Sustainable Mulch MANAGEMENT

Plastic Mulches in Horticulture Production

Summer 2025
Volume 4, Issue 2

Improved End-Of-Life of Plastic Mulches

smallfruits.wsu.edu/plastic-mulches/

California State University Chico
University of Florida
University of Nebraska Lincoln
PDO Technologies
Kentucky State University
The University of Tennessee Knoxville
University of California Agriculture and Natural Resources
CMSF
Cal Poly
NC State University
Washington State University

In This Issue...

Project Director's Note 1

MulcH2O Update: Conclusions and Future Directions from Strawberry and Blueberry Trials 2

Does Soil-biodegradable Plastic Mulch Incorporation Impact Soil Health?......... 4

Sustainable Solutions for Agricultural Mulch Films: A Path Toward Circular Economy... 6

Recycling PE Mulch Films: Challenges and Innovative Pathways...... 10

Lessons from the Field: Reducing Plastic Waste in Agriculture 12

Lessons from the California Strawberry Industry with Hillary Thomas 13

Plastic Pollution in Agriculture: A Growing Global Concern 14

The Power of Outreach: Bridging Science and Agriculture..........15

What's New in the Spanish Resource Section on the Plastic Mulches Website?.......... 16

Recent Publications, Upcoming Events, and Connect and Tune In! 17

Project Director's Note

TOO MUCH GOOD TO FIT IN ONE NEWSLETTER—SO HERE'S ANOTHER!

Lisa Wasko DeVetter, Project Director, Professor, Washington State University

We had a *good problem* with the previous newsletter—we had too much content to place in a single newsletter! Our original aim was to publish our newsletter twice a year, but due to the volume of content this year we will have a third newsletter. This extra newsletter is a testament to the hard work of the individuals all working together to generate and share information about improving sustainable management of agricultural plastics with an emphasis on mulch.

This newsletter starts off by sharing updates on hydromulch. Hydromulch is a cellulose-based mulch alternative that is sprayable and designed to be biobased to meet the needs of certified organic growers looking to reduce their plastic mulch waste generation. While hydromulch is not yet commercially available nor recommended at this timepoint, continued research efforts and partnerships with paper suppliers and material scientists will hopefully make this alternative an affordable and effective reality in the near future.

A deeper dive into soil health and how soil-biodegradable plastic mulches impact soil health is also provided in this newsletter edition. We've learned over the years that a key factor that influences grower adoption of soil-biodegradable mulch is knowing its impact on soil health. Lessons learned to date show soil-biodegradable mulch can increase some aspects of soil health. Continued, longer-term research carried out by our team will shed additional light on how this alternative mulch technology influences the soil we use to grow food.

Be sure to also read the fascinating articles contributed by members of industry, such as the one by Pierre Sarazin on the role mulch films have in the evolving conversation on circularity. Sarazin's article also examines the problems and status of "oxo-degradable" films. This is an important read for anyone that uses mulch or works in a consulting capacity, as oxo-degradable mulches are often sold incorrectly as soil-biodegradable plastic mulches. Oxo-degradable mulches do not biodegrade but instead fragment and pollute the environment with plastic particles. They are not a component of circularity and should be avoided.

Later in the newsletter, expand your knowledge on recycling efforts and the key role engineering companies like Andros have in helping extract, densify, and transport drip tape and mulch so it's more recycle-ready. These efforts have been aided by leadership within organizations like the Southern Waste Information eXchange and Hillary Thomas at Naturipe, who are looking ahead at how industry can address the growing problem of plastic waste generation in agriculture.

This newsletter ends with inspiring stories on the power of extension and how readers can stay connected and help spread the word about the advancing science and practice of sustainable mulch management. Our team, collaborators, and colleagues have so much information to share. We encourage you to tap further into these information resources and share with your colleagues and networks. If you have information you would like to share, let us know and we can include in our Mulch Matters platform.

Lisa Wasko DeVetter, ***editor*** — lisa.devetter@wsu.edu, 360-848-6124
Nataliya Shcherbatyuk, ***assistant editor*** — n.shcherbatyuk@wsu.edu
Carol Miles, ***assistant editor*** — milesc@wsu.edu
Andrew Mack, ***designer***

Cover photo A California strawberry field mulched with TIF plastic near Elkhorn Slough. Photo by Lisa Wasko DeVetter.

USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

This material is based upon work that is supported by USDA SCRI award 2022-51181-38325. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

MulcH2O Update: Conclusions and Future Directions from Strawberry and Blueberry Trials

Ben Weiss, MS Student, Washington State University

Plastic mulch is essential for specialty crop growers because it suppresses weeds, improves soil and crop microclimates, and consequently increases yields and sometimes crop quality. This is especially important for organic systems in the United States, where most herbicides and commercially available soil-biodegradable plastic mulches are not allowed. Despite these benefits, plastic mulch generates roughly 2.2 million tons of waste yearly (Le Moine and Ferry 2019). Most of this plastic is disposed of in landfills, but burning, in-soil burial, and stockpiling are also common. While recycling is an option, it is challenging due to soil clinging to the mulch upon removal, coupled with limited recycling facilities that accept mulch film. Hydromulch is a sprayable, biobased mulch alternative made of cellulose, water, and often a tackifier or conglomerating agent (Fig. 1a). Common cellulose sources for hydromulch include recycled paper or agricultural residues, such as wheat straw. Hydromulch is a promising technology that may help address plastic mulch sustainability issues in certain cropping systems, especially those with low perennial weed pressure. Between 2022 and 2024, Washington State University (WSU) and North Dakota State University (NDSU) conducted research on hydromulch in certified organic systems. Both institutions explored hydromulch in annual, day-neutral strawberry systems during the 2022 season (Fig. 1b). Afterward, WSU evaluated hydromulch in northern highbush blueberry during 2023 and 2024. Meanwhile, NDSU shifted its focus to hydromulch efficacy in vegetable cropping systems.

> Two research papers have been published based on findings from the strawberry trial.
>
> **Ahmad et al. (2024)**, focusing on weed management outcomes.
>
> **Weiss et al. (2024)**, examining yield, fruit quality, and plant nutrition.

In organic day-neutral strawberry production, hydromulch performed comparably to polyethylene (PE) mulch (Fig. 2). Yields of 'Albion' strawberry were similar or higher with hydromulch at both the NDSU and WSU trial locations. Moreover, fruit quality remained similar, and tissue nutrient status was unaffected by hydromulch (see sidebar). This was achieved despite higher weed pressure in hydromulch plots. One factor leading to greater weed pressure may have been color. Hydromulch is gray, while PE film is black. Black mulch transfers more heat to soil, accelerating strawberry canopy development and potentially aiding weed suppression through shading. By the end of the growing season, PE had significantly greater canopy coverage than two hydromulch treatments in this trial, and trended towards greater canopy coverage compared to all treatments. By making hydromulch black, the strawberry canopy may outcompete weeds due to faster establishment. Hydromulches' mechanical properties may also contribute to increased weed pressure, as their lower tensile strength allows weeds to penetrate more readily. Future research should investigate whether weed seeds germinate on top of hydromulch and explore ways to make the mulch's surface less conducive to germination. Another area of interest is biennial and perennial strawberry production, where hydromulch might serve as a planting aid instead of traditional mulch. Similarly, hydromulch should be evaluated for impacts on running, daughter plant formation, and long-term production in commercially relevant June-bearing and ever-bearing strawberries.

Figure 1a. Hydromulch application to blueberry plants in Prosser, Washington.

