A Simple Sampling Plan for Persea Mite in Avocado Orchards

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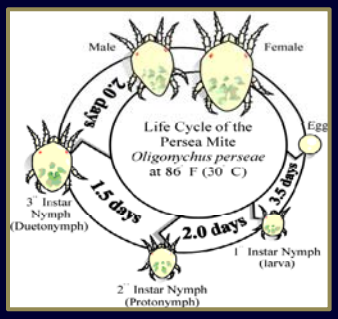
Topics

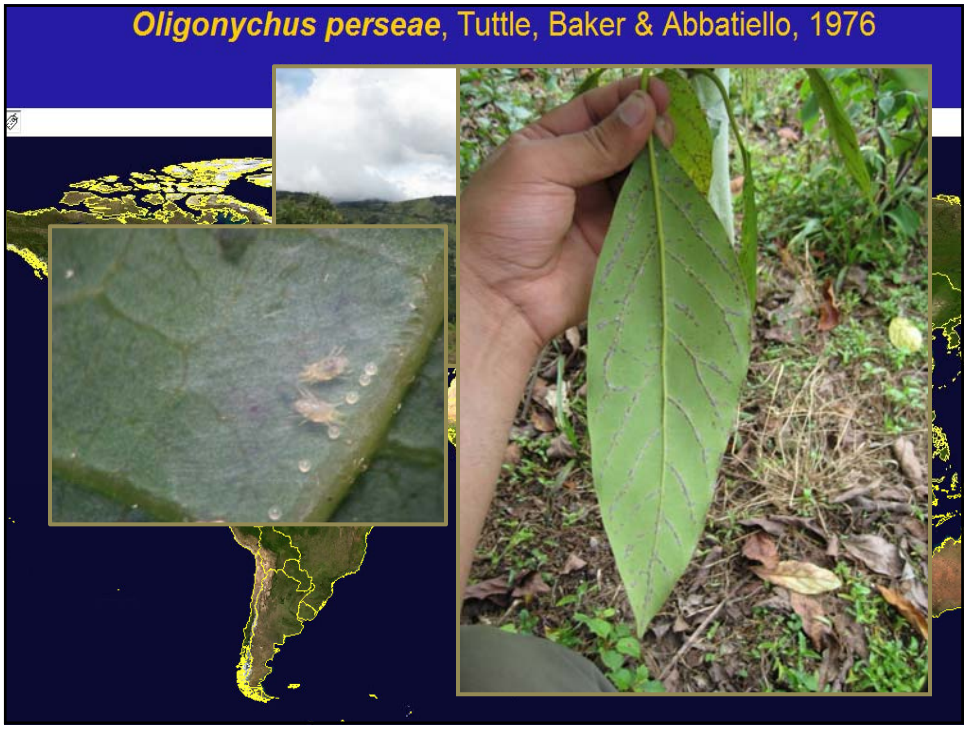
- Persea Mite Biology
- Economic Importance
- Estimating Persea Mite Densities
  - Half-Vein Method
  - Absence-Presence Method
  - Method Evaluation
- How to Collect Avocado Leaves
- Conclusions
- Future Research

