Treatment thresholds for Pacific spider mite based on the prevalence of its primary predator, sixspotted thrips

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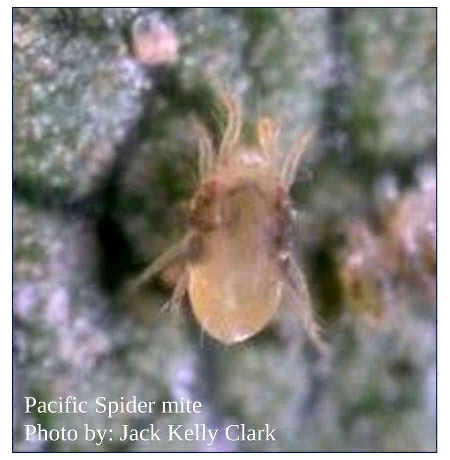
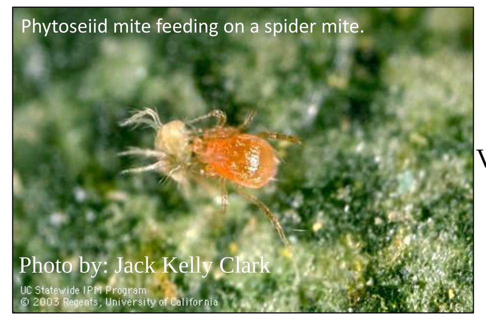
Introduction



Pacific spider mite is a significant pest of almonds. Mite feeding causes stippling to the leaves that can lead to defoliation and yield losses during the following season.

Established treatment thresholds were developed in the 1980s by correlating visual observations that treatments were needed with measurements of the percentage of leaves infested by mites (Wilson et al. 1984). This was done in orchards with and without the presence of phytoseiids. It was determined that treatments should be made if 22% of leaves are infested with mites and there are no predators, or if 42.6% of the leaves are infested and predators are present.

Since thresholds were developed, there have been many changes in the California almond industry, including improved production practices, changes in irrigation practices that cause less stress, and a shift in pesticide use patterns that has caused a new predator, sixspotted thrips, to predominate. These changes justify a new look at treatment thresholds for mites that consider thrips.



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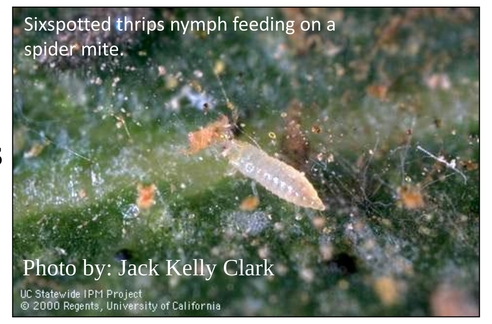

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Objectives

1. Assess the validity of treatment thresholds based on presence-absence sampling for spider mites on almond leaves.
2. Evaluate the influence of predator-prey ratios on change in mite density over time.
3. Develop a simplified model for decision-making regarding miticide use based on absolute capture rates of sixspotted thrips.

Mite-based thresholds

Procedures

- Weekly mite samples were collected from 12 untreated orchards from 2006 until 2017.
- The average number of spider mites per leaf per evaluation date was determined. Since the data was collected across many years, and mite outbreaks occurred on different dates, calendar dates were converted to days before or after reaching a mite density of 1.4 per leaf (defined as Day 0).
- Weekly data were displayed on a scatterplot across all orchards.
- Regression analysis (exponential) was used to describe the exponential rate of increase in mites.
- A treatment threshold was determined as the day on the exponential growth curve where a line tangential to the curve had a slope of 1.
- The action threshold was the mite density 7 days prior to reaching the treatment threshold based on an assumption that it takes one week from the time a treatment decision is made until treatment.