Figure 1b. Hydromulch application to strawberry plants in Mount Vernon, Washington.

Figure 2. Hydromulch deterioration and weed emergence 140 days post-application in 'Albion' strawberry grown in Mount Vernon, Washington. Arrows point to areas of mulch deterioration.

In contrast, hydromulch did not perform well in blueberry production (Fig. 3; Weiss et al. 2025). Hydromulch failed to suppress monocot weeds such as yellow nutsedge and ryegrass. However, despite high weed pressure, yields, fruit quality, and leaf tissue nutrients in blueberry plots remained acceptable and similar to the control treatment—a woven polyethylene and polypropylene groundcover called "weedmat". This was likely due to the field's management under weedmat for the past five years. If hydromulch were used from field establishment, increased weed pressure could severely hamper early bush growth, likely decreasing yields over the field's lifecycle.

Figure 3. Hydromulch deterioration and weed emergence in a five-year-old blueberry field 169 days post-application. Photo taken from a trial in Prosser, Washington.

Although current hydromulch formulations seem unlikely to replace weedmat in blueberries, they could reduce herbicide use or potentially replace them entirely. Many blueberry growers in western Washington manage weeds with herbicides, hand weeding, and sawdust. Research with apple in British Columbia demonstrated hydromulch could replace herbicides (Cline et al. 2011). This experiment showed hydromulch boosted plant vigor by improving crop microclimates as well as avoiding herbicide-related phytotoxicity. Because hydromulch could be produced in white, it may provide additional heat stress protection in climates prone to extreme heat due to its reflective nature.

Overall, hydromulch is unlikely to replace plastic mulch in horticultural crop production soon, however it remains a promising technology, and research should continue to support commercialization to provide another weed management tool in organic systems.

REFERENCES CITED

Ahmad W, DeVetter LW, McFadden D, Maupin B, Bajwa DS, Durado A, Weyers S, Galinato SP, Weiss B, Gramig G. 2024. **Hydromulches suppress weeds and maintain fruit production in organically managed strawberry systems**. *Front Agron*. 6:1375505. https://doi.org/10.3389/fagro.2024.1375505.

Cline JA, Neilsen G, Hogue E, Kuchta S. 2011. **Spray-on-mulch technology for intensively grown irrigated apple orchards: influences on tree establishment, early yields, and soil physical properties**. *HortTech*. 21(4):398-411. https://doi.org/10.21273/HORTTECH.21.4.398.

Le Moine B, Ferry X. 2019. **Plasticulture: economy of resources**. *Acta Hort*. 1252:121-130 https://doi.org/10.17660/ActaHortic.2019.1252.17.

Weiss B, Ahmad W, Maupin B, McFadden D, Bajwa DS, Durado A, Weyers S, Galinato SP, Gramig G, DeVetter LW. 2024. **Hydromulch maintains strawberry yield, fruit quality, and plant nutrition across two contrasting environments**. *HortScience*. 60(1):111-117. https://www.doi.org/10.21273/HORTSCI18224-24.

Weiss B, Maupin B, Bajwa DS, Durado A, Weyers S, Ahmad W, Gramig G, DeVetter LW. 2025. Hydromulch suppresses dicot but not monocot weeds and maintains yield and fruit quality in established blueberry. *HortScience*. In press.

Does Soil-biodegradable Plastic Mulch Incorporation Impact Soil Health?

Deirdre Griffin LaHue, Associate Professor, Soil Health and Sustainable Soil Management, Washington State University

Soil-biodegradable plastic mulches (BDMs) generally provide similar benefits to polyethylene (PE) mulches regarding weed suppression, soil temperature and moisture control, and crop performance (Shcherbatyuk et al. 2025). However, a key difference between BDMs and PE is their post-season management: BDMs are tilled into the soil whereas PE mulch is removed. BDM tillage has understandably raised many questions about how incorporation of BDM fragments will impact soil health.

WHAT DOES "SOIL HEALTH" MEAN, ANYWAY?

Soil health has become a popular topic in the last decade, and soil scientists have rejoiced at the widespread recognition of the importance of soils to the food production systems on which our societies rely. However, like any term that is transformed into a buzz word, we need to come back to its meaning and make sure we are actually striving toward healthier soils.

> **Soil health** refers to the condition of soil's physical, chemical, and biological properties that work together to support life above and below ground.

A healthy soil is alive, with organisms driving many key functions. These include growing healthy plants, cycling and storing nutrients and carbon, filtering and holding water, and maintaining these abilities even when the system is stressed, like during drought, heavy use, or climate extremes. Depending on the landscape or land use, some functions may be more important—or more limiting—than others (Janzen et al. 2021).

HOW DO WE KNOW IF SOILS ARE HEALTHY?

Just as vital signs help give an idea of human health, soil health indicators help us tell a healthier soil from an unhealthy one. These indicators include measurements of properties that are chemical (e.g., organic matter content, pH), physical (e.g., soil compaction, water holding capacity), and biological (e.g., microbial biomass or microbially available carbon). But just as a 20-year-old man might have different target vitals than a 60-year-old woman, soils differ in what "healthy" values might be for these indicators. There is ongoing work to better define expected soil health indicator ranges for different soils.

Soil health research studies often measure numerous indicators to capture different aspects of how soils function. One that is commonly used is potentially mineralizable carbon, or soil respiration. As soil microbes break down carbon inputs, they breathe out CO_2 ("respire"), just like we do. In the lab, we measure CO_2 released from rewetted soil for a quick and inexpensive indicator that relates to potential activity of soil microbes.

STUDYING BDM EFFECTS ON SOIL HEALTH

Concerns regarding the effects of BDM on soil health include the potential accumulation of micro- or nano-plastic fragments in soil when degradation is incomplete, particularly under cool or dry conditions (Yu et al. 2021; Bandopadhyay et al. 2018; Sintim et al. 2019a; Sintim et al. 2019b; Shcherbatyuk et al. 2025). After incorporation and during degradation, can these fragments alter microbial community composition, disrupt or enhance carbon and nitrogen cycling, change water movement in soil, or introduce chemical additives that could affect soil functioning over time (Hayes et al. 2019)? To date, most field studies have reported minimal short-term impacts of BDM on soil biological, chemical, and physical properties, such as pH, aggregate stability, organic matter, and microbial activity compared to PE mulches (Sintim et al. 2019; Sintim et al. 2021; Bandopadhyay et al. 2020; Huang et al. 2022). Modeling of degradation rates has also predicted that BDM should contribute minimal micro- and nano-plastics to the surrounding air and water environments if they are incorporated appropriately into soil or compost (Yu et al. 2021). However, questions remain about the long-term effects of repeated BDM use, especially in systems with limited microbial activity or under environmental conditions that slow degradation. Understanding these potential cumulative effects is a key focus of our research.

Figure 1. Collecting soil samples for measurement of aggregate stability from the long-term mulch trial in Mount Vernon, WA.

In the SCRI mulch project, we are evaluating the soil health effects of BDM incorporation across four distinct locations: California, Florida, Nebraska, and Washington. At each site, we are collecting samples at the end of each growing season (Figure 1) and analyzing a suite of soil health indicators for two black BDM feedstocks (Mater-Bi and ecovio) compared to PE mulch. While the sites in CA, FL, and NE have no prior history of BDM incorporation, the WA site had four years of annual BDM incorporation from 2015-2018 and an additional two years in the current trial. Our current research will therefore allow us to evaluate the potential impacts of BDMs on soil health across climates and with long-term incorporation in a cool, moist climate. Thus far, we've seen no impact of mulch treatments on soil health indicators, even in the long-term WA site (Figure 2 shows preliminary results of potentially mineralizable carbon).

