



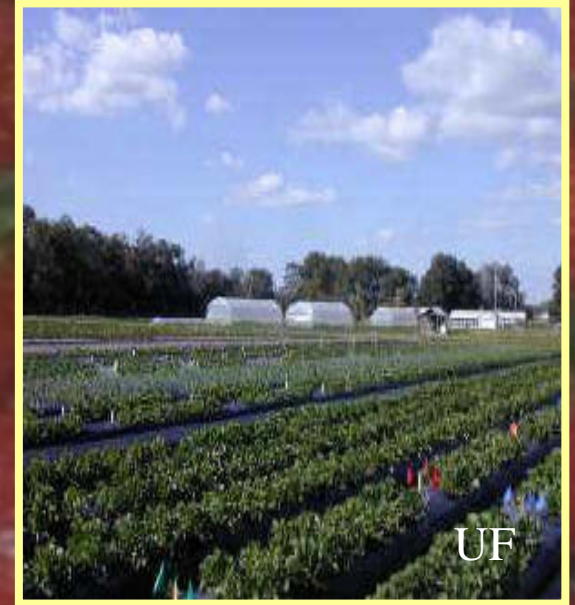
**Effects of Soil Moisture and Predatory
Mites on Populations of Twospotted
Spider Mites**

Oscar E. Liburd, Ph.D.

University of Florida,
Entomology and Nematology
Gainesville, Florida

Florida Strawberry Production

- Florida produces 7,000 acres of strawberry with a farm gate value of 170 million dollars
- Production is located mainly in Central Florida
- Two pests are recognized:
 - Twospotted spider mite (Acari: Tetranychidae)
 - Sap beetles (Coleoptera: Nitidulidae)



Key pests of strawberries in Florida



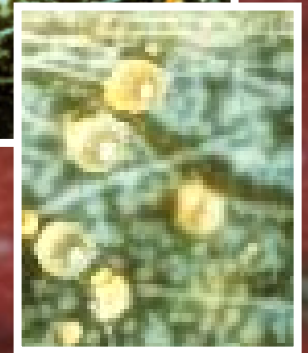
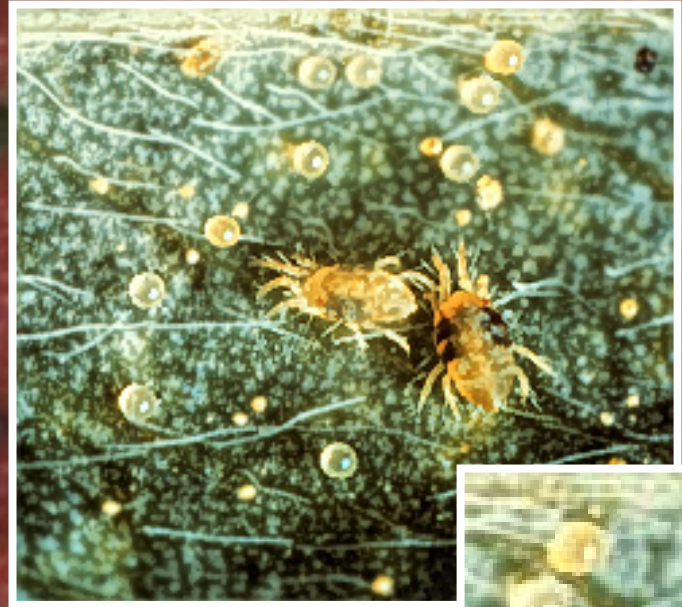
R. Bessin, Univ. of Kentucky



Susan T. Ratcliffe)
Michael E. Gray ()
Kevin L. Steffey ()

Life Cycle of the Twospotted Spider Mite

- Five phases: egg, larva, protonymph, deutonymph and adult
- At around 27°C the life cycle can take 5-20 days



Two-spotted Spider Mite (TSSM) Control

- Several different types of acaricides
- Horticultural oils
- Biological control agents: predatory mites
Orius spp., *Geocoris* spp.
- Cultural practices