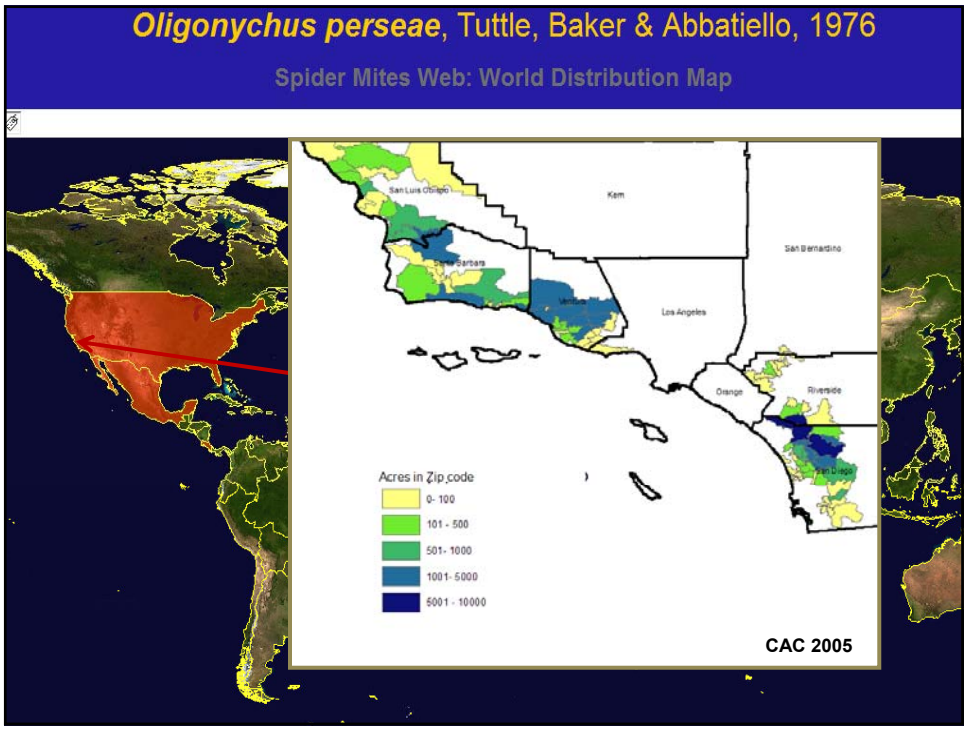
Persea Mite Biology

- 5 stages
- Feeding on leaf undersurface
- Feeding areas turn into necrotic (dead) spots
- Defoliation and fruit sunburn
- Population buildup in late summer



Counting Mites is Time Consuming!


Oligonychus perseae, Tuttle, Baker & Abbatiello, 1976


Oligonychus perseae, Tuttle, Baker & Abbatiello, 1976
Spider Mites Web: World Distribution Map
Kern
San Bernardino
Los Angeles
Orange
Riverside
Acres in Zip code
0- 100
101 - 500
501- 1000
1001- 5000
5001 - 10000
CAC 2005

Control Strategies

Biological Control:

- predatory mites, *Neoseiulus californicus*

Pesticides:

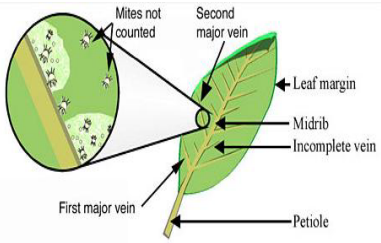
- Abamectin, new pesticides coming soon
- Threshold ≥100 mites per leaf

How do you estimate density of persea mites?

