

Soybean

Cool BEANS!

Soybeans are the seeds of the soybean plant. They grow on the soybean plant in pods, like peas or peanuts. Also, like peas and peanuts, they are part of the legume family and a great source of protein and other essential nutrients. You can find soybeans in all sorts of food and industrial products making it one of the most versatile crops there is.

Soybeans are grown and eaten by people all over the world, but no country grows more soybeans than the United States.



SEED COAT – outside cover that protects the seed

HILUM – brown spot; allows water into the seed coat

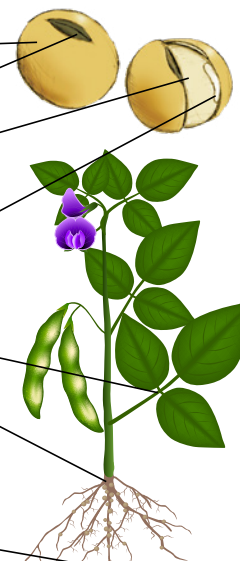
COTYLEDON – the first food source for the soybean and will become the first pair of leaves

EMBRYO – part of a seed that develops into a new plant, including the stem, leaves and roots

TRIFOLIATE – groups of three leaves

TAP ROOT – the main root of the plant, from which smaller roots branch out

LATERAL ROOTS – roots that extend from the tap root and absorb water and nutrients from the soil



Watch It GROW

Farming is a year-round job. Planting and harvesting may only take 4-5 months, but there is a lot more preparation that goes into growing a great crop.

SPRING

Farmers prepare the soil and plant the seeds.

SUMMER

Farmers work to control weeds and insects and irrigate where necessary.

FALL

The big harvest. Farmers collect the beans from the field and store them in grain bins.

About four to seven days after the seeds are planted, the soybean plant begins to grow. As it grows, the plant changes.

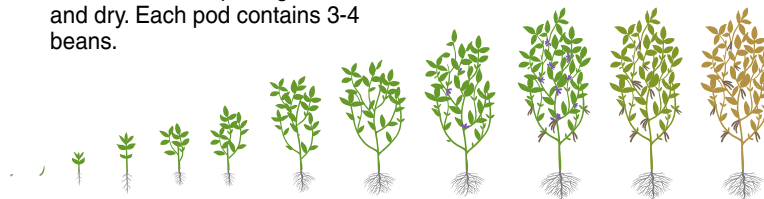
- 1) The planted seed grows a little, tail-like root, called a radicle, which becomes the main root or tap root.
- 2) Soon smaller roots, called lateral roots, branch out from the taproot.

- 3) The plant pops out of the ground. A small round part of the plant called the cotyledon peeks through the topsoil.

- 4) The leaves grow in groups of three called trifoliates.
- 5) Small purple or white flowers appear on the plant.
- 6) Many of the flowers grow into small pods of soybeans.

- 7) In the fall, the plants turn brown and the leaves drop off. The pods stick to the plant and the beans inside the pods get hard and dry. Each pod contains 3-4 beans.

This is when most farmers harvest the soybeans.



AREA:
10.7 Million Acres
(that's 1/4 of IL!)

2018 Illinois Soybean Stats

Average Crop Yield:
65 bushels/acre

TOP-PRODUCING COUNTIES:
1) McLean 2) Champaign 3) Livingston
4) LaSalle 5) Iroquois

PRODUCTION:
698 million bushels
#1 in the United States!

SOYBEAN CROP VALUE:
\$5,874,240,000
USDA Crop values 2017 Summary Feb 2018

EXPORTS:
\$500,000,000



Production & Processing

After the crops are harvested, the soybeans are stored in grain bins or taken to large storage areas in nearby communities. These storage areas are called grain elevators.

Most soybeans grown in the United States are processed to make food, livestock feed, oil and fuel. Almost half of the annual crop is exported. Of the remaining crop in Illinois, most is consumed by livestock. They are Illinois soybean farmer's #1 customer.

When soybeans are processed, the hull (seed coat) is removed. The beans are crushed and rolled into flakes. The oil and soybean meal are then separated. The hull can be used in pelleted form as animal feed. Soy meal can be used in a variety of foods for humans and animals. You can find soy in foods and used in cooking. This oil has countless industrial uses, too!



