Unit 4) Kansas Crops

The state of Kansas is often called the "Wheat State" or the "Sunflower State." Year after year, the state of Kansas leads the nation in the production of wheat and grain sorghum and ranks among the top ten states in the production of sunflowers, alfalfa, corn, and soybeans. Kansas farmers also plant and harvest a variety of other crops to meet the need for food, feed, fuel, fiber, and other consumer and industrial products.

"When tillage begins, other acts follow. The farmers, therefore, are the founders of human civilization."

Daniel Webster, American statesman and orator

Credit: Louise Ehmke

When Kansas became a state, most of the people in the United States were farmers. According to the U.S. Department of Agriculture, the food and fiber produced by the average farmworker at that time supported fewer than five people. Farming methods, which had not changed significantly for several decades, were passed down from one generation to the next. The Homestead Act of 1862 promoted the idea that anyone could become a farmer but people soon realized that once they went beyond the eastern edge of Kansas, survival depended on changing those traditional farming methods.

Out of necessity, Kansas adopted an attitude of innovation and experimentation. Since 1863, faculty at the Kansas State Agricultural College (KSAC) and the KSAC Agricultural Experiment Station have assisted Kansas farmers in meeting crop production challenges. Both entities, now known as Kansas State University and the Kansas State University Agricultural Experiment Station and Cooperative Extension Service (K-State Research and Extension), continue those efforts today. Research conducted at research centers and experiment fields across the state provide test results for a variety of crops.

By 1961, 100 years after Kansas became a state, each American farmer was supplying enough food and fiber to meet the needs of 26 people. Today, one farmer in the United States feeds around 144 people. Without Kansas crops, that statistic would be much different. In 2007, Kansas crops were planted on 22.6 million acres, an area larger than 11 other individual states.

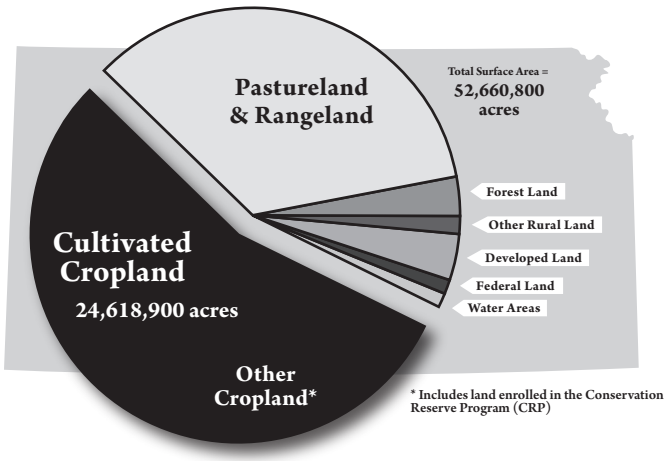
Feeding People

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**
2007	**144 people**

Source: USDA

Surface Area of Kansas – Cultivated Cropland



Source: 2003 Natural Resources Inventory, USDA NRCS

Crops are cultivated plants planted on cropland. Crops can by categorized according to use, by plant families, as annuals or perennials, or in other ways. Generally, fruits, vegetables, flowers, and ornamental plants are considered horticultural crops and included in the both the state and national agricultural crop statistics. Several terms refer to a wide range of agricultural crops that are produced for human food or livestock feed, or processed and resold in a variety of consumer or industrial products. These terms include grains, oilseeds, and forages. Grains are divided into "coarse grains" (corn and grain sorghum) and "small grains" (wheat, oats, barley, triticale, rye, and rice). The term "cereal grains" is used to describe crops from the grass family of plants which produce seeds (grain) used as food by people and livestock. Cereal grains include wheat, rice, corn, grain sorghum, rye, oats, barley, millet, and triticale. Oilseeds include soybeans, sunflowers, canola, cotton, and flax. Forages include those crops harvested for livestock feed, such as alfalfa, forage sorghum, or brome. The term "row crop" originally described crops planted in a specific way, including soybeans, corn, grain sorghum, sunflowers, and cotton. Cotton and flax would also be considered "fiber crops."

Kansas crops serve many purposes. Kansas farmers plan planting sequences and harvesting options according to individual situations, field conditions, potential demand for products, and anticipated economic returns on investments of inputs, time, and capital, as well as other variables. Individual fields may not be planted to the same crop year after year and the acreage statewide may shift between the major crops from year to year, but the overall number of acres planted to crops in Kansas remains reasonably constant. The attitude of innovation and experimentation that allowed Kansans to survive many early challenges is still present in Kansas agriculture today. Kansas crop producers continue to look for new opportunities to produce a variety of crops for food, feed, fiber, fuel and other products.

Kansas Crops
Check out the Kansas Agricultural Statistic Service's web site for the most recent reports on Kansas crop production or for historical data.
http://www.nass.usda.gov/Statistics_by_State/Kansas/index.asp

Crop Categories

Agricultural crops– crops produced for human food, livestock feed, or consumer and industrial products.
Fiber crops– crops produced for the fiber; for example, cotton and flax.
Forages– crops harvested for livestock feed; for example, 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.

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

Wheat
(Triticum aestivum ssp. vulgare)

"No race can prosper till it learns that there is as much dignity in tilling a field as in writing a poem."
Booker T. Washington, educator and author

Flour milling is one of the oldest industries in Kansas. Early pioneers heading west on trails through Kansas had their grain ground into flour in eastern Kansas as early as the 1850s. Many of the early mills were dual-purpose–serving as sawmills during the daytime and grinding grain into flour during the night. At the same time, people were planting more and more wheat in Kansas. By 1878, people were predicting that Kansas would become the "greatest and best wheat growing state in the Union." [1] Those predictions came true. Almost every year, Kansas does produce more wheat than any other state. Kansas also mills more wheat flour and produces more wheat gluten than any other state.

Today the volume of wheat produced in Kansas is amazing. According to the Kansas Wheat Commission, a single Kansas wheat harvest could fill a train that would stretch from the western edge of the state to the Atlantic Ocean. Kansas farmers produce 20 percent of all the wheat grown in the United States. One bushel of wheat is equal to 60 pounds of wheat. A normal Kansas wheat

Wheat
Credit:Kansas Wheat Commission

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; 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

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).

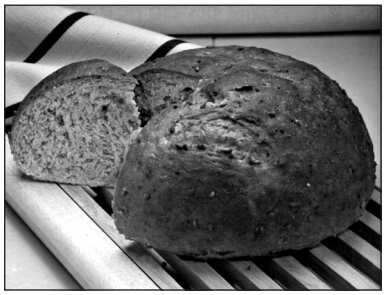
One square mile equals 640 square acres.

One Bushel

Corn	56 pounds
Grain Sorghum	56 pounds
Soybeans	60 pounds
Sunflowers	27 pounds
Wheat	60 pounds

harvest of several hundred million bushels adds more than a billion dollars to the state's economy, according to the Kansas Agricultural Statistics Service.

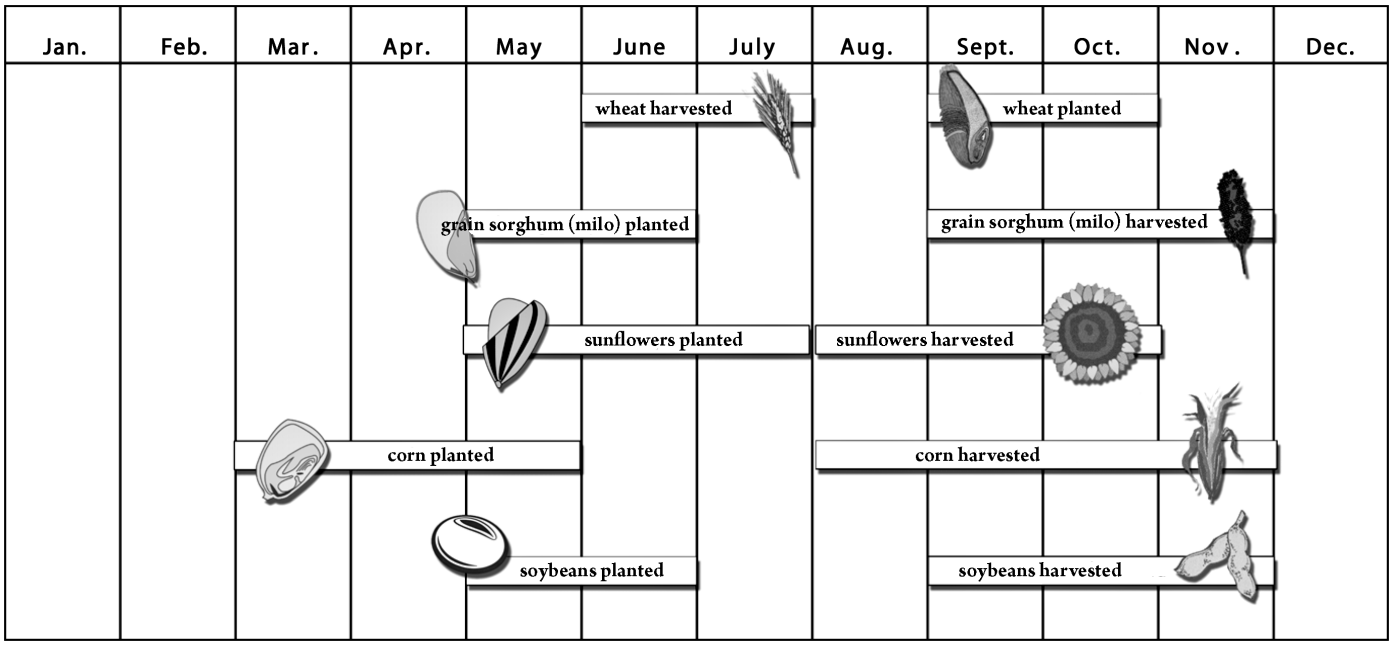
Nearly all of the wheat grown in Kansas is winter wheat–planted and sprouting in the fall, going dormant in the winter, growing again in the spring, and ready for harvest in early summer. Winter wheat is ideally suited for the Kansas climate. Precipitation during winter and spring combines with summer sunshine and warmer temperatures to ripen the wheat in June and July, making it one of the most picturesque crops in the world.



Wheat Bread
Credit: Wheat Foods Council

Wheat contains gluten, the basic structure in forming the dough system for breads, rolls, and other baked goods. Other grains have gluten but not as much as wheat. There are three classes of wheat produced in Kansas: hard red winter wheat, hard white wheat, and soft red winter wheat. Hard red winter wheat accounts for almost 40 percent of the wheat grown in the United States and 94 percent of the wheat grown in Kansas. This wheat has good milling and baking characteristics and makes high-quality yeast breads and rolls. At this time, about 5 percent of the wheat produced in Kansas is hard white wheat, which is primarily used for tortillas, hard rolls, noodles, and yeast breads. Hard white wheat production is being driven by the interest from foreign buyers of Kansas wheat, who typically purchase nearly one-half of the state's annual wheat production. Soft red winter wheat makes up only 1 percent of the wheat produced in Kansas. It is grown in the eastern part of the state and used to make cakes, crackers, flat breads, and pastries.

Timeline for Planting and Harvesting Kansas Crops



Source: KFAC, Exploring Kansas Crops Educator's Guide

Kansas Wheat Facts

- The grain produced in a single Kansas wheat harvest could fill a train that would stretch from the western border of the state eastward to the shore of the Atlantic Ocean.
- One acre of wheat will produce enough grain in one year's harvest to supply bread to feed a family of four for 10 years.

Source: Kansas Wheat Commission

Kansas Wheat
Credit: Kansas Wheat Commission

Wheat Uses

According to the Kansas Wheat Commission, nearly 50 percent of the U.S. wheat crop is exported each year for food use. Another 36 percent of the wheat produced in the United States is consumed in food uses within the United States. Ten percent of the U.S. wheat crop is fed to U.S. livestock and 4 percent is used as seed.

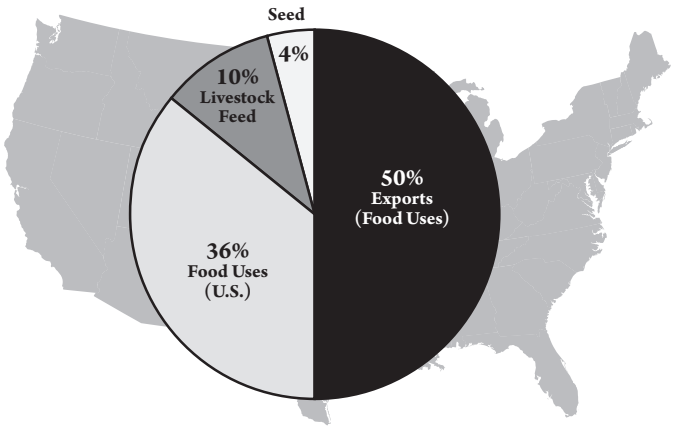
Wheat is the primary grain used in U.S. grain foods– approximately three-fourths of all U.S. grain food products are made from wheat flour. More foods are made with wheat than any other cereal grain. One acre of wheat (the size of a high school football field without the end zones) will supply enough bread to feed a family of four for 10 years, according to the Kansas Wheat Commission.

