SDSU Extension

iGrow Corn

BEST MANAGEMENT PRACTICES

# Chapter: 44
# Weed Management in Organic Corn Production

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As part of the 1990 Farm Bill, the U.S. Department of Agriculture's National Organic Program (NOP) was created to establish national standards and mandatory certification for organically grown products. These regulations are the framework for the production, handling, and processing of all organic agricultural products. The Organic Foods Production Act also established the National Organic Standards Board (NOSB), which advises the Secretary of Agriculture in setting the standards upon which the NOP is based. Producers, who meet NOP standards and are certified through annual onsite inspections by licensed certified inspectors, may label their products as "USDA Certified Organic." Production systems that are certified organic integrate cultural, biological, and mechanical practices that foster cycling of resources; promote ecological balance; and conserve biodiversity without the use of synthetic pesticides, GMO, or other specified products. Certified organic foods generally receive higher selling prices than nonorganic foods. Changing from "conventional management" to organic production requires a transition period free from synthetic chemicals for several years prior to certification. General guidelines for organic certification are available from the U.S. Department of Agriculture, www.usda.gov/organic. The purpose of this chapter is to discuss options for weed management in organic systems.

## Introduction

In numerous surveys of organic growers, weed management and control issues rise to the top of their list of major problems in grain and vegetable cropping systems. Undesirable plants interfere with production, may reduce yields, may cause problems with harvest, and reduce product quality. Early emerging weeds and high weed densities usually cause the greatest yield reductions, whereas late-emerging weeds may interfere with harvest operations and taint harvested products.

Typically, a successful organic weed-management system relies on rotational cropping as a base with further control provided through integrated methods. Most chemical control for weeds is not allowed in organic production. Therefore, the "many little hammers" approach for weed control and management is often discussed, as a single operation will not provide acceptable control. Weeds should be disrupted at key points during their life cycle to prevent growth and seed production.

Weed management should be a planned system over several years and include mechanical or physical methods, cultural control, and biological control techniques, where possible. Starting with a clean seedbed helps the crop establish without weed interference. Then, good management practices should be used that encourage faster corn growth to overtop and outcompete shorter weeds and to provide thicker and

faster canopy development to delay weed growth. More information on weed-control principles in organic systems is available by going to www.extension.org and searching for "An Organic Weed Control Toolbox" (Schonbeck, 2015).

***Role of Competitive Crops and Crop Rotations***

Conventional systems that have used synthetic fertilizers and pesticides cannot become certified as "organic systems" in a single year. Several years are needed to transition away from these chemicals. During the transition period, competitive crops should be grown and managed to reduce the weed seed bank in the soil. Once organic certification is achieved, these crops can be used in rotation to aid in weed management.

Successful organic systems generally rely on multiyear, soil fertility and pest (insect, disease, and weed) management plans. Crop rotations that minimize bridging of diseases and insects from one year to the next also help the main crop remain healthy and better able to withstand other abiotic and biotic stresses. The management plan may include cover crops (Fig. 44.1) and the use of crop seed free of disease and weed seed. Critical criteria for getting a "good" start include seedbed preparation, optimal planting dates and seeding rates, and the use of approved materials.

**Alfalfa** can be grown for 2 to 3 years to help minimize weeds. When planting alfalfa, choose a variety that regrows quickly and use a companion crop such as oats to help control weeds during alfalfa establishment. In trials at South Dakota State University, it has been found that no herbicides are needed during establishment, and even though the field may be quite weedy, alfalfa can establish well. Cut alfalfa at optimum times and heights, leaving enough plant to provide vigorous regrowth, and do not cut too late in the fall (after September 1), so that root carbohydrates have sufficient time to replenish for overwintering conditions. In the first year, if planted with oats, cut oats at heading (late June), and then allow the alfalfa to grow until mid- to late-bloom (about mid- August). This typically is the only cut during the first year. In the second and third years, alfalfa should be cut two or three times at recommended timings. A benefit to alfalfa in the rotation is that weeds are also cut and not allowed to go to seed. Typically, this will help deplete the weed seed bank and the fast regrowth of alfalfa will not allow new weeds to establish. Do not allow the stand to stay in so long that it becomes weak and noncompetitive. Another concern if the stand stays in too long is that alfalfa will dry the soil. These concerns must be balanced against the value of a good alfalfa crop and the weed control that it brings to the system. When coming out of alfalfa, tillage should be done in the fall or spring, preceding corn planting. The mechanical disruption of the terminated alfalfa will slow its regrowth, and volunteer alfalfa plants, even if present, typically do not result in reduction of corn yields.



