Using Cover Crops in New Mexico: Impacts and Benefits of Selecting the Right Crops

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pubs.nmsu.edu • Cooperative Extension Service • Circular 704

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Figure 1. Cover crops provide multiple benefits in arid and semiarid regions, including soil water storage, weed and pest suppression, and enhanced soil microbial communities (modified from Ghimire et al., 2018).

WHAT ARE COVER CROPS?

Cover crops are crops that are planted primarily to cover the soil rather than to be harvested. A cover crop may be planted during the off-season, after the cash crop has been harvested, or aerial seeded a few weeks before harvesting the cash crop. It may be grown as part of a crop rotation during a period that would otherwise be fallow, with the objective of suppressing weeds or reducing soil compaction (Clark, 2019). Cover crops provide soils with seasonal protection from water and wind erosion in addition to improving soil productivity.

WHY GROW COVER CROPS?

Producers use cover crops to improve soil health, enhance water availability, and control soil erosion. Cover crops are established on fields that may otherwise be left bare during a fallow period after the cash crop has been harvested. After crops are harvested, fields may lie bare for several months until the next crop is planted. During this time, bare soil is subject to erosion by wind and/or precipitation. Planting cover crops during this period provides a protective cover that helps prevent soil erosion. Cover crops may also filter water, improve water quality, improve soil quality, and help retain nutrients (Figure 1). They lower soil temperature by providing continuous ground cover. The cover crop's roots may increase the activity of soil organisms that

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Figure 2. Cover crops help improve soil structure and water retention. This diagram illustrates soil with and without cover crops. On the left side, a cross-section of soil is depicted in a fallow field without cover crops, showing water percolating quickly through the soil via a limited number of channels. Nutrients are therefore lost to leaching, making them unavailable to plants. On the right side of the diagram, a cross-section of soil is depicted with cover crops, showing water moving more slowly as it becomes trapped by roots, air pockets, and soil aggregates. This water retention allows plants to utilize water and reduces percolation and leaching of nutrients (image concept by Rajan Ghimire; illustration by Evan Evans, NMSU Innovative Media Research & Extension).

decompose residues and provide nutrients to the subsequent crop. In irrigated arid and semiarid conditions, cover crops can conserve moisture and potentially boost crop yields.

WHAT ARE THE BENEFITS OF PLANTING COVER CROPS?

Erosion, infiltration, water storage, and water quality: Cover crops help reduce soil erosion caused by wind and water. They can keep soil in place during heavy precipitation events. Acting as vegetative buffers, cover crops slow down surface runoff, reducing sediment and nutrient losses to receiving waterways. Cover crops improve water quality by reducing nutrient losses to surface and groundwater. While their actively growing roots temporarily tie up nutrients, this root activity can break hardpans and create root channels that increase water infiltration. When infiltration into soil increases, waterways receive less of the nutrients, pesticides, and pathogens associated with farmland manure.

Soil quality and improved crop production: Cover crops help retain and store nutrients from manure or fertilizers. They can take up nitrates that would otherwise be lost to leaching, thereby helping to protect groundwater. Cover crops increase soil organic matter, which can improve soil structure because organic matter is the glue that holds soil particles together. Improved soil structure means more space for water and air to pass through soil to support better crop growth (Figure 2).

Cover crops as green fertilizer: Cover crops act as green manures when they are turned into the soil to provide organic matter and nutrients. When cover crops are turned into the ground as green manure, decomposing cover crop residues release nutrients to support subsequent cash crops. The decomposition process also increases biological activity in the soil. Active soil biology supports good soil fertility and productivity.

Suppression of soil diseases, weeds, and pests: Cover crops have also been shown to help suppress soil diseases and pests. *Brassica* spp. cover crops produce special compounds in their roots, which could suppress nematodes and some fungal diseases. Mulch from cover crops can also help suppress weed growth.

Ecological benefits and livestock grazing: Cover crops can provide food and habitat for wildlife, beneficial insects, and pollinators, as well as plant material that can be grazed by livestock or fed as hay. In New Mexico and the arid/ semiarid U.S. Southwest, grazing cover crops could be a sustainable way to improve soil health.

COVER CROPS IN NEW MEXICO

New Mexico agriculture generally takes place under "dryland" conditions. Successful cover cropping in these systems depends on cover crop selection, the timing of planting and termination, water use by various cover crop species, and nutrient use/cycling by cover crops and subsequent cash crops in a rotation. Finding a delicate balance between water use, nutrient cycling, and yield benefits is critical for the successful adoption of cover crops in the arid and semiarid U.S. Southwest.



Figure 3. Winter wheat-cover crop rotation at NMSU's Agricultural Science Center at Clovis, NM (photo by Rajan Ghimire).

WHAT DOES THE RESEARCH SUGGEST?

