

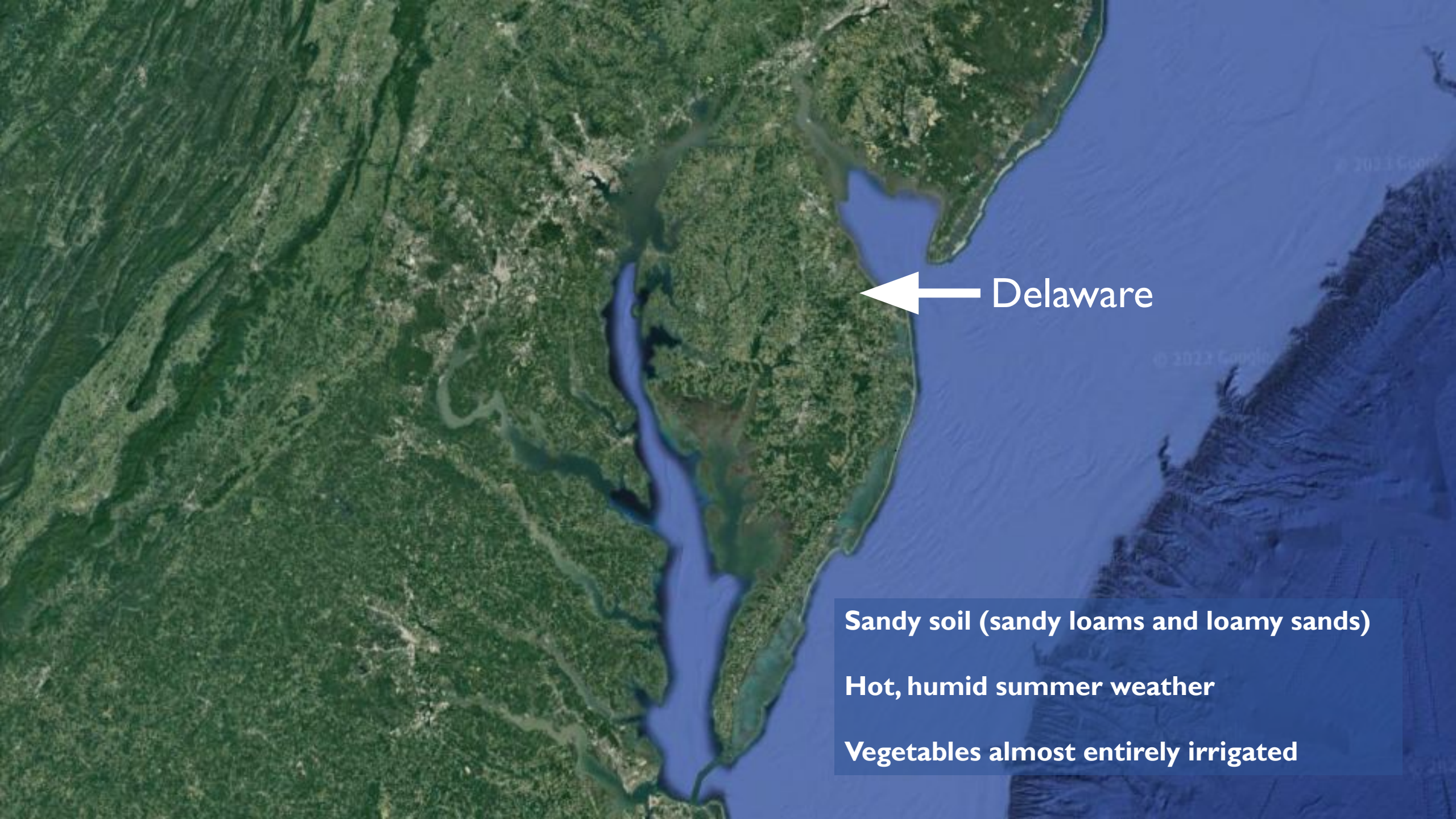
Preventing Yield Loss from Heat Stress in Bell Peppers

Dr. Emmalea Ernest emmalea@udel.edu
Extension Fruit & Vegetable Specialist, Assistant Professor
University of Delaware



Dela-Where?