Wheat Foods
Credit: Wheat Foods Council

Overseas food aid is another important use of Kansas wheat. The abundant wheat crop in Kansas enables the United States to provide shipments of wheat to people in other countries to relieve their suffering due to crop failures, war, drought, floods, hurricanes, and other disasters.

Nonfood and industrial applications represent a growing market for U.S. wheat producers. The unique elastic qualities of wheat gluten, which make wheat ideal for making breads, rolls, and other food products, also make wheat useful in the production of consumer and industrial products such as adhesives, packaging materials, paper, and construction materials. Wheat can also be used to produce ethanol and cosmetic or pharmaceutical products.

U.S. Wheat Uses



Source: Kansas Wheat Commission

Wheat History

Wheat is a member of the grass family of plants that produce a dry one-seeded fruit commonly called a kernel. Wheat originated in the "cradle of civilization" in an area now included in Iraq, Syria, Iran, and Turkey, nearly 10,000 years ago. Wheat's earliest ancestors were wild einkorn, or "one-seed," and emmer. Archeologists have found seed kernels of both plants in excavated villages in Egypt and southwestern Asia's "Fertile Crescent," the area between the upper reaches of the Tigris and Euphrates rivers. There is evidence that during the time of the Swiss Lake Dwellers in early Europe (around 5,000 B.C.), people ground and mixed wheat with water, before baking it to make unleavened (flat) cakes of bread. The first evidence of leavened bread, which rises or expands due to the addition of yeast, appears in Egyptian hieroglyphs from over 5,000 years ago. The Chinese recorded growing wheat in 2700 B.C. [2]

During his second voyage to the New World, Christopher Columbus introduced wheat into the West Indies. The first wheat crop was grown there in 1494. During 1510 to 1520, Spaniards took wheat to Mexico to grow for bread making. From there, wheat spread into the area that is now the southwestern United States. Later in that same century, other explorers took grains of wheat to the East Coast, where settlers at several places along the East Coast grew wheat as a crop in the early 1600s.

The first record of wheat growing in Kansas is that of a crop of wheat produced at the Shawnee Methodist Mission (Johnson County) in 1839. Production in the state grew steadily and reached one million acres in 1876. Yields were usually in the range of 10 to

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.

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.

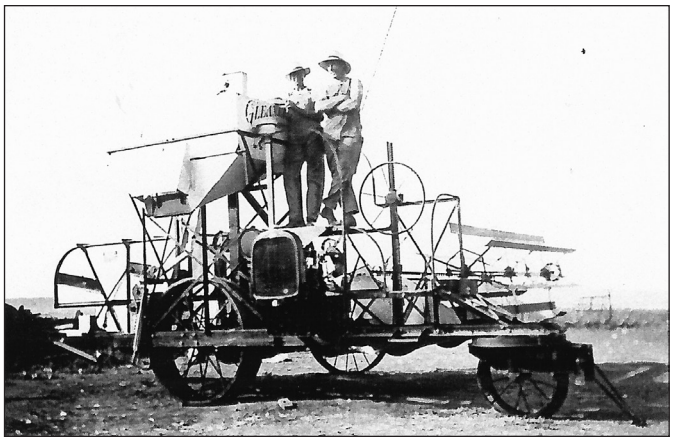
20 bushels per acre. In 1866, the state recorded the first one million bushel wheat harvest. Settlers coming to Kansas brought small quantities of seed with them, varieties that they had grown in the eastern United States and Europe. However, those wheat varieties usually came from areas with mild climates and grew poorly in the Kansas environment.

The situation changed slowly but steadily after the introduction of Turkey Red hard red winter wheat to south-central Kansas by German Mennonites from the Ukraine. The first crop of Turkey Red wheat was planted in Marion County in 1873 and harvested in 1874. The one-year increase in wheat production in Kansas from 1877 to 1878 (668,819 acres) was unparalleled in the history of the United States. [3] The success of the Turkey Red wheat variety was so pronounced that in 1888, the Topeka Daily Capital reported that "All parts of Kansas grow good corn but in wheat Kansas can beat the world." [4] By 1919, when the first wheat variety survey was taken, over 82 percent of the wheat acreage in Kansas and nearly 30 percent of the wheat acreage in the United States was planted to Turkey Red wheat. It remained the most popular wheat variety in Kansas until 1939 and was the most popular wheat variety in the United States until 1944. [5]

Kansas Wheat Timeline

1839– first record of wheat grown in Kansas.
1863– 10,000 acres of wheat grown in Kansas.
1866– first one million bushel wheat crop.
1869– over 100,000 acres harvested.
1873– first crop of Turkey Red variety planted in Kansas (harvested in 1874).
1874– Kansas State University began wheat research.
1876– one million acres harvested.
1891– first crop of over 50 million bushels.
1915– first 100 million bushel crop.
1930– first crop over 200 million bushels.
1937– wheat planted on 17,110,000 acres in Kansas (current state record).
1947– 14,855,000 acres of wheat harvested in Kansas (current state record).
1952– first 300 million bushel crop.
1973– first crop valued at over $1 billion.
1979– first 400 million bushel crop.
1980– Kansas wheat crop valued at $1,587,600,000 (current state record).
1997– 501,400,000 bushels of wheat produced in Kansas (current state record).

Source: Kansas Agricultural Statistics Service



New Combine, 1936
Courtesy: Stoskopf Farms

Modern Combine
Credit: Kansas Wheat Commission

Kansas Crops

Modern varieties of winter wheat in Kansas contain, on average, about 50 percent of Turkey Red hard red winter wheat in their pedigrees according to the Kansas Wheat Commission. However, present-day varieties are very different from the older wheat varieties. The newer varieties produce more grain, grow shorter stalks, mature earlier, are resistant to specific pests and diseases, and produce better quality grain for bread and other products.

In the 1980s, hard white winter wheat was introduced in Kansas. Researchers at the Kansas State University Agricultural Research Center at Hays led the efforts to develop varieties that would produce well under typical Kansas growing conditions. Domestic and foreign buyers are driving the demand for increased production of hard white winter wheat in Kansas.

Plant Varieties

A variety is a plant with specific genetic characteristics that make it different from other plants of the same species. The best 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 (such as wind, low rainfall, or a shortened growing season), and anticipated uses.

Corn

(Zea mays)

"Corn is the sign and seal of a good American agricultural country ... Kansas has corn and so has luck." [6]

John Alexander Martin, Kansas governor, 1885 –1889

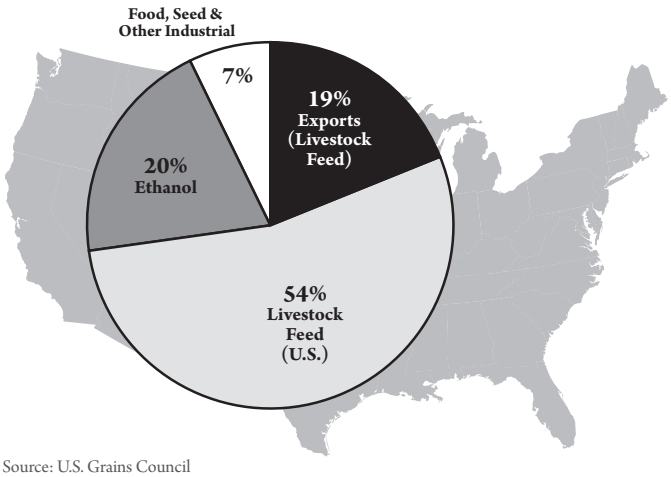
In the United States, corn is the largest crop, both in the number of acres planted and the cash value of the crop produced. The United States produces over 40 percent of the world's corn crop, according to the U.S. Grains Council. Even though Kansas is called the "Wheat State," more bushels of corn than wheat are produced in the state despite the fact that fewer acres are planted to corn than wheat (3–3.7 million acres vs. 9.5–10 million acres). However, the growth of the ethanol industry may cause shifts in crop plantings. In a typical year, the Kansas corn crop yields an average of 135–150 bushels per acre. One bushel is equal to 56 pounds of corn. According to the Kansas Agricultural Statistics Service, Kansas farmers grew a record 465.8 million bushels of corn in 2005.

The predominant type of corn grown in Kansas is yellow dent corn. Kansas is among the top ten corn-producing states in the United States, producing nearly 4 percent of the corn produced for grain in the United States. Corn silage is also a major product in Kansas, with an average 2.5 million tons of silage harvested each year and used as livestock feed, mainly by the beef industry.

Corn

Credit: Larry Rana, USDA

U.S. Corn Uses



Source: U.S. Grains Council

Corn Uses

Nearly 75 percent of the corn produced in the United States is fed to livestock. Around 19 percent of the U.S. corn crop is exported for use as a feed grain and livestock in the U.S. consume about 54 percent of the annual corn crop. Food, industrial, and seed uses consume approximately 27 percent of the U.S. corn crop, according to the U.S. Grains Council.

One of the largest industrial uses of corn is the production of ethanol, which consumed more than 20 percent of the corn produced in the United States in 2006. In Kansas, historically more ethanol was made with grain sorghum than with corn but the two grains are interchangeable in the ethanol making process. In 2007, ethanol production plants in Kansas used over 76 million bushels of grain sorghum and corn. According to the National Corn Growers

East Kansas Agri Energy Ethanol Plant, Garnett

Credit: Kansas Corn Growers Association

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 digestible livestock feed.

Corn is the largest crop produced in the United States, in both number of acres planted and the cash value.

Corn Kernels
Credit: Tim McCabe, USDA NRCS

Association, one acre of corn can produce enough ethanol to run a car for 72,000 miles on E10 (a blend of 10 percent ethanol and 90 percent unleaded gasoline). In Kansas, there are several fueling sites offering fuel for vehicles using E85 (a blend of 85 percent ethanol and 15 percent unleaded gasoline).

Thousands of food items contain corn or are made using some component of the corn kernel. Nearly four times as much corn is turned into corn sweeteners, used in everything from soft drinks and pasta sauces to hot dogs and yogurt, as is used to produce cereal and other food products. Corn-based plastics and textiles, used in the packaging of food and other products, are made from cornstarch, which is also used in pharmaceutical and pet products. Products using corn or corn components are so common that most people do not realize that everything from toothpaste to windshield washer fluid may contain corn.

Cornstarch Products
Credit: Scott Bauer, USDA ARS

Corn History

Corn is native to the American continents. Corn was developed from a wild grass in central Mexico over 7,000 years ago. Until American Indians shared their corn with the explorer Christopher Columbus, corn was not grown outside of North, Central and South America. When he returned to Spain, Columbus took some corn with him and the crop quickly spread throughout Europe and the rest of the world.

The American Indians called corn "maize." It was their main food. Some tribes considered corn one of the three "sisters," along with beans and squash. Many American Indian ceremonies and traditions, including festivals at planting and harvest times, emphasize the importance of corn. Surplus corn was stored for use during the winter.

In 1621, the Pilgrims at Plymouth Rock would have starved if American Indians had not taught them how to grow corn. The Pilgrims and early settlers learned many ways to use corn, such as stuffing mattresses with cornhusks, burning corncobs for fuel, making toys from cornhusks, and feeding corn to livestock. Corn was so valuable that early settlers traded corn with the American Indians for food and furs.

Ethanol Fact

One acre of corn can produce enough ethanol in one year's harvest to run a car for 72,000 miles on E10 fuel.

Source: National Corn Growers Association

Kansas Corn Timeline
1866– 217,000 acres harvested; produced 6.1 million bushels of corn.
1872– one million acres harvested.
1876– two million acres harvested.
1879– three million acres harvested; first 100 million bushel crop.
1881– four million acres harvested.
1883– five million acres harvested.
1888– first 200 million bushel crop.
1902– 214 million bushel crop; 7,140,000 acres harvested.
1917– 9,156,000 acres of corn harvested in Kansas (current state record).
1934– 5,174,000 acres planted; 172,000 acres harvested.
1991– first crop over 200 million bushels since 1902; 1,650,000 acres harvested.
1994– first 300 million bushel crop.
1996– first Kansas corn crop valued at over $1 billion.
1998– first 400 million bushel crop.
2005– 465,750,000 bushels of corn produced in Kansas (current state record).

