Extending Your Growing Season with High Tunnels and Biodegradable Mulches

Annette Wszelaki

Commercial Vegetable Specialist

Topics to Cover

- Maximizing your tunnel for profit
- Beyond yield in tunnels
- New crop for tunnels
- Biodegradable mulches

Maximizing Your Tunnel for Profit

Potential Sales from a 30' x 96' Spring Planted High Tunnel

Before we look at potential sales, there are a few things to keep in mind:

- Your expertise (or lack thereof!)
- Your market and your marketing skills
- Fertility of your high tunnel
- Weather patterns
- Staying on top of plant management-
  - Irrigation, weed control, insect control, trellising, suckering

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Lay-out for 30' wide high tunnel using wide beds

- Beds against the side walls are 30" wide with 3 rows of drip tape 8" spacing starting at 9" in from toe-board
- All aisle ways are 15" wide (for those with big feet!)
- There are 5 – 42"-wide beds with 4 rows of drip tape on 10-1/2" spacing, starting 5" in from edge of aisle **or**
- You can lay 5 rows of drip tape on 9" centers, starting 4" in from the edge of the aisle

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Outside Bed Along Toe board – 30 inches wide

Aisle way – 15 inches wide

Bed #1 – 42 inches wide

Aisle way – 15 inches wide

Bed #2 – 42 inches wide

Aisle way – 15 inches wide

Bed #3 – 42 inches wide

Aisle way – 15 inches wide

Bed #4 – 42 inches wide

Aisle way – 15 inches wide

Bed #5 – 42 inches wide

Aisle way – 15 inches wide

Outside Bed Along Toe board – 30 inches wide

Calculating Potential Profit per Crop

- (Row feet x rows of drip tape)/in-row spacing = # of units of crop (heads of lettuce, carrots, beets, tomatoes, etc.)
- (# of units x % harvestable x # of harvests)/ quantity for market bundle = # of market bunches
- # of market bunches x price per bunch= Potential $$$ per crop

Examples:

Beets:
(24 row feet x 6 rows (3 rows of drip tape, plant a row on either side))/1.5" (0.125') in-row spacing = 1,152 beets

(1,152 beets x 80% harvestable x 1 harvest)/6 beets/bunch = 150 bunches

150 bunches x $1.50 per bunch = $225.00

150 bunches x $3.00 per bunch = $450.00

Options: Make 2 plantings about 2 to 3 weeks apart to spread out harvest giving you 25 bunches a week for 6 weeks

Examples:

Swiss Chard:
(24 row feet x 3 rows of drip tape)/8" (0.66') spacing = 108 plants

(108 plants x 2 leaves per plant per week x 100% harvestable x 8 weeks (harvests)) /16 leaves per bunch = ~14 bunches/week for 8 weeks or 112 bunches

112 bunches x $1.50 per bunch = $168.00

112 bunches x $3.00 per bunch = $336.00

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Examples:

Tomatoes:
90 row feet x 1 row drip x 22" (1.83') spacing = 50 plants

50 Bush Early Girl x 3.5 pounds/week x 80% marketable x 3 weeks per plant = 420 lbs

420 lbs x $2.50 per lb = $1,050.00

420 lbs x $4.00 per lb = $1,680.00

24 assorted cherry plants x 5 weeks x pint per plant per week = 120 pints

120 pints @ $2.50 per pint = $300.00

120 pints @ $4.00 per pint = $480.00

Potential Sales from a 30' x 96' Spring Planted High Tunnel

Remember, there are a few things to keep in mind:

- Your expertise (or lack thereof!)
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- Fertility of your high tunnel
- Weather patterns
- Staying on top of plant management-
  - Irrigation, weed control, insect control, trellising, suckering

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Many thanks to
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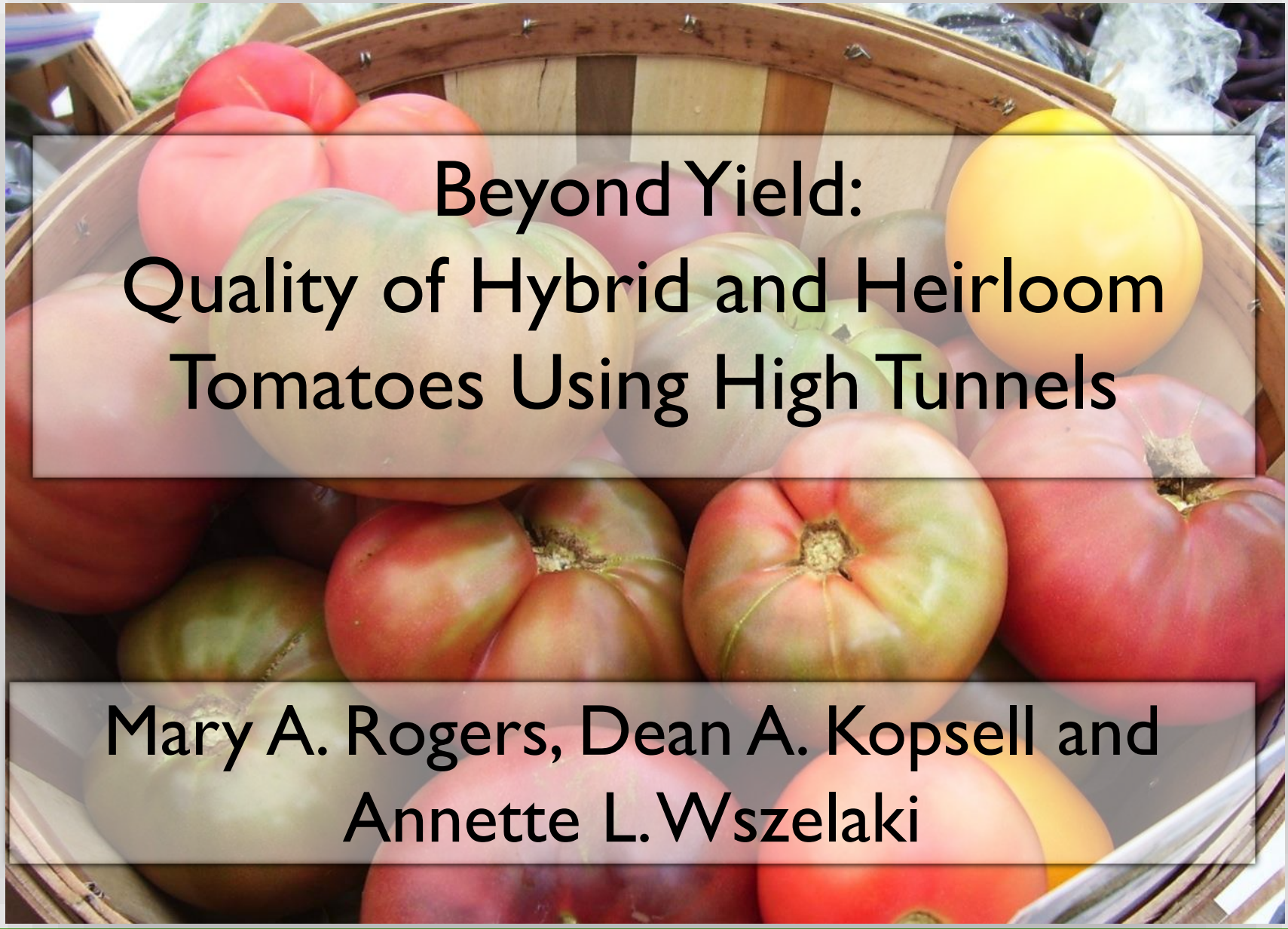
for generously sharing their
slides and insight!