The benefits of cover crops on New Mexico agroecosystems will vary depending on irrigation availability for the cash crops being grown. In three independent research projects, researchers investigated the potential of cover cropping under the hot, dry conditions of the NMSU Agricultural Experiment Station at Clovis, NM (Figure 3). These studies investigated the effects of cover crops on soil health, water use, weed suppression, and cash crop yields (corn, wheat, and sorghum in different rotations) grown under 1) dryland, 2) limited supplemental irrigation, and 3) fully irrigated conditions, and compared those results with fields grown without cover crops.

Under all three water regimes (dryland, limited irrigation, full irrigation), researchers found that:

- Soils were less prone to wind and water erosion due to improved soil structure and stability of the soil.
- Soil temperatures were cooler on cover-cropped fields than fallow fields.
- Cover-cropped fields accumulated more organic matter, more residue on the soil surface, and better soil biological health.

Under limited irrigation and full irrigation, additional benefits observed in cover-cropped fields included:

- Cover crops increased weed suppression, and their effectiveness increased with greater biomass production and ground coverage.
- Soil microbial diversity increased with more diverse cover crop species in the mixture.

Cover cropping increased the yields of fully irrigated corn and sorghum in all years. Yields were the same in four out of five years for limited-irrigation winter wheat and grain sorghum production with and without a cover crop, and sorghum yield was higher with a cover crop in one out of five years. Cash crop yields of corn and sorghum were either comparable or slightly lower under dryland conditions for fields that were cover cropped.

However, when grown in rotation with fully irrigated cash crops, cover cropping, along with minimum or notillage management, improved water-conservation efficiency, increased subsequent corn and sorghum yield by 15 to 22%, and provided other benefits such as erosion control and reduced greenhouse gas emissions.

WHAT COVER CROPS SHOULD I USE AND WHY?

The selection of cover crops will vary according to the cover cropping goal, soil type, rotational cash crop, and irrigation availability on the farm. New Mexico is hot and dry; low-water-use species that grow rapidly to provide ground cover are beneficial to New Mexico farmers. The Northern Great Plains Research Laboratory at Mandan, ND, has developed a cover crop chart to assist producers with decision-making on cover cropping, a link to which can be found in the Where can I *learn more?* section of this publication. While this chart was developed for the Northern Great Plains, the low-water-use species identified in the chart are applicable to New Mexico growers. If you scroll down and click on "Cover Crop Chart Download," it leads you to the Download Form page. Fill out the form to generate up-to-date information on cover crops and specific details of various cover crop species, which could be helpful in planning cover crops for your farm.

ATTRIBUTES OF VARIOUS COVER CROP SPECIES

Leguminous cover crops fix nitrogen, which is often a limiting nutrient. The roots of legumes provide a home for rhizobial bacteria (Figure 4), which convert atmospheric nitrogen into a form that plants can use (NH_4^+) .



Figure 4. Bacteria in the root nodules of legume cover crops can fix free atmospheric nitrogen into plant-available nitrogen (photo by Rajan Ghimire).

Cereal or grass cover crops, such as oats, barley, annual ryegrass, sorghum-sudangrass, and millet, produce large quantities of biomass and increase soil organic matter storage. Because of their high biomass production, cereals provide superior weed suppression compared to other cover crops. Cereals also have deep, fibrous root systems that increase root channels and can improve water and air infiltration.

Brassica cover crops provide good disease suppression. Brassica plants release biotoxic compounds that exhibit broad activity against bacteria, fungi, insects, nematodes, and weeds. In addition, some Brassicas, such as forage radish, rapeseed, and turnip, produce large taproots that can alleviate soil compaction through "biodrilling."

Cover crop mixtures are promoted for multiple soil benefits. Studies at the NMSU Agricultural Science Center



Figure 5. Multispecies cover crops demonstration at NMSU's Agricultural Science Center at Clovis, NM (photo by Rajan Ghimire).

(ASC) at Clovis showed better soil biological health with a mixture of cover crops than by planting a single species (Figure 5). More diversity in cover crops helps feed diverse soil microorganisms, leading to increased nutrient availability and improved soil structure. However, weed suppression and soil organic matter addition were greater with grass cover crops because grass cover crops produced more biomass and had better ground coverage than other cover crops.

WHAT TIME OF YEAR SHOULD I PLANT?

The timing of cover crop planting has become an important topic of discussion in recent years. Many farmers feel as if they are in a race against time to establish their cover crops, particularly in northern New Mexico, where the time interval between cash crop harvest and autumn frosts is short. Innovative growers and interested researchers are experimenting with a range of strategies and timings for seeding cover crops. Aerial seeding of cover crops a few weeks before harvesting previous crops allows early planting of cover crops to maximize biomass production. This is specifically beneficial for winter cover crops. Winter cover crops in the summer cash crop system should be planted from August through October, depending on the cold hardiness of the cover crop. Planting earlier allows cover crops to establish before it gets too cold in the winter. There is more flexibility in summer cover crop planting in the winter wheat-based cropping systems of eastern New Mexico. In this system, soil moisture is the major driver of species selection and timing of cover cropping.

IS COVER CROPPING ECONOMICALLY FEASIBLE?

