Postharvest quality and shelf life of tomatoes grown in high tunnels vs the open-field

LANI MEYER, GRADUATE STUDENT

DR. CARY RIVARD

DR. ELENI PLIAKONI

Vegetable Quality

- **Appearance**
  - Size, shape, and color
  - Absence of defects and decay
- **Texture**
- **Flavor**
  - Sugars, acids, and aroma volatiles
- **Health-related compounds**
  - Desirable: minerals, vitamins, carbohydrates, proteins, and carotenoids
  - Undesirables: heavy metals, pesticides, and nitrates

Environmental Factors

Harvest

Postharvest Handling

contributing

Quality

maintaining

Cultural Practices

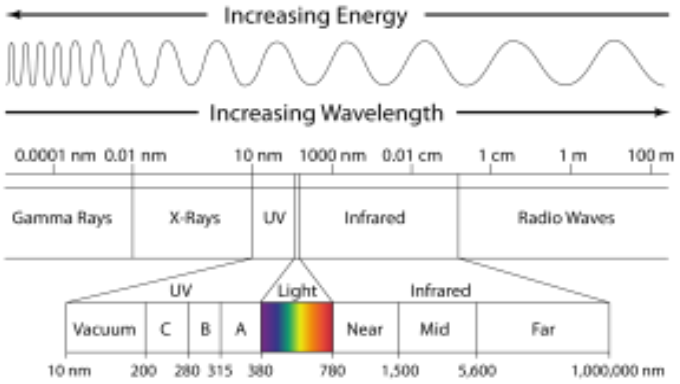
Ultimately, maximum product quality is determined at harvest

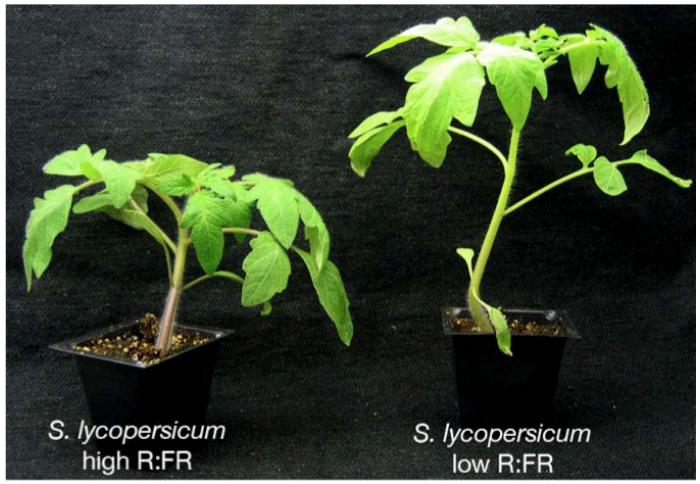
Pre-harvest Factors

- **Genetics**
- **Weather**
- **Pests/Disease**
- **Cultural Practices**
  - Soil
  - Fertilizer
  - Irrigation
  - Pest management
  - Temperature
  - Light

