

Using Cover Crops as a Weed Suppression Tool in Cotton Production

HIGHLIGHTS

Long-term use of cover crops benefits cotton farmers and the environment.

→ **INCREASED DROUGHT RESILIENCE**

→ **INCREASED NUTRIENT CYCLING**

→ **IMPROVED EROSION CONTROL**

→ **IMPROVED WATER INFILTRATION**

→ **INCREASED SOIL ORGANIC CARBON**

→ **IMPROVED HABITAT FOR SOIL LIFE**

→ **REDUCED HERBICIDE RESISTANCE**

→ **REDUCED WEED DENSITIES**

The Soil Health Institute, Texas A&M AgriLife Research, and The Rodale Institute developed this report to describe how cover crops can benefit cotton farmers and the environment.

Cover crops can improve soil health in cotton production systems. Species selection, seeding rate, and planting date are cropping-system specific and important to consider when planting cover crops for weed suppression.

Termination method and timing impact weed suppression potential of cover crops.

It is recommended to start with a small acreage and follow local recommendations to ensure successful implementation of cover crops.

Overview

Cover crops, a component of soil health management systems, are a well-known weed suppression tool that can also positively impact soil and provide other environmental benefits.¹ Cover crops are grown between cash crop seasons, usually planted in the fall and terminated in the spring before the next cash crop. Cover crops can be grasses, legumes, or other broadleaves and may be planted as single species or species mixtures.²

Cover crops can help reduce the total amount of weeds and delay weed emergence, giving farmers a few more weeks before weed populations reach the treatment threshold. In other words, cover crops slow weed emergence and growth. Using cover crops rather than cultivation to control weeds enhances soil structure and minimizes the amount of light that reaches weed seedlings. Cover crop residue can be especially beneficial for building soil health and mitigating weed impact in cotton systems because cotton returns minimal residue after harvesting.³ Cover crops can also reduce the risk of herbicide resistance by minimizing the number of weeds that need to be controlled using herbicides, delaying weed seed emergence, and weakening seedling growth vigor.

Cover crops are a key tool for integrated weed control and may reduce the need for herbicides. While cover crops suppress weeds, they bring the added benefits of reducing the need for tillage, preventing erosion, enhancing nutrient cycling, and adding residue to the soil.



Cover Crop Benefits

Cover crops can be an effective tool for weed suppression in cotton.⁴ Because cotton is a perennial crop with slow establishment, cover crop residues can offer tremendous benefits for early-season weed suppression. Through various mechanisms, cover crops can greatly delay weed seedling emergence, reduce the total number of seedlings that emerge in a season, and weaken the vigor of emerged seedlings.⁵ Specifically, high cover crop biomass production can be beneficial for physical weed suppression.⁶ However, in the arid and semi-arid regions of the U.S. Cotton Belt, cover crop biomass production can be highly variable due to limited moisture availability and soil fertility. Nevertheless, recent studies indicate that even moderate cover crop biomass can be beneficial in suppressing weeds through other mechanisms such as altered light quality, improved surface soil moisture, and reduced soil temperature.⁵

Cover cropping is an effective strategy to combat herbicide-resistant weeds in cotton production systems.⁷ Due to poor crop competitiveness and the need for season-long weed control, herbicide use is relatively high in cotton production. Because herbicides with the same mode of action have been used frequently in the past, several weed species have developed herbicide resistance in cotton, reducing control options and increasing production costs.⁸ Cover crops will not eliminate the need for herbicides in conventional agriculture, but integrating cover crops with judicious herbicide use (e.g., using different modes of action) improves overall weed management efficacy and reduces the risk of herbicide resistance development.⁹ In a long-term experiment conducted across multiple ecoregions in the U.S. Cotton Belt, integration of a cereal rye cover crop along with herbicide programs has significantly reduced Palmer amaranth population densities, compared to a similar program that did not include cereal rye.¹⁰ Overall, cover crops increase the efficiency of chemical herbicides and reduce the likelihood of herbicide resistance development, particularly in reduced tillage systems where there is a high dependency on herbicides.¹¹⁻¹⁴