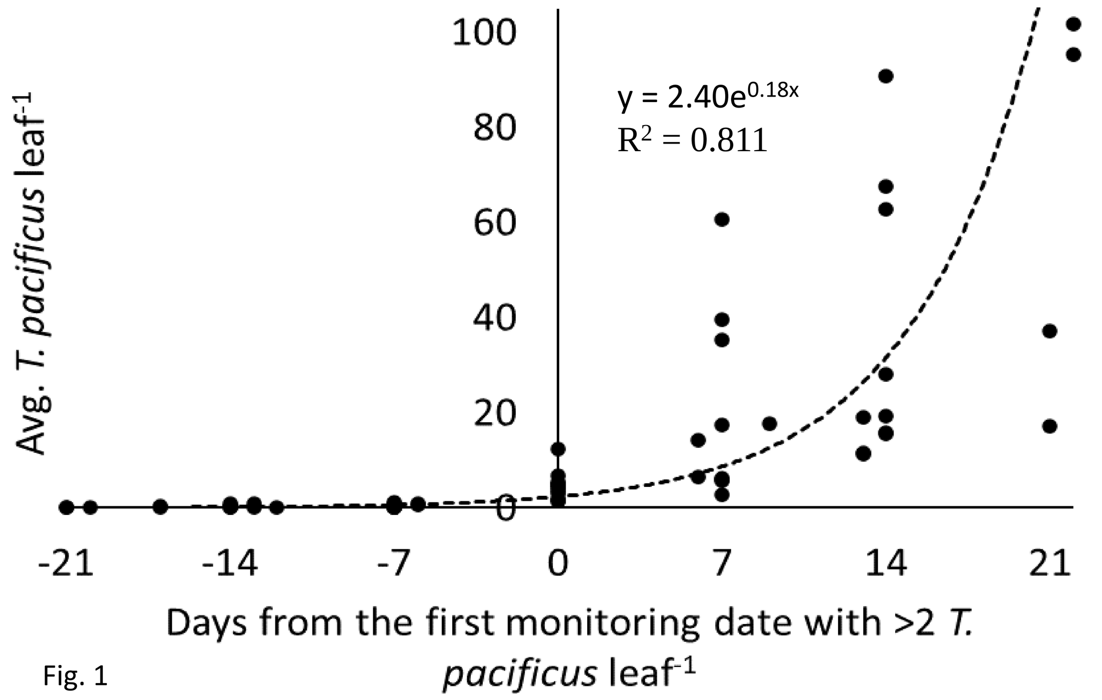


Fig. 1

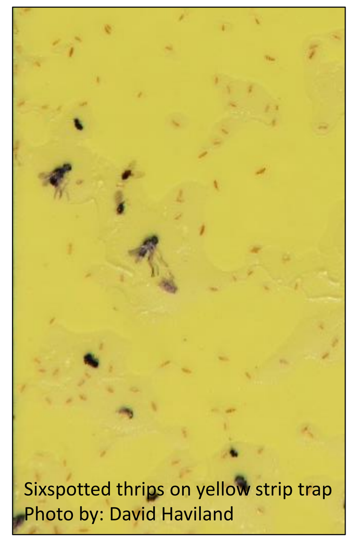
Results

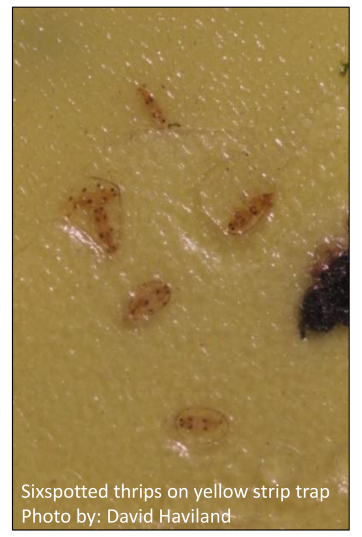
- Exponential increases in spider mite density were defined by the equation $y = 2.40e^{0.18x}$ where y was the average mites per leaf and x was the days before or after reaching 1.4 mites per leaf (Fig. 1).
- According to this curve, the treatment threshold was defined as 5.4 mites per leaf.
- The mite density seven days before reaching a treatment threshold (action threshold) was 1.4 spider mites per leaf.
- Population doubling time averaged 4.0 days, with peak mite density across orchards averaging 44.4 mites per leaf 15.9 days after reaching the action threshold.
- These results were consistent with previous thresholds developed in 1984. Our threshold of 1.4 mites per leaf, when converted to the percentage of leaves infested, was equivalent to 38.1% of leaves infested. This is nearly identical to the Wilson et al (1984) threshold of 42.5% of leaves infested with natural enemies are present (Fig 2).

Impact of thrips:mite ratios on mites

Procedures

- Data were collected weekly from 14 commercial almond orchards during the summers of 2016 through 2018.
- Mite density was evaluated weekly by collecting 20 random leaves.
- Thrips density was evaluated weekly by counting the number of sixspotted thrips per small yellow strip trap (Olson sticky traps, Great Lakes IPM).
- Criteria were established to exclude datasets with very low or high mite density, low thrips density, or that were influenced by miticide applications.
- Weekly data were converted into datasets consisting of the ratio of sixspotted thrips per trap to the average mites per leaf, and the ratio of the number of spider mites in 7 or 14 days to the number of spider mites on the current date.
- Correlations between thrips:mite ratios and change in mite density over 7 to 14 days were made using power (log log) regression.





Results

- As thrips density approached zero, mite density increased exponentially.
- As thrips density approached infinity, mite density decreased exponentially.
- The relationship between thrips:mite ratio (x) and change in mite density (y) over 7 days was defined as $y = 0.711x^{-0.395}$ (Fig. 3).
- After assigning a value of 1 to y (mite density in 7 days equals mite density today), it was determined that no change in mite density occurred over a 7-day period when there were 0.42 sixspotted thrips per trap per week for every 1 mite per leaf.
- Over a 14-day period, there were no changes in mite density if there were 0.08 thrips per trap per week for every 1 mite per leaf.

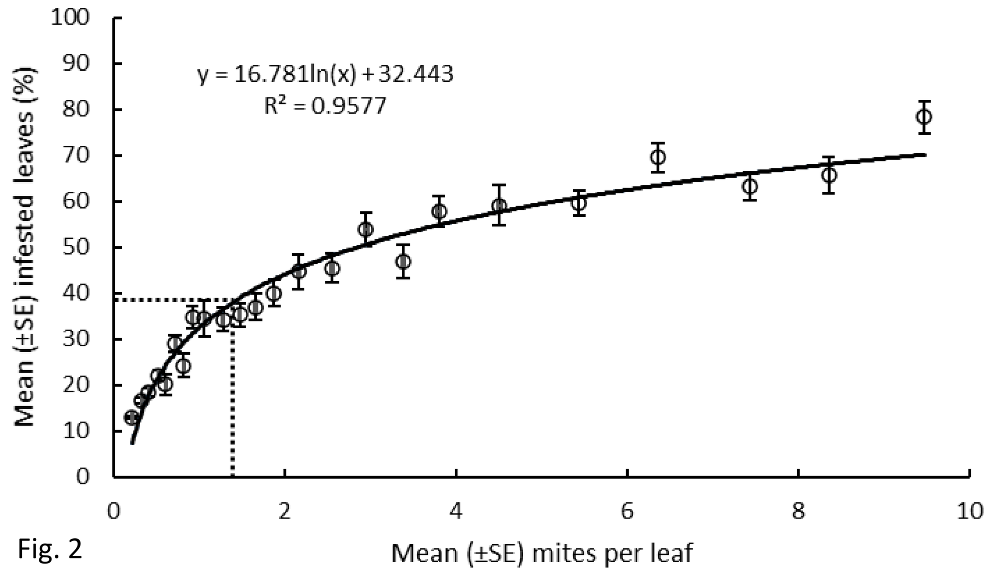


Fig. 2

Thrips-based thresholds

Procedures

- The process used to determine the relationship between thrips:mite ratios and change in mite density was repeated using only thrips per trap per week on the x-axis.
- This was conducted because it is unlikely that pest control advisers have time to count mites per leaf (compared to the industry standard of presence-absence sampling).
- Probability calculations were made regarding the likelihood that mite density would increase, decrease, or stay the same based on absolute thrips captures on traps.

