Science Societies

What is agronomy?

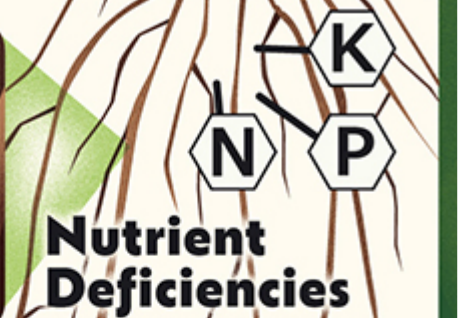
July 9, 2026

What is Agronomy?

Agronomy is a science that takes an integrated, holistic perspective of agriculture.

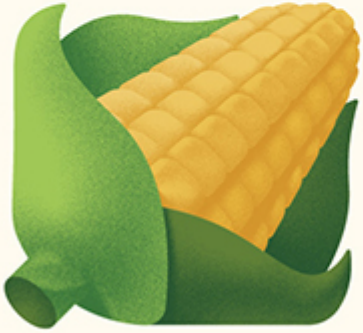
- Microbiology
- Climatology
- Soil Science
- Hydrology
- Economics
- Chemistry
- Environmental Science
- Mathematics
- Genetics
- Physics
- Data Science
- Ecology

Agronomy solves problems in order to grow crops effectively, profitably, and sustainably.



Nutrient Deficiencies

Agronomy feeds, clothes, and fuels the world



Infographic by Jason Clausen, graphic designer.

> What does it mean to be an agronomist, crop scientist, or soil scientist? We're diving into what it means to be a part of our sciences, starting with agronomy. Check out this infographic and article, and share with your network!
>
> This is part of our Down to Earth series, which breaks down and explains food, farming, and environmental sciences for readers of all backgrounds, including those without formal scientific training.

Above all else, agronomy is a science that takes an integrated, holistic perspective of agriculture. Agronomists tackle multiple problems in crop fields through science-based methods.

Agronomists boost the yields of food, feed, fuel, and fiber crops

Agronomists study the production of food, feed, fiber, and fuel crops, different kinds of crops with different purposes:

- **Food crops**, as the name implies, are what we eventually see in the produce section of the grocery store. They also make up bakery items and processed foods like vegetable- or grain-based oils, starches, proteins, and flours. Simply, if it was grown for a human to eat, it's a food crop.

- **Feed crops**, on the other hand, are grown to feed livestock, not people. Alfalfa and other forage crops are common examples of feed crops. Feed crops are given to livestock either fresh (green chop), dried (hay crops), or fermented (silage crops).

- **Fiber crops**, like cotton and industrial hemp, make up the clothes you wear. You might not think of your jeans as coming from a crop, but cotton jeans are a big business!

- **Fuel crops** include sugar-based biofuels (like ethanol extracted from corn ears, wheat, sugar cane, or sugar beets), cellulosic biofuels (from fibrous or woody plants like corn stalks and hay), and biodiesel (created from vegetable or seed oil). We are growing these crops to become more energy independent and environmentally conscious—fuel crops have been grown and processed into alternative sources of energy in the United States since the 1990s.

Whatever they're growing, one of the primary goals of agronomists is to maximize crop yields. But yields are complex variables that are dependent on so many factors—the crop's own genetics, yes, but also the environment: Weather, water, and the overall health of the field the crops are growing in. With an ever-growing population of people to feed, the pressure to increase yields are higher than ever. That requires good resource management—of traditional farm resources like seeds, fertilizers, and pesticides, but also of our natural resources, too.

Agronomists manage soil

About 90-95% of the global food supply relies on soil. Soil supports what we eat, both directly (in the case of fresh produce) and indirectly (like meat from animals that first

ate feed crops).

Soil health is undeniably a large influence on crop success. The health of the field is dependent on different biological, chemical, and physical properties:

- Biologically, soils are comprised of living organisms. Fungi, bacteria, insects, even some reptiles and mammals live in soil. These organisms play an important role in recycling organic materials and altering the chemical and physical structure of soil.

