

How well does biodegradable plastic mulch degrade in compost and soil?

H. Y. Sintim, K. Shahzad, A. I. Bary, and M. Flury

Puyallup Research and Extension Center, Washington State University

Introduction

The use of plastic mulch in crop production is an important management practice that helps to control weeds, to conserve water, to reduce nutrient loss, and also to maintain conducive microclimate. Currently, polyethylene-based mulches are the most commonly used plastic mulches, but have the disadvantage that they have to be removed and disposed after usage.

Unfortunately, disposal options for polyethylene mulch are limited. After usage, they are often contaminated with soil and agrochemicals, and therefore they are not accepted by many recycling facilities. The cost to remove and dispose the plastic mulches into landfills can be high, and sometimes, disposal facilities are not readily available near the farming area.

Biodegradable plastic mulches are now commercially available, and they are designed so that they can be tilled directly into the soil to degrade. Their adoption could alleviate the disposal problem of polyethylene mulch, but there is the need to evaluate how well they degrade under different environmental conditions.

Objectives

To assess the degradation of biodegradable plastic mulches in compost and soil.

Materials and Methods

Four biodegradable plastic mulches (BioAgri, Naturecycle, Organix, PLA/PHA) were used in the study. In addition,

polyethylene mulch was included as a control treatment. The mulches were used for the cultivation of pumpkin (*Cucurbita pepo*) at the Northwestern Washington Research and Extension Center, in Mount Vernon, WA and the East Tennessee Research and Education Center in Knoxville, TN. After pumpkin harvest, the mulches were sampled from the field, cut into 10 cm × 12 cm pieces, and then they were placed in 250 μm opening nylon meshbags.

The meshbags were buried at 60 cm depth in aerated static pile compost prepared at the Puyallup Research and Extension Center, Washington State University, Puyallup, WA, and at 10 cm depth in soil at the respective two field sites. The meshbags were removed after 18 weeks in the compost, and after 18 months in the soil. Degradation of the mulches was assessed based on reduction in surface area as measured by image analysis.

Results and Discussion

Under compost condition, there was no significant difference in the degradation among the biodegradable plastic mulch tested in the study, with average visual degradation of 97.9% (Fig. 1). In soil, however, the biodegradable plastic mulch did not degrade as much (Fig. 2). The biodegradable plastic mulch degraded differently at the two locations, with more degradation observed at Knoxville than in Mount Vernon. Among the biodegradable plastic mulches tested in Knoxville, BioAgri had the greatest degradation, whereas

Organix had the least degradation (Fig. 2). However, the differences were not statistically significant, with average degradation of 17.9%.

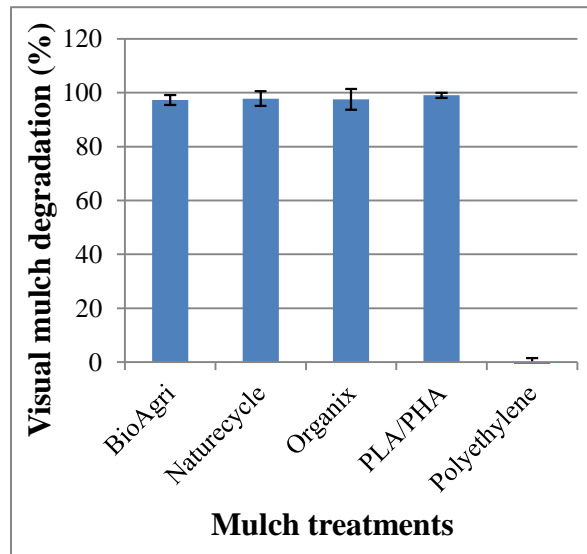


Fig. 1: Visual mulch degradation in compost after 18 weeks. Error bars represents the standard deviation of the mean (n=4).

In Mount Vernon, PLA/PHA underwent considerably lower degradation compared to BioAgri, Naturecycle, and Organix, with average degradation of 2.1% after 18 months of being buried in the soil. Average degradation of BioAgri, Naturecycle, and Organix in Mount Vernon was 7%. As expected, the polyethylene mulch did not degrade in both compost and soil.

The lower degradation of the biodegradable plastic mulches in soil at the two locations raises concerns about their long-term sustainable use. This is because plastic accumulation in soil for a long-term can have adverse impact on the environment. On the other hand, on-farm composting could be a viable disposable method of the biodegradable plastic mulches, because the mulches degraded in compost much better than in soil.

The limitations would be the removal costs, as well as fragmentation of some of the mulches during removal. Fragmentation will largely depend on the type of biodegradable plastic mulch, as some tend to break down prematurely during cultivation.

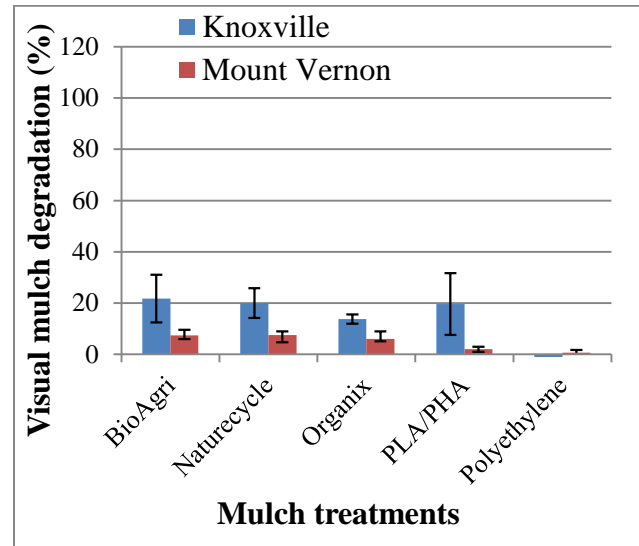


Fig. 2: Visual mulch degradation in soil after 18 months at Knoxville, TN and Mount Vernon, WA. Error bars represents the standard deviation of the mean (n=4).

Acknowledgements

The study was supported by the USDA Specialty Crops Initiative, Coordination Agricultural Project (Award 2014-51181-22382), and the Western Sustainable Agricultural Research and Education Program (Award 2015-38640-23779). Our special thanks go to all project team members, staffs and students who helped with the field work.

Contact Information

Henry Sintim at henry.sintim@wsu.edu or Markus Flury at flury@wsu.edu

Key words: Biodegradable plastic mulch, mulch degradation, compost, soil