# Biodegradable Mulch Product Testing 2006

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**Introduction**

Vegetable growers in New York and the Northeast rely on black plastic mulch film to enhance early growth and total yield of many crops including cucurbits, peppers and tomatoes. These low-density polyethylene mulch films help vegetable producers achieve early, more lucrative markets by enhancing soil warming and earliness of crops. The challenge and concern for using plastic mulch film is the increasing costs and environmental challenges of disposal. Grower estimates of labor to pick up plus charges to dispose of plastic mulch film at a landfill range from $25 to $100 per acre, depending on landfill fees. While black plastic mulch film is relatively inexpensive, biodegradable mulches could be tilled in at the end of the season, reducing labor hours for pick up as well as disposal costs.

Biodegradable mulches of interest are those made from plant starches (corn or wheat) and are completely biodegrade in the soil. Soil microorganisms should be able to break down the mulch to carbon dioxide and water, leaving no mulch residues in the soil. Ideally, these mulches would adhere to the soil, so they do not blow off the field as they degrade. Other degradable films have been commercialized, but growers have complained that breakdown is uneven and large pieces may blow off the field, creating litter. These other degradable films may also be made primarily of polyethylene, and degrade very slowly in the environment.

Predicting degradation is the challenge with using biodegradable mulches. Generally, thicker biodegradable mulches should last longer in the field, but our experience has shown that breakdown rates are not always tied to mulch thickness. With biodegradable mulches, the rate of break down is affected by climate (temperature, sunlight and moisture), soil type, crop cover and weed pressure. Ideal conditions for crop growth are also those that will help with the breakdown of biodegradable mulch. Warm temperatures, rainfall and sunlight enhance microbial activity of the soil and speed the breakdown. Soils higher in organic matter will generally have higher microbial activity, leading to faster breakdown. As the crop grows over the mulch, the shading will provide some protection of the mulch against the sun. As the mulch breaks down, weeds that emerge through holes in the mulch will stretch the mulch and speed breakdown.

The product we have studied for the last several years is produced in by Novamont, in Italy. Mater-Bi agro mulch (http://www.materbiagro.com/ing/home.html) is a thermoplastic material mainly derived from corn starch. The mulch is certified compostable and is IFOAM approved for use by European organic farms. Novamont has not yet pursued approval for use in U.S. organic systems. If the product is considered a

soil amendment, it should be reviewed by OMRI and approved for U.S. organic use. In certified organic systems, polyethylene plastic mulches must be removed from the field at the end of the season; this mulch is not made of plastic.

The MaterBi mulch is an embossed mulch film, manufactured using the same technologies used to produce conventional plastic mulch film. Mater-Bi's physical and chemical properties are similar to those of traditional plastics, but Mater-Bi mulches biodegrade at a rate similar as pure cellulose. They begin to biodegrade as soon as they are stretched during field application and continue to breakdown in soil after incorporation.

For the past four years, we have collaborated with Novamont and evaluated different formulations and thicknesses of the Materbi mulch film (see website for past reports). We have compared its performance to black plastic film for effects on growth and productivity of muskmelons (Cucumis melo L). In some years, we have observed that Materbi mulches do not support the same earliness of melons as black plastic. Materbi has created some different colored mulches to try and improve soil warming. This year, we evaluated one commercially available Materbi film (BioBag, 0.67 mil) with three different colored mulch films from Materbi Italy, including a green, brown and black mulch (0.60 mil). Our black plastic film was also 0.60 mil thick.

**Methods**

Transplant production

Muskmelons were chosen as the indicator crop since they are very responsive to the improved soil environment created by black plastic mulches. The 2006 mulch experiment was conducted at the Homer Thompson Research Farm in Freeville. The melon seed ('Athena') was sown on May 15 in 72 cell trays filled with peat-based medium. They were grown in the greenhouse with 85 F day temperature and 65 F night temperature. The plants received weekly fertilizer applications after the development of the first true leaves (200 ppm N).

Field production

The soil type at Freeville was Howard gravel with 2.2 % organic matter and a pH of 6.6. A large portion of the fertilizer (60 lbs. N, 60 lbs. $P_2O_5$, and 60 lbs. $K_2O$ per acre) was broadcast and incorporated before planting. The mulches were applied on June 7 with a raised bed mulch layer (Model 2600, Rain Flo, PA) along with drip tape (approximately 6" from the center of the bed). Raised beds were formed (6' apart on center) and a single line of drip tape was buried 2" deep and off set 2" from the center of the bed. The melon plants were drenched with Admire 2F (Imidacloprid, 0.02 ml/plant) 24 hours before transplanting for cucumber beetle control.

