Legumes as Orchard Floor Management in Peach

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Challenges Facing Agriculture in Utah and the Intermountain West

- Short growing season
- Cold winters and hot summers
- Arid environment
- Shallow alkaline soils
- Prime fruit growing area
- Under pressure from rapid urbanization

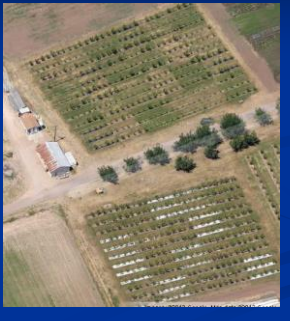
Map used with permission www.utahwild.com

Orchard Treatments

Peach orchards planted 2008 and 2009

Organic orchard		Conventional orchard	
In-row	Alley	In-row	Fertility
Straw mulch	Grass	Bare-ground	NPK
Straw mulch	Legume	Bare-ground	Compost
Living mulch	Grass	Paper	NPK
Living mulch	Legume	Paper	Compost
Tillage	Grass	Transition	
Weed Fabric	Grass		

Organic and Integrated Peach Orchard Trial in Kaysville Utah



Overall Goals

1) Determine extent to which orchard grown legumes can replace the need for external sources of fertilizer and improve soil health.
2) Develop organic production practices suited to fruit growing conditions of Intermountain West.

Orchard Management 2008-2010

- Varieties: Starfire and Coralstar on Lovell rootstock
- Spacing: 8 x 16ft
- Chicken and paunch manure compost: 0.6, 0.9 and 1.12 oz total N tree
- Trace elements: Albion Zinc (Zn), multi-mineral, manganese (Mn), iron (Fe), calcium (Ca), magnesium (Mg)
- Disintegrating sulfur applied in 2010 to soil 0.42lb / tree

Orchard Management: 2011-2014

- Compost applied to meet P needs only ~ 8lb per tree wet weight
- Feather meal applied differently per treatment
- Total N applied 0.3-0.5 lb N per tree.
- Legume biomass 0.25 lb N per tree

Organic Pesticide Applications

- Nordox 75WG, coryneum, spring and fall
- Stylet Oil, coryneum, spring and fall
- Dipel Pro, peach twig borer, 1-2 apps. per gen.
- M-Pede 1% solution, green peach aphids

Orchard Irrigation

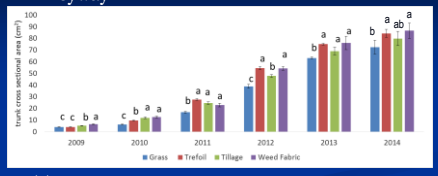
Suspended irrigation lines installed 2012

Micro-sprinklers
360°, 19.8 gph (12)
180°, 10.5 gph (6)

Water applied based on soil moisture drawdown at the plot level.

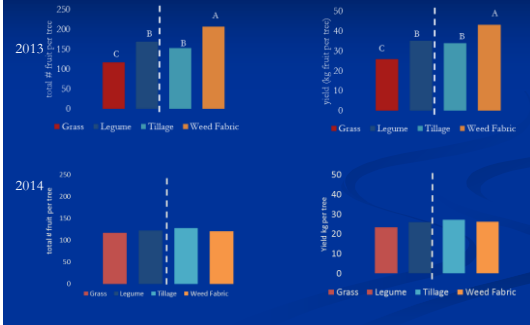
Organic Orchard: Tree growth

Alleyway

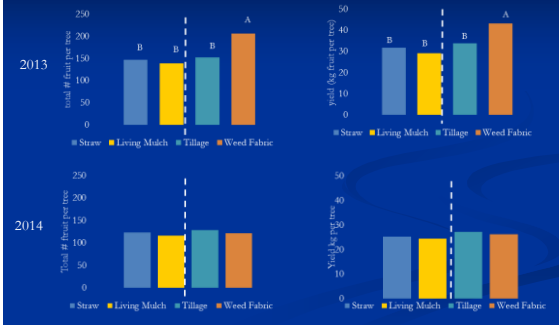


Tree-row

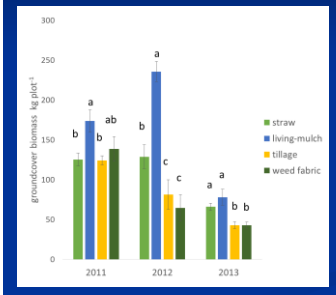
Alleyway Effects on Yield



Tree-row Effects on Yield



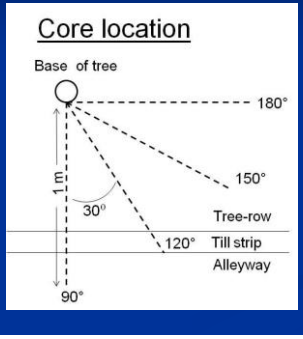
In Row Weed/Living Mulch Biomass



No relationship between biomass, straw mulch, legumes in alleyway and water use.

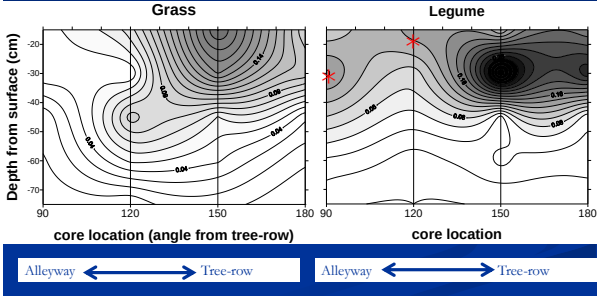
Water use was associated with tree size.

Organic Orchard: Tree Root Distribution

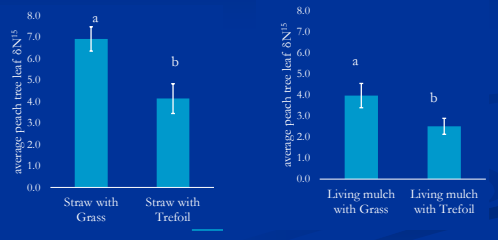


- 4 cores per plot
- 0-60 cm depth
- Roots sorted in 10 cm sections
  - -dry wt. cm3
  - -root length density

Organic Orchard: Tree Roots (g cm^3)

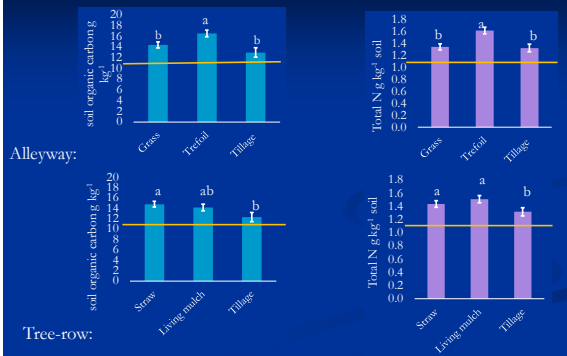


Tree leaf nitrogen natural abundance ($\delta^{15}N$)

