Spider Mite Biology and Identification

Louisiana Agricultural Technology & Management Conference

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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*

Leigh T. F. 1985. Cotton. *In* Spider Mites: Their Biology, Natural Enemies and Control. Vol 1B, W. Helle and M. W. Sabelis, eds. pp. 349-358. Elsevier, NY.

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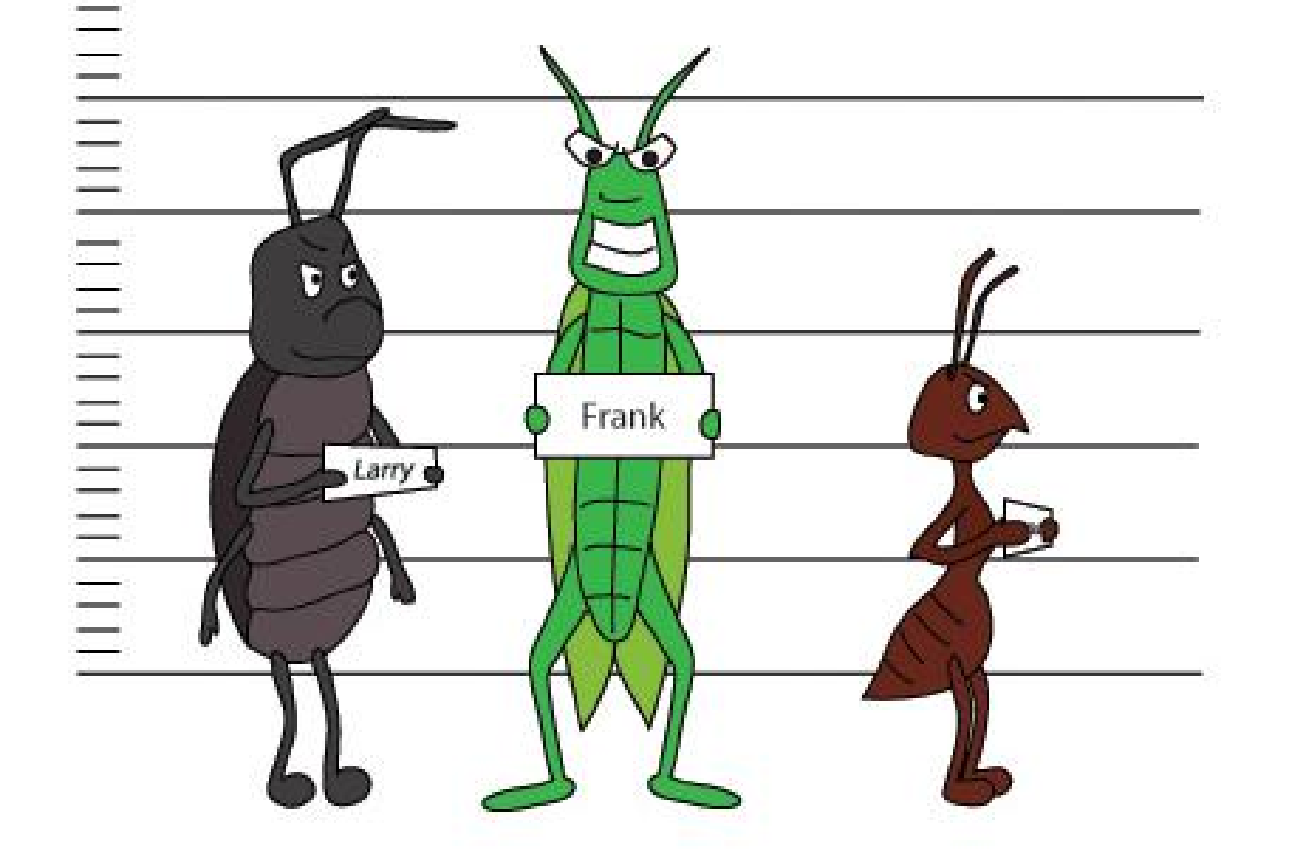
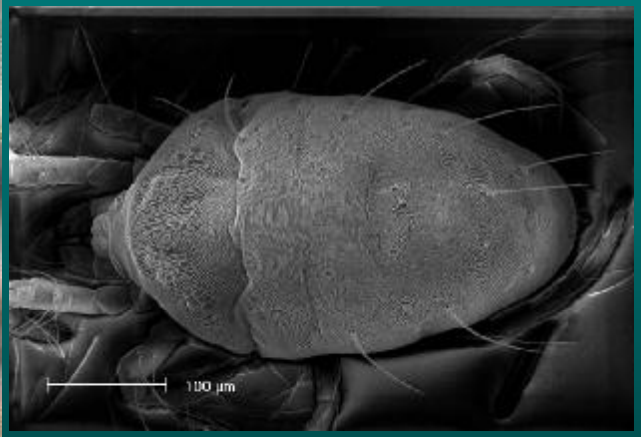
Identification

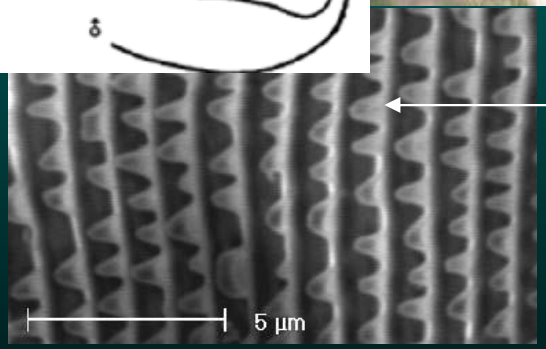


Twospotted and Carmine

Carmine
•Female is red

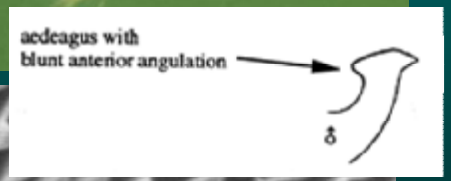


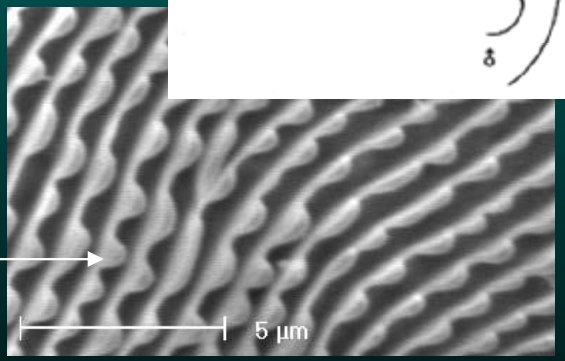
Twospotted
•Female greenish



Striae pointed and tall as broad

Striae rounded





Carbonnelle, S. and T. Hance. 2004. Cuticular lobes in the *Tetranychus urticae* complex (Acari: Tetranychidae): a reliable taxonomic character? Belg. J. Zool. 134: 51-54

Tuttle, D. M. and E. W. Baker. 1968. Spider Mites of the Southwestern United States and a Revision of the Family Tetranychidae, p 143. Univ. of Ariz. Press, Tucson, AZ

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Spider Mite Biology and Ecology

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Host Range of Twospotted Spider Mite

- Cosmopolitan distribution
- Over 900 host species
  - 150 economically important plant species

–Many ornamentals
–Corn
–Cotton
–Cucurbits
–Beans
–Tomato
–Sorghum
–Citrus
–Apples
–Pears
–Eggplants
–Roses

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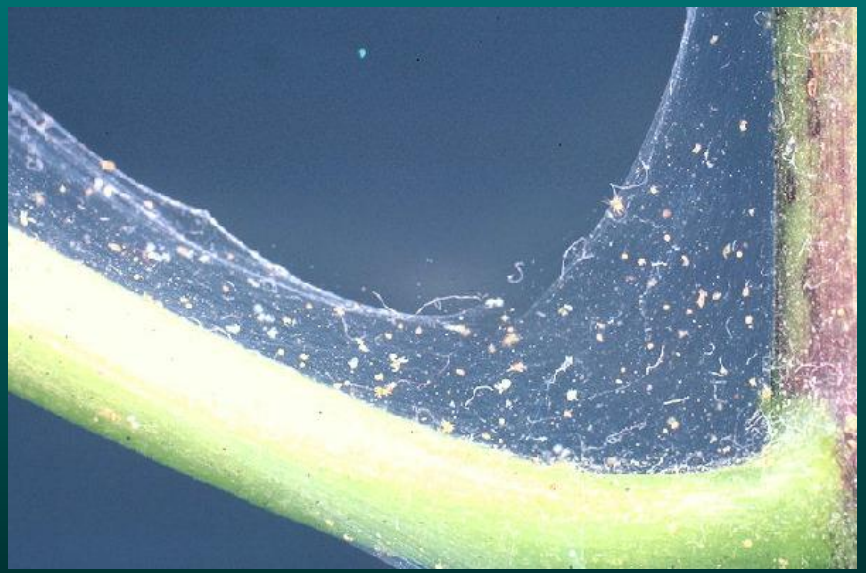
Webbing