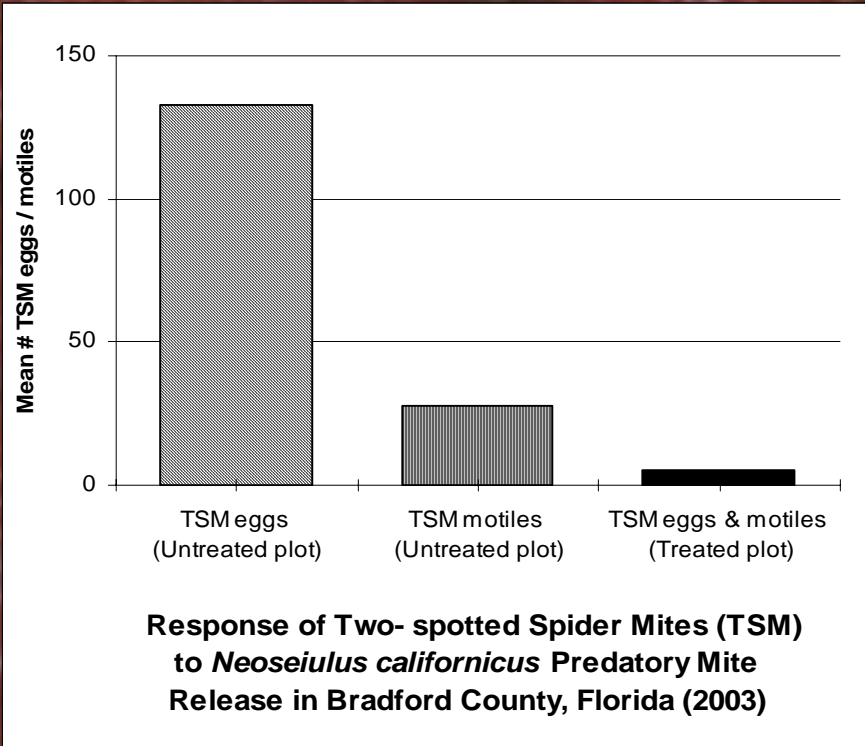
Bio-control strategies for TSSM



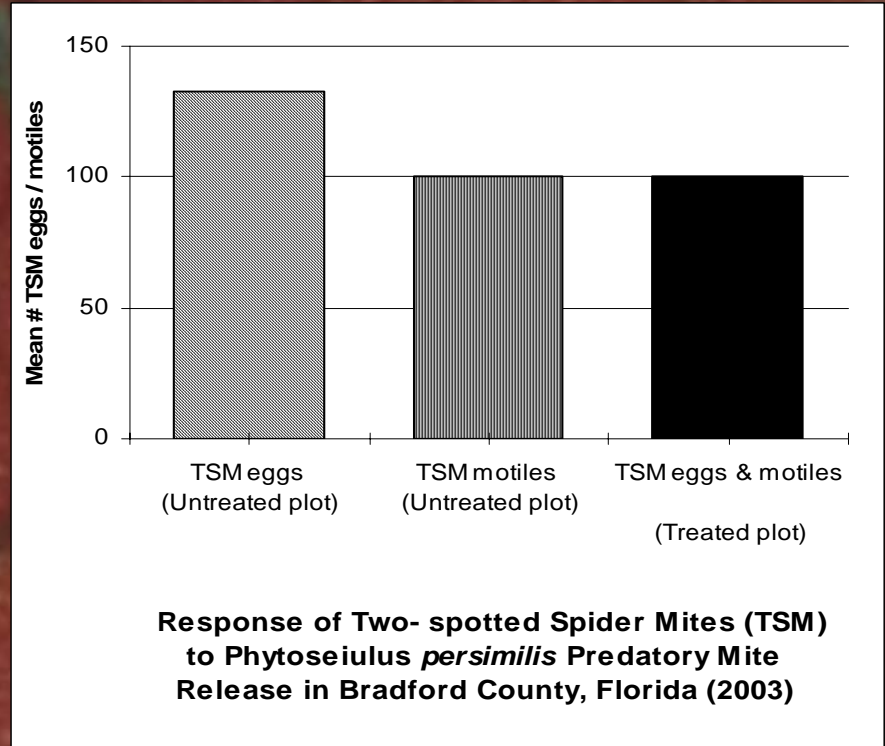
- *Phytoseiulus persimilis* Athias-Henriot is the primary predatory mite used for the control of TSSM
- Specialist predator that feeds exclusively on Tetranychid mites