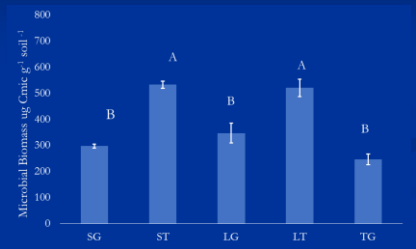


Soil Organic C

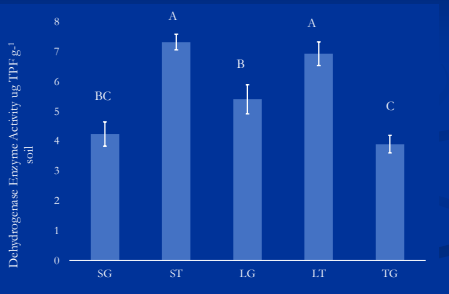
Total Nitrogen



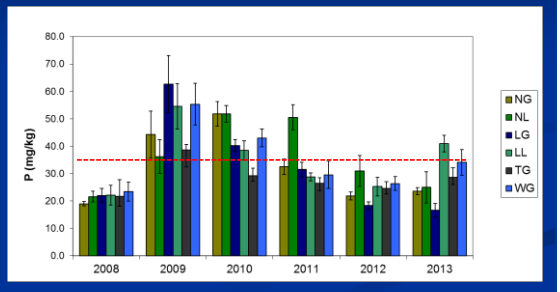
Soil Microbial Biomass



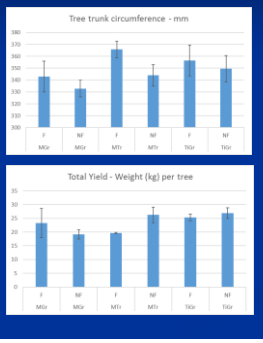
Dehydrogenase Enzyme Activity



Available Soil Phosphorus

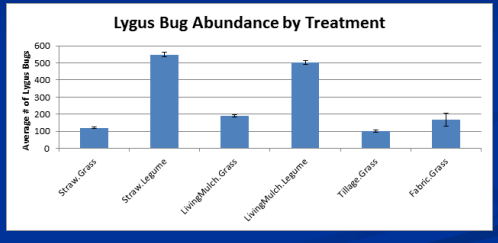


New Orchard Treatments Applied in 2016

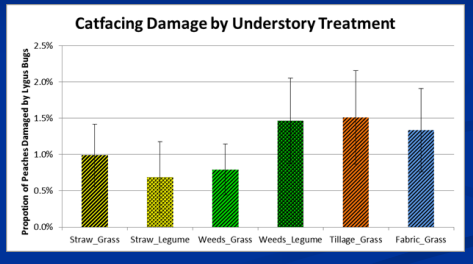


- Mowing (M) vs Tillage (T)
- Fertilized (F) vs non Fertilized (NF)
  - 2.5lb Feathermeal 13-0-0
- Trefoil (Tr) vs Grass (G)

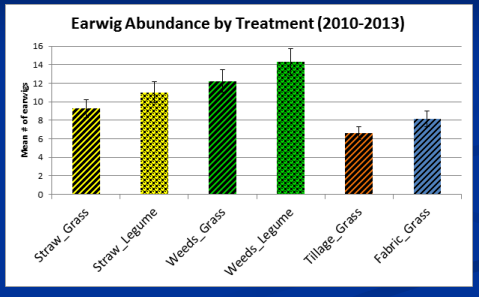
Lygus Bug Abundance



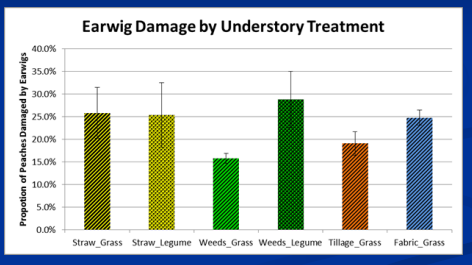
Catfacing Damage



Earwig Abundance



Fruit Damage by Earwig

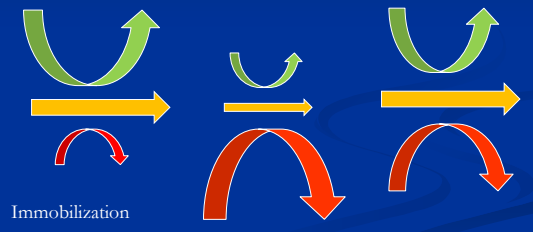


Conclusions

- Organic tree growth (tillage, weed fabric and legume alleyway) equivalent to conventional
- Legumes in alley way overcomes weed competition and reduces cost of inputs
- Major pest is earwig not lygus bug
- Impact of legumes on lygus bug but not earwig
- Yields variable due to frost problems

Organic Soil Fertility Management

Mineralization



Immobilization

Risk Assessment

- Stochastic simulation run 1000 times
  - Cumulative net returns per acre

	Organic	Eco-Friendly	Conventional
Min	-$294,214	**-$224,985**	-$329,108
Mean	**$221,560**	$85,719	$158,224
Max	$672,679	$113,281	**$1,018,937**
Std Dev	$141,120	**$113,281**	$216,653
CV	**64**	132	137

Risk Assessment