SOYBEAN MEAL USE IN ILLINOIS:

Pork production accounts for **85%** of the soybean meal use in Illinois.



Dairy & beef cattle together eat another **5%**



and poultry consumes **4%.**



Soybean meal is not only used for farm animals, but also in food for pets, zoo animals and fish.

Trucks Trains & Ships



Image: Barge on Chain of Rocks Canal of Mississippi River just north of St. Louis.

Soybeans often travel long distances from where they are grown to where they are processed, used or consumed. Soybeans travel around the nation and around the world and do so mostly by truck, train or ships called barges. For shorter distances, like from the field to a grain elevator for storage, soybeans travel in trucks. New innovations in trucking, like adding a sixth axle, can increase a truck's load by 183 bushels.

To move across the country, rail lines make moving large loads of soybeans even easier. Illinois alone has 7,000 miles of railroads crisscrossing the state and 48 different rail lines moving cargo. A 110-car train can carry up to 403,000 bushels of soybeans. That's 84 billion soybeans!

Barges and ships carry the largest number of soybeans the longest distances. Because nearly 60% of Illinois soybeans are exported, barges are used to carry the crop over any of Illinois' 1,100 miles of navigable waterways. (Soy Transportation Coalition)

Did you know?

The Mississippi River is an important route for delivering soybeans to the Port of New Orleans. On a national level, 50% of U.S. soybeans are exported.

It's a fact!

BIODIESEL

Biodiesel is a renewable fuel made from soybeans. It is the fastest growing alternative diesel fuel in the United States. The diesel engine, which runs on the fuel, was developed in the 1890s by inventor Rudolph Diesel. The diesel engine has become the engine of choice for power, reliability and high fuel economy worldwide.

Biodiesel fuel, or a blend of bio- and petroleum fuel, allows engines to run normally and decreases our need to use up our more limited resources.

Olympia School District, in Olympia, Illinois, uses biodiesel in all 33 of its busses. The busses travel up to 4,000 miles per day. Imagine how much petroleum could be saved if all 440,000 school busses in the U.S. switched to biodiesel.

FACTS ABOUT BIODIESEL:

- Biodiesel reduces exhaust leaks compared to petroleum diesel fuel.
- Biodiesel is biodegradable and non-toxic.



Uses of SOYBEANS

HUMAN CONSUMPTION

Cooking Oil	Baby Food
Mayonnaise	Candy
Breads	Cakes
Cheeses	Tofu
Margarine	Grits
Noodles	Cereal
Soy milk	Snack Foods

Batters and Breading
Bakery Products
Salad Dressing
Soy Flour
Coffee Creamer
Peanut Butter



ANIMAL CONSUMPTION

Fish Foods	Bee Foods
Dairy Feeds	Poultry Feeds
Pet Food	

Cattle Feeds
Swine Feeds

CONSUMER & INDUSTRIAL

All-Purpose Lubricants
Animal Care Products
Auto Care Products
Building Products
Medicine
Table Tops
Car Wax
Sunscreen Lotion
Candles

Carpet Backing
Cleaning Products
Crayons
Paint
Soap
Body Lotion
Glue
Cosmetics
Ink
Rubber

Engine Oils
Furniture
Insulation
Paint Strippers
Soy Biodiesel
Weed and Insect Killer
Plastics
Fire Extinguisher
Foam

Technology and Drones

Farmers have been growing soybeans for thousands of years, but the technology used by farmers is constantly changing. Here are just some of the ways technology is changing the soybean industry today:

BLOCKCHAIN – A new technology changing the way banks, companies and people send money to one another. While it is most famous for its uses with digital currencies like Bitcoin, one of the very first blockchain transactions tracked the purchase and shipment of soybeans. This new technology has the potential to speed up and protect soybean sales in the future.

DRONES – Up to 80% of non-military drone use in the United States is for agriculture. Unmanned Aerial Vehicles, or UAVs as they are sometimes called, help farmers survey their fields in new, important ways. Previously, to get an image of an entire field a farmer would have to lease a private pilot to fly over and photograph the field. Now farmers can control UAVs themselves and take clearer images more often, and for a much lower cost.

