

# Crops

## Combining soil, seeds, and water to make food

*Editor's note: Agriculture is the practice of cultivating soil to produce food crops. The term sometimes includes raising cattle and other livestock. Those operations are covered separately starting on page 32.*

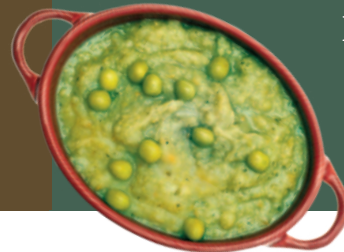
**For thousands of years**, people living in what we now call Montana harvested native plants for food and medicine, including camas root, bitterroot, horse mint, wild plums, huckleberries, and serviceberries. Knowledge of historical plant locations and use continues to be passed down from generation to generation.

Evidence of planted crops dates back a thousand years or more in some regions of the United States. But people living in Montana did not grow plants for food until the mid-19th



Above: The Teton River winds through Teton County across a patchwork of wheat, barley, alfalfa, canola, and other crop fields. Most of the acreage in north-central Montana is dryland (not irrigated), putting it at risk of low yields during drought conditions.

Left: Historic photo of a Nez Perce woman in what is now Idaho sorting and cleaning camas root similar to how the Salish of western Montana processed the plant for thousands of years. PUBLIC DOMAIN. STEPHEN D. SHAWLEY COLLECTION, UNIVERSITY OF IDAHO LIBRARY SPECIAL COLLECTIONS AND ARCHIVES



Montana is among the nation's top producers of "pulse" crops, which include dried peas, dried beans, lentils, and chickpeas. The word is derived from the Latin *puls*, meaning "thick soup," like split pea soup.

century, when missionaries and early farmers planted garden plots and oat fields. Farming as a commercial enterprise started in the mountain valleys of southwestern Montana to feed prospectors and others drawn to the gold rush in the early 1860s.

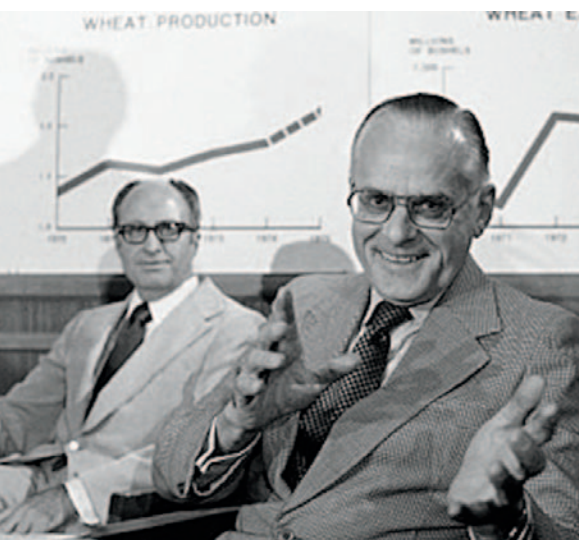
Since then, farming has gone through a series of boom-and-bust cycles. The number of farms and farmers grew during the homesteading era, with a peak in the early 20th century. But years of severe drought starting in 1917 forced many to sell and move to towns or other states. Montana agriculture saw temporary booms in the 1940s due to war-time demand, and in the early 1970s with massive wheat sales to the Soviet Union.

Some producers, having followed the U.S. Department of Agriculture's advice to "get big or get out," in the '70s, over-purchased land and equipment and couldn't make payments when prices dropped in the 1980s. They then had to sell their land or forfeit it to the county if property taxes went unpaid.

#### CONCERNS AND REWARDS

The major challenge facing farmers has always been the lack of control over major elements of their operations, from unpredictable weather to fluctuating global markets.

Farmers always have an eye on the sky. They hope for snow in winter, though not in



Above left: Earl Butz, USDA secretary during the Nixon and Ford administrations, urged farmers to plant "fencerow to fencerow" to increase harvest to meet booming global demand in the 1970s. Many farmers followed his "Get big or get out!" advice and over-purchased land and equipment, saddling themselves with crippling debt once demand and prices fell in the '80s. Above right: Adding to farmers' woes are constantly fluctuating global markets, harvests, and energy prices as well as drought, insects, and the looming threat of summer hail storms. Top: Most ranchers balance the hardships with rewards like raising their kids in the outdoors, knowing they are helping feed the world, and maintaining their family's land stewardship tradition.

amounts that impede travel. As the ground thaws in spring, they keep their fingers crossed for rain, but not so much that it floods fields and prevents planting. After July 1, they bank on drier conditions through the end of summer so ripened crops can be harvested, and cross their fingers that hail won't wipe out an entire harvest.