Source: Kansas Agricutural Statistics Service

In Kansas, corn was the principal crop grown by early pioneers. As early as the 1850s, Kansas farmers were producing large quantities of corn but found it difficult to transport the grain to the markets, which were located closer to the populated areas. Some people fed the corn to livestock and marketed the livestock or meat. Many resorted to burning excess corn for fuel, only to find themselves without food, livestock feed, or seed for planting the next year's crop following the great grasshopper disaster of 1874.

The record for the number of acres of corn harvested for grain in Kansas was set in 1917—almost 9.2 million acres. That means that in 1917, almost 6 percent of the land in the state had been planted to corn that was actually harvested for grain (not pastured for grazing, cut for livestock feed, or lost to drought, disease, insects, or other disasters). In 1933, 7.7 million acres of corn were planted in Kansas.

Irrigated Corn near Syracuse, 1939
Credit: Library of Congress; Russell Lee, photographer

Dramatic changes in precipitation resulted in the setting of a Kansas record the next year. In 1934, only 172,000 acres of corn were harvested for grain in Kansas.

Between 1930 and 1945, there were huge changes in corn production in the United States. There were changes in how corn was harvested as corn went from being picked by hand to being harvested by machinery. There were also major changes in the selection of seed corn. Before the 1930s, seed corn was selected from the tallest or most productive stalks of corn with the expectation that the seeds would grow plants that would produce similar or improved results. However, since pollen that blew in with the wind contained parentage of plants with a wide variety of genetic traits, yields were never consistent and often less than expected.

In 1930, Roswell Garst formed a partnership with Henry Wallace, a plant geneticist who provided seed for Garst to grow a small crop of hybrid seed corn in Iowa. Garst then sold the seed corn to other farmers and by 1945, almost all of the corn grown in the United States was from hybrid seed. The production of hybrid seed requires careful control of the parent seed lines used in the genetics of the hybrid. New seed is purchased each year, chosen for the specific needs of the field in which it is to be planted and the weather and other natural conditions of that specific growing season.

Hybrid seed corn helped the United States respond to worldwide food needs during World War II. By 1969, less than 40 years after the introduction of hybrid seed corn, corn production in the United States had doubled even though only half the number of the acres planted to corn in 1930 were planted to corn in 1969. [7] In Kansas, the changes were even more dramatic. Kansas corn growers went from producing 67 million bushels on 7.1 million acres in 1930 to producing 95 million bushels of corn on 1.5 million acres in 1969.

Today, corn is the most widely distributed crop in the world. Corn can grow at altitudes as high as 12,000 feet in the South American Andes Mountains and as low as sea level. It 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. Corn is grown on every continent except Antarctica.

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.

Grain Sorghum

(Sorghum vulgare)

"If Kansas were limited to the growing of one crop, sorghum would best meet its requirements for feed and grain."

Sorghums for Kansas, Agricultural Experiment Station Bulletin 304, 1942

Grain Sorghum Head
Credit: High Plains Journal

The United States is the largest producer of grain sorghum in the world and Kansas leads the nation in grain sorghum production each year, producing nearly 50 percent of the U.S. grain sorghum crop. Grain sorghum, sometimes called "milo," is one of the most important dryland crops in the area from stretching from Texas to South Dakota. It can be grown under a variety of climatic conditions and has a unique ability to "wait" for precipitation. In other words, as it begins to get dry, a sorghum plant starts shutting down growth and seed production. Once it rains, the plant jump-starts its growth and seed production cycle. This characteristic is important in areas where rainfall is low or erratic and limits the production of other spring crops.

Grain Sorghum Plants
Credit: High Plains Journal

Grain sorghum is one of the later-planted spring crops, generally planted in late May or early June in Kansas. This allows the soil to store water from spring rains prior to planting so that it is available to the sorghum plant's extensive fibrous root system as the plant grows and temperatures rise during the summer. When things work right, the hottest weather of the season is already history before the sorghum plant hits the critical seed-producing stage.

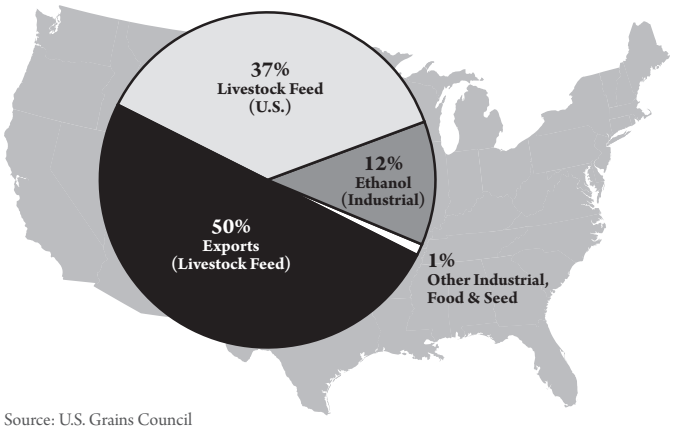
Harvesting grain sorghum in Kansas often presents challenges. Grain sorghum is a perennial plant and the plant remains green and alive after producing seed (grain) until it is killed by freezing temperatures, tillage, or herbicides. In Kansas, the harvest occurs between September and the end of November. The grain is often slow to dry and harvest delays increase the risk of damage due to wind, snow, birds, and other wildlife. Harvesting grain sorghum before the grain dries down to an acceptable level is usually not an option because wet grain sorghum cannot be stored for very long before the grain begins to spoil or starts sprouting. However, planting grain sorghum earlier in the spring does not guarantee an earlier harvest due to the plant's ability to shut down and wait on moisture during the growing season.

In terms of acreage or value, grain sorghum is not the largest or most valuable crop produced in either the United States or the state of Kansas. Less than 500 million bushels of grain sorghum are produced each year in the United States. One bushel of grain sorghum is equal to 56 pounds of grain sorghum although, unlike most other grains and oilseeds, grain sorghum is usually sold by the "hundredweight" (100 pounds) rather than by the bushel. In Kansas, the number of acres planted to grain sorghum increased to 2.8 million acres in 2007 according to the Kansas Agricultural Statistics Service. The Kansas grain sorghum crop is usually valued around 300 million dollars. In addition, nearly 2.5 million tons of sorghum silage are harvested each year in Kansas and used as livestock feed, mainly by the beef industry.

Grain Sorghum Uses

The real value of the grain sorghum crop is in its uses. The primary use (87 percent) of the U.S. grain sorghum crop is as a feed grain for livestock. Consumption is split between exports (50 percent) and U.S. livestock (37 percent), according to the U.S. Grains Council. Over 80 percent of the grain sorghum produced in Kansas is fed to livestock. The production of ethanol, which already consumes around 12 percent of the U.S. sorghum crop each year, represents an expanding market for grain sorghum. In Kansas, more ethanol was made with grain sorghum than corn. The ethanol market is growing. Only 1 percent of the grain sorghum produced in the United States is used as seed or in food and other industrial uses.

U.S. Grain Sorghum Uses



Source: U.S. Grains Council

Although grain sorghum is primarily a feed grain in the United States, that is not the case in many other countries. Worldwide, people and livestock consume nearly equal amounts of sorghum. Sorghum is the leading cereal grain in Africa, and is grown in over 60 countries around the world. [8] Food sorghums (for human consumption) are specific varieties of grain sorghum that produce a white berry that makes a white flour. The yellow and red grain sorghums commonly grown in Kansas, as well as some varieties of cream-colored grain sorghums, do not qualify as food-grade sorghums. Grain sorghum does not contain gluten so sorghum food products can play an important role in the diets of people who cannot eat foods containing gluten.

Grain Sorghum Products
Credit: Stephen Ausmus, USDA ARS

Not all sorghums are grain sorghums. For example, grassy sorghums, such as sudan, are grown for feed and hay, and sweet sorghums are grown to make sorghum syrup. In the late 1800s and early 1900s, broomcorn, a type of sorghum grown for the branches and fibers of the seed clusters, was a very important crop in Kansas. Buyers paid $80 to $100 a ton for Kansas broomcorn, which was shipped all over the world. Some years, Kansas produced over twice as much broomcorn as any other state in the United States. Liberal, Kansas, was considered the biggest broomcorn market in the United States at one time.

Broom Corn
Source: Library of Congress; Russell Lee, photographer

Grain Sorghum History

Sorghum is a grassy plant that is native to Africa. Areas of India and Assyria were also among the first to grow sorghum as a cereal crop. During the thirteenth century, grain sorghum reached China.

The first sorghum seeds brought into the United States may have arrived during the late 1700s on ships. Some historians believe that Benjamin Franklin introduced the first sorghum crop to the United States. Sorghum production was not widespread in the United States until the 1850s, when sorghum seeds were imported from France and South Africa. The U.S. government became interested in sweet sorghum as an alternative source of sweetener. The U.S. Department of Agriculture conducted experiments on the feasibility of producing sorghum sugar. The work also included improvement of the sorghum varieties. The U.S. Patent Office and members of Congress distributed seed to farmers. There were sorghum sugar plants in several Kansas towns and Kansas was the only state producing sorghum sugar in 1891. [9] Even so, at the beginning of the 1900s, the government supported a new crop in western Kansas, sugar beets, that had a higher sugar content than sorghum. A sugar

beet factory was built in Garden City in 1906, signaling that the production of sorghum sugar could not compete successfully with the sugar cane or sugar beet industries. By the 1950s, most of the sweet sorghum grown in the United States was grown for forage (livestock feed).

One of the earliest recognized sorghum varieties, known as Black Amber by Kansas settlers, is said to have originated in China. Early settlers brought this sweet sorghum variety to Kansas around 1880 to grow for the production of sorghum molasses. During a drought, they discovered that the sorghum was also a good forage sorghum for livestock and for the next 30 years, that variety was the leading forage sorghum grown in the state. [10] During this period, the livestock industry in the state went through the transition from grazing on the open range in large herds to smaller herds grazing in fenced pastures and fields. The Black Amber sorghum variety made it easier for farmers to grow the feed necessary for their livestock.

There is some question as to when the earliest grain sorghums became established in the United States. Different varieties carried names not ordinarily associated with grain sorghum today, including African millet, Egyptian corn, milo maize, durra, kafir corn, rice corn, and Jerusalem corn. "Rice corn" came to Kansas from California, where it became established in 1874 after having been imported from Egypt. For at least ten years, rice corn was the only grain sorghum grown in Kansas. There are varying reports about how another variety known as "Jerusalem corn" arrived in Kansas. One report is that a missionary in Palestine sent two seeds of Jerusalem corn to a farmer in Finney County Another report is that a settler from Kentucky brought the first Jerusalem corn seed with him to Finney County. This variety may have reached America during colonial times or may have been grown in Georgia as early as 1838. In 1876, two other varieties of grain sorghum were brought into the United States from South Africa; both reached Kansas by 1889. [11]

Sorghum, Shawnee County, 1938

Source: Library of Congress;; John Vachon, photographer

In 1872, there were just over 4,000 acres of sorghum growing in Kansas, almost all of which was grown for syrup or sugar. Sorghum production exploded in Kansas in the next 40 years as sorghum production switched first to forage sorghums and then to grain sorghums. In just one year, 1896, the acreage planted to grain sorghum more than doubled. The Agricultural Experiment Station at Manhattan conducted early sorghum research in Kansas but once the state acquired the old Fort Hays military reservation in 1900, the Agricultural Experiment Station at Hays, now known as the Kansas State University Agricultural Research Center – Hays, took the lead in conducting sorghum research in Kansas. Careful selection and testing for desired characteristics improved yields. In 1904, the Hays Experiment Station released 4,500 pounds of sorghum seed to Kansas farmers.

The first grain sorghum variety developed at the Hays Experiment Station was Pink kafir. According to the Kansas Agricultural Experiment Station, the U.S. Department of Agriculture imported Pink kafir seed from South Africa in 1905. Seed was sent to the William Rockefeller Ranch at Russell, Kansas, but soon became contaminated. The Hays Experiment Station obtained some of the contaminated seed in 1907 and, from 1907-1910, purified the variety through testing and selection. In 1909, seed was sold to growers and the variety was widely distributed. [12] Pink kafir was considered one of the most valuable grain sorghum varieties for many years. By 1910, production of all types of sorghum in Kansas was valued at almost $14 million and over 1.2 million acres were planted to sorghum.

Kafir Corn, Sheridan County, 1939

Source: Library of Congress; Russell Lee, photographer

Beginning about 1920, changes in harvesting equipment brought about changes in the height of the grain sorghum varieties planted in Kansas. Shorter "dwarf" varieties were developed that could be harvested by combines (rather than being cut, bundled into "shocks," and threshed or fed later). In 1935, seed had to be shipped in from Texas when the drought the year before caused a shortage of grain sorghum seed in Kansas. The Kansas grain sorghum crop was a total failure in 1936.

