Biodegradable Plastic Mulch for Pumpkin Production: Crop Yield, Quality and Mulch Biodegradation in Northwest Washington

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SUMMARY

The use of polyethylene (PE) mulch in agriculture has greatly increased in the last two decades throughout the world. Mulch reduces weed pressure, moderates the soil temperature, conserves moisture and results in higher crop yield. However, disposal of used PE mulch causes pollution, and has created a threat to the soil and environment. This 4-year study evaluates 4 potentially biodegradable plastic mulches (Metabolix, BASF, Naturecycle and Bioagri) on pumpkin yield and quality, and mulch deterioration before and after soil incorporation in Northwest Washington. Cellulose mulch and PE are also included to serve as positive and negative control treatments. Preliminary results from the study showed that fruit yield with Metabolix (22.4 t/ha) and Bioagri (24.3 t/ha) was comparable with PE mulch (27.3 t/ha). Fruit quality did not differ due to mulches. Naturecylce had the greatest percent visual deterioration (PVD) during the pumpkin growing season. While biodegradable mulch can produce comparable fruit yield and quality as PE mulch, deterioration depends upon product formulation. More studies are needed to evaluate mulch degradation in different locations and climates, and impact on crop yield and quality.

INTRODUCTION

- The use of PE mulch increases crop yield by controlling weeds, conserving moisture, and moderating soil temperature.
- Removal of PE mulch from the field after crop harvest involves labor and cost (Miles at al., 2012).
- PE mulch left in the field can impart harmful effects to soil, environment and overall ecology.
- Mulch that has the benefits of PE mulch and that can biodegrade in the field after tillage incorporation with limited impact on agro-ecology could be an alternative to PE mulch.

Fig. 1. Overview of biodegradable mulch experimental field at WSU Mount Vernon NWREC in 2015.

OBJECTIVES

- Evaluate biodegradable plastic mulches in terms of pumpkin yield and fruit quality in Northwest Washington.
- Evaluate the weed incidence with biodegradable plastic mulches.
- Assess degradation of biodegradable plastic mulches above the soil during the growing season and in-soil after tillage incorporation.
- Compare different techniques for measuring mulch biodegradation after incorporating into soil.

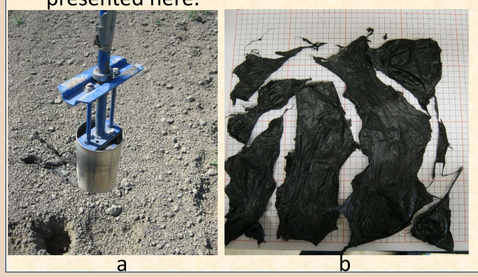
Fig. 2 Stockpiling of PE mulch by farmers after removal from field.

Photo source: Greg Scullin (The Weekly Times. Nov. 13. 2014)

MATERIALS AND METHODS

Fig. 3. Biodegradable plastic mulch in the experimental site at the end of the growing season.

- **Experimental site:** Washington State University (WSU) Mount Vernon Northwestern Washington Research and Extension Center (NWREC) located in the Maritime Pacific Northwest with a cool, humid summer and mild winter climate and having Skagit silt loam soil.
- **Experimental design:** Experiment was laid out in a randomized complete block design with 8 treatments and 4 replications. Treatment included five biodegradable mulches (Weedguard, Metabolix, BASF, Naturecycle and Bioagri) that were tilled into the soil at the end of the crop season, plus PE mulch and Bioagri that were removed at the end of the crop season and Bareground. This experiment will be repeated for 4 years. Data so far collected from the first year are presented here.



a b

Fig. 4 a) Soil sampling from the experimental plot following tillage incorporation, b) Measuring mulch area by graph paper method

