Evaluation of biodegradable mulches in fresh market sweet corn, pepper production

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Executive Summary

Sweet corn growers use clear plastic mulch to warm the soil and advance corn maturity when planted early in the season. Disposal of the plastic at the end of the season is presently not a problem in Ontario, but it has become an issue in other vegetable production regions of North America. It has been estimated that in excess of 500 tons of agricultural plastic is disposed of yearly in Ontario; plastic mulches are a significant contributor to this total. Recently, biodegradable mulch films have become available, which break down through microbial activity in the soil. Data is required on the length of time the biodegradable mulch will last in the field, its soil warming potential, and its effects on crop growth, yield and quality.

Sweet corn mulch treatments consisted of a bare ground, standard clear 0.9 mil polyethylene mulch and five different types of clear degradable mulches: 1) CLFR (0.4 mil), 2) 75 x 6 (0.6 mil), 3) 10 x 6 (0.6 mil), 4) 15 x 6 (0.6 mil) 5) Eco One (0.4 mil). Treatments 1 to 5 are polyethylene based mulches containing an additive to allow it to biodegrade. Pepper treatments consisted of bare ground, standard polyethylene mulch (0.9 mil), and eight different types of degradable black mulches: 1) 75 x 6 dark (0.6 mil), 2) 10 x 6 dark (0.6 mil), 3) 15 x 6 dark (0.6 mil), 4) Eco One (0.6 mil), 5) BLFR72 (0.6 mil), 6) BLFR71 (0.6 mil), 7) Mater Bi green (0.5 mil), 8) Mater Bi brown (0.5 mil). Treatments 1 to 6 are polyethylene based mulches containing an additive to allow it to biodegrade. Treatments 7 and 8 are corn starch based.

Degradation of clear mulches was more rapid at the Simcoe site. Why degradation occurred quicker at Simcoe may be due differences in soil type, or the fact that trickle irrigation was used on the sandy soils at Simcoe, but was not used in Ridgetown. All degradable mulches and clear plastic mulch advanced harvest by 7 days when compared to bare soil, with the exception of CLFR, which only advanced maturity by 3 days. All plots with mulches improved total and marketable yields and there were no differences amoung the mulches

The 75x6 degradable mulch and clear plastic advanced maturity of sweet corn the greatest at the Simcoe site (7 days), while Eco One provided no benefits advancing maturity; this is due to its rapid degradation. There was no significant yield improvement when using mulch at the Simcoe site; bare soil yields similar to the yield of all mulch treatments except Eco One, which was significantly reduced .

Mater Bi mulches provided the greatest soil warming at the Ridgetown site, often better than black plastic; as expected, bare soil was the coolest treatment. Mater Bi Green also provided greater soil warming at the Simcoe site. The Mater Bi (green and brown) BLFR (71 and 72) and Eco One mulch degraded the fastest, which the Eco One and Mater Bi mulches being largely degraded 60 days after application at both sites.. At both sites, 10x6, 15x6 and 75x6 mulches were largely intact in late August.

There was no benefit to using soil mulches in 2007 at either site; there were no differences among all treatments in respect to early yields, fruit characteristics, and total yields.

In conclusion, there are several mulches which perform similarly to standard plastic mulch and may be a potential replacement.

Project Results and Milestones

The objectives of this trial included the following:

1. Compare the maturity, yield and quality of sweet corn and peppers grown on degradable mulches and standard plastic mulch

2. Compare the soil heating effects of plastic mulches and biodegradable mulches.

3. Document the rate of breakdown of degradable mulches when used in sweet corn and pepper production systems at 2 locations (Ridgetown and Simcoe)

The following degradable mulches were used at both sites on sweet corn and peppers respectively:

A. Sweet Corn

1.	Clear plastic mulch:	standard clear polyethylene film; 0.9 mil (22 micron) thick.
2.	Bare soil	no mulch applied
3.	CLFR:	polyethylene based film with additive to allow it to biodegrade. 0.4 mil (10 microns) thick. North American product
4.	75 x 6 clear:	polyethylene based film with additive to allow it to biodegrade. 0.6 mil (15 microns) thick. North American product
5.	10 x 6 clear:	polyethylene based film with additive to allow it to biodegrade. 0.6 mil (15 microns) thick. North American product
6.	15 x 6 clear:	polyethylene based film with additive to allow it to biodegrade. 0.6 mil (15 microns) thick. North American product
7.	Eco One:	polyethylene based film with additive to allow it to biodegrade. 0.4 mil (10 microns) thick. North American product