- Chemically, soils store and release nutrients to plants. The pH of the soil plays an important role in whether nutrients can be taken up by plants. Some soil particles can also hold onto some nutrients due to their electrical charge. Processes in the soil recycle elements from organic forms to their more plant-available mineral forms.

- Physically, soil structure—such as texture and aggregation—plays an important role in nutrient storage, water dynamics, and gas exchange with the atmosphere.

If even one of these factors is damaged or neglected, the health of the field is in jeopardy.

Monitoring the state of a farm's soil can take on different forms. Traditionally, farmers use soil tests to monitor the kinds and amounts of nutrients in their fields, as well as soil pH. Based on the results of the soil test, an agronomist or a crop adviser can estimate how much fertilizer a farmer needs to apply to their field. Modern techniques tell the farmers the same story, just in a different way: New technologies, like sensors placed on tractors or handheld devices, can measure nutrients in real-time. This can show a farmer the exact spots on their fields with nutrient deficiencies, which allows them to develop a site-specific plan to apply exact fertilizer amounts.

Agronomists manage water

Plants are thirsty. Water is essential to plant growth, and thus managing water is essential to crop production.

You get stressed when you're dehydrated, and so do plants. But when plants get stressed, the microscopic holes in their leaves (stomata) close to prevent water from further escaping—but this also reduces the amount of CO_2 they can absorb from the atmosphere, suppressing their ability to grow via photosynthesis. Keep trying to grow without water? Severe dehydration can kill.

Complicating things, different farms have different water needs. The moisture in the air, the amount of rain an area gets, the irrigation style of a farm, or even the life stage of the crop affects how much water a field needs. Soybeans, for example, are susceptible to drought at early pod-producing stages, while wheat needs extra water

twice during its season: Once to start growth, and again to produce good grain kernels.

But if done wrong, irrigation can waste a lot of water (and money)! Irrigating to a one-inch depth of water, spread uniformly across a one-acre field, requires 27,154 gallons of water. A typical center-pivot sprinkler system can water 125-140 acres of land. That's millions of gallons for just one watering, which means that wise water management is essential for farms to remain profitable.

Do you really need that much water everywhere in your field? Agronomists try to savor as much water as possible. Some of their approaches are:

- Delivering water through improved sprinkler systems.
- Installing sub-surface drip systems to reduce evaporation and place the water right near the roots.
- Delivering water to the plants where and when it is most needed.
- Using mulch to insulate the soil and prevent evaporation.

Agronomists manage pests and pathogens

Pests are a huge hurdle to agriculture:

- Weeds outcompete crops for water, nutrients, and sunlight.
- Herbivorous insects eat crop leaves, roots, fruits, and seeds. They can even vector diseases to plants or excrete sugary films on leaves that block sunlight and air and

encourage mold growth. The soybean aphid, for example, does all of these—it drinks plant sap, it excretes honeydew (that can attract sooty mold), and can transmit viruses to the plants it feeds on.

- Other animal pests, like mice, burrow and disrupt root systems.

- Pathogens like fungi, viruses, and bacteria make plants sick and further reduce yields.

To reduce pest pressure, agronomists can develop integrated pest management (IPM) plans for farms. IPM is a science-based process that combines different methods together to address pest needs but also limit environmental impacts and harm to beneficial wildlife. Each IPM plan is tailored to a specific farm's needs. IPM often includes what you typically think about when you think of "pest control" (the use of pesticides), but also emphasizes the need for prevention and other kinds of control methods. There are four steps: First, a threshold for when a pest becomes an economic threat is decided before monitoring, prevention, and (if needed) control measures are set in place. Control methods can be:

- **Cultural**. The manipulation of a crop production system, such as intercropping, crop rotation, and cover cropping, to reduce weeds and other pests.

- **Mechanical**. The physical removal of pests, whether that's through hand weeding, tillage, using heat/fire to kill weeds, or mowing.

- **Biological**. The use of a pest's "natural enemy" to keep its population at bay. A classic example is using lady beetles to control for aphids.