- 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



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Chronological Development

(in days)

Life stage	*Temperature (°F)*				
	59	68	77	86	95
Average adult lifespan	44	28	23	12	11
Egg to egg laying female	36	17	11	7	6
Egg	14	7	4	3	2
Larva	7	3	2	1	1
Protonymph	5	2	2	1	1
Deutonymph	7	3	2	1	1
Preoviposition female	4	2	1	0.5	0.5
Eggs laid per female	98	146	160	135	135

Mondal, M. and N. Ara. 2006. Biology and fecundity of the two-spotted spider mite, *Tetranychus urticae* Koch. (Acari: Tetranychidae) under laboratory conditions. J. Life Earth Sci. 2: 43-47

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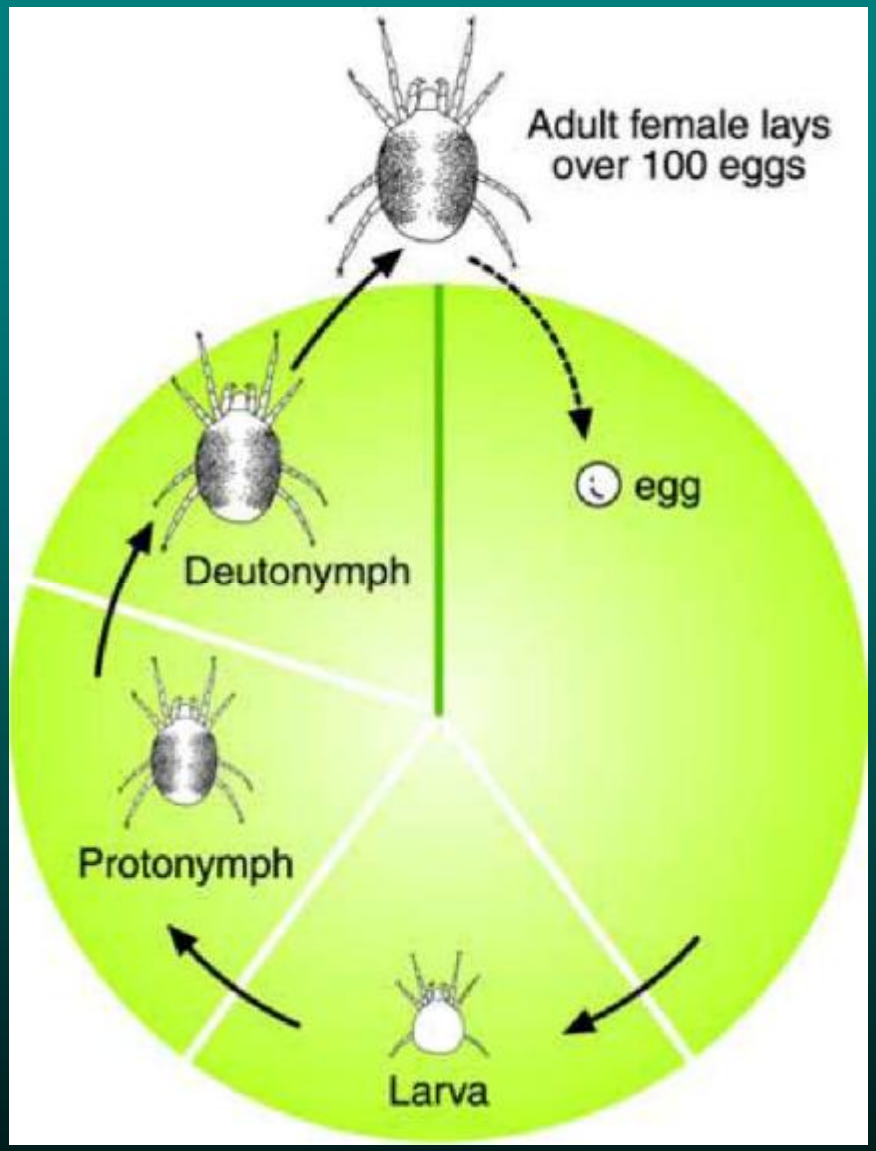
Life Cycle



Parthengenesis Arrhenotoky

Non-mated females lay haploid eggs which produce males

Mated females lay diploid eggs which produce females and males

Martin, N. A. 2000. Two-spotted mite biology, identification and life cycle, New Zealand Institute for Crop Prot.

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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

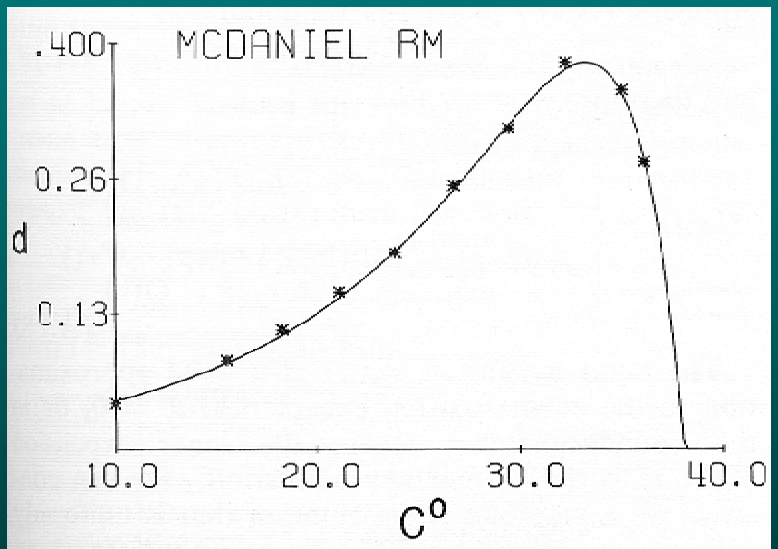

FIG. 6.—Instantaneous population growth rate as a function of temperature for *T. mcdanieli*.

Logan, J. A., D. J. Wollkind, S. C. Hoyt and L. K. Tanigoshi. 1976. An analytic model for description of temperature dependent rate phenomena in arthropods. Env. Entomol. 5: 1133-1140.

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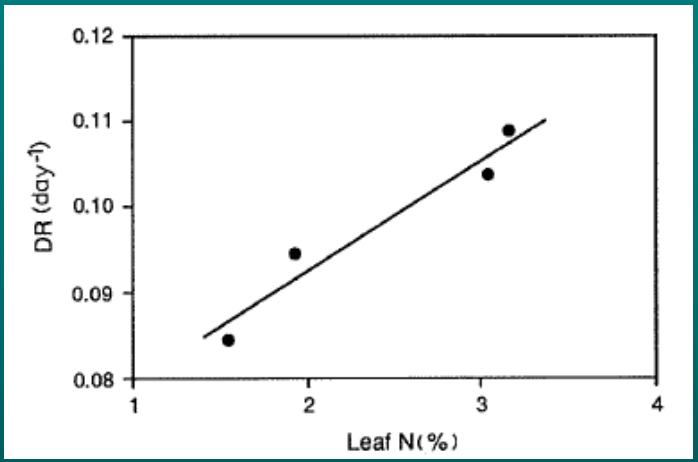
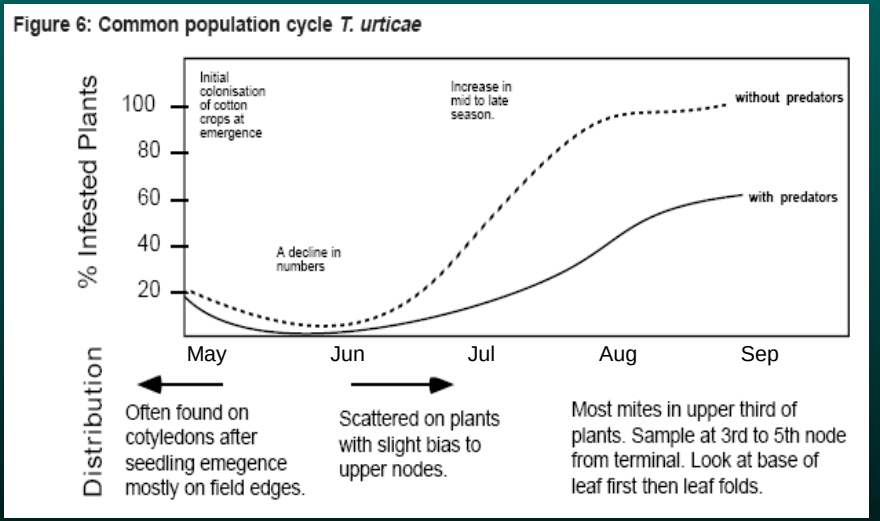
Factors Affecting Population Growth

- 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





Martin, N. A. 2000. Two-spotted mite biology, identification and life cycle, New Zealand Institute for Crop Prot.