B. Pepper

1. Black plastic mulch; standard black polyethylene mulch; 0.9 mil (22 microns) thick

2. Bare soil

3.	75 x 6 dark	polyethylene based mulch with additive to allow it to biodegrade. 0.6 mil (15 microns) thick. North American product
4.	10 x 6 dark	polyethylene based mulch with additive to allow it to biodegrade. 0.6 mil (15 microns) thick. North American product
5.	15 x 6 dark	polyethylene based mulch with additive to allow it to biodegrade. 0.6 mil (15 microns) thick. North American product
6.	Eco One	polyethylene based mulch with additive to allow it to biodegrade. 0.6

		mil (15 microns) thick. North American product
7.	BLFR72	polyethylene based mulch with additive to allow it to biodegrade. 0.6 mil (15 microns) thick. North American product
8.	BLFR71	polyethylene based mulch with additive to allow it to biodegrade. 0.6 mil (15 microns) thick. North American product
9.	Mater Bi green:	corn starch based. 0.6 mil (15 microns) thick. Typically lasts for 3 months (dependant upon how tight it is laid; soil microorganisms). Product of Italy
10.	Mater Bi brown:	corn starch based. 0.5 mil (12 microns) thick. Typically lasts for 3 months (dependant upon how tight it is laid; soil microorganisms). Product of Italy

<u>Ridgetown Site</u> - materials and methods

The sweet corn trial was established on a Brookston clay loam sand spot phase soil on the Ridgetown College research farm. Mulches were laid on 29 May, and sweet corn (cv = BC 0805 (Attribute - Bt); "Triple Sweet" sugar type) was seeded using a Rain-Flo model 1600 water wheel transplanter on 29 May. The corn was double seeded every 26 cm on 76 cm (30") rows; emergence counts were taken 14 days after seeding at which time doubles were removed for a final population of 45,000 plants/ha (20,000 plants/acre).

Weeds were controlled with a preplant incorporated treatment of Primextra II Magnum (3.0 l/ha) and a post-emergent treatment of Pardner (1.2 l/ha) and Dual II Magnum (0.7 l/ha) Weed escapes were controlled with hoeing.

Nitrogen fertilizer was applied preplant at a rate of 90 kg/ha actual N. Phosphorous and potassium applications were based on soil analysis.

European corn borers were controlled with sprays of Sevin XLR, Lannate, Pounce, and Decis. There were a total of 5 insecticide sprays applied.

The pepper trial was established on a Brookston clay loam sand spot phase soil on the Ridgetown Campus research farm. Mulches were laid on 13 June; embossed black plastic was used as a standard comparison. Bell peppers (cv = Aristotle) were hand transplanted on 14 June on a double row (45 cm x 45 cm diamond pattern) for a plant population of 29, 630 plants/ha (12, 000 plants/acre). Nitrogen fertilizer was applied preplant at rate of 60 kg/ha actual N. Phosphorous and potassium applications were based on soil analysis.

Weeds were controlled with a preplant incorporated treatment of Treflan. Weed escapes were controlled with hoeing. All plots were trickle irrigated.

Soil temperatures were collected mid-afternoon at a depth of 10 cm with a hand held probe once per week for 3 weeks after the mulch was laid in both trials. Four weeks after seeding, ten corn plants were measured for extended leaf height. The date of 80% silking was determined daily by counting the cobs with silks emerged. A rough harvest date was determined to be 18 days after 80% silk, which was fine tuned by determining the kernel moisture content with a CEM Model AVC 80 moisture/solids analyser. The targeted moisture content at harvest was 68-72%. From this data the number of days to maturity and the corn heat units were determined.

At sweet corn harvest, the following data was collected using the methodology described:

cob height - average height of 5 plants measured to base of cob
tip cover
- mean of 5 cobs evaluated on a scale of 1-5 where:
1 = exposed 4 = 2.5 - 5.0 cm
2 = just covered 5 = greater than 5.0 cm
3 = up to 2.5 cm

tip fill
- mean of 5 cobs evaluated on a scale of 1-5 where:
1 = 5 cm from the tip is not filled 4 =
2 = 5 = perfectly filled
3 = 2.5 cm from the tip is not filled

cob length (cm) - mean of 10 cobs
cob width (cm) - mean of 10 cobs
cob weight (husks off) (g) - mean of 10 cobs.
marketable yield (dozens/acre)
marketable yield (tons/acre)

Peppers were harvested according to Ontario processing standards: mature green peppers were a minimum 2 3/4" diameter with a 5% tolerance on color. At the first harvest (green only), samples were taken and the following assessment made:

a. fruit length: average length of 10 fruit per plot
b. fruit diameter: average diameter of 10 fruit per plot
c. wall thickness: average thickness of 10 fruit per plot

Culls were minimal and not recorded.

The various mulches were rated according to their rate of degradation, approximately every 2 weeks according to the following scale:

0 = no breakdown of mulch, 100% soil cover.
1 = small holes forming in mulch, nearly 10% soil uncovered.
2 = one or more small tears; 80% soil uncovered.
3 = multiple tears and holes in mulch, 70% soil uncovered.
4 = multiple tears and holes, 60% soil uncovered.
5 = mulch deteriorated, 50% soil uncovered.
6 =
7 = mulch essentially gone, 70% soil uncovered
8 =
9 =
10= complete breakdown; mulch not present

The experiments were established as a randomized complete block design with four replications. A single plot consisted of 4 rows, 8 m in length with 75 cm between the rows. Prior

to harvest, a 7.0 m section of the center 2 rows was marked and used for harvest in order to eliminate the effect of edge plants. Data was collected on the center 2 rows.