The cost of growing cover crops includes seed, equipment, fuel, and labor costs associated with planting and termination. Because of the soil and environmental benefits of cover cropping, the New Mexico Department of Agriculture (NMDA) and the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA) promote cover crops as a conservation measure and offer incentive programs. Various incentive programs available for New Mexico farmers can be found at https://www.nrcs.usda.gov/wps/portal/nrcs/ detail/national/programs/financial/?cid=nrcseprd1328253.

A study making use of experimental data from the NMSU ASC at Clovis, NM, to evaluate the potential economic impact of introducing cover crops during the fallow period on crop yield, farming risk, and profitability of a crop-fallow system shows that NRCS incentive programs such as the Environmental Quality Initiatives Program can cover the cost of cover cropping and provide additional incentives to farmers. The study also examined the economics of secondary benefits (e.g., adding green fertilizer and adopting erosion controls) on farming risk and profitability and found that cover cropping was economically profitable when these secondary benefits were included. In 2019, the state of New Mexico enacted the Healthy Soil Act and is now promoting conservation farming practices, including cover cropping. This program supports cover cropping practices through the Healthy Soil Program (https://www.nmda.nmsu.edu/nmda-homepage/divisions/ apr/healthy-soil-program/), which provides grant funding to farmers to start small-scale demonstration projects. Farmers who are interested in cover cropping can apply for an NMDA grant to start a demonstration project. To start the process, reach out to your local NRCS office, Cooperative Extension Service office, soil and water conservation district (SWCD), Nation, Tribe, Pueblo, or acequia association. They can help with the grant application process and partner on the demonstration project.

SUMMARY

Cover crops can be an effective tool to improve soil health and water retention, reduce erosion, and maintain or improve crop yields over time.

- Cover crops benefit cropping systems in hot, arid, and semiarid regions such as New Mexico.
- Soil organic matter increases with cover cropping.
- Cover crops improve soil structure, biological activity, and ultimately soil health and soil water conservation.
- Cover crops may slightly reduce cash crop yield in dryland situations, but can increase yield up to 22% under irrigation.
- State incentive programs can cover the costs of planting and terminating cover crops; farmers enrolled in these programs can benefit from cover cropping both economically and by improving the soil health of their fields. For a list of programs available to New Mexico farmers, visit https://www.nrcs.usda. gov/wps/portal/nrcs/detail/national/programs/ financial/?cid=nrcseprd1328253.

WHERE CAN I LEARN MORE?

- 1. For the basics of cover cropping in New Mexico, consult NMSU Extension Guide A-150, *Principles of Cover Cropping for Arid and Semi-arid Farming Systems* (https://pubs.nmsu.edu/_a/A150.pdf).
- For more about cover cropping from a nationwide perspective, consult Cover Crops for Sustainable Crop Rotations (https://www.sare.org/resources/cover-crops/).
- 3. To learn how other producers are using cover crops, see the annual report of the National Cover Crop Survey (https://www.sare.org/wp-content/uploads/2019-2020-National-Cover-Crop-Survey.pdf), conducted by USDA's Sustainable Agriculture Research and Education (SARE) program, Conservation Technology Information Center (CTIC), and American Seed Trade Association (ASTA).
- 4. For more about cool-season cover crops, see Evaluation of Cool Season Cover Crops in the Southwest Region (https://www.nrcs.usda.gov/Internet/FSE_ PLANTMATERIALS/publications/natpmtn13595. pdf) from USDA-NRCS.
- 5. For more about soil health, see the USDA-NRCS Cover Crops and Soil Health page (https://www. nrcs.usda.gov/wps/portal/nrcs/detail/national/ climatechange/?cid=stelprdb1077238).
- For interactive graphs related to water retention and movement in soils, see Movement & Storage of Water in Soils (https://scienceofagriculture.org/water-insoils/index.html).
- For more about the economics of cover crops, see the Cover Crop Economics page from USDA-SARE (https://www.sare.org/resources/cover-crop-economics/).
- 8. For a cover crop selection chart developed by the Northern Great Plains Research Laboratory, visit https://www.ars.usda.gov/plains-area/mandan-nd/ ngprl/docs/cover-crop-chart/.
- 9. If you are interested in adding cover crops to your operation but are concerned about the cost, talk to your county Cooperative Extension Service office (https://aces.nmsu.edu/county/). Programs to support farmers establishing cover crops are also available through the state NRCS office (https://www.nrcs.usda.gov/wps/portal/nrcs/main/nm/contact/state/) and the New Mexico Department of Agriculture (https://www.nmda.nmsu.edu/nmda-homepage/contact-us/).

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ACKNOWLEDGMENTS

This material is based upon work that is supported by the USDA National Institute of Food and Agriculture, Agricultural and Food Research Initiative Competitive Program, Climate and Land Use, grant #2018-68002-28109. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

We also wish to acknowledge students who contributed to this work, including Vesh R. Thapa, Ph.D. student; Pramod Acharya, Ph.D. student; Evan Evans, artist; and Brandy Vega, undergraduate student intern.



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