Sorghum Shocks, Shawnee County, 1938

Source: Library of Congress; John Vachon, photographer

For many years, producers chose from a handful of standard grain sorghum varieties. Since the late 1950s, researchers have offered grain sorghum producers hundreds of hybrid grain sorghums. Hybridization, which requires the purchase of new seed each year, has resulted in yield improvements as well as quality improvements, such as disease resistance, pest resistance, and standability (stalk strength). Grain sorghum is grown under a wide range of climatic conditions across the state and the average length of the growing season varies greatly from one side of the state to another.

Any changes in the number of acres planted to grain sorghum in Kansas are reflections of national trends, caused in part by the potential for higher economic returns from planting and harvesting other crops. Grain sorghum continues to be an important crop in Kansas, providing a valuable product to the Kansas livestock and ethanol industries. Kansas continues to be a leading producer of grain sorghum in the United States.

Feed Wagon, early 1920s

Courtesy: Stoskopf Farms

Kansas Grain Sorghum Timeline
1904– first release of grain sorghum seed from Hays Agricultural Experiment Station.
1910– over 1.2 million acres planted; valued at almost $14 million (all sorghum types).
1932– over two million acres planted; over one million acres harvested.
1933– over three million acres planted; only 112,000 acres harvested.
1940– 4.6 million acres planted; first crop to produce over 20 million bushels.
1944– first time over two million acres harvested; produced nearly 50 million bushels.
1957– nearly 8.2 million acres planted (current state record); over 6 million acres harvested (current state record); first crop to produce over 100 million bushels.
1971– first crop over 200 million bushels.
1972– first crop valued at over $300 million.
1973– first crop valued at over $400 million.
1979– first crop valued at over $500 million.
1986– first crop over 300 million bushels.
1996– 354,200,000 bushels produced (current state record); crop valued at over $800 million (current state record).

Source: Kansas Agricultural Statistics Service

Soybeans

(Glycine max)

"... wouldn't it be wonderful if someday, the President sat down and looked at the crop report and said, man, we've got a lot of soybeans; it means we're less dependent on foreign sources of energy."

George W. Bush, 43rd President of the United States

The soybean plant grows in a bushy shape, rather than with straight stalks like wheat, corn, and grain sorghum. The soybean plant is a legume, which means that the growing soybean plant produces and deposits nitrogen into the soil through its root systems. The next crop uses the stored nitrogen when it begins growing in the same field, reducing the amount of added fertilizer required by the new crop. Soybeans are planted in late spring and produce 60-80 pods over the summer. Each pod holds three seeds (soybeans). Each soybean is slightly larger than a pea. It takes 2,500 to 3,400 soybeans to weigh one pound. One bushel of soybeans is equal to 60 pounds of soybeans.

Soybeans

Source: Minnesota Soybean

Until recently, the United States was the world's largest exporter of soybeans. Currently, although the world-wide consumption of soybeans is rising, the U.S. accounts for less than 40 percent of the world's soybean production, according to the American Soybean Association. In the United States, soybeans rank second (behind corn) in the number of acres planted and the value of the crop produced. At the present time, soybeans account for 90 percent of the oilseeds produced in the United States.

Soybean Plants

Source: USDA

The number of acres planted to soybeans in Kansas is fluctuating. In 2004, soybean production jumped 95 percent from the year before to a record 111.1 million bushels according to the Kansas Agricultural Statistics Service. In 2006, Kansas farmers planted over three million acres of soybeans but soybean acreage in Kansas dropped by over 20 percent in 2007. New herbicide resistant varieties of soybeans that allow for better weed control and produce higher yields, along with a rising demand for corn, are some of the factors driving the changes in soybean production in Kansas.

Soybeans Ready for Harvest

Credit: Scott Bauer, USDA ARS

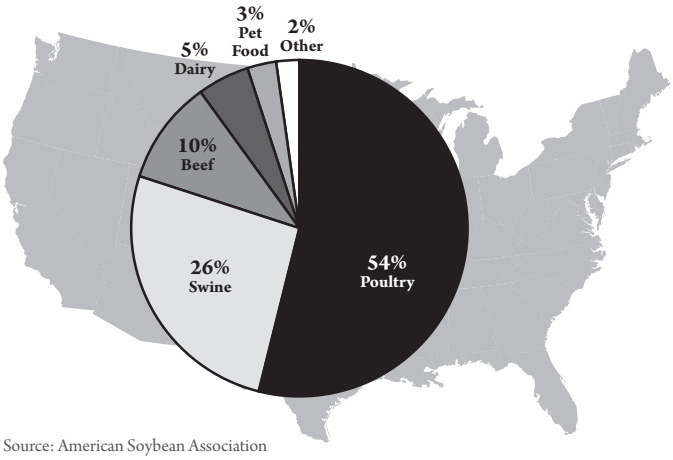
Pod with Soybeans

Credit: Scott Bauer, USDA ARS

Soybean Uses

Nearly all the soybeans produced in the United States are "crushed," which is the process of separating and extracting the oil. The extraction process creates soybean meal, an easily digested, high protein product. For every bushel (60 pounds) of soybeans that is crushed, 80 percent (48 pounds) becomes soybean meal. Worldwide, soybean meal is the largest source of protein feed. Over 90 percent of the soybean meal consumed in the United States is fed to livestock. According to the American Soybean Association, 54 percent of the soybean meal produced in the U.S. is fed to poultry. Another 26 percent is fed to swine. Swine cannot digest raw soybeans but can eat soybean meal because the soybeans have been

U.S. Soybean Use by Livestock



Source: American Soybean Association

cooked during the oil extraction process. Soybean meal is also used in baking ingredients and as a meat substitute in foods for human consumption.

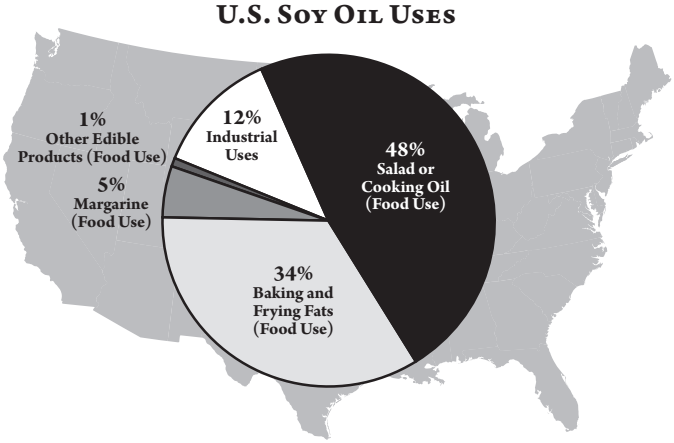
The most widely used vegetable oil in the world is soybean oil (soy oil). Between 18 to 19 percent of the weight of the whole soybean is oil. Nearly all of the soy oil produced in the United States is used in salad and cooking oil, bakery shortening, frying fat, and margarine. Industrial applications for soy oil, which consume 12 percent of the soy oil produced in the United States, are expanding and expected to consume even more soy oil in the future. Soy oil is used in plastics, printing inks, lubricants, solvents, crayons, textiles, and biodiesel.

Soybean Products
Credit: Scott Bauer, USDA ARS

Soy Crayons
Source: Minnesota Soybean

While whole soybeans represent nearly 80 percent of the soybean products exported by the United States, only a small portion of the U.S. soybean crop is not crushed. Whole soybeans are used for seed, dairy feed, snack foods, and processed into traditional soyfoods, such as tofu and soy flour.

U.S. Soy Oil Uses



Source: American Soybean Association

Soy Oil

Soy oil (soybean oil) is the most widely used vegetable oil in the world.

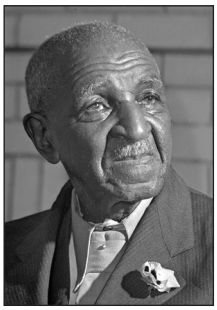
Source: American Soybean Association

Soybean History

A Chinese emperor made the first record of soybeans around 5,000 years ago in books describing plant life. Chinese records suggest that soybeans were sown yearly during ceremonies by Chinese emperors. These were such significant events that poets wrote about the importance of the crop to Chinese civilization. Soybeans were important to the rest of Asia as well.

In 1765, the first soybeans in the United States were planted on a farm in Georgia. A seaman brought the seed to the United States from China, by way of England. The crop was harvested for hay and what remained was tilled into the soil for use as a fertilizer for future crops. While in England in 1770, Benjamin Franklin sent soybean seeds to a leading botanist in Pennsylvania. In the 1800s, sailors loading ships leaving China used soybeans as an inexpensive ballast. When the ships arrived in the United States, the soybeans were dumped so that the ships could be loaded with cargo. U.S. farmers began growing the soybeans and even raised one variety to use as soy sauce.

During the Civil War, soldiers and others who could not get "real" coffee often substituted soybeans for coffee beans. In the late 1800s, soybeans became popular as a forage crop for cattle. Then, in the early 1900s, George Washington Carver began studying soybeans and discovered the potential for soybeans to be more than just a forage crop. Carver researched potential soy protein and oil products, including a variety of food and industrial products - even a biodiesel fuel product.



George Washington Carver
Source: Library of Congress; Arthur Rothstein, photographer

Soybeans became popular in the southern states where Carver's research was promoted and farmers were looking for alternatives to cotton. In 1890, the Kansas State Agricultural College Experiment Station in Manhattan offered free soybean seed to farmers to introduce the crop into Kansas. [13] However, the Kansas Department of Agriculture did not begin tracking soybean production in the state until 1924. That year, farmers in Kansas planted 11,000 acres but harvested only 2,000 acres of soybeans, producing just 22,000 bushels, according to the records of the Kansas Agricultural Statistics Service. From late 1929 to 1931, William J. Morse, a scientist with the U.S. Department of Agriculture, spent two years in Japan, Korea, and China collecting over 4,000 soybean varieties. Researchers used those seeds to lay the foundation for the United States to become the world's leader in soybean production.

By 1940, the United States was a net exporter of soybeans and soybean products. Soybean production began expanding again in the mid-1940s when herbicides and pesticides became available for use by farmers. During World War II, food processors turned to soy oil when imports of edible fats and oils were disrupted. Soybean

Kansas Soybean Timeline
1890– Kansas State University offered free soybean seed to farmers.
1924– 11,000 acres planted but only 2,000 acres harvested, producing 22,000 bushels.
1931– first crop over 100,000 bushels.
1941– first crop over 500,000 bushels.
1942– 2.4 million bushels produced; 290,000 acres planted but only 212,000 acres harvested.
1950– 7.1 million bushels produced.
1961– 703,000 acres planted; produced 15.1 million bushels.
1966– first 20 million bushel crop.
1973– 1.2 million acres harvested.
1987– 2.1 million acres harvested.
2004– 111,110,000 bushels produced (current state record).
2006– 3.2 million acres planted (current state record); 3.1 million acres harvested (current state record); crop valued at $601.2 million (current state record).

Source: Kansas Agricultural Statistics Service

meal triggered an expansion in livestock and poultry production in the United States in the early 1950s when it became available as a low-cost, high-protein feed ingredient. In the late 1950s and 1960s, an inexpensive source of nitrogen fertilizer, anhydrous ammonia, led to higher crop yields and soybean acreage increased in many states, including Kansas.

In 1973, Kansas farmers planted–and harvested–over one million acres of soybeans for the first time. Even though soybean acreage slipped across the United States in the 1980s, Kansas reached a milestone in 1987 when Kansas farmers planted over two million acres. During the 1990s, production across the United States continued to soar and the U.S. was the world's largest producer and exporter of soybeans. Stiff competition from South America, especially Brazil and Argentina, cut the United States' share of the world's soybean exports from 95 percent in the 1990s to below 50 percent today.

Inside the United States, the demand for soy oil is being supported by the interest in renewable fuels, such as biodiesel. About 85 percent of the biodiesel produced in the U.S. is produced from soy oil.

Biodiesel

One bushel of soybeans (60 pounds) yields 1.5 gallons of biodiesel.

Source: American Soybean Association

Sunflowers

(Helianthus annuus)

"What is a weed? A plant whose virtues have not yet been discovered."
Ralph Waldo Emerson, American author, poet, and philosopher

Although Kansas is known as the "Sunflower State," the state flower is actually the wild sunflower that is native to North America. The sunflowers that are planted by Kansas farmers today are generations removed from the seeds that were taken to Europe, started a sunflower industry in Russia, came back to North America with Russian immigrants, started a commercial breeding program in Canada, and were imported back into the United States.