Wermelinger, Bb, J. J. Oertli and J. Baumgartner. 1991. Environmental factors affecting the life-tables of *Tetranychus urticae* Koch (Acari: Tetranychidae). III. host-plant nutrition. Exp. & appl. Acar. 12: 259-274.

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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

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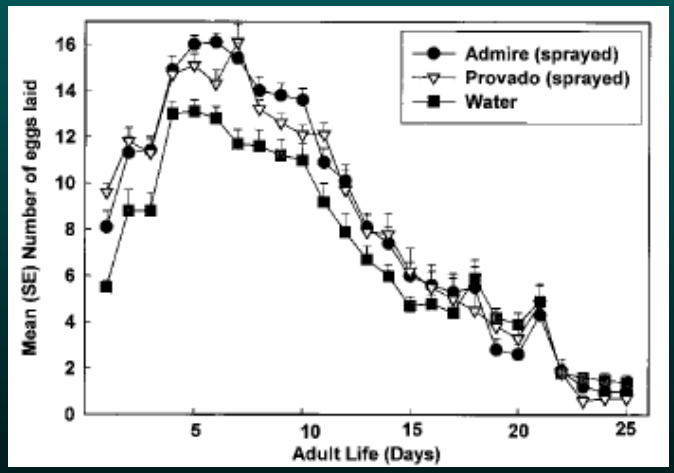
Impact of Insecticides on Mite Reproduction

- 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

Table 1. Effect of imidacloprid (0.013% [AI], Admire 2 Flowable) sprays on egg production of *T. urticae* during the first 12 d of adulthood, compared with water-only spray (experiment 1)

Replicate and Treatment	Mean (±SE) egg production	
	Daily	12-d period
1		
Admire	*14.3 (0.8)	*172.6 (8.6)
Water	12.6 (0.4)	150.1 (7.7)
2		
Admire	*16.2 (1.0)	*194.6 (4.3)
Water	12.9 (0.7)	155.1 (5.2)
3		
Admire	*16.3 (0.7)	*195.6 (5.4)
Water	14.8 (0.5)	177.7 (5.3)
Overall (1–3)		
Admire	*15.6 (0.5)	*187.6 (6.1)
Water	13.4 (0.5)	160.9 (6.9)

*, All means for Admire were significantly greater than for corresponding water treatments ($P < 0.05$, t-test).



James, D. G. and T. S. Price. 2002. Fecundity of two spotted spider mite (Acari:Tetranychidae) is increased by direct and systemic exposure to imidacloprid. J. Econ. Entomol. 95: 729-732.

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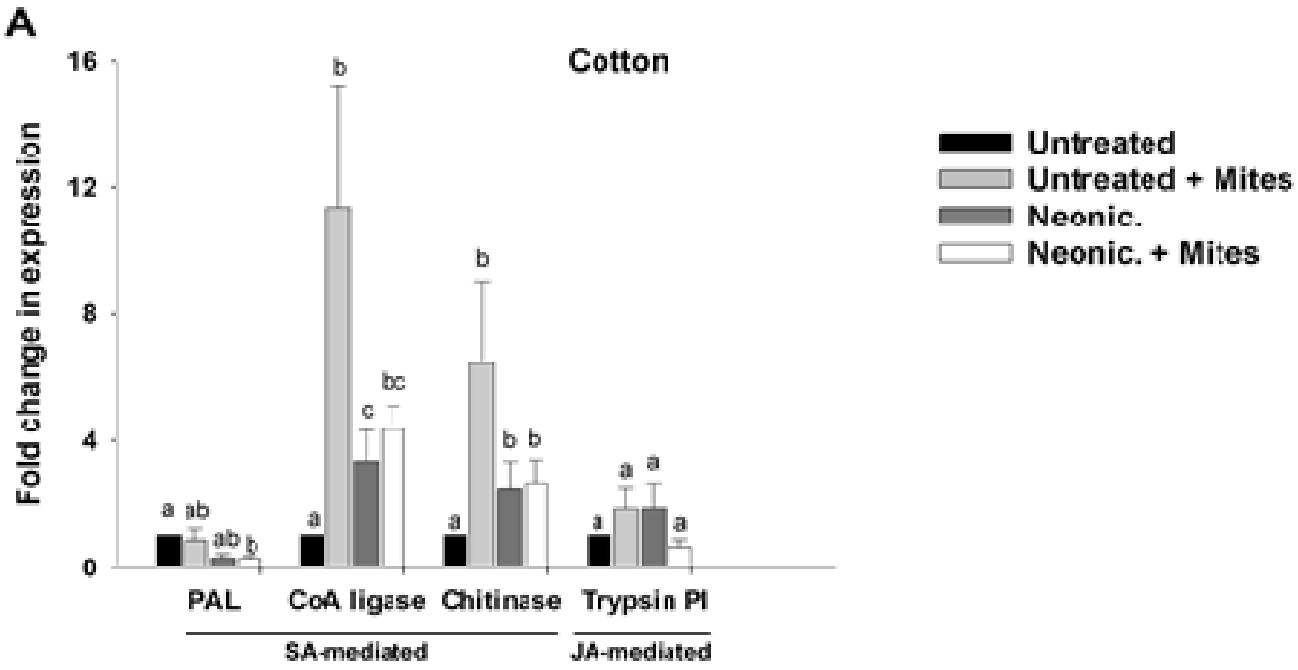