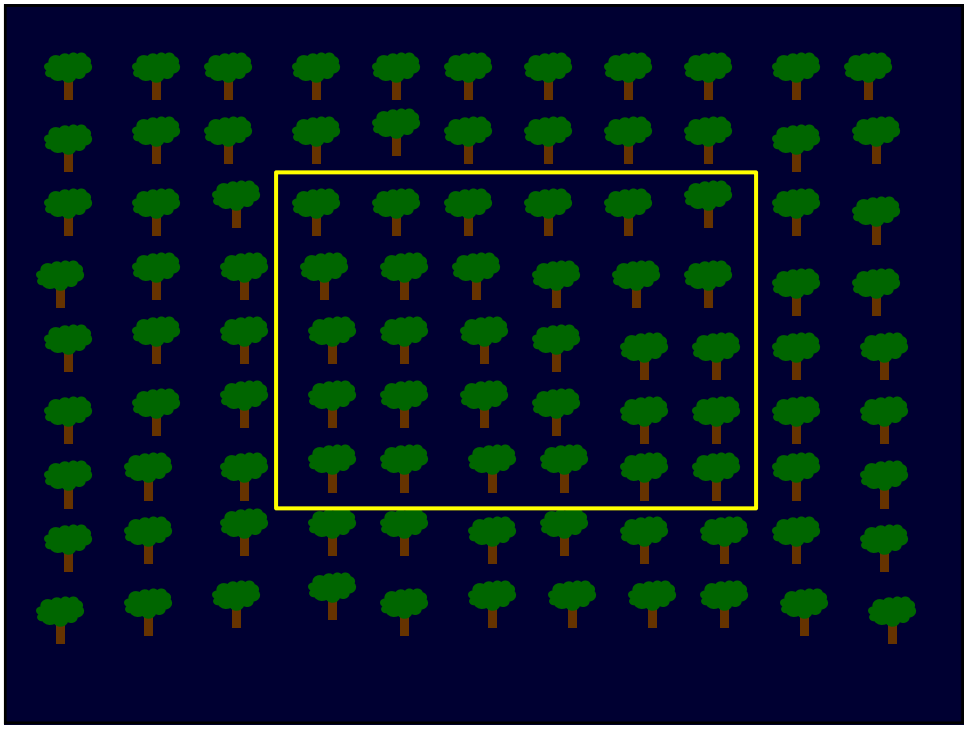
Questions

1. **Is there a method to estimate persea mite densities on avocado leaves?**
2. **How reliable (accurate) is this method in the field and under lab conditions?**
3. **Are there other methods to estimate persea mite densities?**

Half-Vein Method



Leaf sample	Persea mites
1	
2	
3	
4	
5	
6	
7	
8	
9	
9	
10	
Total mites on the second major vein samples from 10 trees:	
Average mites per sample: (Total mites / 10)	
Estimated average mites per leaf: (Average persea mites x 12) or (Average predator mites x 6)	



Work in Avocado Orchards

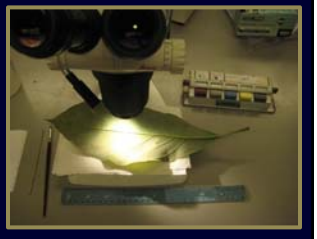
Field Observations

Flagging Trees

Distance Between Trees

Systematic Leaf Collection

Bring Leaves to Lab



Count Mites!

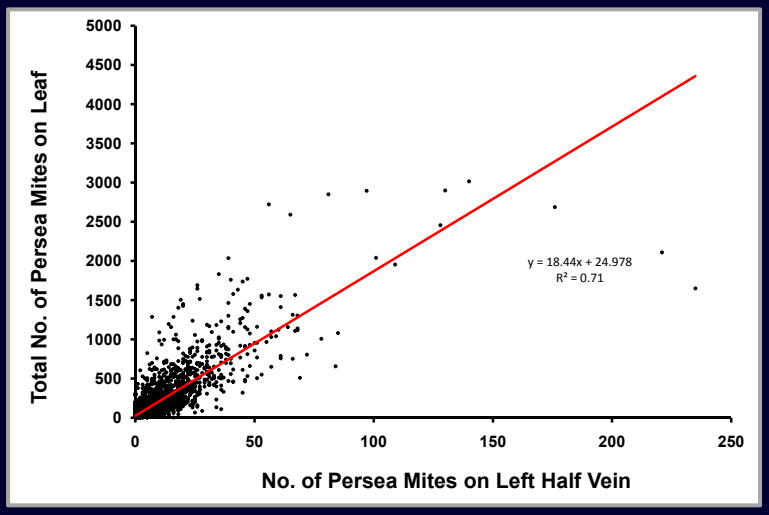
Half-Vein Method Evaluation

Orchard	N Leaves	Observed Mean	Half-Vein (Microscope)	% Error
1	1608	8	4	47
2	240	37	34	8
3	240	42	21	50
4	240	49	29	40
5	247	77	30	61
6	239	205	100	51
7	240	208	110	47
8	240	307	171	44
8	240	342	212	38
9	260	528	214	60

Half-Vein Method Evaluation

Orchard	N Leaves	Observed Mean	Handlens/Optivisor	% Error
1	1608	8	3	62
6	239	205	68	67
7	240	208	63	70
9	260	528	134	75