Light

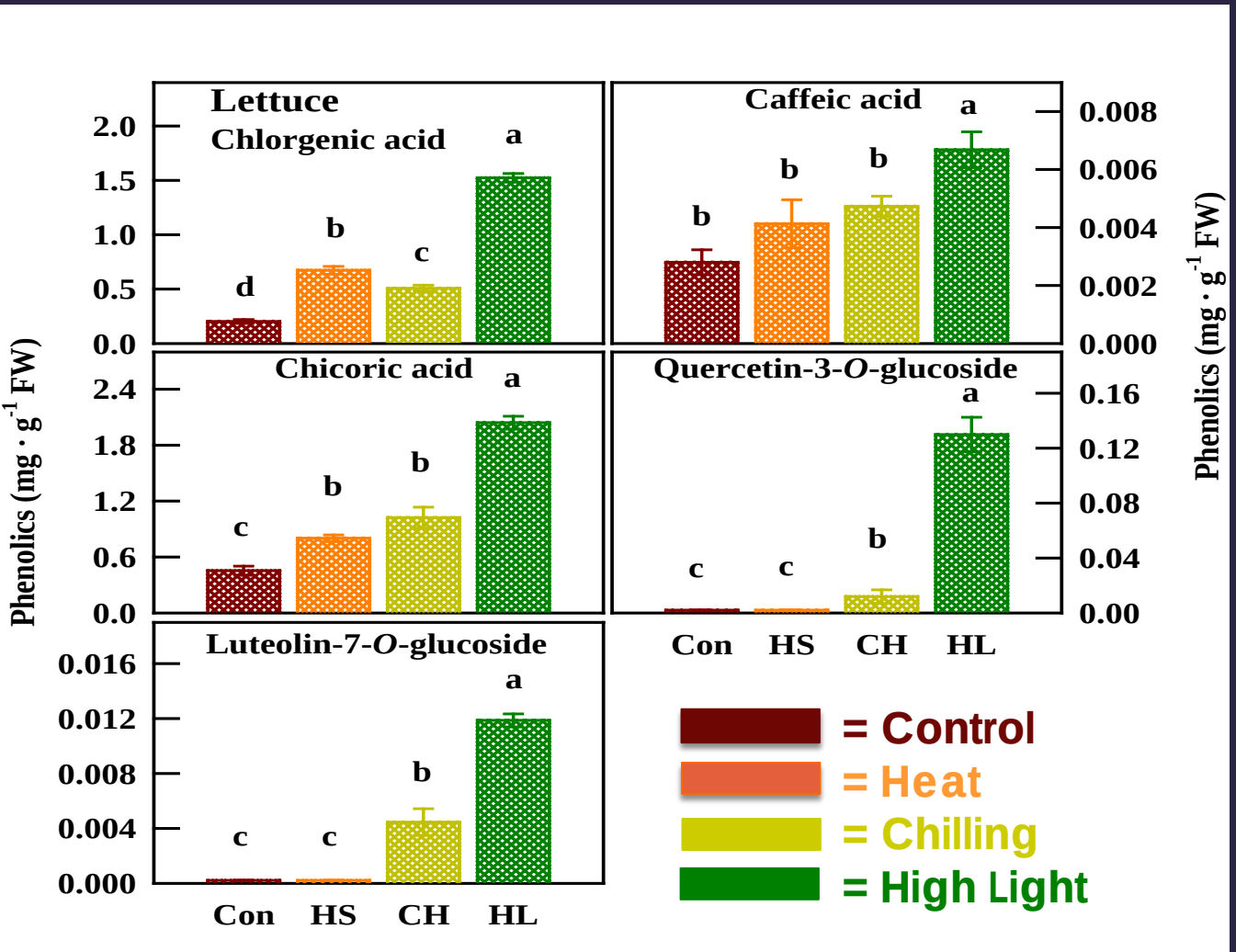
- Key in photosynthesis and morphogenesis
  - **Quality** light
  - **Quantity** light





2009: Lettuce Growth Chamber Studies

Fig. 1 The effect of environmental factors, **heat (HS), chilling (CH) and high light (HL)** on phenolic compounds in lettuce.



(Oh, internal communication)

High Tunnels

- **Protection from elements**
  - Rain, hail, wind
  - Pests
  - Intense sunlight
- **Control of environment**
  - Irrigation
  - Temperature
  - Weed pressure
  - Light
- **Less environmental stress**
- **Increase yields and external quality**

High Tunnels

- **Soil management**
- **Space limitations**
- **Increase cost/maintenance**
- **Decrease light**
  - Block UV/IR light
  - Reduce light intensity 15-20%
  - Shade cloth additional 30%