The data was statistically analysed using analysis of variance for a randomized complete block design. A protected LSD was used to separate the treatments with significant differences. Means followed by the same letter (when present) do not differ significantly (P=0.05, Duncan's New MRT)

<u>Ridgetown Site</u> - sweet corn on clear films

Figure 1: Soil temperature (20 cm depth) under standard and biodegradable clear mulch films. Ridgetown Campus, 2007

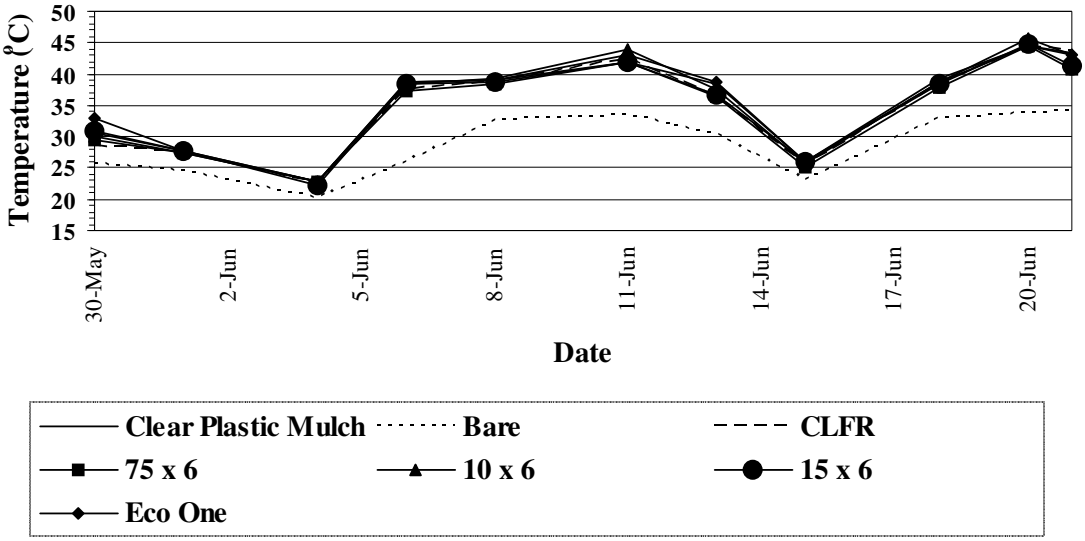

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Table 1. Plant stand, growth, and maturity of BC 0805 sweet corn on standard and biodegradable mulches. Ridgetown College, 2007.

Mulch Treatment	Percent Plant Stand (14 days)	Plant Height (14 days) (cm)	Days to Maturity	Corn Heat Units
Standard Plastic	96 a	18.0 a	85	2009
Bare Soil	57 b	8.8 b	92	2183
CLFR	86 a	19.1 a	89	2108
75 x 6	91 a	21.6 a	85	2009
10 x 6	81 a	16.8 a	85	2009
15 x 6	87 a	17.1 a	85	2009
Eco One	88 a	18.3 a	85	2009
C.V.	15.1	5.7	-	-
LSD	12.2	22.4	-	-
P-value	0.0013	0.007	-	-

Table 2. Plant height, cob height and cob characteristics of BC 0805 sweet corn on standard and biodegradable mulches. Ridgetown Campus, 2007.

Mulch Treatment	Plant Height (m)	Cob Height (cm)	Cob Weight Husk off (g)	Cob Length (cm)	Cob Width (cm)
Standard Plastic	2	55	320	22	5.1 a
Bare Soil	1.8	53	273	21.3	4.8 b
CLFR	2	58	313	21.1	5.2 a
75 x 6	1.9	53	302	21.7	5.1 a
10 x 6	2	57	302	21.9	5.0 a
15 x 6	2	57	317	22	5.1 a
Eco One	2	57	308	21.4	5.1 a
C.V.	-	-	-	-	0.1
LSD	4.2	7	13.7	1.9	1.9
P-value	N.S.	N.S.	N.S.	N.S.	0.0037

Table 3. Yield of BC 0805 sweet corn on standard and biodegradable mulches. Ridgetown Campus, 2007.

