SUSTAINABLE MULCH MANAGEMENT

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Biodegradable Mulches in Horticulture Production

WASHINGTON STATE UNIVERSITY

Biodegradable Mulch News

MAKING THE SWITCH TO SOIL-BIODEGRADABLE MULCHES (BDMS) - LESSONS LEARNED FROM FARMERS

Lisa Wasko DeVetter, Associate Professor of Horticulture
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Washington State University, NWREC

Highlights

- Labor savings are a big benefit of BDM use
- Farmers also say BDMs simplify end-of-season field clean up and are safer than mulch removal equipment
- Long-time (20+ years) BDM users have not seen declines in soil health or plastic build-up in soils
- For first time users, the advice is to start small and don't apply BDM too tight!

Farmers are among the most knowledgeable people we get the opportunity to work with. When they take the time to share their wisdom and experiences, it is important to both listen and learn. That is why in this second edition of *Sustainable Mulch Management* we wanted to highlight some of the information shared by four farmers that participated in a webinar on soil-biodegradable plastic mulch (BDM) held on March 1, 2022. These four growers differed in their years of experience working with BDMs, which provided a spectrum of knowledge that encompassed first- to long-time users of BDMs.

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Soil-biodegradable mulch field trial conducted at Rebecca Bozarth's farm. Photo by Brenda Madrid.

Representing the first-time user was Rebecca Bozarth. Bozarth is not new to agriculture, however, and has been growing strawberries commercially in California for 30 years. What led her to want to try BDMs was her concern with plastic residue left in fields after growing strawberry with conventional polyethylene (PE) mulch, which was costly to remove by hand and poses environmental and food safety concerns for rotational crops like lettuce. In lettuce systems there is the concern that fragments left in the field could be accidentally harvested and become a food contaminant. If BDMs don't break down fast enough there is similar concern about degrading fragments becoming contaminants.

Research is ongoing on Bozarth's farm to monitor BDM degradation and see if it can be accelerated through application of potentially degrading products. Specifically, she is evaluating whether Fluid Compost [Willbur-Ellis, Yakima, WA; contains compost extract, humic acid from leonardite, azomite, and kelp (*Ascophyllum nodosum*)] and Nutrio Unlock® (Willbur-Ellis, Yakima, WA; a biological catalyst containing multiple microorganism species), both combined with BenViero FolioSentials (Willbur-Ellis, Yakima, WA; a 3-0-3 liquid fertilizer derived from molasses, beet extract, and soy protein hydrolysate), increase degradation relative to an untreated control. However, her experience to date has been that BDMs apply and perform in the field similarly to traditional PE films. In her system, she recommends discing and tilling the field thoroughly to incorporate BDMs well into the soil. Yet, an important question remains - how fast will BDMs degrade and will it be fast enough for the lettuce growers she rotates land with?

With just under a decade of experience was Bruce Gresczyk Jr. of Connecticut. Gresczyk uses BDMs for all of his mulched vegetables and strawberries. For Gresczyk, the labor and cost savings provided by BDMs during end-of-season clean up has kept him a repeat user (BDMs just need to be tilled into the soil). Gresczyk recommends growers try BDMs on their own farms based on his positive experiences but cautions them about application. Application is different relative to PE and BDMs tighten after laying, so it's important not to initially apply too tightly or that will weaken the material.

Trevor Hardy represented a diversified fruit and vegetable grower in New Hampshire with 20 years of experience working with BDMs on his farm (except in the organic sections where commercially available BDMs don't meet organic requirements). Hardy also sells agricultural supplies in the northeast region of the United States, including BDMs. What attracted Hardy to BDMs and keeps him a long-time user is the labor savings during mulch removal and disposal. Field clean up is also faster when using BDMs, allowing

Vegetable crops grown using soil-biodegradable mulches. Photo by Shuresh Ghimire.

Hardy to establish a fall cover crop for improved soil health.