- **Chemical**. The careful use of pesticides. Pesticides can be both natural or man-made (synthetic) and need to be screened by the EPA before commercial use. The EPA also sets exposure limits (both for on-farm exposure and residues allowed on food).

Agronomists think of sustainable solutions to continue feeding, fueling, and clothing the world

Increasing crop yields is always a priority—there are, after all, billions of people we need to feed. Historically, though, we've often sacrificed environmental integrity for high yields and cheaper maintenance costs, which has degraded our soil and our water, elevated greenhouse gas emissions, caused us to lose out on ecosystem services, and altered how elements like nitrogen and phosphorous cycle through the Earth. If this damage continues unchecked, it can continue to damage our environment and our ability to keep our crop systems up and running.

It's already difficult to manage a field—just see the soil, water, and pest management sections we've covered—but these difficulties will only be exacerbated with depleted resources, excess pollution, and a changing climate. Climate change has been exacerbating agricultural and environmental issues for decades. The Earth is running a fever—its average temperature has risen by 1.5°F since 1880. For plants, soil microbes, and other living things, that rise in temperature is a big difference. Not to mention, extreme weather events exacerbated by climate change, like floods and droughts, will harm crops too.

Burning fossil fuels, deforestation, and even agriculture contributes to climate change:

- Burning fossil fuels in vehicles and power plants release extra carbon dioxide.
- The use of nitrogen fertilizers has led to an increase in atmospheric nitrous oxide.
- Animal-production systems and certain crops, like rice, release methane.

But there are ways to mitigate these effects, better tolerate them, and even reverse course. Agronomists look into ways to protect and even regenerate our farmlands by:

- Studying more efficient ways for crops to use water.
- Creating crop breeds that are more tolerant to drought, high temperatures, or pests.
- Implementing precision agriculture to help farmers use fertilizers more efficiently.
- Improving feed to work better with animal digestive systems, reducing methane production.
- Finding ways to store and apply manure in a way that reduces nitrous oxide.
- Adopting conservation practices like no-till or cover crops to restore soil health and encourage the storage of carbon in soil.

Cover crops and conservation tillage

Reducing (or eliminating) tillage on farms and planting cover crops are popular ways to protect soil health in fields. Typically grown between cash crop seasons, cover crops have been shown to protect soil from wind and water erosion, improve biodiversity of the farm system, reduce competition from weeds, recover nitrogen, control pests and diseases, increase soil organic matter, encourage soil microbial life, and reduce runoff of sediments, nutrients, and agricultural chemicals. Reducing soil disturbance through limited tilling also reduces soil erosion, increases organic matter, and even reduces fossil fuel use by reducing the need for petroleum-fueled farming equipment. While tilling helps with weed control, loosens the soil, controls certain soil-borne pests, and captures moisture form the rain, the benefits of no-till may outweigh the benefits of tilling in some farms, especially if limited/no-till is paired with other ways to manage for weeds and soil-borne pests. Combining no-till with cover crops (and other management practices, like crop rotations) can manage needs, prevent input loss, and even keep carbon locked underground.

Precision agriculture and nutrient management

Growers strive to follow the four “Rs” (the “right” nutrient application rates, “right” application methods, “right” application timing, and “right” nutrient source) when creating nutrient management plans on their farms. This can be easier said than done. But by combining spatial tools and new technologies with a farm’s data about yield (or another agronomic trait), the exact amount of fertilizer needed in different parts of a field can be applied. This saves growers money and uses less resource

s, which reduces pollutants from excess inputs. Precision agronomists are always striving to produce more using less. Technology can help automate management in a

number of ways. For example, drones can “scout” fields in ways impossible for human labor. Field sensors, AI, and satellites offer the potential for a more productive and efficient (and therefore more sustainable) agricultural system. These principles can also be applied to pesticide use, as well.

Agronomists are key parts of our food systems, and key members of our Societies. We hope to uplift the work done by top agronomists in our magazines: *CSA News* and *Crops & Soils*. Read more!

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