In addition to weed suppression, long-term use of cover crops can boost soil health in cotton production systems through nutrient cycling, erosion prevention, water infiltration, increased soil organic carbon, and improved soil habitat for life.¹⁵⁻¹⁸ Cover crop adoption, along with reduced tillage, saves fuel costs, minimizes soil compaction, improves soil structure, and enhances soil organic carbon and nitrogen. This combination of benefits stabilizes or improves net economic returns.¹⁹⁻²¹ Moreover, these practices can improve cropping system resilience during uncertain climatic conditions and variabilities.^{22,23}

Cover crops also provide the benefit of plant diversification in crop rotations. This is particularly important for cotton, which is typically grown with limited options for a crop rotation. Diversifying plants through cover crops and crop rotations can interrupt the life cycles of weeds and other pest organisms that are accustomed to only a few crops (Figure 1). Even in continuous cotton systems, cover crops grown between two cotton crops during the fallow can greatly improve diversity and offer tremendous ecosystem benefits. Cover crop species mixtures can especially provide broad functional diversity and ecosystem services,²⁴ yet research is limited in this regard.



Figure 1. Cotton seedlings emerging through a mowed oat cover crop. Cover crops can interrupt the life cycles of weeds and other pests.

Photo Credit: Gustavo Camargo Silva.

Cover Crop Management

CROP ESTABLISHMENT

Proper planning is essential for growing a successful cover crop that has the ability to control weeds. Growers need to purchase seeds in a timely manner because some cover crop species sell out early. Planting the cover crop early can improve the likelihood of good cover crop establishment. If planting after cash crop harvest, the sooner the cover crop is planted, the better. Planting cover crops early provides good establishment for winter survival and spring growth. Well-established plants (Figure 2) enhance the weed suppression effects of cover crops in the fall and spring.²⁵ Legumes and brassicas should be planted at least six weeks before frost to ensure sufficient growth that will enable winter survival. Small grains can be planted later in the fall (up to three weeks before frost) due to the relatively higher tolerance of these species for the mild winter conditions typical to the U.S. Cotton Belt region.

For successful cover crop establishment and growth, species selection, time of seeding, seeding rate, and termination are all important factors to consider. Choice of cover crop species and seeding rates can be highly variable from region to region. When deciding what species or mix should be planted and at what rate, it is important to refer to a source that provides information specific to the region. Focusing on appropriate seeding rate and termination timing can assist in optimizing biomass production for weed suppression in a given production environment. In addition to biomass production, species selection for residue retention following termination can be valuable for weed suppression.^{4,26} Cereal cover crops tend to last longer due to high lignin content and high carbon to nitrogen ratio. Existing weeds can be terminated before cover crop planting to ensure a less competitive environment. Cover crops can be drilled, broadcasted using ground spreaders, or seeded with other methods such as aerial seeding. Drilling with a grain or grass seeder provides improved seed-to-soil contact and emergence over broadcasting, but may require more time. Some farmers use air seeders that can cover many acres quickly.

Field history is also a crucial piece of information to consider prior to planting. Some cover crops are sensitive to herbicide residuals from the previous season, so be sure to keep track of possible residual herbicide effects from the previous season. A quick, easy way to check for this issue is to collect a few soil samples from the field, plant the desired cover crop in pots, and check for germination and establishment issues.



Figure 2. A well-established multispecies cover crop mix including radish, hairy vetch, and triticale.

Photo Credit: Alisson Clark.

TERMINATION

There are several different methods for terminating cover crops, including chemical, frost, mowing, crimping, and tillage. Termination methods like tillage and mowing can speed up the release of nutrients to the soil and help the soil dry out prior to planting cash crops, but these methods weaken the weed suppression effects of cover crops. Chemical termination and crimping keep the residue intact, allowing for better weed suppression (Figure 3). Chemical termination is the most common method and may be used with or without rolling the residues. If using herbicides for termination, it is critical to select a chemical that will stop the cover crop but not have a residual effect on the following cash crop.

