Alternative Mulch Products 2003

Anu Rangarajan, Betsy Ingall and Mike Davis
Department of Horticulture
Cornell University, Ithaca, NY 14853

Introduction

Vegetable growers in New York and the Northeast rely on black plastic to enhance early growth and total yield of many crops including cucurbits, peppers and tomatoes. Mulches help vegetable producers achieve early, more lucrative markets by enhancing earliness of their crops. The challenge and concern for using plastics is the increasing costs and environmental challenges of disposal. While black plastic mulches are relatively inexpensive, paper mulches and *starch based mulches* could be tilled in at the end of the season, reducing labor hours for pick up as well as disposal costs. Alternative mulches are still in the early stages of development. The quality has improved tremendously since we started working with these products six years ago. The first products were very difficult to apply and degraded quickly. In 2000, 2001 and 2002 we compared experimental paper and starch based mulches to black plastic for effects on growth and productivity of muskmelons (*Cucumis melo L*). International Paper produced excellent paper mulch but has chosen to discontinue paper mulch research. In 2003, we added two variations of the 2002 starch based product Mater-Bi, a new product and another location. The mulch experiment was conducted at the Cornell Willsboro Farm in Willsboro, NY (northern NY) and the Homer Thompson Research Farm in Freeville. Muskmelons were chosen as the indicator crop since they are very responsive to the improved soil environment created by black plastic mulches.

Three Mater-Bi mulches *and* Green Plastic (Symphony, Inc.) were compared to black plastic mulch in the 2003 experiment at the Homer Thompson Research Farm in Freeville and the Cornell Willsboro, NY. The soil type at Freeville was Howard gravel with 2.2 % organic matter and a pH of 6.6. At the Willsboro Farm the experiment was grown on a Claverack Loamy Fine Sand. The "Bioplastic" Mater-Bi products are manufactured by Novamont SpA, Novara, Italy. Mater-Bi is a new generation of bioplastics derived mainly from natural renewable resources.

Transplant production

The melon seed ('Athena') was sown on May 19, 2003 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 were thinned to one plant per cell ten days later. They received weekly fertilizer applications after the development of the first true leaves (200 ppm N). On May 24, the plants were removed from the greenhouse and placed outdoors in a cold frame.

Field production

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 May 30 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, 3" high and 10' apart on center in Willsboro) and a single line of drip tape was buried (2" deep). 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 12 in Freeville and by hand in Willsboro. Starter fertilizer was applied to each plant. Irrigation was applied through the drip system based on moisture block readings. Additional fertilizer was added through the drip system (60 lbs. N, 60 lbs. P_2O_5, and 60 lbs. K_2O per acre), resulting in a total of 120 lbs. of N, 120 P_2O_5, and 120 K_20 per acre applied in the growing season. The melons were sprayed with fungicides as recommended and with insecticides when needed. On July 7, five uniform, consecutive plants were harvested from each plot and fresh and dry weights were recorded.

Mater-Bi Agromulch (Mater-Bi-A through Mater-Bi-C)

Mater-Bi agro mulch (http://www.materbi.com/welcomeSi.html) is a thermoplastic material mainly derived from corn starch. The mulch is certified compostable in Europe and the company is seeking IFOMA approval for use in organic systems. It is manufactured using the same machines traditionally used to process conventional plastics. Mater-Bi physical and chemical properties are similar to those of traditional plastics, but it is completely biodegradable in different environments, just like pure cellulose. The biodegradation percentage is the ratio of the CO2 produced by the test material compared to the total theoretical amount. They are designed to biodegrade once incorporated into the soil. Mater-Bi materials biodegrade at a rate similar to pure cellulose. Mater-Bi 'A' is 0.6 mil (15 microns), Mater-Bi 'B' is slightly thinner (0.5 mil or 12 microns) and Mater-Bi 'C' is the same thickness as 'A' but a slightly different formulation.

All Mater-Bi products were easy to apply and punch holes for transplanting. Mater-Bi 'A' was included in the alternative mulch experiment in 2002.

Green Plastic by Symphony Plastics

Green plastic mulch, developed by Symphony Plastic (http://www.symphonyplastics.co.uk/index.htm) in England, is described as degradable mulch. This mulch has been designed to start degrading as soon as it is stretched during application. The product is polyethylene based mulch, with cross linkages that allow microbes to degrade the mulch into smaller and smaller pieces. Time to disappearance will vary based on soil type, moisture and management.

Black Plastic

Black Embossed Plastic (1.1 ml.) was used as the standard mulch in our experiment. It is used by commercial vegetable growers. It was easy to apply and make holes for transplanting.

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. was 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 on 9 dates (August 18, 20, 22, 25, 27, 29, and September 2, 5, 10). Statistical analysis was conducted on all data using a $P<0.05$ for significance.

Freeville Field Application and observations

All products did remain intact in the field for most of the season, which is a significant improvement relative to previous years. Green plastic did break down more quickly.

Mater-Bi

Overall, application was similar to black plastic. The product has excellent stretch and appears to have similar soil warming properties. Mater-Bi was starting to break down (areas exposed to direct sunlight) at the end of the harvest while the Green Plastic mulches were degraded extensively.

Green Plastic

This product was very similar to black plastic in appearance and application. It did break down more quickly than other treatments but provided adequate coverage for melons. Green Plastic (2003 formulation) may break down too quickly for pepper and tomato production under this year's weather conditions.

Melon Growth and Yield

Mid season plant sample data shows that plant growth on black plastic was much higher than Mater-Bi A (See Table 1.). Black plastic mulch produced significantly higher early yields (both number and tons per acre) compared to all other treatments. Early yield data included harvests on August 18, 20 and 22. The improved early season growth in black plastic resulted in higher fruit set and marketable fruit per plant in some comparisons. Total yields however were similar. Average plant yield (weight), fruit size and weight (3.4 - 4.5 lbs) were similar among mulch treatments. Plants grown on Black plastic mulch produced more fruit per plant but yield by weight was similar which accounts for the slightly lower average fruit weight.

Willsboro Field Application and observations

We did not observe any differences in melon growth or development associated with the mulch treatments at the Cornell Willsboro Farm. The melons grew well and weed control was excellent on all five mulches. It should be noted that the trial was planted on June 12 into a warm, sandy soil. At this point in the season any differences in the mulches capacity to warm the soil bed environment would be less likely to have an influence on melon growth. It is possible that differential soil heating could result from the different mulch treatments if they were applied earlier in the season when soil temperatures are still relatively low.

All five mulches remained intact and provided good weed control during the first part of the trial while the melon plants were young. By mid-August the Mater-Bi mulches had become brittle, and had started to tear and develop holes. The green symphony mulch also developed some holes, but not to the extent of the Mater-Bi mulches (see end of season photos). No tearing was observed with the embossed black plastic. Melon vines completely covered the beds by the time the Mater-Bi and Symphony mulches started to tear, so late season weed control did not appear to suffer from the holes in the mulch.

Freeville and Willsboro Results (Table 1 and 2)

Summary

Overall, the mulches supported good yields in both locations. All mulch treatments produced similarly at Willsboro while black plastic produced much higher early yields in Freeville. In 2002, Mater-Bi and black plastic also produced similar yields in Freeville. However yields were lower than with black plastic. Growers must decide if yield reductions can be justified based upon labor and disposal savings with a biodegradable mulch.