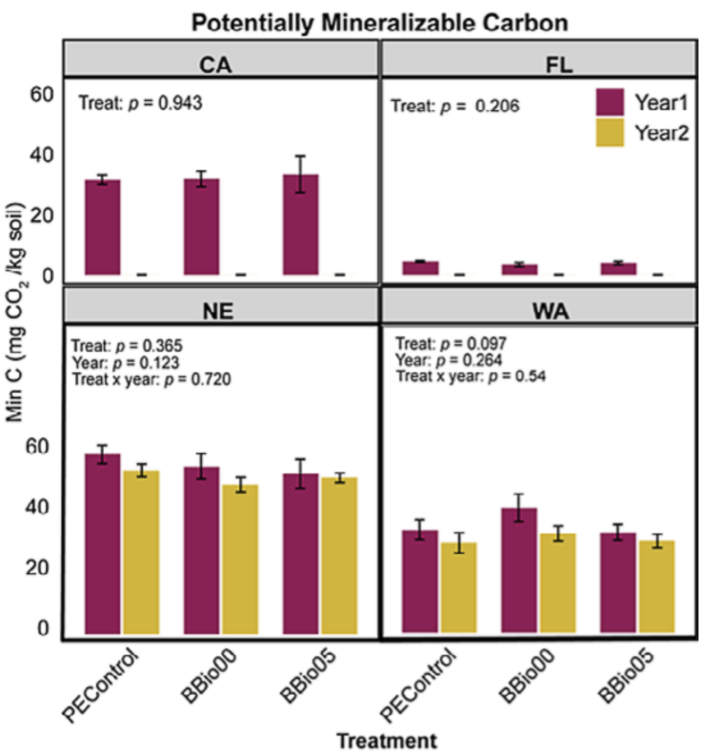

Figure 2. Preliminary data from the SCRI Mulch Project. The means ± standard errors of soil potentially mineralizable carbon (MinC) under black polyethylene (PE) and soil-biodegradable plastic mulch film (BDMs) treatments: black Mater-Bi (BBio00), black ecovio (BBio05) at California, Florida, Nebraska, and Washington trial sites. Note: Year 2 data for CA and FL is in progress. Figure courtesy of PhD student Nayab Gull.

We'll be wrapping up data collection at all sites this fall and look forward to having a comprehensive picture of the impacts of BDMs on soil health across climates. Stay tuned!

REFERENCES

Bandopadhyay S, Martin-Closas L, Pelacho AM, DeBruyn JM. 2018. **Biodegradable Plastic Mulch Films: Impacts on Soil Microbial Communities and Ecosystem Functions**. *Frontiers in Microbiology*. 9(APR):1–7. https://doi.org/10.3389/fmicb.2018.00819.

Bandopadhyay S, Sintim HY, DeBruyn JM. 2020 .**Effects of Biodegradable Plastic Film Mulching on Soil Microbial Communities in Two Agroecosystems**. *PeerJ* . 8:e9015. https://doi.org/10.7717/peerj.9015.

Hayes DG, Anunciado MB, DeBruyn JM, Bandopadhyay S, Schaeffer SM, English M, Ghimire S, Miles C, Flury M, Sintim HY. 2019. **Biodegradable plastic mulch films for sustainable specialty crop production**, p 183–213. In: Gutierrez T (eds). *Polymers for agri-food applications*. Springer, Cham. https://doi.org/10.1007/978-3-030-19416-1_11.

Huang F, Wang B, Li Z, Liu Z, Wu P, Wang J, Ye X, Zhang P, Jia Z. 2022. **Continuous Years of Biodegradable Film Mulching Enhances the Soil Environment and Maize Yield Sustainability in the Dryland of Northwest China**. *Field Crops Research.* 288:108698. https://doi.org/10.1016/j.fcr.2022.108698.

Janzen HH, Janzen DW, Gregorich EG. 2021. **The 'Soil Health' Metaphor: Illuminating or Illusory?** *Soil Biology and Biochemistry.* 159(February). https://doi.org/10.1016/j.soilbio.2021.108167.

Shcherbatyuk N, Weiss B, Yu Y, Gull N, Williams A, DeVetter LW, Miles C. 2025. **Frequently Asked Questions about Soil-Biodegradable Plastic Mulches**. *HortTechnology*. 35(4):470–480. https://doi.org/10.21273/horttech05652-25.

Sintim HY, Bandopadhyay S, English ME, Bary AI, DeBruyn JM, Schaeffer SM, Miles CA, Reganold JP, Flury M. 2019a. **Impacts of biodegradable plastic mulches on soil health**. *Agriculture, Ecosystems & Environment*. 273:36–49. https://doi.org/10.1016/j.agee.2018.12.002.

Sintim HY, Bary AI, Hayes DG, English ME, Schaeffer SM, Miles CA, Zelenyuk A, Suski K, Flury M. 2019b. **Release of Micro- and Nanoparticles from Biodegradable Plastic during in Situ Composting**. *Science of the Total Environment*. 675:686–693. https://doi.org/10.1016/j.scitotenv.2019.04.179.

Sintim HY, Bandopadhyay S, English ME, Bary A, Liquet y González JE, DeBruyn JM, Schaeffer SM, Miles CA, Flury M. 2021. **Four Years of Continuous Use of Soil-Biodegradable Plastic Mulch: Impact on Soil and Groundwater Quality**. *Geoderma*. 381 (February 2020): 114665. https://doi.org/10.1016/j.geoderma.2020.114665.

Yu Y, Griffin-LaHue DE, Miles CA, Hayes DG, Flury M. 2021. **Are Micro- and Nanoplastics from Soil-Biodegradable Plastic Mulches an Environmental Concern?** *Journal of Hazardous Materials Advances.* 4:100024. https://doi.org/10.1016/j.hazadv.2021.100024.

Sustainable Solutions for Agricultural Mulch Films: A Path Toward Circular Economy

Pierre Sarazin, Vice President for R&D and Sustainability, PolyExpert

The agricultural sector has long relied on plastic mulch films to enhance crop productivity, improve soil conditions, and reduce weed growth. However, the environmental challenges posed by conventional plastic films have spurred the need for sustainable alternatives. The PolyExpert Sustainability Approach for mulch films provides farmers with choices to shift toward eco-friendly materials to reduce plastic waste through biodegradability. Farmers need to be aware that not all plastic mulch that is marketed as biodegradable is truly biodegradable; here we will discuss biodegradable polymers and certifications so farmers and their suppliers can recognize good and poor choices.

SOIL-BIODEGRADABLE FILMS

Soil-biodegradable mulch films contain polymers or polymer blends that are degraded by soil microorganisms. These are generally mixtures of polymer feedstocks well known for their biodegradability. The polymer feedstocks are certified biodegradable by independent bodies (e.g., TÜV Austria, Din Certco from TÜV Rheinland) in accordance with specific standards and test methods. Similarly, there are standards in Europe (e.g., EN17033) for evaluating mulch film formulations (polymer feedstocks, additives) and their biodegradability, taking into account the thickness of the films. Certification is issued by these bodies based on passing the test criteria.