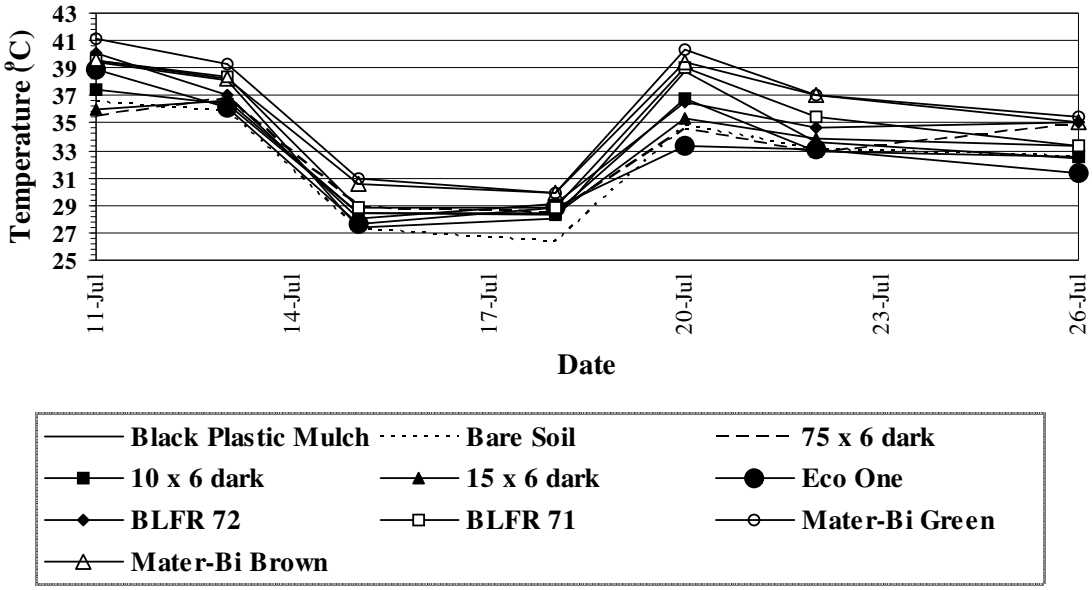
Mulch Treatment	Total Yield (doz/acre)	Marketable Yield (doz/acre)
Standard Plastic	1954 a	1935 a
Bare Soil	1547 b	1306 b
CLFR	1935 a	1806 a
75 x 6	1982 a	1954 a
10 x 6	2065 a	2028 a
15 x 6	1982 a	1898 a
Eco One	2037 a	1991 a
LSD (.05)	271	223
CV	9.5	8.2
P-value	0.0149	0.0001

Table 4. Breakdown of clear degradable mulches used in sweet corn production. Mulch was applied 29 May. Ridgetown Campus, 2007

Mulch Treatment	Mulch Degradation Rating (1-10)			
	July 05 (37 days after application)	July 20 (52 days after application)	Aug 15 (78 days after application)	Aug 23 (85 days after application)
Standard Plastic	0	0	0	0
CLFR	0	1	2	2
75 x 6	0	0	1	1
10 x 6	0	0	0	1
15 x 6	0	0	1	1
Eco One	4	6	9	9

<u>Ridgetown Site</u> - pepper on dark films

Figure 2: Soil temperature (20 cm depth) under standard and biodegradable dark mulch films. Ridgetown, 2007



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5. Fruit characteristics of Aritstotle bell pepper grown on standard and biodegradable mulch. Ridgetown Campus, University of Guelph, 2006.

Mulch Treatment	Fruit length (cm)	Fruit Diameter (cm)	Wall Thickness (mm)	Average fruit weight (g)
Black plastic mulch	10.8	8.5	6.52	230
Bare soil	10.2	7.9	5.71	247
75 x 6 dark	10.5	8.6	6.39	225
10 x 6 dark	10.1	8.6	6.65	237
15 x 6 dark	10	8	5.72	218
Eco One	10.5	8.1	6.3	220
BLFR 72	10.1	8.2	6.1	221
BLFR 71	10.3	8.5	6.5	214
Mater-Bi Green	10.4	8.5	6.4	219
Mater-Bi Brown	10.3	8.2	6.4	213
LSD (.05)	-	-	-	-
CV	4.4	4.9	8.8	9.5
P-value	N.S.	N.S.	N.S.	N.S.

Table 6. Yields of Aristotle bell pepper grown on standard and degradable mulches. Ridgetown Campus, University of Guelph. 2006.

Mulch Treatment	Early Yield (t/acre)	Fruit/ plant	Total Yield (t/acre)
Black plastic mulch	5.3	5.8	18.2
Bare soil	2.4	4.9	16.1
75 x 6 dark	5.9	6.2	19
10 x 6 dark	5.6	5.4	17.6
15 x 6 dark	3.4	5.2	15.6
Eco One	5.1	4.9	14.8
BLFR 72	3.7	4.8	14.6
BLFR 71	4.6	4.9	14.4
Mater-Bi Green	4.1	4.9	14.8
Mater-Bi Brown	3.4	5.3	15.4
LSD (.05)	-	-	-
CV	36.1	16	14.6
P-value	N.S.	N.S.	N.S.

Table 7. Breakdown of dark degradable mulches used in bell pepper production. Mulches were applied on 13 June. Ridgetown Campus, 2007.