Soybean farmers use different types of imaging when surveying with drones. Aside from spotting flooded areas, and mapping the terrain, specially equipped drone cameras can take Normalized Difference Vegetation Index images (NDVI) which can help farmers analyze crop health.

BIOTECHNOLOGY – By making small changes in the genetics of plants, biotechnology practices can help those plants thrive in less than perfect conditions. Like flipping a light switch on and off, scientists activate or deactivate certain traits in a plant by turning parts of the plant's genetic code on or off. For soybeans, this technology is used to help more soybeans grow in less space. In a way, biotechnology has been around since the ancient beginnings of farming through selective breeding. Early on, people realized they could replicate the traits they liked in their crop by planting the seeds of plants with that trait.



Soybeans Through History

FARMERS IN CHINA BEGAN GROWING SOYBEANS MORE THAN 5,000 YEARS AGO.

1730s Made famous by novelists, explorers and researchers, soybeans are finally planted across Europe.

1765 Samuel Bowen plants the first soybeans, or "Chinese vetches" as they were known, in the North American British colonies, in what is today the state of Georgia.

1804 James Mease, a physician and amateur horticulturalist, reported that soybeans had adapted to Pennsylvania's growing climate.

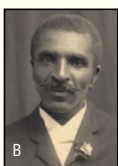
1829 Soybeans were thriving in Massachusetts.

1861-1865 Soybeans were used to brew a hot drink for soldiers during the Civil War.



1897 The University of Illinois published its first research bulletin on soybeans.

1898 The United States Department of Agriculture (USDA) introduced several varieties of soybeans from Asian countries and set up a system to keep track of the different kinds of seeds.

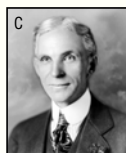


1904 George Washington Carver began studying soybeans at the Tuskegee Institute in Alabama. Carver discovered a method

of extracting soybean oil and also invented a process for making paints and stains from soybeans. Farmers in the South were encouraged to plant soybeans to keep the soil fertile for their cotton crop.

1907 William J. "Bill" Morse joined the USDA and devoted his life to studying soybeans. He was also the founder of the American Soybean Association and wrote more than 80 publications about soybeans.

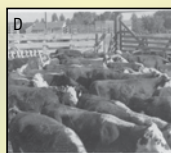
1920s A.E. Staley opened a soybean processing plant in Decatur, Illinois, in 1922 with 1,547 bushels from the Andrews Grain Company. Shippers were paid 99.75 cents per bushel.



1940 Henry Ford took an ax to a car trunk made with soybean plastic to demonstrate its durability. This increased the popularity of soybeans

and the United States began to export soybeans and soybean products.

1940s Farmers plant more soybeans to meet the demand of oils and plastics during World War II.



1950s Soybean meal became available to use as a livestock feed ingredient. It is high in protein and low-cost. This prompted a large increase in livestock and poultry production in the United States.

1964 Land of Lincoln Soybean Association was formed to provide legislative representation for growers.



1969 The United States was growing 76% of the world's

soybeans and exporting more than 50% of the crop.

1990s Soybean-based crayons win the first Indiana Soybean Development Council/Purdue University Soybean Utilization Contest.

2002 USDA's Agricultural Research Service begins heating its buildings in Beltsville, Maryland, and fueling all its diesel vehicles, generators and equipment sterilizers with B20 made from soybeans.

2005 Since 1976, average U.S. soybean yields increased by 50%.

2010s Animal agriculture became a top funding focus for Illinois soybean farmers.

Today Farmers throughout the United States produce 4 billion bushels of soybeans each year. Farmers in Illinois alone produce more than 600 million bushels yearly, which puts them first in the United States!

Buying & Selling



There is a large market for soybeans because they have so many uses. Soybeans are used in animal feed, as cooking oil, eaten whole, and so much more. That means that a lot of people purchase soybeans for their own needs or to use as an ingredient in a new product. With so many people buying and selling soybeans, prices for the crop go up and down regularly.

Illinois soybeans are sold around the world. A lot of research goes into getting the best price for a crop. Sometimes the best prices come from Mexico, China, Taiwan or The Philippines. Sometimes the best prices come from much closer to home. Global trade of soybeans is important because Illinois grows far more soybeans than can be consumed if the entire crop stayed local. Likewise, many areas cannot grow soybeans well

and depend on Illinois for their supply.

