown to feed animals. Forage crops – crops planted and cultivated to produce animal feed rather than grain or seeds – include both legumes and grasses.

Pasture Fence
Credit: Meghan Blythe



Silage
Credit: Stephen Ausmus, USDA ARS

Hay Bales
Credit: Mary Anne Stoskopf

Legumes

Legumes are plant species that have the ability to take nitrogen from the atmosphere and transform it into a form that plants need for growth and development. A legume stores any nitrogen not needed by the plant itself in the soil for the next growing season or for the next crop to be planted in that field.

Nitrogen-filled Root Nodules
Credit: Markus Dubach, USDA ARS

Legumes planted as forage crops in Kansas include alfalfa and clover. Both are perennial plants, but clovers are better suited for planting as a grass mixture in a pasture rather than being harvested for hay. Clovers require longer drying times between cutting and baling, more frequent re-planting than alfalfa, and can cause bloating in animals – a medical condition that can be fatal if not treated promptly.

Red Clover
Credit: R.R. Smith, USDA ARS

Alfalfa

Alfalfa is a perennial plant that grows two to three feet tall and produces lush green foliage with leaves that have high protein content. Alfalfa is the most cultivated legume in the world, able to grow and produce large quantities of nutritious and pleasant-tasting animal feed in a wide range of climatic conditions.

It is the most important forage crop grown in the United States because it produces a greater amount of protein per acre than any other livestock feed. Around the world and in the United States, alfalfa is primarily fed to dairy cows to increase milk production for human consumption. In Kansas, only the highest quality alfalfa (high in protein and low in fiber) is fed to dairy cows. The rest, which constitutes most of the alfalfa produced in Kansas, is fed to beef cattle.

Alfalfa Plants
Credit: Mary Anne Stoskopf

Dairy Cows
Credit: Scott Bauer, USDA ARS

In addition to cattle, alfalfa is important in the diets of many other animals, including horses, sheep, and small animals such as rabbits, mice, and gerbils. Many animals eat dehydrated alfalfa made by drying, grinding, and forming the alfalfa into cubes or pellets appropriately sized for the targeted animal species. In addition to protein, alfalfa provides other important nutrients like calcium and carotene.

Pellets
Credit: Jeff Vanuga, USDA NRCS

Alfalfa History

Alfalfa was likely first grown more than 6,000 years ago in the Persian region (Iran, Iraq, and Sudan). When they traveled, the military and traders carried alfalfa as feed for their horses, spreading the plants throughout the Greek, Roman, and Chinese empires. The Romans introduced alfalfa in Europe. But it was during the Middle Ages that alfalfa spread into many areas of Northern Africa and Europe, including Spain. When the first plants reached Spain, the Spanish called it by its Arabic name – "alfalfa," meaning "horsepower." Spanish and Portuguese explorers introduced alfalfa in Central and South America, and it eventually moved northward into the United States.

Early American colonists experimented with growing alfalfa. Later in the 1820s, German immigrants planted alfalfa in New York from seed they carried into the United States. However, the full potential of alfalfa for hay production was first recognized in California. Alfalfa production then spread from the west coast eastward, although alfalfa seed production is still concentrated in the northwestern United States.

Early settlers brought the first alfalfa seeds into Kansas. Alfalfa was considered a profitable crop in the 1880s, and alfalfa acreage in Kansas expanded until the 1920s. As agricultural machinery became mechanized, fewer horses were needed on Kansas farms. As the number of horses and mules on farms dropped, so did the need for alfalfa hay. However, when the meat processing and beef feeding industries began expanding in southwestern Kansas in the 1960s, alfalfa production increased to meet the need for high-quality livestock feed. Today, Kansas produces about 4 percent of the alfalfa produced in the United States, according to the Kansas Agricultural Statistics Service.

Alfalfa Facts

In most countries around the world, the alfalfa plant is called "lucerne."

The Spanish were the first to call the plant by its Arabic name – "alfalfa," meaning "horsepower."

The Alfalfa Plant

Alfalfa is an upright plant that develops secondary shoots in addition to the main stem, giving the plant a branched appearance. A crown forms at the surface of the soil. The crown – along with the root tissue – serves as a storage center for the carbohydrates produced through photosynthesis. The stored carbohydrates provide the energy necessary to begin new growth each time the plant material is harvested. The carbohydrates also support the plant through the winter and provide the energy necessary to begin new growth in the spring.

Alfalfa Plant
Credit: Mary Anne Stoskopf

Alfalfa production is measured in tonnage, or the number of tons of plant material removed per acre. Although alfalfa is a perennial plant, production for several years depends on planting and maintaining a good stand of healthy plants. Planting alfalfa either requires extensive seedbed preparation or no-till planting. The difference between a new alfalfa stand's success or failure is dependent on adequate soil moisture for germination and timely rains during early growth stages. Once established, an alfalfa plant's root system may penetrate as deep as 25 feet below the soil's surface.

