Biodegradable Plastic Mulches for Profitability in Agricultural Applications

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• Overview of mulch use in agriculture, and alternative mulch products — conventional plastic (PE) mulches and biodegradable plastic mulches (BDM).

• Feasibility case study: use of BDM in pie pumpkin production in western WA

• Potential drivers of BDM adoption – Clicker Survey
Mulch use in agriculture

- Weed management
- Soil moisture retention
- Reduction in fertilizer leaching
- Improved crop quality
- Other benefits
PE Mulch
• Most commonly used
• Disposal process
  – Landfill
  – Field burning
  – Stockpiling

BDM
• Same benefits as PE mulch
• Additional benefit of being biodegradable – thus, no disposal
• An environmentally friendly alternative
• Tilled in the soil at the end of the season
## Cost of BDM vs PE mulch

<table>
<thead>
<tr>
<th></th>
<th>Plastic BDM</th>
<th>PE mulch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available roll length</td>
<td>Up to 6,000 ft</td>
<td>Up to 4,000 ft</td>
</tr>
<tr>
<td>Available roll width</td>
<td>3-5 ft</td>
<td>3-5 ft</td>
</tr>
<tr>
<td>Roll thickness</td>
<td>0.5-1.5 mil</td>
<td>0.5-1.5 mil</td>
</tr>
<tr>
<td>Purchase cost per 1,000 ft (length), w/o input supplier discount or shipping cost</td>
<td>$46-$190</td>
<td>$25-$65</td>
</tr>
<tr>
<td>Machine application</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- Shipping cost can increase base price significantly if local suppliers do not carry BDM.

- Source: Survey of 10 mulch distributor websites in 2016. The table above includes most commonly used dimensions.
## Primary differences

<table>
<thead>
<tr>
<th>PE Mulch</th>
<th>BDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of PE mulch</td>
<td>Use of BDM</td>
</tr>
<tr>
<td><strong>End of season activities:</strong></td>
<td></td>
</tr>
<tr>
<td>• Removal of PE mulch (labor)</td>
<td>• Tilling into the soil (labor)</td>
</tr>
<tr>
<td>• Disposal:</td>
<td></td>
</tr>
<tr>
<td>- Labor</td>
<td></td>
</tr>
<tr>
<td>- Transportation</td>
<td></td>
</tr>
<tr>
<td>- Landfill fee</td>
<td></td>
</tr>
</tbody>
</table>

All else are the same.

**Will elimination of the end of season activities offset the cost of BDM?**
Partial Budgeting Analysis: Understanding the economic feasibility of adopting BDM

Additional Income

Reduced Costs

Net Change in Profit

Reduced Income

Additional Costs

Present Profit

Partial Budgeting Analysis: Understanding the economic feasibility of adopting BDM

Additional Income

Reduced Costs

Net Change in Profit

Reduced Income

Additional Costs

Present Profit
Assumptions for case study: Pumpkin production in western WA

<table>
<thead>
<tr>
<th>Details</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between row spacing</td>
<td>8 ft</td>
<td>Field study</td>
</tr>
<tr>
<td>PE plastic mulch</td>
<td>4’ x 4,000’ x 1 mil; $128/roll*</td>
<td>Ave. price (online)</td>
</tr>
<tr>
<td>BDM</td>
<td>4’ x 4,000’ x 0.6 mil; $254/roll*</td>
<td>Ave. price (online)</td>
</tr>
<tr>
<td>Required no. of rolls</td>
<td>2 rolls</td>
<td>Calculation</td>
</tr>
<tr>
<td>Marketable yield</td>
<td>50 bins (24-in bin)</td>
<td>Field study</td>
</tr>
<tr>
<td>Output Price</td>
<td>$181.67/bin (wholesale)</td>
<td>USDA AMS</td>
</tr>
<tr>
<td>Labor cost</td>
<td>Manual - $14.12/hr</td>
<td>U.S. Dept. of Labor</td>
</tr>
<tr>
<td></td>
<td>Mechanical/harvest - $15.12/hr</td>
<td>U.S. Dept. of Labor</td>
</tr>
<tr>
<td>Disposal cost</td>
<td>$90 per ton</td>
<td>Skagit County</td>
</tr>
<tr>
<td>Labor req. (man-hours per acre) – PE mulch</td>
<td>9 hr/ac pull out &amp; roll up PE mulch and drip tape, 6 hr/ac pick up fragments, 0.5 hr/ac dispose</td>
<td>Field study</td>
</tr>
<tr>
<td>Labor req. (man-hours per acre) – BDM</td>
<td>2 hr/ac pull out drip tape before BDM tillage, 1 hr/ac tillage</td>
<td>Field study</td>
</tr>
</tbody>
</table>
# Partial budget results