High Tunnel vs. Open-Field

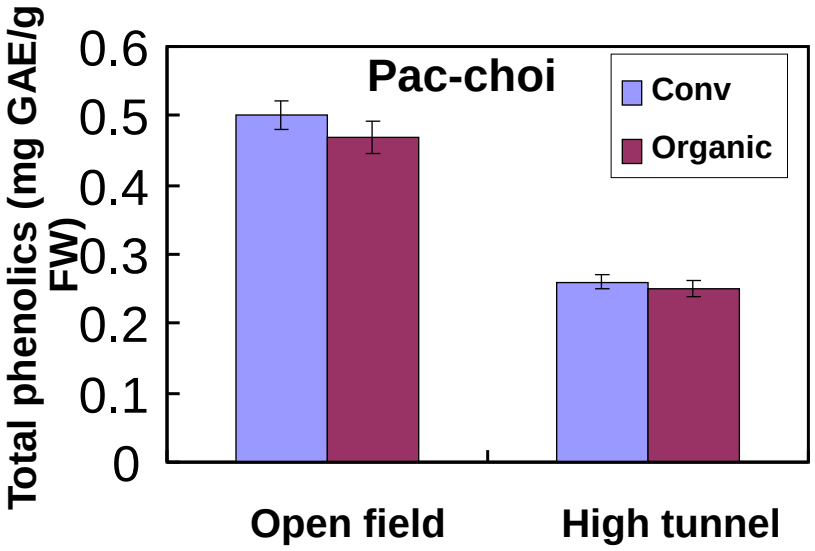
KSU OHREC Research

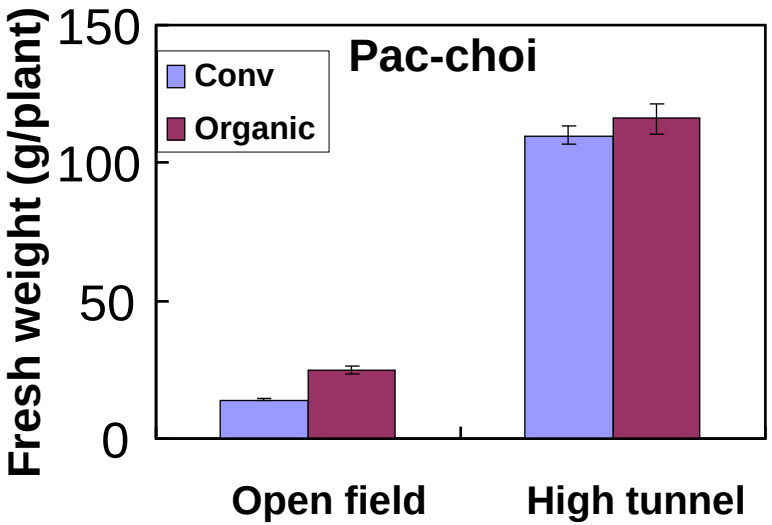
- **2003: Lettuce trials** (Zhao and Carey)
  - Replicated field (F) and high tunnel (HT) plots
  - Conventional and Organic plots
  - **Total phenolic varied with cultivar and season**
  - **Higher total phenolic in spring F plots than HT**
  - No significant difference for summer plots

