Advances in Small Farm Production

Cary L. Rivard, Ph.D.

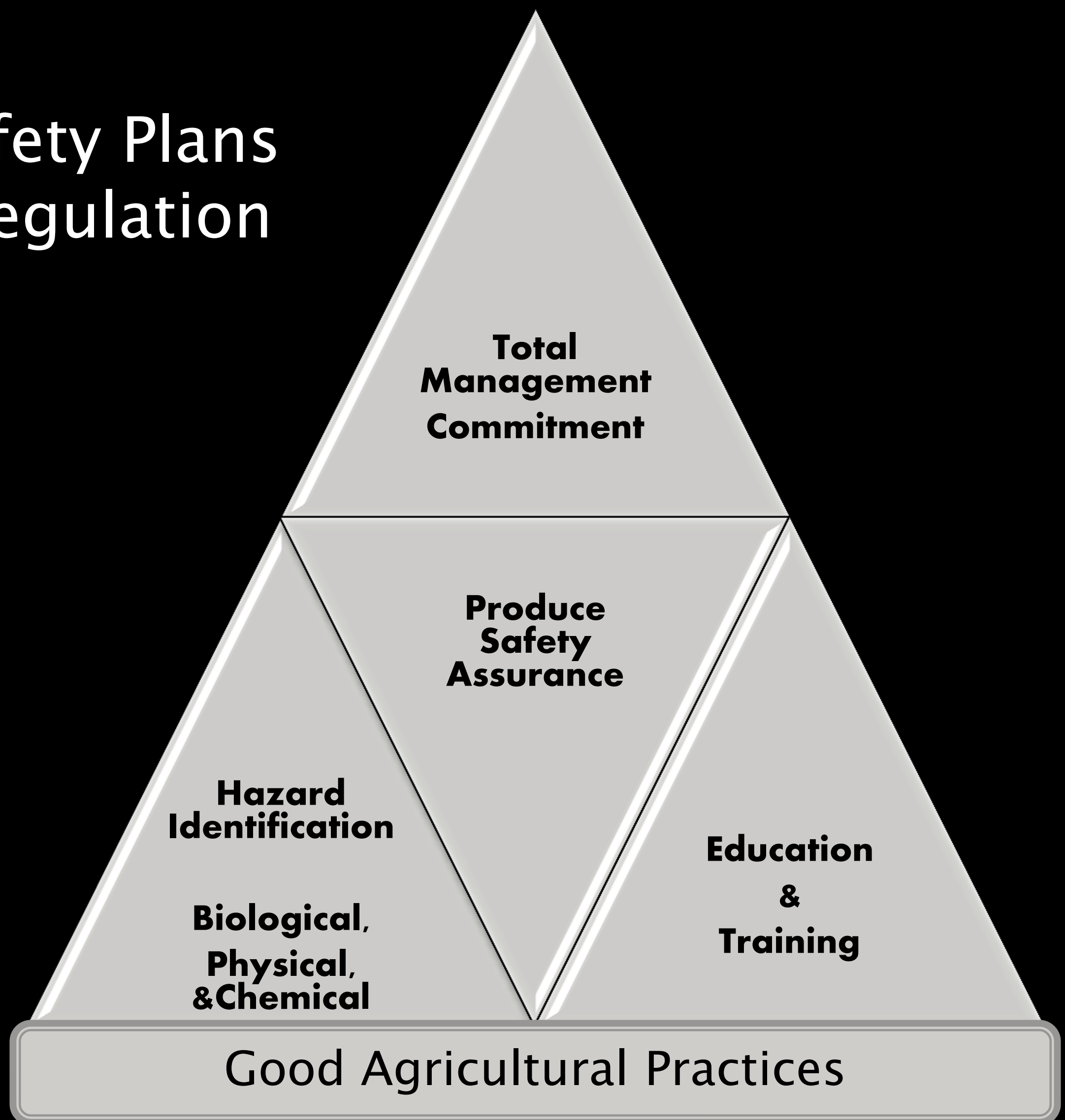
Dept. of Horticulture

Olathe Res. & Ext. Center

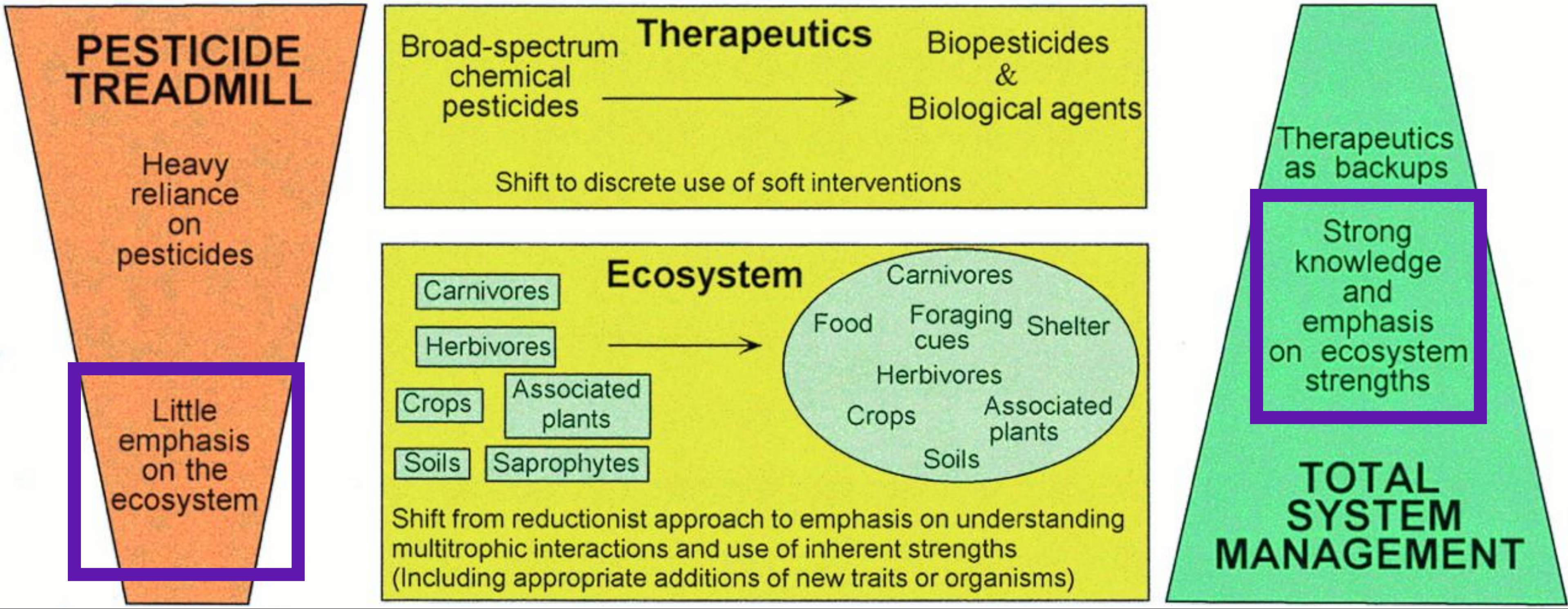
K·STATE
Research and Extension

Food Safety Modernization Act

- Food Safety Plans
- Tiered regulation



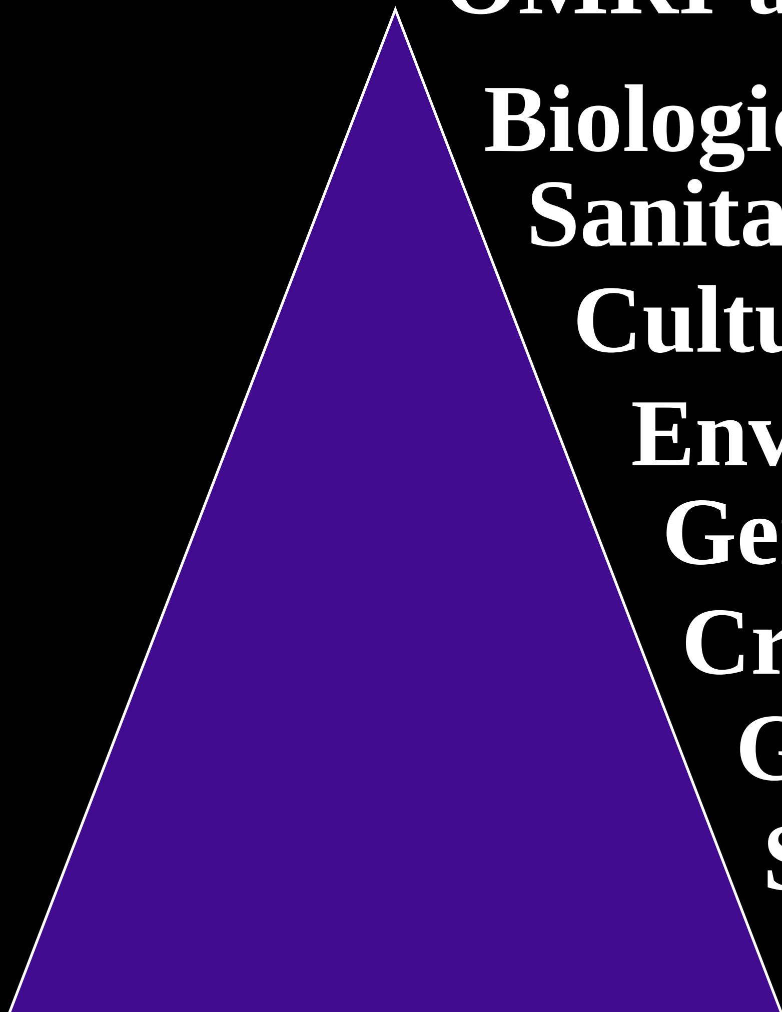
Organic Management



(Lewis et al., 1997)

- What do we do when the system fails?
  - Re-design it
  - Add, replace, or remove a cog
  - Add a whole series of cogs

Integrated Pest Management



OMRI-approved Fung. & Pest.
Biological control
Sanitation
Cultural control
Environmental control
Genetic resistance
Crop Selection
Growing system
Site Selection
Knowledge/Experience

High Tunnel Production

- NRCS EQUIP Program
- Role of Season Extension
- Role of Environmental Protection

High Tunnel Research

Why High Tunnels?

Photo courtesy: ***S. O'Connell*** **(NCSU)**

- All shapes and sizes
  - Three or four seaaon
- Climate Control
  - Season Extesnion
  - Use of low tunnels, etc.
  - Protection
- Reduced Foliar Disease
- Access to new market windows
- Production stability

Incredible growth of warm and cool season crops

Why High Tunnels?

Environmental Protection