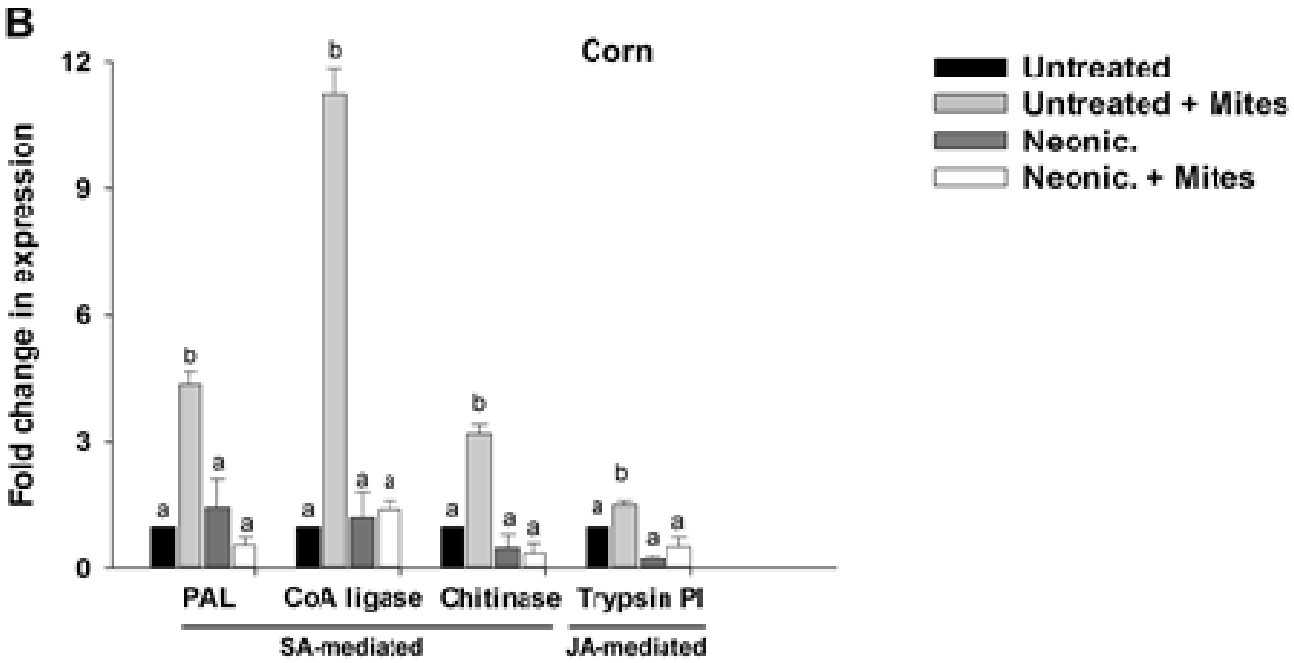

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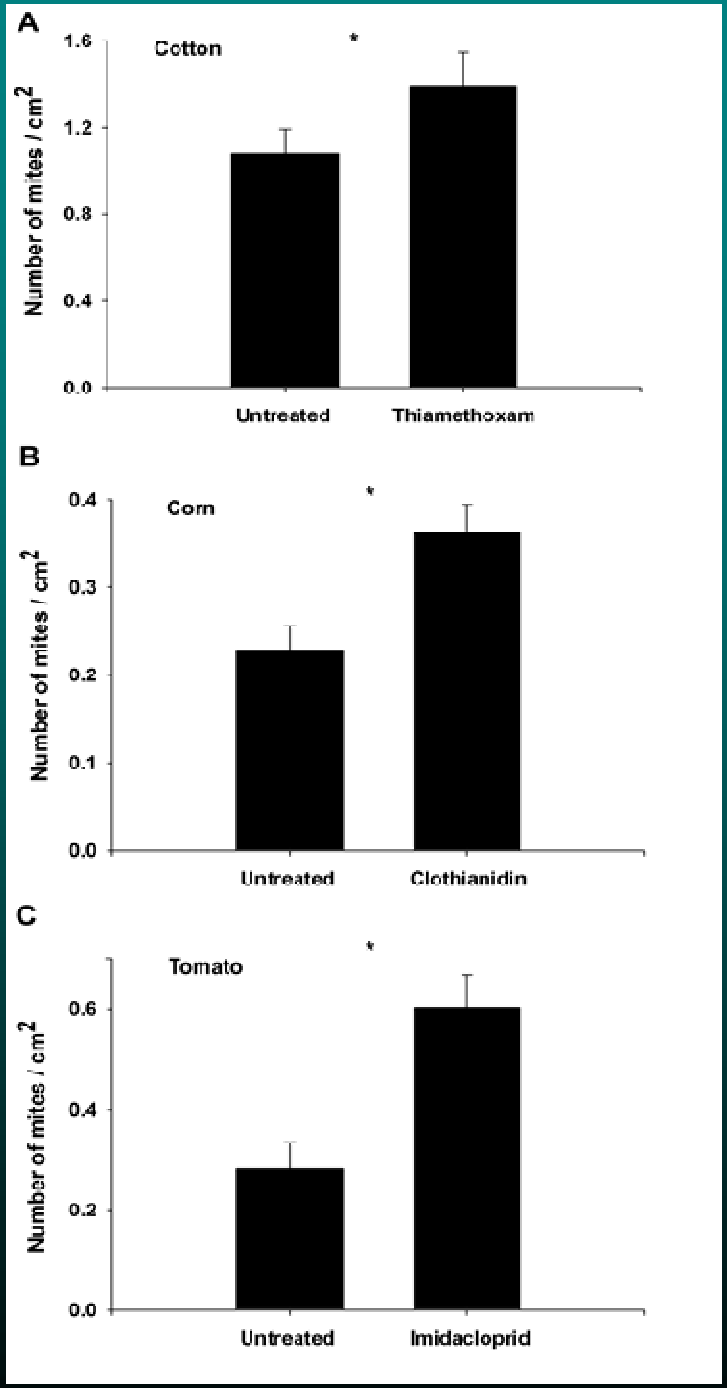
A
Cotton
*
Number of mites / cm2
1.6
1.2
0.8
0.4
0.0
Untreated
Thiamethoxam
B
Corn
*
Number of mites / cm2
0.4
0.3
0.2
0.1
0.0
Untreated
Clothianidin
C
Tomato
*
Number of mites / cm2
0.6
0.4
0.2
0.0
Untreated
Imidacloprid

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

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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

Kennedy, G. G. and D. R. Smitley. 1985. Dispersal. *In* Spider Mites: Their Biology, Natural Enemies and Control. Vol 1A, W. Helle and M. W. Sabelis, eds. pp. 233-252. Elsevier, NY.

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Feeding

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

Photo Courtesy of Washington State University

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Damage

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

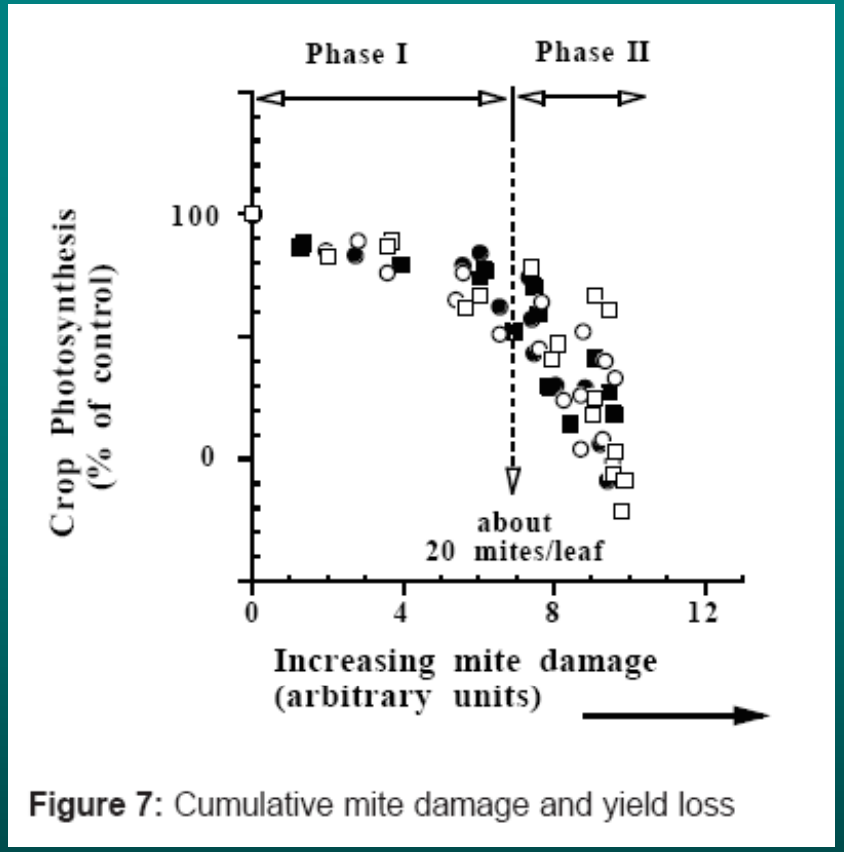

Figure 7: Cumulative mite damage and yield loss

Wilson, L. and V. Sadras. 1997. Mite Ecology on Cotton. CRC Newsletter for Research and Extension Education Program, Vol. 3 (4) 6 p.

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When to Treat for Spider Mites in Cotton

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Current Threshold

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

Texas: **Spider Mite Action Threshold**

Action threshold
Treat when 50% of the plants show noticeable reddened leaf damage and the mite population is increasing

Spot treat when infestations are relegated to small areas.
Cease sampling and treating when NAWF = 5 + 650-750 DD60's.

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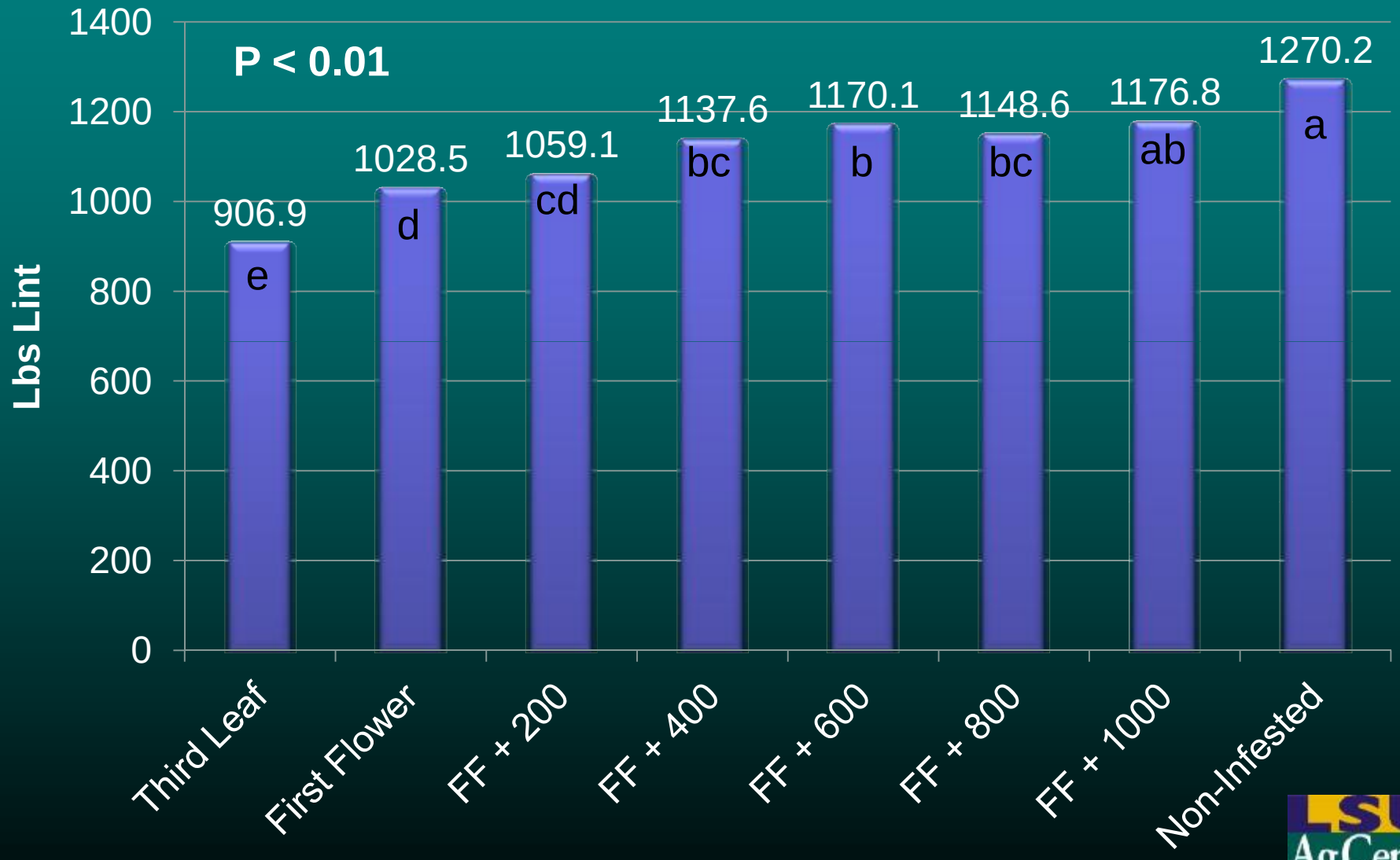
Objective
Infestation Timing*Yield

- 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)



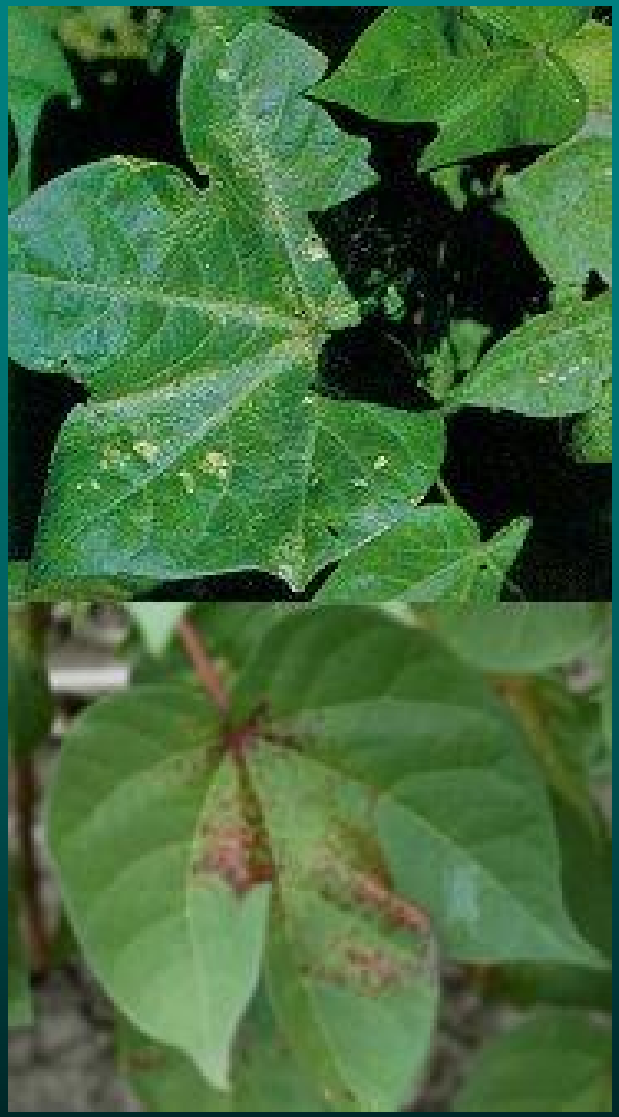
Summary and Conclusions
Infestation Timing*Yield

- 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

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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