http://aunaturelfarm.homestead.com/



Beyond Yield: Quality of Hybrid and Heirloom Tomatoes Using High Tunnels

Mary A. Rogers, Dean A. Kopsell and Annette L. Wszelaki

Methods

- Planting dates: 27-Mar, 17-Apr & 7-May (2009 & 2010)
- Three replicates grown in high tunnels and in open field plots, managed organically
- Pre-plant with mushroom compost (124 lbs of N/acre) and fertigate with fish emulsion (3.5 lbs of N/acre)

Varieties

Heirlooms

'Arkansas Traveler'

'Cherokee Purple'

'Valencia'

Hybrids

'BHN 589'

'Fletcher'

'Primo Red'

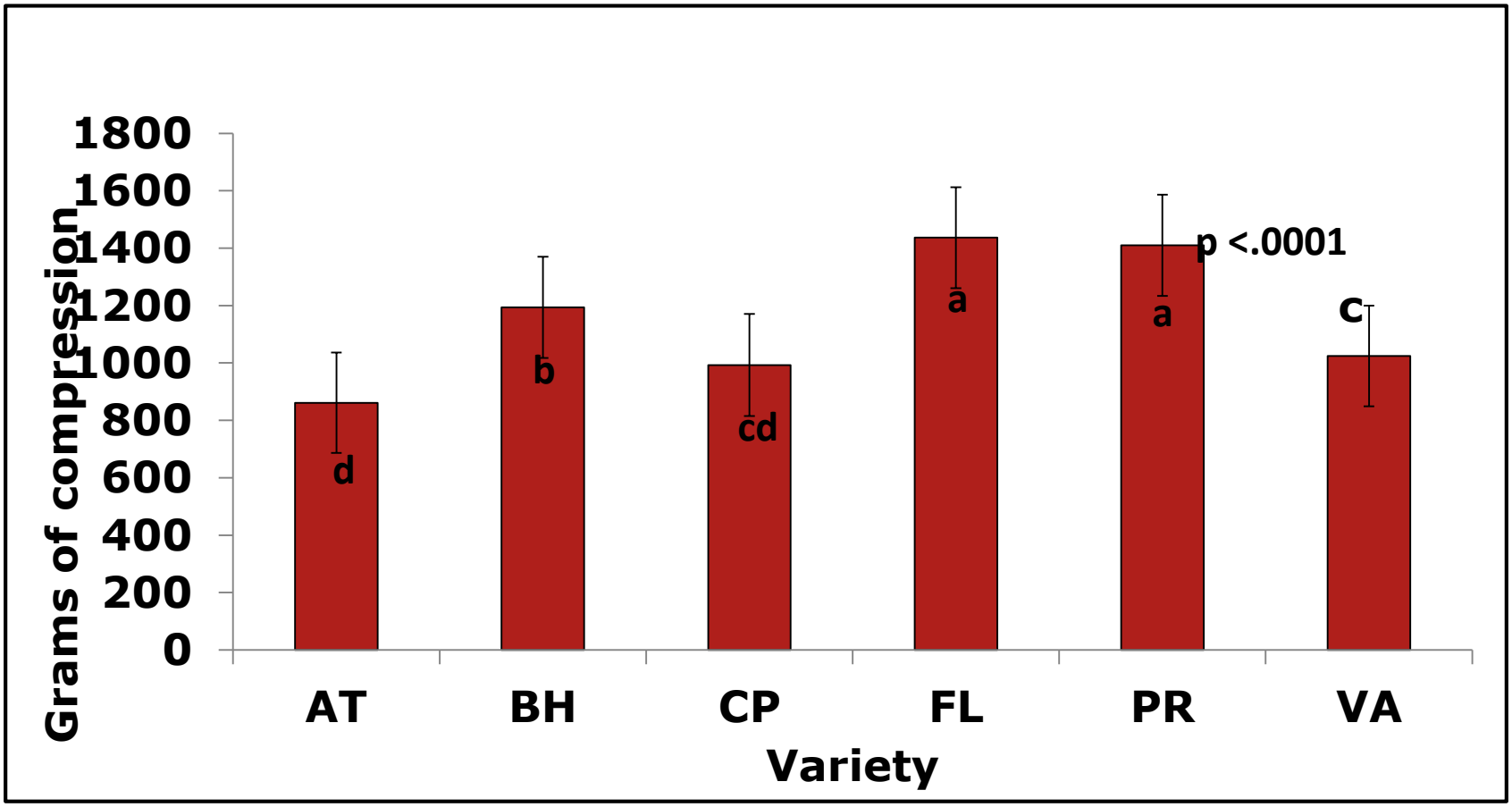
Photo credits: 'Arkansas Traveler': www.back40farmandgarden.com/; 'Cherokee Purple': www.flowerdalenurseries.blogspot.com; 'Valencia': www.seedsofchange.com; 'BHN 589': www.abcgrow.com; 'Fletcher': http://www.reimerseeds.com; 'Primo Red': www.growingproduce.com