← Delaware

- Sandy soil (sandy loams and loamy sands)**
- Hot, humid summer weather**
- Vegetables almost entirely irrigated**

Effects of Heat Stress in Peppers

Stem Girdling from Heat Necrosis



June 1, 2022

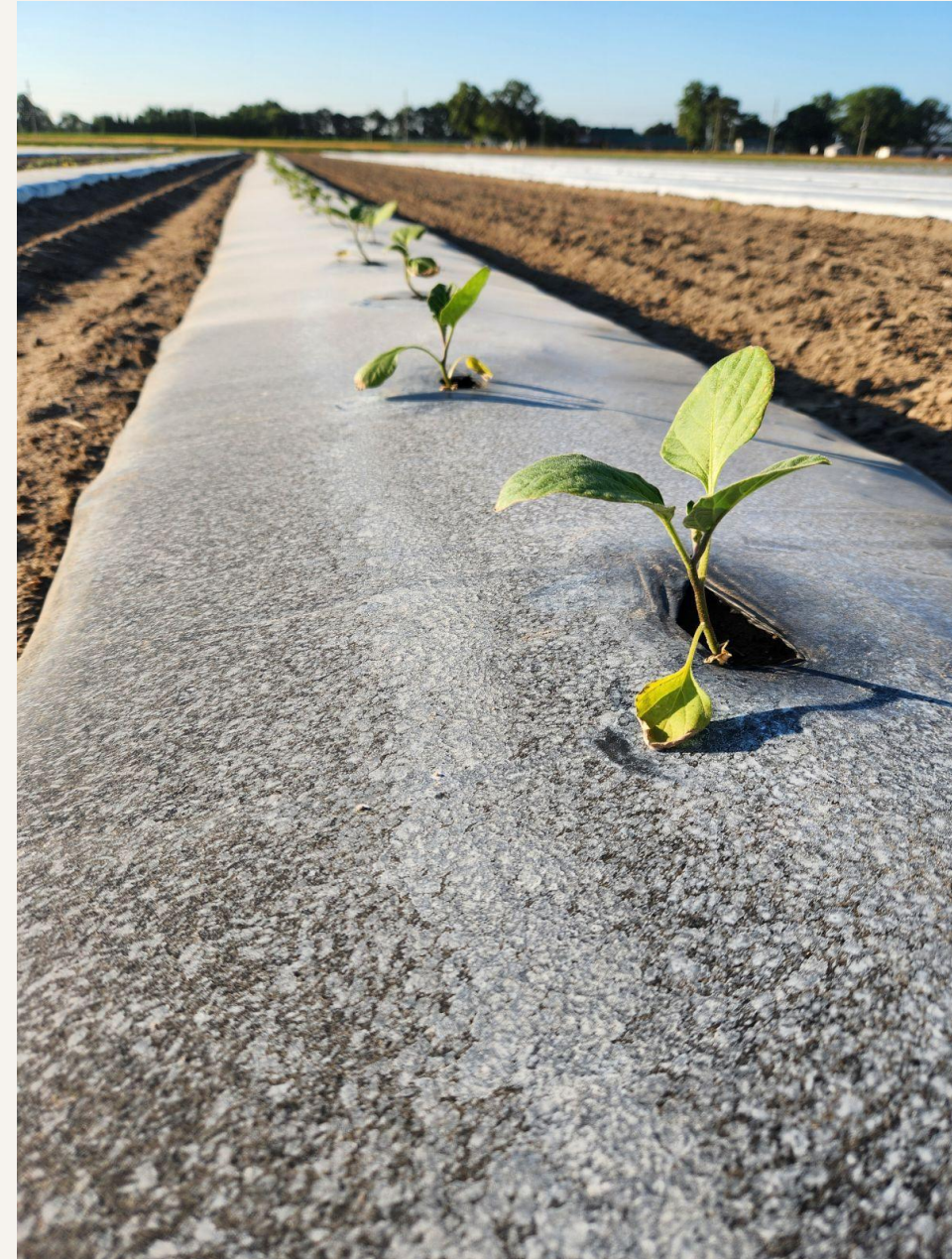


July 20, 2022

Effects of Heat Stress in Peppers

Strategies to Combat Stem Girdling

- Irrigate
- Use larger cell size transplants 72s not 128s
- Plant on bare ground
- Use white plastic mulch
- Spray particle film on black mulch
- Apply shade cloth



Effects of Heat Stress in Peppers

Sunburn or Sunscald



Photooxidative Sunburn = too much light



Sunburn Necrosis = too much heat

Skin temps exceeding 105-108°F in peppers

Effects of Heat Stress in Peppers

Strategies to Combat Sunscald & Sunburn

- Irrigate
- Stake plants
- Protect foliage from disease
- Apply particle film
- Apply shade cloth



Trial Setup

- Trials in 2018 & 2019
- Bell pepper varieties 'Socrates' and 'Archimedes'
- Shade treatments:
 - No Shade
 - 30% Black
 - 30% Aluminet (silver)
 - 30% Red
 - 22% White
 - 40% White

Results Summary

- 30% black shade cloth treatment had significantly higher marketable yield than the other four shade treatments
- 30% black shade cloth increased marketable yield: 3x the marketable yield of no shade
- 30% black shade cloth increased the % marketable weight from 39% to 67% marketable.