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Test Area From Road

Mite infestation not apparent

Test Area In Field

Early Phase II damage apparent

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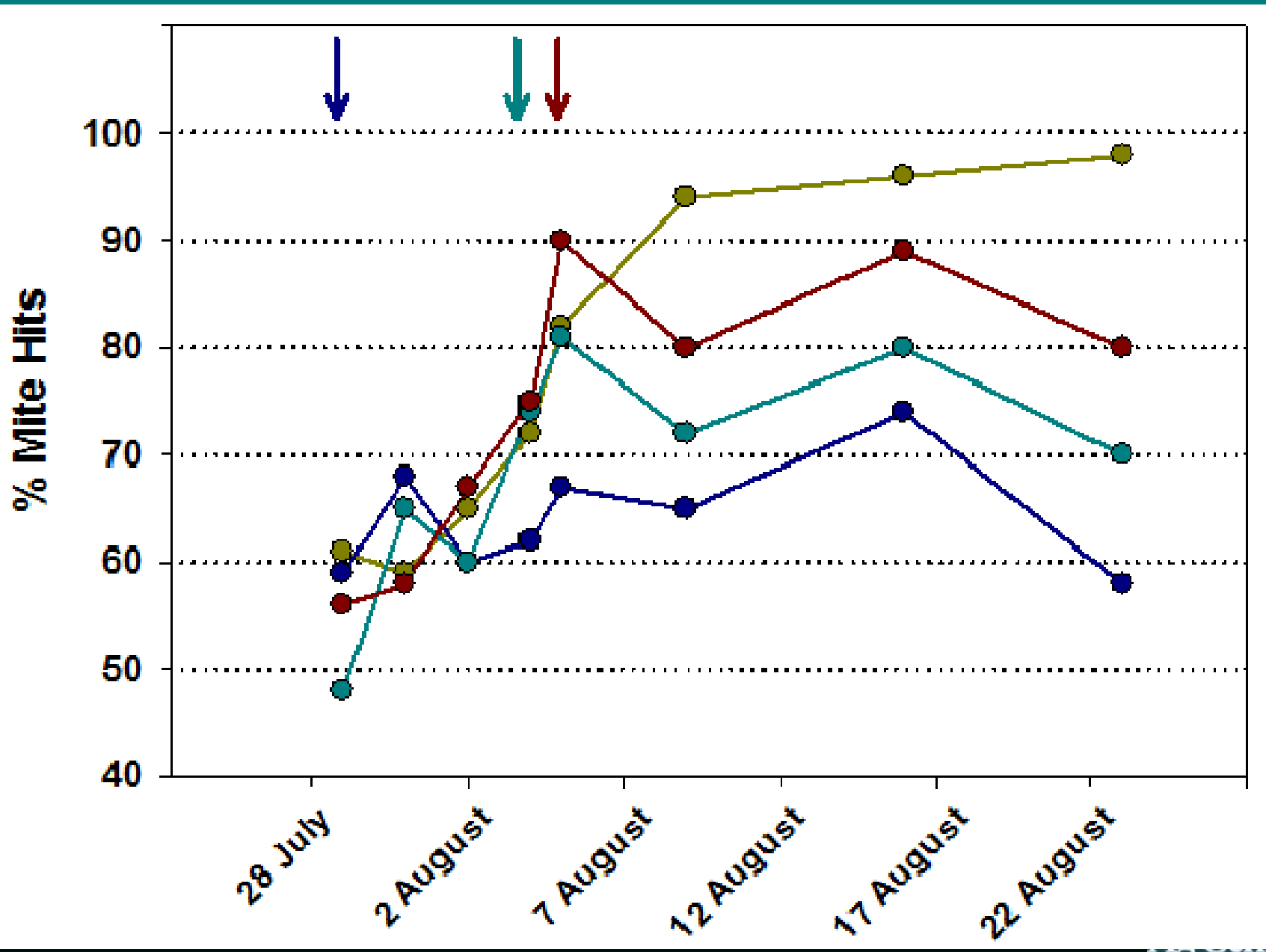
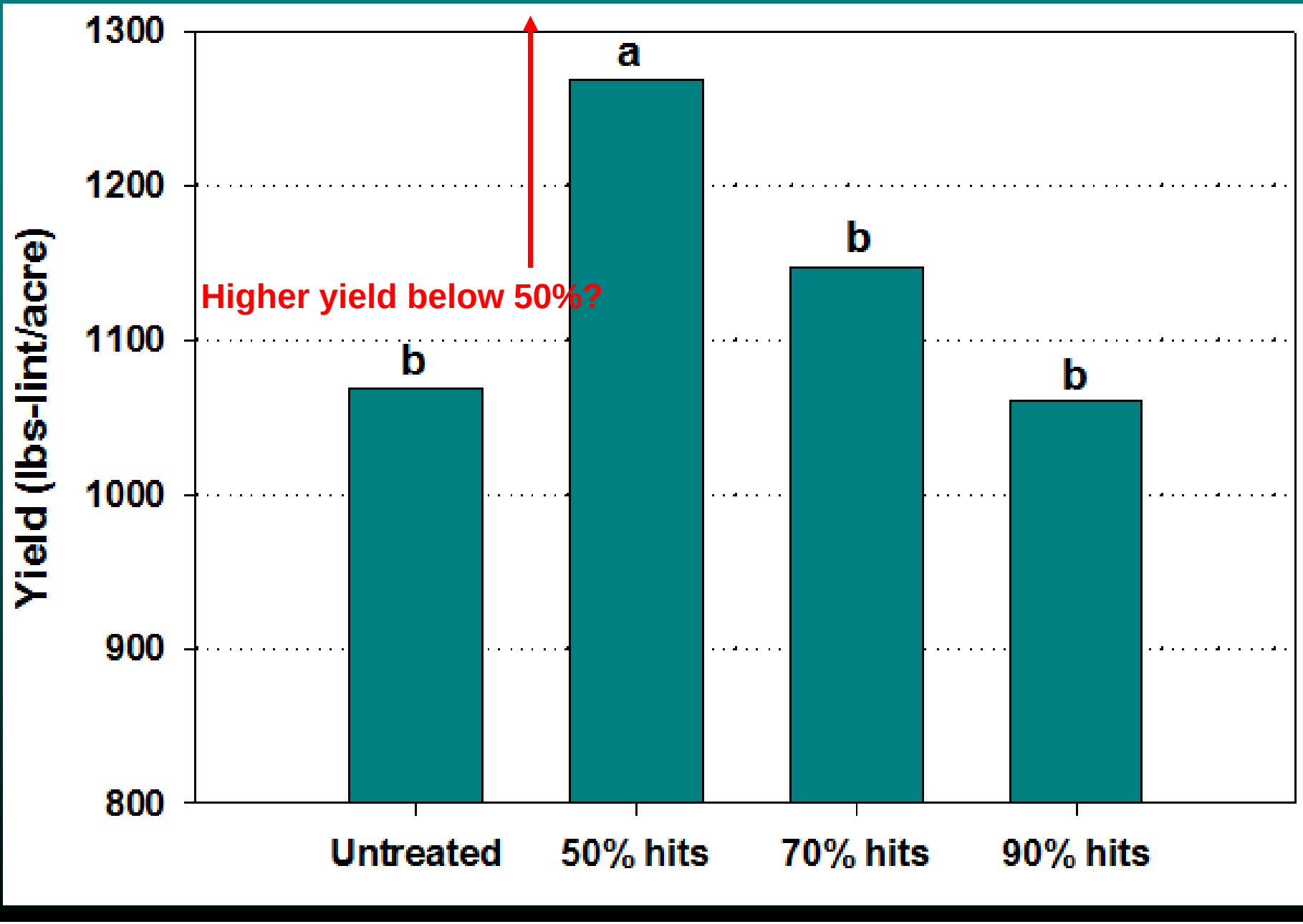
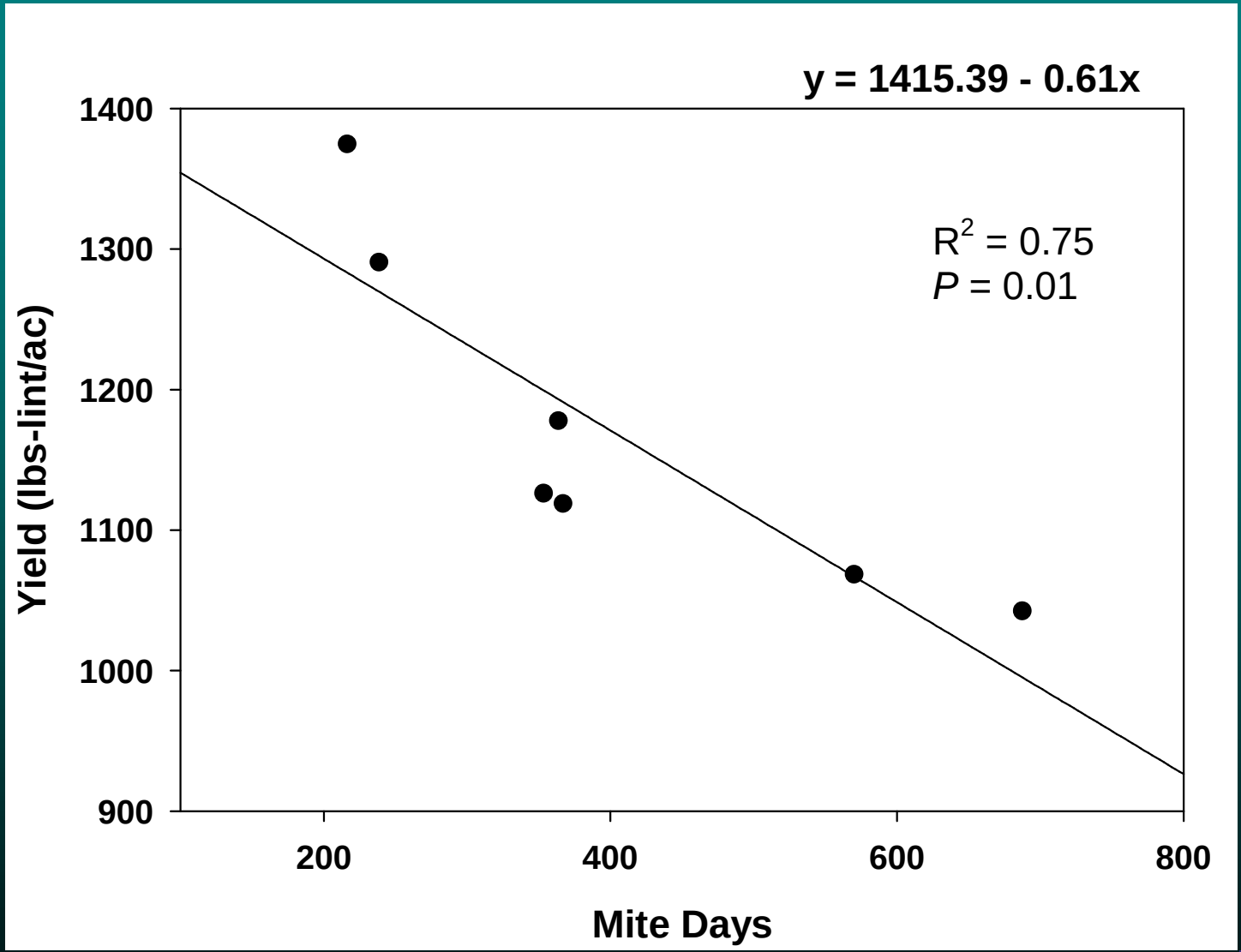
Mite Hits


% Mite Hits
100
90
80
70
60
50
40
28 July
2 August
7 August
12 August
17 August
22 August

Yields


1300
1200
1100
1000
900
800
Yield (lbs-lint/acre)
a
b
b
b
Higher yield below 50%?
Untreated
50% hits
70% hits
90% hits