<table>
<thead>
<tr>
<th>Additional Returns</th>
<th>$0.00</th>
<th>Additional Costs</th>
<th>$271.58</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current assumption:</strong> No changes in output price and yield.</td>
<td></td>
<td><strong>Plastic BDM</strong></td>
<td>$252.00</td>
</tr>
<tr>
<td>Plastic BDM</td>
<td></td>
<td>BDM tillage (labor)</td>
<td>$15.12</td>
</tr>
<tr>
<td>Other (overhead, interest)</td>
<td></td>
<td>Other (overhead, interest)</td>
<td>$4.46</td>
</tr>
<tr>
<td>Reduced Costs</td>
<td>$208.62</td>
<td>Reduced Returns</td>
<td>$0.00</td>
</tr>
<tr>
<td>Labor savings</td>
<td>$190.62</td>
<td><strong>Current assumption:</strong> No change in output price and yield.</td>
<td></td>
</tr>
<tr>
<td>Disposal savings</td>
<td>$18.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Total additional revenue and reduced costs =</td>
<td>$208.62</td>
<td>B. Total additional costs and reduced revenue =</td>
<td>$271.58</td>
</tr>
</tbody>
</table>

**Net Change in Profit (A minus B) = - $62.96**

Given the assumptions, there will be a loss of ~$63/acre mainly due to the higher cost of BDM.
Sensitivity analysis of profit given changes in BDM cost ($254/roll – baseline)

Profit$_{BDM}$ = Profit$_{PE}$ Mulch

Difference in profit ($/acre)

BDM minus PE

BDM price ($/roll)

- $208
- $225
- $240
- $254
- $270
- $285

$0

$20

$40

$60
Sensitivity analysis of profit given changes in labor cost

Profit_{BDM} = Profit_{PE Mulch}

Manual labor cost ($/hour)

Difference in profit ($/acre)

$12 $14 $16 $18 $19 $20 $22

Profit_{BDM}
Summary

• **Primary benefits - BDM:** savings in labor costs during cleanup, and disposal costs (labor and disposal fee).

• Case study of pie pumpkins in western WA: Using plastic BDM can be more profitable than using PE mulch if:
  – Purchase cost of BDM is lower than $225 per roll or $56.25 per 1,000 ft. (while holding all else the same); or
  – Manual labor cost is more than $19 per hour (while holding all else the same).
Considerations

- Cost of labor
- No. of hours to remove and dispose PE mulch
- Disposal cost/Landfill fee
- Cost of BDM
- BDM tillage cost
Additional Resources

- Project’s Website: [www.biodegradablemulch.org](http://www.biodegradablemulch.org)
  - Basic Information Resources, Scientific Publications, Videos


- “The Economics of Adopting Biodegradable Plastic Mulch Films” – economic factors to know before adopting BDM [www.biodegradablemulch.org](http://www.biodegradablemulch.org) ➔ Basic Information Sources

- “Biodegradable Plastic Mulch and Suitability for Sustainable and Organic Agriculture” – source of BDM, biodegradability, organic ag