High Tunnel vs. Open-Field

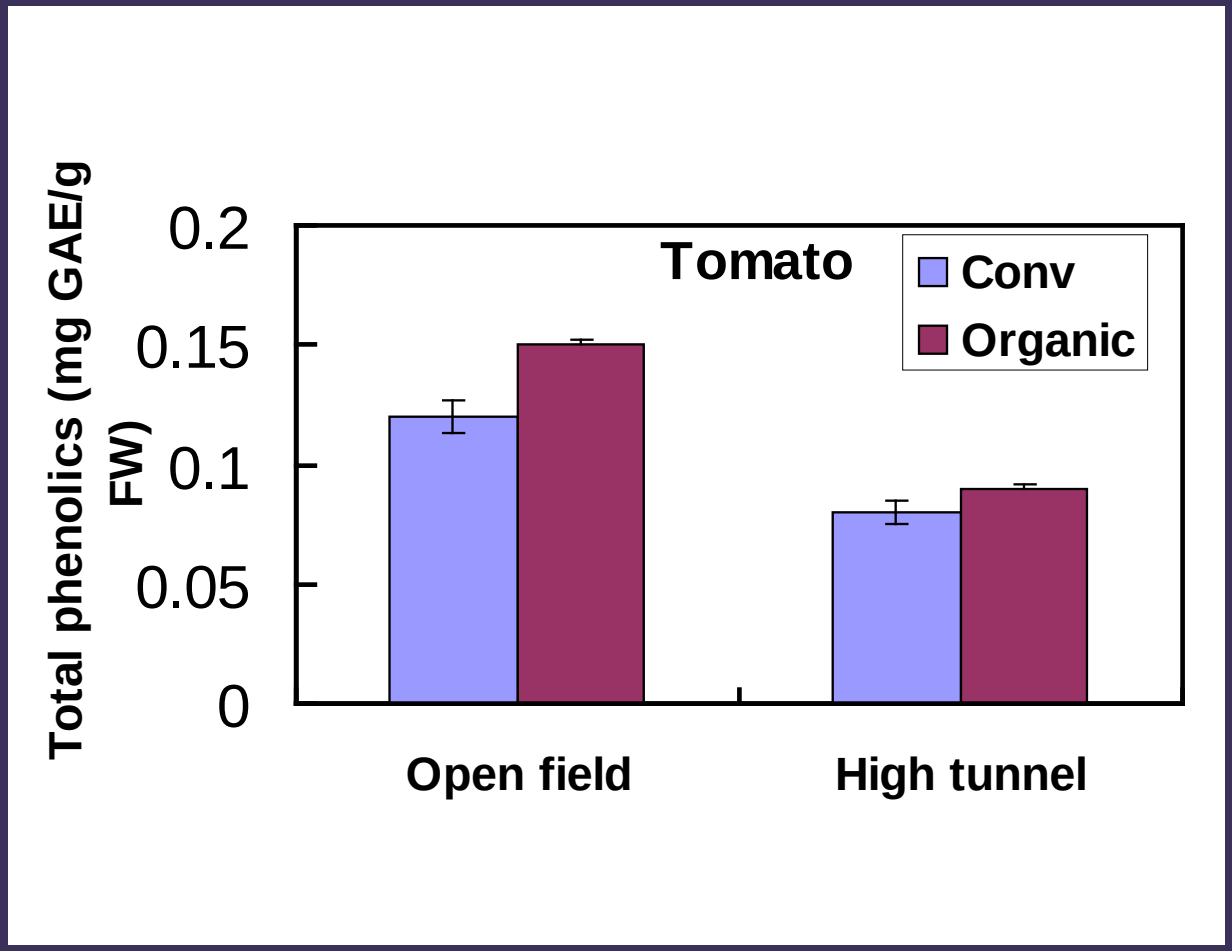
- **2008: Pac-choi and tomato trials** (Rajashekar and Oh)
  - 2 year study
  - Replicated field (F) and high tunnel (HT) plots
  - Pac-choi cv. ‘Mei Qing’ and Tomato cv. ‘Bush Celebrity’
  - Conventional and organic methods

Response of total phenolics and yield of pac-choi in open field and high tunnels





Total phenolics in tomato in preliminary studies.



High Tunnels and Quality

- **High tunnel effects on quality**
  - Decrease environmental stress
    - Especially LIGHT
  - **Increase yields and external quality**
  - **Alters the phytochemical levels (internal quality?)**

- **How can we manage high tunnels to maximize both internal and external quality?**