Quality Assessment

Tested three vine-ripe, marketable fruit per plot from the third fruit cluster from the bottom of the plant

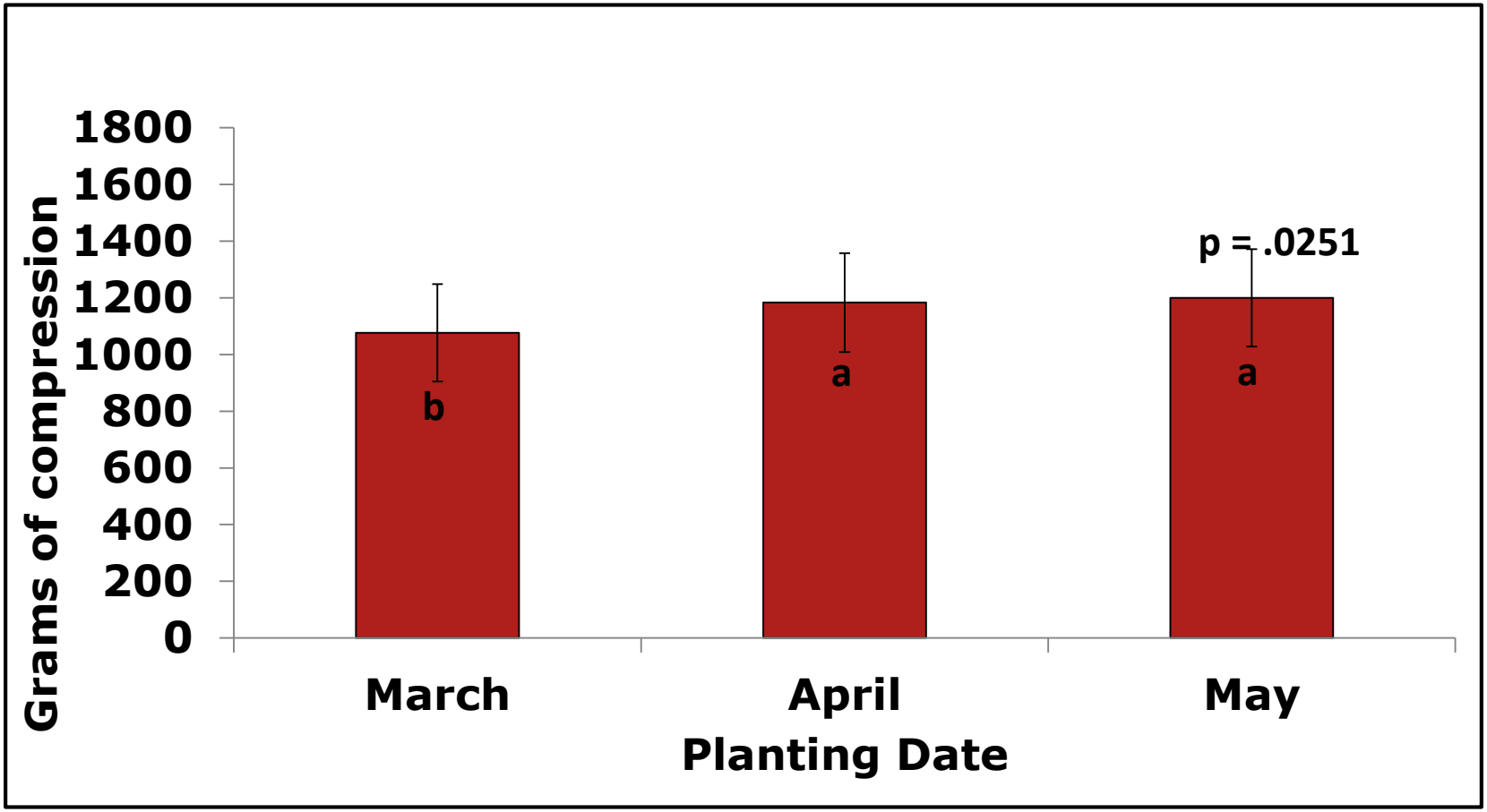
- Skin color
- Firmness
- Soluble solids
- Titratable acidity
- Lycopene content

