Spider Mite Biology and Identification
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David Kerns
Research & Extension Entomologist
LSU AgCenter
Macon Ridge Research Station
Winnsboro, LA
Mites Affecting U.S. Cotton
(19 species)

- Twospotted spider mite – *Tetranychus urticae*
- Carmine spider mite – *T. cinnabarinus*
- Strawberry spider mite – *T. turkestani*
- Pacific spider mite – *T. pacificus*
- Desert spider mite – *T. desertorum*

Identification
**Twospotted and Carmine**

**Carmine**
- Female is red

**Twospotted**
- Female greenish

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Host Range of Twospotted Spider Mite

- Cosmopolitan distribution
- Over 900 host species
  - 150 economically important plant species
    - Many ornamentals
    - Sorghum
    - Corn
    - Citrus
    - Cotton
    - Apples
    - Cucurbits
    - Pears
    - Beans
    - Eggplants
    - Tomato
    - Roses
Webbing

• Aid in courtship and mate finding
  – Webbing holds pheromone
  – Males use webbing to mark territory

• Locomotion and dispersal

• Microclimate manipulation

• Protection
  – Climate
  – Competitors
  – Natural enemies
  – Miticides
# Chronological Development

*(in days)*

<table>
<thead>
<tr>
<th>Life stage</th>
<th>Temperature (^{\circ})F</th>
<th>59</th>
<th>68</th>
<th>77</th>
<th>86</th>
<th>95</th>
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</thead>
<tbody>
<tr>
<td>Average adult lifespan</td>
<td></td>
<td>44</td>
<td>28</td>
<td>23</td>
<td>12</td>
<td>11</td>
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<tr>
<td>Egg to egg laying female</td>
<td></td>
<td>36</td>
<td>17</td>
<td>11</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Egg</td>
<td></td>
<td>14</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Larva</td>
<td></td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Protonymph</td>
<td></td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Deutonymph</td>
<td></td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Preoviposition female</td>
<td></td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Eggs laid per female</td>
<td></td>
<td>98</td>
<td>146</td>
<td>160</td>
<td>135</td>
<td>135</td>
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</table>

Life Cycle

**Parthenogenesis**

*Arrhenotoky*

Non-mated females lay haploid eggs which produce males

Mated females lay diploid eggs which produce females and males

Factors Affecting Population Growth

- Abiotic Factors
  - Temperature
    - $r_m$ increases with increased temps, but mites prefer moderate temps
  - Humidity/precipitation
    - Higher egg laying and survival at low humidity
  - Dusty conditions
    - Maybe due to impact on the effectiveness of predators

Factors Affecting Population Growth

- Biotic Factors
  - Host water stress
    - Decreased reproduction on water stressed hosts
  - Previous host
    - Adaptation to select hosts
  - Hosts previous exposure to mites
    - Plants with previous mites develop slight resistance
  - Leaf nitrogen, phosphorus and carbohydrates
    - Mite population growth positively correlated
  - Natural enemies
    - Predators and diseases
  - Pesticide use
    - Kill natural enemies
    - Kill mites
    - Stimulate reproduction

Figure 6: Common population cycle *T. urticae*

Natural Enemies

- Insect predators
  - Minute pirate bugs
  - Big-eyed bugs
  - Twice stabbed lady beetle
  - Western flower thrips
  - Sixspotted thrips
  - Lacewings
- Predatory mites
  - Phytoseiid mites
  - Tydeid mites
- Diseases
  - *Neozygites floridana*
Mite Predators

- Tydeid mites
- Sixspotted thrips
- Spider mite destroyer
- Phytoseiid mites
Impact of Insecticides on Mite Reproduction

- Imidacloprid applied as a systemic soil treatment or as a foliar spray has been demonstrated to increase mite fecundity and longevity.
  - Other neonicotinoids may elicit similar responses.

Initial Sources of Mites Infesting Cotton

• Overwintering
  – Induced by day length and temperature
  – Adult female (red form)
  – Seek out dark, humid areas such as leaf litter

• Weeds
  – Morning glory
  – Palmer amaranth
  – Many more

• Other crops
  – Soybeans
  – Corn
Green Bridge Concept

- Mites developing on spring weeds will move into adjacent cotton
  - Crowding
  - Host deterioration
  - Disperse by crawling or slight wind
Dispersal

- Disperse in response to host plant quality degradation
- Infestation intensity in one crop or weeds is often directly proportional to density in nearby crops or weeds
- Most dispersal is by pre-reproductive forms

Mechanisms
- Crawling
  - Primary method for movement to localized plants
- Aerial dispersal
  - Blown
  - Roping/ballooning
    - Primary method for moving longer distances (yards to miles)
- Phoresy
  - Carried on machinery

Feeding

- Pierce clusters of plant cells with their chelicerae.
- Use palpi to suck the palisade and mesophyll cells.
- Damaged cells in clusters.
Damage

- Initial damage appears as white specs, or stipules (Phase I).
- As mites persist and damage increases, the leaf reddens. (Phase II).

When to Treat for Spider Mites in Cotton
Current Threshold

**Louisiana Threshold:** Treat when mite infestations cause areas where plants have discolored leaves. Anticipate repeating applications in 5 days.