Pepper Shade Timing Methods

Shade Treatments

- no shade
- June
- June/July
- July
- June/July/half August

Variety Treatments

- Anisotle
- Abay
- Milena
- Carmen

Production Procedures

- Double row plasticulture, staked
- Transplanted June 1, 2022
- Drip irrigated

Trial Setup

- Split plot design (variety subplots)
- 40 plants per plot (10/variety)
- 4 replications



Pepper Shade Timing Methods



Harvest

- Harvest began Aug 16
- Harvested weekly 8x
- Varieties weighed and graded separately
- Grade Categories:
 - Fancy
 - No. 1
 - Small (unmarketable)
 - Misshapen (unmarketable)
 - Sunscald/BER (unmarketable)





Canopy Temperature

- Temperature recorded at 5-minute intervals
- Used HOBOTemp Pendant Logger MX2202
- No Shade, June and June/July treatments
- 3 reps

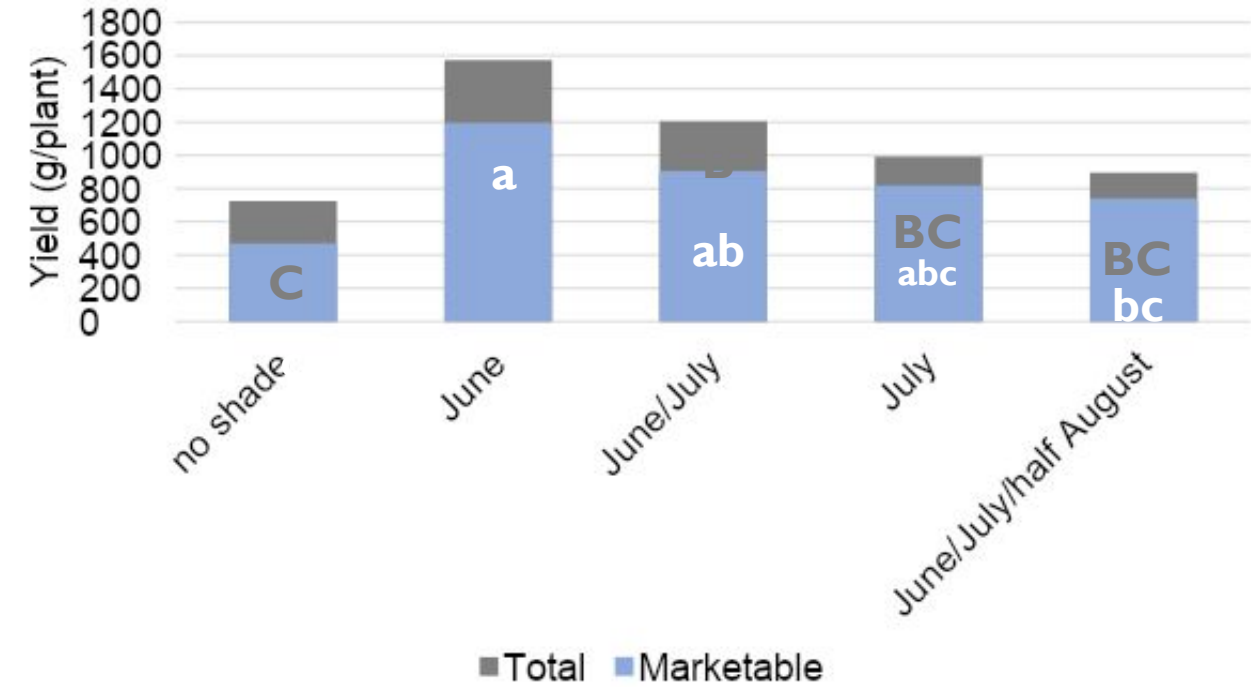
Soil Temperature

- Measured with temperature probe
- No Shade and June/July/Aug treatments
- 4 reps x 10 samples
- Measured in early afternoon on Jul 19