Results: Firmness



Analysis was done using Mixed Models ANOVA (SAS 9.3); $\alpha = 0.05$

Results: Firmness



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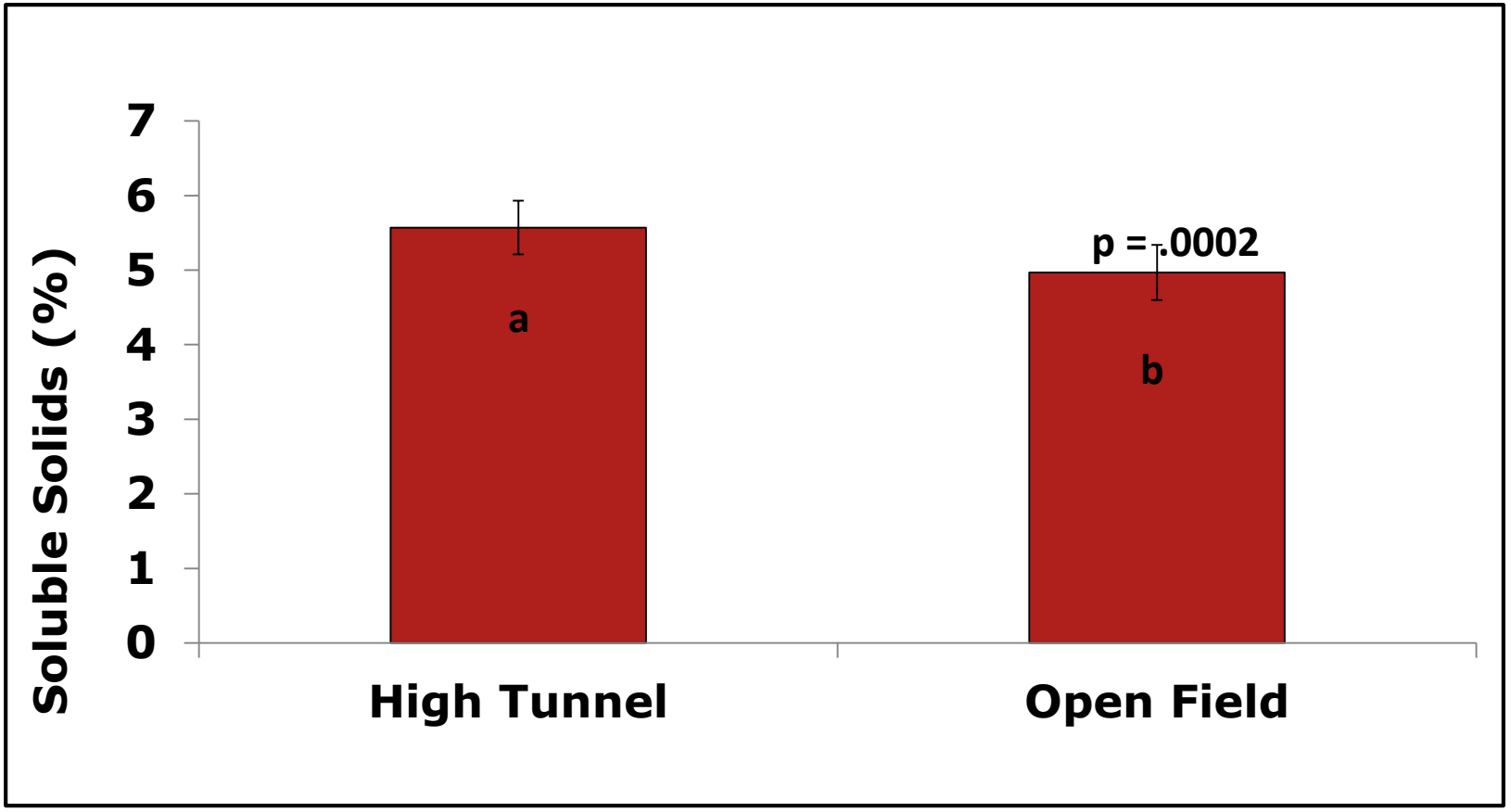
Results: Soluble Solids



Analysis was done using Mixed Models ANOVA (SAS 9.3); $\alpha = 0.05$

Results: Lycopene

Variety	Lycopene (mg/100 gfw)	
	High Tunnels	Open Field
Arkansas Traveler	2.67 **d**	3.47 **cd**
BHN 589	3.39 **cd**	3.75 **bcd**
Cherokee Purple	7.07 **a**	4.42 **bc**
Fletcher	4.93 **b**	2.86 **d**
Primo Red	2.80 **d**	1.32 **e**
Valencia	0.00 **f**	0.00 **f**
TRT	p = .0032	
VAR	p <.0001	
TRT*VAR	p = .0018	

Analysis was done using Mixed Models ANOVA (SAS 9.3); $\alpha = 0.05$ (Data reported for 2009 only)

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Transplanted on June 17th – about 3 weeks late!
Slide courtesy of Paul and Alison Wiediger, Au Naturel Farm

First top dressing and hilling
July 5th

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Au Naturel Farm

Slide courtesy of Paul and Alison Wiediger,
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September 29th


First harvest
Slide courtesy of Paul and Alison Wiediger,
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Harvest from 6 row feet on September 29th

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Ginger
October 11th

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Harvest from
December 10th
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Au Naturel Farm

Ginger Production – Key Points

- Pre-sprout before planting
- Hungry crop – needs both food and water
- Soil temps between 55 and 90 degrees F
- Needs to be hilled – 2 or better yet, 3 times
- Top dress when hilling
- Water deep before it gets dry – at least 2X per week
- In warmer climates will need shading

Slide courtesy of Paul and Alison Wiediger, Au Naturel Farm


Ginger available from
Hawaiianorganicginger.com
Slide courtesy of Paul and Alison Wiediger,
Au Naturel Farm

Many thanks to
Paul and Alison Wiediger
for generously sharing their
slides and insight!

http://aunaturelfarm.homestead.com/

Do biodegradable mulches have a place in your production system?

Annette Wszelaki[1], Jennifer Moore[1],
Carol Miles[2] and Shuresh Ghimire[2]

[1]Department of Plant Sciences, University of Tennessee
[2]Department of Horticulture, Washington State University

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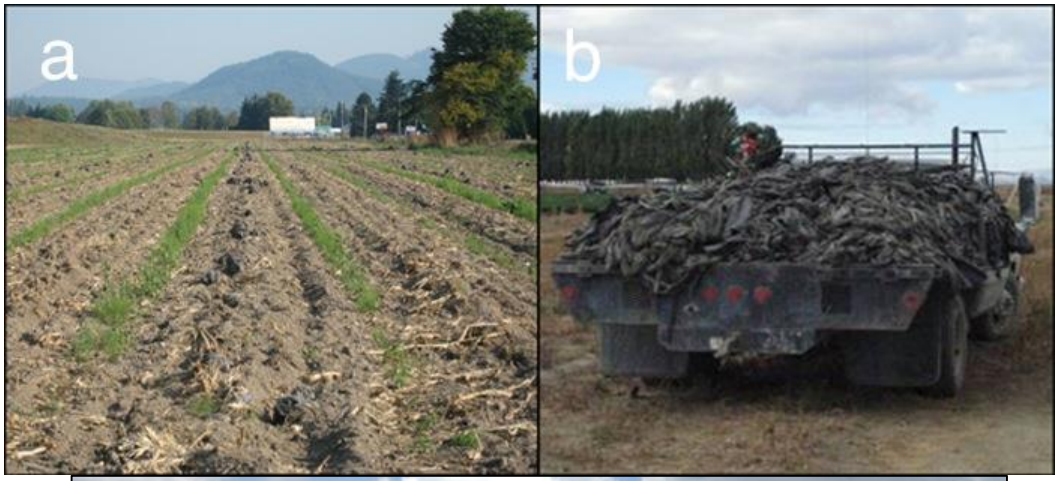
Benefits of Plastic Mulch

- Weed management
- Reduces some diseases and insect pests
- Warms soil in spring
- Increases yield
- Reduces erosion
- Hastens time to harvest
- Conserves moisture
- Increases crop quality
- More efficient use of water and fertilizer
- Reduces soil compaction
- Efficient double or triple cropping

Problems with Plastic Mulch

- Need for removal and disposal
- Disposal cost is $145-236/ac (Galinato et al., 2012)
- Generally not all plastic is removed
- Issue of sustainability
- Decrease soil productivity, water quality
- Overall environmental hazard



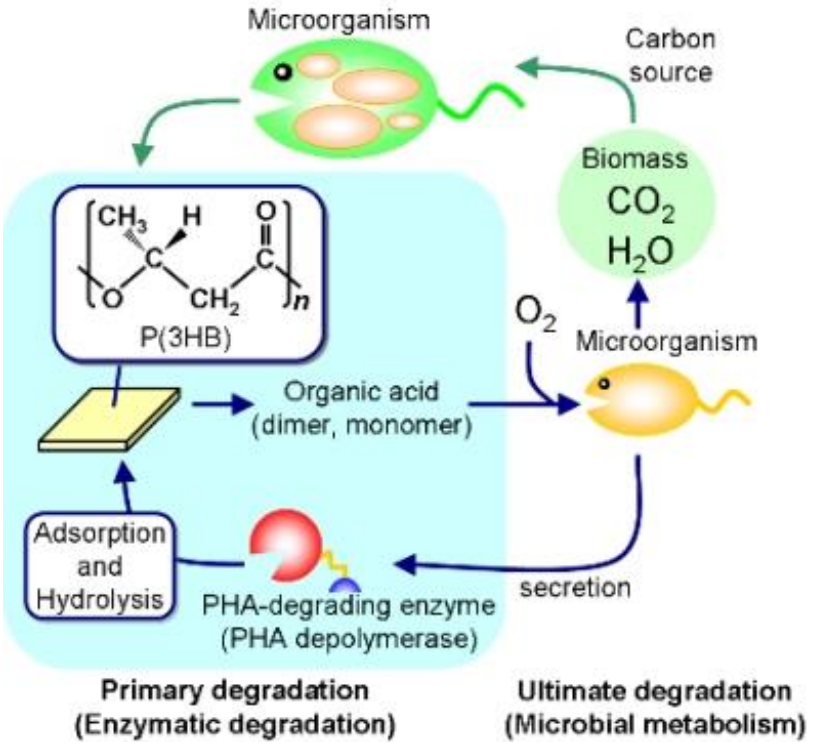
Biodegradable Plastic Mulch

Has the potential to be a sustainable technology if it:

- Provides equal benefits as plastic mulch
- Reduces labor costs for removal and disposal
- Reduces landfill waste
- Completely biodegrades
- Causes no harm to soil ecology or environment

What does biodegradable mean?

- Capable of being broken down via microbial activity
- Complete biodegradation (i.e., mineralization) refers to the oxidation of the compound to carbon dioxide and water
- Biodegradation provides carbon as a source of food for the growth and reproduction of microorganisms



Source: Numata, 2009

Biodegradable and Biobased

Biodegradable: Microbial activity that results in CO_2, H_2O and microbial biomass

Biobased: Feedstocks derived from renewable resources (plant and/or animal mass) via biological processes

Biobased ingredient that doesn't biodegrade in soil: PLA[1]

Synthetic ingredients that biodegrade in soil: PCL, PBS, PBAT

[1] Probably would degrade over 10+ years if thin enough; passes ASTM/ISO compostability standard

Biobased Content

Feedstocks derived from renewable resources (plant and/or animal mass) via biological processes

- Certified biobased by measuring level of ^{14}C, indicates recent fixation via photosynthesis *ASTM D6866*

USDA NOP memo July 24, 2015

- Report by OMRI, June 5, 2015: current biodegradable mulch films contain 10-20% biobased feedstock
- Remaining content includes polymers derived from fossil fuels, dyes, mineral and in some cases heavy metals

USDA NOP Rule

Effective October 30, 2014, final rule added **biodegradable biobased mulch film** to list of allowed substances (USDA organic regulation *7 Code of Federal Regulations section 205*)

- To be considered biobased and biodegradable, a mulch film MUST:
  1. Be biobased *ASTM D6866*
  2. Reach ≥ 90% biodegradation in soil within 2 years *ISO 17556* or *ASTM D5988*
  3. Meet compostability specifications of *ASTM D6400*, *ASTM D6868*, *EN 13432*, *EN 14995*, or *ISO 17088*
- Must be produced without organisms or feedstock derived from excluded methods (i.e., synthetic, GMO)
- Must be produced without the use of non-biobased synthetic polymers; minor additives (colorants, processing aids) not required to be biobased

What are we lacking?

- Better understanding of biodegradation of commercially available mulches in different climates
- Information on mulch accumulation after multiple applications
- Technology to measure mulch biodegradation in soil
- Good agriculture practices to hasten mulch biodegradation

http://biodegradablemulch.org

Performance and Adoptability of Biodegradable Plastic Mulch for Sustainable Specialty Crop Production

Funded by USDA-NIFA through Specialty Crop Research Initiative (SCRI)

Experiments at Knoxville, TN and Mount Vernon, WA

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USDA United States Department of Agriculture National Institute of Food and Agriculture

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USDA SCRI BDM Project

- Evaluate impacts of repeated use on agricultural soil ecosystem (soil quality, microbial communities, carbon storage)
- Identify degradation mechanisms and interrelationships among life-cycle stages: fossil fuel-derived or biobased, role of weathering, soil degradation or composting
- Evaluate degradation in diverse climates to improve performance and evaluation methods
- Compare results of lab-scale standardized tests for biodegradability and weathering with results from field studies
- Identify potential crop weed, disease and insect pest problems

USDA SCRI BDM Project (contd)

- Identify supply chain steps with focus on economic relevance and feasibility, regulation, and farmer's perceptions to elucidate bridges and barriers to adoption
- Educate farmers, intermediaries, consumers and the general public on BDMs, biodegradation, and biobased plastics
- Interact with consumers, farmers, intermediaries, regulators, composters, and scientists to increase interest in sustainable use of BDMs
- Educate and train students, research associates, and scientists on skills needed to work on transdisciplinary research problems

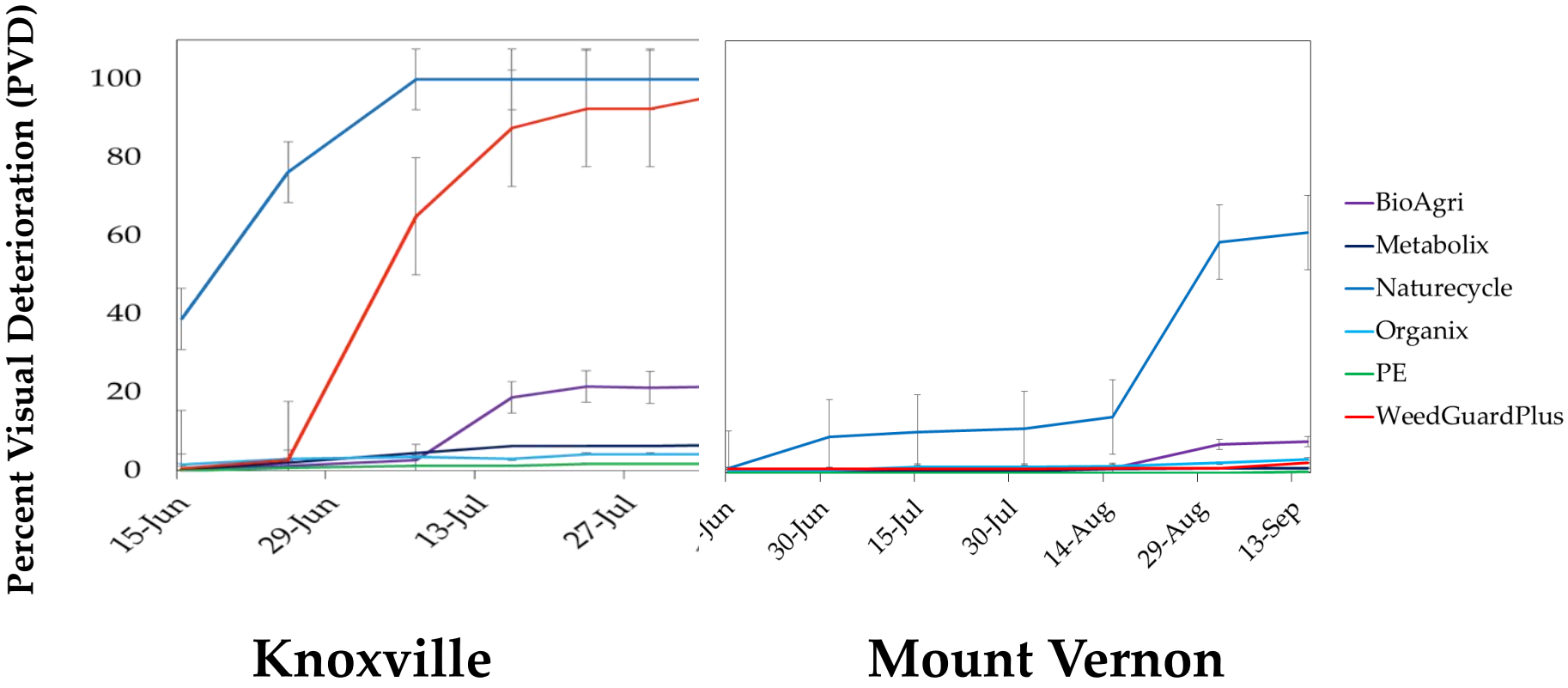
Project Design

- Two locations: Knoxville, TN & Mount Vernon, WA
- 'Cinnamon Girl' pie pumpkin
- 30 ft plots of 5 rows each, replicated 4 times
- Seeded direct: 15 June Knoxville
- Transplanted: 28 & 29 May Mount Vernon
- Harvested: 14 Sept. Knoxville
  16 Sept. Mount Vernon
- Eight treatments

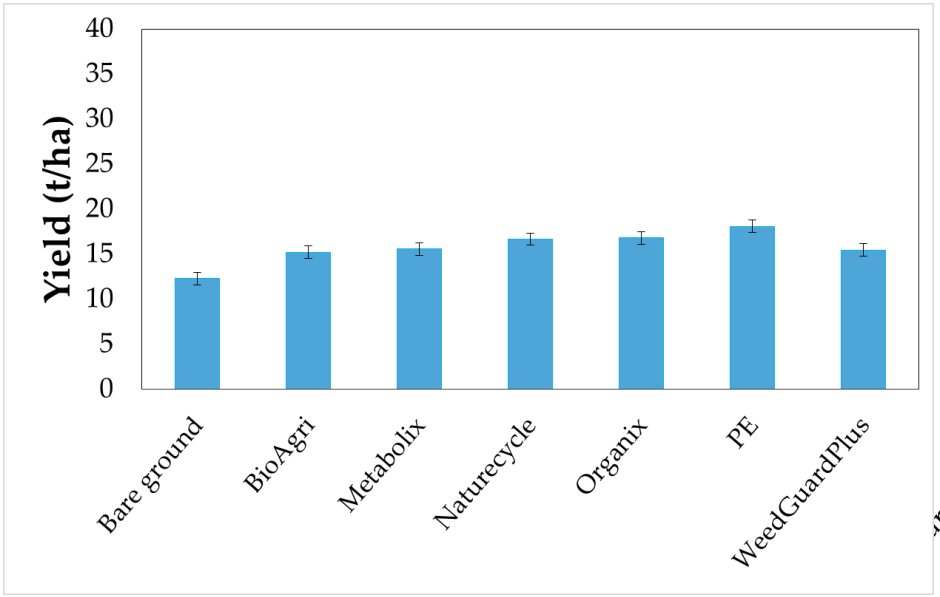
Mulch Products in Experiment

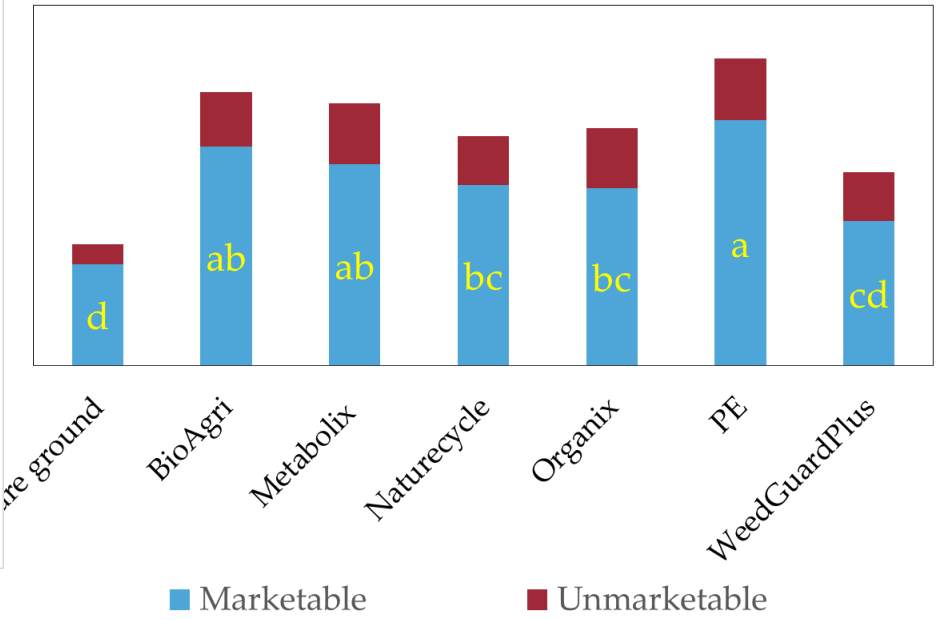
Trt.	Mulch Product	Company	Width (In.)	Thickness (mm)
1	Bare ground			
2	Polyethylene plastic	FilmTech Corp.	48	0.0254
3	Weed Guard	Sunshine Paper Co.	48	0.24
4	BioAgri	BioBag USA	48	0.018
5	Naturecycle	Custom Bioplastics	48	0.0254
6	Organix	BASF/Organix Ag.	48	0.0177
7	Experimental	Metabolix	48	0.0381
8	BioAgri Removed	BioBag USA	48	0.018