These mulch films will only begin to biodegrade when they come into contact with microorganisms. For example, when microbial activity is intense, premature biodegradation can occur where the film is buried in the soil along the bed sides. This is why the mulch along the sides of beds can develop tears well before the top of the growing bed. It is important to note that soil-biodegradable plastic mulch does not need oxidation for biodegradation to occur. Soil-biodegradability certification demonstrates that biodegradation takes place in soil under conditions that are fairly close to actual conditions where the mulch film is used, and also ensures that biodegradation does not lead to release of toxic substances. It is expected that the least active biological conditions, for example cold winter climate, will slow down the activity of microorganisms, but that the total biodegradation of the mulch film takes place in less than two years.

OXO-DEGRADABLE FILMS

Oxo-degradable plastics fragment and are a source of microplastics in the environment where they are used, resulting in plastic pollution. Yet oxo-degradable plastic is marketed as an environmentally friendly solution to the plastic mulch waste problem as marketers claim it breaks down faster than traditional plastics. Oxo-degradable plastics are made with traditional plastic polymers such as polyethylene and include additives that cause it to become brittle and break apart into fragments when exposed to UV light, heat, and/or oxygen. PolyExpert's R&D department analyzed the available documentation on oxo-degradable plastics and found that they have been banned in large parts of the world and that there is growing consensus on the issue. Based on the available information, it was decided not to produce films based on oxo-degradable formulations. In Canada, the Single-use Plastics Prohibition Regulations (Government of Canada 2022) prohibit the manufacture, import, and sale of foodservice ware that contains an oxo-degradable plastic. The definition in the regulation is: "A plastic that contains any additive that, through oxidation, leads to chemical decomposition or to the fragmentation of the plastic material into micro-fragments. Also known as 'oxo-degradable plastics,' 'oxy-degradable plastics,' and 'oxo-biodegradable plastics,' among other terms." More recently, the province of British Columbia (B.C.) has been proactive: As of July 15, 2024, B.C. businesses can no longer sell or distribute any packaging or single-use (disposable) products that contain oxo-degradable plastics (Government of British Columbia 2023).

There have recently been reports on public television revealing the impact of oxo-degradable mulch on corn production in northern regions of Quebec. A study at the University of Quebec at Chicoutimi (UQAC) has reported on the very slow decomposition of these plastics in the soil and their dispersion into aquatic ecosystems (Paré et al. 2025).

The ASTM D6954 standard is often cited when it comes to testing oxo-degradable films. This standard outlines a three-tier road map for evaluating oxo-degradable plastics.

- **Tier 1** measures the rate and extent of molecular weight loss resulting from oxidation that is indicative of losses in physical properties from oxidation. The tests can be accelerated or long-term trials, and are carried out in a specified humidity environment. For accelerated trials, the standard recommends choosing conditions and temperatures based on the application. Practices that can be used include ultraviolet fluorescent exposure (D5208, method for photodegradable plastics) and exposure in a Xenon Arc Apparatus (D5071, method for photodegradable plastics). These two standards relate to the loss of molecular weight resulting from oxidation preferentially caused by UV radiation. Next, the physical properties are measured using D3826, which determines the "degradation end point" at which polyethylene and polypropylene are found to be brittle. As indicated in the standard, Tier 1 accelerated oxidation tests are not indicators of biodegradability as these are oxidation degradation mechanisms in which microorganisms do not play a role.
- **Tier 2** estimates the biodegradability of all the fragmented products from Tier 1 using the standards developed for the biodegradation of plastics (ASTM D5338, D5988). As stated in the standard, the results of the first two tiers "shall be combined and used for comparison and ranking purposes between polymers of interest."
- **Tier 3** focuses on ecological impacts and consists of comparing the soil before and after oxidation and biodegradation.

As indicated in the standard, these tests are a sequential assembly of separate, unconnected standard tests and practices. Furthermore, the standard reiterates that the correlation of results for mulch films has not been determined, and as such, the results should be used only for comparative and ranking purposes. Even if the use of this standard under very specific conditions demonstrated the biodegradation of an oxo-degradable plastic film under specific conditions, there is a major limitation to its use as a mulch film. In Tier 1, oxidation mainly caused by UV light and/or temperature produces fragments of oxo-degradable mulch film, which corresponds to the time period when the mulch is in use. For this fragmentation step to occur, the mulch must be on the soil surface so it is exposed to conditions favorable to oxo-degradation, unless certain additives allow the plastic to break down through oxidation once buried in the soil. At the end of mulch use, it may not be sufficiently fragile or fragmented before it is tilled into the soil, where microorganisms that enable biodegradation are found. If fragmentation by oxidation is insufficient, biodegradation will be limited, and plastic fragments will remain in the soil. If fragmentation has been very effective, the plastic particles can be dispersed into the air before being buried in the soil. Thus, oxo-degradable plastics are a source of plastic fragments that can pollute the fields where they are applied and the surrounding environment when carried by wind and water.

There are numerous independent studies on these issues. The **review paper by Sciscione et al. (2023)**, published by the Royal Society Open Science, provides a description of oxo-degradable polymers, standards used to test oxo-degradable plastics, and an overview of research studies featuring oxo-degradable plastic. The authors conclude there is insufficient evidence to demonstrate oxo-degradable plastics will not form plastic fragments and microplastics in the environments where they would be used. Further, there is a need to assess the potential effects on the environment and biological organisms through systematic ecotoxicity studies. As an example, in a field in the southern U.S. where oxo-degradable plastic mulch had been applied 3 years ago, there were polyethylene fragments throughout the field (Fig. 1). I visited a similar field in Florida with a grower who was always on the lookout for new products and was conducting numerous trials with mulching films. He told me that he had tried an oxo-degradable mulch film and more than 5 years after use black flakes were present all over the plot where it had been used. The farmer was glad he had only done a limited trial, as this meant he hadn't polluted his entire field.

Figure 1. A field in the southern U.S. contaminated with fragments of oxo-degradable mulch film that remained 3 years after use; in addition to the visible fragments on the soil surface, there were fragments in the soil.

MOVEMENT TO BAN OXO-DEGRADABLE PLASTIC

In 2017, major companies worldwide such as Unilever, Nestlé, and PepsiCo, supported the prohibition of oxo-degradable plastic by endorsing a total ban on its use. Several global organizations, including the Ellen MacArthur Foundation (2021), have **called for a ban on these materials due to their environmental risks**. The European Parliament has officially **banned oxo-degradable plastics** (European Commission 2021) as well as single-use plastic products from the European Union (E.U.) market. This follows a 2016 report requested by the European Commission, **"The Impact of the Use of Oxo-degradable Plastic on the Environment"** (Hann et al. 2016) commissioned for the European Commission DG Environment Project. In 2018, a **report on the impact of the use of oxo-degradable plastic** from the Commission to the European Parliament and the Council concluded: *"It is undisputed that oxo-degradable plastic, including plastic carrier bags, may degrade quicker in the open environment than conventional plastic. However, there is no evidence that oxo-degradable plastic will subsequently fully biodegrade in a reasonable time in the open environment, on landfills or in the marine environment. Sufficiently quick biodegradation is in particular not demonstrated for landfills and the marine environment (European Commission 2018)."*

In 2019, the E.U. published the **Single-use Plastic Directive (2019/904)**, banning products made from oxo-degradable plastic: *"The restrictions on placing on the market introduced in this Directive should also cover products made from oxo-degradable plastic, as that type of plastic does not properly biodegrade and thus contributes to microplastic pollution in the environment, is not compostable, negatively affects the recycling of conventional plastic and fails to deliver a proven environmental benefit."* Article 5 of Directive 2019/904, entitled 'Restrictions on placing on the market', specifies that *"Member States shall prohibit the placing on the market of the single-use plastic products listed in Part B of the Annex and of products made from oxo-degradable plastic (European Union 2019)."* In 2021 the European Commission published the **guidelines for implementation** (European Union 2021), and in 2024 the E.U. Court of Justice **dismissed a counter-suit** by Symphony Environmental Technologies and Symphony Environmental Ltd, and validated the ban on oxo-degradable plastics (European Union 2024).

