

Managing Weeds Organically: Do We Have to Plastic?

A Decision Case Study

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Managing Weeds Organically: Do We Have to Use Plastic?

“We don’t want to use plastic mulch!” Shannon insisted emphatically. Shannon and her husband Micah run a five-acre certified organic diversified vegetable farm, as well as raising sheep and putting up hay. As they fought weed pressure on their newly transitioned land, they tried other options for weed control in their vegetable crops, to avoid the expense and lack of sustainability they associated with plastic mulch. Are there other options that work as well as plastic? Or must Shannon and Micah sacrifice some of their agricultural sustainability values to sustain their farm operation?

Farmers Shannon and Micah Andersen* have been farming for four years and purchased just over 150 acres from a third-generation dairy farm two years ago. Micah holds a Bachelor’s degree in sustainable agriculture and gained experience working on a variety of different farms – mostly small, diversified, family farms as well as a school garden and a farm non-profit. Micah and Shannon decided to certify their land for organic production because they deeply valued sustainability and working with nature’s patterns.

In the farm partnership with Shannon, Micah takes the lead in growing the produce and fixing the machinery when it breaks down. Shannon is the farm shepherd, as well as the business marketer, writer, and photographer. She loves learning about and meeting the biological and psychological needs of her flock. When she’s not in lambing season or

** While these cases describe actual situations, names have been changed to protect the identity of participants.*

moving portable fencing, Shannon is in the fields working with Micah on the vegetables.

Micah and Shannon were able to obtain organic certification of their vegetable operation almost immediately on some fields of the land they had bought. On these fields, they grew vegetables like salad greens, radishes, cucumbers, and squash, as well as fruit like melons and cantaloupe. Their mission is to improve the land and maintain the homestead’s infrastructure, while providing the local community with high-quality farm products.

After first purchasing the farm, Micah and Shannon worked on building and balancing the soil in fields that had been fallow. Weeds, however, were persistent, having had many years to establish. Yellow foxtail, a grass, was their biggest problem (*see EXHIBIT A: Yellow Foxtail*). The yellow foxtail on their farm was producing a seed head when the grass was approximately two inches tall, so the tractor-towed brush hog mower that cuts three

inches at its lowest setting couldn't reach the grass before it became a reproducing seed head. The foxtail continued to multiply, threatening the health of their vegetable crops by taking nutrients from the soil, shading out the sun and providing habitat for potentially harmful insects.

Shannon and Micah tried a number of weed control methods, but as they increased their production acreage each year, they were running out of weed control options. As they scaled up production to five acres, using many of the same soil preparation techniques and equipment, Shannon and Micah simply didn't have time to hand weed their expanded acreage. It was only the two of them with one very part-time employee, and they didn't have the income to pay for the labor of another employee.

Organic Control Options for Large Acreages

Shannon and Micah started exploring their options (see *EXHIBIT B: Friends or Foes? Farmers Talk about their Relationships with Weeds*). The first method they used was tried and true: cultivation and hand weeding. The first few years when they were farming two acres or less, Shannon and Micah were able to keep up with their weeds by using cultivation and hand-weeding on a schedule. For example, in spring they would prepare the soil bed with a borrowed tractor, plowing to break up overwintered cover crops. The residue would break down after a week or two, after which they would add compost. After allowing the germination of a few more weed seeds, they would use the wheel hoe to break up the soil and get rid of the small weeds. They would then direct seed lettuce salad mix. They would hand weed once more when the

salad mix had germinated and was about two inches tall. This routine usually allowed them to make it to harvest with no more hand weeding, as they had gotten rid of most of the weed seeds before planting. Longer season crops such as kale that are planted in spring, stay in the ground and are harvested all season. Shannon and Micah could prepare the beds similarly for these crops, and then hand weed at least three times during the season to keep the weeds at bay.