Consumerism is YOU choosing, buying and using the products.

Soybeans and their products are included in all the food groups except fruits. Soybeans are a source of high-quality protein and contain all nine of the essential amino acids. Very few vegetables have all nine amino acids. Soybeans also contain essential vitamins and

minerals including calcium, iron, potassium and folic acid.

READ the labels! Ingredient labels are required on all products we buy. The ingredients on a label are listed by the amount of each ingredient in a product from the MOST to the LEAST. Check out your labels and look for soy oil, soy flour, soy protein isolates and soy lecithin.

A typical snack bar nutrition label

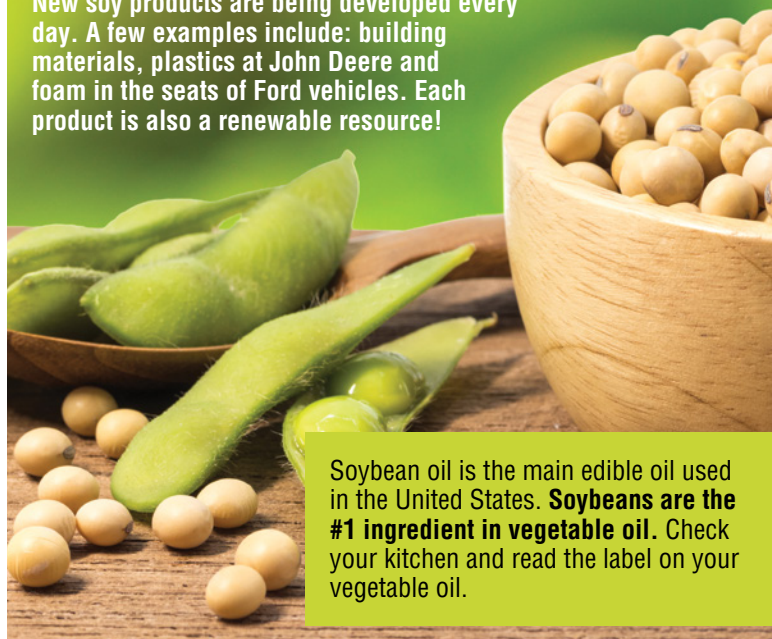
INGREDIENTS: Oats, cane sugar, semi-sweet chocolate (sugar, chocolate liquor, cocoa butter, soy lecithin, vanilla extract), canola oil, tapioca syrup, brown rice, milled, honey, coconut, buckwheat, amaranth, molasses, brown rice flour, oat flour, gum acacia, curcun, sea salt, brown rice syrup, vanilla extract, Vitamin E (tocopherols to maintain freshness).	Nutrition Facts		Amount/Serving	% Daily Value	Amount/Serving	% Daily Value
			Total Fat 5g	6%	Total Carb. 23g	8%
Serving size 1 bar (35g)			Sat. Fat 1.5g	8%	Dietary Fiber 2g	7%
			Trans Fat 0g		Total Sugars 8g	
Calories per serving 150			Polyunsaturated Fat 1g		Incl. 8g Added Sugars 16%	
			Monounsaturated Fat 2.5g		Sugar Alcohol 0g	
			Cholesterol 0mg	0%	Protein 2g	
			Sodium 65mg	3%	Vitamin D 0% • Calcium 2% • Iron 6% • Potassium 2%	
Allergen Information: Contains coconut and soy.						
Made in a facility that processes peanuts, tree nuts and sesame seeds.						

It's a fact!

One bushel of soybeans weighs 60 pounds and provides:
 11 lbs. of crude soybean oil 47 lbs. of soybean meal
Crude soybean oil is used for human consumption and consumer and industrial products.
Soybean meal is used for livestock feed.

The average American consumes nearly half a cup of soybeans in some form each day.

New soy products are being developed every day. A few examples include: building materials, plastics at John Deere and foam in the seats of Ford vehicles. Each product is also a renewable resource!



Soybean oil is the main edible oil used in the United States. **Soybeans are the #1 ingredient in vegetable oil.** Check your kitchen and read the label on your vegetable oil.

Beanie Baby

Now that you know how soybeans grow, why not grow your own?