- Early/late frosts
- WIND
- Thermal Stress
- Storms
- Heat ??

Working / Harvesting Conditions

Protection from Heat

High Tunnels = Early Planting Date

- Fruit set before heat
- Plant is established
  - Root system
  - Foliage – fruit shading
- Planting Preference
  - Scheduling
  - Varieties
  - Transplant quality

Protection from Heat

High Tunnels *CAN* be cooler than the field

- Ventilation
- Plastic type
  - UV/IR blocking
- Shade cloth
  - 30% is recommended
  - Timing
  - Structural ??

Pre-harvest Effects on Postharvest Quality of Strawberries Grown in High Tunnels

Kelly Gude, C.L. Rivard, K.Oxley, H. Chiebao, and E. Pliakoni

Overall objective: to determine the effect of **variety** and **evaporative cooling** on **postharvest quality, decay, and shelf life** of day-neutral strawberries grown in a **high tunnel**

National Strawberry Sustainability Initiative

Walmart

Kansas State University Olathe

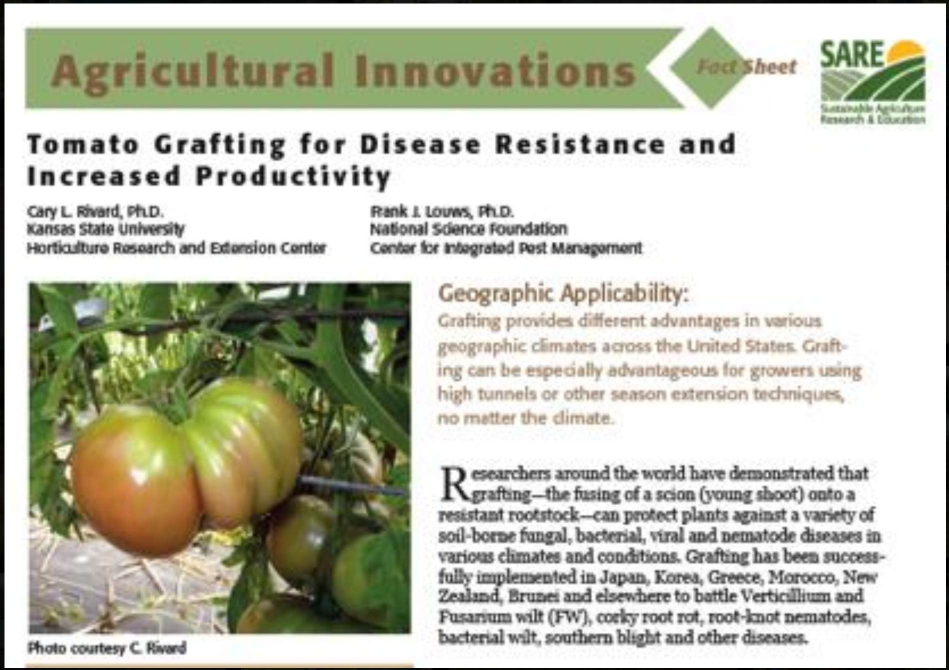
Early Tomato Production

Tomato Grafting

- **First reports of vegetable grafting occurred in Asia in the 1920's.**
  - **Fusarium wilt of melon**
- **Popularized in Japan and Korea**
  - **Tunnel and Greenhouse production**

Tube Grafting

- Grafting for the US
  - High tunnels
  - Disease Management
- Technique and Econ



Agricultural Innovations — Fact Sheet — SARE Sustainable Agriculture Research & Education

Tomato Grafting for Disease Resistance and Increased Productivity

Cary L. Rivard, Ph.D.
Kansas State University
Horticulture Research and Extension Center

Frank J. Louws, Ph.D.
National Science Foundation
Center for Integrated Pest Management

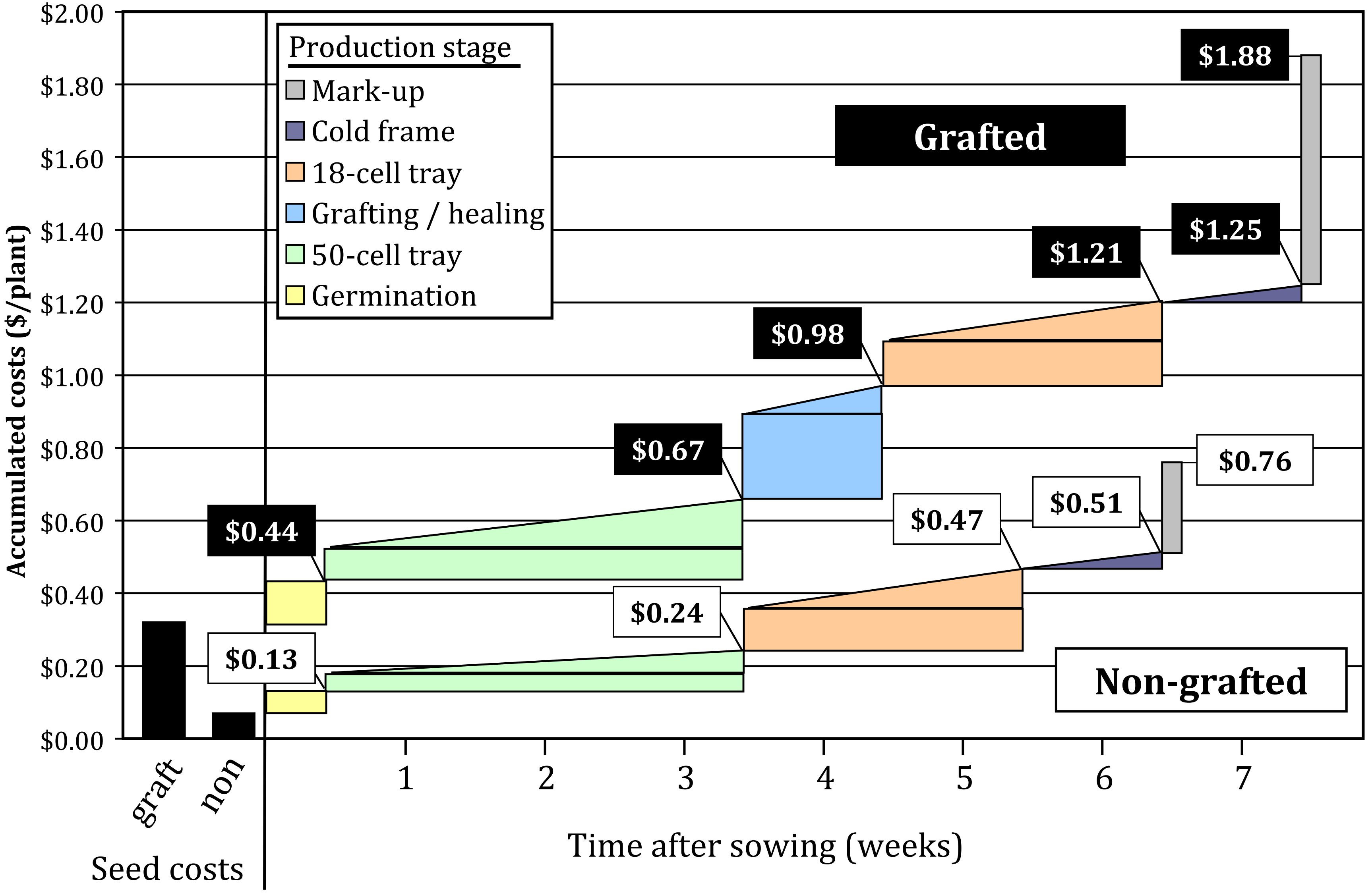
Photo courtesy C. Rivard

Geographic Applicability:
Grafting provides different advantages in various geographic climates across the United States. Grafting can be especially advantageous for growers using high tunnels or other season extension techniques, no matter the climate.

Researchers around the world have demonstrated that grafting—the fusing of a scion (young shoot) onto a resistant rootstock—can protect plants against a variety of soil-borne fungal, bacterial, viral and nematode diseases in various climates and conditions. Grafting has been successfully implemented in Japan, Korea, Greece, Morocco, New Zealand, Brunei and elsewhere to battle Verticillium and Fusarium wilt (FW), corky root rot, root-knot nematodes, bacterial wilt, southern blight and other diseases.

(Rivard and Louws, 2011)

Propagation Costs

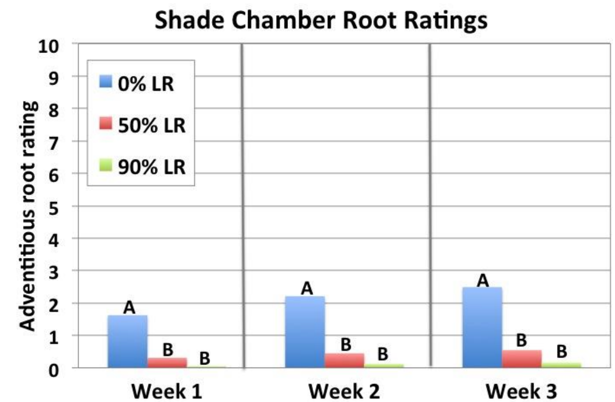


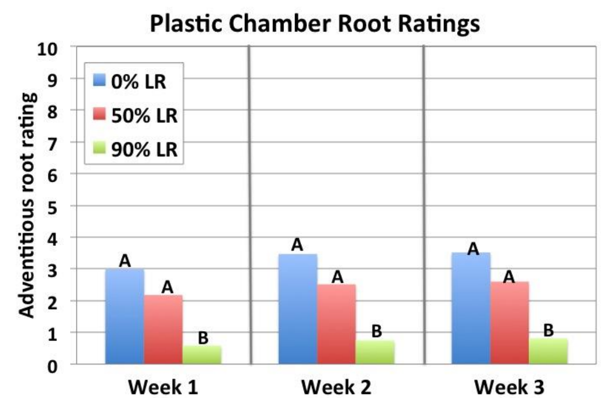
(Rivard et al., 2010)

Grafted Tomato Propagation

- **Goal:** *To optimize grafted tomato propagation systems that can be utilized by small-acreage growers with limited propagation capacity.*

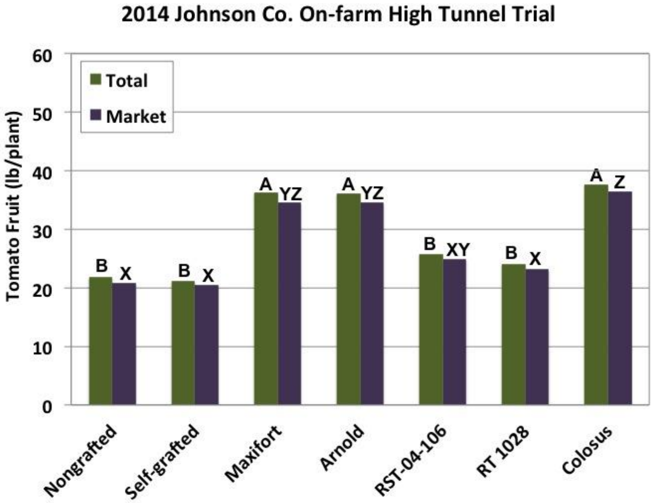
- Investigation of **healing chamber environment**
- Working with **leaf removal** as a way to reduce water stress in the scion
  - Follow-up studies of mature plants (field and GH)
- Determine ways to reduce **adventitious roots** from the scion post-grafting
  - Environment, leaf removal, hormone interactions

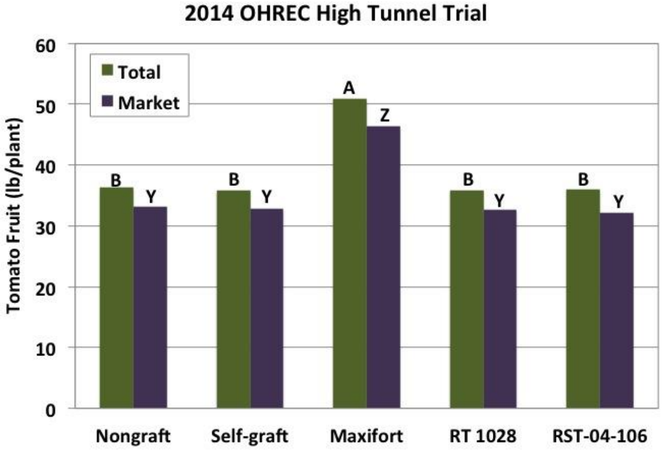




Coordinated Rootstock Trials

- **Goal:** *To identify vigorous tomato rootstocks which increase productivity with little to no disease pressure, particularly in high tunnel systems.*
  - *Complementary to disease management work*
- Mostly hybrid scion (BHN 589)
- Rootstocks:
  - **Maxifort**
  - **Mulitfort**
  - **Arnold**
  - **DRO 131**
  - **Colosus**
  - Trooper Lite
  - Estamino
  - Emperador
  - RST-04-106
  - RT 1028
  - (**Have shown to significantly increase yield in high tunnels**)

