Plasticulture for Hemp Production

Trevor Hardy
Brookdale History

• Brookdale Fruit Farm established in 1847
• Currently managed by the 5\textsuperscript{th}, 6\textsuperscript{th}, and 7\textsuperscript{th} generations of the family
• Farming hundreds of acres
  – Certified Organic 6+ Acres
• 4 major business units
  – Wholesale, Retail, Pick Your Own, Farm Supplies
### System Design

- **Field plan**
  - Equipment
  - Plastic + tape
  - Water requirements
  - Soil

#### Field Layout

![Field Layout](image)

#### System Design Details

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<tr>
<th>Quantity</th>
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<th>Description</th>
<th>Unit Price</th>
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**Total** $12,342.25
Plastic / Hemp

• Raised bed system 4 foot width
  – Warms soil
  – Blocks weeds
  – Conserves nutrients / water
  – Moisture retention
  – Increase yield deeper roots
  – Clean environment

• Plastic Mulch Types
  – Embossed plastic Raised Stetch 1 or 1.25 mil
  – Smooth plastic flat layer 1 or 1.25 mil
  – Biodegradable plastic 0.6 or 0.8 mil
  – Roll length 4000 feet
Hemp Plasticulture

PROCESS
1. Plow
2. Harrow
3. Pick Rocks
4. Fertilize
5. Land Level
6. Lay plastic
7. Test Irrigation
8. Transplant
9. Water Plants In

EQUIPMENT
• Plastic and Drip Tape
• Plastic layer
• Plastic lifter
• Plastic winder
• Transplanter
• Irrigation pump
• Irrigation Filter
• Fertilizer injector
• Fittings
Field Layout

• Irrigating 5 acre zones or less
  – Ideal for Fertilization
• Rows less than 850 feet
• Flexibility
• Access Roads
• Spray / Harvest Rows
• **Row Spacing**
  - 6’ = 72” = 7260 row feet per acre
  - Tractor width factor

• **Supplies / acre**
  - 2 rolls plastic
  - 1 roll drip tape 8 mil

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### Driptape; G.P.M. Per Acre @ 8 P.S.I.

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Plastic Layers
Machine Parts

1. Metal Shoes collect mound soil
2. Bed former
3. Rollers
4. Tensioning wheels
5. Covering discs
6. Dirt Shields
7. Drip Tape spool
8. Drip tube applicator
Laying Process

- Start with prepped field
- Drive around edge mark line
- Lower plastic layer
- Dirt on plastic under wheels
- Tie drip to stake behind plastic
- Drive forward to lay plastic
- Adjust coulters cover edge
- Check for firm bed
Covering Discs

- Disc Adjustment
  - Angle / height / pressure
- Dirt Shields
- No clumps
- Practice and Time Adjustment
Adjustments

Goal Uniform raised firm bed with sight crown center 4 inches cover per side

• Level machine
• Tape 1 to 3 inches deep
• 4 to 6 inch raised bed
• Position of tape in raised bed
Drip Tape Tube

NO SHARP EDGES  CAN CUT DRIP TAPE
Most Common Problem for tape Defects
Field Prep Key to Success

- Proper Tillage
- Loose soil
- No clumps
Tips

• Shovel
• Knife
• Magnet
• 2 stakes
• Paint Marker

• Bio parallel tensioning wheels
• No roll tension
Smooth Ends
Video
Water Wheel Planter

- Pokes hole plastic
- Adjustable spacing
- Adds water hole
- Add starter fertilizer
- Light pressure on bed
- Rigidly mounted
- Drive careful
- 1500 – 2000 / hour
- 48” spacing 1815 plants acre on 72 inch row center
Water Wheel

- Hit drip tape
- Center tow
- Create void
3 row machines

- 3 x adjustments
- 3 x problems
- 1.5 times labor savings not 3
- Greater potential for error
- Flat ground
Row Cover

- Early Establishment
- Warmer soil
- Control environment
Weed Management

- 1.7 OZ Black Row Cover Fabric
- UV Stabilized
- Pinned every 3 feet with staples
- 3 to 5 year life span
- Re useable weed barrier

- Permeable for rain water filtration
- Cost effective weeding solution
- 4 and 5 foot widths
- Cost $700 to $850 / acre / spacing
Field Clean UP

- Plastic Lifter
- Plastic Winder
- Tape Winder
Contact

Trevor Hardy
Brookdale Fruit Farm Inc.
38 Broad Street
Hollis NH 03049
603 465 2240
tractortrv@aol.com
www.brookdalefruitfarm.com
BIODEGRADABLE MULCH APPLICATIONS AND RESULTS

Dan MARTENS
Burlington VT
February 8, 2019
SUMMARY

NOVAMONT, WHO WE ARE: MISSION & NETWORK

MATER-BI®: BIODEGRADABLE AND COMPOSTABLE SOLUTIONS

MATER-BI® MULCH FILM: CHARACTERISTICS

MATER-BI® MULCH FILM: FIELD EXPERIENCES
NOVAMONT, WHO WE ARE: MISSION & NETWORK
Who we are

A world leader in the sector of BIOPLASTICs and biochemicals obtained through the integration of chemistry, environment and agriculture.