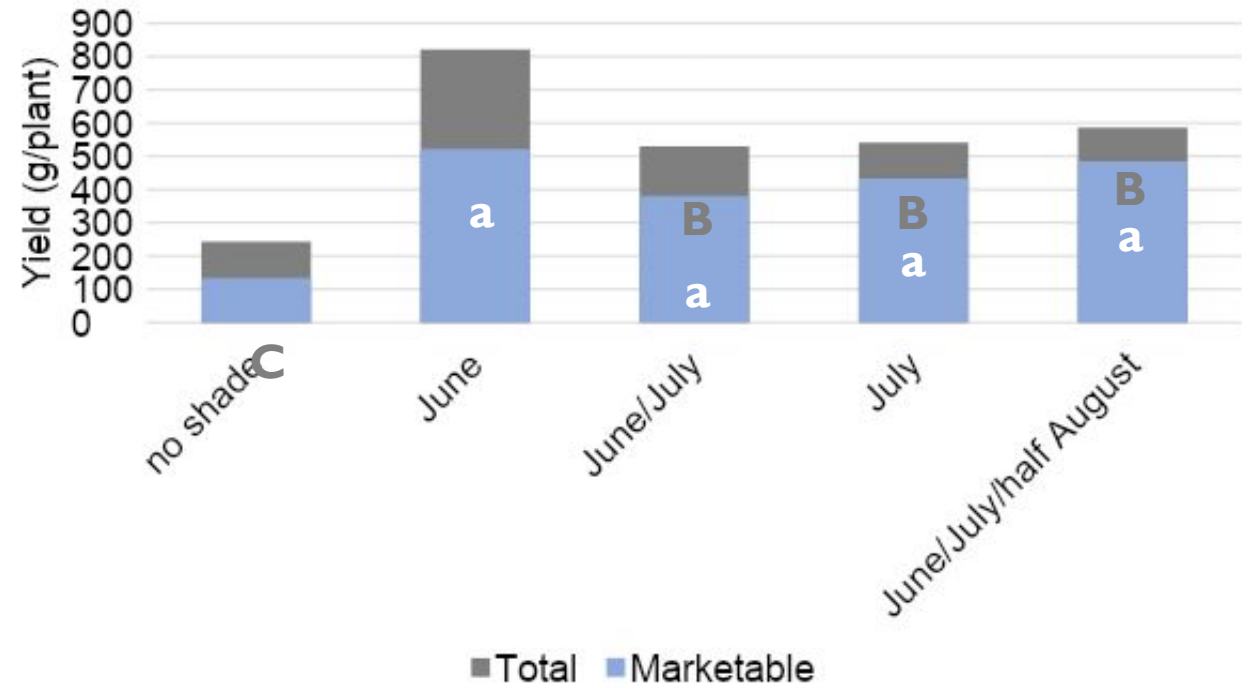


Pepper Shade Timing Total & Marketable Yields

Carmen Total & Marketable Yield



Bell Varieties Total & Marketable Yield



Pepper Shade Timing What does shade cloth do?

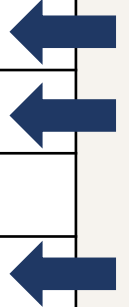
Increased Percent Marketable

| Trt | % Marketable |
|-------------|--------------|
| no shade | 52 c |
| Jun | 62 bc |
| Jun/Jul | 74 ab |
| Jul | 77 ab |
| Jun/Jul/Aug | 81 a |



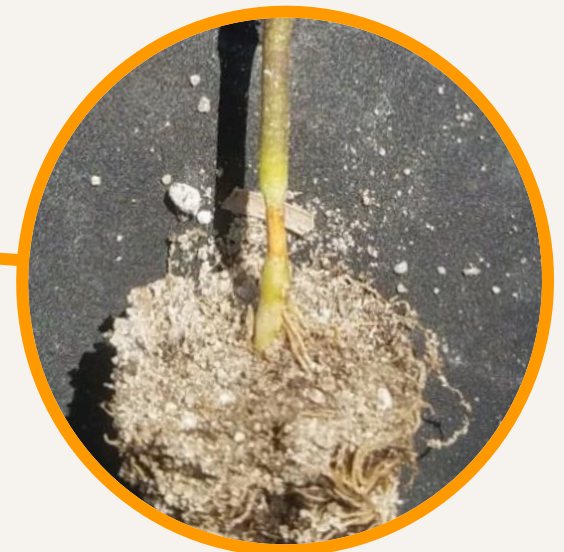
Increased Plant Survival

| Trt | % Survival |
|-------------|------------|
| no shade | 64 c |
| Jun | 97 a |
| Jun/Jul | 98 a |
| Jul | 81 b |
| Jun/Jul/Aug | 97 a |



Increased Fruit Size

| Trt | Avg Fruit Wt (g) |
|-------------|------------------|
| no shade | 71 c |
| Jun | 94 b |
| Jun/Jul | 110 ab |
| Jul | 110 ab |
| Jun/Jul/Aug | 123 a |



Pepper Shade Timing What does shade cloth do?



Pepper Shade Timing

What does shade cloth do?