Mulch Treatment	Mulch Degradation Rating (1-10)		
	05 July (22 days after application)	20 July (37 days after application)	15 Aug (63 days after application)
Black plastic mulch	0.3	0.3	0.3
75 x 6 dark	0.8	1	1.4
10 x 6 dark	0.3	0.8	1
15 x 6 dark	0.5	0.5	0.8
Eco One	5.1	8	9
BLFR 72	1	3.6	6.3
BLFR 71	2.3	4.3	7.9
Mater-Bi Green	4	7	9.3
Mater-Bi Brown	8.3	9.6	10

Simcoe Site - materials and methods

The sweet corn trial was established on a Berrien sandy loam soil (pH of 7.4) at the University of Guelph's Simcoe Research Station. Clear mulch was laid on 31 May; prior to laying mulch, 265 kg/ha ammonium nitrate (34% N) and 100 kg/ha potassium sulphate (50% K_2O, 18% S) was broadcast and incorporated..

Sweet corn (cv = BC 0805 (Attribute - Bt) "Triple Sweet" sugar type) was planted by hand on 13, 15, 18, 20 June. Beds of mulch were spaced 1.5 m apart. Two 8.0 m long rows of corn were planted on each bed with 0.60 m between rows and 0.26 m between plants in the row. Plots consisted of 2 beds for a total plot size of 8 m x 3 m. Plots were irrigated approximately one inch per week using Streamline drip tape (8 mil, emitter spacing of 30 cm, flow rate of 0.23 gph per emitter). The tape was installed on the soil surface below the plastic mulch.

Weeds were controlled with a preplant application of s-metolachlor/benoxacor/atrazine (Primextra II Magnum) at a rate of 2.16 kg/ha.

Aristotle bell peppers were seeded on 4 May into 128 cell black plastic trays filled with a commercial soil-less mix. Transplants were raised in a greenhouse following standard commercial practices. Prior to transplanting in the field, 205 kg/ha ammonium nitrate (34% N), 165 kg/ha potassium sulphate (50% K_2O, 18% S) and 80 kg/ha muriate of potash (60% K2O) was broadcast and incorporated. Soil type was a Bookton sandy loam (pH = 7.4).

Mulch was laid on 22 June using a mulch layer. Peppers were transplanted by hand on 25, 26 June. Beds of mulch were spaced 1.5 m apart. Plots consisted of two 8 m long rows of peppers spaced 0.45 m apart. Plants were spaced 0.45 m apart in the row. Plots were irrigated approximately one inch per week using Streamline drip tape (8 mil, emitter spacing of 30 cm, flow rate of 0.23 gph per emitter). The tape was installed on the soil surface below the plastic mulch. Weeds were controlled with a preplant application of trifluralin (0.6 kg/ha).

The days to 80% silking, cob height and plant height of sweet corn were recorded prior to harvest. Corn was hand picked on 29 August, 4, 11 September from the inside 6 m of the twin rows of each plot. Numbers and weights (husk off) of marketable and unmarketable cobs were recorded. Cob length and diameter were also recorded for ten marketable cobs from each plot.

Peppers were hand picked on 6, 25 September at the mature green stage from the inside 6 m of the twin rows of each plot. Fruit was graded as: marketable (> 2.5 inches (6.35 cm) in diameter and free from defects), small (under 2.5" (6.35 cm) in diameter and free from defects), or unmarketable (blossom end rot, sun scald, decay, etc.). The number of fruit and weight for each grade category was recorded. Ten marketable fruit from each plot were selected randomly and assessed for fruit length, fruit diameter and wall thickness.

Soil temperature was measured between 12:30 and 1:30 p.m., three times per week from 9 July to 10 August in the sweet corn trial and from 9 July to 3 August in the pepper trial. A 10 cm long temperature probe was used. Ratings of the degree of mulch degradation was recorded taken several times over the summer. Data were analysed using the General Linear Model procedure of SAS ver. 9.1.

Simcoe - sweet corn on clear films

Figure 3: Soil temperature (20 cm depth) under standard and biodegradable clear mulch films. Simcoe, 2007