A company with a triple vocation:
✓ Industrial reality
✓ R&D CENTRE
✓ Training CENTRE

We promote a BIOECONOMY model as a driving force for enhanced territorial regeneration.
Our mission

Developing materials and biochemicals through the integration of chemistry and agriculture, by starting up third-generation biorefineries in local areas and providing application solutions that ensure an efficient use of resources throughout their entire life cycle, with advantages for social, economic and environmental systems.
Our unique identity

The company

- Turnover: **145 mln/€**
- MATER-BI: **120,000 ton/y**
- Polyesters: **70,000 ton/y**

Research and development

- **7,2%** of investments compared to 2014 turnover
- **Over 25 years** of experience
- Equipment and facilities ranging from lab scale to innovative pilot plants

People and training

- **412 Employees*** (20% in R&D)
- **+28%** of growth in the last 3 years
- Over **300 training activities since 2000** for young researchers and experts in collaboration with universities and research centres of excellence in Italy and abroad
A company with roots in the territory

- **Novamont** (Novara) - Headquarters and Research Centre
- **Novamont** (Terni) - MATER-BI production
- **Mater-Biopolymer** (Patria, FR) - 78% NOVAMONT, Production of polyesters Origo-Bi
- **Matrica** (Porto Torres, SS) - (JV 50/50 Novamont Versalis) Biochemicals production
- **Sincro** (Terni) - (JV 50/50 Novamont Coldiretti)
- **Novamont** (Piana di Monte Verna, CE) - Biotechnology Research Centre
- **Mater-Biotech** (Adria, RO) - 100% NOVAMONT, Bio-butaneediol Production

**Brookdale Fruit Farm**
Irrigation & Row Crop Supply
Hollis NH (603) 465 2240
A worldwide company
MATER-BI®: BIODEGRADABLE AND COMPOSTABLE SOLUTIONS
From Novamont research

It becomes Mater-Bi

Innovative family of bioplastics based on vegetable resources and polymers which are biodegradable and compostable

Created to find solutions for specific environmental problems and applications

Use of renewable raw materials (low-input crops, scraps)

Biodegradable with the possibility of organic recovery, through composting
MATER-BI IN AGRICULTURE
INNOVATIVE SOLUTIONS BIODEGRADABLE IN SOIL
MATER-BI® MULCH FILM: CHARACTERISTICS
Mater Bi® mulching film: 15 years of evolution

2000:
The first Mater Bi® mulching film is placed on the market

2007:
A new generation of Mater Bi® mulching film was born: better performances and longer lasting

2013:
3° generation of Mater Bi® mulching film was born with better field performances
Mater - Bi® biodegradable mulching film

- Mater-Bi® mulching film contents starch and vegetable oils and it is biodegradable in soil, so at the end of the crop cycle it can be plowed with crop vegetables residues and microorganisms in the soil will biodegrade it producing **carbon dioxide, water and biomass**

- It is suitable for several crops (short, medium and long cycle) and in different climatic conditions

CHARACTERISTICS OF THE FILM

- **Color:** black with biodegradable masterbatch Mater-Bi® based
- **Standard thickness:** 12, 15, 18, 20 microns
- **Lasting in field:** 2-6 months for 15microns film, until 10 months for 20 microns, higher than 10 months and until 24 months for 40 microns film.
Biodegradation: the process

Soil microrganisms + WATER + CO$_2$ + Biomass
Biodegradability: the certification program

Mater Bi® mulch film complies - compostability and biodegradability certifications:

- ASTM D 6400:2004 (USA)
- UNI EN 14995:2006 (EUROPE)
- UNI EN 13432:2002 (EUROPE)
- UNI EN 11183:2006 (ITALY)
- NF U 52-001 (FRANCE)
- Main European organisms certification programs: Vincentte (Belgium) e DIN CERTCO (Germany)
Biodegradability in soil

- ONLY Mater-Bi® mulch film received “OK BIODEGRADABLE SOIL” certification from Vinçotte (both on raw material and on processed film)

- Mater Bi mulch film is the first on the market getting this certification on the processed product

![OK biodegradable certification from Vinçotte]

- Based on EN 13432
- Biodegradation test at 20-25 °C (soil T°)
- 90% in 2 years
Biodegradability in soil of Mater- Bi® mulch film