Fall 2003

Neoseiulus californicus



Phytoseiulus persimilis



Objectives 2002/2003

- ❖ To investigate the effects of soil moisture and temperature, on the reproduction of twospotted spider mites and its associated predatory mites
- Goal was to determine if improvement in cultural techniques, watering programs and irrigation systems can reduce the amount of pesticides used to control twospotted spider mites

Previous Work

- Little work has been done to determine the effect of soil moisture on TSSM
- Hoy (1985) noted that improper irrigation accentuated feeding damage of TSSM in almonds
- Temperature has been noted to play a significant role in the rate of TSSM reproduction

Soil Moisture (Laboratory)

- 12 mite-free strawberry plants were selected from the greenhouse
- Soil moisture was measured using a soil moisture meter (0 being completely dry, 10 completely saturated)
- The plants were then assigned (3 treatments) Low (1-3 on soil moisture meter), Moderate (4-6) and High (7-9)
- Four replicates per treatment:

Soil Moisture (Laboratory)

- 10 adult TSSM were added to each plant at the start of the experiment
- Soil moisture was maintained by checking plants daily and adding tap water as needed
- TSSM populations were monitored every three days



Effect of Soil Moisture on Two-spotted Spider Mite Motile Development

Total mean # of TSSM motiles (\pm SEM)

	3 Days ^I	6 Days ^{II}	9 Days ^{III}
Low	27.3 \pm 5.7 a	375.8 \pm 100.8 a	487.5 \pm 99.0 a
Moderate	37.3 \pm 3.3 a	202.5 \pm 66.4 ab	524.8 \pm 112.6 a
High	16.8 \pm 1.3 b	89.5 \pm 48.4 b	147.3 \pm 15.4 b

^I $F = 5.3$, $df = 2,6$, $P = 0.05$, Means followed by the same letter are not significantly different ($P = 0.05$, LSD)

^{II} $F = 4.4$, $df = 2,6$, $P = 0.07$, Means followed by the same letter are not significantly different ($P = 0.05$, LSD)

^{III} $F = 12.8$, $df = 2,6$, $P = <0.01$, Means followed by the same letter are not significantly different ($P = 0.05$, LSD)

Temperature (Laboratory)

- Temperature experiment was set up using the same procedure as the soil moisture experiment
- Plants were kept in Percival environmental chambers
- Low (18°C), Moderate (27°C) and High (35°C)
- 3 Treatments and /4 Replicates –



Effect of Temperature on Two-spotted Spider Mite Motile Development

Total mean # of TSSM motiles (\pm SEM)

	3 Days ^I	6 Days ^{II}	9 Days ^{III}
Low (18°C)	6.3 \pm 1.7 a	6.8 \pm 2.5 c	4.8 \pm 1.8 c
Moderate (27°C)	10.5 \pm 1.9 a	40.8 \pm 14.4 b	91.3 \pm 16.4 b
High (35°C)	8.5 \pm 0.9 a	137.5 \pm 22.2 a	204.3 \pm 36.2 a

^I $F = 1.9$, $df = 2,6$, $P = 0.24$, Means followed by the same letter are not significantly different ($P = 0.05$, LSD)

^{II} $F = 31.9$, $df = 2,6$, $P < 0.01$, Means followed by the same letter are not significantly different ($P = 0.05$, LSD)

^{III} $F = 68.4$, $df = 2,6$, $P < 0.01$, Means followed by the same letter are not significantly different ($P = 0.05$, LSD)

Preliminary findings (Laboratory)

- Low soil moisture promotes twospotted spider mite development
- High temperature promotes twospotted spider reproduction
- At 18°C twospotted spider mite reproduction slows and practically stops

Soil Moisture (Field)

Drip Irrigation

- 1) water every day with drip irrigation (High)
- 2) water every other day with drip irrigation (Moderate)
- 3) water every third day with drip irrigation (Low)

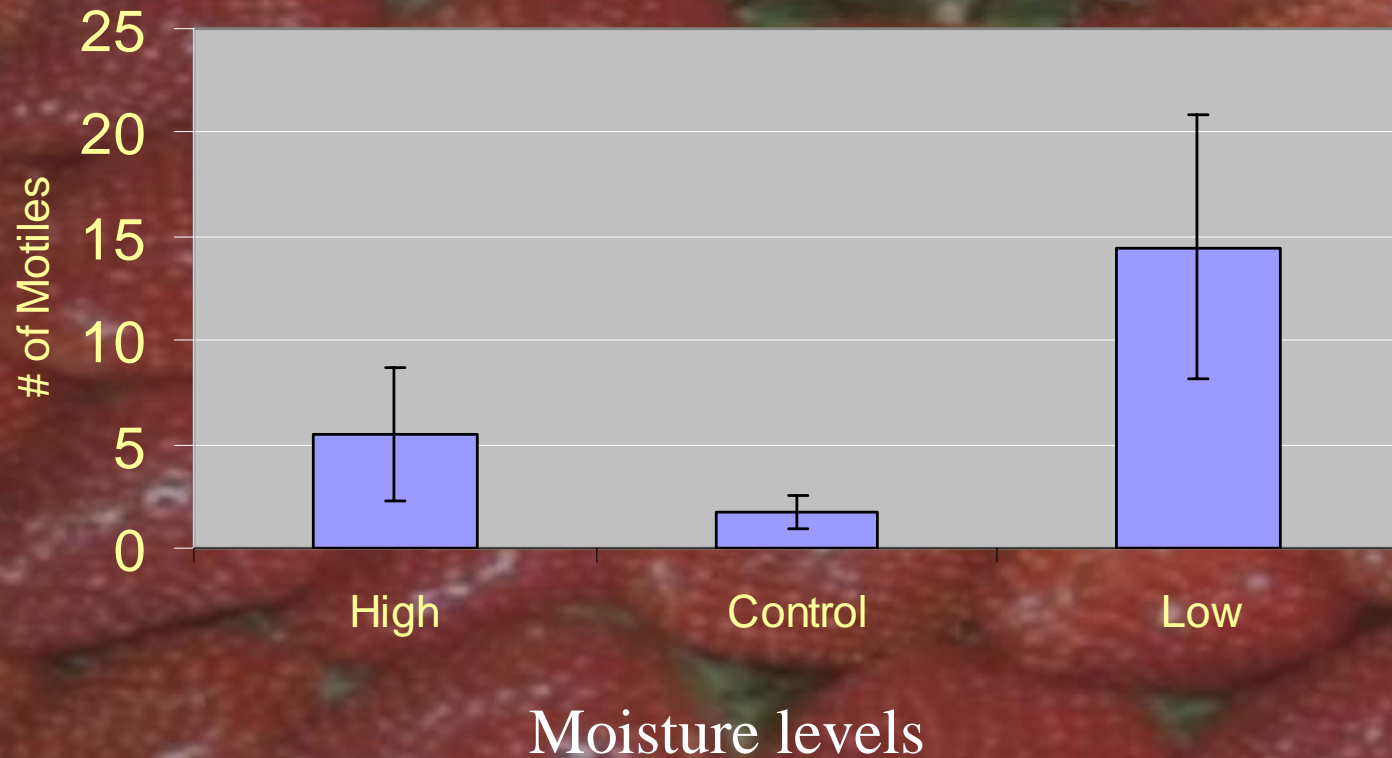
Drip+Overhead Irrigation

- 4) water every day with drip and overhead (High)
- 5) water every other day with drip and overhead (Moderate)
- 6) water every third day with drip and overhead (Low)

Soil Moisture (Field)