The second method they tried was to crowd out unwanted weeds using long-season rotations with relay cropping, a technique where multiple crops are grown on the same ground in one year (see *EXHIBIT C: Common Five-Year Crop Rotations on a Vegetable Farm*). They also experimented with under-seeding a cover crop with vegetables to provide additional crop competition with weeds. For example, under and in between the kale plants, they would seed a cover crop like crimson clover to crowd out the other weeds. This technique required favorable weather and perfect timing – two things that a small farm team doesn't often have. Crimson clover can build up soil organic matter and fix nitrogen so it's available for crops to use, but it takes a while to establish, and so is not an ideal weed suppression cover crop. Cover crop seed is also generally expensive, and while a valued luxury used in resting fields to build soil, it is an expensive weed control method to use in existing crop rows.

Thirdly, Shannon and Micah discussed buying a small cultivating tractor to use for weed control. They had purchased a larger tractor for plowing and baling hay, but didn't have a smaller model that could easily get between the rows to inter-row cultivate. With all of the other expenses that come with small

diversified vegetable farming, the expense of a cultivating tractor had not yet fit into the budget. It would save them a lot of labor time currently used for hand weeding, but the expense hadn't been feasible.

Is Plastic the Only Option?

Shannon and Micah started feeling that plastic mulch might be their only option. Many small diversified certified organic vegetable farmers consider plastic the best weed control option, despite the uneasiness that comes with using a petroleum product that will go into a landfill every year. Plastic mulches effectively block weed emergence, and promote soil warming and early crop growth. It's also easy to use drip irrigation underneath the mulch, and control efficient watering through drip tape. However, organic regulation requires farmers to pull up the mulch at the end of the season. The mulch can't be used again or recycled so it is thrown away every year.

However, reliance on mulches rather than cultivation may be better for soil quality in the long term. Intensive cultivation of soil, like the repeated cultivation often used every year to control weeds on organic farms, is known to break up soil aggregates and reduce fungal and earthworm numbers in soils. As fungi and earthworms contribute to soil quality by improving soil structure and tilth, important for water infiltration and holding capacity and nutrient cycling, repeated cultivation can lead to soil degradation in the long term. The financial and ecological cost of plastic mulch could be outweighed by the damaging effects of cultivation year in and year out on their farm.

Biodegradable mulch is available, but its development is very much a work in progress.

Even the newest products that claim to be biodegradable break down very slowly and oftentimes not completely. Plastic mulch is also expensive, at approximately \$250 per acre, and almost double that for biodegradable mulch. Instead, Shannon and



Micah were using natural mulches like straw from their forage fields. They had a mostly good experience with

this method, and used it primarily in between rows and only on transplanted crops, rather than those that were direct-seeded. The problem with this was keeping up with production; they chose to use their own hay, and were not able to produce enough to feed their sheep over winter as well as using hay in the vegetable fields as mulch. They also found that it had to be laid down very thickly to prevent the foxtail from finding its way through the straw, and the whole process took a lot of time.

Micah and Shannon knew they could not continue to rely on hand weeding to keep weeds at bay in their vegetable crops. However, they did not have the capital to invest in machinery to perform weed control cultivation operations more quickly. They felt that they had to choose between petroleum plastic, biodegradable plastic, or straw mulch. Each of the mulch options have their pros and cons, including expense, labor and negative environmental impact. Should Shannon and Micah use plastic mulch in their fields this year? What weed control plan could they adopt for the long term? What combination of these weed control methods could work within Shannon and Micah's small farm business?