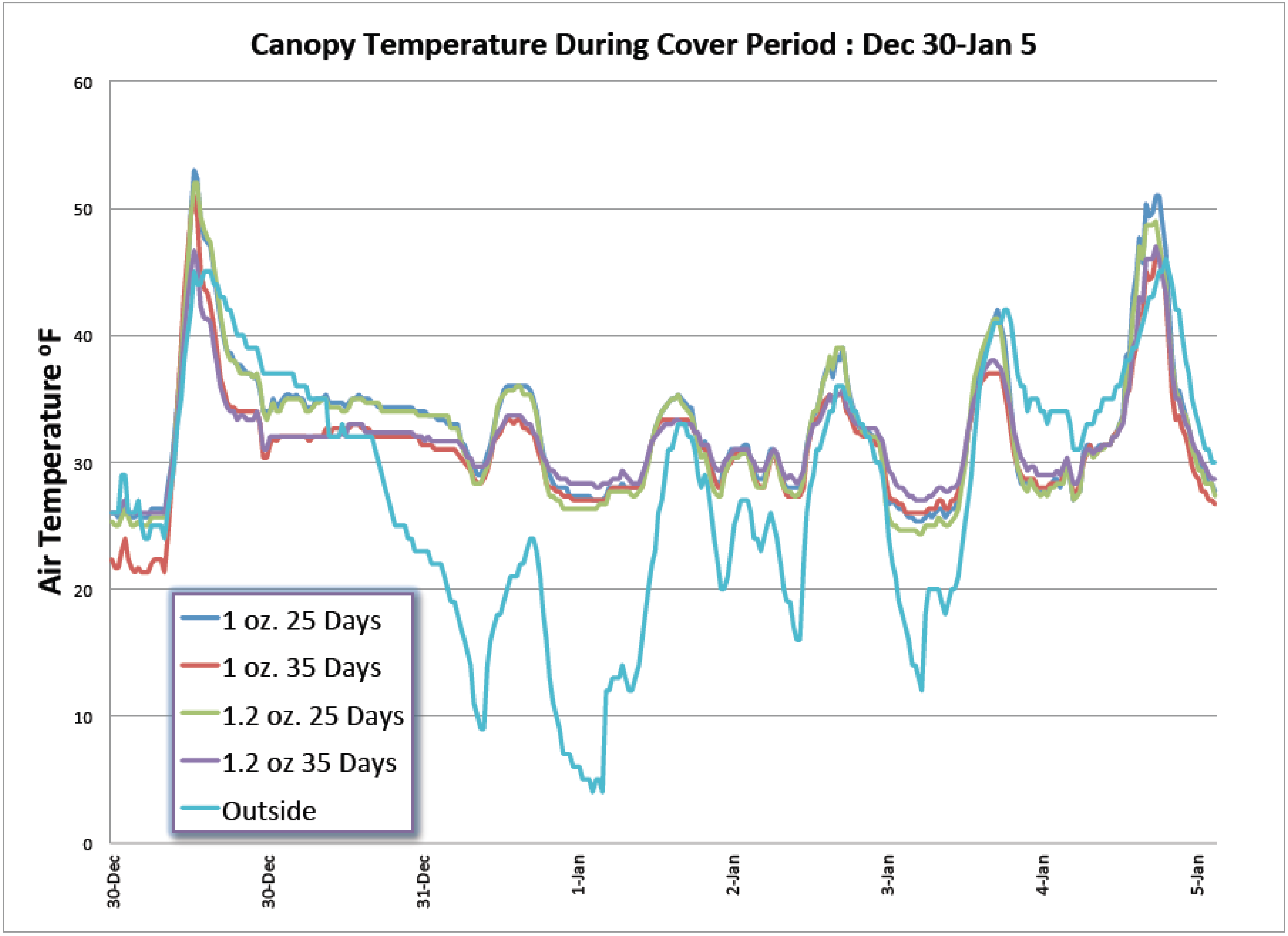




Annual Strawberry Production

Planting date is very IMPORTANT


Managing Winter Injury


Canopy Temperature During Cover Period : Dec 30-Jan 5
Air Temperature °F
60
50
40
30
20
10
0
30-Dec
30-Dec
31-Dec
1-Jan
2-Jan
3-Jan
4-Jan
5-Jan
1 oz. 25 Days
1 oz. 35 Days
1.2 oz. 25 Days
1.2 oz 35 Days
Outside

No-Till NRCS CIG Project

NRCS Conservation Innovation Grant Program

- *Rivard, C.L., M. Kennelly, J. Griffin, R. Janke, D. Presley, P. Tomlinson, R. Wynia* (NRCS)*, M. Bates* (MU)
- Demonstrate no-till systems
  - Pumpkin, sweet corn, snap bean
  - Equipment (planter) experience
- 4 replicated trials at KSU/NRCS locations
- 16 demonstration trials at commercial farms (2014-15)

NRCS | K-STATE Research and Extension | UNIVERSITY OF MISSOURI Extension

No-Till Veggie Crops

Characteristics of Crops that Do Well in No-Till

- **Competitive** crops do best
  - Canopy development
  - Water and nutrients
- Planting date
  - Late (summer crops)
- Crops that do well under mulch
- Transplants
- Crops that require intensive weed management


KUBOTA
L4400
RENTAL
HST
4X4
SILVERADO

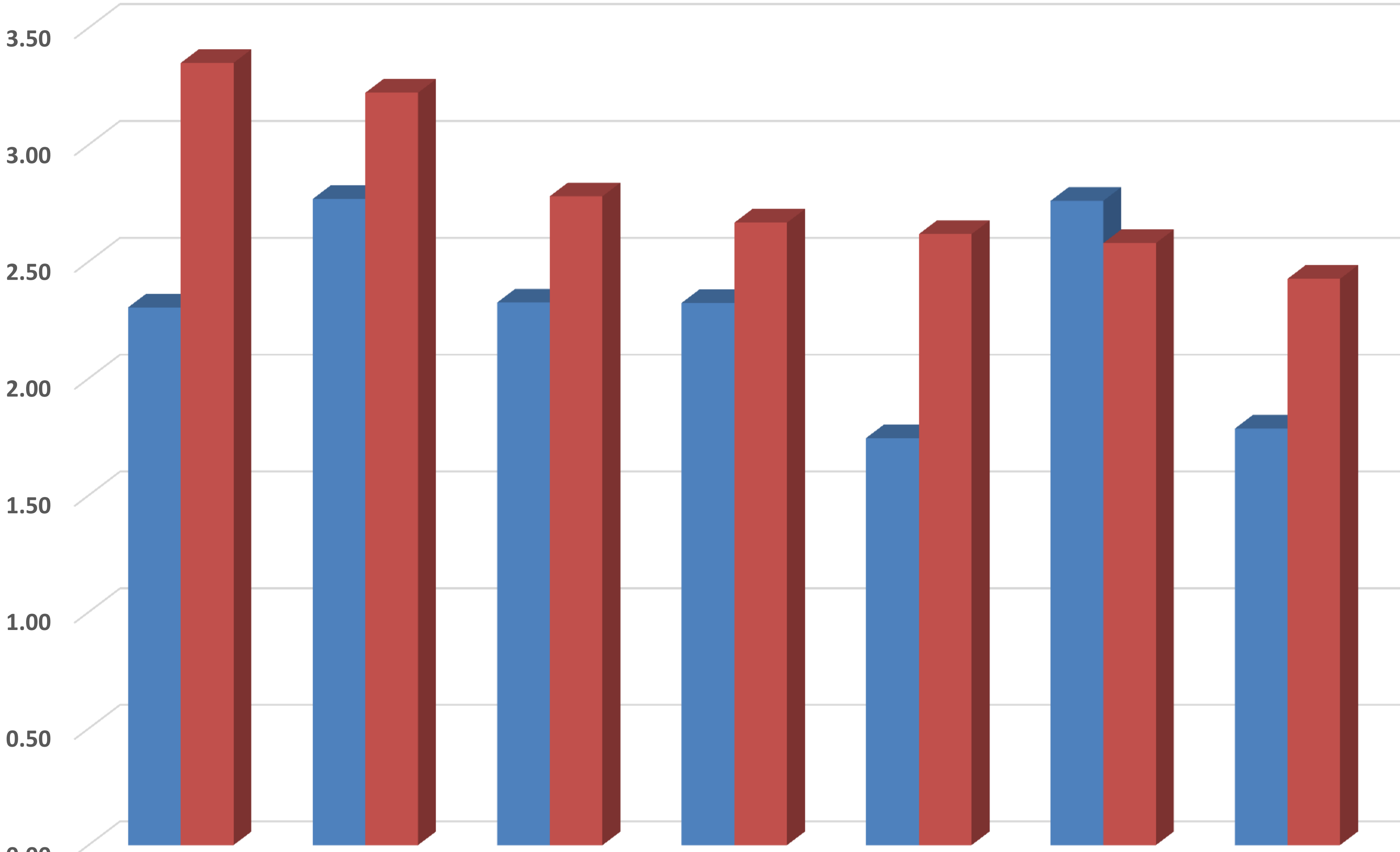
Benefits of No-Till

Grow Your Own Mulch

- Cover crop residues serve as mulch
  - Weed management
  - Soil moisture
  - Crop health and quality
- Reduced soil temperatures
  - Fall crops