Alfalfa Crown
Credit: Mary Anne Stoskopf

A well-maintained alfalfa field in Kansas may produce good quality hay for five to seven years. Alfalfa plants are especially vulnerable to insect pests that strip the leaves off or even kill the plants. However, because alfalfa is pollinated by insects, insecticides are chosen very carefully to target only the specific insect species threatening the alfalfa crop and used only when necessary.

Alfalfa Flower
Credit: Keith Weller, USDA ARS

When provided with adequate water, alfalfa plants regrow each time they are harvested during the growing season. In fact, the plants stop growing only after the first hard freeze in the fall. To provide the highest quality feed, alfalfa should be cut right before or after the plants begin blooming – approximately 28 days after the previous time the stems and leaves were cut from growing plants. The first step in harvesting alfalfa is swathing. A machine called a "swather" cuts the alfalfa plants about two inches above the ground and gathers the cut alfalfa into windrows, long narrow piles that run the length of the field.

Alfalfa Regrowth
Credit: Mary Anne Stoskopf

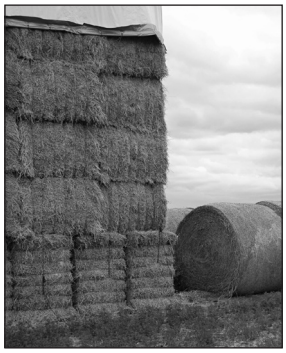
Alfalfa Bale Comparison

Small Square Bale:
60-90 pounds, 14 inches by 14 inches x 30–36 inches long

Round Bale:
1500 pounds, 5 feet wide x 5 1/2 feet tall

Large Square Bale:
2000 pounds, 4 feet by 4 feet x 8 feet long

Small Square Bale vs. Round Bale
Credit: Jessica Baetz Caylor

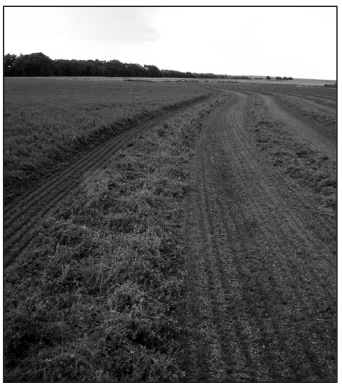


Round Bale vs. Large Square Bales
Credit: Mary Anne Stoskopf

An alfalfa plant is about 80 percent water, so the cut plant material must dry down before it can be baled, usually the second step in harvesting alfalfa. The leaves dry faster than the stems, but by the time the stems are dry, the leaves are so dry that they would fall off the stems if the alfalfa was baled immediately. Any handling of the cut plant material must be carefully timed so the leaves stay attached to the stems. The leaves have the highest nutritional value, taste better, and are easier for animals to digest than the stems.

In Kansas, swathing and baling are the most common practices for harvesting alfalfa. Alfalfa is also harvested as greenchop – cut as a green crop by a forage cutter that deposits the cut alfalfa into a truck. The truck delivers the alfalfa directly to a dairy, feedlot, alfalfa pellet mill, or other feed processing facility.

Swathing Alfalfa – Rear View
Credit: Mary Anne Stoskopf



Alfalfa Windrows
Credit: Mary Anne Stoskopf

Baling Alfalfa
Credit: Dean Stoskopf

Native Prairie Grasses
Credit: Meghan Blythe

Grassed Waterway
Credit: Jeff Vanuga, USDA NRCS

Grasses

The grass family of plants includes annual species, biennial species (plants that live for two years and do not produce seeds until the second year), and perennial species (plants that grow for more than two years and produce flowers and seeds either once each year or continuously). Many of the agricultural crops grown in Kansas originated in the grass family of plants, but are grown as annual crops that are planted and harvested each year.

Grasses are categorized as either cool season grasses or warm season grasses. Cool season grasses grow actively in the cool seasons – winter, early spring, or late fall – although they may go dormant during the winter in climates with extremely cold temperatures or during the summer in areas where temperatures are high (above 90° during the daytime). Warm season grasses are dormant during fall, winter, and early spring – actively growing and producing vegetation during the summer. Most of the native prairie grasses found in Kansas are warm season grasses.

Smooth Bromegrass

Smooth bromegrass is native to Europe, Russia, and Siberia. In 1884, it was introduced in the United States. It is a common hay crop in the Great Plains region and the most widely-used cool season grass in North America, grown in the area from the East coast to the Great Plains and up into Canada. Smooth bromegrass is a perennial plant that can remain productive for 40 years or more when harvested properly and fertilized to encourage green plant growth.

The leafy stems of smooth bromegrass grow two to four feet tall and should be harvested just as the heads begin to emerge. At least three inches of the growing plant is left to ensure the plant is strong enough to produce another growth of vegetation. In Kansas, smooth bromegrass growth slows down and the plant becomes dormant during the heat of summer. It begins to regrow in the fall as the amount of sunlight decreases and temperatures fall. One cutting (harvest) of smooth bromegrass per year is most common in Kansas. Smooth bromegrass is usually swathed and baled for later feeding.

