

Introduction

There has been increased interest in biodegradable plastic mulch in recent decades due to the limited disposal options for polyethylene mulch. However, sustainable application of biodegradable plastic mulch will depend on how well they maintain microclimate to support plant growth and undergo complete degradation.

Objectives

1. Evaluate the effects of biodegradable plastic mulch on soil microclimate
2. Evaluate the degradation of biodegradable plastic mulch in soil and in compost
3. Determine whether micro-residues are released upon degradation of biodegradable plastic mulch

Materials & Methods

Sites:

- ▶ Knoxville, TN and Mount Vernon, WA

Plant:

- ▶ Pie pumpkin (*Cucurbita pepo* L.)



Map showing field sites



Mount Vernon field site under pie pumpkin production

Mulch treatments:

- ▶ Bareground (control treatment)
- ▶ Biodegradable plastic mulch (PLA/PHA; Metabolix Inc., Cambridge, MA)
- ▶ Polyethylene plastic mulch (Filmtech, Allentown, PA)

Soil Microclimate

Soil water content:

- ▶ Measured at 10cm and 20cm depths

Soil temperature:

- ▶ Measured at 0cm, 10cm, and 20cm depths

Light illuminance:

- ▶ Light illuminance (soil surface and directly underneath mulch)

Mulch Degradation

Degradation in soil and in compost:

- ▶ Harvested mulch samples and cut into 10cm×12cm
- ▶ Placed mulch samples in Nylon meshbags (250μm opening)
- ▶ Buried meshbags in soil at 10cm depth and retrieved every six months
- ▶ Placed meshbags in compost pile at 60cm depth and retrieved every two weeks
- ▶ Determined mulch degradation by image analysis (ImageJ software)



Burial of meshbag in soil



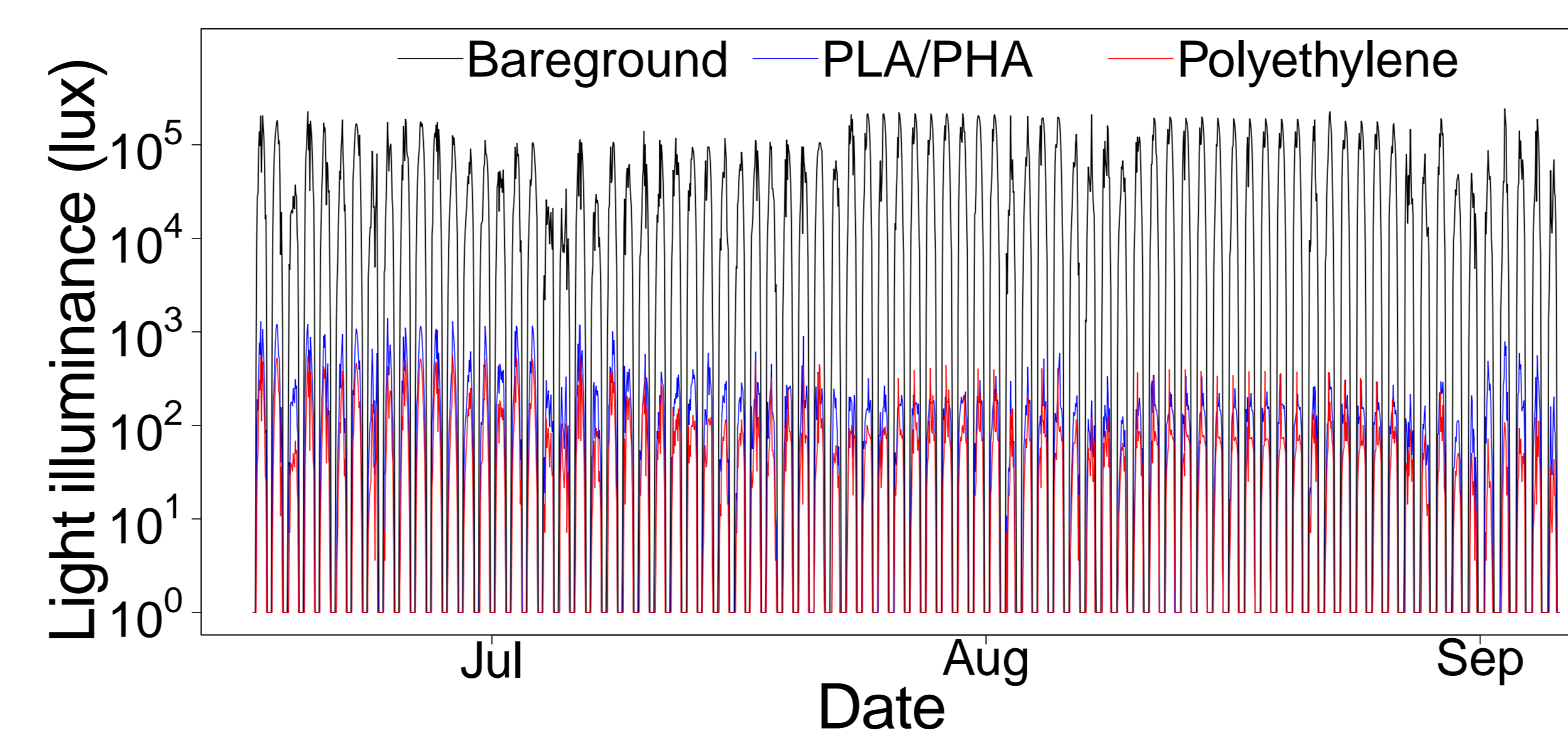
Meshbags retrieved after two weeks of composting

