Photodegradable Mulches and Watermelon Production

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Abstract. Two formulations (221B and 2B) of Plastigone brand photodegradable mulch were compared to non-degradable plastic and bare ground culture for use in watermelon production in 1987. Splitting of the plastic was first observed in the 221B mulch after 15 days in the field and in the 2B mulch after 29 days in the field. After 55 days in the field, most of the 221B mulch had been windblown out of the plots while the 2B mulch was relatively intact. Both formulations of photodegradable mulch were equally effective as non-degradable mulch in enhancing early watermelon fruit yield. The 2B photodegradable and the non-degradable had the greatest total yields. The early degrading mulch (221B) appears to photodegrade too quickly for effective season-long watermelon production.

Introduction

Many first-time and experienced users of polyethylene mulch for growing selected vegetable crops are encouraged by yield enhancements with use of the mulch, but discouraged by the inconvenience of the end-of-the-season clean-up of their fields caused by the presence of the polyethylene. Typically, a labor crew unburies the edges of the plastic from the soil, removes the wide strips of plastic, and stacks the plastic at the edge of the field. The heaps of plastic either await natural degradation, taking several years, or are burned, which can be environmentally objectionable.

Photodegradable polyethylenes, plastics that are manufactured to begin degradation after a threshold level of UV radiation is intercepted, offer some promise as mulching material that overcome some of the inconveniences of removal and disposal of non-degradable polyethylene. Since these plastics can be formulated to degrade at specific threshold levels of UV light interception, early-season degrading and late-season degrading mulches can be manufactured and are available.

1 Use of trade names in this publication is solely for identification. No endorsement of the products named is implied by Clemson Univ. or the South Carolina Experiment Station nor is descrimination intended to the exclusion of similar products not named.
Research on the use of photodegradable mulches for vegetable crops production began in the late 1960's (9). Research continued during the 1970's (1, 3, 7, 10, 12) and 1980's (4, 5, 8, 11, 13). Presently, there are at least three commercial manufacturers of photodegradable mulch (13). Information is lacking, though, on how effective the presently available photodegradable mulches are in enhancing production of many of the commonly grown vegetable crops with plastic mulch. The objective of this research was to determine the effectiveness of two formulations of Plastigone brand (Ideamasters, Miami, FL) photodegradable mulch for producing watermelons in South Carolina.

Materials and Methods

Two formulations of a Plastigone brand (Ideamasters, Inc., Miami, FL.) polyethylene photodegradable mulch were compared to non-photodegradable mulch and bare soil culture for effectiveness in watermelon (Citrullus lanatus (Thunb.) Matsum & Nakai) production during the summer of 1987 at Clemson University's Edisto Research and Education Center in Blackville, SC. Fertilizer at N, P and K rates of 135, 196 and 448 kg/ha, respectively, was incorporated into the top 0.2 m of a Norfolk sandy loam soil (Typic paleudults) immediately prior to the field application of the mulch treatments on 23 April 1987. No herbicides were used, and weeds were routinely removed from the bare soil treatment and from between the rows. All mulch material was black, 1.5 m wide, and covered beds 0.8 m wide and 0.1 m high. One formulation (221B) of photodegradable mulch was developed by the manufacturer to degrade approximately 30 to 40 days after exposure to sunlight, the second formulation (2B) was developed to degrade after 60 to 90 days. The non-degradable mulch was embossed. Treatments were arranged in a split plot design with four replications; mulch treatments were randomized as the main plots and cultivars were the subplots.

Transplants of three cultivars of triploid watermelons ('Fraser's Wonderful', 'Fengshan No. 1', 'Supersweet') were placed in the mulch treatments on 24 April 1987 at an in-row spacing of 1.5 m with rows 1.5 m apart. A diploid cultivar ('Crimson Sweet') was planted every forth row on bare soil for pollination of the triploid cultivars. Bee hives were located near the field and recommended pesticide sprays (6) were applied. Overhead irrigation was used to supplement natural rainfall. Mature fruit was harvested once a week. Fruit harvested during the first two weeks of harvest was considered early yield.

Results and Discussion

Photodegradable mulch breakdown characteristics

The first observed characteristic of sunlight-induced breakdown of both formulations of photodegradable mulch was a lateral splitting of the plastic originating from the transplant hole. Splitting was first observed in the 221B photodegradable mulch after 15 days in the field and in the 2B photodegradable mulch after 29 days in the field. With advanced splitting and cracking of the plastic, sections of the photodegradable mulches were blown out of the plots by the wind. After 55 days in the field, the 221B mulch was mostly missing from the plots (except for edges not exposed to the sun) and the 2B mulch was mostly still in place but had large lateral cracks. Several weeks after the last harvest, field clean-up consisted of hand removal of the non-degradable mulch and disking the photodegradable mulches. Photodegradable mulch
residue was not a problem for field preparation in 1988.

Mulch effects on watermelon yield

There were no statistically significant mulch by cultivar interactions and for discussion mulch treatment results were average over all cultivars. Earliest plant flowering and fruiting was observed in the non-degradable mulch treatment, and the latest in the bare soil treatment (Table 1). There was no significant difference in early yield from plants in the photodegradable mulch formulations and the non-degradable mulch. The use of either a photodegradable mulch or a non-photodegradable mulch enhanced early fruiting of watermelon by at least 5 days and resulted in greater early yield. Similar effects of polyethylene mulch on early yield had been previously reported for watermelon (2). Plants grown with the non-degradable and 2B degradable mulch produced more total fruit than plants grown with 221B degradable or bare soil culture. Mulch treatments had no effect on average fruit weight or fruit soluble solids.

Table 2. Influence of photodegradable and non-degradable mulch treatments on the production of watermelons.

<table>
<thead>
<tr>
<th>Plastic mulch treatment</th>
<th>Days to first harvest</th>
<th>Early</th>
<th>Total</th>
<th>Ave. weight per fruit (kg)</th>
<th>Soluble Solids (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-deg.</td>
<td>62.7 c</td>
<td>600 a</td>
<td>3493 a</td>
<td>4.68</td>
<td>11.3</td>
</tr>
<tr>
<td>2B deg.</td>
<td>65.7 b</td>
<td>706 a</td>
<td>2926 a</td>
<td>5.81</td>
<td>11.1</td>
</tr>
<tr>
<td>221B deg.</td>
<td>67.2 b</td>
<td>600 a</td>
<td>1376 b</td>
<td>5.22</td>
<td>10.7</td>
</tr>
<tr>
<td>Bare soil</td>
<td>72.7 a</td>
<td>353 b</td>
<td>1235 b</td>
<td>5.08</td>
<td>10.6</td>
</tr>
</tbody>
</table>

Significance:

1 Average value calculated as 31 days from first female blossom.

2 Statistical treatment of treatment means is indicated by * (significant at P=0.05), or ** (significant at P=0.01). Mean separation within columns by L.S.D. (5%).

Conclusions

These results suggest that the late degrading formulation of Plastigone brand photodegradable mulch (2B) can be successfully used in the production of watermelons. Both formulations of photodegradable mulch (2B and 221B) were equally effective as the non-degradable polyethylene mulch in enhancing early watermelon yield, but only the 2B mulch was as effective as the non-degradable in enhancing total yield. The early degrading mulch (221B) appears to photodegrade too quickly for effective season-long watermelon production.
Literature Cited