Hardy was full of wisdom on the use of BDMs. For first-time users, he recommends starting with a 0.6 mil film and testing it on a small portion of the farm before scaling up in future years. Mulch thickness can be adjusted in future years if the 0.6 mil is too thin or thick. Mulch laying will likely take longer than PE mulch, but application time should be comparable as the grower gets more familiar with the material. Additionally, apply when the weather is good and fields have been properly tilled (i.e., no big clods). Similar to Gresczyk, Hardy warns to avoid applying BDMs too tightly as this creates stress and can reduce its performance - it should be somewhat loose and will eventually shrink to form a good fit on raised beds. During tillage, Hardy advises tilling BDMs in the direction it was laid if using raised beds and then spreading cover crops perpendicular to rows to enhance degradation.

Last among our invited growers was Sandro Colombia of Italy. Colombia has 20-25 years of BDM experience. In the European Union, BDMs are allowed in organic/biological farming and this was one factor that influenced Colombia to try BDMs. In addition, some of the equipment used for PE mulch removal and disposal was considered to be hazardous by Colombia. BDMs avoid those risks by just needing to be tilled in.

With such a long period of use, the audience was pleased to learn BDM fragments are not visible after the following season on Colombia's farm, indicating degradation was rapidly occurring. Additionally, Colombia has benefited economically by making the switch to BDMs - he saves on tractor fuel, labor, and associated costs that otherwise occur when removing non-degradable mulch at the end of the production cycle. He also feels his workers are safer because they spend less time operating mulch removal machinery that may not be safe. Columbia would recommend BDMs to growers but advises them to spend more time on site preparation before laying in order to ensure the integrity of the product once deployed in the field.

If you want to see a recording of the panel, please visit the link below on our website.

https://smallfruits.wsu.edu/plastic-mulches/

BUILDING A BETTER MULCHING INDUSTRY: A BIODEGRADABLE MULCH Q&A WITH DR. HUAN ZHANG

Former student, Dr. Huan Zhang, in his raspberry research trial. Photo by Lisa DeVetter.

Current Washington State University (WSU) graduate students, Dakota McFadden and May Wang, sat down with a former graduate student to discuss his experience and opinions on soil-biodegradable mulches (BDMs) and what the future of mulching in agriculture may look like.

Can you tell us a little about yourself and your educational background?

My name is Huan Zhang. I completed my bachelors degree at the University of Nebraska before pursuing graduate school at WSU. After starting graduate school as a Master's student, I switched to a PhD program in Small Fruit Horticulture where I studied biodegradable and non-biodegradable [i.e., polyethylene (PE)] mulches in red raspberry with Dr. Lisa DeVetter. I also collaborated with Dr. Carol Miles in Vegetable Horticulture on BDM application and adhesion in pumpkin. Currently, I am working as an agricultural consultant in China offering services to the apple, cherry, grape and berry industries.

Explain your experiences with mulches in specialty crop production systems.

I mainly worked on evaluations of biodegradable and nondegradable plastic mulches in raspberry and strawberry, but I also collaborated with Dr. Carol Miles on the BDMs in pumpkin and bean projects. I am very positive and confident about my research impacts to local Washington growers. Washington raspberry growers continuously study and adapt to new technologies, which is very promising for developing sustainable agriculture. In the past decades, Washington raspberry growers planted raspberry in bare ground, but now they change to plant raspberry with plastic mulches like PE mulch. Currently there are approximately 1000 acres of raspberry production implemented with plastic mulches in Washington. Plastic mulches provide a lot of benefits to crop production, especially they can promote yield. For BDM, there is no labor cost for removal after planting. Even though BDM degrades over time, we found it still maintained the yield and fruit quality for raspberry production in western Washington, so I highly recommend growers to take the lead of using BDM. In the future, I hope agriculture researchers can have more opportunities to keep the communications with growers, build more connections and disseminate our research findings.

What does the future of mulching in specialty cropping systems look like to you?