Exhibit A. Yellow Foxtail

SUMMER ANNUAL GRASS

Yellow foxtail

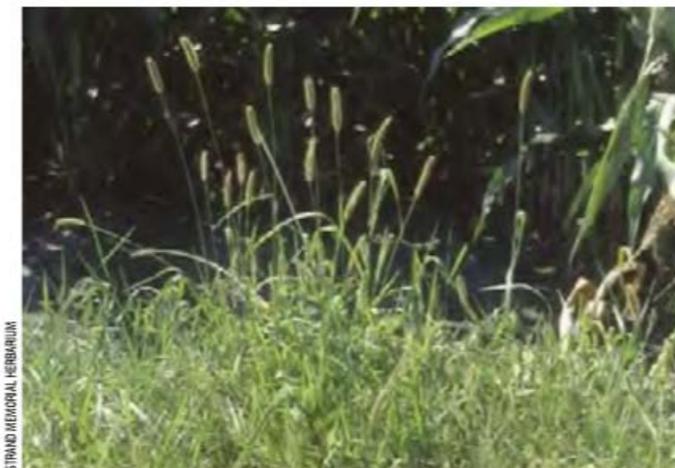
Setaria pumila Poaceae Family



UNIVERSITY OF MINNESOTA EXTENSION
Seedling.



UNIVERSITY OF MINNESOTA EXTENSION
3 to 5 leaf stage.



STRAND MEMORIAL HERBARIUM
Plants.

Also known as: *cattail grass, pigeongrass, yellow bristlegrass*

Seed emergence time: *at end of corn planting, late May to early June, about the time of crop planting, seed can also germinate later in the summer with adequate soil moisture*



ID: Seedling—*long hair at base of leaf only*

Roots—*Fibrous*

Stems—*erect, smooth, branch at base, 1-2 feet tall*

Leaves—*flat, often with spiral twist, many long hairs on upper surface near base*

Flower—*dense, erect spikelet, yellow at maturity*

Risk to yield:

Corn: potential losses can occur at densities greater than 1 plant/ft²;

up to 80% loss with large infestations

Soybean: potential losses of 5% at 1 plant/ft²

Risk Level	
Corn/Soybean	LOW
Small grains	LOW
Forages	LOW

Other traits:

- *Moderate persistence of seed: 50% reduced at 5 years; 99% reduced at 30 years*
- *Prefers compact, fertile soils*
- *Intolerant of shade*

Source: Coulter, J., Moncada, K., and Sheaffer, C. 2010. Chapter 7: Weed Profiles. In: K. Moncada and C. Sheaffer, eds., *Risk Management Guide for Organic Producers*. University of Minnesota. (<http://organicriskmanagement.umn.edu>)

Exhibit B. Friends or Foes? Farmers Talk about their Relationships with Weeds

The following is an excerpt from the Organic Broadcaster by Patrick Lillard of Purdue University, found at the MOSES website: <https://mosesorganic.org/farming/farming-topics/field-crops/friends-or-foes-farmers-talk-about-their-relationships-with-weeds/>.

Whether or not we like it, we all have relationships with those plants we call “weeds.” Farmers can use some colorful language to describe these persistent companions. I had the chance this past summer to hear what organic farmers think about weeds as I toured six organic farms in different parts of the country. At each farm, I asked the farmers how they’d describe their relationship with weeds. I got a few strange looks, quite a few laughs, and a word I had to look up after the interview. (Now I know what “peripatetic” means). Still, almost everyone noted something we all can learn from weeds.

“Actually, we do learn a lot from weeds,” said Dave Campbell of Lily Lake Organic Farm in Illinois. “It’s hard to believe just a matter of 40 acres away in another field, I’ll have different weed pressures than I will in another part of the farm. So I look at weeds and try to observe what kind of weeds I have, what the issue is, and why I’m having these weeds and try to address that issue.”

Bob Cannard, an organic farmer in California, went beyond seeing weeds as beneficial, considering them essential on his farm. “They’re my number one crop!” Bob said. The vegetable plants are a secondary response to a good soil and a good digestive system. A lot of people don’t like weeds. Well I love weeds, and it is all about managing the population densities and controlling the time/ space sharing between the different cropping systems.” Each of these farmers saw weeds’ role on their farm in different ways, from indicators of problems to an integral component in a farm’s ecosystem. These perceptions drove how and when they decided to manage weeds.