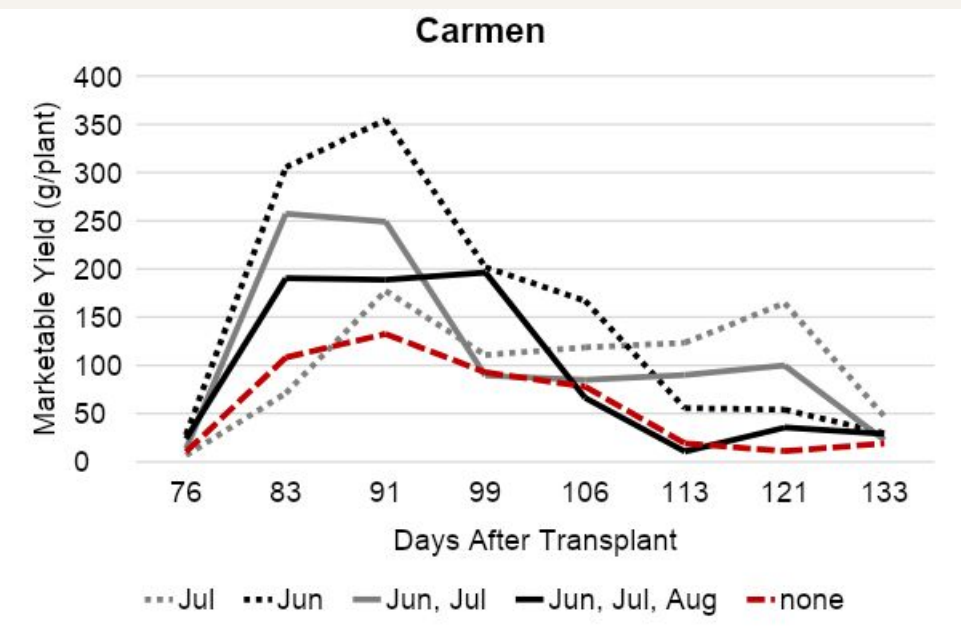
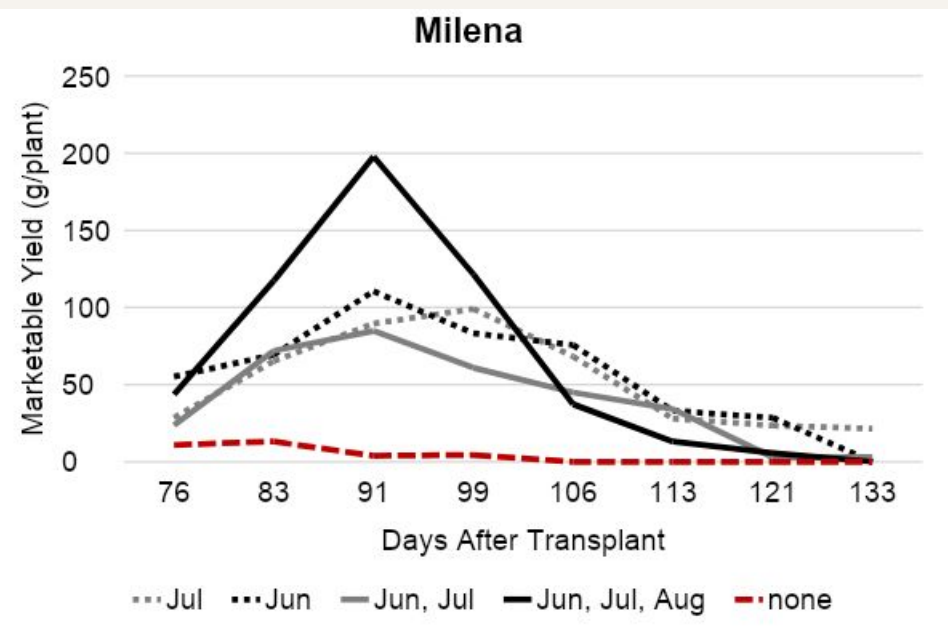