Smooth Bromegrass
Credit: Mary Anne Stoskopf

Smooth bromegrass has a deep root system that helps the plants stay healthy and alive during cold winters as well as during periods of drought. It is a sod-forming grass, producing new plants from existing ones by sending out rhizomes (underground stems) and building a strong root system. For that reason, it may be used to hold the soil in place in grassed waterways and areas prone to soil erosion. Although the long narrow seeds make it difficult to plant, smooth bromegrass will spread naturally from seed production as well as the rhizomes.

Triticale

Triticale is a hybrid plant species produced by crossbreeding wheat and rye plants. The first attempts at crossbreeding wheat and rye species began in the 1800s. However, the first successful commercial triticale varieties were not available until the 1960s. By using genes from winter wheat varieties, plant breeders have produced triticale varieties that can withstand cold Kansas winters. Triticale is used primarily as a forage crop because it is better suited to being grazed as pasture than making hay or silage.

Triticale
Credit: Louise Ehmke

In Kansas, triticale is planted from mid-August to late September. The plants grow quickly and grazing can begin four to six weeks after planting. Triticale helps meet the nutrition needs of grazing animals during the fall when pasture grasses and other forage crops have matured and are not producing as much green vegetation. Triticale can also provide early spring pasture.

Triticale

The name "triticale" comes from the scientific names of the two plants used to produce this crop – *Triticum* (wheat) and *Secale* (rye).

Toxic Plants

Under certain environmental conditions, summer annual forages can accumulate potentially toxic levels of nitrates. Additionally, when stressed by drought, frost, or freezing, sorghums and sudangrass are also known to produce prussic acid (hydrogen cyanide), a rapid acting poison.

Both nitrate and prussic acid poisoning interfere with the transport and utilization of oxygen in an animal's red blood cells, eventually suffocating the animal. However, agricultural producers minimize the potential for both problems with careful management of summer annual forages.

Summer Annual Forages

Summer annual forages are warm-season grasses that tolerate the hot, dry weather found in Kansas. Summer annual forages commonly used in Kansas include sudangrass, forage sorghums, and sorghum-sudangrass hybrids.

Sudangrass

Sudangrass is a fine-stemmed, leafy plant growing three to eight feet tall that produces lots of vegetation in late summer. In Kansas, it is planted in early summer after the danger of frost has passed. Sudangrass may be harvested multiple times in a single growing season. Sudangrass regrows rapidly after each harvest until cool temperatures or a lack of moisture slow down growth processes. Sudangrass is harvested as greenchop, silage, or hay. Although the plants produce small stems, the stems are hard to dry so it can be difficult to maintain the nutritional quality if sudangrass is swathed and baled for hay.

Sudangrass is native to Africa, but was imported by the U.S. Department of Agriculture in 1909 as a potential pasture and hay crop able to withstand higher temperatures in areas of lower rainfall.

Forage Sorghums

Forage sorghums are also planted in early summer in Kansas. The plants grow from eight to 15 feet tall. They mature late in the growing season and produce only one cutting. Although forage sorghums yield high volumes of plant material, the stems are thick, which is why forage sorghums are most often harvested as silage.

Forage Sorghum
Credit: United Sorghum Checkoff Program

Sorghum-sudangrass Hybrids

Sorghum-sudangrass hybrids are the most common annual grass grown in Kansas. These plants combine genes from both sorghum and sudangrass parents. Although not as palatable (pleasant-tasting) to livestock as sudangrass, the sorghum-sudangrass hybrids produce large quantities of high-quality feed in the form of greenchop, silage, hay, or pasture. The plants grow from six to eight feet tall, but have large stems, which make drying more difficult when harvesting the plants for hay.

Sowing Success

According to the Kansas Agricultural Statistics Service, more than 56 percent of the land in Kansas is considered cropland, or land available for the cultivation of plants or agricultural produce such as grain, vegetables, or fruit. Kansas has about 30 million acres of available cropland, more than any other state except Texas.

Kansas farmers face many of the same challenges faced by earlier generations of Kansans – erratic rainfall, unpredictable weather, destructive insects, invasive weeds, and crop diseases. New challenges include producing the food needed by the expanding worldwide population, responding to international competition, adapting to regulations affecting agricultural practices and products, and addressing concerns over environmental factors, like global climate changes. With crop production representing the largest land use in Kansas, today's agricultural producers meet all those challenges by using the latest advances in technology, plant breeding, and scientific knowledge to provide food, feed, fuel, fiber, and other products.

Kansas Cropland
Credit: Louise Ehmke

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Teacher's Resources

The Kansas Foundation for Agriculture in the Classroom (KFAC) offers lesson plans and other educational resources on the KFAC website: **www.ksagclassroom.org**.

Notes: