Biofumigation And Reduced Tillage For Managing Phytophthora And Other Soil-borne Pathogens

Margaret Tuttle McGrath

Cornell University, School of Integrative Plant Sciences
Plant Pathology and Plant-Microbe Biology Section
Long Island Horticultural Research and Extension Center
Riverhead, New York. mtm3@cornell.edu

Sandra Menasha

Cornell Cooperative Extension – Suffolk County
423 Griffing Ave, Suite 100, Riverhead, New York

Phytophthora Blight

Biofumigant Mustard Cover Crop

Lots of bees and beneficials.

Select variety high in glucosinolates.

Plant in early spring or fall. 10 lb/A.

50-100 lb/A N.

Drill or broadcast.

Incorporate after 5-6 weeks flowering:

- Flail chop well early in day when coolest.
- Incorporate asap.
- Seal surface.
- Plant >1 week later.

Biofumigant Mustard Cover Crop

> 5-ft tall
1 July 2008

Effective for:

nematodes,
Phytophthora,
Pythium,
Rhizoctonia,
Sclerotinia,
Fusarium, and
Verticillium

Research 2008

Variety: Caliente 199
10 lb/A = $45 (current)
6 May Drilled Seed
12 June Flowering
7 July Incorporated

7 July 2008:
Chopped, Rototilled, Cultipacked, Irrigated.
23 July 2008:
Seeded zucchini.

Mustard seed immature.

Mustard decomposes:

Glucosinolates

break down into

allyl-isothiocyanate

(methyl isothiocyanate is in Metam Sodium)

Healthy zucchini only after mustard. 8-15-08 Phytophthora blight.