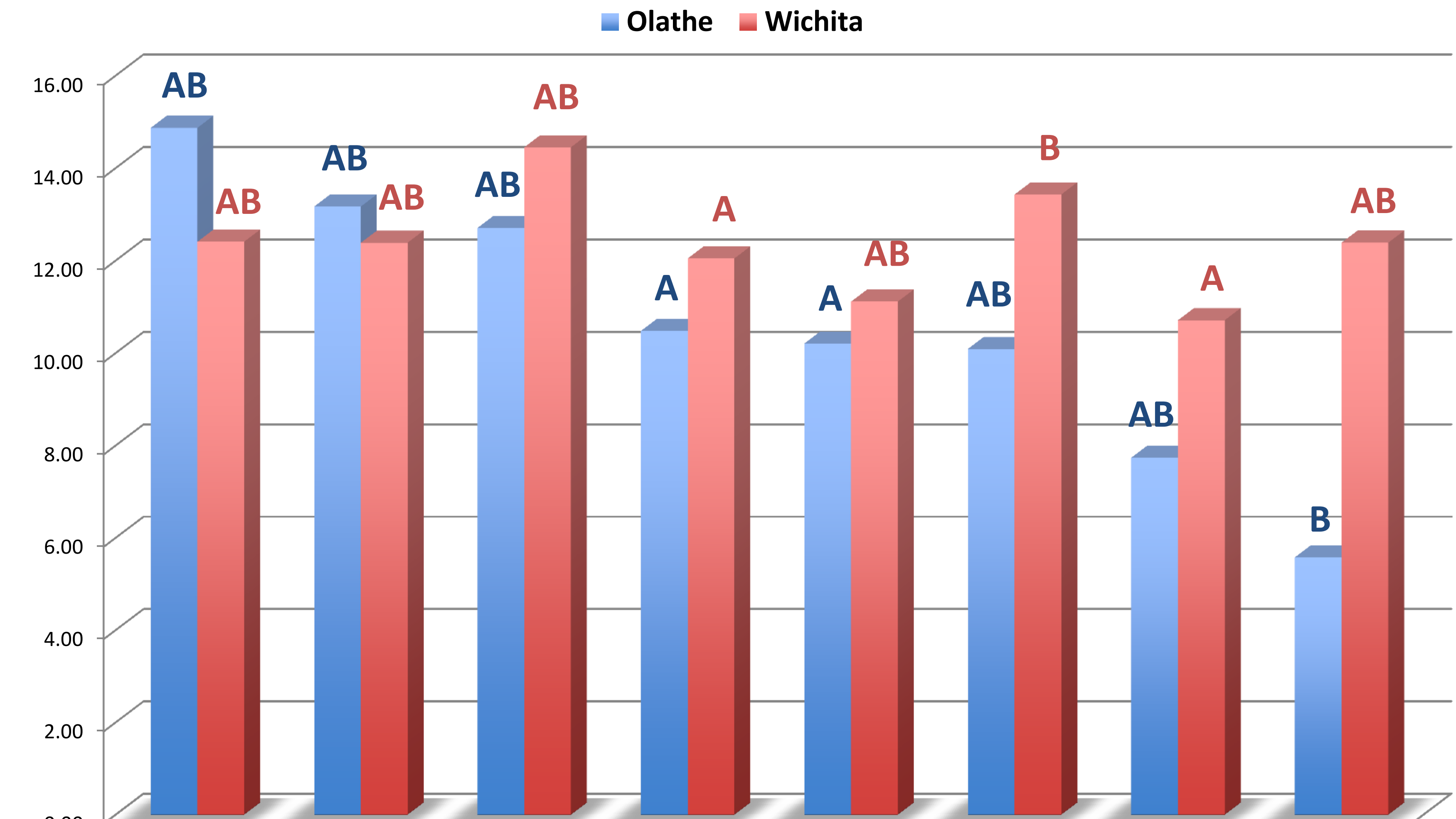

John C. Pair Center

2014 COVER CROP BIOMASS PRODUCTION



	Spring Oats/Pea	Spring Oats	Winter Rye/Pea	Winter Rye/Hairy Vetch	Winter Rye/Canola	Winter Rye/Hairy Vetch/Canola	Winter Rye
OHREC	2.30	2.77	2.33	2.32	1.75	2.76	1.79
JCP	3.35	3.22	2.78	2.67	2.62	2.58	2.43

2014 Fruit Yield



	Winter Rye/Pea	Conventional Tillage	Winter Rye/Hairy Vetch	Winter Rye/Hairy Vetch/Canola	Spring Oats	Spring Oats/Pea	Winter Rye/Canola	Winter Rye
Olathe	14.87	13.17	12.71	10.48	10.21	10.09	7.74	5.58
Wichita	12.41	12.38	14.45	12.05	11.11	13.43	10.71	12.39

Challenges of No-Till

Challenges exist in No-Till Systems

- Soil temperature
- Nutrient Management
- Managing cover crops
- Disease and pest pressure
- Production logistics

Southern Blight on Tomato

	Biomass (lbs/acre)		C:N	Available N (lbs/acre)
	Rye	Vetch		
High Tunnel	3749.4	329.4	9.8	83.2
Field	721.8	1589.1	8.5	54.2

Fertilizing with Cover Crops

Nitrogen Recovery / Deposition

- NO_3 Recovery
- Legume cover crops
- Calculated lbs/A N
  - Legumes
    - 3.5-4% (young tissue)
    - 3-3.5% (flowering)
  - Grasses
    - 2-3% (young tissue)
    - 1.5-2.5% (flowering)