2015 Preliminary PVD



2015 Preliminary Yield

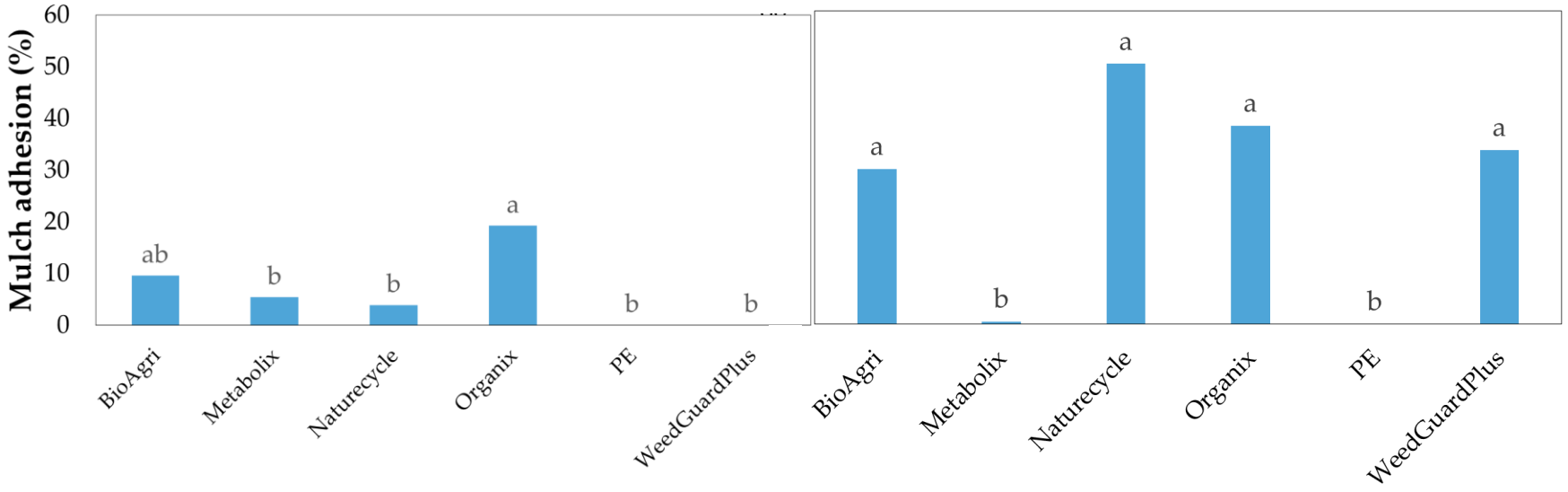




Knoxville **Mount Vernon**

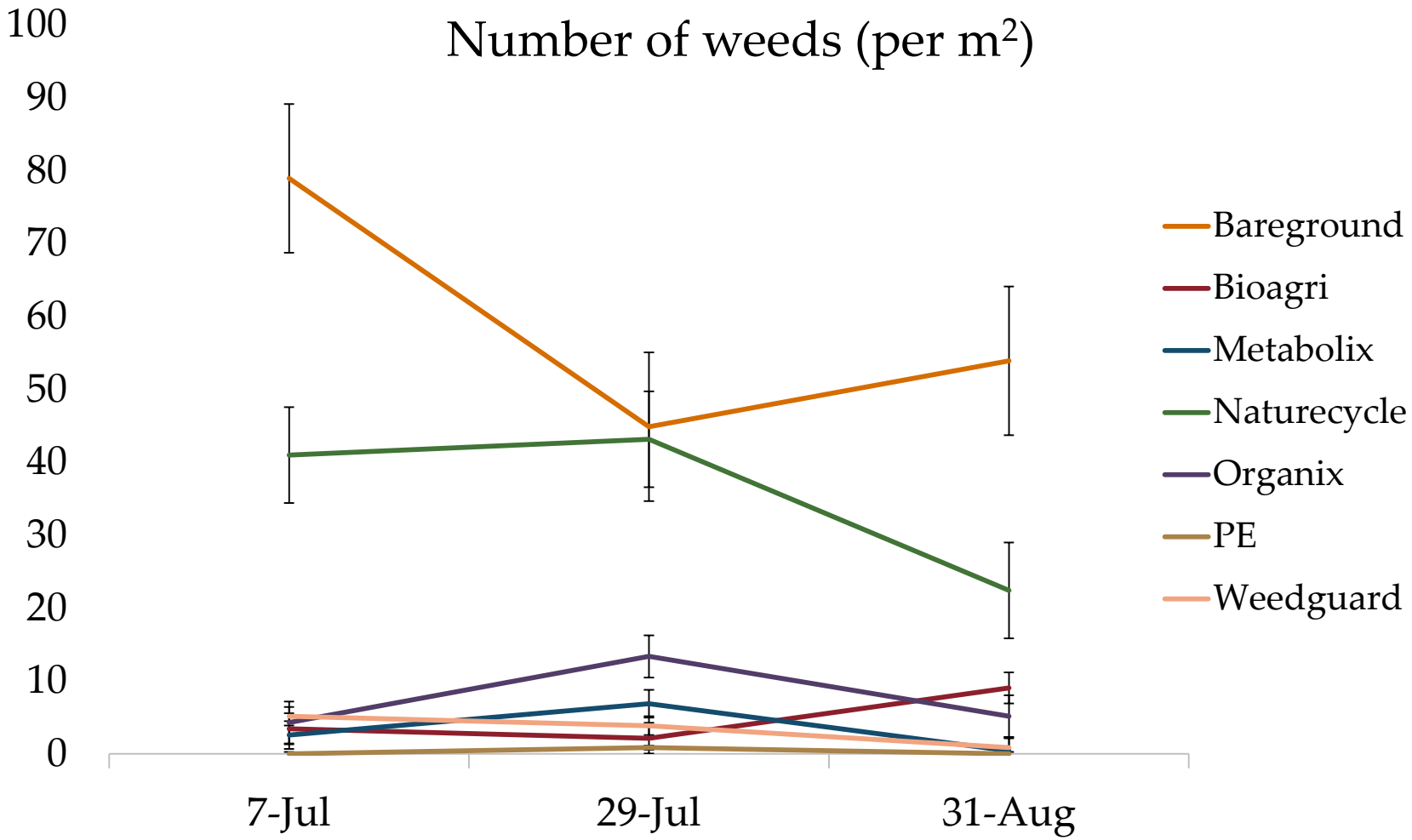
Mulch Adhesion

2015 Preliminary Mulch Adhesion



Knoxville **Mount Vernon**

Preliminary Data: TN Weeds



Preliminary Weeds Information

Predominant weeds in TN:

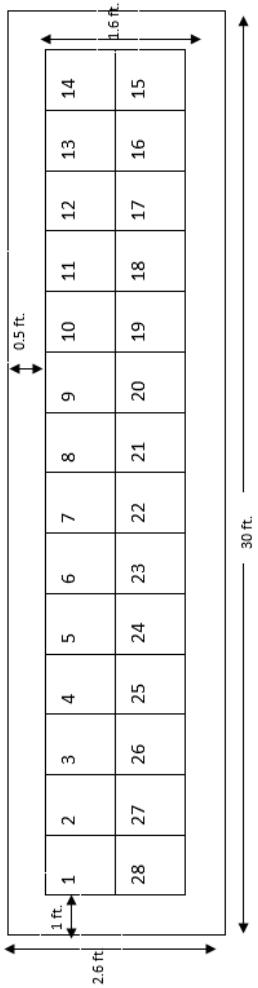
1. Nutsedge
2. Carpetweed
3. Goose grass
4. Annual bluegrass
5. Crabgrass

Predominant weeds in WA:

1. Pigweed
2. Chickweed
3. Grass (assorted)

Mulch Soil Incorporation

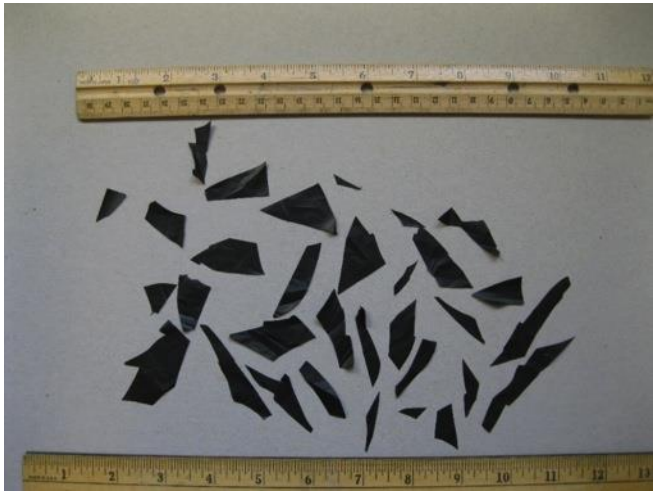
Soil Sampling BDM Post Tillage



Collecting BDM

Measuring BDM Area

1. Graph paper



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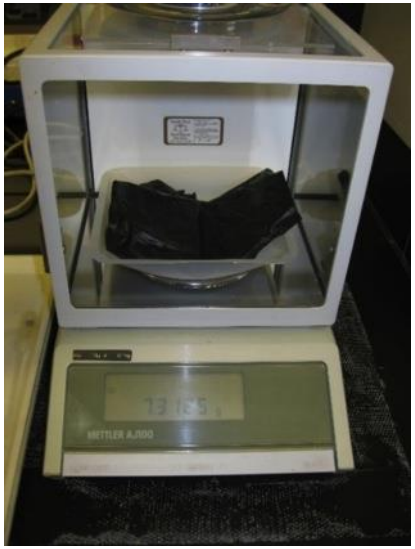

3. Weight

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MT: Eric Belasco

For more information: www.biodegradablemulch.org

USDA United States Department of Agriculture National Institute of Food and Agriculture

UTIA Institute of Agriculture The University of Tennessee

Washington State University

Montana State University

Thank you!

Questions?

annettew@utk.edu

http://organics.tennessee.edu

http://vegetables.tennessee.edu