As yet in the U.S., neither the federal government nor any individual state has officially banned oxo-degradable plastic films. Yet **the U.S. Plastics Pact includes oxo-degradable additives** (Heffernan 2024) on its **list of "problematic" plastics** (U.S. Plastics Pact 2025) slated for elimination by 2025. In 2014, the Federal Trade Commission (FTC) **requested that plastic bag manufacturers provide supporting evidence regarding claims that "oxo-degradable" and "oxo-biodegradable" are degradable or biodegradable**, or the terms should be retracted. In 2023, the California Legislature introduced Assembly Bill 1290 that seeks to ban plastic packaging containing additives, including oxo-degradable additives. Until oxo-degradable plastics manufacturers provide evidence that these products biodegrade, compost, or become a recyclable material, farmers and agricultural suppliers should not use them. Farmers should further be aware that mixing oxo-degradable plastics with other plastics can contaminate plastic recycling units. Policies would help sustain ongoing efforts to address unsupported environmental marketing claims regarding biodegradation of oxo-degradable plastic products. Even more recently, in 2025 the Food and Agriculture Organization of the United Nations (FAO) proposed actions to prevent plastic pollution in agriculture and improve the life cycle management of plastics in agriculture. Regarding plastic sustainable design principles, the **FAO recommends discouraging the use of oxo-degradable plastics in agriculture** (FAO 2025).

MOVING TOWARD A CIRCULAR ECONOMY IN AGRICULTURE

To achieve long-term sustainability, agricultural plastic use must transition from a linear economy (use and dispose) to a circular economy (reuse and recycle). Biodegradable mulch films provide a promising alternative, offering similar agronomic benefits as traditional polyethylene (PE) films but without long-term environmental damage. Biodegradable mulch films are designed to:

- Fully biodegrade in soil under proper conditions
- Reduce the need for disposal and plastic waste accumulation
- Meet organic certification requirements in certain countries.

Several key initiatives are in place to ensure that biodegradability claims are met and that farmers have sustainable options:

- Certification that biodegradable mulch films fully decompose without harming soil health
- Improved recycling technologies for conventional PE mulch to enhance end-of-life management
- Life cycle assessments (LCA) to evaluate the environmental footprint of different mulch film options

GOING FORWARD

As agricultural sustainability takes center stage, the push for better mulch film solutions continues. Farmers, policymakers, and industry stakeholders must work together to support certified biodegradable alternatives, optimize recycling efforts, and transition toward a circular agricultural system. By prioritizing eco-friendly innovations, the industry can reduce waste, minimize environmental impact, and ensure that future farming practices remain both productive and sustainable. To ensure agricultural sustainability, it is important for farmers, agricultural suppliers, and Extension personnel to be aware that oxo-degradable plastic mulch is not biodegradable and is a significant source of plastic pollution if used in the field. Products that claim to be biodegradable or compostable should include certification labels that show they have been tested by third-party entities. Choices today make a lasting difference for the environment, your farm, and the generations to come.

Learn more about sustainable alternatives to oxo-degradable mulch.

REFERENCES

Ellen MacArthur Foundation. 2021. **Oxo-degradable plastic packaging is not a solution to plastic pollution, and does not fit in a circular economy**. https://www.ellenmacarthurfoundation.org/oxo-statement

European Commission. 2018. **Report from the commission to the European Parliament and the Council on the impact of the use of oxo-degradable plastic, including oxo-degradable plastic carrier bags, on the environment**. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:35:FIN

European Commission. 2021. **EU restrictions on certain single-use plastics. Information and resources on the new EU rules on single-use plastics**. https://environment.ec.europa.eu/topics/plastics/single-use-plastics/eu-restrictions-certain-single-use-plastics_en

European Union. 2019. **Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment**. https://eur-lex.europa.eu/eli/dir/2019/904/oj/eng

European Union. 2021. **Commission notice — Commission guidelines on single-use plastic products in accordance with Directive (EU) 2019/904 of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment**. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=oj:JOC_2021_216_R_0001

European Union. 2024. **Judgment of the General Court (First Chamber, Extended Composition) of 31 January 2024**. Symphony Environmental Technologies plc and Symphony Environmental Ltd v European Parliament and Others. Non-contractual liability – Environment – Directive (EU) 2019/904 – Prohibition on the placing on the market of products made from oxo-degradable plastic – Sufficiently serious breach of a rule of law intended to confer rights on individuals – No distinction between products made from oxo-degradable plastic and products made from oxo-biodegradable plastic – Impact assessment – Equal treatment – Proportionality. Case T-745/20. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:62020TJ0745

FAO. 2025. **A provisional voluntary code of conduct on the sustainable use and management of plastics in agriculture**. Rome, Italy. https://doi.org/10.4060/cd3004en

Federal Trade Commission. 2014. **FTC Staff warns plastic waste bag marketers that their "oxodegradable" claims may be deceptive**. https://www.ftc.gov/news-events/news/press-releases/2014/10/ftc-staff-warns-plastic-waste-bag-marketers-their-oxodegradable-claims-may-be-deceptive

Food and Agriculture Organization of the United Nations. 2025. **A Provisional Voluntary Code of Conduct on the Sustainable Use and Management of Plastics in Agriculture**.

Government of Canada. 2022. **Single-use Plastics Prohibition Regulations (SOR/2022-138)**. https://laws-lois.justice.gc.ca/eng/regulations/SOR-2022-138/

Government of Canada. 2022. **Single-use Plastics Prohibition Regulations – Technical Guidelines**. https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/reduce-plastic-waste/single-use-plastic-technical-guidance.html

Government of British Columbia. 2023. **Single-Use and Plastic Waste Prevention Regulation (B.C. Reg. 254/2023)**. Ministry of Environmental and Climate Change Strategy. https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/v66n20_254-2023

Hann S, Ettlinger S, Gibbs A and Hogg D. 2016. **The impact of the use of "oxo-degradable" plastic on the environment**. Final report. European Commission. https://op.europa.eu/en/publication-detail/-/publication/bb3ec82e-9a9f-11e6-9bca-01aa75ed71a1

Heffernan M. 2024. **U.S. Plastics Pact adds to its list of 'problematic' plastics**. *Plastic Recycling updates*. https://resource-recycling.com/plastics/2024/09/05/u-s-plastics-pact-adds-to-its-list-of-problematic-plastics/

Paré MC, Morisette O, Boivin M, Piochon M and Pichette A. 2025. **Significant increase in areas covered by plastic mulch in Saguenay-Lac-Saint-Jean, Quebec Canada**. Canadian *Journal of Soil Science*. https://www.researchgate.net/publication/382254886_Augmentation_significative_des_superficies_recouvertes_par_du_paillis_de_plastique_au_Saguenay-Lac-Saint-Jean_Quebec_Canada

Sciscione F, Hailes HC and Miodownik M. 2023. **The performance and environmental impact of pro-oxidant additive containing plastics in the open unmanaged environment—a review of the evidence**. Royal Society Open Science. 10(5):230089. https://doi.org/10.1098/rsos.230089

U.S. Plastics Pact. 2025. **Problematic and unnecessary materials**. Report. https://usplasticspact.org/problematic-materials/

Recycling PE Mulch Films: Challenges and Innovative Pathways

Gene Jones, CEO, Southern Waste Information eXchange, Inc. (SWIX)

This article is based on the presentation *"A Review of Agricultural Mulch Film Recycling: Obstacles and Opportunities"* by Gene Jones, CEO of the Southern Waste Information eXchange, Inc. (SWIX), delivered at the 2025 ASHS Workshop: *Mulch Matters! Lessons Learned on Improving End-of-Life Outcomes for Plastic Mulch*.