Sunflower Heads
Credit: Bruce Fritz, USDA ARS

Russia continues to be the world's largest producer of cultivated sunflowers. Other significant producers are Argentina, the European Union, China, India, Turkey, and South Africa. In the United States, 1.9 million acres were planted to sunflowers in 2007. Kansas ranks third in both sunflower acreage and production behind North Dakota and South Dakota. North Dakota alone accounts for over 50 percent of the planted acres and 25 percent of the nation's production of sunflowers. According to the Kansas Agricultural Statistics Service, around 150,000 acres are planted to sunflowers in Kansas each year, producing over 450,000 pounds of sunflowers valued at over $46 million.

One unusual characteristic of sunflowers is that the plants follow the sun as it moves across the sky from east to west each day (returning to the east each morning), an action called heliotropism. This 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. The sunflower heads become heavy as the seeds fill and the heads may turn so that they face the ground.

Sunflowers are drought-tolerant and heat-tolerant. Cultivated sunflowers are grown from hybrid seed that is purchased each year. Each seed grows a single stalk with one sunflower head, unlike the native sunflower plants that produce multiple heads. Each

Field of Sunflowers
Credit: Bruce Fritz, USDA ARS

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.

sunflower plant has an extensive root system, with a long taproot that can reach deep into the soil to find water. Researchers have measured sunflower roots that were growing nearly 9 feet below the surface of the soil. Because there are so many wild sunflowers growing in Kansas, the chances are increased that insects that find sanctuary in native sunflowers will attack cultivated sunflowers at susceptible stages of development. However, some insects are beneficial and the use of insecticides is always carefully managed according to the amount of insect activity, the pest species present, and the stages of plant growth. After the sunflower seeds have formed, bird damage is another concern producers must face. In some areas of Kansas, resident or migrating birds make it impractical to grow sunflowers.

Opening Sunflower
Source: National Sunflower Assn.

Drying Sunflowers
Source: National Sunflower Assn.

There are two types of sunflowers produced in Kansas: oilseed and non-oil (confection). Each type requires specific crop production management techniques, separate storage, and different processing facilities. Oilseed sunflowers produce seeds that are shiny, black and smaller than the seeds of non-oil sunflowers, which produce black-colored seeds with white stripes that are approximately five-eighths of an inch long. Nearly 80 percent of the sunflowers produced in the United States are oilseeds.

The sunflower industry is an important agricultural industry in Kansas even though Kansas does not lead the nation in sunflower production statistics. Kansas is home to several sunflower processing and birdseed packaging plants, including a sunflower oil production plant near Goodland and two confection sunflower processing plants at Colby and Goodland.

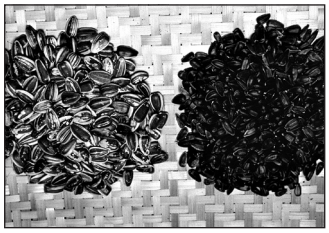
Cultivated Sunflowers
Credit: Edward McCain, USDA ARS

Wild Sunflowers
Credit: Douglas S. Helmke, KRWA

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 Uses

The oil content of an intact oilseed sunflower seed is over 42 percent. There are three different kinds of oilseed sunflowers; each produces an oil with distinctive qualities. According to the National Sunflower Association, 70 percent of the oilseed sunflowers planted in the United States are NuSun® varieties. NuSun® oil is an excellent frying oil and is used commercially by major snack food manufacturers and other segments of the food industry. High oleic sunflower oil is a commercial oil used in baking, frying, and in food products such as non-dairy creamers, cereal, crackers, and dried fruit. In many countries, the traditional sunflower oil, linoleic sunflower oil, is the preferred oil for cooking. In the United States, it is also used in margarine and salad oils.

Sunflower Oil and Chips
Source: National Sunflower Assn.

Sunflower meal is produced in the process of "crushing" sunflower seeds to extract sunflower oil. Nearly all of the sunflower meal produced in the United States is used as an ingredient in livestock feed. Oilseed sunflowers can also be fed to dairy cattle or packaged for birdseed.

Non-oil (confection) sunflowers produce seeds for baking or for sunflower seeds, an American original! Confection sunflower seeds are sorted according to size. The largest seeds are sold intact. The hulls (shells) are usually removed from 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 Kernel
Source: National Sunflower Assn.

Sunflower Seeds
Source: National Sunflower Assn.

Sunflower History

The sunflower plant is native to Central America, where the sunflower held a place of honor in the Aztec culture. The Aztec temples in what is now Mexico included pure gold symbols of sunflowers. From Central America, the domestication of sunflowers spread north and east. Native Americans grew and used sunflowers in many ways. Food uses included flour, seeds, and oil. Purple sunflower dyes were used for body painting and for painting and dyeing fabrics and other materials. Sunflower stalks were used as building materials and parts of the sunflower plant had medicinal uses.

In the 1500s, Spanish explorers carried sunflowers seeds back to Europe where the sunflower became an ornamental garden plant. Although some experimentation with oil extraction took place in the 1700s in England, the sunflower was not recognized as a food plant until it reached Russia, sometime before 1800. Sunflower oil was being commercially manufactured in Russia by 1830. It jumped in popularity when sunflower oil was left off the list of foods prohibited from being consumed during Lent by the Russian Orthodox Church. Selective breeding programs developed single-headed, large-seeded plants and varieties with high oil content.

Seeds in Sunflower Head
Source: National Sunflower Assn.

When the Lewis and Clark expedition passed through the Great Plains in 1805, the explorers noted how the American Indians made use of the sunflower plants. Early travelers and settlers used dried sunflower stalks for fuel and sunflower seeds for poultry feed. About the same time that Russian sunflower seed was finding its way back into the United States, probably being carried into states like Kansas by Russian immigrants, Kansas was attracting attention as the "Sunflower State." As early as 1880, newspaper editors and other prominent citizens proposed that the wild sunflower be adopted as the state flower. [14] In 1903, the sunflower was named the official state flower.

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 in Argentina. The sunflower industry in North America took longer to develop than that of Russia or Argentina. In the United States, the first commercial use of sunflowers was as silage feed for poultry. In 1930, Canada started the first official government sunflower breeding program. From Canada, sunflower production spread down into Minnesota and North Dakota.

In the late 1970s, Russia could not export enough sunflower oil to meet the demand in Europe and producers in the United States

Kansas Sunflower Timeline

1903– native wild sunflower named state flower.
1988– 200,000 acres planted; produced over 240 million pounds of sunflower seeds.
1994– first 300 million pound crop.
1995– 300,000 acres planted.
1999– first 400 million pound crop.
2001– 335,000 acres planted (current state record); 323,000 acres harvested (current state record).
2005– 452,100,000 pound crop (current state record); crop valued at $46.5 million (current state record).

Source: Kansas Agricultural Statistics Service

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

expanded sunflower acreage to over 5 million acres. According to the National Sunflower Association, the first NuSun® oilseed sunflower varieties were developed in the mid-1990s in anticipation of health concerns that the food industry would be asked to address. In Kansas, the number of acres planted to sunflowers jumped in 1994 and has remained fairly constant ever since. Today, Western Europe depends on its own production to meet its demand for sunflower oil.

Sunflowers
Credit: Bruce Fritz, USDA ARS

Sunflowers have always been popular. Famous artists like Picasso and van Gogh and modern-day designers have used sunflowers as the subject for art, fabric, and objects of every kind imaginable. Poets, songwriters, authors, and movie producers have all immortalized the state flower of Kansas. No longer just a wildflower, the sunflower is also one of the leading agricultural crops in Kansas.

Alfalfa

(Medicago sativa)

"On every stem, on every leaf ... and at the root of everything that grew, was a professional specialist in the shape of a grub, caterpillar, aphis, or other expert, whose business it was to devour that particular part."

Oliver Wendell Holmes, American poet and writer

Known as "lucerne" in most countries around the world, alfalfa is a perennial plant that grows two to three feet tall and produces lush green foliage with leaves that have a high protein content. As a legume, the alfalfa plant has the ability to take nitrogen from the atmosphere and transform it into the form of nitrogen that the plant needs for growth and development. Excess nitrogen produced by the alfalfa plant is stored in the soil for the next growing season or future crops. The roots of an alfalfa plant can penetrate as deep as 25 feet below the soil's surface.

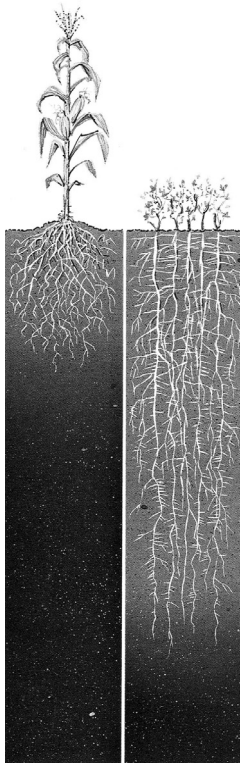
Alfalfa Plant
Credit: Mary Anne Stoskopf

When planting alfalfa in Kansas, the goal is to establish a field of healthy growing plants before extreme weather conditions hit– either the heat in late spring or a hard freeze in the fall. The production for several years depends on planting and maintaining a good "stand" of healthy plants. Planting alfalfa is an expensive operation usually requiring extensive seedbed preparation. Adequate soil moisture for seed germination and timely rains during early growth stages often mean the difference between success and failure. A thin stand, one in which the alfalfa plants are farther apart, allows weeds to grow between the alfalfa plants and reduces the quality of the hay that can be produced. Weeds also attract and harbor insects that attack the alfalfa plants and reduce the quantity of hay produced.

When planting, the choice of alfalfa variety is a critical management decision because it determines hay production qualities and quantities for several years. Soil types, disease and pest resistance, availability of water or drought tolerance, and the anticipated livestock market determine variety choices.

Alfalfa Re-growth
Credit: Mary Anne Stoskopf

Depth of Corn Roots (left) vs. Alfalfa Roots (right)
Source: University of Minnesota Extension Service



Alfalfa is a labor-intensive crop. When provided with adequate water, alfalfa plants re-grow each time they are harvested during the growing season and stop growing only after the first hard freeze in the fall. Under optimal growing conditions, alfalfa reaches the stage for harvesting approximately 28 days after the previous time the stems and leaves were cut from growing plants. During the growing season, each harvest of the alfalfa plants is considered one "cutting." A swather (machine) cuts the alfalfa plants about 2 inches above the ground and gathers the cut alfalfa into windrows, long narrow piles that run the length of the field.

An alfalfa plant is about 80 percent water so the cut plant material must dry down before it can be baled–collected and compacted into manageable units for transportation and feeding. The leaves–which have the highest nutritive value, taste better, and are easier for livestock to digest–dry faster than the stems. By the time the stems are dry, the leaves are so dry they would all fall off if the alfalfa was baled right then. To help the cut alfalfa dry uniformly, a rake may be used to roll and fluff the windrows, bringing the bottom layer to the top. Timing is critical as the producer waits for humidity levels to be just right to produce high-quality bales of alfalfa. If the alfalfa is baled at high moisture levels, it will produce mold inside the bales and livestock will not eat the hay. If the alfalfa is too dry when it is raked or baled, it will not have as high a nutritive value because the leaves will not stay attached to the stems and it may need to be mixed with higher-quality hay before livestock will eat it.

Swathing and baling is the most common harvesting practice for alfalfa in Kansas. However, alfalfa is also harvested as haylage—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.

Swather– front view
Credit: Mary Anne Stoskopf

Swather– rear view
Credit: Mary Anne Stoskopf

Baling
Credit: Dean Stoskopf

Raked Windrows
Credit: Dean Stoskopf

Unlike many other Kansas crops, alfalfa is a perennial plant and fields of alfalfa are maintained for years, rather than months. A well-maintained field of alfalfa may produce good quality hay for five to seven years in Kansas. Alfalfa fields provide habitat and food for many species, but alfalfa plants are particularly vulnerable to insect pests that can strip the leaves off the plants or even kill the plants. When it becomes necessary, an insecticide targeted for the specific insect species threatening the crop will be used on the alfalfa plants. Since alfalfa is pollinated by insects, insecticides are chosen very carefully and used only when necessary. When harvested as hay or silage, alfalfa is cut before seed production starts. If a seed crop is being produced, pollination is critical and beneficial insects, usually bees, may even be placed in the alfalfa field to ensure that pollination takes place.

Alfalfa Flower
Credit: Keith Weller, USDA ARS

According to the National Agricultural Statistics Service, around 21.5 million acres of alfalfa were harvested in the United States in 2007. Domestic animals, many on the same farms where the alfalfa is produced, consume about 90 percent of the U.S. alfalfa crop each year. In Kansas, more farms grow alfalfa than corn. Kansas produces about 5 percent of the alfalfa produced in the United States, according to the Kansas Agricultural Statistics Service. Among the states, Kansas ranks 8th in both alfalfa acreage (900,000 acres) and production (3.6 million tons in 2006). Alfalfa production is measured in tonnage - the number of tons of plant material removed per acre.