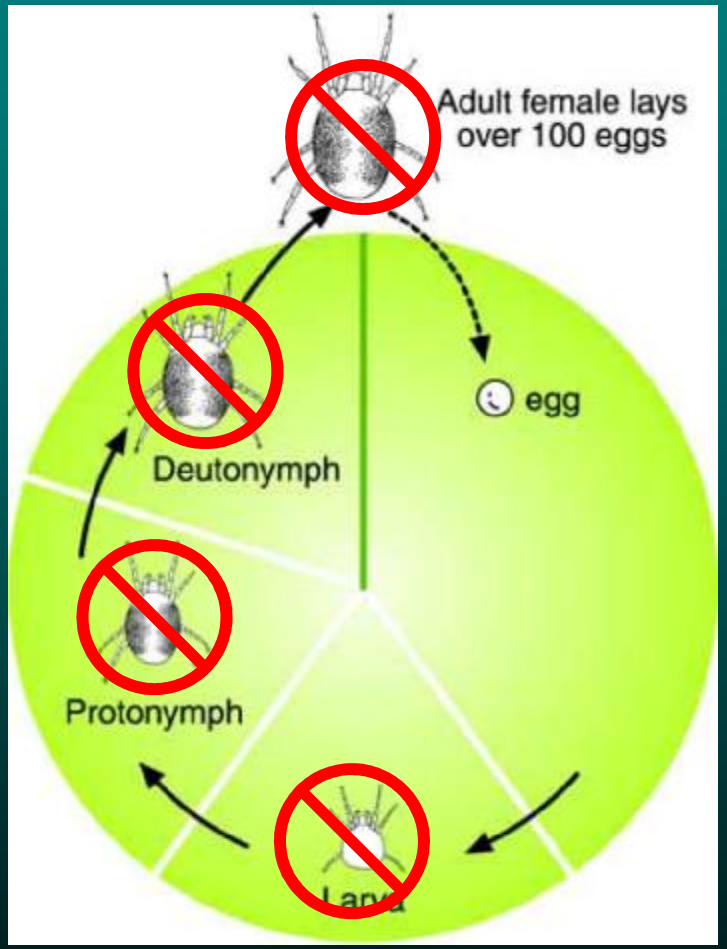
Duration Matters



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



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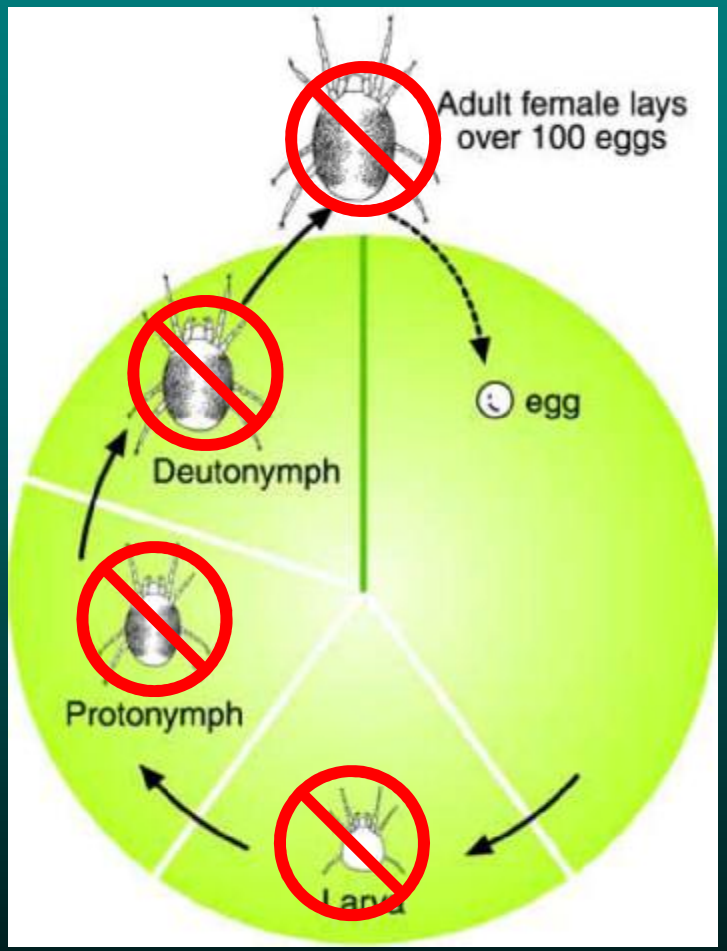
Bifenthrin Activity

- 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



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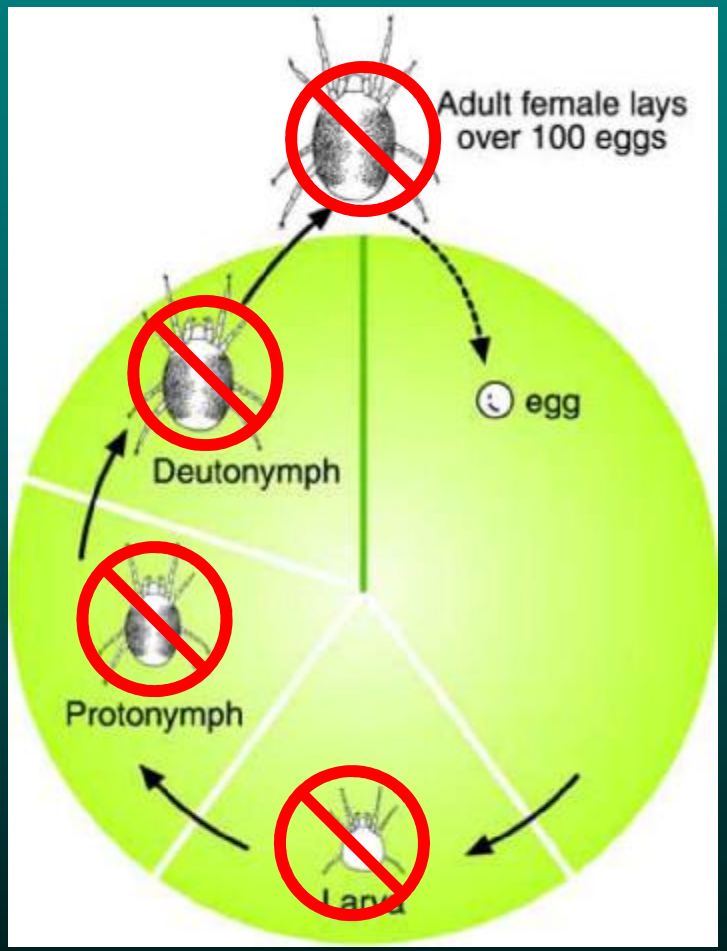
Portal Activity

- 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



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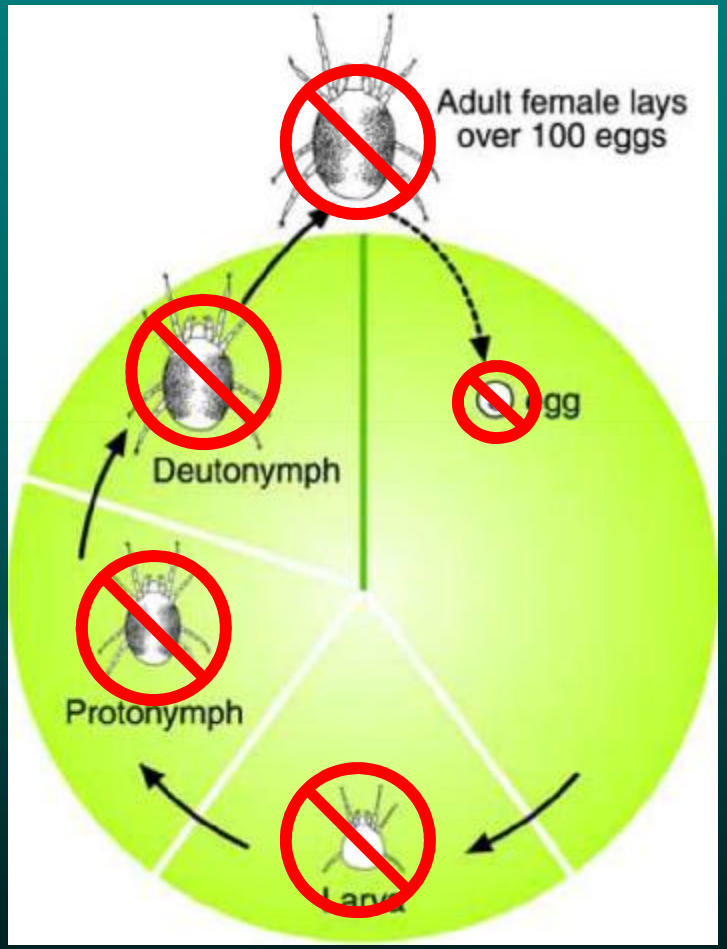
Oberon Activity

- 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 ovicidial activity



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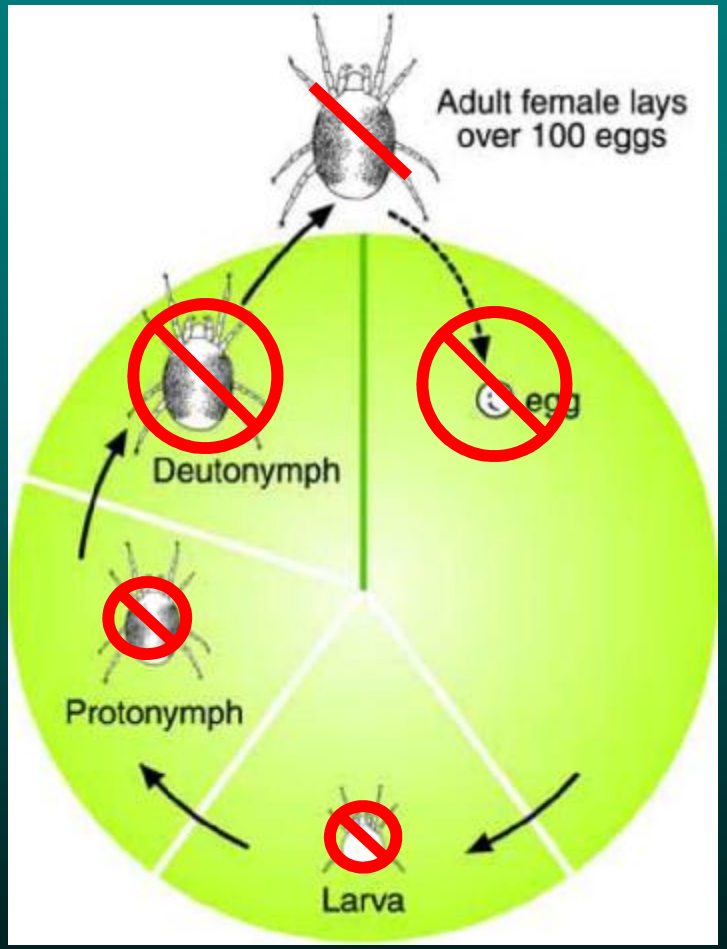
Zeal Activity