In perennial crop production such as raspberry and blueberry, PE mulches tend to be dominant. Weedmat mulch [made from woven PE or polypropylene] is very popular to blueberry growers due to its durability. There are a few growers using BDM in the United States and BDM is still relatively new to them. Most growers know less about BDMs and worry about their risks. So there needs to be more work related to different kinds of BDMs in various crop production systems. BDMs are mostly developed in the research phase, and dissemination of BDMs need to be more to the grower audience, that is our purpose to make BDM newsletters, to let more people know about BDMs, be familiar with this new material and not to feel risky to use. The mulch industry also needs to invent more BDM products that meet growers' needs and develop the market. In recent years, environmental changes brought more people's attention to behave environmentally friendly. Recycling plastic mulch is a key step to reduce plastic waste. However, BDMs seem to be ideal and they are more feasible than PE mulch recycling due to challenges with recycling mulch films.

You have done several research studies on BDMs. What are your personal opinions on their adoption and acceptance in farming? Do you have any suggestions to offer the BDM production industry to make BDMs more appealing to farmers?

I would expect to see more adoption and acceptance if they met the standards for organic production in the United States, which none of the plastic BDMs do. The growers are not satisfied with current BDM options which greatly hinders their adoption and acceptance. The suggestions I would have for the BDM production industry would be to focus on improving the products first. Once BDM products are able to meet organic guidelines, educating farmers and researchers should be the top priority. After the industry has been properly educated about newly improved BDMs, then these improved BDM products which meet organic specifications should be advertised.

Read more about BDMs in organic production here:

https://smallfruits.wsu.edu/plastic-mulches/organics/

Do you see opportunity for other alternative BDMs, such as water based mulches, to be adopted into commercial production?

Absolutely. The market for quality mulch is present, so these newly developed BDM options could be utilized and they may become popular. Overall, mulches are designed to bring more financial gain to growers. The manufacturers need to understand that every grower has a different purpose for wanting to use mulch on their farm. Some farmers may want a mulch that warms the soil, while other farmers might be more focused on weed control, or yield improvement. Having a wide array of diverse mulching products available is a good thing, and it can provide growers with more options, which can in turn help improve the sustainability and environmental responsibility of the mulching industry.

INTRODUCTION TO HYDROMULCH

Dakota McFadden, PhD Graduate Student

Washington State University, NWREC

Hydromulches (HMs) are a new approach to agricultural mulching which combines water with biodegradable organic fibers and tackifiers to produce a slurry. HM slurries are applied to the field as a water-based mulch. Commercially available HM products are commonly tank mixed with seed and applied to fields to foster revegetation, prevent erosion and suppress weeds in a method called hydroseeding. Despite the widespread use of HM products in hydroseeding applications, hydromulching has not been adopted in commercial agricultural or horticultural practices.

Hydromulch trial on greenhouse-grown strawberry plants. Photo by Dakota McFadden.

Early research studies investigating HM use in farming systems show potential (Liburd et al. 1998; Claramunt et al. 2020; Puka Beals and Graming 2021). HM weed suppressive abilities have shown to provide adequate control (Cline et al. 2011; Granatstein et al. 2003), similar to that of polyethylene (Warnick et al. 2006). HM have also been documented to reduce soil temperatures in some cases (O'Brien et al. 2018, Warnick et al. 2006, Cline et al. 2011), which may cause decreased productivity in a maritime climate, but may be ideal for cultivations in semi-arid or warm regions like eastern Washington.

Common fibers and tackifiers used to create HM include: paper, wood fiber, flax fiber, mushroom compost, rice hulls, hemp hurd, guar gum, psyllium husk, camelina meal, etc. Formulations for HM are being developed by Montana State University (MSU) and tested for their puncture resistance, tensile strength, rain-fastness, porosity, density, soil adhesion, and C:N ratio as part of a collaborative USDA OREI grant (#2021-51300-34909). The best HM formulations provided by MSU will be utilized in field research at WSU Northwestern Washington Research and Extension Center in Mt. Vernon and at North Dakota State University during the 2022 field season on organic day-neutral strawberry. They will also be tested in 2023 in Eastern Washington at an industry partner's organic blueberry farm. This research will help growers in Washington State and similar climatic regions better understand if using HM could benefit their berry cultivation system, and if they can replace their PE mulch without sacrificing yields in organic systems.