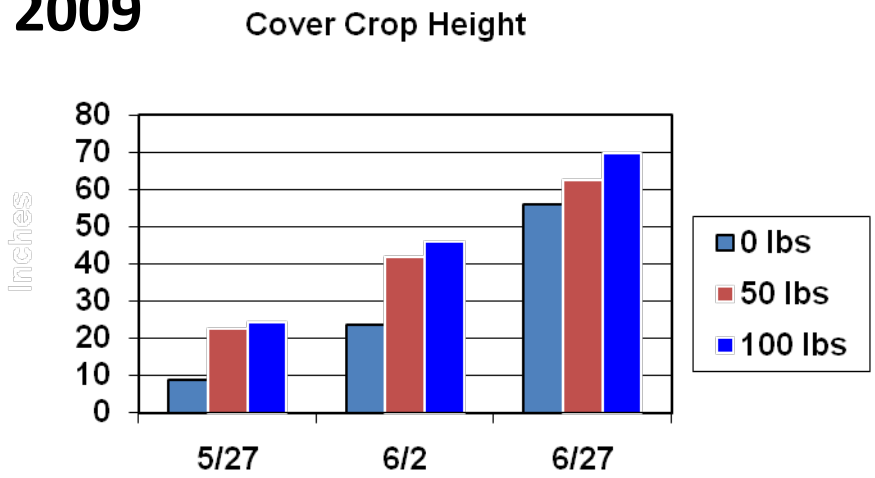

14 Sept 2009

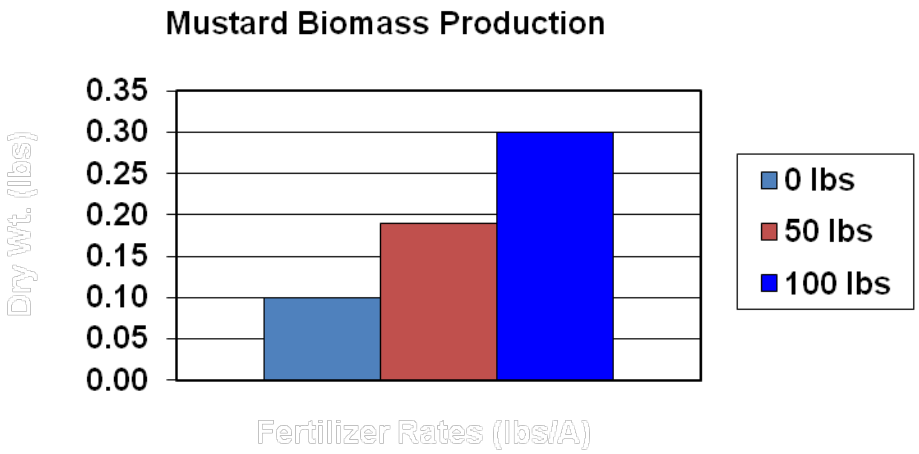
No Mustard Row with Phytophthora Blight

Squash Healthy Following Mustard

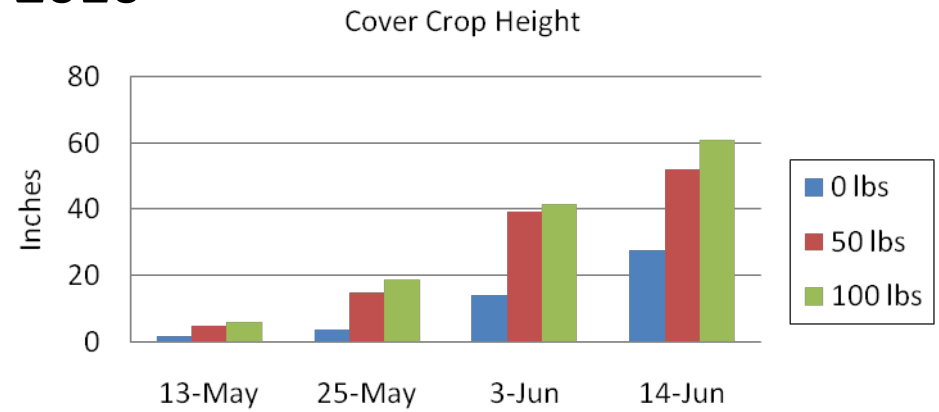
Nitrogen Fertility and Biomass Production

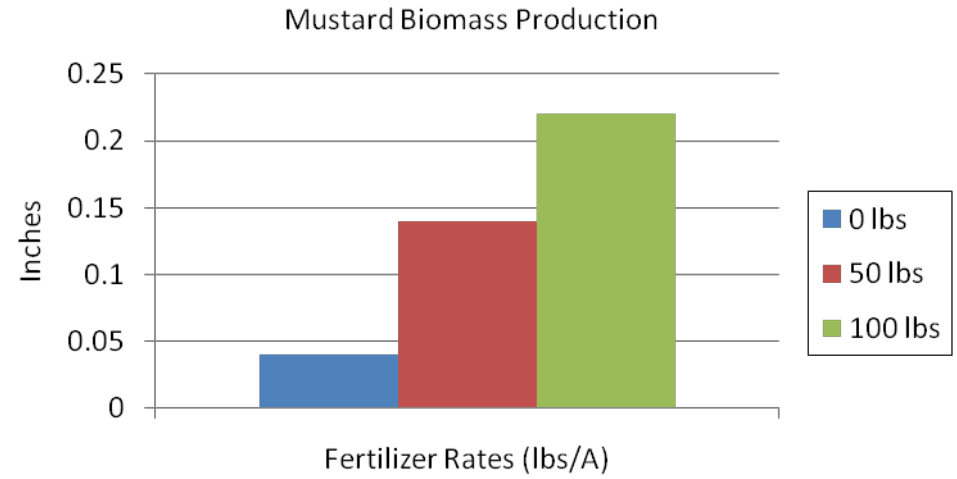
2009





2010

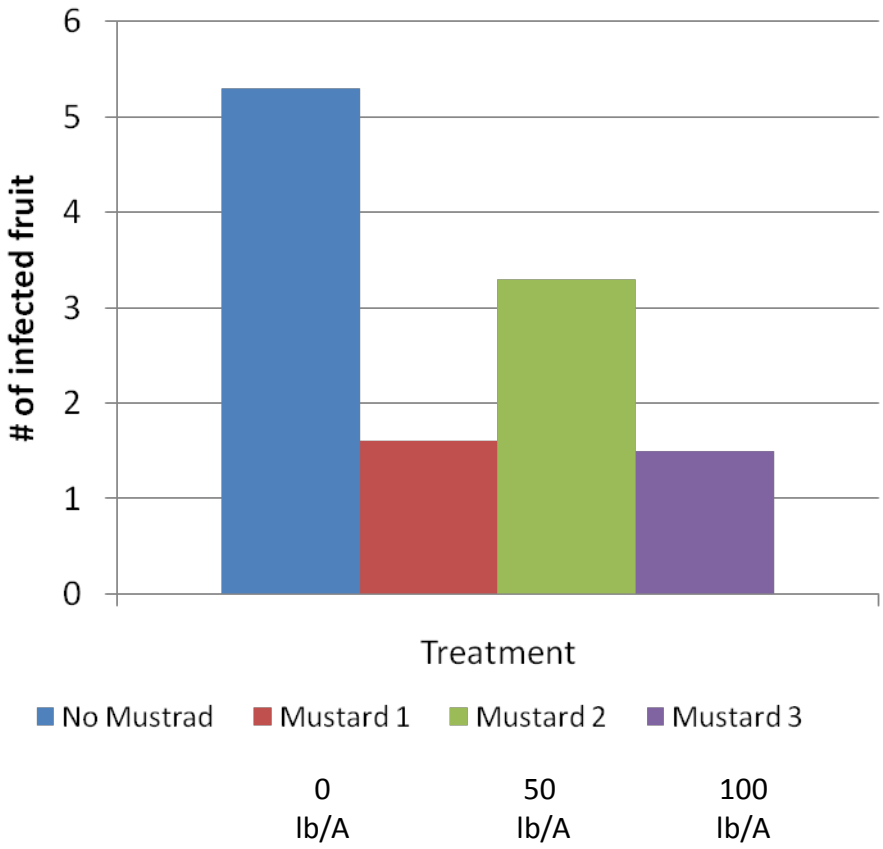




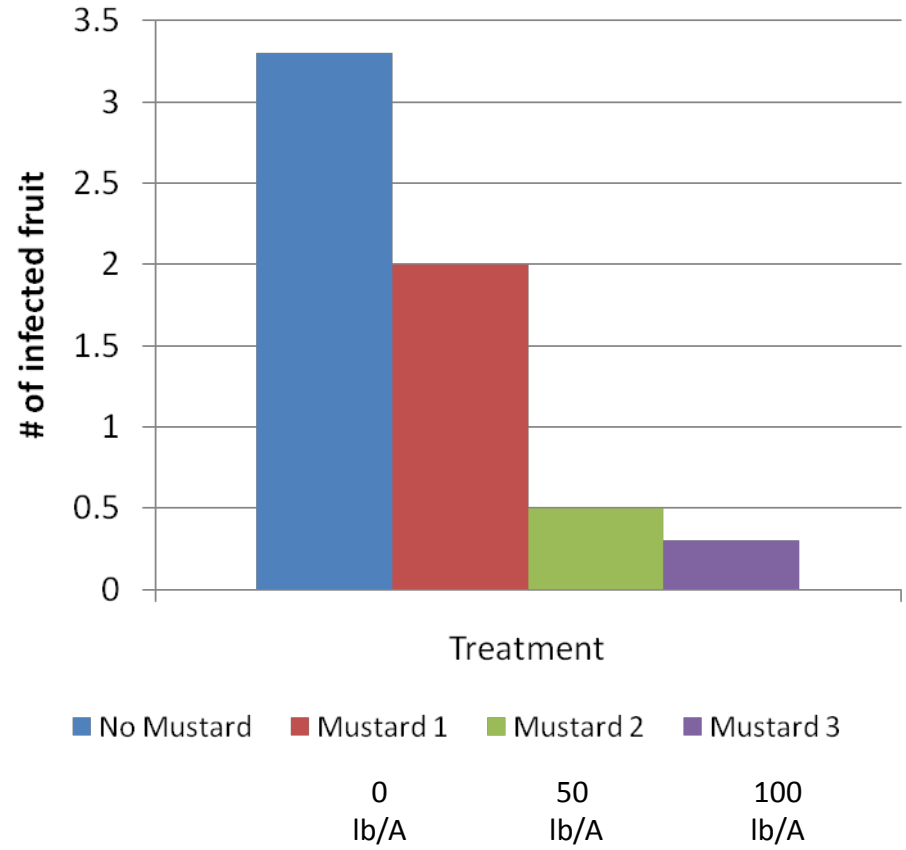
cf. Sandy Menasha

Phytophthora Fruit Rot Incidence

2009



2010



cf. Sandy Menasha

Integrated Management Program in Field with Severe Phytophthora Blight in 2011

Caliente 199 10 lb/A

Goal: incorporate within 20 minutes

4-3-12 seeded mustard

7-3-12 seeded pumpkin

6-12-12

Fungicide Program Implemented 2012

Jul 18	ProPhyt		
Jul 31	Curzate, Presidio, Ranman		
Aug 8	Revus		
Aug 17	Presidio	Sep 7	Forum
Aug 24	Ranman	Sep 14	Presidio
Sep 1	Revus	Sep 21	Presidio

Bravo +/or copper included except Jul 18


8-16-12

Disked about 40 of 350 feet on 8-24-12

Fungicide Program Implemented 2012

Jul 18	ProPhyt		
Jul 31	Curzate, Presidio, Ranman		
Aug 8	Revus		
Aug 17	Presidio	Sep 7	Forum
Aug 24	Ranman	Sep 14	Presidio
Sep 1	Revus	Sep 21	Presidio

Bravo +/or copper included except Jul 18

Oct 17 91% fruit without rot.


Disked End
9-20-12
P cap
Disked End

Commercial Field on Long Island before Pumpkin


Grower commented
‘Can feel soil tilth
improved when disked’

Pumpkin crop after Mustard Biofumigation - Long Island

Commercial Field Dry Spring No Irrigation

Caliente 119 Mustard

Caliente 199 Mustard

Caliente Rojo

Newest mustard release with purplish/red leaves and the highest glucosinolate production currently available. Vigorous growth with high leaf biomass and extensive root system.

Biofumigation - Keys to Successful Disease MGT

Use variety developed for biofumigation.

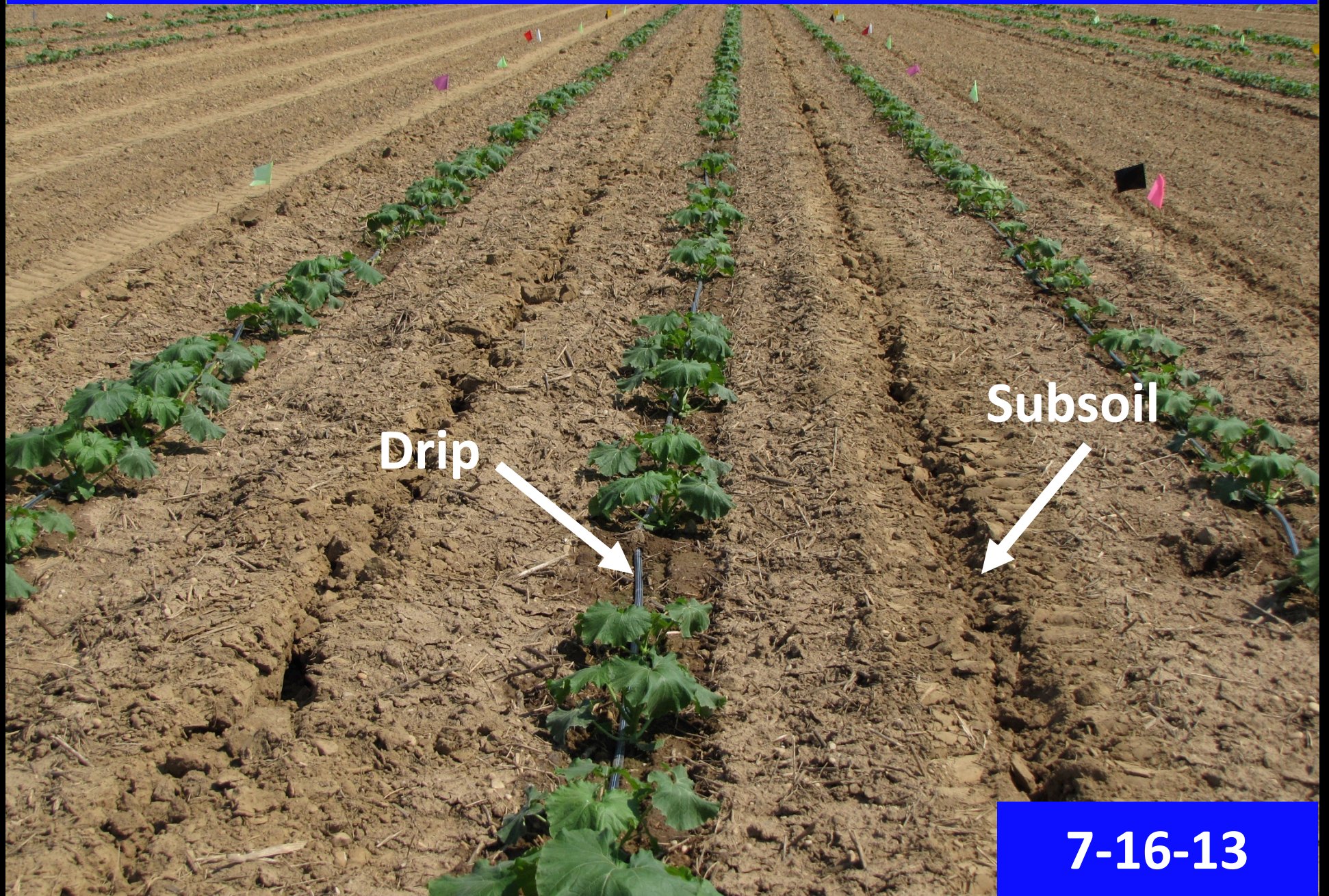
Treat like a cash crop: water, fertilize, etc.

Mustard.

- Plant in spring as soon as can work ground.
- Apply sulfur if soil level low.
- Drill better than broadcasting seed.
- Flail chop well when in full flower; 6 week window.
- Incorporate within 20 min. Seal soil surface. Water.
- Disk before planting crop at least 7 days later.

Use with other management practices for target disease including fungicides.