Lbs biomass

x

Estimated % N

x

50% Availability

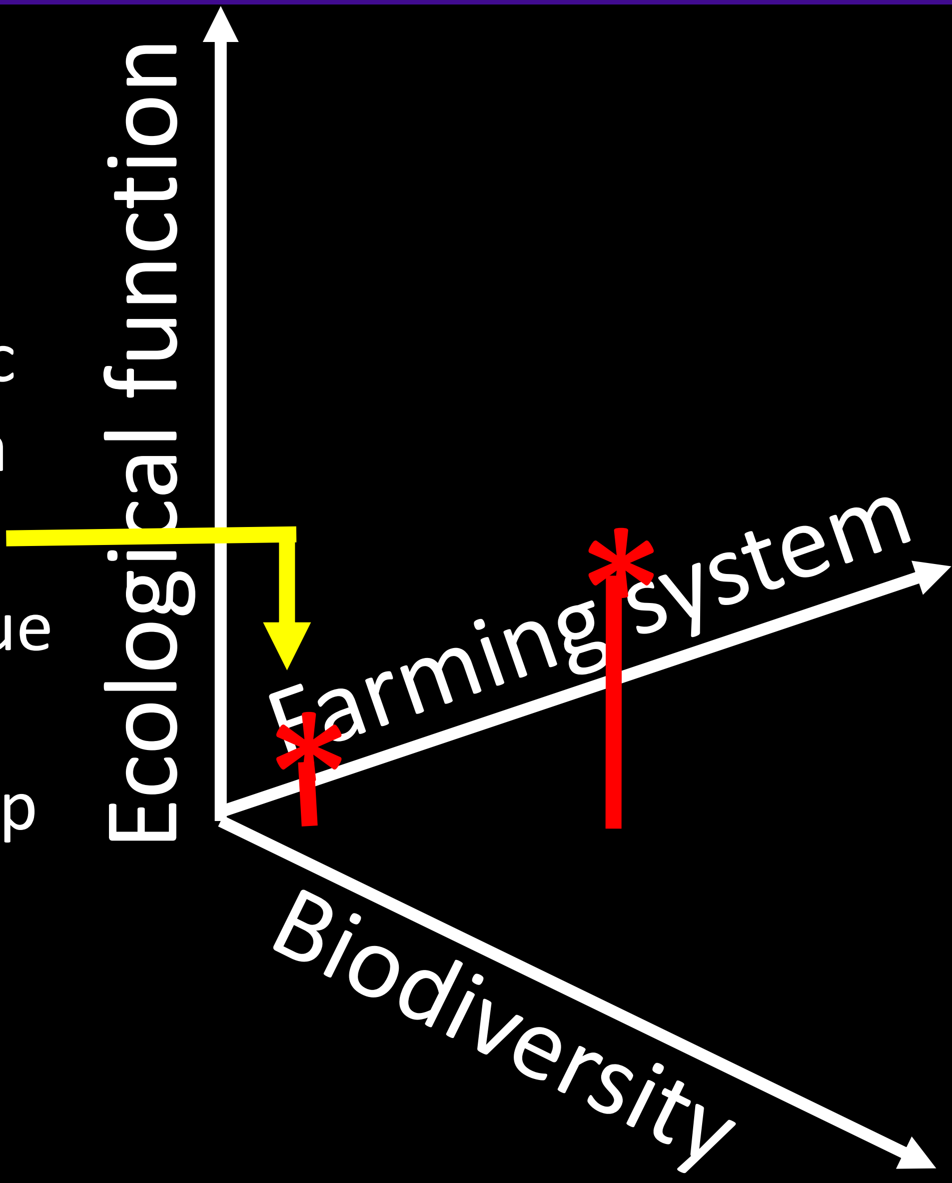
= Total Nitrogen

Beneficial habitat planted around the tunnel

Systems Approach

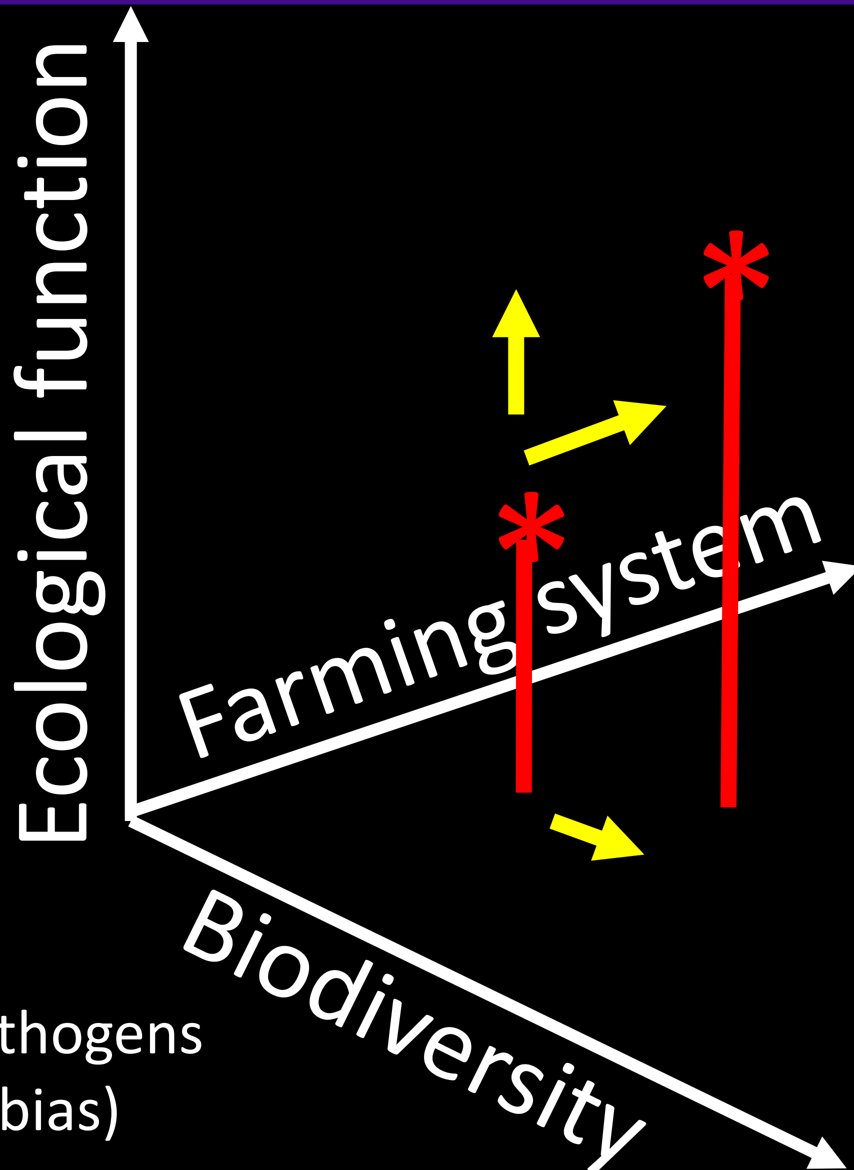
- Cover crops
- Compost

Single tactic control of a single problem/issue in a mono-cultured crop



Systems Approach

- Disease suppression
- Plant growth promotion
- Good yields

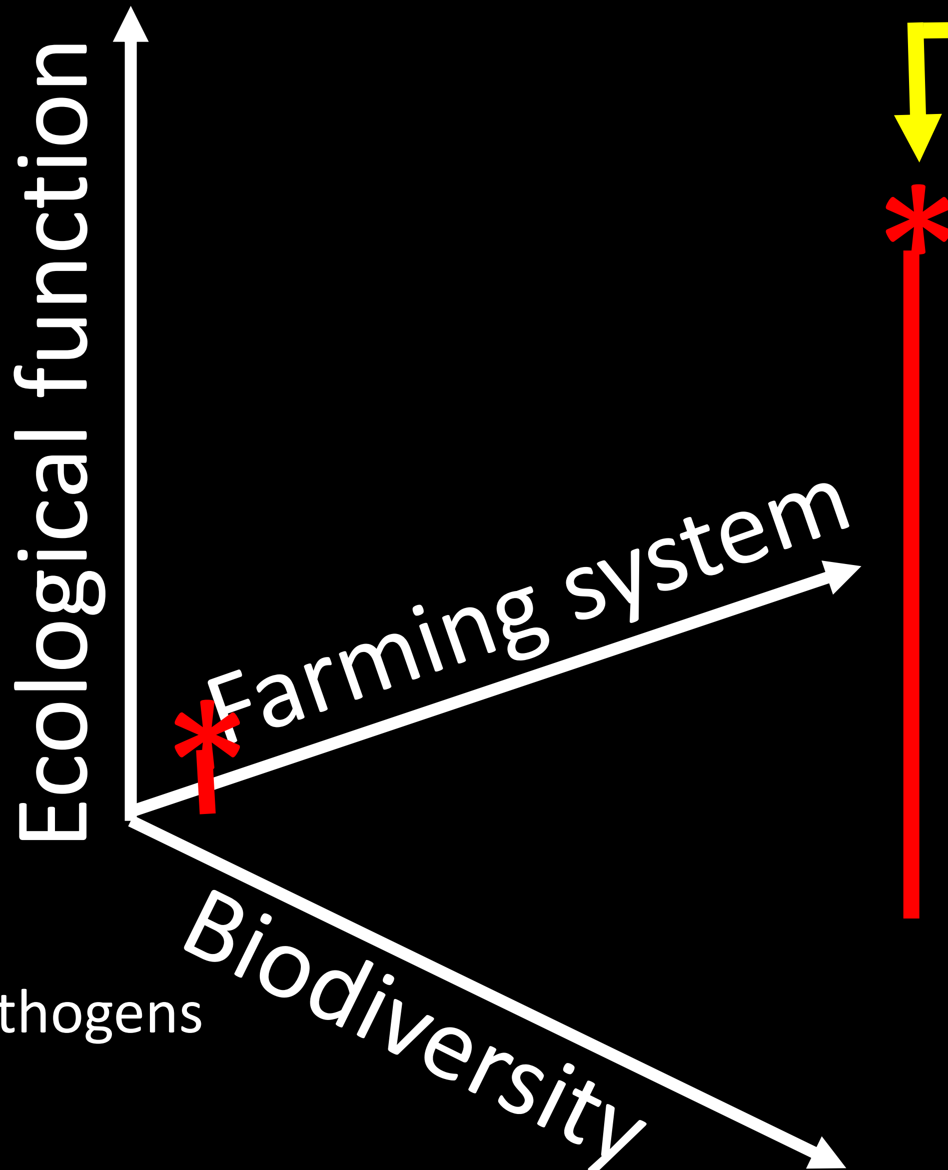


- Cover crops
- Compost
- Certified plants