*Figure 44.1 Buckwheat can be used as a smother or cover crop in organic systems to aid in weed management (courtesy John Ruter, University of Georgia, Bugwood.org and Carl Dennis, Auburn University, bugwood.org)*

**Smother crops** can provide an environment where weeds do not thrive and weed seed banks can be depleted. Buckwheat, cereal rye, sorghum, corn for silage, and other crops may be used for this purpose (Fig. 44.1). Typically, seeding rates are high and rows are narrow to get early canopy cover. If planted in narrow rows, cultivation is not used for in-season control, whereas wide-row plantings may require between-row weed control (flaming or cultivation) to minimize weed populations. Short-season spring crops may be followed with overwintering crops. Residues may be left on the field to further hamper weed establishment.

**Cover crops** planted after a short-season spring crop or interseeded into crops after the critical weed-free period can also provide some weed suppression. Vigorous cover crops not killed by overwinter conditions must be controlled through physical means prior to seeding cash crops because these vigorous plants will act as weeds. Flail mowing before seed set in cereal rye has provided successful control in the spring, as has roller-crimping immediately after rye flowering. The mowed or crimped rye can form mulch and, if thick enough (~4 inches), prevents emergence of weed seedlings. Additionally, some cover-crop species, including rye and radish (and other brassicas), have allelochemicals in the residue that are leached into the soil, further hampering weed-seed germination and reducing weed pressure.

## Physical Weed Control for Weed Management

Physical weed control is the most widely used method for immediate weed control in organic systems. Plastic barriers and hand-hoeing may be used throughout the field to minimize weeds in high-value crops, such as sweet corn, and transplanted crops, such as tomatoes and peppers. In grain and commodity crops, these operations may be too expensive, except in small areas where extra weed management may be needed, such as isolated patches of perennial weeds. Other physical means of weed control include cultivation (secondary tillage, rotary hoe), flaming, hoeing, and abrasive-grit applications.

### *Cultivation*

Many types of cultivation implements are available and may be used once or many times during the season. Cultivation provides a clean seedbed and can be used to provide immediate control of weeds between the rows. In the Midwest, two or three cultivations are typical for organic corn grain systems. Timing for all cultivation operations is critical, and it may take several years to establish optimal timing for weed control in your fields. However, complacency and performing the same operation at the same time every year will result in a spread of species other than those that were originally problematic. Rotary hoeing and harrowing can be used if the corn and weeds are not too large (that is, weeds at the white-thread stage). Rotary hoeing on a diagonal, rather than up and down the rows, at 10 to 12 mph is purported to provide the greatest weed control.


*Figure 44.2 Rotary hoe operation to remove small weeds. (Courtesy Mike Owen, Iowa State University)*

There are challenges with cultivation that should be considered prior to adoption. In rolling landscapes, erosion possibilities may outweigh the benefits of tillage and should be assessed because permanent damage can occur to soils with one untimely operation. Soil health may also be reduced by untimely operations causing crusting, reduced water infiltration, and reduced organic matter and residues in surface soils.

### *Mulching*

Mulching with residues, plastic, or approved organic plant meals (such as corn gluten, soybean, or mustard meals) hampers weed germination, establishment, and development. Meal application rates are often very high, at hundreds of pounds per acre. Placement should be between rows so that crop growth and development are unimpeded. However, within-row weed management should not be forgotten, as weeds

closest to the crop tend to cause the greatest yield loss. If within-row weeds become a problem, abrasive grits sprayed toward the base of the crop plants, hand-hoeing, or shielded cultivators to get as close to the crop as possible may need to be used.

***Hand-hoeing***

Hand-hoeing is a time-tested approach to control weeds. However, the practice is often overlooked in organic production fields because of cost and labor requirements. Notwithstanding, new infestations of a weed, control of within-row weeds, or control of scattered plants may warrant individual attention. Weed seeds can last in the seed bank for 3 to 50 years, and one weed can produce several hundred to several hundred thousand seeds. "An ounce of prevention, can be worth pounds of cure" – through careful management, weeds can be controlled (Fig. 44.3).

*Figure 44.3 Carefully tended cropping areas in Vietnam display minimal weed problems. (Courtesy of the author)*

***Flaming, Steaming, and Microwave Systems***

Flaming, steaming, and microwave systems have been used to kill weeds through desiccation and high-temperature exposure (Fig. 44.4). Young weeds (and germinating seeds, in some cases) can be killed quite readily with these practices. Larger weeds need to be treated for a longer period of time and the growing point must be affected. The problem with these methods is that the contact time needs to be optimized, often leading to slow operating speeds for equipment, low labor efficiency, and high fuel bills. Caution must be taken because crops can be sensitive to the heat as well. Typically, corn can withstand the heat if the growing point is below the soil surface, but care must be taken not to directly heat the crop, once the growing point is above ground.