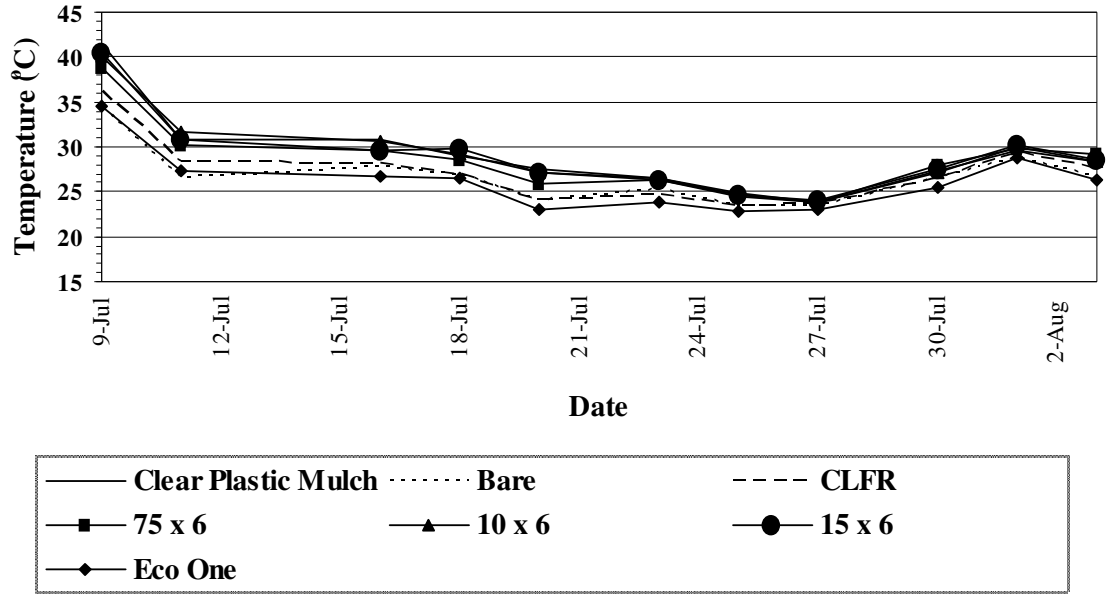

Table 8. Breakdown of clear mulches used in sweet corn production.. Mulch was applied 31 May/07

Treatments	Mulch degradation[z]			
	June 9 9 day after application	August 9 70 days after application	August 24 85 days after application	September 04 96 days after application
Eco One	9.0 a	9.7 a	10.0 a	10.0 a
CLFR	4.5 b	5.7 b	5.5 b	6.5 b
15 x 6 clear	0.0 c	1.7 c	2.5 c	3.0 c
10 x 6 clear	0.0 c	1.0 c	2.0 c	2.5 c
75 x 6 clear	0.0 c	0.0 c	0.7 c	1.2 cd
Standard clear	0.0 c	0.0 c	0.0 c	0.0 d
Lsd .05	1.18	2.35	2.34	2.31

[z]Mulch degradation rating: 0 = 100% soil cover (no breakdown of mulch), 1 = 10% soil uncovered (small holes forming in mulch), 2 = 20% soil uncovered (one or more small tears), 3 = 30% soil uncovered (multiple tears and holes in mulch), 4 = 40% soil uncovered (multiple tears and holes), 5 = 50% soil uncovered (mulch deteriorated), 6 = 60% soil uncovered, 7 = 70% soil uncovered (mulch essentially gone),8 = 80% soil uncovered, 9 = 90% soil uncovered, 10= complete breakdown, mulch not present.
Means within a column followed by the same letter are not different using Duncan's multiple range test at the 5% level.

Table 9. Days to silking and harvest, corn heat units and plant growth measurements of sweet corn grown with various plastic mulches.

Treatments	Days to 80% silking	Days to 50% harvest	CHU to 80% silking	CHU to 50% harvest	Cob height (cm)	Plant height (cm)
Bare soil	63 a	85 a	1595 [NS]	2125 a	59.8 [NS]	198.6 [NS]
Eco One	61 ab	85 a	1550	2125 a	61.1	198.6
15 x 6 clear	57 b	81 ab	1467	2047 ab	53.4	200.4
CLFR	57 b	81 ab	1462	2037 ab	52.4	202.3
10 x 6 clear	57 b	80 ab	1461	2003 b	49.2	198.7
75 x 6 clear	57 b	78 b	1450	1959 b	52.3	201.1
Standard clear	56 b	78 b	1430	1968 b	51.9	203.7
Lsd .05	4.8	4.6	114.5	111.1	8.37	14.41

[NS]Not significant at $P \leq 0.05$.

Means within a column followed by the same letter are not different using Duncan's multiple range test at the 5% level.

Table 10. Yield of sweet corn grown with various plastic mulches.

Treatments	Yield (t/ha)		Yield (# cobs/ha)		Weight per cob (kg)	Cob length (cm)	Cob width (cm)
	Marketable	Total	Marketable	Total			
75 x 6 clear	11.1 a	11.5 [NS]	45,833 a	48,333 [NS]	0.24 [NS]	20.8 [NS]	4.2 [NS]
Bare soil	10.8 a	11.5	45,278 a	50278	0.23	20.8	4.3
Standard clear	10.5 a	10.8	44,167 a	46111	0.24	20.6	4.2
CLFR	9.8 ab	10.1	40,556 ab	43333	0.23	20.3	4.2
15 x 6 clear	9.7 ab	10.3	40,833 ab	44444	0.23	20.6	4.3
10 x 6 clear	9.7 ab	10.1	40,000 ab	43889	0.23	20.5	4.2
Eco One	8.2 b	9.6	37,500 b	46111	0.21	20	4.1
Lsd .05	1.79	1.51	5673	5091	0.022	0.86	0.2

[NS]Not significant at $P \leq 0.05$.