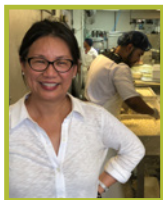
MATERIALS NEEDED:

- Jewelry size resealable bag (found in craft stores)
- Crystal Soil (Found in plant nurseries or from Flinn Scientific 800-452-1261)
- Hole Punch
- Water
- Measuring spoons
- Soybeans
- Yarn



1. Punch a hole in the top of your bag, above the zipper seal.
2. Place ¼ teaspoon of Crystal Soil into the bag.
3. Drop 1-2 soybeans into the bag.
4. Add 1 tablespoon of water.
5. Seal your bag.
6. Insert the yarn into the hole to make a necklace.
7. Use the yarn to hang your beanie baby around the room to chart the effect of various exposures to light and heat. You might want to wear it around your neck and under your shirt to provide constant heat for your Beanie Baby!
8. Check your Beanie Baby several times a day to watch the process of germination.
9. Record the growth on a chart.

CAREERS



JENNY YANG

Entrepreneur

Phoenix Bean, LLC
Chicago, IL

How long have you been with Phoenix Bean?

I took over Phoenix Bean 16 years ago and have grown the company from 6 employees to 18. We expect to grow significantly in the next few years.

What is tofu, exactly?

Tofu is basically soybean curd. Many people know edamame, or yellow raw soybeans, but do not know they are eating soybeans. To make our tofu, we clean our soybeans which have been purchased from the farmers. Then we soak them overnight to let the soybean open up and begin sprouting. When the sprout is about 1/3 of an inch, they are perfect for grinding. We grind the whole soybean and pasteurize the mash. This process creates a solid, sometimes called soy flour, and a liquid, or the curd.

Is there any waste from producing your product?

We actually recycle much of our soybean scrap. We work with Loyola University where they are turning that scrap into a product for mushroom growers. There is still a lot of protein in that material which can help the mushrooms grow.

Why do you think more people are eating soybean products like tofu and edamame in the U.S. in recent years?

People are realizing that soybeans are really nutritious. In Japan for example, they eat them to reduce wrinkles in their skin. You can lose some of that nutrition the more you process the soybean, so people are turning to products like our tofu ground from the whole bean.



DR. MARK BERHOW

Research Chemist

USDA, ARS, NCAUR
Peoria, Illinois

What is the NCAUR?

The National Center for Agricultural Utilization Research, or NCAUR, is a laboratory created by the United States Department of Agriculture in 1940. It was originally created to find new uses for wheat and corn. Today, the lab is staffed by 100 research scientists and 160 other staff members who work to bring new uses of US agricultural commodities, like soybeans, from the lab to the marketplace. The site was where Dr. Andrew J. Moyer and his team first mass-produced Penicillin, opening the era of antibiotics.

How are soybeans important to your work?

Perhaps the most successful alternative crop developed by NCAUR is the soybean. Initially grown only for use as livestock feed, soybeans have become the second-biggest row crop in the United States and the #1 source of vegetable oil as a result of Peoria research. Today, ingredients from soybeans are found in hundreds of supermarket products and numerous industrial applications such as inks, lubricants, glues and coatings.

What is your role?

As a research chemist, I research compounds that plants create which are not required for the plant to survive. These are called secondary metabolism compounds, or metabolites. In my research, I explore how metabolites interact with other plants and insects and in the animals and humans that consume them. This information can be used for creating new techniques for pest control, food additives or medicines.

This issue of Ag Mag has been provided by: The IAA Foundation.



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Common Core Standards: ELA-Literacy.RI.4.1; ELA-Literacy.RI.4.3; ELA-Literacy.RI.4.5; ELA-Literacy.RI.4.7; ELA-Literacy.L.4.3

Next Generation Science Standards: Interdependent Relationships in Ecosystems: 3-LS4-3; Energy: 4-ESS3-1; Structure, Function, and Information Processing: 4-LS1.A; Structure and Properties of Matter: 5-PS1-3; Structure and Properties of Matter: 5-PS1-4

IL Social Science Standards: Economics: SS.EC.1.3, SS.EC.1.4, SS.EC.2.4, SS.EC.2.5; Financial Literacy: SS.EC.FL.1.4; Geography: SS.G.3.4, SS.G.2.5; History: SS.H.1.3