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<td>14th JUNE (15 dd after laying)</td>
<td></td>
</tr>
<tr>
<td>28th JULY (60 dd after LAYING)</td>
<td></td>
</tr>
<tr>
<td>12th AUGUST (75 dd after LAYING)</td>
<td></td>
</tr>
<tr>
<td>22th SEPTEMBER (120 dd after LAYING)</td>
<td></td>
</tr>
<tr>
<td>29th OCTOBER (150 dd after LAYING)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mater-Bi 12 µm</strong></td>
<td></td>
</tr>
<tr>
<td>14th JUNE (15 dd after laying)</td>
<td></td>
</tr>
<tr>
<td>28th JULY (60 dd after LAYING)</td>
<td></td>
</tr>
<tr>
<td>12th AUGUST (75 dd after LAYING)</td>
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<td></td>
</tr>
<tr>
<td>29th OCTOBER (150 dd after LAYING)</td>
<td></td>
</tr>
</tbody>
</table>
Biodegradable mulch films and oxophotodegradable films: the difference

**BIODEGRADABLE FILM:**
- In soil it is converted to **carbon dioxide, water and biomass** by microrganisms
- Biodegradation process complies **national and international norms and standard requirements** and it can be measured using specific and standardized methods
- At the end of the biodegradation **not residues or ecotoxical effects** are recorded.

**OXOPHOTODEGRADABLE FILM:**
It’s a traditional plastic added with additives that in presence of oxygen and light activate the disintegration creating the fragmentation of the film until its pulverization
- There are not tests demonstrating a complete biodegradation after the disintegration (maximum rate up to 60%; standards requirement are at least 90%)
- These materials don’t comply national and international standards requirement on biodegradation
Biodegradable mulch films and oxophotodegradable films: the difference
Biodegradable mulch films and oxophotodegradable films: The difference?????? Don’t Stop at Biodegradable.

You have to be aware! Know the difference between OXO’s and Compostable

Ask the questions:

1) **Does the film contain PolyEthylene? (PE)**
2) **Does the film have compostable certifications**
   1) **For the raw material or film**

Do not take the representatives word. Ask the questions

ONLY YOU CAN PROTECT YOUR SOIL

If there is 20% or more price difference --- Be cautious

Remember Compostable is eaten by Microbs. Oxos only fragment
If your interested here are some resources – Google it!

**You can find these on the internet – Novamont Website**

1) Biodegradable Mulch Product testing 2006 – Cornell Vegetables
2) PSU extension – BioDegradable Mulch Film Fact Sheet 2010
3) AgroBioFilm 2013 – PDF Compostable Films for Agriculture
4) Handbook of Biodegradable Polymers 2° Edition
6) USDA NOSB memo 15-1 January 2015 for Organics
7) SCRI research group. USDA funded Acedemic Group UT WS others
What specifically can organic farmers use now for mulching?
7 CFR 205.601

Currently allowed options for mulching are:

1. Non-synthetic, untreated materials such as wood chips, leaves, or straw
2. Newspapers or other recycled paper, without gloss, glossy inks, or color inks
3. Plastic mulches and covers provided they are removed from the field at the end of the growing season, and they are petroleum-based, but not polyvinyl chloride (PVC)
4. Biodegradable bio-based mulch film - provided that it complies with the requirements and restrictions of the USDA organic regulations, and Policy Memo 15-1 in the NOP Program Handbook. **HOWEVER, no such mulches are currently approved for organic farming.**
MATER-BI® MULCH FILM: FIELD EXPERIENCES
## APPLICATIONS

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Time Period</th>
<th>Technique</th>
<th>Countries</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Several horticultural crops</td>
<td>Spring - Summer</td>
<td>Open field/tunnel</td>
<td>Italy, Greece, Spain, Germany, USA, Australia</td>
<td>3 - 8</td>
</tr>
<tr>
<td>Zucchini</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy</td>
<td>3 - 5</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy, Germany</td>
<td>4</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Spring - Summer</td>
<td>Open field/tunnel</td>
<td>Italy, France, Germany</td>
<td>2 - 3</td>
</tr>
<tr>
<td>Solanaceae (tomato, pepper, aubergine)</td>
<td>Spring - Summer</td>
<td>Open field/tunnel</td>
<td>Italy, Spain, France, Australia, USA, Canada</td>
<td>4 - 6</td>
</tr>
<tr>
<td>Melon</td>
<td>Spring - Summer</td>
<td>In tunnel/lowtunnel</td>
<td>France, Italy, Greece</td>
<td>3 - 4</td>
</tr>
<tr>
<td>Melon, watermelon</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy, Greece</td>
<td>3 - 4</td>
</tr>
<tr>
<td>Grape</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy</td>
<td>6</td>
</tr>
<tr>
<td>Basil</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy, France</td>
<td>4</td>
</tr>
<tr>
<td>Potato</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy</td>
<td>4</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy, Spain, Germany</td>
<td>4 - 5</td>
</tr>
<tr>
<td>Onion, garlic</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy, France</td>
<td>6 - 8</td>
</tr>
<tr>
<td>Gherkin</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Germany</td>
<td>6</td>
</tr>
<tr>
<td>Corn</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy, Canada</td>
<td>4 - 6</td>
</tr>
<tr>
<td>Processing tomato</td>
<td>Spring - Summer</td>
<td>Open field</td>
<td>Italy, Spain</td>
<td>5</td>
</tr>
<tr>
<td>Strawberry</td>
<td>Summer - Spring</td>
<td>Open field/tunnel</td>
<td>Italy, Spain, Belgium, Germany</td>
<td>6 - 12</td>
</tr>
<tr>
<td>Vinegrape</td>
<td>From Spring/Autumn</td>
<td>Open field</td>
<td>Italy (North e South)</td>
<td>12</td>
</tr>
<tr>
<td>Berries (cranberry, raspberry)</td>
<td>Autumn/Spring</td>
<td>Open field</td>
<td>Italy (North e South)</td>
<td>6 - 12</td>
</tr>
</tbody>
</table>
MELON (Italy)