Environmental Factors

Harvest

Postharvest Handling

contributing

Quality

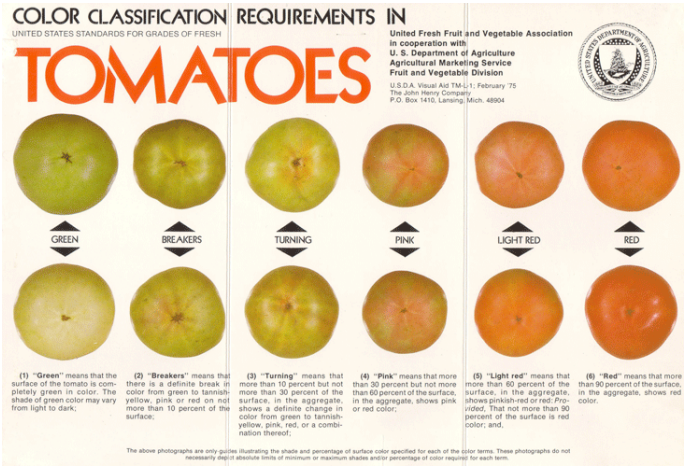
maintaining

Cultural Practices

Ultimately, maximum product quality is determined at harvest

Harvest

- Maturity stage
- Time of day
- Time of year
- Temperature
- Humidity
- How product is harvested?
  - Mechanical or person
  - Equipment



Environmental Factors

Harvest

Postharvest Handling

contributing

Quality

maintaining

Cultural Practices

Ultimately, maximum product quality is determined at harvest

Postharvest Handling

- **Remember, it is ALIVE during this process**
- **Reduce Respiration**: gas exchange, water loss
- Reduce injury
- Postharvest Methods:
  - **Temperature**
  - **Humidity**
  - Modified packaging
  - Heat and chilling treatments
  - Ethylene management
  - Chemical treatments

How can we manage high tunnels to maximize both internal and external quality?

How does high tunnels affect the shelf life (maintaining quality) of fresh produce?