Farmers also use plenty of electricity and fuel, making energy prices a constant concern. Other Montanans may wince when they fill their gas tank, but farmers often have to fuel a half-dozen or more vehicles.

Then there's the rising or dropping demand in major global markets such as China, or fluctuations in other global grain producers like India that can alter prices that Montana farmers receive for their harvest.

That's a lot to manage. Yet for most farmers, outweighing these challenges are rewards like turning seeds into food, knowing their work sustains communities, continuing the family's land stewardship, raising their kids in fresh air and sunshine, and looking up each night and seeing millions of stars from the back porch.

#### CROP TYPES

Montana's major field crops are categorized as grains (wheat, barley, and corn, also known as cereals) and legumes: alfalfa, soybeans, and "pulses" (dry peas, dry beans, lentils, and chickpeas).

Producers water these crops either by counting on nature or doing it themselves. Dryland farming, used mainly for wheat, barley, pulse crops, and oilseeds, relies only on moisture from rain and snow. Irrigated farming—used mostly for alfalfa, dry beans, sugar



Harvesting wheat near Chinook. Because of the harsh climate, which creates more protein in wheat, Montana's Hi-Line is one of the nation's top durum-producing regions.

beets, and potatoes—involves flooding or spraying fields with water pumped from underground or diverted from rivers or reservoirs.

Montana's top moneymaker is wheat (spring, winter, and durum), accounting for about 45 percent of the state's total crop revenue. Hay, mainly an alfalfa-wheatgrass mix, is the next highest revenue producer, followed by pulses, then barley (used to make hay, beer, and "sweet meal" for baked goods).

Treasure State farmers also produce oilseeds (canola, flax, sunflower, and safflower), sugar beets, and seed potatoes. The Flathead region's moderate climate makes it ideal for growing cherries and melons. Honey production is considered a part of agriculture, too (see page 42).

Montana is the nation's top producer of durum wheat, lentils, and dry peas, and is ranked number two for barley production.

Some farmers grow just one crop, like hard red wheat or malting barley. But others plant a half-dozen or more types, hedging bets on rainfall and global prices, and rotating crops

to reduce insects, weeds, and disease. Many farmers also raise cattle, another way of diversifying income and reducing risk.

#### FOUR-SEASON WORK

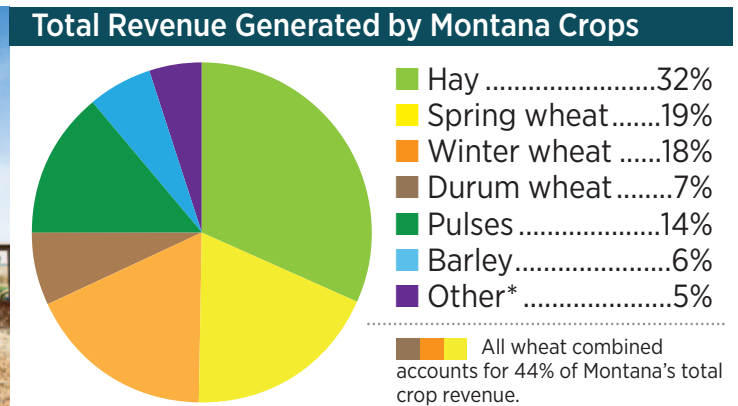
Planting cool-season crops like spring wheat, sugar beets, and barley begins as soon as soil temperatures allow in April or May. That's also when lentils and peas are sown. Warm-season crops like safflower, sunflower, and corn are planted in June. Alfalfa and grass hay are perennials and only need to be planted every 6 to 15 years.

During summer, crops are fertilized and sprayed for weeds and pest insects.

Typically, harvest season begins in July with lentils and dry peas, then winter wheat in late July, spring wheat and barley in mid-August, and corn in September. Sugar beet harvest comes in October.

During winter and between planting and harvest, farmers purchase seed, fertilizer, insecticides, and other necessities for the coming year. They also meet with state and federal ag agency employees who provide advice and assistance with grants, loans, and insurance. Winter is also a time for repairing machinery and vehicles.

A pickup truck is indispensable for hauling everything from fence posts to bags of seed to hay bales. Then there are UTVs (utility vehicles like four-wheelers) and tractors, along with attachments like plows, manure spreaders, seeders, drills (which punch seeds down into dirt without plowing), and hay balers. For wheat and barley farmers, the most important (and costly) machine is the combine harvester (or simply combine, see page 13.) Another piece of equipment



FROM TOP: TODD KLASSY; SHUTTERSTOCK

CLOCKWISE FROM TOP: TODD KLASSY; DOUGLAS ROANIE; ASSOCIATED PRESS



Though wheat, hay, pulses, and barley are Montana's top moneymakers, farmers also grow a wide range of other crops including, clockwise from top left: canola, sugar beets, cherries, and potatoes.

you might see is the grain auger—a gigantic screw encased in a long metal tube installed at the base of a grain bin. As the auger turns, it moves grain through the tube to either empty a truck's contents into the grain bin or fill a bin or a rail car headed to market.