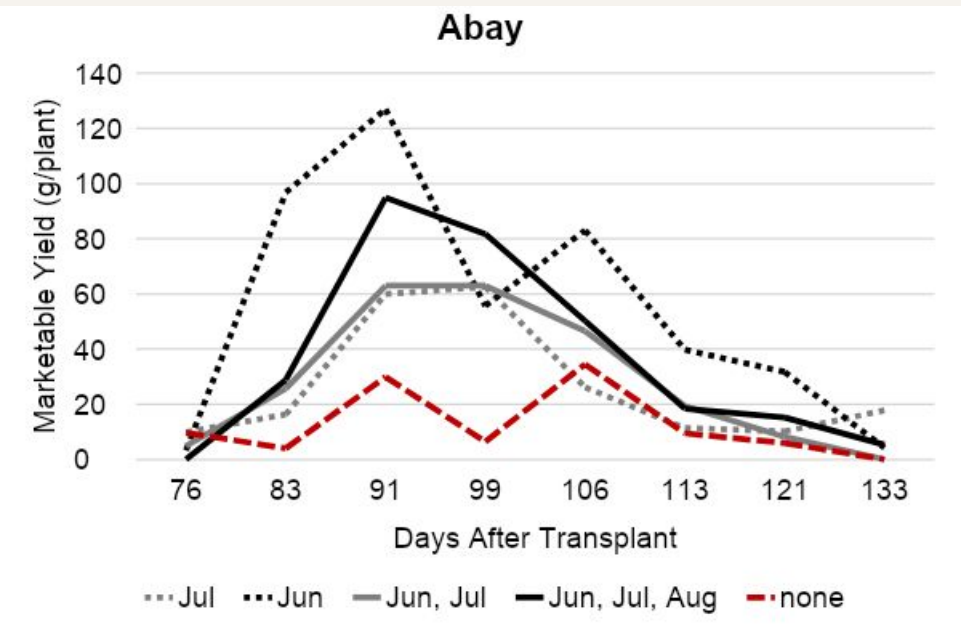
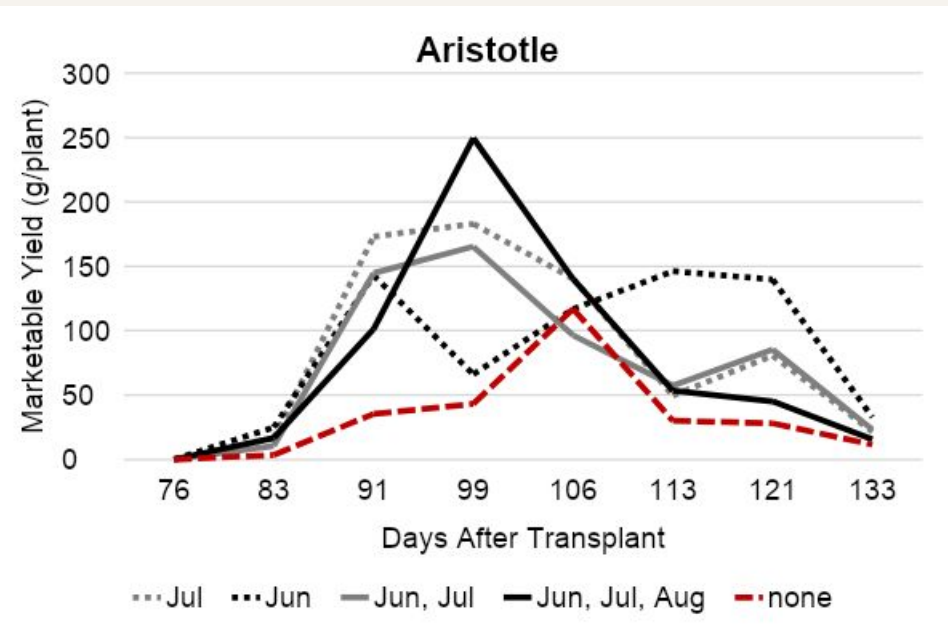