SWIX is a nonprofit that supports businesses and municipalities with waste management challenges.

REMOVAL AND DISPOSAL OF AGRICULTURAL MULCH FILMS

At the end of each growing season, the removal and disposal of polyethylene (PE) mulch films present a major operational hurdle for farmers. Typically, agricultural workers remove mulch manually by walking down crop rows and pulling the film from the soil (Fig. 1). However, this used film is frequently contaminated—up to 72% by weight—with soil and plant debris, making it unsuitable for most standard recycling processes (Fig. 2).

In Florida, common disposal methods include landfilling or open-field burning (Fig. 3). Burning reduces volume but introduces environmental concerns, especially air quality issues, and still requires eventual disposal of the residue. These practices underscore the urgent need for scalable, environmentally sound alternatives.

OBSTACLES AND CHALLENGES

To design a more sustainable and economically viable approach to mulch film recycling, our team quantified contamination levels and evaluated methods for reducing soil load. Following a three-step rinsing process (Fig. 4), we confirmed a contamination rate of 72% by weight. This high level, combined with the fragility of aged PE mulch, complicates recycling logistics and inflates processing costs. To mitigate these issues, we examined alternative collection methods aimed at leaving more soil in the field.

Figure 1. Field removal of PE mulch by hand.

Figure 2. Pulled PE mulch in the field at the end of the season.

Figure 3. Piled PE mulch ready to be burned at the end of growing season.

Figure 4. Collection and measure of soil contamination on used PE mulch.

EXPLORING RECYCLING SOLUTIONS: MECHANICAL AND ADVANCED APPROACHES

Used PE mulch was collected from the field using various methods and equipment, and alternative physical and chemical treatment strategies were explored to address the recycling challenges associated with high contamination levels. To evaluate potential solutions, two targeted projects were carried out with used PE mulch.

Project 1: Mechanical Recycling

RLC Operations, based in Labelle, FL, recycles high volumes of used PE mulch, with an inventory of 50,000 tons accumulated over eight years. To address soil contamination, the company tested a M&J 440 shredder (eFACTOR3, Rock Hill, SC), which processed 10 tons per hour. The system uses trommel screens, wash tanks, secondary shredders, dryers, and extruders to transform the material into pellets (Fig. 5), removing approximately 90% of soil during the process.

Project 2: Advanced Recycling

ExxonMobil's Houston facility processes hard-to-recycle plastics via advanced chemical recycling. We partnered with ExxonMobil to test the used PE mulch that was processed by RLC Operations. The facility now accepts all processed PE mulch from this project, converting it into petrochemical raw materials.

Looking Ahead

These pilot projects offer meaningful insights into managing agricultural plastic waste. By addressing contamination and testing both mechanical and chemical pathways, we are beginning to close the loop on PE mulch disposal. Lessons learned here can inform future innovations across the U.S. agricultural sector.

Figure 5. PE mulch following mechanical processing, transformed into plastic pellets.

> For more information on advanced recycling technologies and how this approach can address the challenges of recycling used PE mulch, as well as issues related to other hard-to-recycle materials, see *“Recycling Mulch: A Closer Look at Advanced Recycling”* by DeWhitt et al. (2023) in **Sustainable Mulch Management Newsletter Spring/Summer 2023 (pdf)**.

Lessons from the Field: Reducing Plastic Waste in Agriculture

Nataliya Shcherbatyuk, Washington State University

CONVERSATION WITH BEN ANDROS, PRESIDENT OF ANDROS ENGINEERING

The use of plastic in agriculture, particularly in plasticulture systems, has long been a double-edged sword. While plastic mulch, drip tape, and netting enhance efficiency, conserve water, and improve crop yields, their disposal poses significant environmental challenges.

INNOVATING FOR A SUSTAINABLE FUTURE

Andros Engineering has been at the forefront of creating mechanized solutions to retrieve and recycle agricultural plastics. Ben highlighted how the company initially focused on viticulture and irrigation but gradually expanded into plastic mulch and drip tape retrieval systems. By developing machines that efficiently extract, clean, and bundle used plastic materials, Andros is making plastic recycling more viable for farmers.

One of the key takeaways from our discussion was the importance of mechanization in making plastic recycling cost-effective. Manual removal of plastic mulch and drip tape is labor-intensive and inefficient, which often leads farmers to opt for landfilling or burning instead. Andros' equipment, such as the Mega Binder, Ultra Binder, and their entire suite of drip tape life cycle machinery enable farmers to install, extract, and densify plastic efficiently, making it easier and more economical to transport for recycling.

CHALLENGES AND SOLUTIONS IN RECYCLING AGRICULTURAL PLASTICS

While mechanization has made great strides, plastic recycling in agriculture remains a complex challenge. According to Ben, one of the biggest hurdles is contamination—dirt, moisture, and non-plastic components like emitters or fittings can complicate the recycling process. However, advancements in material science and partnerships with mulch manufacturers are helping to create more durable and easily retrievable plastics, increasing the likelihood of successful recycling.

Moreover, collaboration is key. Andros Engineering works closely with growers, recycling facilities, policymakers, and researchers to develop practical solutions that balance economic feasibility and environmental responsibility. By fostering industry-wide engagement, the goal is to standardize best practices and create a circular economy for agricultural plastics.

LOOKING AHEAD: THE FUTURE OF PLASTICULTURE

Plastic mulch use is not going away—it is an essential tool in modern farming. However, as consumer and regulatory pressures mount, the industry must find ways to improve plastic end-of-life management. Biodegradable mulches, improved retrieval technologies, and better recycling infrastructure are all part of the evolving solution.

As Andros continues to refine its equipment and work with partners to expand plastic recycling efforts, the industry is seeing a shift towards sustainability. The key, as Ben emphasized, is ensuring that any solution remains economically viable for farmers.

FINAL THOUGHTS

Agricultural plastic waste is a growing concern, but through innovation, collaboration, and practical solutions, the industry is making progress. The work being done today will help create a cleaner, more efficient, and sustainable future for farming.

To learn more about how Andros Engineering is tackling the challenges of plasticulture, visit their website **www.andros-eng.com** *or listen to the full conversation on the* **Mulch Matters podcast***.*

Lessons from the California Strawberry Industry with Hillary Thomas

Nataliya Shcherbatyuk, Washington State University

A CONVERSATION WITH HILLARY THOMAS, RESEARCH AND TECHNICAL DIRECTOR, NATURIPE BERRY GROWERS

NAVIGATING THE CHALLENGES OF STRAWBERRY FARMING

California produces 90% of the nation's strawberries, but this success comes with its share of challenges. Rising labor costs, regulatory pressures, and pest management limitations are reshaping the industry. According to Hillary, rising production and labor costs are the most pressing issues, followed by soilborne disease pressure and regulatory challenges related to sustainability and water use reporting requirements. While strawberry growers have long embraced integrated pest management (IPM) principles, the need to "show rather than tell" their sustainability efforts presents an added hurdle for on-farm data collection, and for setting measurable goals to reduce inputs.