- 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



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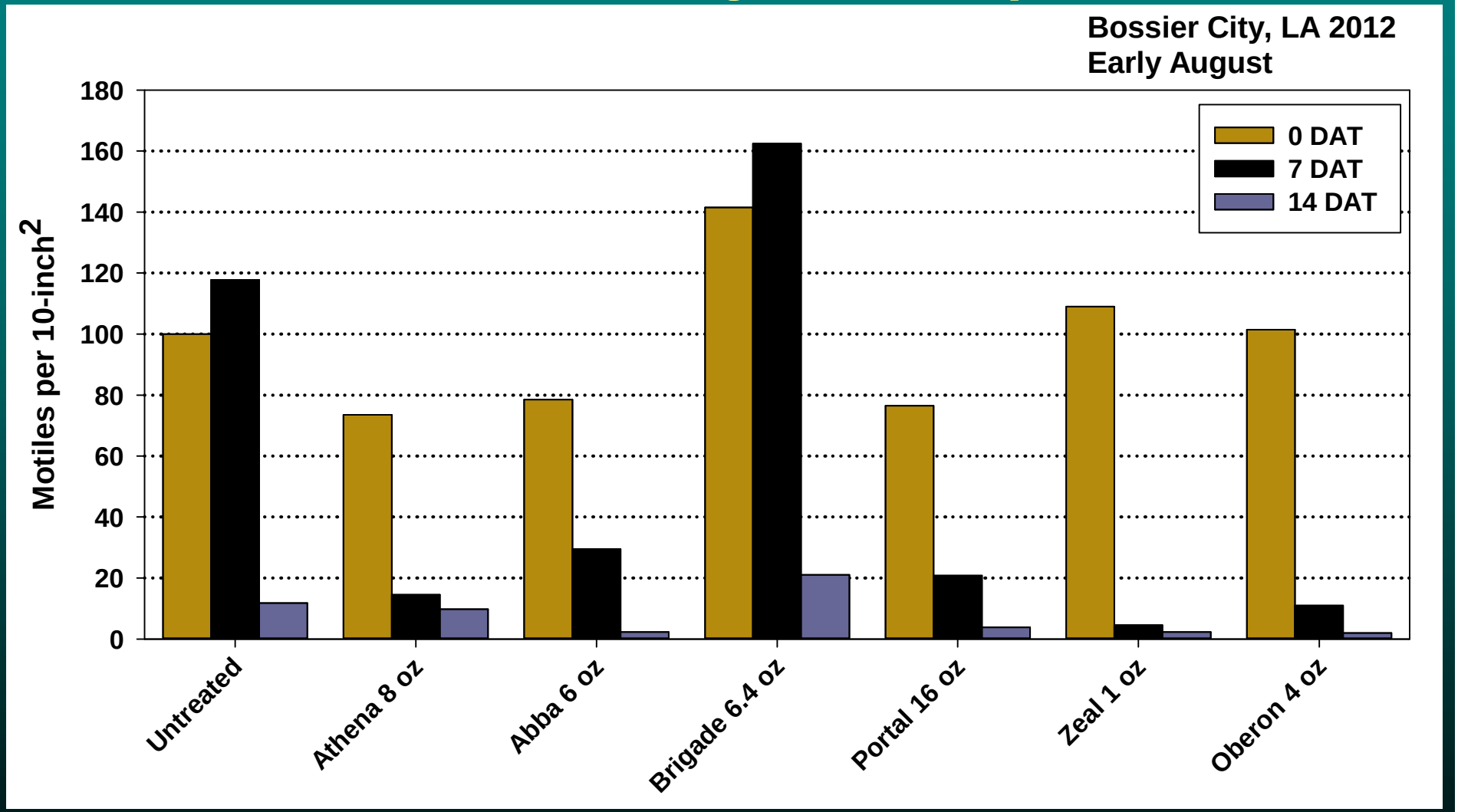
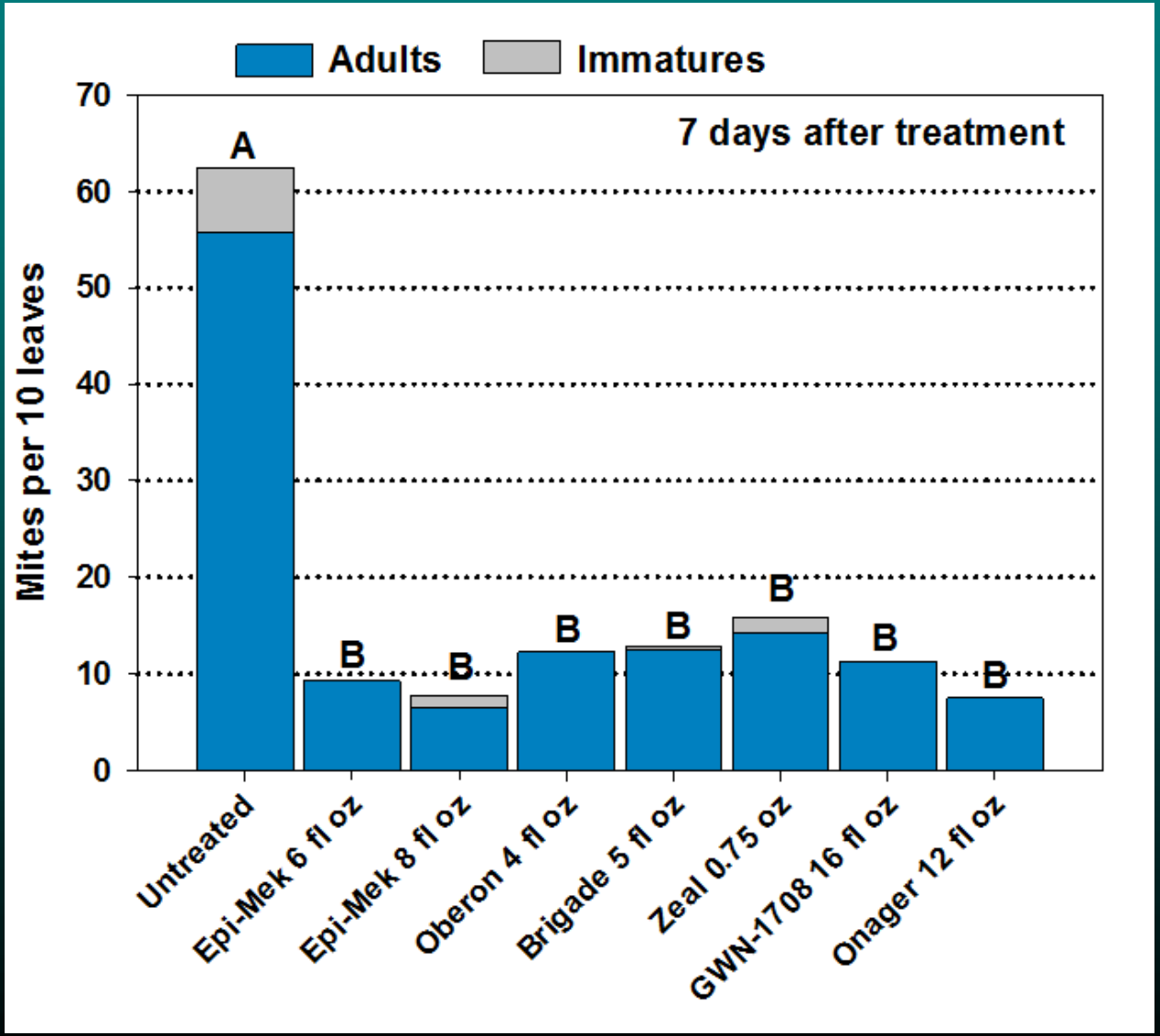
Miticide Efficacy

Mature Cotton – High Mite Population



Miticide Efficacy

Mid-season / Short Stature Cotton
Texas High Plains



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