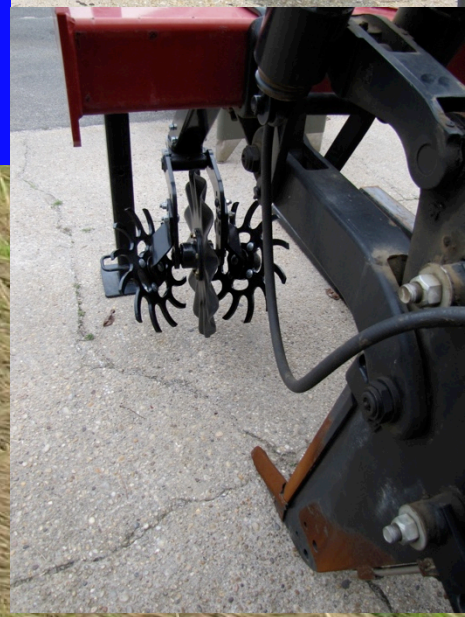
Pumpkin Powdery Mildew Research Field, LIHREC



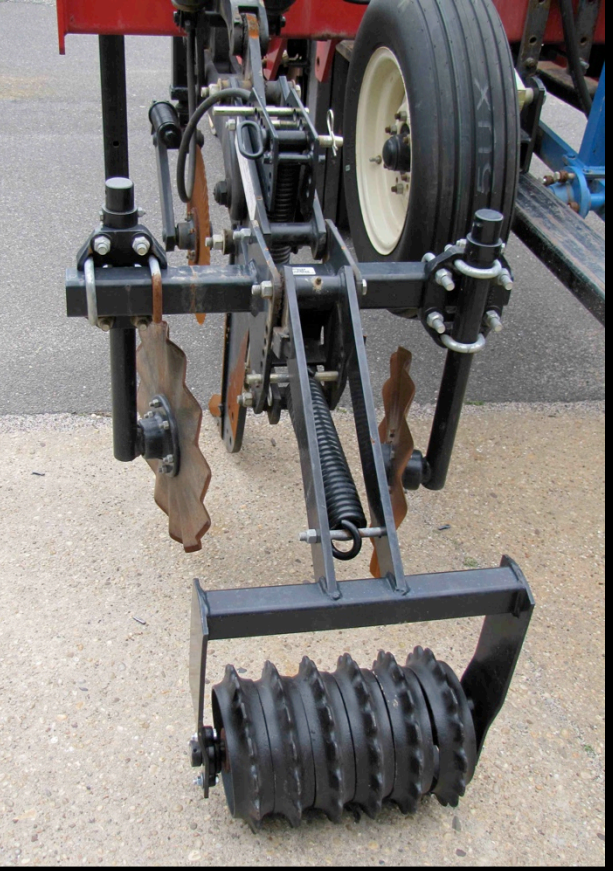
7-16-13

Reduced tillage Research 2004 -

Unverferth Zone-builder

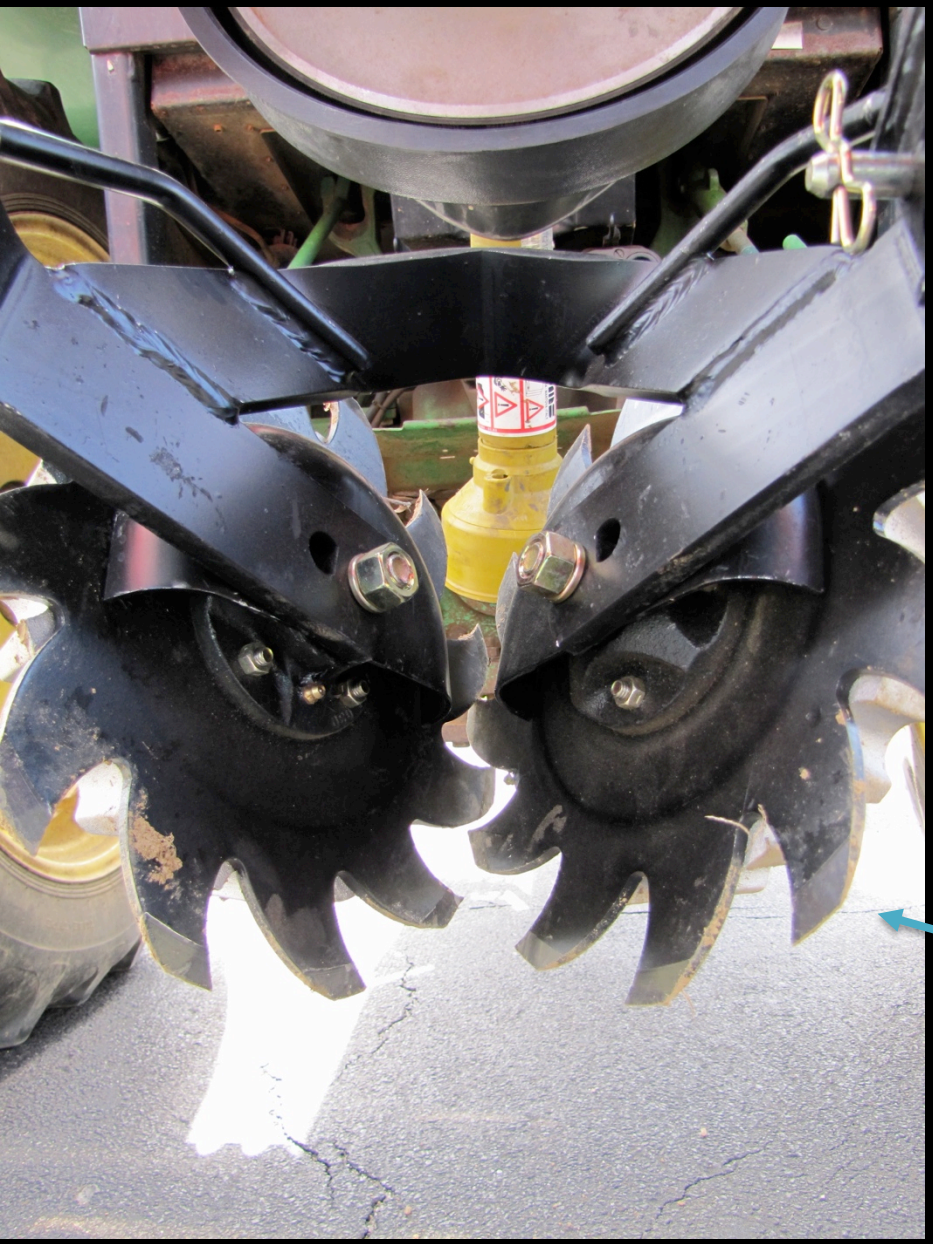



Unverferth
Zone-builder



Adjustments to LIHREC Zone-builder:

1. Cultipacker wheel replacing rolling basket.
2. Row cleaners and wavy coulter on front.



Row cleaners added to seeder.

Potential Impacts of Reduced Tillage on Disease

Positive impacts

Improved soil health and increased activity of beneficial microbes results in more effective biocontrol and conditions less favorable for pathogens.

Pathogen survival structures buried in soil less likely to be brought to the surface.

Disease being managed with reduced tillage: Phytophthora blight.

Potential Impacts of Reduced Tillage on Disease

Negative impacts

Infested plant debris left on soil surface rather than incorporated in soil. Debris in soil breaks down faster and pathogen spore dispersal is hindered.

Diseases of major concern caused by pathogens with long-lived survival structures: ex. white mold.

Reduced-till Pumpkin

Unverferth
Zone-builder
Preparing rows

Commercial Reduced-till Pumpkin Crop on Long Island

Field with long history of pumpkin production and Phytophthora blight. Used reduced till for couple years. No blight in this crop. Blight developed in his U-pik field where reduced till hadn't been implemented.