Means within a column followed by the same letter are not different using Duncan's multiple range test at the 5% level.

Simcoe - pepper on dark films

Figure 4: Soil temperature (20 cm depth) under standard and biodegradable dark mulch films. Simcoe, 2007

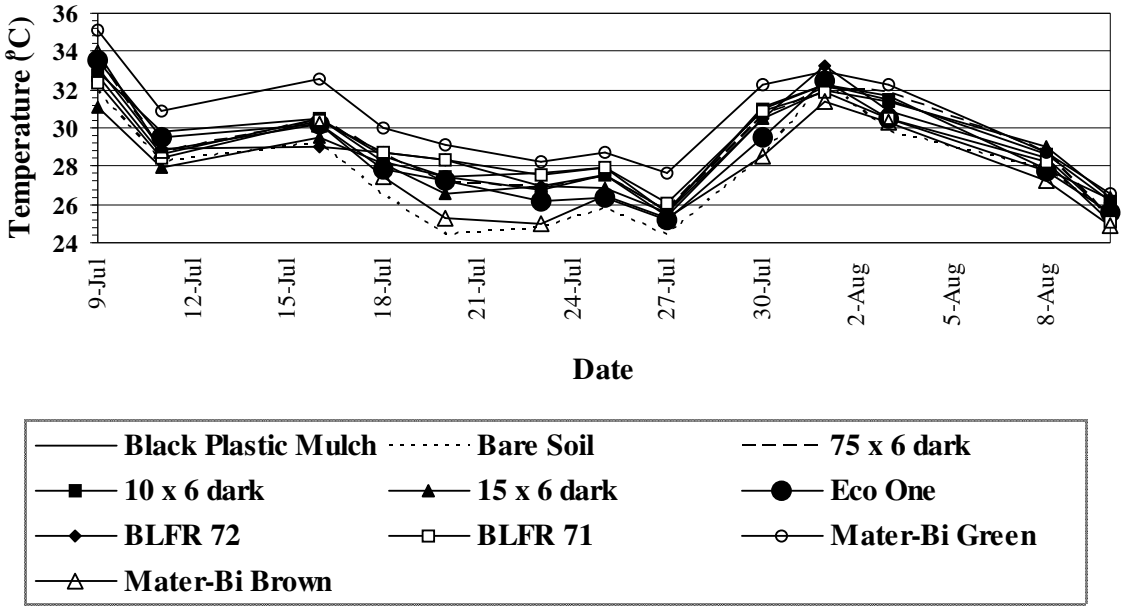

Table 11. Breakdown of dark biodegradable mulches used in pepper production . Mulch was applied on 22 June.

Treaments	Mulch degradation[z]			
	July 9 (17 days after application)	August 9 (48 days after application)	August 24 (61 days after application)	September 7 (75 days after application)
Mater Bi brown	0[NS]	9 a	10 a	10 a
Eco One	0	6 b	7 b	9 b
BLFR72	0	6 bc	6 bc	7 c
BLFR71	0	5 c	6 bc	8 bc
Mater Bi green	0	4 d	6 c	8 b
10 x 6 dark	0	0 d	0 d	0 d
15 x 6 dark	0	0 d	0 d	0 d
75 x 6 dark	0	0 d	0 d	0 d
Black plastic mulch	0	0 d	0 d	0 d
Lsd .05	-	1.2	1.1	1.2

[z]Mulch degradation rating: 0 = 100% soil cover (no breakdown of mulch), 1 = 10% soil uncovered (small holes forming in mulch), 2 = 20% soil uncovered (one or more small tears), 3 = 30% soil uncovered (multiple tears and holes in mulch), 4 = 40% soil uncovered (multiple tears and holes), 5 = 50% soil uncovered (mulch deteriorated), 6 = 60% soil uncovered, 7 = 70% soil uncovered (mulch essentially gone),8 = 80% soil uncovered, 9 = 90% soil uncovered, 10= complete breakdown, mulch not present.
[NS]Not significant at $P \leq 0.05$.
Means within a column followed by the same letter are not different using Duncan's multiple range test at the 5% level.

Table 12. Yield and fruit quality of Aristotle bell peppers grown under various types of degradable plastic mulch.