Key to the California strawberry industry's success was the mid-20th century innovation of fumigants for soil-borne disease management. While California farmers have adapted to many changes, regulatory pressures to reduce the reliance on fumigants as part of the California Department of Pesticide Regulation's (CDPRs) Sustainable Pest Management (SPM) roadmap challenges the long-term viability of strawberry production. Hillary highlights the importance of science-backed solutions to ensure both economic and environmental sustainability while maintaining the high record household penetration levels for consumption of strawberries.

THE ROLE OF PLASTIC MULCH IN STRAWBERRY FARMING

Plastic mulch has been a cornerstone of strawberry farming since the 1950s, offering benefits such as moisture retention, early crop advancement, improved fruit quality, and weed suppression. However, the use of plastic in agriculture is now under scrutiny due to environmental concerns. Precedent has already been set through California's Plastic Pollution Prevention and Packaging Producer Responsibility Act (SB 54) which requires producers to have 100% recycle-ready packaging. The California strawberry industry has achieved that goal, and now looks to the future of field plastic end-of-life solutions including recycling and plastics alternatives such as soil-biodegradable mulches (BDMs).

Hillary warns that any regulatory move to limit plastic mulch use in agricultural production could have catastrophic economic consequences, particularly for key strawberry-producing counties like Monterey, Santa Cruz, San Luis Obispo, Santa Barbara, and Ventura where strawberries are the number one agricultural commodity. Plasticulture is not just an incremental tool in strawberry farming—it is a foundational innovation that has enabled the industry's success.

EXPLORING ALTERNATIVES: THE FUTURE OF PLASTIC MULCH MANAGEMENT

Despite concerns over plastic waste, Hillary remains optimistic about collaborative efforts to develop sustainable solutions. She points to ongoing research on BDMs, led by Dr. Lisa DeVetter's team at Washington State University, as a promising avenue. While BDMs have shown positive results in achieving yields comparable to grower standards, they also present challenges—such as the inability to fumigate under them, and food safety concerns due to fragmentation of BDM materials as they break down in the soil.

Beyond biodegradable options, Hillary highlights multi-stakeholder collaborations between the marine community, agricultural industry, plastic manufacturers, and waste disposal industries aimed at improving plastic recycling, reducing waste, and optimizing the end-of-life management of mulch films. Agricultural engineers, marine conservationists, agricultural industries members, and policymakers are all working together to develop viable, economical long-term solutions.

A PASSION FOR STRAWBERRIES AND INDUSTRY INNOVATION

Hillary, an entomologist by training, has dedicated her career to finding efficient, science-based solutions for the challenges facing growers. She emphasizes that the California strawberry industry is built on innovation and collaboration, with researchers and farmers working together to define and refine best practices.

Her favorite part of the job? Tasting new strawberry varieties straight from the field. She acknowledges that breeding for durability has sometimes come at the expense of flavor, but advancements in strawberry genetics continue to prioritize both taste and resilience.

FINAL TAKEAWAYS

This conversation underscores the importance of strategic innovation and collaboration in agriculture, particularly as sustainability expectations grow. The California strawberry industry must continue adapting to regulatory changes, environmental pressures, and evolving consumer demands, all while maintaining productivity and economic viability.

Want to dive deeper into the future of mulch technologies and sustainable agriculture? Listen to **the full podcast episode**.

THE OHIO STATE UNIVERSITY

Plastic Pollution in Agriculture: A Growing Global Concern

Nataliya Shcherbatyuk, Washington State University

CONVERSATION WITH KAREN MANCL, OHIO STATE UNIVERSITY

Plastic pollution has long been associated with images of ocean waste, single-use packaging, and overflowing landfills. However, one of the most significant—and often overlooked—sources of plastic waste lies beneath our feet: the agricultural fields that feed the world. The widespread use of plastic in agriculture, such as plastic mulches, is now raising serious environmental concerns around the globe.

Over the past several decades, plastic has become a crucial tool in modern agriculture. From conserving soil moisture to suppressing weeds and enhancing crop yields, agricultural plastic mulches have enabled farmers to produce more food on less land. This is especially evident in countries like China, where productive agricultural land is limited and population pressures are high. While both China and the United States have comparable land areas, China supports over 1.4 billion people compared to 330 million people in the United States. The challenge of feeding such a large population has driven innovations in agricultural intensification, and plastic mulch has played a central role.

Yet, the very benefits that make plastic mulch attractive also carry long-term environmental consequences. In China, where plastic mulch use increased significantly starting in the 1980s, the industry's reliance on ultra-thin films has made it nearly impossible to recover and recycle plastic mulch after use. These thin mulches are often left in the field and plowed back into the soil season after season. The result is an alarming accumulation of plastic fragments—commonly referred to as microplastics—that now pose serious threats to soil health, crop productivity, and the broader environment.

Studies have shown that microplastics in soil can alter its physical properties, impeding water movement, affecting aeration, and potentially disrupting microbial communities. In some cases, microplastics may absorb harmful chemicals or even be taken up by plants, introducing contaminants into the food chain. While this field of research is still emerging, early findings suggest a need for urgent attention and action.

Several strategies are being explored worldwide to mitigate the impact of plastic pollution in agriculture. One promising approach is **Extended Producer Responsibility (EPR)**, which holds plastic manufacturers accountable for the lifecycle of their products—even after they've been sold. Ireland, for example, has implemented successful EPR policies that incentivize proper collection and recycling of agricultural plastics. In China, the government has taken steps to ban the thinnest plastic mulches, setting minimum thickness standards to facilitate easier retrieval from fields. Additionally, potential bans on open-field burning of plastic waste by local governments aim to reduce air pollution and the spread of plastic particles through atmospheric deposition.

Another innovative solution gaining attention is the use of **soil-biodegradable plastic mulches (BDMs)**. These materials are designed to break down in the soil over time, eliminating the labor needed for post-harvest removal and disposal. However, BDMs also come with limitations. They tend to be less durable, less effective at water retention and soil warming, and their initial cost is more expensive than traditional plastics (note, however, that adoption of BDMs can be economically advantageous relative to conventional plastic mulch which can have high end-of-life management costs such as mulch removal and disposal). Furthermore, while they are biodegradable in soil, they may not degrade in the air or water, posing challenges if they are not properly incorporated into the soil.

To address these challenges, investment in biodegradable mulch research is expanding across the United States, China, and Europe. Encouraging progress has been made in improving the strength, performance, and cost-effectiveness of these materials. Yet, a lack of consistent global standards and labeling practices continues to hinder widespread adoption. Growers need assurance that the materials they are using meet tested and verified environmental criteria.

The broader conversation around plastic waste in agriculture also extends to **consumer behavior**. From berry clamshells to mesh produce bags, packaging choices significantly contribute to the plastic footprint of our food system. Many of these materials are not accepted by local recycling programs, despite labels suggesting they are recyclable. Better public education, infrastructure investment, clearer labeling, and creation of recyclable or compostable products are essential steps toward reducing this source of waste.

Ultimately, addressing plastic pollution in agriculture will require a multifaceted approach—one that combines policy, innovation, industry accountability, consumer acceptance, and international cooperation. As global food production continues to intensify, particularly in high-pressure regions like China, solutions that balance productivity with sustainability are more critical than ever.

