Cover Crops:
Sustaining Soil

By Alyssa Jorgensen

Agriculture is a necessary aspect of human civilization, but current commercial agricultural techniques tend to emphasize yield over environmental welfare. Planting cover crops is a revolutionary agricultural technique that will improve crop yields while protecting and helping the environment. However, according to the 2017 Census of Agriculture conducted by the U.S. Department of Agriculture, less than 10% (141,046 crop-farms out of 1,475,627 crop-farms) use cover crops and only about 3.6% of cropland (14,368,669 acres of cropland out of 396,433,817 acres of cropland) used cover crops.[1] So what are cover crops? Why aren't farmers using them more often, and how are they beneficial?

What Are Cover Crops?

Cover crops are low-growing plants that cover the soil and are planted alongside a commercial crop for the benefit of that crop, the environment, or both.

Although the primary purpose of cover crops is to aid in the growth of a commercial crop, some cover crops are also harvested for commercial use or to feed livestock rather than just discarded. There are a variety of cover crops that serve a variety of different functions and have a variety of needs.

Terms to Know

Tillage: An agricultural technique where soil is overturned to prepare for planting often burying weeds. It's considered an unsustainable practice because it disturbs and breaks up the topsoil which results in erosion and loss of nutrients.

Monoculture: The agricultural practice of planting a single crop in a particular area.

Erosion: The process by which soil and sediment is moved from one location to another typically by wind or water. Excessive erosion is undesirable because it results in nutrient loss and water pollution.

Runoff: The excess water in rainfall that does not get absorbed into the soil and, instead, inevitably flows toward a water source often carrying sediments, soil, pesticides, herbicides, and fertilizers.

Topsoil: The top layer of soil which contains the most organic matter. It is the most vital part of the soil because that's where most of the nutrients are located.

Carbon Sequestration: The process of transferring Carbon Dioxide from the air into the soil.

Percolation: The process by which soil absorbs water.

Compaction: A state of soil where percolation is severely limited due to lack of space between soil particles.

[1] U.S Department of Agriculture, "2017 Census of Agriculture," *United States Department of Agricultural National Agricultural Statistics Service* (2019): 7, 645-53, https://www.nass.usda.gov/Publications/AgCensus/2017/index.php#full_report.

Why Aren't Farmers Planting Cover Crops?

As stated before, less than %10 of crop farms in the U.S. use cover crops. So why aren't more farmers planting cover crops? Well, despite all the benefits of cover crops, there are certain factors that make it difficult for some farmers to implement them. Cover crops are not suitable or available in every situation, and some situations require extra steps and care if farmers want to reap their benefits.

Costs

Planting cover crops requires a lot of time and labor. Small farms are less likely than large farms to adopt cover crops because small farms may not be able to afford labor costs.[2] Meanwhile, extremely large farms require even higher labor costs than both small and large farms, so they are also less likely to plant cover crops. [2]

Furthermore, the seed costs are "highly variable" due to the variability of supply year to year.[7] High or unpredictable seed prices may keep some farmers from considering cover crops.[3]

Therefore, there are some financial risks to cover crops if the farmer is inexperienced or there happens to be a bad harvest year.

Water Competition

Like any other plant, cover crops require water. However, while some cover crops can thrive on very little water, other species may compete with the commercial crop for water. This can be especially problematic in areas with droughts like California.[4]

Nutrient Competition

Not every cover crop fixes nitrogen into the ground. Grasses use up a lot of nitrogen.[5] However, this issue can be offset by planting legumes like Crimson Clover or Hairy Vetch.[4]

Benefits of Cover Crops

Cover crops do take time and care, but when given the right circumstances cover crops can provide a variety of benefits to both the environment and the farmer.

Healthy Soil

Commercial agricultural methods such as **tillage** and **monoculture** destroy the soil.[5] When soil is degraded, it leads to issues such as **erosion**, which leads to **runoff** during rainfall. This presents a problem because the act of erosion means that the **topsoil**, the most vital part of the soil, is being carried away. Without that topsoil, the environment fails to perform other tasks such as filtering water, maintaining clean water, supporting life, and **carbon sequestration**, among others. Additionally, A farmer's yields may suffer if the soil is subpar, and the farmer may even have to convert healthy, untouched ecosystems into farmland.