Alfalfa Uses

Alfalfa is the most important forage crop grown in the United States. The highest quality hay is high in protein and low in fiber, meaning that it supplies high levels of energy and nutrition without requiring the animal to use as much energy to digest the feed as other feeds and grains might. In addition to protein, alfalfa provides other important nutrients such as calcium and carotene.

Around the world and in the United States, alfalfa is primarily fed to dairy cows. In Kansas, the highest quality alfalfa is usually sold to dairies; however, most of the alfalfa produced in Kansas is fed to beef cattle. Calves in feedyards or cows without calves do not have the high-protein, low-fiber dietary requirements of dairy cattle. In addition to cattle, alfalfa is important in the diets of 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.

Dairy Cows
Credit: Scott Bauer, USDA ARS

Although alfalfa sprouts first appeared on salad bars in the 1970s, alfalfa sprouts (produced from alfalfa seeds) remain a minor use of the U.S. alfalfa crop. On the other hand, alfalfa is the main crop used to produce honey in the United States, accounting for one-third of the honey produced in this country each year. [15]

Honey
Credit: Scott Bauer, USDA ARS

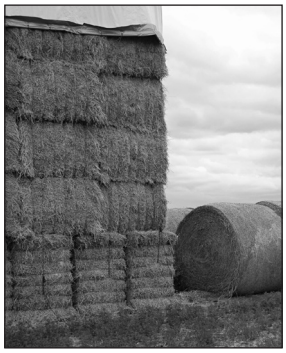
Alfalfa Bale Comparison

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

Round Bale:
1500 pounds, 5 feet wide, 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

Alfalfa History

Alfalfa is an ancient crop, probably first grown more than 6,000 years ago in the Persian region (Iran, Iraq, and Sudan). From Persia, alfalfa spread to the Greek, Roman, and Chinese empires as it was carried along as feed for military and other horses. The Romans introduced alfalfa in Europe, and during the Middle Ages, alfalfa spread into many areas of Northern Africa and Europe, including Spain. In most countries around the world, the plant was, and still is, called "lucerne." However, when the plant first reached Spain, the Spanish called it by its Arabic name–"alfalfa," meaning "horsepower." Spanish and Portuguese explorers brought alfalfa to Central and South America. In the early 1850s, alfalfa moved

Alfalfa Fact

Alfalfa is the one of the most important crops grown for livestock feed in the United States. Alfalfa is high in protein and other nutrients important in the diets of dairy cattle, beef cattle, and other animals.

Kansas Alfalfa Timeline
1870s– KSAC Agricultural Experiment Station begins field experiments with alfalfa.
1893– State Board of Agriculture's first report of alfalfa as a separate crop states 75,200 acres were harvested in Kansas.
1895– first crop over 100,000 acres.
1898– first crop over 200,000 acres.
1903– first crop over 500,000 acres (566,592 acres).
1912– first crop over one million acres.
1915– tonnage and value first reported by State Board of Agriculture; over 1.3 million acres harvested, produced 4.6 million tons valued at $28.4 million.
1919– 2.5 million tons produced (largest crop produced until 1957); valued at $61.8 million.
1921– State Board of Agriculture began tracking alfalfa seed production.
1955– 1,538,000 acres harvested (current state record).
1998– 4.6 million tons produced (current state record).
2006– 3.6 million tons produced; valued at $397,100,000 (current state record).

Source: Kansas Agricultural Statistics Service

north to California. On the eastern coast of the United States, early colonists, including Thomas Jefferson, experimented with growing alfalfa. German immigrants planted alfalfa in New York in the 1820s from seed they carried into the United States. It was in California, however, that the potential of alfalfa for hay production was first recognized. Alfalfa production spread from the west coast eastward, although alfalfa seed production is still concentrated in the northwestern states.

Like many other crops in Kansas, early settlers brought the first alfalfa seeds into the state. In the early 1870s, the Kansas State Agricultural College's Experiment Station began field experiments with alfalfa. [16] In the 1880s, alfalfa gained a reputation as a profitable crop in Kansas. However, the State Board of Agriculture did not report "tame grass" statistics, which included alfalfa and other types of hay, until 1891. By 1893, the State Board of Agriculture was reporting alfalfa as an individual crop and alfalfa seed was in high demand. One Kansas farmer reported that the seed from his 1893 alfalfa crop was worth the price of the land it was raised on, and he had had two cuttings of hay that year as well. [17] In 1894, the State Board of Agriculture completed a study of alfalfa and by 1902, alfalfa was growing in 99 counties in Kansas. Alfalfa acreage in Kansas had expanded from 75,000 acres in 1893 to nearly 500,000 acres in 1902. In 1908, the government bought and furnished Peruvian dryland alfalfa seed for 30 farmers to plant in Grant and Haskell counties. [18]

Hay Wagon, 1937
Credit: Library of Congress; Russell Lee, photographer

According to the records of the Kansas Agricultural Statistics Service, in 1919, there were 1.3 million acres of alfalfa planted in Kansas, producing 2.5 million tons of alfalfa hay. In 1923, the number of acres dropped below one million but production continued to rise. Acreage dipped in the late 1930s, reaching a low of 380,000 acres in 1939 before starting to climb again in the 1940s. In 1947, the state once again had one million acres of alfalfa in production. A record number of acres were in alfalfa production in 1955–1.5 million acres. Kansas growers set the record for the largest alfalfa crop ever produced in Kansas–to date–in 1998 when they produced 4.6 million tons of alfalfa on one million acres.

Round Bales
Source: High Plains Journal

In 1980, the Kansas Agricultural Experiment Station established an official alfalfa testing program. New varieties are tested for at least three years, providing growers with useful performance comparisons.

Cotton

(Gossypium hirsutum)

"Not a breath of air stirred over the free and open prairie;
the clouds were like light piles of cotton;
and where the blue sky was visible, it wore a hazy and languid aspect."
Francis Parkman, American historian

Even though it is grown as an annual crop in the United States, cotton is a perennial plant that does not die in the fall in its native tropical habitat. The growing season in Kansas is relatively short because warm days and warm nights are required for optimum growth and development. In Kansas, cotton is generally planted during the month of May and early June.

Because it is a perennial plant, cotton produces vegetation (leaves) and fruiting structures (fruiting branches, flower buds, blooms, and bolls) at the same time. Fruiting branches produce the flower buds, referred to as cotton squares, which bloom and may become harvestable cotton bolls. Typically, only 35 to 40 percent of the flowers (blooms) make cotton bolls. The fruit of the cotton plant is the boll, a capsule with four to five sections that contains the seed, linters (fuzz attached to the seed), and lint (long fibers).

Cotton
Credit: Scott Bauer, USDA ARS

top left: ***Cotton Flower***
Credit: USDA NRCS

top right: ***Open Cotton Boll***
Credit: Peggy Greb, USDA ARS

left: ***Cotton Boll close-up***
Credit: USDA NRCS

The U.S. cotton crop is mechanically harvested. In Kansas, cotton producers use stripper machines that pull all the bolls from the cotton 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. Each module will contain about 10 to 11 bales of cotton after ginning. At the cotton gin, the lint is separated from the cottonseed and cleaned. The lint is packed into bales weighing 480 pounds each. Each bale is sampled and valued according to the length of the cotton fiber (measured as "staple"), color (whiteness), fiber strength, micronaire (fineness), uniformity, and the amount of leaves or other things such as dust, grass, or oil that might be found in the cotton. Both quality and quantity determine the value of the harvested lint.

Cotton Harvester
Credit: David Wright, USDA ARS

Cotton Module
Credit: Gary Kramer, USDA NRCS

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

The lint accounts for about one-third of the harvested crop. It takes about 2,350 pounds of cotton to produce a 480-pound bale of lint. Another 740 pounds of seed and 210 pounds of gin trash (stems, leaves, etc.) will be produced from the same 2,350 pounds of cotton. Although cottonseed once had no value, today cottonseed accounts for about 15 percent of the value of the cotton crop. There are three products produced from cottonseed–oil, meal, and hulls.

Raw Cotton (left) vs. Ginned Cotton (right)
Credit: USDA ARS

Examining Cotton Gin Waste
Credit: Scott Bauer, USDA ARS

It is estimated that the U.S. cotton crop stimulates around $120 billion in business revenue in the United States economy each year. In 2007, over 11 million acres were planted to cotton in the United States, expected to produce over 20 million bales of cotton according to the National Cottonseed Products Association. Texas, Arkansas, and Mississippi lead the states in cotton production. Cotton production in Kansas climbed from just 1,200 acres in 1994 to 115,000 acres in 2006 before dropping back to 55,000 acres in 2007. In 2006, Kansas produced 140,000 bales of cotton, according to the Kansas Agricultural Statistics Service.

Cotton Uses

Today, the world uses more cotton than any other fiber, and cotton is the leading value-added crop in the United States. According to the National Cotton Council of America, the main uses of the U.S. cotton crop are apparel (64%), home furnishings (28%), and industrial products (8%). Nearly all Kansas cotton is used to produce denim.

Cotton Yarn
Credit: Scott Bauer, USDA ARS

Cottonseed can be fed to dairy cattle as "whole cottonseed." Cottonseed is also run through delinting machines, cleaned, and dehulled to produce cottonseed oil. On average, one ton of cottonseed produces about 320 pounds of oil, 910 pounds of meal, 540 pounds of hulls, and 167 pounds of linters. Of the three products produced from cottonseed–oil, meal, and hulls–cottonseed oil is the most valuable. It is extracted from the seed kernels after the hulls and cotton linters have been removed. Cottonseed oil, which requires

Denim Jeans
Source: Franklin County CD

One Bale of Cotton Can make:

215 jeans
249 bed sheets
409 men's sport shirts
690 bath towels
765 men's dress shirts
1,217 men's t-shirts
1,256 pillowcases
3,085 diapers
4,321 mid-calf socks
21,960 women's handkerchiefs
313,600 $100 bills

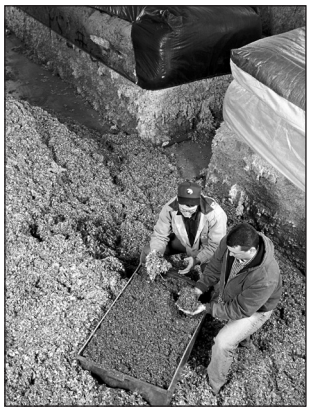
Credit: Scott Bauer, USDA ARS

Source: The National Cotton Council

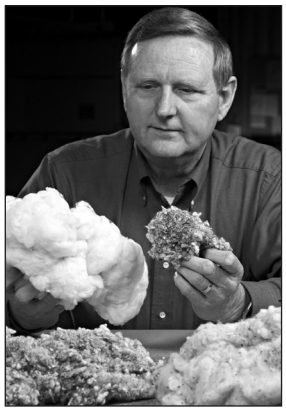
Cotton Oil
Credit: The Cotton Foundation

further processing before it is used in food, is used primarily as a salad or cooking oil and it is also used in baking and frying snack and other foods. Crushed cottonseed meal, made by crushing the seed kernels without removing the linters, is a concentrated high-protein livestock feed, often mixed with other feed ingredients. Cottonseed meal is also used as a lawn and garden fertilizer. The cottonseed hull is the tough coating that surrounds the seed kernel and linters. Some of the cotton linters attach themselves to the hull. Cottonseed hulls are fed to livestock as roughage, rather than as a protein supplement. They are also sold as mulch for flowerbeds.

Cottonseed linters, the short fibers removed from the seed, are used in a wider variety of consumer and industrial products than any of the other cottonseed components. Cotton linters are used in cotton swabs, cotton balls, and medical items. Other industrial uses of cotton linters include carpet yarns, vehicle and furniture cushions, mattresses, and high-grade paper, including paper used in printing money.



Cottonseed
Credit: Scott Bauer, USDA ARS



Cotton Lint
Credit: Peggy Greb, USDA ARS

Cotton History

Cotton has been grown and used in the manufacture of fabric and textiles for thousands of years. Evidence exists that cotton was cultivated in both the Western and Eastern hemispheres, apparently during the same time period 5,000 to 7,000 years ago. Cotton textiles have been found in Pakistan, Peru, and Mexico. Early explorers, including Christopher Columbus and Hernando Cortez, found cotton growing in the West Indies and Mexico.