Stay up to date on HM research led by Dakota and others by following this webpage:

https://eorganic.info/hydromulch

GRADUATE STUDENT HIGHLIGHT

Srijana Shrestha

Washington State University, NWREC

Graduate student, Srijana Shrestha, is studying soil-biodegradable plastic mulches in vegetable systems and outreach initiatives.

I am a Master's student with Dr. Carol Miles in the Vegetable Horticulture program. The objective of my project is to provide current science-based information on soil-biodegradable plastic mulch (BDM) to agricultural professionals and fill information gaps on BDM. I have done this by developing educational materials including PowerPoint slide sets, course lectures, presenter notes, fact sheets, and videos. We are disseminating these resources via our WSU website (https://smallfruits.wsu.edu/plastic-mulches/) that anyone can directly access.

Agricultural producers and the extension specialists who serve them have insufficient knowledge about BDM and this is a major barrier to BDM adoption in the US. I hope my project will contribute to increase awareness about BDM so that agricultural professionals are better prepared to answer the questions and/or concerns that growers have about BDM. Furthermore, my project identifies the need for research areas based on interactions and questions from the audience during conferences, workshops, and farmers' field day events.

In the future, I see the increased use of BDM by growers for horticultural crop production. I also see continued strong collaborations among research, extension, and stakeholders to answer new questions that emerge. I anticipate that BDM will be a part of sustainable production systems and will mitigate the agricultural plastic waste and disposal issues.

Sweet potato production using soil-biodegradable plastic mulch. Photo by Srijana Shrestha.

RECENT PUBLICATIONS

⇒ **Plastic mulch and in-row spacing effects on sweetpotato yield in northwest Washington.** Shrestha, S., and C. Miles. 2022. HortTechnology. 32(2):241-251.

⇒ **Activities of microplastics (MPs) in agricultural soil: A review of MPs pollution from the perspective of agricultural ecosystems.** Jin, T., J. Tang, H. Lyu, L. Wang, A.B. Gillmore, and S.M. Schaeffer. 2022. Journal of Agricultural and Food Chemistry. 70(14):4182–4201.

⇒ **Comparing overhead versus drip irrigation for production of three cultivars of romaine lettuce on biodegradable plastic mulch.** Moore, J.C., B, Leib, Z.R. Hansen, and A.L. Wszelaki. 2022. HortTechnology. 32(1):39-46.

⇒ **Formulation of biodegradable plastic mulch film for agriculture crop protection: A review.** Akhir, M.A.M., and M. Mustapha. 2022. Polymer Reviews. 1-29.

⇒ **A review on the occurrence and influence of biodegradable microplastics in soil ecosystems: Are biodegradable plastics substitute or threat?.** Fan, P., H. Yu, B. Xi, and W. Tan. 2022. Environment International. 163:107244.

UPCOMING EVENTS

- **Machine Harvesting Red Raspberry Field Day. July 12. 1-3 pm PST @ Honcoop Farms (9696 Northwood RD, Lynden, WA). Contact: wkhe@wsu.edu**

- **Field Day—Evaluating New Mulch Technologies in Strawberry . Sept. 9. Watsonville, CA. *Additional details pending*. Contact: lisa.devetter@wsu.edu**

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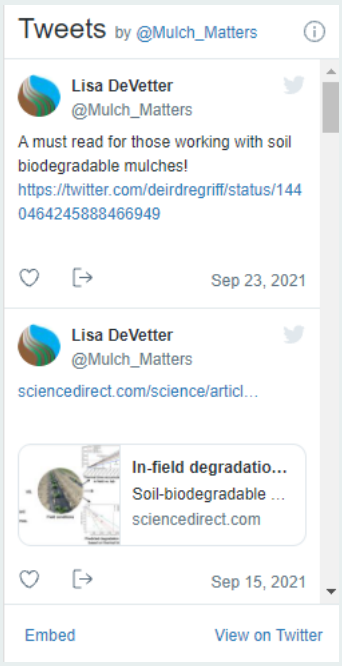

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