



## Biodegradable Mulches for Specialty Crops Produced Under Protective Covers

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**INTRODUCTION.** High tunnels are passively heated, three or four season field structures that are widely utilized throughout Asia and Europe for specialty crop production, and are steadily gaining popularity in the U.S. as a way to extend the growing season, make use of limited farmland, and grow crops organically. Three regions currently underserved in high tunnel research and extension are parts of the Southeast, High Plains and Pacific Northwest. High tunnels require good management for weed control, pest and disease protection and optimization of soil temperature and water. Thus, they often employ raised beds with mulch covers. Until now, polyethylene plastic mulches made primarily from petroleum have been mostly used to control water loss and reduce weed competition in both high tunnels and open fields. To many specialty crop growers, plastic mulch has no rival. However, there are serious drawbacks associated with plastic mulches, including the costs of purchase, labor and disposal as well as the negative environmental consequences of using non-renewable and non-degradable feedstocks.

This SCRI project, awarded in October 2009, is ascertaining whether leading commercially-available, and spunbond nonwoven experimental materials composed of polylactic acid: Are biodegradable mulches (BDMs); provide services of similar quality to conventional agricultural plastic mulches; have potential for sustainable high tunnel systems; are better for the environment; and, if nonwovens (which can be readily manufactured) have sufficient attributes to serve as the next generation of BDMs in agriculture.

**METHODS.** Synchronous field plot designs; cultural practices; crop, pest, disease and harvest assessments; environmental monitoring; soil sampling and analysis; BDM sample receipt, cleaning, storage and analysis; crop budgets; and, a framework for defining clean technologies have been coordinated. Data on barriers and bridges to successful adaptation, implementation and long-term feasibility of BDMs are also being acquired to understand values, beliefs and attitudes towards BDMs, and the social norms and practices of participating communities. To date, one post-doctoral associate and four graduate students have been hired. One website has been created for sharing information among team members; a public website on plasticulture, <http://vegetables.wsu.edu/plasticulture.html> has been dedicated for outreach.

Multi-site field experiments are underway in 2010 to: (i) evaluate six treatments for mulch performance and (bio)degradation and, (ii) test adaptability of six cultivars each of lettuce, strawberry and tomato for high tunnel production. All experiments are utilizing the contrasting field environments, soil conditions and pest/disease pressures of TN, TX and WA.

### 2010 High Tunnel vs. Open Field Treatments—Knoxville, TN; Lubbock, TX; Mount Vernon, WA

**Experimental spunbond nonwoven;** Saxon, GER  
100% PLA from NatureWorks LLC, Blair, NE  
<http://www.natureworkslc.com/>

**BioBag Ag-Film;** BioBag; Palm Harbor, FL  
100% cornstarch; biodegradable & compostable  
<http://www.biobagusa.com/compostable-film.html>

**BioTelo Agri;** Dubois Agrinovation; Waterford, ON, CAN  
100% cornstarch; biodegradable & compostable  
[http://www.duboisag.com/catalog/php?product\\_id=9](http://www.duboisag.com/catalog/php?product_id=9)

**Weed Guard Plus;** Sunshine Paper Co. LLC; Aurora, CO  
100% cellulose; biodegradable control  
<http://www.weedguardplus.com/>

**Black Plastic, 1.0 mil;** Pliant Corp.; Schaumburg, IL  
Standard polyethylene; agricultural plastic control  
<http://www.pliantcorp.com/>

**Mulch treatments in a high tunnel**  
Experimental nonwoven (foreground); bare ground control (background); black plastic (right)



A lettuce cultivar plot in TX



A strawberry cv plot in TN



A strawberry cv plot in WA



A tomato cultivar plot in TN



Multi-site BDM experiment

Multi-site crop cultivar experiments

### MULCH & TUNNEL RESULTS (TO DATE), AND IMPLICATIONS.

#### Crops Working Group:

- The white experimental spunbond nonwoven mulch transmits too much light to the soil, allowing unacceptable levels of weed seed germination and weed growth
- Tomato plant size appears to be less in some spunbond and bare ground plots compared to other plots across sites; reduced size could lower yield and/or quality
- Unusual high winds revealed structural weaknesses to the model of Haygrove high tunnel in WA; subsequent efforts to research high tunnel structural stability and educate growers on wind management are unexpected project developments

#### Economics Working Group:

- Crop budgets for growing lettuce, strawberry and tomato under high tunnels in TN, TX and WA, previously unavailable, are now drafted
- Risk management tools, including crop and other insurance options, for high tunnel production, particularly under conditions of flooding and high winds, are identified

#### Materials Working Group:

- Alternative feedstocks are being investigated for new nonwoven blends, that may better meet the weed suppression and mulch degradation potential required for agricultural uses
- Mulch samples are being analyzed in the lab for multiple physical and chemical characteristics, visually in the field, and for *in situ* (bio)degradation over time
- The definition of biodegradability within an agricultural soil environment is being developed by this SCRI team, and may contribute to a new ASTM standard

#### Soils Working Group:

- Baseline soil samples from WA, TX and TN have been analyzed for bulk density, wet aggregate stability, and aggregate size distribution; also, electrical conductivity, pH, and cation exchange capacity; and finally, microbial biomass C, two enzyme potentials related to C and N cycling, potentially mineralizable N, and microbial community structure via phospholipid fatty acid profiling
- Experimental protocols are being finalized in order to follow the (bio)degradation of mulch samples for up to two years in field plots, following the 2010 tomato harvest
- Root and foliar diseases, and soil and plant health are being regularly monitored
- Soil moisture and temperature data at various depths have been collected across sites, using environmental monitoring instruments

#### Sociology Working Group:

- Concerns about BDM degradation byproducts, and satisfactorily managing barriers during two focus group meetings on the high tunnel adaptation in WA