However, the varieties of cotton grown in Central and South America did not grow well in the southeastern United States. In the early 1600s, colonists began growing small amounts of cotton. Following the American Revolution, cotton was recognized as one of the major crops in the United States. At the time, the British still controlled the textile industry and even went so far as to prohibit anyone familiar with textile machinery from moving to another country. In 1793, Samuel Slater disguised himself as a farmer, came to the United States and, from memory, built the machinery for the first successful cotton yarn mill in this country. Also in 1793, Eli Whitney invented the cotton gin, a simple hand-turned machine that could separate lint from cottonseed. By 1860, the United States was producing almost a billion pounds of cotton each year, nearly two-thirds of the world's supply. [19]

When the Civil War disrupted cotton production in the traditional cotton growing states, settlers in Kansas and other western states experimented with raising cotton. Someone in practically every county in Kansas tried growing cotton but by 1878, there were only 508 acres in 22 counties planted to cotton. [20] Kansans continued to plant cotton through the years, mostly in southern and southeastern Kansas. In 1887, it was reported that 30 carloads (railcars) of cotton had been produced near Iola. [21] In 1928, 300 bales of cotton were produced on 1,700 acres in Kansas according to the records of the Kansas Agricultural Statistics Service.

In the 1930s, cotton acreage in Kansas began dropping until 1943 when only 200 acres were planted. According to the Kansas

Kansas Cotton Timeline

1887– 1,639 acres harvested.
1888– over 200,000 acres harvested; produced 653,000 pounds valued at $51,600.
1892– harvested acres slipped below 700 acres.
1910– only three acres of cotton reported in Kansas.
1913– State Board of Agriculture stopped reporting cotton statistics in annual report.
1928– Kansas Agricultural Statistics Service began reporting cotton statistics; 1,600 acres harvested; 300 bales of cotton produced
1943– cotton acreage slipped to 200 acres; reporting suspended until 1982.
1996– 4,000 acres harvested; produced 4,100 bales of cotton.
1997– 10,000 acres harvested; produced crop valued at $2.6 million.
2003– 80,000 acres harvested.
2006– 110,000 acres harvested (current state record); 140,000 bales produced (current state record).

Source: Kansas Agricultural Statistics Service

Agricultural Statistics Service, 100 bales of cotton were produced on those 200 acres but official state production records were not kept from 1943 until 1982. In 1982, 500 acres were planted to cotton in Kansas. Just 15 years later, in 1997, production jumped to 10,000 acres and by 2000, 40,000 acres of cotton were growing in Kansas.

One of the factors affecting the profitability of growing cotton is the ability to gin the cotton before the quality of the lint is affected by weather or other conditions. Since 1998, four gins have been built in Kansas at Winfield, Anthony, Cullison, and Moscow. Watch for cotton to continue to gain prominence as a major agricultural crop in Kansas.

Other Kansas Crops

"I know of nothing so pleasant to the mind, as the discovery of anything which is at once new and valuable—nothing which so lightens and sweetens toil, as the hopeful pursuit of such discovery. And how vast, and how varied a field is agriculture, for such discovery."

Abraham Lincoln, 16th President of the United States

Kansas farmers have always experimented with a variety of agricultural crops. In the 1860s, flax, hops, rye, tobacco, and Indian corn were included in the state's annual agricultural reports. Crops such as hemp, castor beans, sugar beets, cowpeas, and broomcorn were prominent agricultural crops in Kansas at one time or another. Some crops that have always been produced in Kansas, such as potatoes, oats, and barley, have never been as prominent as wheat or corn. Nevertheless, these crops make a significant contribution to the Kansas economy and add to the diversity of agricultural products grown in Kansas. For example, according to the Kansas Agricultural Statistics Service, potato production in Kansas is valued at over $10 million annually while the state's average pinto bean production is valued at almost $5 million. Oats, grown for the cereal and food industry or for livestock feed, are planted on 90–100,000 acres in Kansas each year, but many years over one-half of those acres are harvested as hay. Barley is also grown for the cereal and food industry or for livestock feed.

above: ***Triticale***
Credit: Louise Ehmke

top right: ***Potato Plant***
Credit: Scott Bauer, USDA ARS

bottom right: ***Pinto Beans***
Credit: Scott Bauer, USDA ARS

Scientific research and experimentation continues to play a vital role in the development of new crops or new varieties of traditional crops that will be profitable for Kansas farmers to grow. Crops like cotton are making a comeback in Kansas because the modern-day varieties have improved genetic qualities that fit the needs of today's agriculture. New varieties of traditional crops, like hard white winter wheat, allow Kansas farmers to add value to traditional agricultural products and tap into new markets. Today, agricultural biotechnology allows plant breeders to make precise genetic changes and address specific challenges more rapidly than traditional plant breeding methods.

Canola
Credit: Bob Nichols, USDA

Canola may turn out to be another major crop in Kansas. Canola is a member of the mustard family of plants, with bright yellow flowers. New winter canola varieties have been developed that are planted in the fall, similar to winter wheat, and are harvested just prior to winter wheat in early summer. Canola is an oilseed, producing tiny purple seeds that are crushed for oil. The oil can be marketed as cooking oil or used for making biodiesel. At the present time, 70 percent of the canola oil used in the United States is imported from Canada and Europe, according to K-State Research and Extension faculty. However, one of the challenges facing Kansas canola producers is the lack of canola processing facilities within the state. Perhaps this will change, just as the number of cotton gins in the state has risen with the increase in cotton production in Kansas.

Another crop making headlines in Kansas is rice. In 2006, officials announced plans to open a bioprocessing facility for plant-made pharmaceuticals in Junction City, Kansas. Plans call for the facility to process rice. All of the rice produced in Kansas will be delivered to the facility for processing. One reason the Kansas site was selected is that rice is not a traditional or historical Kansas crop. Rice is not expected to become a major agricultural crop in the state.

Interest in cellulosic-based ethanol may drive other changes in Kansas crop production. Crops under consideration for cellulosic ethanol include perennial grasses, such as switchgrass, and forage sorghums. However, dramatic shifts in Kansas crop acreage probably will not occur until additional research is completed and production facilities are in place. By then, researchers and crop producers may have set their sights on other opportunities.

Food, Feed, Fiber, Fuel, and the Future

"We are probably far from possessing, as yet, all the [crops] for which nature has fitted our country. To find out these, will require an abundance of unsuccessful experiments. But if, in a multitude of these, we make one or two useful acquisitions, it repays our trouble."

Thomas Jefferson, 3rd President of the United States

All together, Kansas crops represent the largest land use in Kansas. Nearly 50 percent of the land in Kansas, around 23 million acres, is planted to agricultural crops each year. Even though Kansas is known as the "Wheat State" or the "Sunflower State," Kansas is a leading producer of a wide variety of crops. The crops produced in Kansas propel the state's economy, creating jobs in food, feed, fiber, fuel, and related industries. Kansas crops, products from those crops, and products from livestock fed Kansas crops are distributed throughout the United States and exported around the world.

Today, Kansas farmers face many of the same challenges that the early Kansas settlers faced–erratic rainfall and unpredictable climatic conditions, destructive insects, weeds, and crop diseases. Advancements in technology, plant breeding, and scientific knowledge give today's crop producers additional tools to compete against the challenges and protect the future of their families' investments in the croplands of Kansas.

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Career Profile:

Cindy Falk

Nutrition Educator, Kansas Wheat Commission

Cindy Falk (at left)
Credit: Kansas Wheat Commission

Cindy Falk is a spokesperson for agriculture. She works with media, consumers, educators, students, and even trade representatives. She combines the goals of Kansas wheat producers with the magic of public relations and the result increases the domestic demand for wheat.

Falk grew up on a diversified farm in Pottawatomie County. At an early age, her mother began teaching her about cooking and baking skills. As a 4-H member, she learned about many things, including public speaking and foods and nutrition. "I began presenting 4-H bread demonstrations in middle school and received awards at the county and state level," Falk says. "Teachers, 4-H leaders and judges instructed me with communication skills, and as I grew up, serving as a volunteer in different organizations helped me develop leadership skills."

She served as a volunteer spokesperson for wheat in 1986, sharing information about the crop by presenting bread demonstrations and nutrition and wheat marketing talks. Three years later, Falk was hired by the Kansas Wheat Commission to expand her duties and increase the size and scope of her public relations work. Her job title is now nutrition educator. Her job title has changed over the years, but her duties have always focused on marketing Kansas wheat.

"I enjoy representing Kansas's wheat producers and promoting an agricultural product in my home state," Falk says. While no day is the same, each day's work includes responding to consumer questions and requests for educational materials.

"Yesterday, after reading e-mails, I presented a program on the benefits of whole grains in the diet to a ladies' organization. Following the program, I participated in a conference call with the national Wheat Foods Council membership committee. And afterward, I assisted other staff members with hosting an Israeli Trade Team that was in Manhattan, Kansas."

At certain times of the year, Falk presents information to students at agricultural events, works in the Kansas Wheat booth at the Kansas State Fair, and also writes articles and recipes. Over the past fifty years, the Kansas Wheat Commission has developed hundreds of recipes using a variety of wheat products. Currently, many are featured on the Kansas Wheat Commission's website and in annual recipe booklets.

When a state or national publication or media requests a specific recipe, Falk is called upon to put her culinary and design skills into action. "The media usually also request a photo of the prepared food. Part of my job is to develop, test, write, and bake the product for the photo," she says. "Next, I arrange or 'stylize' the food, so it appeals to consumers so they will want to prepare the recipe. A professional photographer is often hired to snap the photo while some photos are taken in our test kitchen by staff."

Falk is most proud of the education programs and exhibits that she has helped offer to audiences of all ages. "With help from our dedicated spokespersons and staff, we have educated many people about agriculture, nutrition, and home baking. We can take credit for spreading the word about the importance of wheat foods to a healthy diet and efforts to increase consumption," she says. "The most overwhelming exhibits I have assisted with were at national meetings such as the American Dietetic Association, National 4-H Congress and conferences of FCCLA (Family, Career and Community Leaders of America, Inc.). And, with new technology, our messages and educational materials can be used throughout the world."

Her message is not full of empty promises–Falk believes in what she promotes. "Farmers provide a safe and affordable food supply that all of us can enjoy," she says. "It is very rewarding to know that the product you are marketing is a nutritious food consumed throughout the United States and the world." Falk sees many opportunities ahead for the career-minded. "The work that needs to be done to promote agriculture is almost unlimited."

Teacher Resources

Books:

* *Teachers & Advanced Readers;* AR - *Accelerated Reading Level*

The Biography of Corn
Nielsen, L. Michelle. 2007 (AR - 7.5)

The Biography of Cotton
Gleason, Carrie. 2005 (AR - 7.3)

The Biography of Wheat
Lackey, Jennifer. 2007 (AR - 6.8)

The Bread Winner
Whitemore, Arvella. 2004 (AR - 4.5)

Cotton T-Shirt
Ridley, Sarah. 2006 (AR - 5.8)

Farmland Innovator: A Story about Cyrus McCormick
Welch, Catherine A. 2007 (AR - 5.2)

Career Profile:

Mary Knapp

State Climatologist

Credit: Barbara Oplinger

If a farmer wonders what the probability of drought is in the coming year, he or she might call Mary Knapp for the answer.

Knapp is a climatologist for the state of Kansas. She works from the Weather Data Library at Kansas State University, merging pieces of information to answer questions about weather and how it affects the citizens of Kansas and the agriculture of the state.

"It's like solving a huge puzzle," Knapp says. "I really like my job."

Knapp herself began asking questions about the weather early on. "I was just always interested in that sort of thing–weather and its effect on every aspect of life. In 1966, a major tornado had devastating effects on Topeka and its surrounding areas. It left a lasting impression. During high school in Junction City, I did a science fair project on weather modification by cloud seeding and the legal aspects of altering the climate," she says. "It made a big impact."

Knapp attended Kansas State University majoring in agronomy because of the variety of coursework and the diversity of opportunities available to its students and its graduates and its ability to "take you places."

After graduation, Knapp worked as a Peace Corps volunteer on a rice growing project in the Dominican Republic. To ensure the success of the crop, the growers needed to know about the crop itself, but in addition they needed information about the cultural practices of the area, the issues within the community, and the weather and microclimate of the country.

After her volunteer experience, Knapp returned to Kansas State University to work for the department of entomology and then moved to the newly formed department of communications. She subsequently took the job as state climatologist.

Among her primary responsibilities is the duty of sharing information about the weather with the people across the state. Because weather conditions affect crops in many ways, farmers pay particular attention to the information Knapp and her colleagues provide.

"We try to get the truth out," Knapp says. "Kansas has a variable climate. We try to help people think about weather outlooks, maybe consider crops in areas that traditionally haven't grown them before."

To answer someone's query, Knapp looks for the data, using many sources and computer models. The questions she asks are varied: Can we grow cotton further north? Are we fighting invasive species or are we bringing them in? What do we need to consider when we start problem solving? Are we even asking the right questions?

Other things to consider are the sources of the data and its possible bias. "Does the logic need to be questioned?" Knapp asks.

