

**CSANR ORGANIC CROPPING RESEARCH FOR THE NORTHWEST  
RESEARCH PROGRESS REPORT**

**TITLE:** Alternatives to Plastic Mulch for Organic Vegetable Production

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**COOPERATORS:** None

**DATE:** January 2004 – November 2004

**KEYWORDS:** Plastic mulch, degradable mulch, paper mulch, organic agriculture, Washington, vegetable production

**ABSTRACT:** Black plastic is widely used by farmers to control weeds, increase plant growth, and shorten time to harvest. Though effective and affordable, plastic mulch has become an environmental concern due to disposal issues. The purpose of this study was to identify degradable products that can be effective and affordable mulch alternatives to standard black plastic. We tested five alternative mulches in an organic vegetable system for durability and effect on soil temperature and crop yield of lettuce, broccoli, bell pepper, and icebox watermelon. The mulches were: 81-lb Kraft brown paper, 42-lb Kraft brown paper with polyethylene coating, Garden BioFilm (corn starch based plastic), Envirocare 1 XP-4611W (thermal/photo degradable plastic composed of polyethylene + TDPA), Envirocare 2 XP-4611J (thermal/photo degradable plastic composed of polyethylene + TDPA), and black plastic (control). Black plastic and Envirocare 1 and 2 were the most durable, and Garden BioFilm was the least. Broccoli was the most productive with Black plastic, Garden BioFilm and Kraft 81-lb paper. Watermelon was the most productive with Envirocare 1, and least productive with the Kraft paper products. Significant differences were not observed in lettuce and pepper harvests, but both crops tended to produce well with Envirocare 1 and Garden BioFilm. All of the mulches insulated underlying soil, except for Kraft 81 paper which showed greater temperature extremes. Preliminary results indicate that Envirocare films are comparable to black plastic in durability, crop yield, soil temperature, and affordability, and provide growers a choice between longer and shorter degradation times.

**OBJECTIVES:**

1. Identify degradable mulch products that can be used as effective and affordable alternatives to standard plastic mulch in organic vegetable production systems.
2. Evaluate mulch products for durability, effect on crop yield, and underlying soil temperature.

**PROCEDURES:** Black plastic and five alternative mulches were tested in an organic vegetable production system in 2004. The mulches were evaluated for durability and effect on soil temperature and crop yield. The mulch products included: 81-lb Kraft brown paper, 42-lb Kraft brown paper with polyethylene coating, Garden BioFilm, Envirocare 1 (XP-4611W), Envirocare 2 (XP-4611J), black plastic (control). Our field site was certified organic and managed accordingly. The experimental design was a randomized complete block with four replications. Plots were 50 feet long by 3 feet wide and each included four subplots, one for each vegetable crop. Lettuce (short season cool, variety 'Pirat'), broccoli (long season cool, mixed varieties 'Gypsy' and Green Goliath'),

and bell peppers (short season warm, variety ‘California Wonder’) were planted in double 10-foot rows, while icebox watermelon (long season warm, variety ‘Smile’) was planted in single 20-foot rows. The plots were drip irrigated, with drip tape laid beneath the mulch prior to planting. Each plot was rated bi-weekly for mulch quality. Vegetables were harvested at weekly intervals and measured to determine marketable yield, number of fruits or heads, plant biomass, and number of days to harvest. Beneath each mulch product, soil-surface temperatures were gathered throughout the study using Hobo field temperature monitors. The findings of this study are being disseminated to farmers and industry representatives through meetings, conferences, field days, newsletters, and our web site.

**PROGRESS TOWARDS OBJECTIVES:** The field trial and report have been completed for this study. A full report is posted on our website <http://agsyst.wsu.edu/AltMulch.htm>. A summary of the results is presented here.

Durability. The mulch products evaluated in this study showed significant differences in quality over time (durability). The standard black plastic (control) was the most durable mulch product in this study, with quality declining only slightly over the course of the growing season. The Envirocare mulches were the only products that compared to black plastic’s durability. Both Kraft paper mulches exhibited fair quality at the end of the season, but were significantly less durable than black plastic and Envirocare mulches. Garden BioFilm was the least durable, steadily declining to a final quality rating of 2, indicating that this mulch is nearly gone at the end of the growing season.

Days to First Harvest. Crops were planted into the field as seedlings on June 24<sup>th</sup>, 2004. Results of this study show a significant difference among mulch treatments in the number of days to broccoli harvest, but all other crops were not significantly different. Broccoli was harvested earliest from plots treated with Garden BioFilm, and latest from plots treated with black plastic.

Crop Yields. The different mulch products significantly affected broccoli and watermelon yields, but not yields of lettuce and pepper.

- Broccoli yield (kg) and number of heads was significantly greater in the black plastic mulch plots than in the other plots. Garden BioFilm and Kraft 81-lb paper produced large yields as well, while Envirocare 2 was the least productive in both yield and number of heads. There was no significant difference in average head weight.
- Watermelon yield (kg) and number of fruit were significantly greater in Envirocare 1 plots. Kraft 81-lb paper produced significantly lower yields and fruit number than all other mulch treatments. There were no significant differences in average fruit weight, therefore differences in overall yields were due to differences in fruit number.

Underlying Soil Temperature. Black Plastic mulch showed an insulating effect on underlying soil. That is, temperature highs and lows beneath the mulch were less extreme than above it. All of the mulches appeared similar to black plastic in their insulating effect, except for the Kraft 81-lb paper, which showed greater extremes of both high and

low temperatures. This is probably due to the porosity of the Kraft paper material, but further studies would be needed to determine the true cause.

Affordability. Approximate costs per acre were calculated for 80% mulch cover. Black plastic costs \$252 - \$281 per acre, and may differ depending on the source. Envirocare films are similar in price to black plastic, ranging from \$215 to \$243 per acre, and the coated Kraft 42-lb paper is also similar in cost, approximately \$235 per acre. The cost of Garden Bio-Film is higher, ranging from \$695 to \$1087, and the 81-lb Kraft Paper cost is variable depending on the source. The relatively heavy weight of paper makes shipping costs higher for paper mulches.

**OUTPUTS:**

Poster presentation at Washington and Oregon Tilth Conference Symposium, Portland, Oregon, November 12, 2004. 170 Participants. Paper published in proceedings: Miles, Carol, Kathryn Kolker, Gail Becker, Jodee Nickel, Carolyn Adams and Martin Nicholson. 2004. Alternatives to Plastic Mulch for Weed Control in Organic Vegetable Production, p. 48.

Web page: [www.agsyst.wsu.edu/AltMulch.htm](http://www.agsyst.wsu.edu/AltMulch.htm). This page includes a brief introduction to alternatives to plastic, the full report from this study, and a report from a preliminary study that we conducted in 2003.

**IMPACT:** Currently, degradable plastic products appear to be in non-compliance with certified organic practices. We are investigating the reasons for this to see if new degradable plastic products may be allowed.

**INSTITUTION:** Washington State University, Vancouver Research and Extension Unit

**STATE:** Washington

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**FUNDING AMOUNT(S):** \$14,691

**ORGANIC RESEARCH LAND** (indicate number of acres on all that apply):

Station	___ non-organic	___ transitional	<u>2</u> certified
On-farm	___ non-organic	___ transitional	___ certified

**FARMER COOPERATOR(S):** None