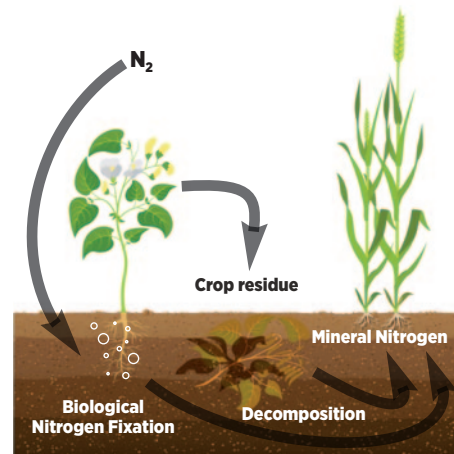
### FERTILIZING

Producing grain year after year demands a lot from soil, which eventually gets depleted of nitrogen, phosphorus, and potassium. To compensate for the loss, farmers treat soil with natural or commercial fertilizers, much the same as homeowners do with house and garden plants.

Most farmers add nitrogen, phosphorus, potassium (potash), and other nutrients to the soil either in pellet, powder, or liquid form. Application rates depend on the particular crop and soil fertility, measured by testing pH (acidity) and soil nutrient levels.

Though they allow farmers to continue producing crops, nitrogen- and phosphorus-rich commercial fertilizers can cause environmental problems. Some wash off the soil

surface with rain into nearby rivers and streams, fueling excess algae and aquatic plant growth harmful to trout and other fish. Some nitrogen seeps into the aquifer, where it can increase levels of harmful nitrates in drinking water. Repeated use of commercial



Farmers often plant "cover crops" of peas and other legumes that "fix" nitrogen in the soil, adding to its fertility. Bacteria on the plants' roots convert nitrogen in the air into nitrogen that wheat and other crops can use later.

fertilizers can also cause soil to acidify and stop plant growth altogether.

Farmers may instead spread natural fertilizers such as cattle, swine, or poultry manure across their fields or plant a "cover crop" of peas or other legumes after harvest rather than let a field sit fallow (unsown). In addition to providing a harvest, a cover crop can "fix," or connect, nitrogen in the soil.

Nitrogen enables photosynthesis, which allows plants to use sunlight energy to produce plant tissue. Most plants can only derive nitrogen from the soil. But bacteria on legume roots can convert nitrogen gas into nitrogen available to plants. After beans or peas are harvested, the nitrogen-rich stems and roots are left to decompose and enrich the soil for future wheat or barley plantings.

Some fields may be intentionally left "in fallow" (not planted) to regenerate nutrients and help retain ground moisture. Traditionally, fallow fields are plowed to kill weeds. But because this increases soil and moisture loss, many cereal crop producers are now killing weeds with herbicides,

## Combine harvesters

The only palatable part of crops such as wheat and barley are the seeds (grains) at the top of each plant. The inedible dry seed husks (chaff) are discarded with the stalks and leaves. Separating the seeds from the chaff is one of grain farming's major operations.

Two hundred years ago, people cut wheat or barley with big, curved knives called scythes. Then they separated grain from the chaff by beating (threshing) the cut stalks. Finally, workers cleaned the remaining debris away from the seeds. Because this work required a lot of time and labor, farms required a lot of laborers. Today, far fewer people are needed to work the land due to the mechanization of farm work.

The most revolutionary device was the combine harvester, which "combines" four separate harvesting operations—reaping, threshing, gathering, and winnowing—into a single process.

Combines were invented in the United States in 1835. The first models were drawn by teams of up to 30 horses, which were eventually replaced with steam and diesel engines. The largest combines today have 700-plus-horsepower engines and are fitted with "headers" that gather a swath of standing crop up to 60 feet wide.

Combines are expensive, and depending on header width may cost up to \$750,000 each. The driver sits in a cab fitted with digital displays on a touch-screen monitor and a joystick covered in buttons. Lasers guide the cutter bar from dropping too low and hitting rocks or dirt mounds.

Some farmers don't own combines but instead contract with seasonal crews, who start harvest in Texas in May and move north. Peak combining in Montana is in August. Other farmers use their own combines or share with family members or neighbors.

A combine consists of the wide header **1**, or draper, which gathers the standing crop. On it is a rotating reel **2** with horizontal bars and tines that pull the stalks down to a cutter **3**. The cutter bar's razor-sharp teeth rapidly open and close to cut the crops at the base.