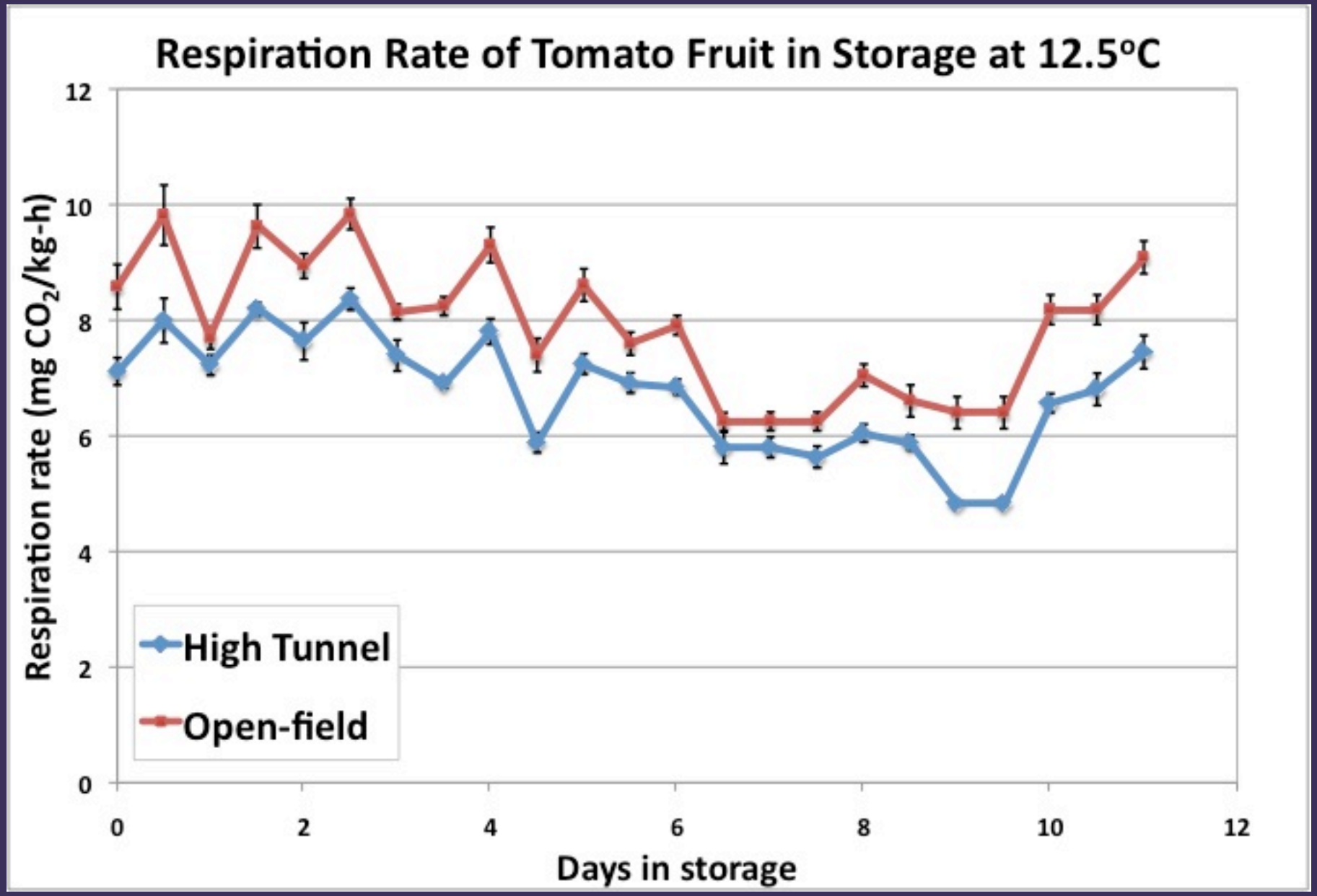
Preliminary Research

Objective: Examine the shelf life and quality of organic tomatoes grown in high tunnels and the open field.

- High tunnel vs open field plots at OHREC with **tomato cv. BHN 589**
  - Planted May 31 and fruit harvested on Sept. 11
  - High tunnel = fabric weed barrier and drip irrigation
  - Open field = plastic mulch and drip irrigation