Commercial Reduced-till Pumpkin Crop on Long Island

Phytophthora Fruit Rot in Reduced-till Crop


ZONE-BUILDER

Previous Crops Here Reduced-till

10-2-12

Phytophthora blight throughout field

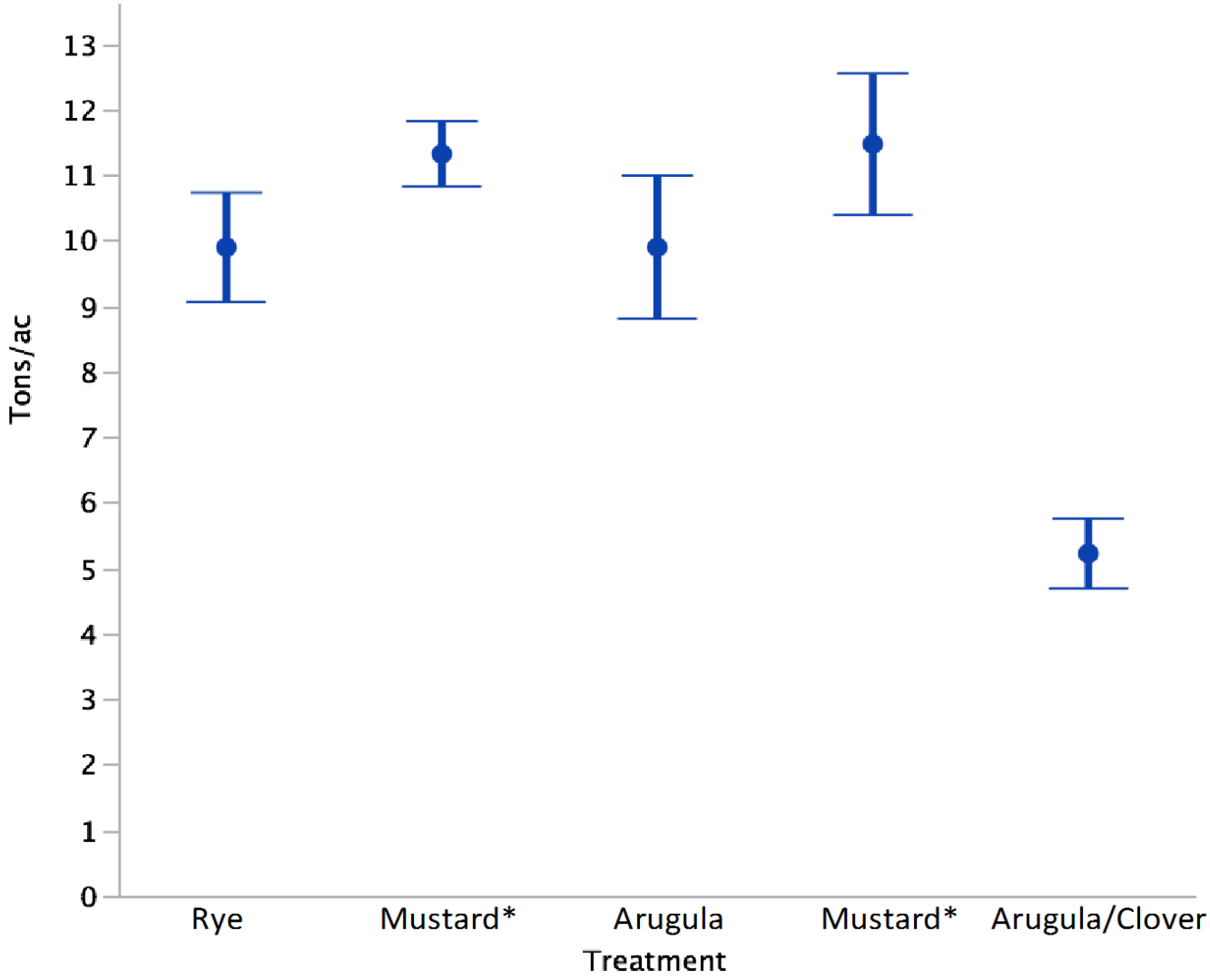
Integrated Phytophthora Blight Management in Vegetable Crops with Enhanced Soil Health From Cover Crops, Reduced Tillage, and Brassica Biofumigation

- Integrated management:
  Current IPM guidelines + biofumigation & reduced tillage
  - Biofumigation reduces inoculum (fumigation, burial)
  - Reduced tillage reduces contact with inoculum
  - Biofumigation + reduced tillage fosters soil health improvement
- 2-year field research component
- 7 on farm trial sites, plot study at LIHREC
- Biofumigation & RT vs. standard practice, C, N returned to soils, infiltration rates
- Year one: Brassica biomass C and N, cucurbit yields