Unshaded Treatment Jul 20, 2022



Shaded Treatment Jul 20, 2022

Pepper Shade Timing Does shade cloth delay harvest?



Pepper Shade Timing Temperature Effects

Reduces Soil Temperatures

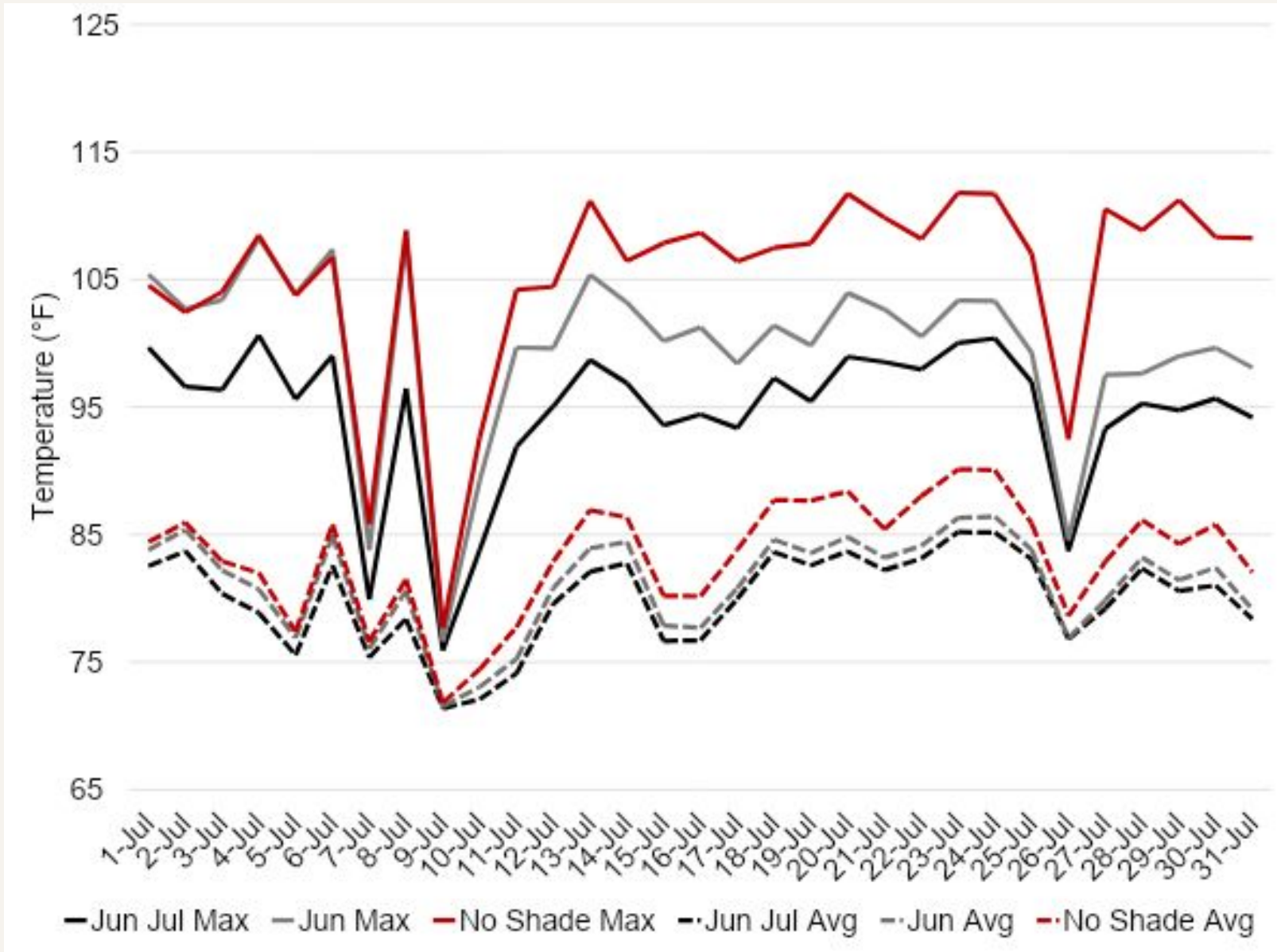
- 98 vs 85°F in mid July in early afternoon