Cut crops are then carried into the heart of the combine, where a threshing cylinder (rotor) **4** rolls the crops over and over to separate the wheat seeds from the husks (chaff). The grains fall through sieves **5** into a collecting tank **6** while the chaff, leaves, and stalks are carried by conveyors **7** to the back of the machine, where they are chopped into smaller pieces and blown onto the ground.

Meanwhile, an auger **8** carries the grain up from the collecting tank. Then it goes into a grain truck **9** traveling alongside the combine. The truck hauls the grain to bins for storage or to commercial elevators along railroad lines.

Left in the field are rows of cut stems, called stubble, visible in fall and winter. Cut stem shafts, called wheat straw, are packed into bales and used for animal bedding, cat litter, biofuels, biomass, paper and packaging, and even house construction. Straw left on fields adds organic matter to the soil.

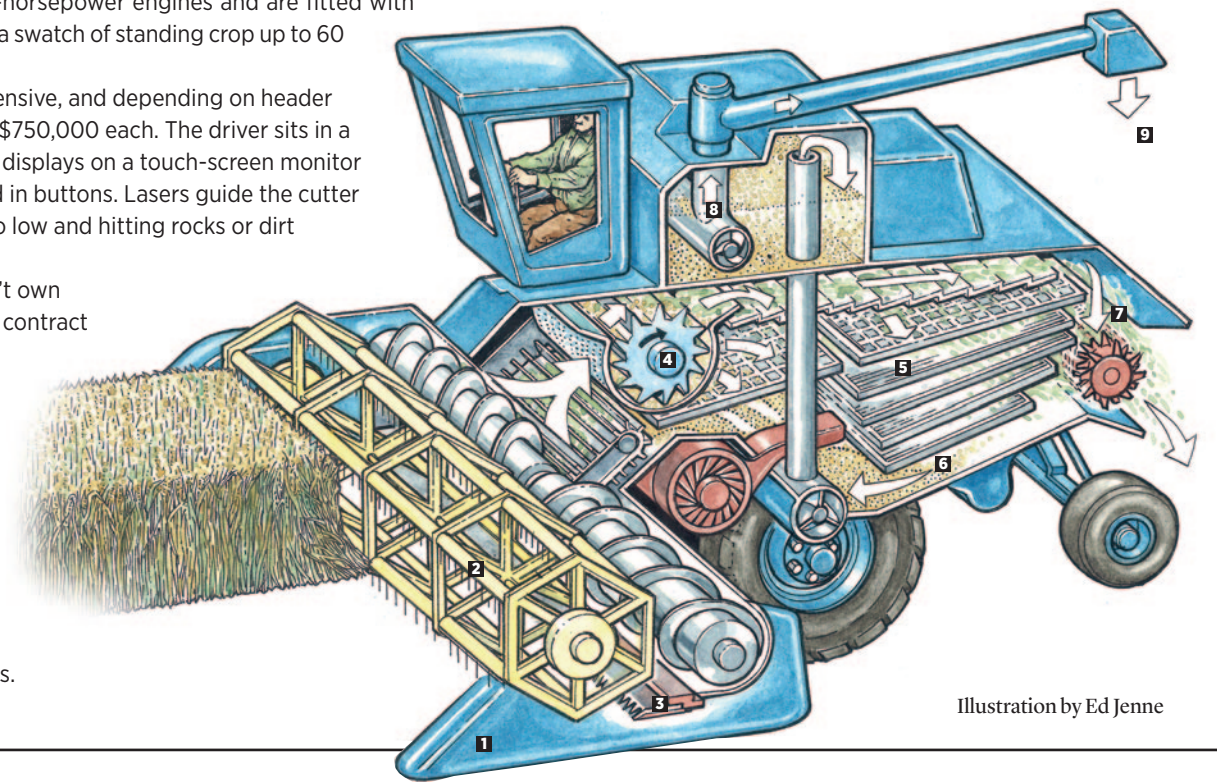


Illustration by Ed Jenne

known as "chem fallow."

Some cropland may be "retired" from crop production and put into conservation use. The Conservation Reserve Program (CRP) is one of the best-known and most substantial federally authorized and funded conservation programs. Introduced in 1985 and reauthorized in every U.S. Farm Bill since, CRP pays producers to retire erosion-prone farmland for 10 or 15 years, planting perennial grasses and legumes instead of annual crops.

The vegetation keeps soil from eroding and provides habitat for grassland birds like pheasants and sharp-tailed grouse as well as

white-tailed deer, mule deer, and waterfowl.