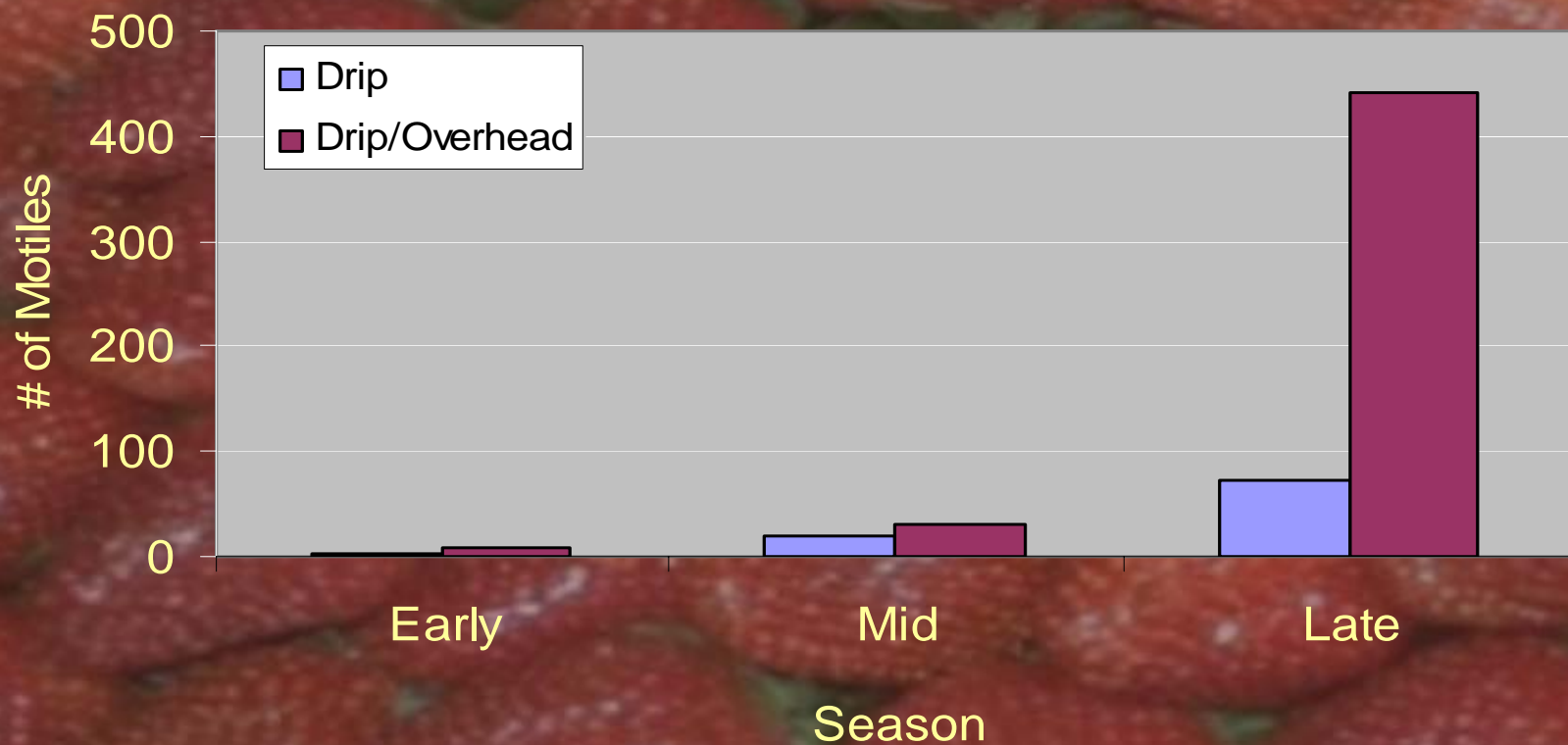
- TSSM sampled weekly by inspecting 20 leaves per rep (80 leaves per treatment)
- Four replicates per treatment
- Randomized complete block design

Comparisons of Different Moisture Levels Under Drip Irrigation (Motiles) Early Season (Nov. 11-Dec. 8)



Statistical analysis used Poisson regression in SAS v.9.0 with proc genmod to estimate parameters (LSD)

Comparison of Drip Irrigation vs. Drip/Overhead Within Moderate Blocks (Motiles)



Statistical analysis used Poisson regression in SAS v.9.0 with proc genmod to estimate parameters (LSD)

Conclusions (Field)

- During the early season (Nov. 11-Dec. 8) low soil moisture seems to promote twospotted spider mite development
- During the spring when temperatures were high (exceeding 27°C) and rainfall were excessive soil moisture no longer played a significant role in twospotted spider mite development
- The application of drip/overhead irrigation seems to promote twospotted spidermite development later in the season

What does this mean?

Growers need to pay particular attention to their watering programs especially during periods of hot dry weather because twospotted spider mites are likely to reproduce quickly and spread throughout their strawberry fields.

It appears that the best approach is to use both drip and overhead irrigation in cold or hot periods. However, the use of drip irrigation should be encouraged as much as possible because it reduces both twospotted spider mite and disease problems

Future considerations

- Develop a more efficient mite monitoring system to be used by growers
- Release *Neoseiulus californicus* McGregor in grower fields to test success rates
- To study watering regimes and determine their effects within mite management programs

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