Reduces Canopy Temperatures

- 3.4°F lower average daily temperature
- 10.6°F lower maximum daily temperature

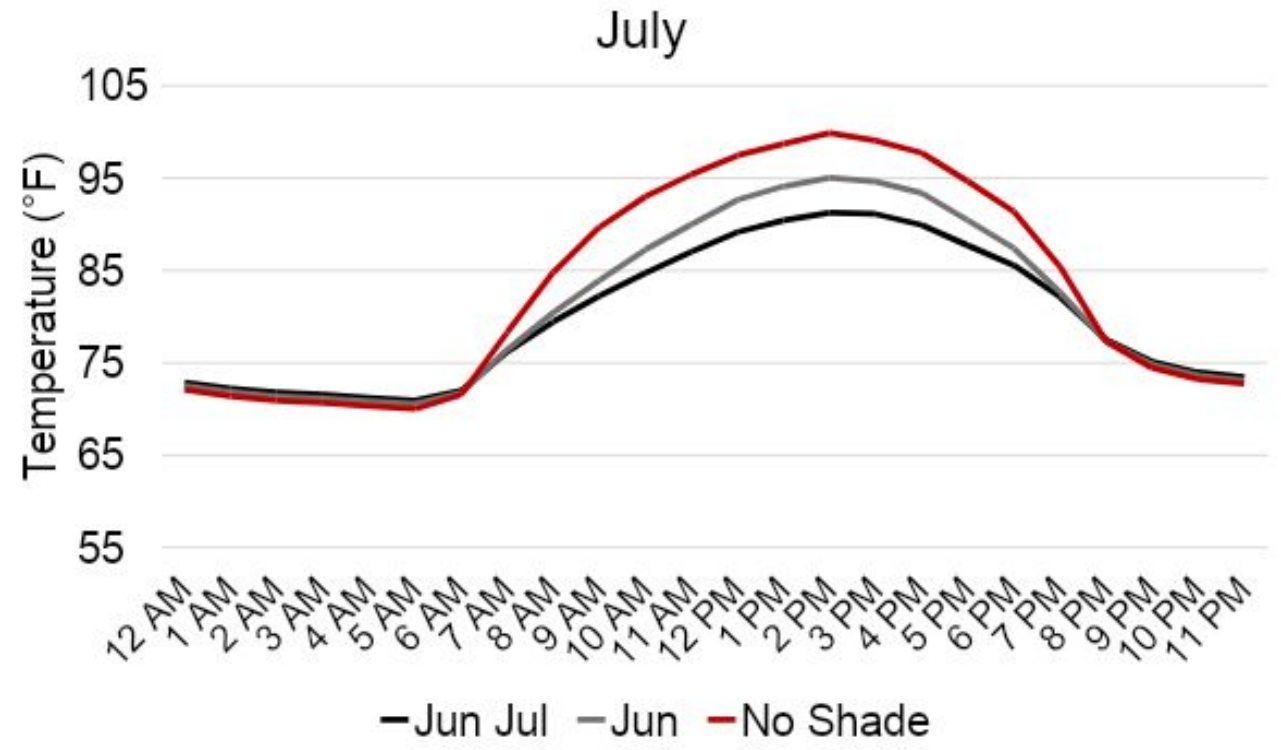
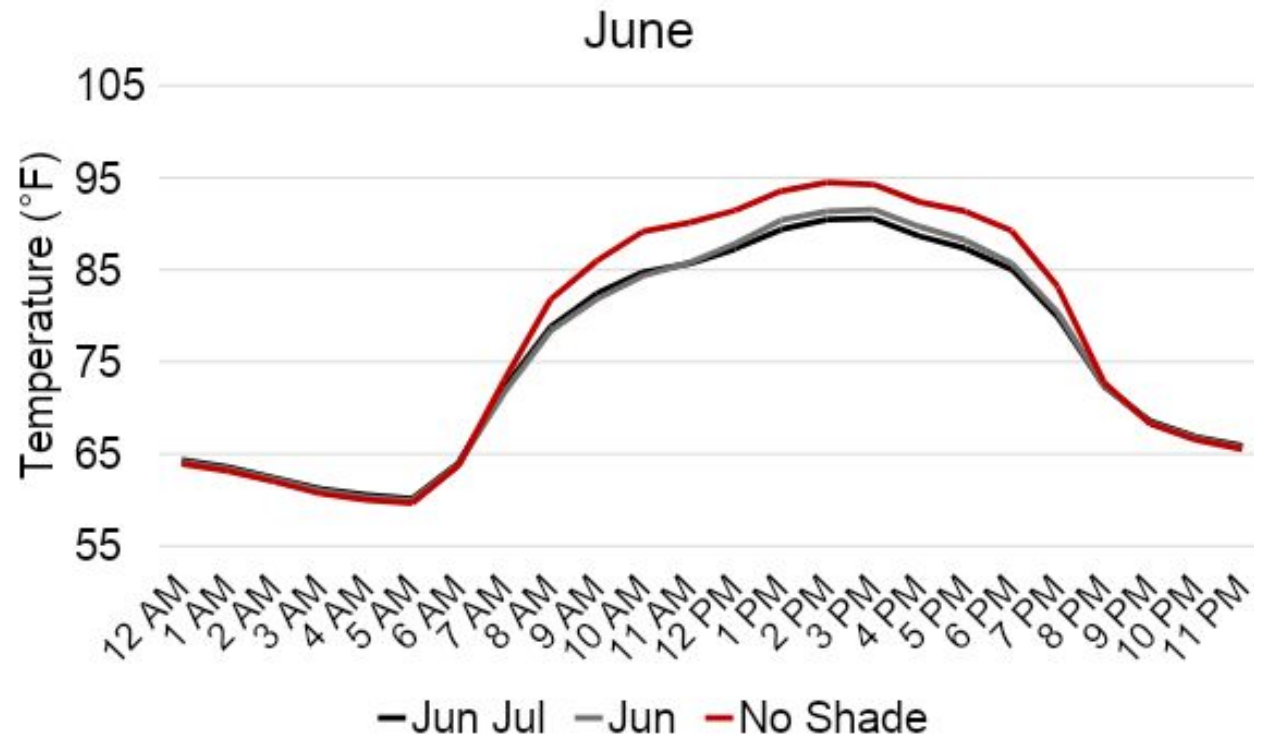


Average and Max Daily Temps in No Shade, Jun, & Jun/Jul



Pepper Shade Timing Temperature Effects

Hourly Average Temperatures



- Shade reduced daytime temperatures
- Shade slightly increased night temperatures
- Daytime temperature reductions greater in July than June
- Dense foliage also reduces canopy temperatures

2023 & 2024 Trials



Pepper Shade Timing Summary

- Shade increased total & marketable yield
- There are variety differences in yield response to shade
- Early shade increased plant survival in 2022
- Late shade increased fruit size and decreased defects
- Daily max temperatures more impacted than average temperature
- Shade did not delay maturity in 2022



Implementing Shade Cloth



Thank You



2022 Summer Crew

Aaron Doll
Mya Jones
Austin Truitt
Jenna Anger
Emily Jones
Amber Green

2023 Summer Crew

Mya Jones
Austin Truitt
Paige Sammons
Lily Hearn
Ketsia Murat
Arely Arriaga-Gonzalez

2024 Summer Crew

Lily Hearn
Ketsia Murat
Arely Arriaga-Gonzalez
Brayden Hearn
Twyla Beachy
Sam Cooke



Lyndsie Mikkelsen

Carvel Farm Staff

Funding

Specialty Crop Block Grant
Funding for the colored shade cloth research was made possible by a grant/cooperative agreement from the U.S. Department of Agriculture (USDA) Agricultural Marketing Service. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.