Release of micro-residues:

- ▶ Visual observation of meshbags
- ▶ Electron Microscopy
- ▶ Electrophoretic mobility test

Results: Light Intensity

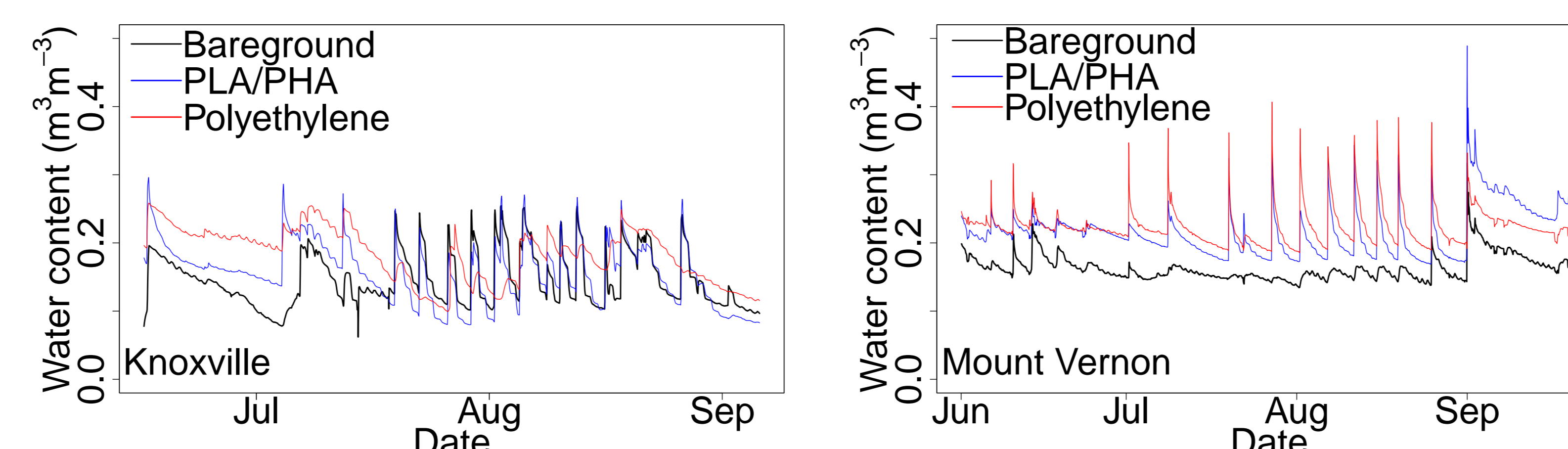
Light illuminance as affected by mulch:



- ▶ Light illuminance reduced by 2 orders of magnitude below mulch
- ▶ Comparable light illuminance of Polyethylene and PLA/PHA