NORTHEAST SARE
Sustainable Agriculture Research & Education

Nemat Arugula

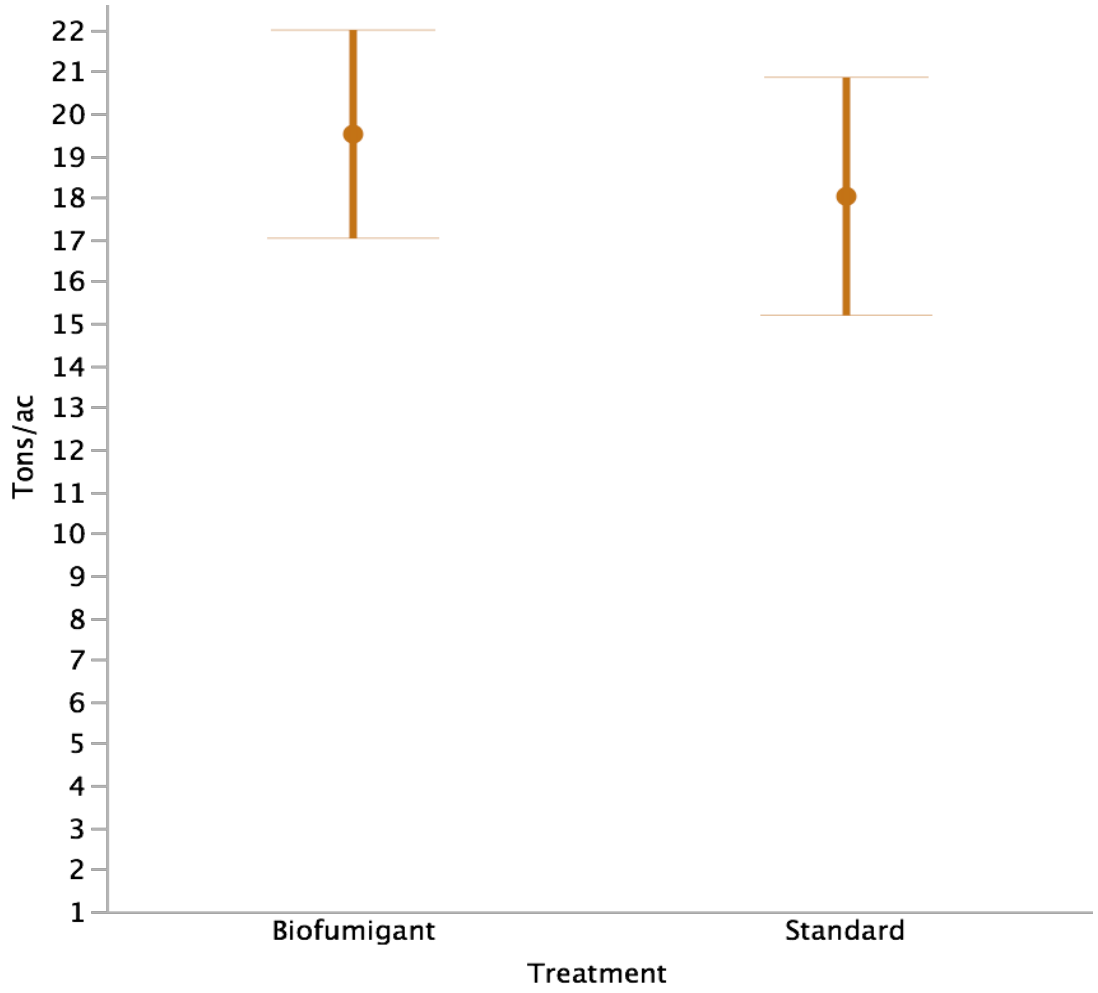
Prelim. data, LIHREC '15: Kubocha yield



Each error bar is constructed using 1 standard error from the mean.

cf. Justin O'Dea

Prelim. data, on-farm '15: Pumpkin yield



cf. Justin O'Dea

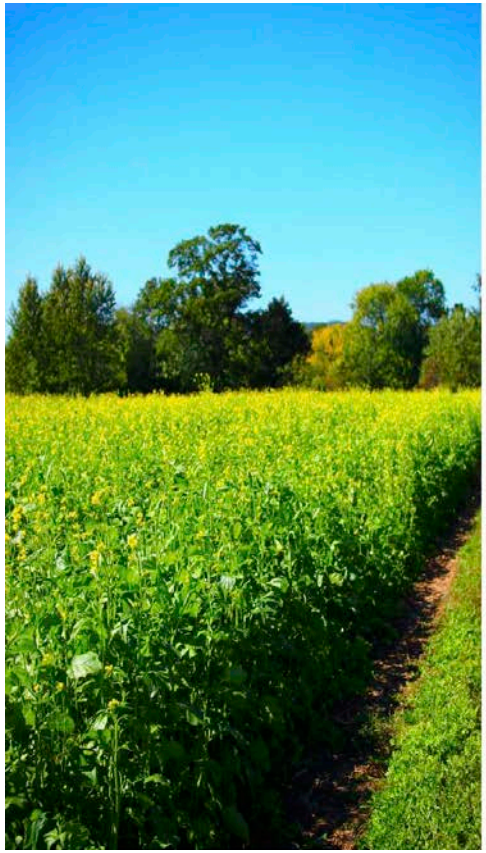
Where(40 rows excluded)
Each error bar is constructed using 1 standard error from the mean.

Prelim. data, on-farm '15: Phytophthora

- A little, but overall, **negligible**!
  - Hypothesis: Generally dry conditions.

2016: Reduced tillage (RT) year

- Ex: **Aug 1-** 'Caliente' mustard **> Oct 1-** biofumigation **> Oct 10-** rye cover **> May-** rolled rye, zone till (RT)



2016 Preliminary observations

- P-cap incidence overwhelmingly where rye mulch layer was thin or absent & allowed fruit/soil contact

Summary

- An integrated approach is recommended
- Longer term studies are needed to determine effects of system on Phytophthora incidence
  - Generally conditions were just not conducive for disease development
- By increasing soil health over time you can sustain yield goals and minimize potential for Phytophthora
  - Improved infiltration
  - Decreasing pathogen populations