The melons were transplanted 2 feet apart using a water wheel transplanter (Model 16 Series II Rain Flo, PA) on June 8. Irrigation was applied through the drip system based on moisture block readings. Additional fertilizer was added through the drip system (20 lbs. N, 20 lbs. $P_2O_5$, and 20 lbs. $K_2O$ per acre), resulting in a total of 80 lbs. of N, 80

P2O5, and 80 K20 per acre applied in the growing season. The melons were sprayed with fungicides as recommended and with insecticides when needed. On July 6 five uniform, consecutive plants were harvested from each plot and fresh and dry weights were recorded.

We also monitored soil temperatures using HOBO data loggers (Onset Computer, Bourne, MA) buried 4 inches deep. Temperatures were recorded every two hours.

Products Tested

| Mulch product and color | Mulch Thickness (mil) | Mulch Thickness (microns) | Mulch Cost per Acre[a] |
|---|---|---|---|
| Black Plastic | 0.60 | 15 | $154 |
| Biobag Black Biodegradable | 0.67 | 17 | $543 |
| MaterBi green | 0.60 | 15 | $522 |
| MaterBi brown | 0.60 | 15 | $522 |
| MaterBi | 0.60 | 15 | $484 |

[a] Six foot between row spacing provides 7260' per acre of 48" wide mulch, 2007 prices excluding shipping.

Black plastic was purchased from Robert Marvel, Annville, PA
Biobag Black was received from BIOgroupUSA, Inc., Palm Harbor, FL
Mater-Bi products were received from Novamont SpA, Novara, Italy

Pictures Provided by Novamont

Harvesting

Melons were harvested from the data plants when mature (at full slip). Fruit were graded into two size classes: large (3 lbs. and greater) and medium (2 lbs. to 2.99 lbs.). Any fruit under 2 lbs. were culled (very few in experiment). Total numbers and weight in each size class were recorded for each plot. Length and diameters of the fruit were recorded at each harvest also. Fruit were harvested five times (August 14, 17, 21, 24 and 30). Statistical analysis was conducted on all data using a $P<0.05$ for significance.

**Results (Table 1 and photo gallery)**
Field Application and observations

Field application of Mater-Bi was similar to black plastic. The products had excellent stretch and soil temperatures were similar early in the season (Figure 1).

All Mater-Bi products were starting to break down (areas exposed to direct sunlight) at the end of July (see attached pictures).

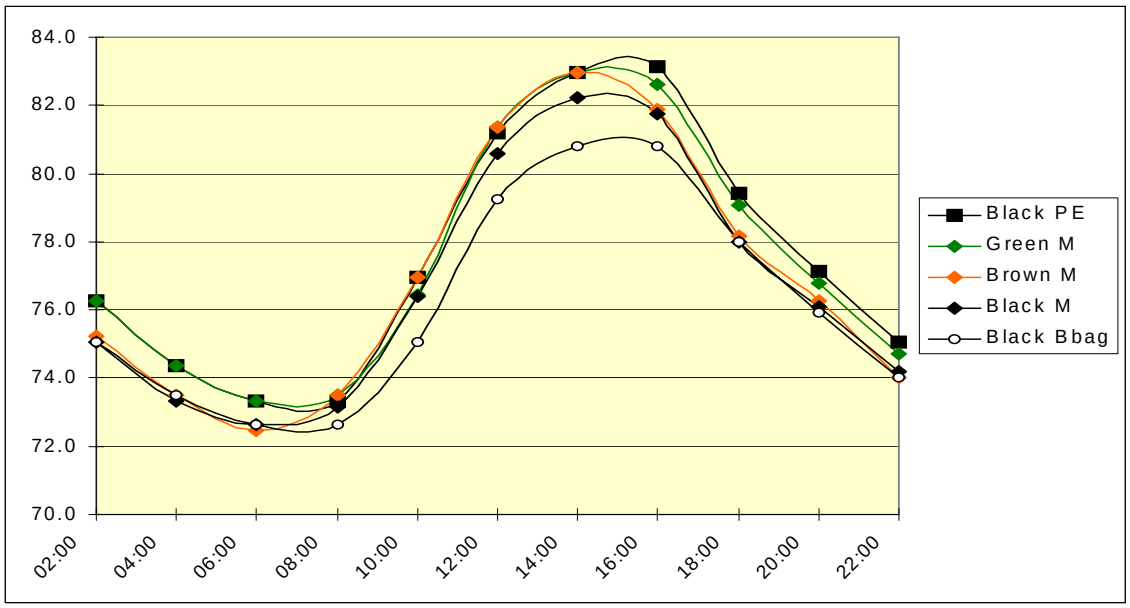


Figure 1. Soil temperatures on June 23, 2006, 15 days after mulch application.