Choosing when to terminate cover crops involves tradeoffs. Later termination allows more time for biomass production, which makes weed suppression more efficient. At the same time, providing enough time to ensure complete termination before cotton planting is important to avoid any negative effects on cotton establishment. To achieve best results, considerations for planting into high biomass may include planter selection and modification. Planting green (i.e., planting the cash crop into living cover crop, which is terminated days after) has been widely studied in other crops as a strategy to achieve more biomass, but anecdotal observations in cotton suggest that cotton growth can be significantly impacted in this system, so testing a small area on your own farm is a good idea if you are considering planting green. In any case, termination should be achieved before cover crop seed maturity, ideally during the early flowering stage. Weather conditions should also be taken into consideration before terminating the cover crop. Terminating before heavy rainfall can help maintain the soil moisture for the cash crop. During dry periods, cover crops may be terminated earlier to save moisture for cash crops.

Termination timing and cover crop selection can affect nitrogen and water availability to the cash crop. Cover crops with a high carbon-to-nitrogen ratio tend to break down slowly, allowing residue to remain on the soil surface for a longer period during the season. These factors are beneficial for weed suppression. However, there is a risk of immobilizing nitrogen in the soil and reducing nitrogen availability to the cotton crop. Supplemental nitrogen application should be considered in these circumstances. To provide enough water for the cotton, termination should occur early enough so that a rainfall event may occur before the cash crop is planted. Just as the cover crop can deplete surface moisture affecting seed germination, cover crop residue can also preserve soil moisture for the subsequent crop²⁷ if adequate biomass is achieved. Though no simple formula exists, considering these factors can aid in decision-making and success stories.



Figure 3. Terminating a cover crop mix of black oats and winter pea with a roller crimper, ahead of organic cotton planting in College Station, Texas.

Photo Credit: Muthu Bagavathiannan.

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You've got to have a lot of biomass for weed suppression. Don't be afraid of the biomass, but make sure you have the right equipment to work with it. Make sure to spray your cover crops at least two weeks ahead of planting. You also need to have a roller on the strip-till and a sweeper on the planter.”

*Myron Johnson
Headland, Alabama*

SPECIES SELECTION AND SEEDING RATES

Choice of cover crop species and seeding rates can be highly variable from region to region. Depending on climatic conditions, certain species may be more suited for one region than another. For example, in the lower region of southeastern cotton growing states, subterranean clover may be favored over hairy vetch which may perform better in the upper southeastern region; in the southwest, medic may be the best legume option.²⁸ Rye is a common cereal cover crop in most cotton growing regions; however, portions of the southwestern states may be too dry to establish a rye cover crop. When deciding what species or mix should be planted and at what rate, it is helpful to refer to a source that provides information specific to the region.



When choosing cover crops, particularly for a cover crop mix, start small with a three-way mix. It could include rye, triticale, or black oats. Pick a legume to go with it, and if you can get your cover crop planted early enough, put a little tillage radish with it. If money is a problem, just use two of them.”

*Sledge Taylor
Como, Mississippi*

Conclusions and Recommendations for Success

Cover crops have the potential to assist with long-term sustainability goals and improve farm profitability. With a wide variety of cover crop choices and management systems, reaping the multiple benefits of cover crops takes practice and active management. Therefore, it is wise to start with small acreage that is easily managed and seek advice from local practitioners or advisors who have been successful at using cover crops. It is crucial to prioritize the planting of cover crops so they can establish as early as possible and keep the cover on long enough to get the benefit of adequate biomass production. Overall, biomass production is the essential aspect of using cover crops for weed suppression, therefore consideration of seeding rate, termination timing, and climate are all necessary.

Making Cover Crops Work in Organic Systems

Rotational, cover crop based organic no-till offers an approach to enhance soil fertility and manage weeds without relying on synthetic inputs. This method involves carefully timed and dense planting of cover crops. Legumes like hairy vetch and crimson clover are particularly helpful to produce sufficient biomass for effective weed suppression and soil mulching while also providing nitrogen for the crop. The strategy focuses on maintaining soil health and nutrient balance. The term rotational refers both to the importance of diverse crop rotations and the fact that this practice is not continuous no-till. In organic systems, it is recommended to till and prepare a good seedbed when planting cover crops to remove existing weeds and improve cover crop stands and growth. Termination techniques such as roller-crimping are employed to prevent cover crop regrowth and seed production, with tools like high-residue cultivators, in-row mowers, and WeedZapper™, among others, available for managing breakthrough weeds. An integrated approach, using a diversified organic grain crop rotation with cover crops and tillage, has been shown to improve soil health.^{29,30}

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