Collaborative research, like that supported by the USDA-NIFA Specialty Crop Research Initiative, is helping to drive this change by evaluating sustainable alternatives such as BDMs and improving end-of-life management for conventional plastics. These efforts are not just academic—they have real-world implications for soil health, environmental quality, and the future of agriculture.

The Power of Outreach: Bridging Science and Agriculture

Nataliya Shcherbatyuk, Washington State University

We all know that scientific research is essential for advancing agricultural practices, improving sustainability, and addressing persistent and emerging challenges in agriculture through innovation. But it's important to understand that the impact of research is only as strong as its ability to reach those who need it most—growers, industry professionals, policymakers, and other stakeholders. Without effective outreach, valuable scientific discoveries can remain locked in academic papers, disconnected from the real-world applications that could enhance farming efficiency and sustainability.

Traditionally, agricultural extension programs have relied on in-person field days, printed fact sheets, and workshops to disseminate research findings. While these methods remain valuable, current digital age technology has transformed how information is shared and perceived, offering new tools that allow for broader and more immediate reach. Social media platforms, podcasts, short videos, and online resources have become integral to science communication, helping to bridge the gap between research and practice in ways that were previously unimaginable.

One of the most significant benefits of modern outreach is its ability to translate complex scientific findings into practical strategies. Researchers often work with highly complex data, but for growers and industry professionals, what matters most is how those findings can be applied in their world. Outreach efforts ensure that scientific discoveries are presented in a way that is accessible, actionable, and relevant to daily agricultural operations.

The need for timely communication has also become more pressing. Agricultural landscapes are constantly evolving due to changes in weather patterns, shifts in markets and policy, labor challenges, and soil and environmental health concerns. The ability to share real-time updates and best practices is crucial for helping growers make informed decisions. Social media has emerged as a powerful tool in this regard, allowing extension specialists and researchers to quickly distribute research findings, industry news, hands-on activities, and best practices. Through platforms like LinkedIn, Instagram, and others information can reach thousands of people instantly, fostering direct interaction between scientists and those working in the field.

Another transformative tool in science outreach is podcasting. Unlike written reports or in-person conferences, podcasts provide a flexible and engaging way for professionals to stay informed while managing their daily tasks. The Mulch Matters Podcast is an example of how research findings can be shared in an accessible format. Through interviews with experts, discussions on industry trends, and exploration of sustainable agricultural practices, the podcast brings valuable insights to listeners in a convenient, on-the-go format. Podcasts allow for deeper conversations, where experts can discuss the nuances of their research and its real-world applications, making science more approachable and engaging.

Looking ahead, outreach efforts in agriculture must continue to evolve and it is essential for successful extension programs to be able to integrate both traditional and modern communication methods, ensuring that research findings reach diverse audiences. Engaging directly with growers through social media, offering educational resources in multiple formats and languages, and maintaining interactive discussions through podcasts and webinars can create a more connected and informed agricultural community not only on the local or national scale but also worldwide.

Ultimately, outreach is about more than just sharing information—it is about fostering collaboration, building trust, and ensuring that scientific advancements translate into real-world impact. As agricultural challenges become more complex, strengthening these communication pathways will be essential for driving innovation and sustainability forward in the industry.

At "Improving end-of-life management of plastic mulch in strawberry systems", we are committed to making research more accessible through targeted outreach, digital engagement, and interactive content. By embracing both traditional extension methods and modern communication tools, we aim to support growers, enhance industry collaboration, and promote sustainable agricultural practices.

WE INVITE YOU TO STAY CONNECTED

- Subscribe to the Mulch Matters Podcast
- Follow us on social media for research updates
- Participate in upcoming workshops and webinars
- Browse presentations on our website
- Provide feedback on the topics that matter most to you!

Together, we can ensure that agricultural research translates into real-world impact, helping growers make informed decisions and drive innovation in the industry.

What's New in the Spanish Resource Section on the Plastic Mulches Website?

Gracia Puerto and Carol Miles. Washington State University
Northwestern Washington Research and Extension Center

We have recently added some new content to the **Recursos Disponibles en Español** section of our website. These resources aim to support Spanish-speaking agricultural workers by providing easy access to research-based information on sustainable practices, with a focus on soil-biodegradable plastic mulch (BDM).

The section includes a PowerPoint presentation and speaker notes highlighting the use of BDM in strawberry production, which can be downloaded and used for field days, workshops, conferences, etc. Also on this webpage is a factsheet that provides valuable information on BDM, specially phrased for Latino agricultural workers interested in sustainable farming practices. The webpage also includes video recordings from the 2024 BDM conference. These nearly two-hour-long videos share all Spanish-language content from the conference.

Our goal is to continue expanding the availability of Spanish-language resources to support the Spanish-speaking agricultural community. Providing this information in Spanish helps reduce language barriers and increases access to reliable information on innovative agricultural technologies that support both productivity and environmental sustainability.

We welcome your suggestions for additional content in Spanish, especially related to BDM or polyethylene (PE) mulch. If there are specific topics you'd like to see addressed, please feel free to reach out to Carol Miles (milesc@wsu.edu) or Nataliya Shcherbatyuk (n.shcherbatyuk@wsu.edu).

Recent Publications

RESEARCH

Shcherbatyuk N, Wortman SE, McFadden D, Weiss B, Weyers S, Ahmad W, Bajwa DS, Galinato SP, Formiga A, Gramig G and DeVetter LW. 2024. **Alternative and emerging mulch technologies for organic and sustainable agriculture in the United States: A Review**. *Hortscience*. 59(10):1524-1533. https://doi.org/10.21273/HORTSCI18029-24

Wang K, Min W, Flury M, Gunina A, Lv J, Li Q and Jiang R. 2024. **Impact of long-term conventional and biodegradable film mulching on microplastic abundance, soil structure and organic carbon in a cotton field**. *Environ. Pollut.* 356:124367. https://doi.org/10.1016/j.envpol.2024.124367.

Wang K, Flury M, Kuzyakov Y, Zhang H, Zhu W and Jiang R. 2025. **Aluminum and microplastic release from reflective agricultural films disrupt microbial communities and functions in soil**. *J. Hazard. Mat.* 491:137891. doi:10.1016/j.jhazmat.2025.137891.

Dada OI, Habarakada Liyanage TU, Chi T, Yu L, DeVetter LW and Chen S. 2025. **Towards sustainable agroecosystems: A life cycle assessment review of soil-biodegradable and traditional plastic mulch films**. *Environmental Science and Ecotechnology.* 24:100541. https://doi.org/10.1016/j.ese.2025.100541

Upcoming Events

Mark your calendars for the following agricultural plastic recycling and waste conversion technology conferences and trade shows:

CALIFORNIA FIELD DAY

Dates: Aug. 27, 2025; 9:00 - 11:00 am Pacific
Location: Christiansen Ranch
250 Natividad Road, Salinas, CA

Mulch Matters - New Mulch Technologies and Management Tools for California Strawberry. This field day will include technical talks from scientific and industry experts regarding new mulch technologies and recycling efforts for plastic mulch film. The field day will also showcase a mulch trial hosted by Naturipe and demonstrate mulch collection technologies to aid recycling efforts.

RSVP required: **lisa.devetter@wsu.edu**

Connect and Tune In!

INSTAGRAM	LINKEDIN	LIBSYN
Mulch_Matters	MulchMatters	Mulch Matters Podcast

The Mulch Matters Podcast *is also availabile on your favorite streaming platform including* **Audible**, **Spotify**, *and* **Apple Podcasts**.