Robbie Long of Earthbound Farms in California described his approach to managing weeds with one word: “cultivation.” He starts by pre-irrigating the beds a couple of times and cultivating shortly afterward to eliminate the first few flushes of weeds right after they germinate. Then, after the crop is planted and established, he’ll do a precision cultivation, leaving less than two inches either side of the plant uncultivated. A general weeding crew will go through and, while thinning the plants, they’ll hoe any weeds in the row. This is then followed by another cultivation and one last hoeing. Robbie is strict about not letting weeds go to seed in the field, and will actually have the weeding crew pack the weeds out of the field if they are going to seed. This labor can be expensive, ranging from \$100 an acre for a fairly clean field all the way up to \$1,000.



Bob Cannard’s weed management is a balancing act of letting the crop get established and then allowing weeds to assert themselves. He lets weeds complete their life cycle and then mows them with a flail mower before planting the crops. Once the crop is planted, he maintains a critical weed-free period by cultivating shallowly with a roto-tiller and wheel hoe, and occasionally mowing. Once the crop is established, he allows the weeds to grow, which provides several benefits. As he explained, the challenge to this strategy is that very delicate balance between the weeds and the crop. “You have to pay attention,” Bob said. “You have to be intimately concerned and part of your farming operation. If you slack off, why the weeds are gonna take over and you’re gonna have plenty of soil food but not enough people food.”

Exhibit C. Common Five-Year Crop Rotations on a Vegetable Farm

Y1	Winter	Mulch		Crimson Clover		
	Spring	Lettuce		Tomatoes OR Peppers		
	Summer	Beans				
	Fall	Radish		Red Clover	Winter Brassicas	Lettuce (strip crop)
Y2	Winter	Winter Rye		Red Clover		
	Spring	Carrots		Okra - Flowers - Basil		
	Summer					
	Fall	Beans	Turnips	Winter Brassicas	Vetch	Lettuce (strip crop)
Y3	Winter	Rye		Vetch		
	Spring	Lettuce		Cucurbits		
	Summer	Winter Squash (with hay mulch)				
	Fall	Mulch		Crimson Clover	Lettuce (strip crop)	Winter Brassicas
Y4	Winter	Mulch		Red Clover		
	Spring	Beets				
	Summer					
	Fall	Radishes		Red Clover	Winter Brassicas	Lettuce (strip crop)
Y5	Winter	Winter Rye				
	Spring	Tomatoes (with hay mulch)				
	Summer					
	Fall	Mulch		Return to Year One		

Sources: Mohler, C.L and Johnson, S.E. (eds). 2009. Crop rotation on organic farms: a planning manual. Natural Resource, Agriculture, and Engineering Service-177. Cornell Cooperative Extension. <http://www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms>

Teaching Notes:

Case Objectives:

- Understand how weed pressure affects beginning farmers using organic methods.
- Realize how scaling up production and increasing acreage have implication on available options for weed control.
- Recognize that biology of weeds is a consideration in their management.

Use of the Case:

This case is developed for use by extension educators, post-secondary instructors, state agency personnel, and others interested in increasing understanding of the organic transition process.

Materials Needed:

- Copies of the decision case study/ies on which to make notes as participants read.
- A laptop and projector to show slides of the farm, the markets, and the farm family. It could also be used to project discussion questions, certification requirements, or other materials of interest.
- A “U” or horseshoe-shaped seating arrangement for maximum participation among participants and the facilitator.

Dealing with Controversy:

Often in the discussion of a decision case study, participants will disagree about certain issues. While this is a mark of an effective case, the facilitator should keep the discussion from becoming argumentative and unproductive. Participants should be reminded that there are many points of view and to keep the discussion atmosphere constructive and nonthreatening. If desired, techniques such as role-playing or role reversal can help participants discuss the issues in a less personal way.