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**Texas:**

<table>
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<tr>
<th>Action threshold</th>
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<td>Treat when 50% of the plants show noticeable reddened leaf damage and the mite population is increasing</td>
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<tr>
<td>Spot treat when infestations are relegated to small areas.</td>
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<tr>
<td>Cease sampling and treating when NAWF = 5 + 650-750 DD60’s.</td>
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Objective
Infestation Timing*Yield

- RCBD, 4 Reps, 4 rows X 15 ft plots
- Only the two center rows infested
- Record stunting and injury at various timings
- Treatments included:
  - Non-infested
  - 3rd True Leaf
  - First Flower
  - First Flower + 200 HU
  - First Flower + 400 HU
  - Etc.
Evaluation of Yield Losses by Spider Mites
2009-2011 - Established Infestation (7)

Lbs Lint

<table>
<thead>
<tr>
<th>Condition</th>
<th>Lbs Lint</th>
</tr>
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<tr>
<td>Third Leaf</td>
<td>906.9</td>
</tr>
<tr>
<td>First Flower</td>
<td>1028.5</td>
</tr>
<tr>
<td>FF + 200</td>
<td>1059.1</td>
</tr>
<tr>
<td>FF + 400</td>
<td>1137.6</td>
</tr>
<tr>
<td>FF + 600</td>
<td>1170.1</td>
</tr>
<tr>
<td>FF + 800</td>
<td>1148.6</td>
</tr>
<tr>
<td>FF + 1000</td>
<td>1176.8</td>
</tr>
<tr>
<td>Non-Infested</td>
<td>1270.2</td>
</tr>
</tbody>
</table>

P < 0.01

e, d, cd, bc, b, bc, ab, a
Summary and Conclusions

Infestation Timing*Yield

- Early infestations significantly stunted plants
- Spider mites caused significant yield losses up to 800 HU past first flower
- No significant yield losses were observed at ≥800 HU
- Cotton should be protected at least until 1000 HU past first flower (approximately 35-45 days)
Mite Damage

Phase I damage

Phase II damage

Data from Australia suggests significant reduction in photosynthesis in leaves with Phase II damage
Threshold Evaluation

• We decided noticeable was a quick glance at a plant and seeing any reddening
• Very quick; glance and go “hit”
• No mite counting
• Treat at 30%, 50%, 70%, 90% and untreated (missed 30%)
• RCBD, 4 reps, Plots 4 rows x 60 ft
• Treated with Oberon 4 fl-oz/ac at each threshold
• Took yields
Mite infestation not apparent

Early Phase II damage apparent
Mite Hits

% Mite Hits

28 July, 2 August, 7 August, 12 August, 17 August, 22 August
Duration Matters

\[ y = 1415.39 - 0.61x \]

\[ R^2 = 0.75 \]
\[ P = 0.01 \]
Miticide Efficacy
Abamectin Activity

- Abamectin is a presynaptic nerve poison (GABA site)
- Translaminar
  - Has been shown to benefit from addition of crop oil
- Soft on beneficials
- Fast acting
- Short lived
- Active towards all motile stages
Bifenthrin Activity

• Bifenthrin is a pyrethroid (nerve poison)
• Non-translaminar
  – Contact activity
• Harsh on beneficials
• Fast acting
• Short lived
• Active towards all motile stages
• Resistance issues
• Coverage issues
Portal Activity

• Portal is a mitochondrial poison
• Non-translaminar
  – Contact activity
• Soft on beneficials
• Fairly fast acting
  – Temperature dependent
• Good residual activity
• Active towards all motile stages
  – Intoxicated adults cease feeding and laying eggs
  – Intoxicated immatures die during molting
  – Essentially the intoxicated mites are like non-feeding zombies
Oberon Activity

- Oberon inhibits lipid biosynthesis
- Translaminar
- Soft on most beneficials
- Can work fairly fast
  - Temperature dependent
  - Addition of COC can increase activity
- Good residual activity
- Most immediate activity occurs on motile stages-immature stages
  - Some sterility of females
  - Some ovicidal activity
Zeal Activity

- Zeal is a mite growth regulator
- Translaminar
- Soft on beneficials
- Can work surprisingly fast for a MGR
  - Temperature dependent
- Good residual activity
- Most activity occurs on late-immature stages (inhibits molting)
- Sterilizes adults
  - Lay in viable eggs
  - This is where long residual control comes from
Mite Efficacy
Mature Cotton – High Mite Population

Bossier City, LA 2012
Early August

Motiles per 10-inch²

- Untreated
- Athena 8 oz
- Abba 6 oz
- Brigade 6.4 oz
- Portal 16 oz
- Zeal 1 oz
- Oberon 4 oz

0 DAT
7 DAT
14 DAT
Miticide Efficacy
Mid-season / Short Stature Cotton
Texas High Plains

7 days after treatment

Mites per 10 leaves

- Untreated
- Epi-Mek 6 fl oz
- Epi-Mek 8 fl oz
- Oberon 4 fl oz
- Brigade 5 fl oz
- Zeal 0.75 oz
- GWN-1708 16 fl oz
- Onager 12 fl oz

Adults
Immatures