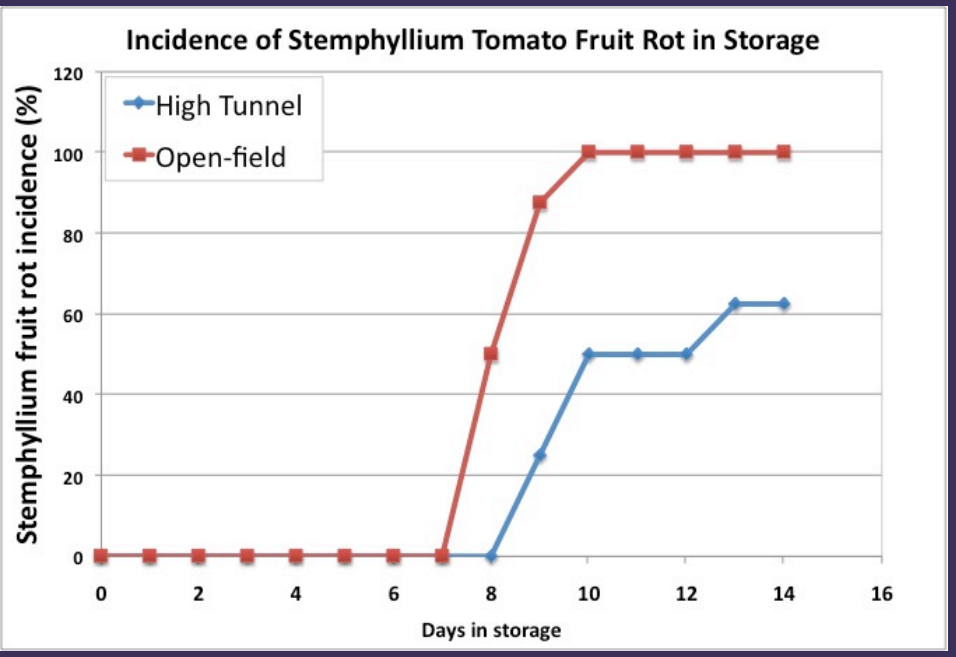
Methods

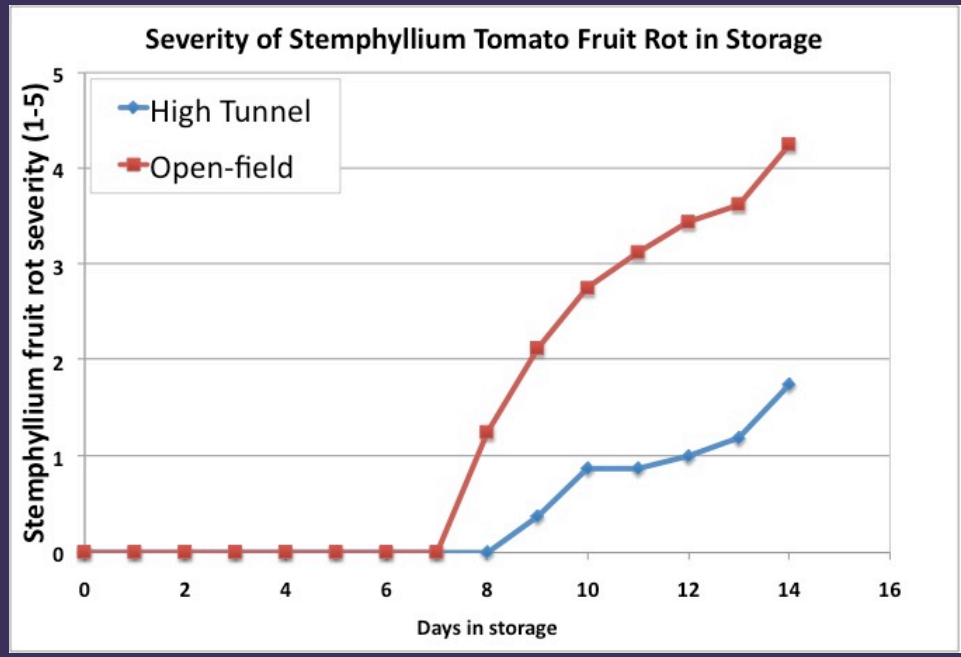
- Shelf life experiments
  - **Breaker and pink stage fruit** were stored at **54.5 F** (12.5 C) for **21 days**
  - Replicated **respiration** measurements of pink fruit every 12 hours
  - Evaluated daily for **color**
  - Evaluated for incidence and severity of **decay**


Respiration Rate of Tomato Fruit in Storage at 12.5°C
Respiration rate (mg CO_2/kg-h)
0
2
4
6
8
10
12
Days in storage
0
2
4
6
8
10
12
High Tunnel
Open-field


High Tunnel
Day 11


Open Field
Day 11


Incidence of Stemphyllium Tomato Fruit Rot in Storage
Stemphyllium fruit rot incidence (%)
120
100
80
60
40
20
0
High Tunnel
Open-field
0
2
4
6
8
10
12
14
16
Days in storage


Severity of Stemphyllium Tomato Fruit Rot in Storage
Stemphyllium fruit rot severity (1-5)
5
4
3
2
1
0
High Tunnel
Open-field
0
2
4
6
8
10
12
14
16
Days in storage

Conclusion

High Tunnels regards to postharvest quality

- Reduces respiration rate
- Reduces incidence and severity of *stemphyllium* fruit rot
- **Increases shelf life**

Future Work

Pre-harvest factors on quality and shelf life

- High tunnel vs. open-field production
  - Tomato, spinach
- Effects of grafting and rootstock
- Strawberry cultural practices – evaporative cooling

Postharvest handling effects on quality and shelf life

- Physical treatments
- Modified atmosphere packaging (MAP)
- Chemical treatments (NOP-approved)

THANK YOU!!!

- K-State Olathe
- Olathe Horticulture Research and Extension Center: Kim Oxley, Mark Gawron, Vicente Moscate
- Helena Chiebao

K-STATE
Research and Extension

KANSAS STATE UNIVERSITY | Olathe

Questions?