In Montana, amounts of CRP-enrolled land decreased from more than 4 million acres in the 1990s to less than 2 million acres in the 2020s. With rising grain prices, some landowners could earn more per acre farming than from CRP payments, so they returned land to crop production.

### SUPPORT AND SUBSIDIES

Raising crops is a complex enterprise, requiring knowledge of soil science, weather, botany, insects, plant disease, crop genetics, plant nutrition, hydrology, mechanical

machinery, computers, and world markets. To help farmers manage that information and stay financially afloat, federal and state agencies and public universities offer scientific and marketing advice as well as grants, loans, cost-sharing, and disaster assistance.

One federal program pays subsidies to farmers if their revenue per acre falls below a benchmark or guaranteed level. Another gives farmers a loan at harvest time so they can hold their crops to sell at a higher price later. Farmers may be covered for losses if conditions during spring, such as flooded fields, prevent them from planting some

CLOCKWISE FROM TOP LEFT: NICK FUCCI; SHUTTERSTOCK; SHUTTERSTOCK; SHUTTERSTOCK

areas. Government-subsidized insurance often covers crop losses due to drought, disease, and other natural events.

Some critics of farm subsidies point out that they pay disproportionately to large agribusinesses over small farmers. But without subsidies, many small Montana operations couldn't turn a profit each year. That, in turn, might force land to be sold to housing, industrial, or commercial developers who may not understand the high value that Montanans place on wide-open spaces that provide wildlife habitat, hunting, and scenic views, and add to the state's quality of life. 🐾



A farmer heads out for a day of harvesting wheat on a field near Havre, Hill County.



Protein levels increase when wheat is stressed by weather extremes, common in eastern Montana's summers.

**Durum**, the hardest wheat of all, is used to make the coarsely ground semolina flour and the finer semola. Both are use for pizza and pasta and are high in gluten, which helps pasta keep its shape when boiled. Durum thrives in a climate with cool summer nights, long warm days, adequate but not excessive rainfall, and a dry harvest season—conditions typical north of the Hi-Line, where most of this variety is grown.

**Soft wheats**, not common in Montana, have lower protein and gluten content and are used for cakes, cookies, and crackers.

**Winter wheat** is a hard red wheat planted in September or October that usually sprouts before going dormant when cold weather arrives. If there's little snow in November and December and it's warm, you may see the green sprouts coming up in fields. The advantage of winter wheat is that it benefits from overwinter moisture in snow. The risk is that cold, wet weather can foster plant diseases. In spring, the

plants resume growth and grow rapidly until the summertime harvest.

**Spring wheat** and durum wheat are planted in spring and harvested in summer or early fall.

The commercial Gold Medal and other **all-purpose flours** that people buy in grocery stores are made of mixes of red and white winter and spring wheat. ■

## AN ODE TO WHEAT

Montana farmers produce more than a dozen different crops, but wheat is by far the top revenue producer, accounting for nearly 45 percent of total crop sales. Wheat does best in dry climates, and is grown throughout the Great Plains. In Montana, the grain thrives in the arid north-central region, the Golden Triangle (roughly bordered by Great Falls, Havre, and Conrad), and in the state's northeastern corner.

Montana ranks third among all states in total wheat production (behind North Dakota and Kansas), first in certified organic wheat production, and second or third, depending on the year, in spring wheat and durum wheat.

Roughly 80 percent of Montana's durum wheat is shipped to West Coast ports and on to Japan, Taiwan, and South Korea, where it is made into flour for noodles.

Wheat is categorized as red or white (red has more protein), hard or soft (hard has more protein), and winter or spring (for when the grain is planted).

**Hard wheats** are named for the force required to grind them. These wheats are milled for flour used mainly in baking breads and rolls. The hardness of wheat comes from the amount of protein and gluten it contains.



Above: White-tailed deer feed on a haystack in the Gallatin Valley. If farmers are willing to provide public hunting access on their property to help reduce overabundant deer and elk numbers, FWP will help fence off haystacks in winter and provide special "kill" permits. Right: Pheasants take cover in a shelterbelt. Wildlife biologists work with landowners to plant more of these and other habitats on private land.

### FWP and farmers



FWP helps farmers prevent or reduce damage to crops or fences by elk, deer, and other game animals if the landowners allow public hunting. Assistance includes hazing the wildlife, providing stackyard fencing, holding public "damage" hunts to reduce numbers, and providing landowners with special permits to kill wildlife.

FWP also provides technical assistance and shares costs for protecting wetlands, grasslands, nesting cover, shelterbelts, food plots, and streamside areas. The department can also pay most of the costs to treat weeds and restore native vegetation.