DATA COLLECTION

- **Weed control:** Number and weight (fresh and dry) of weeds in the central 1 m of each plot were recorded three times: 1) at 2 week post-planting, 2) at mid-season, and 3) at 2 week prior to harvest.
- **Percent visual deterioration:** Mulch deterioration in each plot during the crop season was rated visually twice a month where 0% represents completely intact mulch and 100% represents fully deteriorated mulch.
- **Fruit yield, quality and storage:** Weight and number of marketable fruit were measured at harvest. Total soluble solid (TSS), dry matter, and weight were measured at harvest and thereafter every 2 weeks for 2 months.
- **Post-incorporation mulch area:** Collect 5 soil cores (Fig 4a) from each designated plot, extract mulch fragments, measure area by 3 techniques: weight, graph paper and Image J photo software.

PRELIMINARY RESULTS

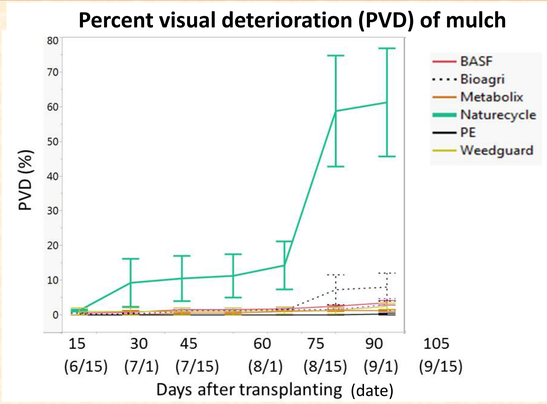


Fig. 5. Percent visual deterioration (PVD) of mulch during crop growing season in 2015 .

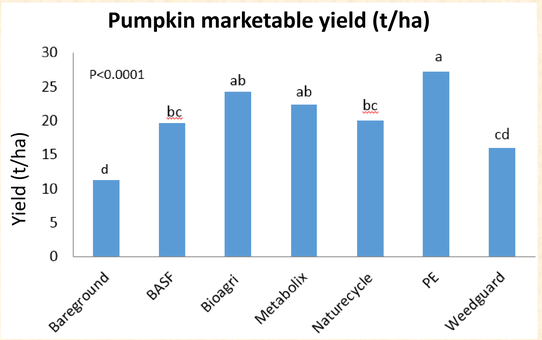


Fig. 6. Pumpkin marketable yield (t/ha) with mulch treatments in 2015.

PRELIMINARY RESULTS

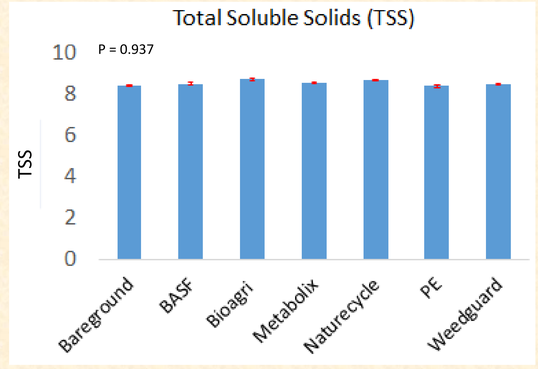


Fig. 7. Total soluble solid of pumpkin fruit with mulch treatments measured at harvest in 2015.

CONCLUSION

- PVD differed for mulch products.
- Marketable yield of pumpkin grown with Bioagri and Metabolix were comparable with PE mulch.
- Pumpkin fruit yield was lowest with Bareground.
- No difference in fruit quality due to mulch products.

Fig. 8. Harvesting pumpkins from biodegradable mulch experimental field in 2015.

Fig. 9. Storage of pumpkin for fruit quality assessment over time in 2015.

DISCUSSION

- Biodegradable plastic mulch produced comparable yield and quality of pumpkin as PE mulch similar to the findings of Miles et al. (2012) and Cowan et al. (2013).
- The PVD of mulches differed over time and by product which is in consistence with the findings of Cowan et al. (2013).

REFERENCES

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