Results

- The relationships between thrips per trap (x) and change in mite density over 7 and 14 days were described by the equations $y = 3.224x^{-0.724}$ and $y = 3.30x^{-1.075}$, respectively (Fig. 4).
- Over 7 days there was no change in mite density if there were 5.0 thrips per trap per week. At 5.0 thrips per trap per week there were 70 and 78% probabilities that mite density would decrease within 7 and 14 days, respectively.
- Over 14 days there was no change in mite density if there were 3.0 thrips per trap per week. At 3.0 thrips per trap per week there were 73 and 80% probabilities that mite density would decrease in 7 and 14 days, respectively.

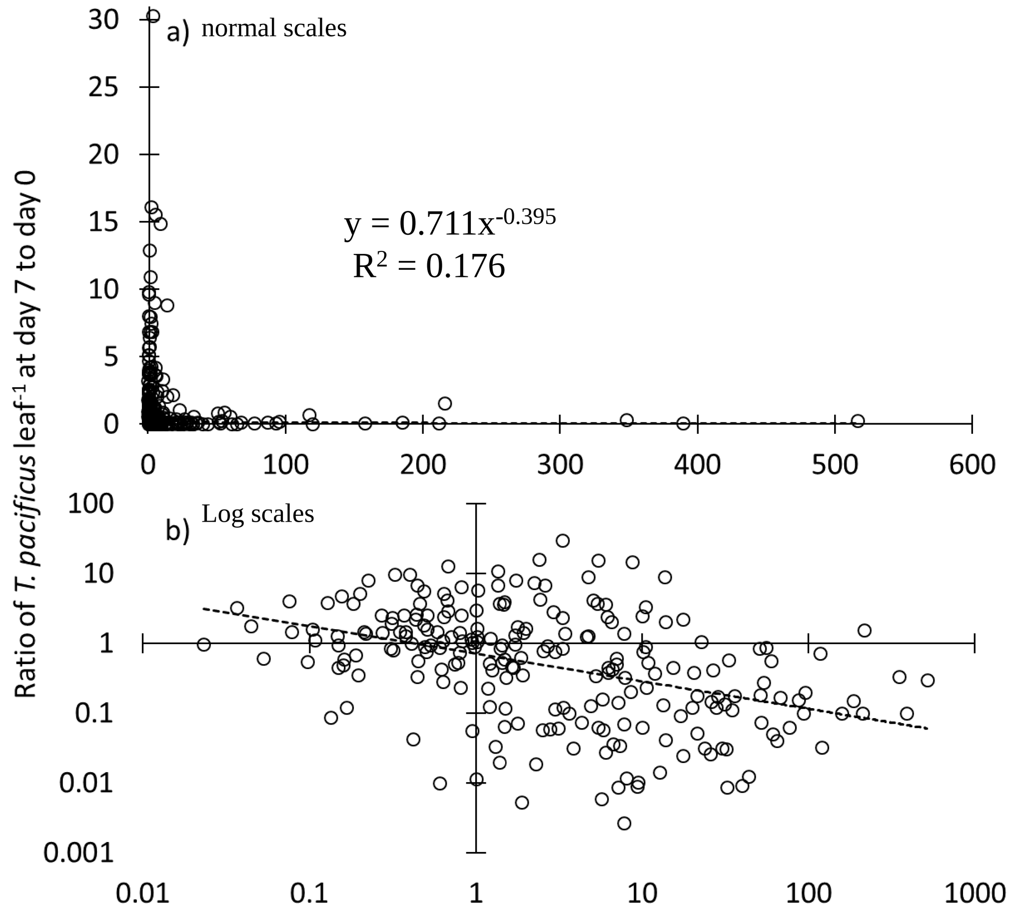


Fig. 3 Ratio of *S. sexmaculatus* trap^{-1} week^{-1} to *T. pacificus* leaf^{-1}