FWP and the state provide cash and tax credit incentives to farmers and other landowners who increase public hunting access on their land or allow travel across their property to otherwise inaccessible federal lands. The incentives compensate for road degradation and other effects of providing access.



### MSU Extension

Farmers and others living in rural Montana who need practical information often find it at a Montana State University (MSU) Extension office, found in every county and Indian reservation in the state.

MSU is one of roughly 100 land-grant colleges and universities nationwide. The institutions were established in the 1860s to ensure that instruction in agriculture, mechanical arts, and classical studies was available for working-class Americans. Land-grant universities are so named because major funding comes from revenue generated by federal lands given to each state.



MSU extension agents conduct a plant ID workshop.

A key component of land grant universities is the agricultural experiment stations, where scientists and ag experts study crop genetics, soil

science, livestock breeding, and related fields. Extension services—named for extending their work beyond the campus—disseminate the information to farmers, ranchers, gardeners, and others.

MSU Extension works with counties and reservations to identify local needs. Over the past 130 years, the service has expanded to provide information on personal finance, caregiving, landscaping, nutrition, food safety, housing, forestry, and community development. MSU Extension also runs the 4-H Youth Development (page 76) and Master Gardener programs.

FROM TOP: TODD KLASSY; JUDY WANTULOK; MONTANA FWP; MSU NEWS SERVICE  
FROM TOP: CHRIS MCGOWAN; SHUTTERSTOCK



### Organic farming

Organic farming uses few or no synthetic fertilizers, herbicides, or pesticides and instead relies on natural processes. The idea is to promote practices that are better for the environment and human health. To be U.S. Department of Agriculture (USDA) "certified organic," crops and produce must be grown on soil that had no synthetic fertilizers and pesticides applied for three years before harvest and meet other strict standards for growing, processing, and handling.

As of 2021, Montana had 206 certified organic farms and was among the top states in certified organic acres (mostly spring wheat). Though that represents only about 2 percent of the total farm acreage in the state, Montana ranks first in the nation in certified organic wheat production.

Some organic farms are large-scale operations. Others are modest operations, often run by young people who grew up on a farm or ranch, may have gone to college elsewhere, and then returned to Montana to manage the family property with new approaches and ideas.

## Grain elevators

Wooden grain elevators rising above railroad tracks are landmarks across Montana. For decades, these handsome structures stored harvested wheat and barley before the grains were shipped to distant markets. The name comes from a device inside the tall, slope-shouldered structures that elevates grain to the top of the building.

According to Bruce Selyem of Bozeman, founder of the Country Grain Elevator Historical Society, Montana had roughly 360 sites with grain elevators in 1929. Today only about 130 sites still have elevators, some of them newer concrete versions shaped like silos. Owned by corporations or farmer co-ops, modern elevators still purchase wheat and barley from farmers after harvest and hold it, often for months, while monitoring fluctuating global grain prices. Or farmers may pay the elevator to store their grain until deciding to sell.

Very few of the old wooden elevators are still operating, Selyem says.

As in years past, modern elevator operators check the quality of the grain they buy, paying more for higher grades like durum. They also regularly measure grain moisture levels, monitor markets and prices, and arrange to ship the grain by truck or rail to wherever it has been sold.

The first elevators built in Montana in the early 1900s were all wood and stood about 10 stories high. Many burned when sparks from trains ignited nearby grasses or machinery in the structures caught fire. Owners added galvanized steel siding to protect the buildings and eliminate the need for costly repainting. Every elevator had an attached office that served as the operator's headquarters and housed the engine that drove the grain-elevating machinery.

Grain elevators were both physical and social centerpieces of rural prairie communities. Farmers gathered at the elevator even when they weren't unloading grain because it was the heart of the area's economic activity.

Some communities have restored and even repurposed these "prairie skyscrapers." But most wooden elevators deteriorated and were abandoned when rail spurs were discontinued or railroad towns dried up. As commercial trucking increased following construction of the federal interstate highway system, grain elevator construction waned.

To tell if a grain elevator is still in use, pull over and look for flying or roosting pigeons. The birds hang out looking for spilled grain.

### How a traditional grain elevator worked

1. Grain elevators consisted of a main structure, called the house **1**, and an upper unit known as the headhouse **2**.

2. Trucks carrying farmers' grain pulled into a covered building to be weighed on a floor scale **3**.

3. The grain was then dumped from the truck into the "pit" **4** and carried in buckets **5** attached to a conveyor belt up to the headhouse.

4. From there grain was gravity fed into one of a dozen or more vertical bins **6**, each holding grain of various types and quality.

5. When it was time to transport the grain, it was again elevated to the headhouse and gravity fed down a spout **7** that emptied into a rail car or truck.