Results: Soil Water Content

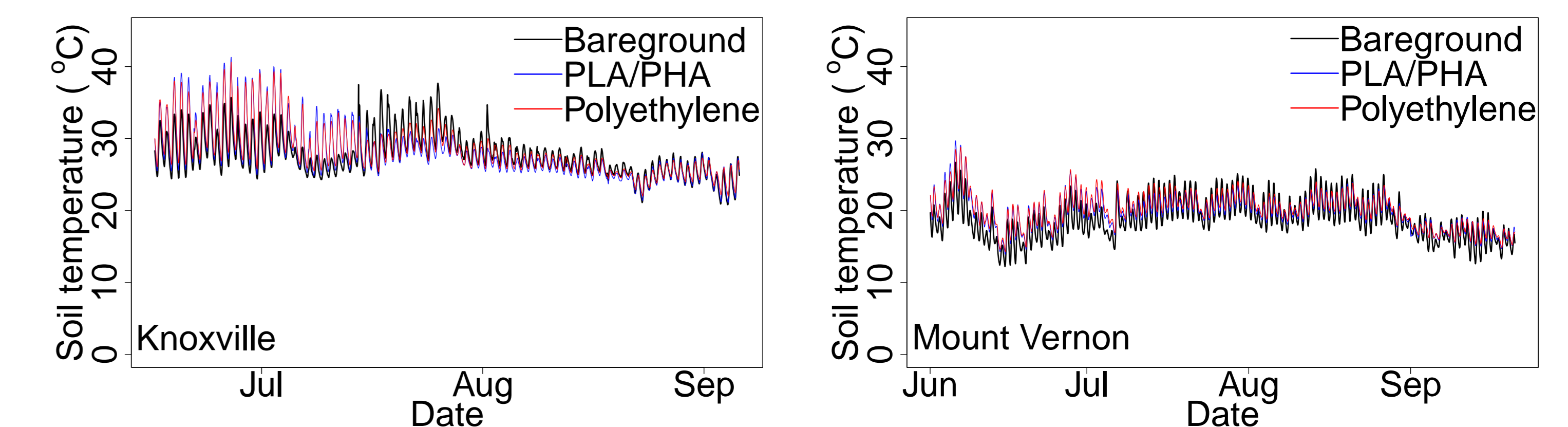
Soil water content as affected by mulch:



- ▶ Increased soil water conservation of Polyethylene and PLA/PHA

Results: Soil Temperature

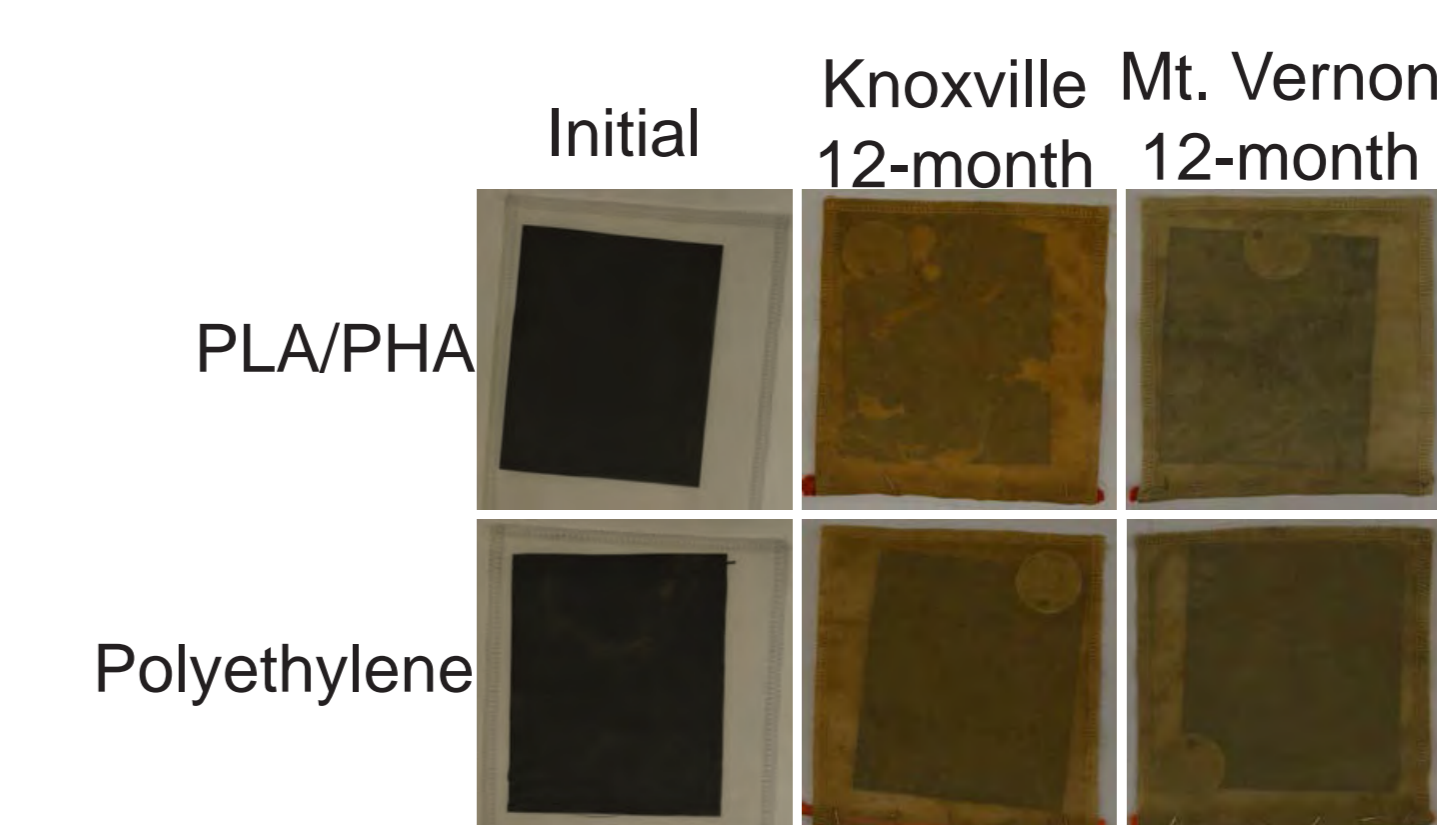
Soil temperature as affected by mulch:



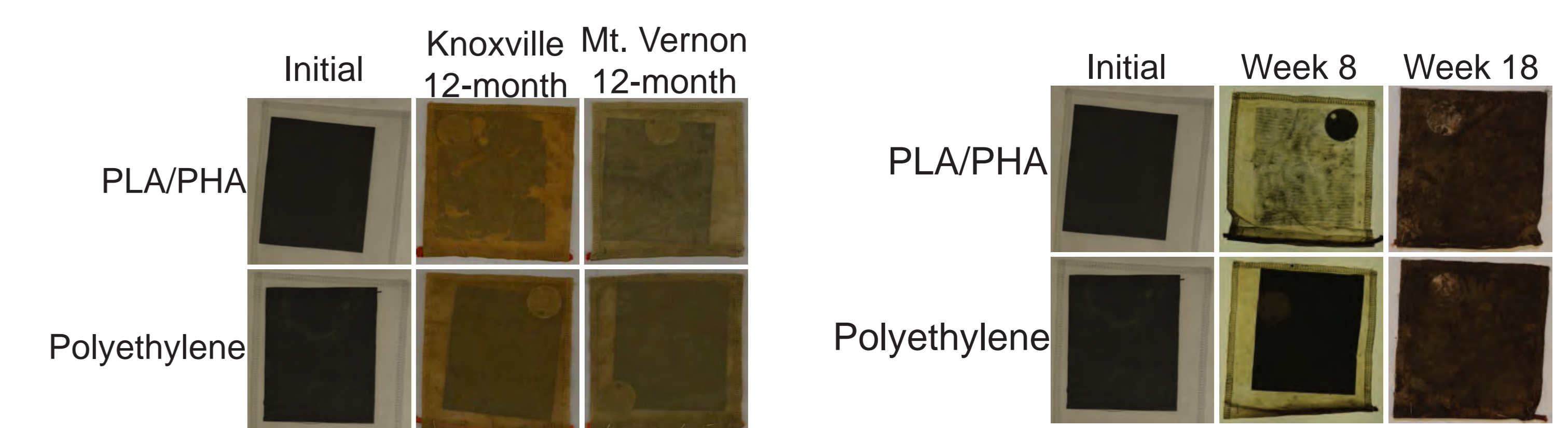
- ▶ Increased early season soil warming of Polyethylene and PLA/PHA