Mid season plant fresh weights indicate that growth on Mater-Bi mulches was similar to black plastic (Table 1). Early yield data included harvests on August 10 and 14. Black plastic early yields were equivalent to all Mater-Bi treatments. Average fruit size and weight (4.0 lbs) were similar among mulch treatments. Despite some midseason breakdown, Mater-Bi yields were equal to black plastic. This suggests that a minimum time of early season soil warming is needed by melons, but full season mulch may not be important to insuring good yields in this location.

Table 1. Midseason plant fresh wt and total and early (first two harvests) number and yield and total soluble solids (Brix) of 'Athena' muskmelon fruit when grown on five different agricultural mulch films.

| Mulch treatment | Midseason plant fresh wt (lb) | Total fruit number/acre | Total tons/acre | Total early fruit number | Total early tons/acre | Total Brix |
|---|---|---|---|---|---|---|
| Black Plastic[a] | 2 | 6806 | 14.1 | 2143 | 3.5 | 11.8 |
| Biobag Black | 1.4 | 6080 | 13.1 | 893 | 1.6 | 11.7 |
| Materbi Black | 1.4 | 5990 | 12.2 | 1518 | 2.4 | 11.5 |
| Materbi Brown | 1.8 | 7305 | 15.0 | 1679 | 2.8 | 11.8 |
| Materbi Green | 2.1 | 6534 | 12.9 | 1696 | 2.8 | 11.1 |

[a] Plastic and Materbi mulches were 0.60 mil (15 um); Biobag mulch was 0.67 mil (17 um).

Green Mater-Bi on July 26

Green Mater-Bi on August 8

Brown Mater-Bi on June 29

Brown Mater-Bi on August 8

Black Mater-Bi on June 29

Black Mater-Bi on August 8

Biobag on July 20

Biobag on August 8

**Summary**
In 2006, we found no differences in early or total yield with any of the different colors of biodegradable mulch and black plastic mulch. This season was fairly cloudy and cool, which reduced likelihood of seeing yield differences. We will examine the colored mulches for another season. There was not yield benefit to the colored biodegradable mulch in a similar trial at Penn State this summer. In Italy, a comparison of these colored mulches did indicate improved earliness with the green biodegradable. In our climate, however, there was no benefit to using the colored biodegradables.

Growers have showed a growing interest in these biodegradable mulches. If growers trial these mulches, they should observe the mulch for initial splitting and breakdown. The mulch may start to split either lengthwise or across the width. If they have concerns about the product performance, this type of feedback is useful to the manufacturer.

<u>Some tips on using this type of biodegradable mulch:</u>
Storage

- Buy what you need each year. The product performance will be best with new product. More rapid degradation may be seen with older product.
- Store upright, on ends. Pressure created from stacking may lead to mulch binding together or to degradation.
- Store rolls in a cool, dark and dry location. This product will start to degrade if stored warm, in sunlight and if rolls get wet.

Application

- Do not stretch this mulch as tight over the bed as standard black plastic. This is contrary to recommendations for black plastic, which performs best when laid tightly over the bed.
    - Stretching starts the breakdown of the biodegradable mulch.
    - Stretching will increase rate of breakdown
    - The product will mold to the bed like saran wrap soon after application.
- Apply right before planting
    - Sunlight and moisture will start breakdown.
    - If applied too far in advance of planting, the mulch may not last as long as needed.

Target Crops

- Do not use for earliest crop
- Cooler temperatures under mulch may delay harvests
- Colored mulches may help, but more data needed

Incorporation into soil

- Chisel or till the mulch into the soil as soon as possible to maximize breakdown

- Breakdown needs warm temperatures and moisture. If it is late in the season, mulch may still be visible in the spring. However, as soil warms, the product will be degraded.
- Rototilling will make smaller pieces that breakdown faster.
- The product will breakdown more quickly in soils with higher organic matter

**2007 Commercial Sources and prices**

Biobag USA
www.biobagusa.com
1-800-959-2247
Types: 4’ x 4000’ or 5’ x 3280’, 0.67 mil, black
Price for all types:
$299 per roll plus shipping for less than a pallet (16 rolls)
$289 per roll for pallet orders. Specials with 3+ pallets

Dubois Agrinovation
www.DuboisAg.com
1-800-667-6279
Types:
4’ x 6000’ 0.50 mil black $326 per roll plus shipping
5' x 5000' 0.50 mil black $339 per roll plus shipping
4' x 5000' 0.60 mil black $333 per roll plus shipping
5' x 4000' 0.60 mil black $333 per roll plus shipping
4' x 4000' 0.80 mil black $355 per roll plus shipping
5' x 4000' 0.80 mil black $444 per roll plus shipping

Colored mulches are approximately 8% more expensive.