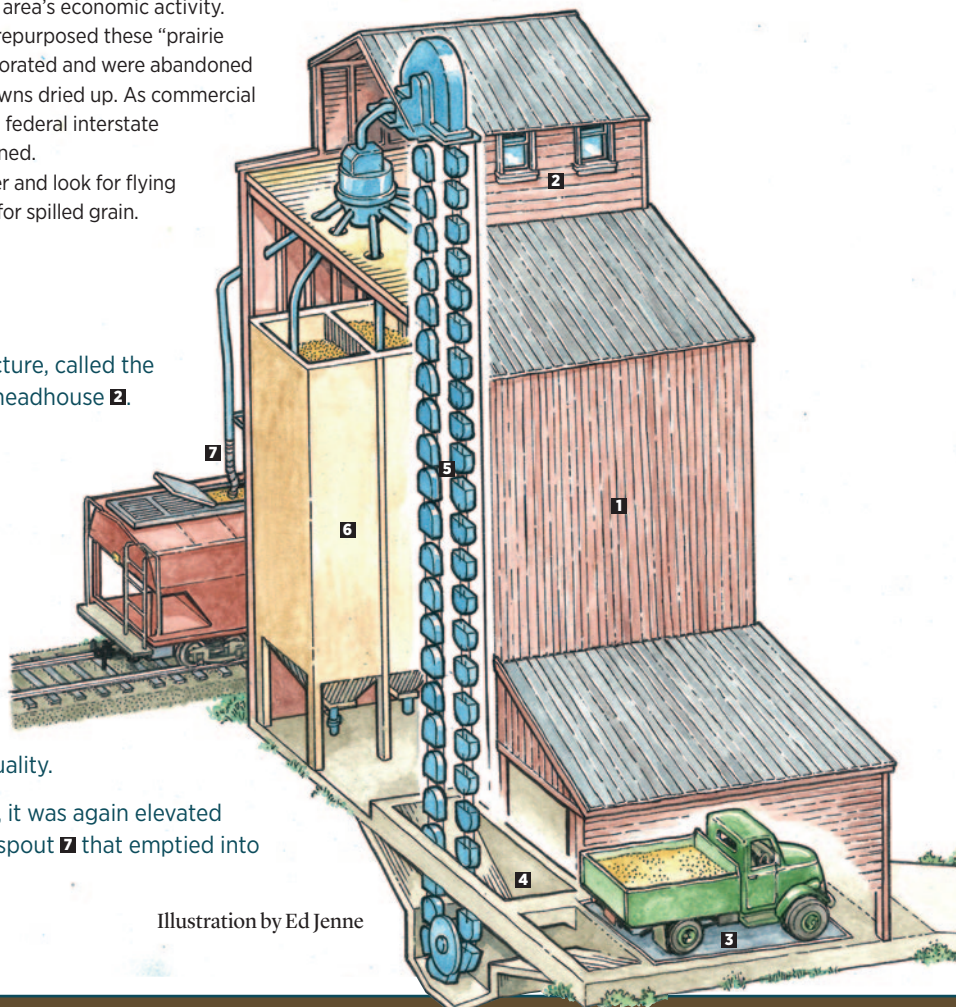


Illustration by Ed Jenne



Two abandoned grain elevators along the railroad tracks at Hobson, Judith Basin County.

## Crop identification

Most crops you see in river valleys and near streams are **alfalfa**. This clover-like species, a member of the pea family, requires large quantities of irrigation water. Look for fields of thick, green, waist-high vegetation with purple flowers in summer.

Farther from rivers and streams, especially in the state's middle and northern tiers, the crops are usually wheat or barley.

**Wheat** can be identified by its short "beard" (the bristly material protecting the kernels), which stands straight up from the stiff stem. When ready for harvesting, it has a golden-brown color. In the wind, fields of ripe wheat quiver but do not make "waves" (like barley does). After harvest, rows of wheat stubble (cut stems) stand up straight from the ground like millions of straws in long, even rows. From late fall to early spring, if there's no snow on the ground, fields of newly planted winter wheat can be identifiable as vast expanses of green (or brown, when it's cold) shoots.