Conclusions

- Miticide treatments based on leaf sampling alone should be made if approximately 40% of leaves are infested with mites and predators are present. This is an average of approximately 1.4 mites per leaf.
- Growers should use yellow sticky traps to monitor for sixspotted thrips. Data from monitoring can be used to follow trends in sixspotted thrips abundance and can be used in thresholds.
- No treatment is needed if there are 0.42 thrips per trap per week for every 1 spider mite per leaf. This means that if mite density is below a treatment threshold, the presence of thrips confirms that treatment is not needed. This information is extremely important as a confirmation not to treat for growers who routinely use prophylactic treatment programs in the spring.
- In cases where spider mite density has exceeded a treatment threshold based solely on mite sampling, thrips captures on sticky traps should be considered. If there are an average of 3 thrips per trap per week there is an 80% chance that mite density will decrease within 14 days.

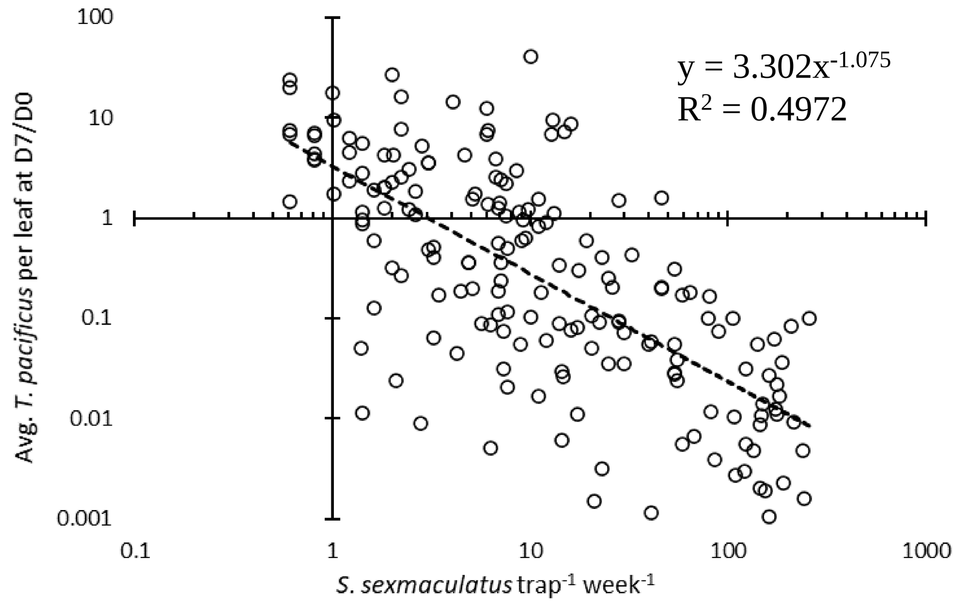
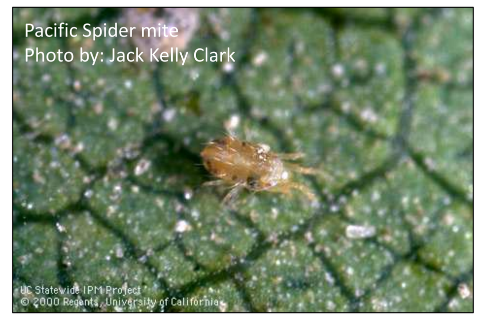
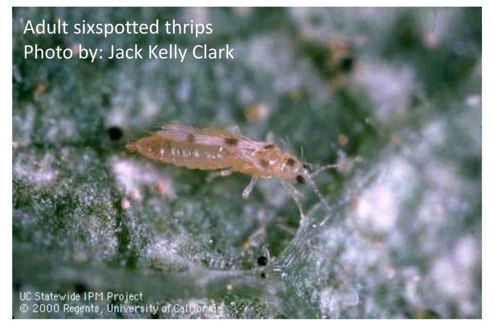


Fig. 4





Acknowledgements

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References

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