Results: Mulch Degradation

Degradation in soil:



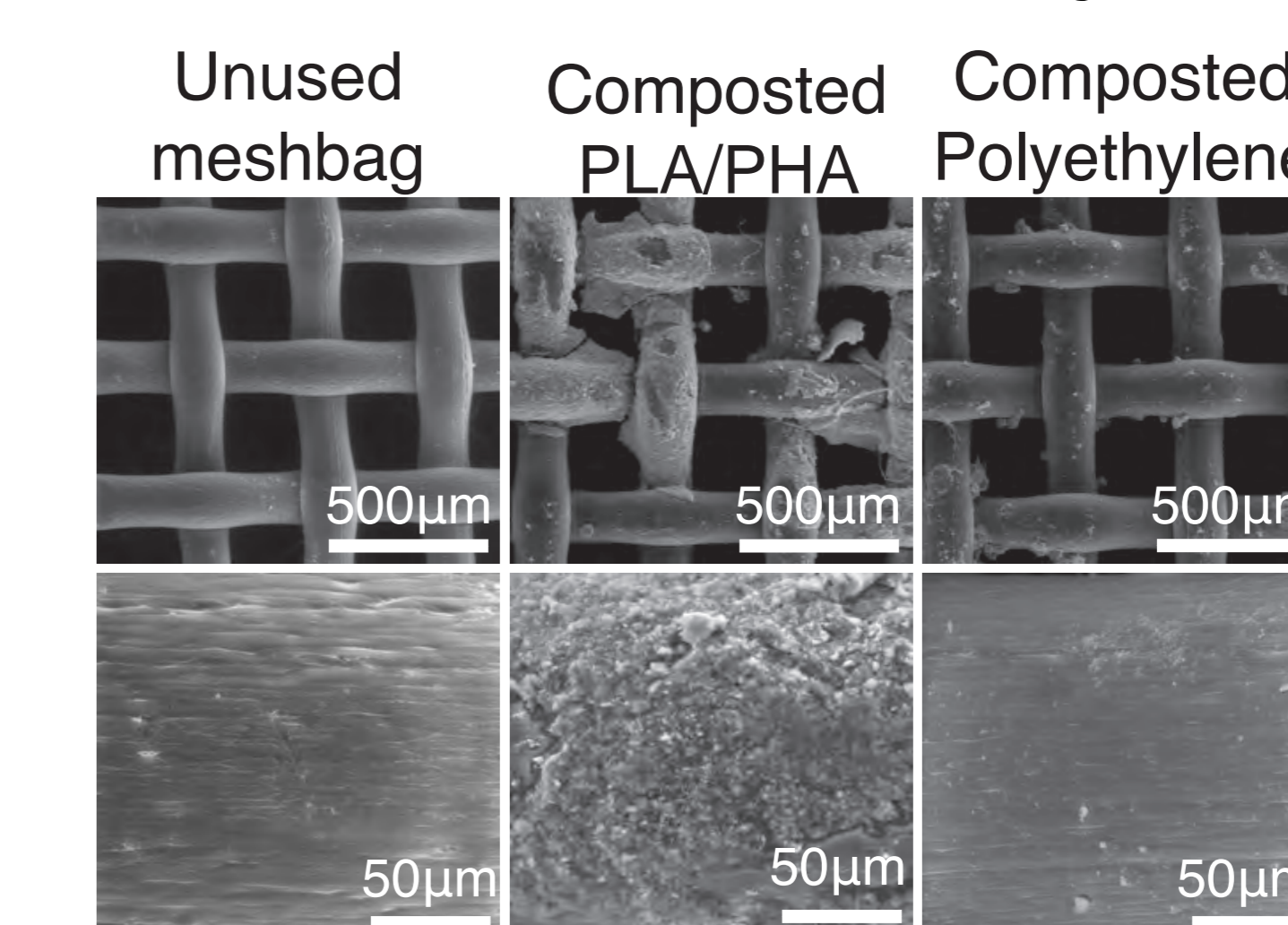
Degradation in compost:



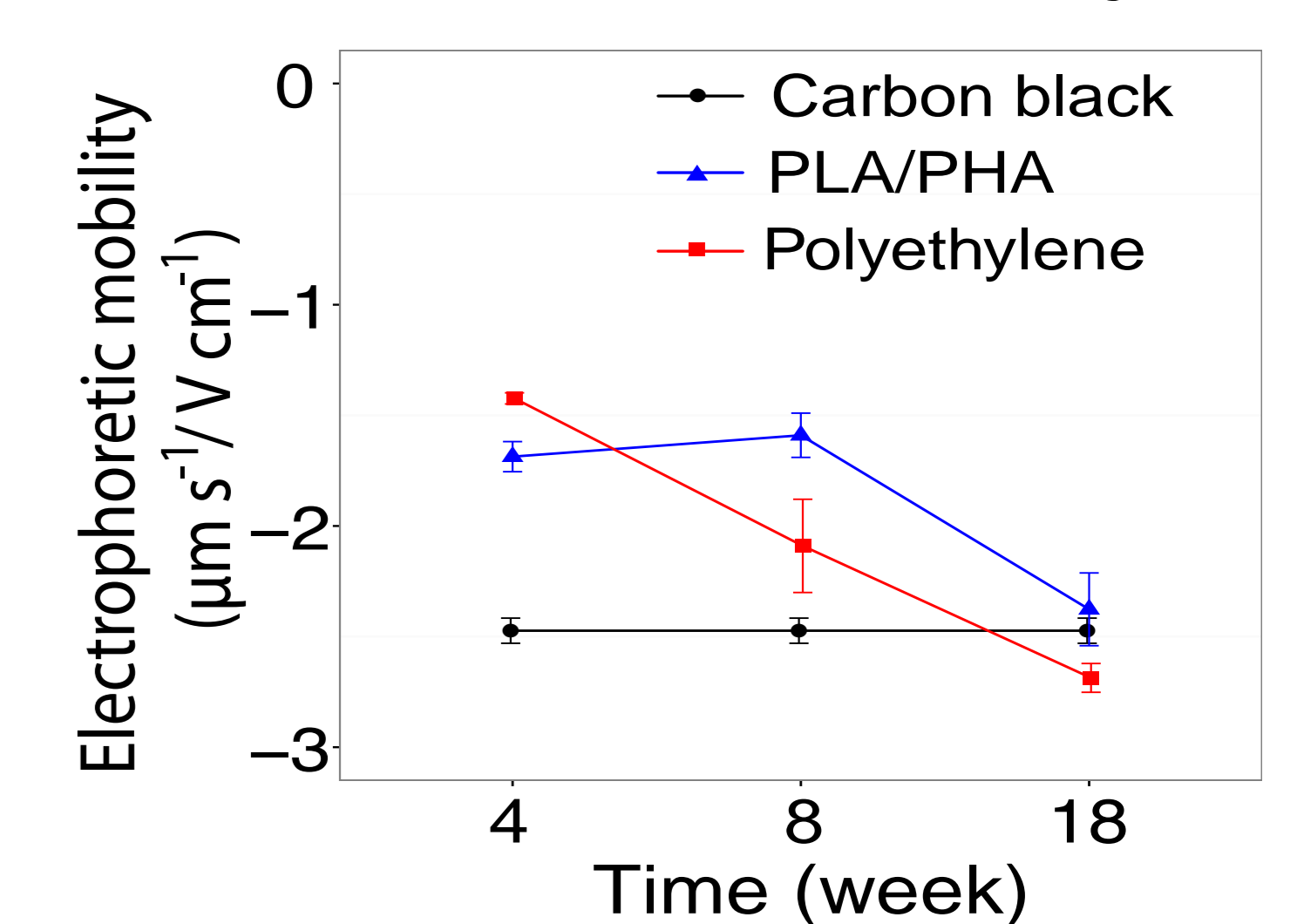
- ▶ Minimal degradation of PLA/PHA in soil
- ▶ >99% degradation of PLA/PHA after 18 weeks of composting

Results: Release of Micro-residue

Electron Microscopy:



Electrophoretic mobility:



- ▶ Micro-residues observed after composting for 18 weeks
- ▶ Some micro-residues may be carbon black

Conclusions

- ▶ Microclimate of biodegradable plastic mulch comparable to polyethylene mulch
- ▶ Incomplete breakdown of biodegradable plastic mulch

Acknowledgement