She says climatologists follow a standard learning model: "It's very important to take the time to investigate, explore, and evaluate. That's the only chance to really get answers."

With technological advances and the extensive use of computers, Knapp's job has changed over the years. There was a "huge language gap" between the scientists in agriculture and the computer specialists when she began her job.

"When I first started, desktop computers weren't available," she says. "I have tried to fill the gap between those who know how to use computers with the science needed to use them for that. We are trying to merge data from water, plants, economics, weather, insects, and lots of other fields to try to answer questions in agriculture."

Knapp cautions that one has to take care not to make drastic conclusions and provide quick solutions to fix what can be regarded as a problem. "I think there are a lot of uncertainties about global warming, and our data is for such a short time, really," Knapp says. "When people tamper with nature, they may end up with larger issues than they even knew they had to begin with…we should be wary of 'fixing' what we don't know a lot about yet. Each one of us can do things to minimize our impact on the environment, while trying to increase our understanding of how it works."

Knapp is undaunted by the challenge of constantly merging information and then offering answers. "People ask tough questions about weather–some of the data we have and some of it isn't to be found yet," Knapp says. "To do this job, I recommend the ability to communicate–a desire to know about things–a curiosity and persistence to always be asking questions."

Teacher's Resources (continued)

From Seed to Plant
Gibbons, Gail. 1993 (AR - 3.4)

George Washington Carver What Do You See?
Benge, Janet. 2003 (AR - 5.0)

The Gristmill
Kalman, Bobbie. 1990 (AR - 5.3)

Haystack
Geisert, Arthur. 2003 (AR - 3.4)

The Honey Makers
Gibbons, Gail. 2000 (AR - 4.8)

How It Happens at the Cereal Factory
Rocker, Megan. 2004 (AR - 5.4)

How Plants Survive.
Kudlinski, Kathleen V. 2003 (AR - 4.6)

Kansas Crops Showcase:

Wheat Genomics Laboratory at Kansas State University

Department of Plant Pathology

John Fellers in the Wheat Genomics Laboratory
Credit: Julia Stoskopf-Debes

Crop loss can be devastating in an economic sense to a farmer, but it may also trickle down to higher priced groceries at the store and hungry people worldwide.

Scientists at the Wheat Genomics Laboratory at Kansas State University are trying to help wheat breeders avoid problems like crop loss and accentuate the positive characteristics of what is the most consumed cereal grain. By studying the specific gene order, scientists can find answers to the problems that plague a wheat crop, such as diseases, insects, and low yields. In the future, the possibilities an accurate genome map could help produce are varied: for example, a grain that has higher protein content or exhibits more cancer fighting traits for those who eat it, or a wheat that can be grown in the desert, requiring less land and less water.

The Wheat Genomics Laboratory is actually several labs in which researchers work on different projects that reveal certain aspects of wheat's genetic code. A bigger picture results as the findings of each lab are compiled. One of the goals of the research is to share the discoveries to enhance others' knowledge of the structure and function of a plant's genome.

The rooms that make up the Wheat Genomics Laboratory may look like conventional labs, but some contain large, highly specialized equipment including an Q-bot, a $250,000 robot which is used to automate the picking of bacterial colonies that are used in DNA cloning, and an Applied Biosystems DNA sequencer, used to read the DNA sequence of a clone.

John Fellers, USDA Research Molecular Biologist in the Department of Plant Pathology, says that there are around 100 people working at any one time, most of whom have a background in genetics, biology, plant pathology, and biochemistry. Many are educators and international students. Fellers grew up on a farm and says that has contributed to his excitement about the lab work. "I can see the impact and possibilities that my work has on agriculture."

Fellers' main project deals with wheat leaf rust, a fungi that can spread through a wheat field and be carried across countries and continents if conditions are right. Leaf rust can cause a 20 percent crop loss. The reddish-orange pustules that form on the wheat leaves are filled with spores that spread easily. Leaf rust causes both the infected leaves to die prematurely and all the nutrients to go toward the fungi rather than toward grain production.

An accurate genome sequencing map can help wheat breeders utilize the plant's own resistance to invaders like rust. When an infestation occurs, the plant can sometimes stop the spread by killing the cells around the point of infection.

"It is like a lock and key, where the lock is the resistance gene in the plant and the key is a protein in the pathogen," Fellers says. "If they fit together, you get resistance, but if something doesn't fit or is more or less powerful in the lock or the key, you get infection."

Some wheat varieties are less likely to develop leaf rust, but the resistance lasts only a few years. With a genome sequencing map, the scientists hope to find the exact spot where the resistance takes place and capitalize on it through biotechnology.

"Plants get sick. They get fungal, bacterial, viral, and insect infestations just like people do," Fellers says. "However, they don't have a circulation system, so you can't immunize them against disease, and they can't swat away insects. The plants just have to sit there and take it."

The Life and Times of the Honeybee
Micucci, Charles. 1997 (AR - 5.2)

The Life Cycle of a Sunflower
Tagliaferro, Linda. 2007 (AR - 1.5)

Pancakes, Pancakes!
Carle, Eric. 2005 (AR - 3.2)

Plant Development *
Hopkins, William G. 2006

The Story of George Washington Carver
Moore, Eva. 1990

The Super Soybean
Bial, Raymond. 2007

A Weed Is A Flower: The Life of George Washington Carver
Aliki. 1988 (AR - 4.3)

Kansas Crops Showcase:

Ethanol

Ethanol (ethyl alcohol) is a grain alcohol produced from crops high in starches or sugars. Most of the ethanol produced in the United States is made using corn. However, ethanol can be produced from any starch-rich material, including grain sorghum, wheat, barley, and potatoes. Sugar cane is used to produce ethanol in Brazil, which leads the world in ethanol production. Historically, more grain sorghum has been used in Kansas ethanol plants than corn. The two grains are interchangeable in the ethanol-making process.

Cellulosic Ethanol

Researchers are developing methods to produce cellulosic ethanol, which would be made from materials high in cellulose, such as wheat straw, corn stover, milo stalks, wood chips, and grasses. In August 2007, Abengoa Bioenergy announced plans to build a cellulosic ethanol plant at Hugoton as well as a grain-based ethanol plant at the same location. The company received funding from the U.S. Department of Energy to develop the cellulosic plant. While technology is developing rapidly, no commercial-sized cellulosic plants were in operation in 2007. Most industry-watchers believe cellulosic ethanol production will become a reality in the near future.

Production Process

Most of the newer ethanol production plants use the "dry milling" method to produce ethanol from grain. A bushel of corn or grain sorghum produces 2.8 gallons of ethanol during an eight-step process that takes several days.

Step 1. Milling

The grain is ground into small particles. This exposes the starch, which will be used for the fermentation process. The starch is removed and milled into a fine powder. The remaining material–protein, fiber, vitamins, and minerals–is used for livestock feed.

Step 2. Cooking

The starch powder is mixed with water and an enzyme that helps break the starch into smaller particles. The resulting mash is cooked to liquefy the starch and reduce bacteria levels, before being heated to 225 degrees to help break the starch down further.

Step 3. Conversion

The mash is removed from the cookers and cooled. Then a second enzyme is added to help convert the liquid starch into a sugar (dextrose) that can be fermented.

Step 4. Fermentation

The mash is mixed with yeast, which changes the sugar to ethanol and carbon dioxide. It takes about 48 hours for the mash to ferment.

Step 5. Distillation

The fermented mash contains about 10 percent ethanol. To separate the ethanol from the water and any remaining solids, the mixture is heated to a temperature at which ethanol vaporizes. The ethanol vapor is collected. As it cools, it condenses and becomes a liquid. The solids become distillers grain, a nutritious livestock feed. The carbon dioxide is collected, purified, compressed, and sold for many uses, such as carbonated beverages, dry ice, food processing, and petroleum extraction.

Step 6. Dehydration

To purify the ethanol and remove any remaining water, the ethanol passes through a dehydration system. After this step, the ethanol is approximately 200 proof.

Step 7. Denaturing

A small amount of gasoline is added to the ethanol (2 percent to 5 percent) to make it unfit for human consumption–a requirement for all fuel-grade ethanol.

Step 8. Processing and Distribution of Coproducts

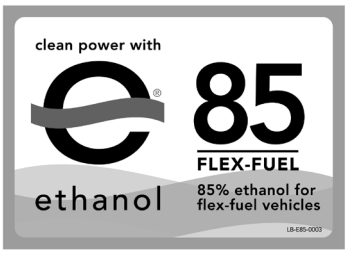
For every bushel of corn or grain sorghum used in the production of ethanol, one-third becomes ethanol, one-third becomes distillers grains, and one-third becomes carbon dioxide.

History

Ethanol has been used in the United States since 1826 when inventor Samuel Morey first used it as a motor fuel. In the 1850s, ethanol was a popular fuel for lighting in homes. Henry Ford's first automobile, designed in the late 1880s, ran on pure ethanol. In 1908, he designed the "Model T" to run on pure ethanol, gasoline, or a blend of the two fuels. However, just as the use of ethanol was gaining momentum in the United States, it was banned during Prohibition. Because it was considered liquor from 1919 until 1933, the only legal way to sell ethanol in the United States was to mix it with petroleum fuel. Ethanol production increased, particularly in the Midwest, but dropped dramatically starting in the mid-1940s due to low prices for petroleum-based fuels. Interest in ethanol production revived in 1973 as the result of an OPEC

Ethanol Fermentation
Credit: ICM, Inc.

(Organization of the Petroleum Exporting Countries) oil embargo. Legislation intended to reduce pollution led to increased acceptance, use, and production of ethanol. In 2005, legislation passed that required the use of 4 billion gallons of biofuels in the U.S. fuel supply beginning in 2006 and 7.5 billion gallons by 2012. Today, ethanol is blended into nearly 50 percent of the fuel supply in the United States. Any vehicle requiring unleaded gasoline can operate on E10, a blend of 10 percent ethanol and 90 percent unleaded gasoline. Flexible Fuel Vehicles can operate on unleaded gasoline blended with ethanol percentages as high as 85 percent, known as E85 fuel.



Environmentally Friendly

In engines, ethanol burns much cleaner than petroleum-based gasoline. When ethanol is blended and used with gasoline in automobiles, carbon monoxide and hydrocarbon tailpipe emissions are significantly reduced. In 2005, the U.S. Department of Energy estimated that the use of ethanol-blended fuels reduced carbon dioxide emissions equivalent to those produced annually by over 1 million automobiles.

The quantity of water used by an ethanol plant may be a concern and is addressed during the site selection process. Most modern ethanol production plants re-use the water that circulates through boilers and cooling towers during the heating and cooling processes involved in ethanol production. Water that comes into contact with the grain and contains dissolved solids may be concentrated into a syrup and added to distillers grains. Systems that do not discharge any liquid water from the fermentation process into the environment are under development. New technologies continue to improve the utilization of water in the ethanol-making process.

Kansas Impact

By January 2008, the 11 ethanol plants in Kansas were capable of producing over 439 million gallons of ethanol each year. With other plants in various stages of planning and construction across Kansas, ethanol production in the state continues to increase.

The rapid expansion of the ethanol industry is creating a high demand for skilled workers who are educated and trained for a variety of positions including electricians, shipping and receiving operators, microbiologists, chemists, engineers, and marketing professionals. New career opportunities are being created across Kansas and other states in the Midwest, many near rural communities.

Teacher's Resources (continued)

Websites:

The Alfalfa Factory: A Remarkable Perennial Legume Finds Many Uses
USDA Agricultural Research Service
http://ars.usda.gov/is/AR/archive/jul02/legume0702.htm

Cotton Counts Educational Resources
National Cotton Council of America
http://www.cotton.org/pubs/cottoncounts/resources.cfm

Cottonseed and Its Products
National Cottonseed Products Association.
www.cottonseed.com/publications/cottonseedanditsproducts.asp

Ethanol
National Corn Growers Association
www.ethanolfacts.com

Ethanol Promotion and Information Council
www.drivingethanol.org

The Humble Soybean
American Soybean Association
http://66.201.71.163/soyindustry/index.htm

Kansas Agricultural Statistics Service
Annual Statistical Bulletin - Farm Facts
(by state total or individual county)
http://www.nass.usda.gov/Statistics_by_State/Kansas/index.asp

Kansas Corn Commission
Kansas Corn Growers Association
Kansas Grain Sorghum Producers Association
www.ksgrains.com

Kansas Grain Sorghum Commission
www.ksgrains.org

Kansas Soybean Association
Kansas Soybean Commission
www.kansassoybeans.com

Kansas Wheat
www.kswheat.org

National Sunflower Association
www.sunflowernsa.com

Weather Data Library
K-State Research and Extension
www.oznet.ksu.edu/wdl/

Notes: