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Evaluating Degradable Mulches for Muskmelon Production

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Abstract
Plastic mulches can provide vegetable growers with earlier crop maturity, increased yields and quality, improved disease, insect and weed control, and more efficient fertilizer and water use. However, standard polyethylene mulches must be removed and disposed of at the end of each season, which is a dirty and costly undertaking. One solution to this problem has been the development of degradable mulches that can be left in the field after harvest to disintegrate and be incorporated into the soil. Unfortunately, degradable mulch performance hasn't always met expectations. And now there are different types of degradable mulches being aggressively marketed creating questions about which one is best. The objective of this study was to evaluate three types of degradable mulches for ease of use, speed of breakdown, and how they influence transplanted muskmelon performance.

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Introduction

Plastic mulches can provide vegetable growers with earlier crop maturity, increased yields and quality, improved disease, insect and weed control, and more efficient fertilizer and water use. However, standard polyethylene mulches must be removed and disposed of at the end of each season, which is a dirty and costly undertaking. One solution to this problem has been the development of degradable mulches that can be left in the field after harvest to disintegrate and be incorporated into the soil. Unfortunately, degradable mulch performance hasn't always met expectations. And now there are different types of degradable mulches being aggressively marketed creating questions about which one is best. The objective of this study was to evaluate three types of degradable mulches for ease of use, speed of breakdown, and how they influence transplanted muskmelon performance.

Materials and Methods

The degradable mulches included in this evaluation were a 0.6 mil clear and a 0.6 mil black biodegradable mulch (trade name BioTelo) from Dubois Agrinovation, Quebec, Canada; a 0.9 mil clear and a 0.9 mil black photodegradable mulch from Poly Expert Inc., Quebec, Canada; and a 0.4 mil clear and a 0.5 mil black oxo-biodegradable mulch from Eco-One, Ontario, Canada. All mulches were 4 ft wide. Mulch treatments were laid in the field on April 25 using a Rain Flo raised bed mulch layer. Trial design was a randomized complete block with three replications. A plot consisted of a single row of mulch 50 ft long. Muskmelon plants, cultivar Aphrodite, were transplanted on May 18 using a Holland pot transplanter capable of planting through mulch. Weed control was achieved by applying Prefar herbicide to beds before laying mulch and applying Strategy and Sandea herbicides between the beds after laying the mulch. Standard cultural practices were followed for irrigation, fertilization, and pest control as outlined in Midwest Commercial Vegetable Production Guide. Mulch strength (puncture resistance) was measured once a month with a Chatillon digital force gauge. Mature muskmelon fruit were harvested from July 21 through August 8 to determine effect of mulch on early and total yield.

Results and Discussion

The biodegradable (0.6 mil) and the oxo-biodegradable (0.5 mil) mulches were noticeably thinner than the photodegradable (0.9 mil) mulches. Because of their thinness, and possibly because of their composition, they were quite fragile and difficult to install in the field, or transplant into, without tearing or puncturing. In fact, we couldn't use the transplanter's press wheels without splitting the biodegradable or oxo-biodegradable films. The thicker and stronger photodegradable mulches were similar to conventional mulches and were used without difficulty.

All the black mulches provided good weed control but weeds grew thickly under the clear mulches even though herbicide was used, possibly because of field location and weather conditions. When the sun shone, weeds under the clear photodegradable mulch became burnt and stunted due to high temperatures under the mulch. But the clear biodegradable and to a lesser extent the clear oxo-biodegradable didn't trap the heat under the mulch due to tears and holes allowing the weeds to grow unchecked. Early and total yield of the clear biodegradable mulch

treatment, and the total yield of the clear oxo-biodegradable mulch treatment, was reduced because of weed competition (Table 1). Special instructions that come with the biodegradable and oxo-biodegradable mulches recommend they be laid immediately before planting to get maximum benefit from the mulch before breakup. However, as it worked out, the mulch treatments were laid on April 25, but due to weather conditions and time restraints, we weren't able to transplant until May 18, about three weeks later. This delay was too long as the clear biodegradable and oxo-biodegradable mulches started breaking up shortly after transplanting which caused weed problems.

Muskmelon yield data are presented in Table 1. All of the black mulches and the clear photodegradable mulch produced good total yield. Normally, because of soil warming, clear mulches enhance early season crop growth and early yield but that wasn't the case this season. Conditions after transplanting were cool, cloudy, and rainy resulting in slow vine growth on both clear and black mulches. Then, toward late June, the weather became hot and sunny resulting in vigorous growth. Under these conditions the clear mulches did not produce greater early season yields than the black mulches.

A problem was noted on fruit harvested from the black biodegradable mulch plots. By harvest time the black biodegradable mulch was breaking down and becoming brittle and soft enough that fragments would stick to the bottoms of the heavy muskmelon fruit where they sat on the mulch. With some effort the fragments could be brushed off by hand but in large pickings hand brushing would not be feasible.

A digital force meter was used to determine puncture resistance of the mulches and monitor how fast they lost their elasticity in the field after installation (Table 2). The clear biodegradable and oxo-biodegradable mulches gave the weakest readings after field installation and lost strength fairly rapidly. The readings also found that the buried edges of the black and clear photodegradable mulches still had good elasticity and strength in September at the end of the season.

Summary

The photodegradable mulches, because of their strength, were the easiest to use, produced good yields, but in the fall after disking, left the largest pieces of plastic in the field. The oxo-biodegradable mulches were thin and fragile making them difficult to work with. However, the black oxo-biodegradable mulch did provide good weed control and produced a good muskmelon yield. After disking at the end of the season, the oxo-biodegradable mulches left long strips in the field but they were smaller and more brittle than the photodegradable remnants and are not expected to interfere with next season's field work. The biodegradable mulches were also fragile and required careful handling. Due to a delay between mulch laying and transplanting, the clear biodegradable mulch broke up too quickly in the season resulting in severe weed competition and low muskmelon yield. Using Dubois Agrinovation for muskmelon production is experimental as the product recommends the clear biodegradable (BioTelo) mulch be used only for early corn production. The black biodegradable mulch worked reasonably well for muskmelon production except for the small fragments that would stick to the bottom of the fruit at harvest. To their credit, the biodegradable mulches were, by far, the best looking at the end of the season in terms of breakdown and disappearance. After disking in September all that remained were small brittle pieces.

Table 1. Aphrodite muskmelon early and total yield by mulch treatments.

	Early			Total		
Mulch treatment	**Number fruit/acre**	**Cwt/acre**	**Fruit wt (lb)**	**Number fruit/acre**	**Cwt/acre**	**Fruit wt (lb)**
Clear photodegradable	1864	106.6	5.8	5900	351.8	6.0
Clear oxo-biodegradable	1760	101.2	5.6	5072	286.1	5.7
Clear biodegradable	104	4.8	4.7	2277	119.0	5.2
Black photodegradable	1967	109.8	5.7	5796	335.4	5.8
Black oxo-biodegradable	2070	126.8	6.0	6417	399.0	6.3
Black biodegradable	1035	66.9	6.3	5279	342.1	6.6
Trial Mean	*1467*	*86.0*	*5.7*	*5123*	*305.6*	*5.9*
LSD $_{0.05}$	*861*	*52.4*	*0.9*	*1427*	*76.1*	*n.s.*

Table 2. Mulch strength readings in lbf (pound-force) required to puncture. All readings taken from top of mulch bed except for September 10 readings in parenthesis, which were taken on buried edges.[a]

Mulch treatment	**May 10**	**June 10**	**July 10**	**August 10**	**Sept. 10**
Clear photodegradable	1.35	1.12	1.19	0.97	0.87 (1.33)
Clear oxo-biodegradable	0.39	0.29	0.23	0.15	0.14 (0.24)
Clear biodegradable	0.45	0.23	0.14	0.03	0.05 (0.17)
Black photodegradable	0.95	0.91	0.81	0.57	0.48 (0.87)
Black oxo-biodegradable	0.61	0.57	0.56	0.39	0.33 (0.40)
Black biodegradable	0.49	0.39	0.33	0.11	0.09 (0.36)

[a]All readings taken from top of mulch bed except for September 10 readings in parenthesis, which were taken on buried edges.