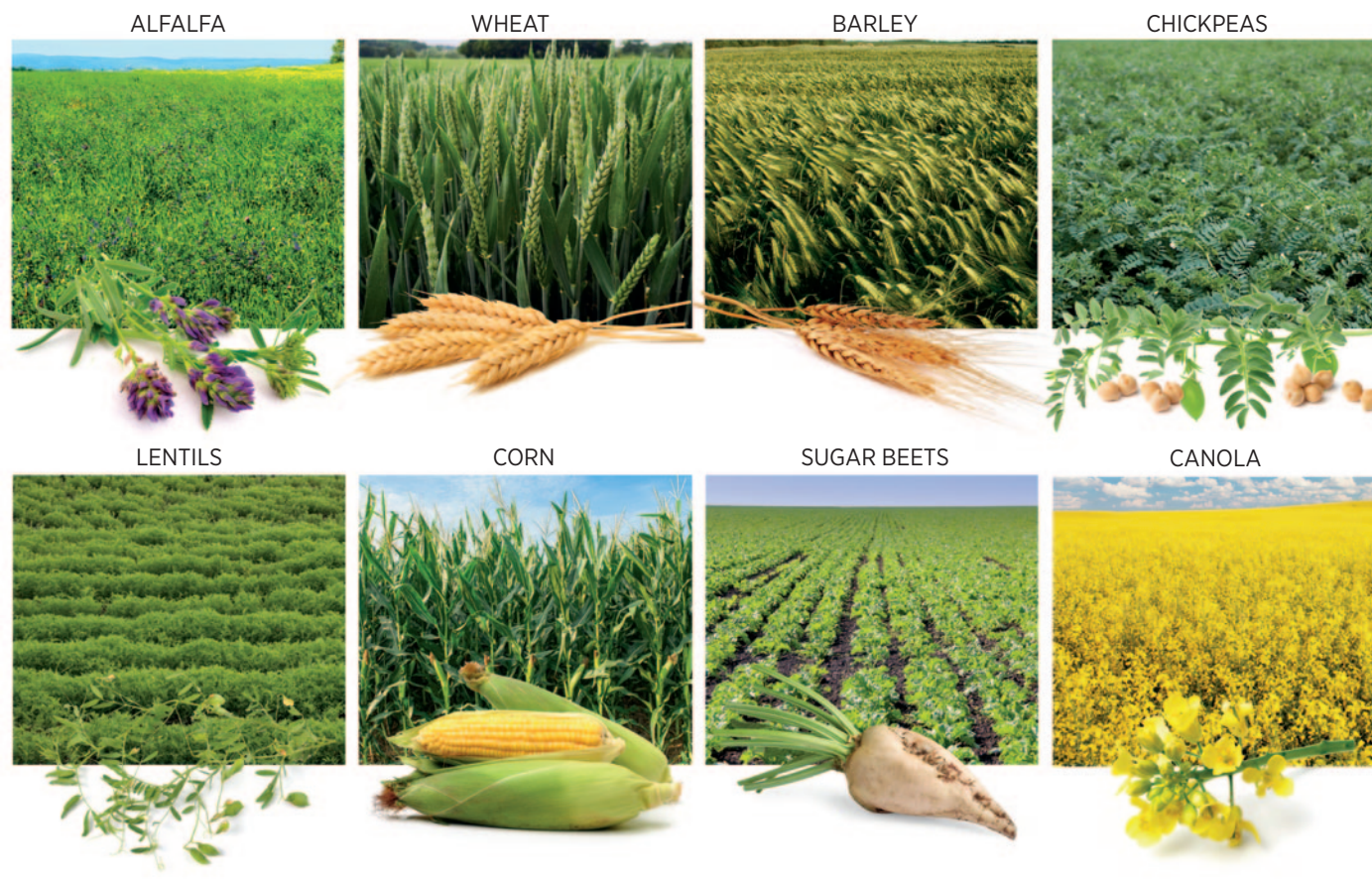
**Barley** has a longer "beard" than wheat, giving a ripe field a fuzzy appearance. And because the plants are more flexible, the whole spike bends, forming "waves" in the wind.

**Lentils and chickpeas:** Lentils and chickpeas are shorter plants, 12 to 15 inches tall, with small paired leaflets that give fields a more tangled appearance than other crops.

**Corn:** This grain is easy to identify by the tall (4 to 8 feet) green stalks and large husk-covered ears.

**Sugar beets:** This vegetable is identified by the rows of 15-inch-tall plants sporting numerous bright green leaves that look the same as those on red beets sold in grocery stores.

**Canola:** Grown for seeds processed to make cooking oil, canola plants are tough to distinguish from most crops in the early stage. But by summer, fields stretching for miles are covered in bright yellow flowers.



## Grain bins or grain silos?

Glinting in the distance on sunny days, grain bins are the round, galvanized steel structures found on farms and ranches. Grain bins are sometimes called silos, but silos are slightly different storage buildings made to store silage—fermented hay or corn used to feed cattle in winter.

**Silos** are taller, thinner, topped with a rounded roof, and kept airtight to hold moisture.

**Bins** are far shorter, squatter, topped with a peaked roof, and fitted with fans and vents to keep grain dry.



GRAIN BINS

SILLO