*Figure 44.4 An image of a propane flamer. (Courtesy of Michigan State University)*

***Abrasive grit***

Abrasive-grit systems are being tested by SDSU, the University of Illinois, and USDA-ARS for their ability to control weeds (Fig. 44.5). The machine uses organically certified grits (walnut shells, corncobs, soybean meal, pelletized poultry manure) applied at 100 psi to in-row weeds with nozzles pointed toward the base of the plant. The grit blasts the weeds causing enough damage to kill young broadleaf weeds and injure the growing points of older weeds. We found that two operations, one at V1 or V2 and another at V3 or V4, controlled broadleaf weeds and maintained cash-crop yield. If the operation occurred at V5, weeds were well-developed and, while abrasion caused some damage to the weeds because of earlier interference, corn yield was reduced (author's unpublished data). Timing on grass weeds needs more research because of the ability of a defoliated plant to regrow if the growing point is below ground at the time of treatment. Optimization of grit types, rates, timing, and spectrum of weeds controlled are still in the early stage of research.

*Figure 44.5 Four-row grit applicator for weed control in row crops designed by SDSU Ag & Biosystems Engineering Dept. (Dan Humburg and Corey Lanoue) Ground corncob grit was used as the spray. (Courtesy of F. Forcella, USDA-ARS)*

### *Robotic Hoeing and Flaming*

Recent developments in nonchemical weed control include the "Robovator," a robotic implement that hoes weeds within crop rows (Fig. 44.6). In this case, the crops have to be precision-planted and the Robovator uses a knife to remove any and all plants between the spaced crop plants. An equally innovative implement is a robotic flame weeder that senses the presence of a crop plant and withholds a flame jet, but singes all other plants (Fig. 44.7).

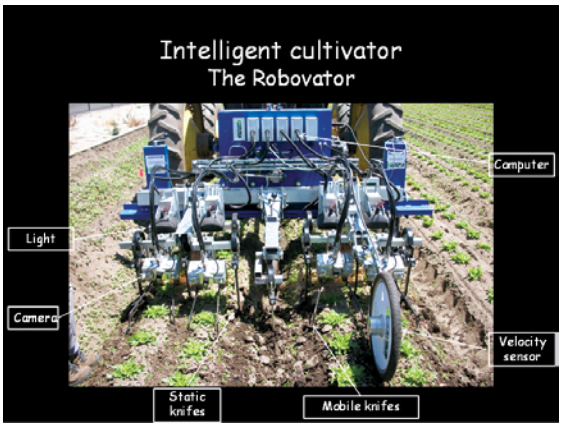


*Figure 44.6 Robovator that was developed to combine "smart sensors" with knives to mechanically hoe organic fields. (Courtesy of Steve Fennimore, UC, Davis)*


*Figure 44.7 A "smart" flame weeder that uses sensors to detect weeds in the interrow of transplanted crops. Note that some areas are being flamed and other areas are not. (Courtesy F. Poulsen Engineering ApS., Denmark)*

### *Organic Approved Sprays*

There are some chemical herbicides approved for use in organic production, however, the efficacy of these applications are inconsistent in South Dakota. In 2015, sprays approved for application for weed control in organic systems with or without approved organic surfactants included: clove, cinnamon, and garlic oils; citric acid; and ammonium nonanoate. Reports from credible research trials should be consulted prior to purchase, as rates, surfactant types, and timing of applications have had mixed results. As with any pesticide application, always read and follow label directions.

## Summary

Premium prices for organically grown crops can be financially beneficial. However, based on numerous surveys of organic producers, weed management is one of the most challenging aspects of growing organic crops. As in conventional systems, there is no one "silver bullet" technique for weed control. Understanding the biology of the weedy species infesting the area will help in planning timely operations to disrupt weed establishment and growth. The use of many diverse techniques (e.g., smother crops, flaming, cultivation) and crop rotations are key aspects to minimize weed problems in organic farming.

## References and Additional Information

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## Acknowledgements

Support for this document was provided by South Dakota State University, SDSU Extension, and the South Dakota Corn Utilization Council.

Supported in part by: SOUTH DAKOTA CORN UTILIZATION COUNCIL

A GROWING INVESTMENT

Clay, S.A. 2016. Chapter 44: Weed Management in Organic Corn Production. In Clay, D.E., C.G. Carlson, S.A. Clay, and E. Byamukama (eds). iGrow Corn: Best Management Practices. South Dakota State University.