- Crop rotation
- Nutrient mgmt

- Biologicals
- Knowledge of pathogens
- Soil community (bias)

Systems Approach

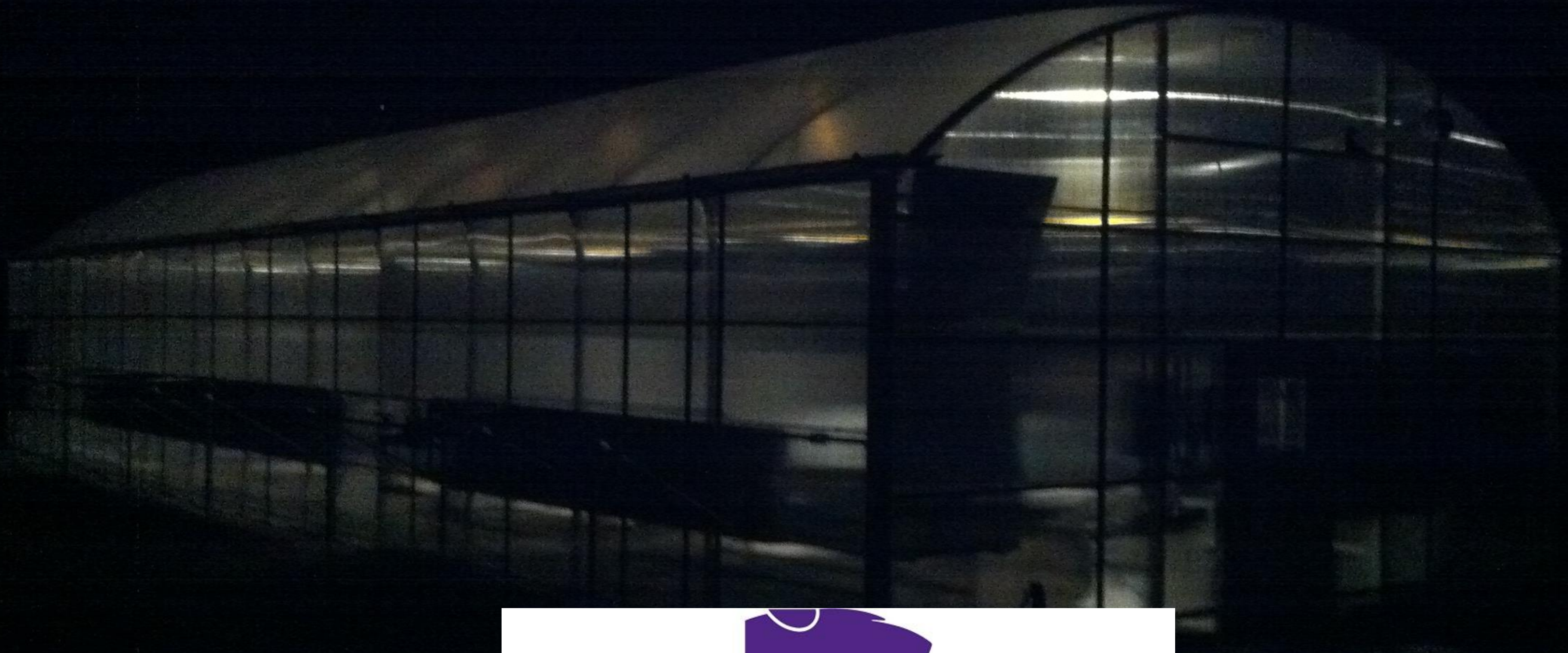
- Disease suppression
- Plant growth promotion
- Good yields
- Weed suppression
- Nutrient cycling/CEC



Multiple crops over time and space to foster high biodiversity, multi-pest suppression, and vigorous plant health

- Biologicals
- Knowledge of pathogens
- Soil community
- Crop diversity

QUESTIONS ??



K-STATE
Research and Extension