Treatments	Yield (t/ha)			Weight per fruit (kg)	Fruit length (cm)	Fruit diameter (cm)	Wall thickness (mm)
	Total	Marketable	Small				
75 x 6 dark	41.8^{NS}	35.0^{NS}	2.0^{NS}	0.24^{NS}	9.0^{NS}	9.1^{NS}	6.4^{NS}
15 x 6 dark	37.9	31.3	2.3	0.24	9.3	9.2	6.7
BLFR72	35.8	29.6	2.0	0.25	9.1	9.1	6.3
10 x 6 dark	35.1	27.8	2.0	0.24	8.9	9.4	6.5
Eco One	34.4	29.6	2.0	0.25	8.9	9.4	6.4
Black plastic mulch	33.2	26.6	2.4	0.24	9.0	8.9	6.5
Bare soil	31.6	27.2	1.0	0.24	9.5	8.8	7.0
Mater Bi green	31.2	25.7	1.7	0.24	8.9	9.2	6.4
Mater Bi brown	31.0	24.9	2.1	0.24	9.2	9.4	6.6
BLFR71	28.8	23.2	2.3	0.25	8.7	8.9	6.1
Lsd .05	12.3	10.4	1.0	0.02	0.54	0.51	0.55

^{NS}Not significant at $P \leq 0.05$.

Discussion

At the Ridgetown site, all clear degradable mulches heated the soil in a similar fashion as clear plastic mulch, and all were more effective than having no mulch (Figure 1). This was not as apparent at the Simcoe site, where 10x16 and 15x6 mulches were often similar to clear plastic, and Eco One was often similar in soil heating as having no mulch (Figure 3). This may be due to the fact that mulch temperatures were only recorded up to 1 month after application at Ridgetown, while recording at Simcoe began after the mulch had been in place for one month (early July) and continued until early August.

The Eco One mulch degraded much quicker than any other clear degradable mulch under evaluation; this was apparent at both sites (Table 4, 8). After 37 days in the field at Ridgetown, Eco One was only providing 60% soil cover; at the end of harvest only 10% of the soil was covered by mulch. At this time CLFR, 75x6, 10x6 and 15x6 had degraded very little (Table 4).

Degradation of these mulches was more rapid at the Simcoe site. Surprisingly, 9 days after application, Eco One was only providing 10% soil cover. This may be due to laying the mulch too tight, which can cause some degradable films to fail. Other mulches degraded more rapidly at the Simcoe site as well; for example, after a similar time period in the field (85 days) CLFR, 15x6 and 10x6 had ratings of 5.5, 2.5 and 2.0 respectively at Simcoe, whereas they had rating of 2.0, 1.0 and 1.0 respectively at Ridgetown (higher rating is more degradation). Why degradation occurred quicker at Simcoe may be due differences in soil type, or the fact that trickle irrigation was used on the sandy soils at Simcoe, but was not used in Ridgetown.

Plant emergence and plant heights after 14 days were improved with all mulches at Ridgetown when compared to bare soil, and there was no difference amoung the various mulch treatments (Table 1). All degradable mulches and clear plastic advanced harvest by 7 days when compared to bare soil, with the exception of CLFR, which only advanced maturity by 3 days. (Table 1). All plots with mulches improved total and marketable yields (Table 3) and there were no differences amoung the mulches. Cob widths were also improved with all mulches when compared to the bare soil treatment at Ridgetown (Table 2)

The 75x6 degradable mulch and clear plastic advanced maturity of sweet corn the greatest at the Simcoe site (7 days), while Eco One provided no benefits advancing maturity; this is due to its rapid degradation. There was no significant yield improvement when using mulch at the Simcoe site; bare soil yields similar to the yield of all mulch treatments except Eco One, which was significantly reduced (Table 10). No other parameter was affected by mulch treatment.

Mater Bi mulches provided the greatest soil warming at the Ridgetown site, often better than black plastic; as expected, bare soil was the coolest treatment (Figure 2). Mater Bi Green also provided greater soil warming at the Simcoe site (Figure 4). The Mater Bi (green and brown) BLFR (71 and 72) and Eco One mulch degraded the fastest, which the Eco One and Mater Bi mulches being largely degraded 63 days after application at Ridgetown (Table 7); this trend was similar at the Simcoe site (Table 11). At both sites, 10x6, 15x6 and 75x6 mulches were largely intact in late August.

At the Ridgetown site, there was no benefit to using soil mulches in 2007; there were no differences among all treatments in respect to early yields, fruit characteristics, and total yields (Tables 5,6). Similar results were found at the Simcoe site (Table 12).

This project provides data to support the use of degradable mulches in vegetable production. These produce have the potential to reduce production costs, and reduce the consumption of non-renewable resources. Direct job creation numbers cannot be given.

Milestones

1. Source material and establish plots - 01 May
   - this milestone was completed a bit later than indicated (May 01). Typically we do not establish peppers in the field until early June in order to avoid frost. All plots were established adequately

2. Complete data collection - 01 November
   - completed

3. Complete report - 30 November
   - completed

Communication Plan

A vegetable research tour, which was organized in cooperation with the Ridgetown OMAFRA crop specialists, was held at the Ridgetown Campus for local fresh and processing vegetable growers on 30 July, 2007. Approximately 65 people attended this event, which included this research tour, which included viewing these plots.

Representatives of mulch manufacturers and suppliers toured the plots on 25 September.

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