Fortunately, cover crops can mitigate these problems by restoring and maintaining the soil by fixing nitrogen into the soil and reducing soil erosion.

Fix Nitrogen into the Soil

Certain cover crops (aka. Legumes) can fix nitrogen into the soil. This is because there are nodules on the roots that contain the rhizobia, a bacteria that produces nitrogen which gets released into the soil when the plant dies and decomposes.[9] This is important because nitrogen is a necessary component in creating life making it absolutely necessary for plant growth.[7]

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[2] Seungyub Lee and Laura McCann, "Adoption of Cover Crops by U.S. Soybean Producers," *Journal of Agricultural and Applied Economics* (2019): 4, doi:10.1017/aae.2019.20.
[3] Jason S. Bergtold, Steve Ramsey, Lucas Maddy, Jeffrey Williams, "A Review of Economic Considerations for Cover Crops as a Conservation Practice," *Renewable Agriculture and Food Systems* (2017): 8, DOI: 10.1017/S1742170517000278.
[4] Ingels, 5.
[5] Stefani Daryanto et al., "Quantitative synthesis on the ecosystem services of cover crops," *Earth-Science Reviews* (2018): 357, https://doi.org/10.1016/j.earscirev.2018.06.013.
[6] J. de Bruijn, Frans, *Biological Nitrogen Fixation* (2015): 2, DOI:10.1002/9781119053095.
[7] Ibid., 1.

Reduce Soil Erosion

Cover crops reduce erosion by blocking wind and Rain, increasing **percolation**, and holding the soil together.

The leaves and stalks of cover crops block the soil from rain, reducing the rate at which rainfall hits the soil. This allows the soil to absorb more water, avoiding runoff.

Part of reducing soil erosion is reducing **compaction**. Tap-rooted cover crops like Forage Radish and Rapeseed create pores in the soil that break up compacted soil and allow for percolation, reducing runoff.

Cover crops also increase organic matter in the soil. The cover crop's roots and the organic matter hold the soil together to prevent erosion.[8]Organic matter in particular does this by binding the soil into larger aggregates which are harder to break apart and therefore remain intact during rainfall.[8] Organic matter also increases the soil's water holding capacity soil which also reduces runoff.[9]

Clean Water

Farmland is a major source of water pollution due to the use of chemicals like fertilizers and herbicides. Soil disturbances like tilling and planting lead to erosion. Under these conditions, runoff during periods of rainfall will contain fertilizers, herbicides, sediment, and other soil particles that will inevitably end up in a water source like a river, lake, ocean, etc.
Cover crops not only reduce water pollution by reducing runoff (as previously covered), but cover crops reduce water pollution by reducing the need for fertilizers and herbicides.[10]

Mitigate Climate Change

Cover crops can mitigate climate change by facilitating carbon sequestration.[11] Carbon is a greenhouse gas that can have a warming effect on the planet if there is too much in the atmosphere. Therefore, by taking carbon out of the air and fixing it into the soil, cover crops mitigate climate change.

Additionally, cover crops keep carbon out of the air by reducing erosion.[10] When soil is disturbed, carbon is released into the air, so when the soil is intact, it prevents excess carbon from getting released into the air.

It's Not One Size Fits All

Cover crops can provide a myriad of benefits that can increase crop and yields and help the environment.[12] However, not every cover crop is perfect for every situation, and farmers need to be educated on when to plant and kill/harvest cover crops if they want to reap their benefits and avoid the downsides. Although there may be savings when it comes to herbicides and fertilizers, there are other costs that some farmers are unable to afford.[10] Keeping all this in mind, it is important to recognize that each farmer has a unique situation; therefore, it is important for each farmer to do their research and figure out what cover-cropping system will work best for them if any.[13]

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[8] Stefani Daryanto et al., 362.

[9] Haider, Cheema, and Farooq, 54.

[10] Daryanto et al., 371.

[11] Jason P. Kaye and Miguel Quemada, "Using cover crops to mitigate climate change. A review," *Agronomy for Sustainable Development* (2017): 7, DO1 10.1007/s13593-016-0410-xI.

[12] Lee and McCann, 14.

[13] Bergtold, Ramsey, Maddy, and Williams, 34