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>Average fruit weight (Kg)</th>
<th>Total production (Kg/m²)</th>
<th>Fruits/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mater-Bi 15 µm</td>
<td>1,3</td>
<td>5,0</td>
<td>3,8</td>
</tr>
<tr>
<td>PE 40 µm</td>
<td>1,3</td>
<td>4,2</td>
<td>3,1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>Flesh firmness (Kg/cm³)</th>
<th>Sugars content (°Brix)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mater-Bi 15 µm</td>
<td>2,5</td>
<td>11,25</td>
</tr>
<tr>
<td>PE 40 µm</td>
<td>2,0</td>
<td>8,95</td>
</tr>
</tbody>
</table>

- Productive results show similar data between Mb film and PE, without statistically significant differences.
- Qualitative data show good influence on sugars content (important commercial parameter) probably due to the water permeability of Mb film higher than PE film, enhancing sugar concentration.
LETTUCE (Italy)

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>Head weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mater Bi® 15µm</td>
<td>229.97</td>
</tr>
<tr>
<td>Not mulched</td>
<td>220.13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>Chlorophyll a (µg/cm²)</th>
<th>Chlorophyll b (µg/cm²)</th>
<th>b/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mater Bi® 15µm</td>
<td>3.99</td>
<td>3.05</td>
<td>0.77</td>
</tr>
<tr>
<td>Not mulched</td>
<td>3.41</td>
<td>2.55</td>
<td>0.75</td>
</tr>
</tbody>
</table>

- Productive results show similar data between Mb film and PE, without statistically significant differences.
- Qualitative data show similar chlorophyll content for plants on MB films and on PE.
30 days after transplant, plants mulched show more uniform and higher growth compared to not mulched ones. During crop cycle this difference will be mitigated.
PROCESSING TOMATO (Italy)

Presence of Mater-Bi® mulch film doesn’t disturb mechanical harvest and tomato fruits picked are not contaminated from film pieces.
PROCESSING TOMATO (Italy)

Recording soil humidity under mulched and not mulched plants, it has been evaluated that mulch film allows 15-20% of water saving in the soil.
PROCESSING TOMATO (Italy)

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>Average fruit weight (Kg)</th>
<th>Fruits/plant</th>
<th>Average weight per plant (Kg)</th>
<th>Fruit caliber (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mater-Bi 15 μm</td>
<td>72</td>
<td>60</td>
<td>4,32</td>
<td>46</td>
</tr>
<tr>
<td>Not mulched</td>
<td>68</td>
<td>52</td>
<td>3,54</td>
<td>42</td>
</tr>
</tbody>
</table>

Plants mulched with MB mulch film show higher fruits weight, higher fruits number per plant and higher fruit caliber. Presence of mulch film positively influences productive aspects.
Laying Compostable mulch is an exciting adventure!

Read the technical reports and get tips from your approved representatives
MATER-BI® MULCH FILM: ECONOMICS
Mater-bi Biodegradable mulch film: advantages

**NO REMOVAL & DISPOSAL** at the end of the crop cycle: a biodegradable mulch film at the end of the crop cycle should be worked into the soil, in order to properly biodegrade (thought the mineralizing action of soil microorganisms) = **NET REDUCTION OF PLASTIC WASTE**

**COSTS REDUCTION** in terms of manpower (removal, dispose of, transport)

**REDUCTION OF IMPACTS** on the environment when the plastic films are not properly removed and disposed of
"The challenge of our millennium is in the balance between the technical means that humanity possesses and the wisdom in how we will make use of them”
UMBERTO COLOMBO