Use the following strategies to facilitate a productive, healthy discussion where controversy may be involved:

- Establish ground rules. These may include: allowing only one person at a time to speak; no one should speak twice before everyone has had a chance to speak once; no criticizing of others’ comments, etc.
- Encourage participants to use “I” messages when stating their viewpoint. Avoid using “you” or blaming statements.
- Ask clarifying questions such as, “Why do you think that?” A major communication problem is misunderstanding what was said.
- Ask participants to try to imagine the situation from the other person’s point of view. (Role-playing can also help with this.)
- Encourage participants to focus on what they want in the future or where they would like to go, rather than where they have come from or what has happened in the past.

Lesson Outline:

Discussion of this decision case study can last from 20 to 60 minutes, depending on the degree of preparation by the participants and the desired depth of the discussion. The outline below is one example of the way a facilitator might structure the discussion. In general, a decision case study discussion is a forum where participants talk to each other in addition to the facilitator. The format described here is useful when advanced preparation of the participants is not possible. If desired, the facilitator can include additional information on local crop production and social issues to enhance discussion and create a broader understanding of those topics.

- Introduction
- Facilitator introduces the case study and describes the goals and approach to be used
- Focus on a real situation
- Practice problem solving
- No single right answer – each person and situation is unique
- The Decision Case Study
- Facilitator introduces the decision case study.
- Participants read or reread the narrative of the decision case study
- Facilitator divides the participants into small groups of 2-4 people and asks them to discuss questions.
- Participants return to large group and share key points of their discussion
- Facilitator guides a group discussion on the remaining questions
- Conclusion
- Group members may select a preferred option or facilitator may have participants write individually and describe their decision in response to the dilemma and the rationale for the response
- Closing comments

Discussion Questions:

Below are examples of the kinds of questions the decision case study facilitator can use to stimulate discussion of the issues in this case. Participants may discuss some of these questions in groups of two to four and some questions as a large group. The questions used can vary depending on your time limit and the issues you wish to discuss. Other questions may be added as needed and appropriate to the situation.

1. Why might organic vegetable producers rely on hand weeding for weed control? What are pros and cons to using hand weeding for weed control?
2. What are the environmental and economic pros and cons of relying on cultivation throughout the season to control weeds?
3. What weed management options exist to produce organic foods under no-till conditions? What options should be researched in the future?
4. After plastic mulch is used and disposed of on organic farms, what does the rest of its life cycle consist of? What about a “biodegradable” mulch that consists of 20% plant materials? What about a biodegradable mulch that consists of 100% plant materials?
5. How long is too long for plastic-type mulches to biodegrade, for them to not be considered sustainable? How and who should determine what regulations are fair and necessary for biodegradable mulch use in certified organic production?
6. Are there resources on Shannon and Micah’s farm that they could use for weed control that they may not have considered? How could these resources be used?
7. How can the greater community help small, certified organic diversified farm operators succeed?



The following resolution to the case study, along with an analysis, is offered for the benefit of the instructor in preparing for leading a discussion of the decision case study. The information it contains and the final resolution of the decision case study may or may not be disclosed to discussion participants, at the instructor's discretion. Should the resolution be shared with participants after the discussion takes place, the authors suggest debriefing the epilogue and final decision with the students.

Epilogue:

The next season, Shannon and Micah did end up using plastic mulch, but they tried to use it sparingly to limit the environmental impact. They used it for long-season crops that were transplanted like kale and squash, because it was longer lasting. At this time there were still no biodegradable mulch films approved under NOP rules so they used natural mulches in addition to the plastic. Direct-seeded crops that were planted close together like carrots and beets were mulched with straw that decomposes over time and did not require removal like plastic mulch. They couldn't yet afford a tractor for cultivation, and were continuing to save money toward that. They also began researching some no-till options involving planting transplants into crimped cover crops such as winter rye. They felt confident that someday in the near future they would be able to eliminate plastic mulch from their operation.