Evidence for Relationship



Questions

1. **Is there a method to estimate persea mite densities on avocado leaves?**

   Answer: Yes, the half vein method

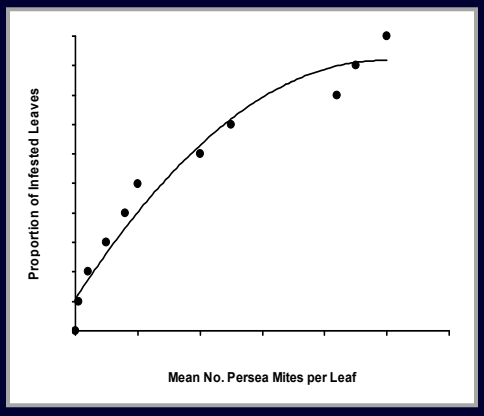
2. **How reliable (accurate) is this method in the field and under lab conditions?**

   Answer: Accuracy is low; 40-60% error. Method Still involves counting!

3. **Is there another method to estimate persea mite densities that involves less counting and is reliable?**

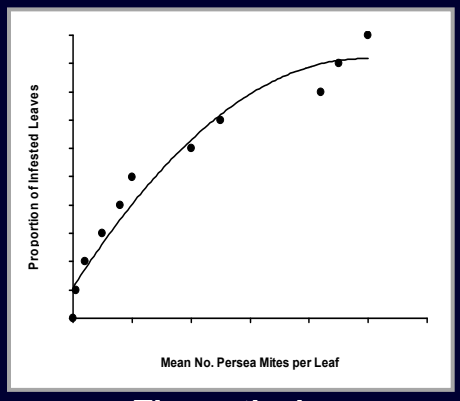
Absence-Presence Method

- Absence/presence of persea mite on leaves
- Use proportion of infested leaves to estimate the density of persea mites

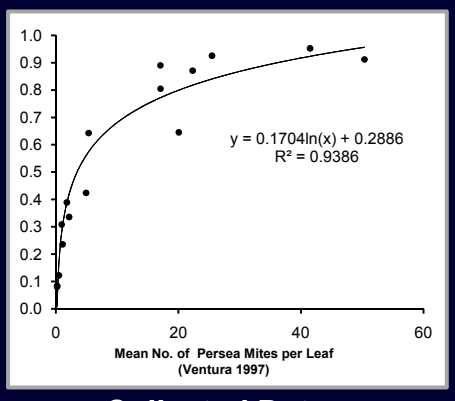


Theoretical Relationship

Visualizing the Relationship



Theoretical

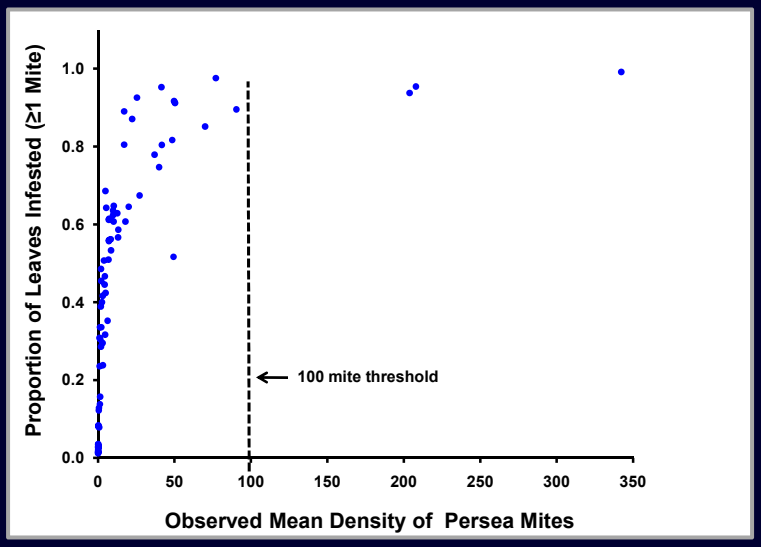


Collected Data

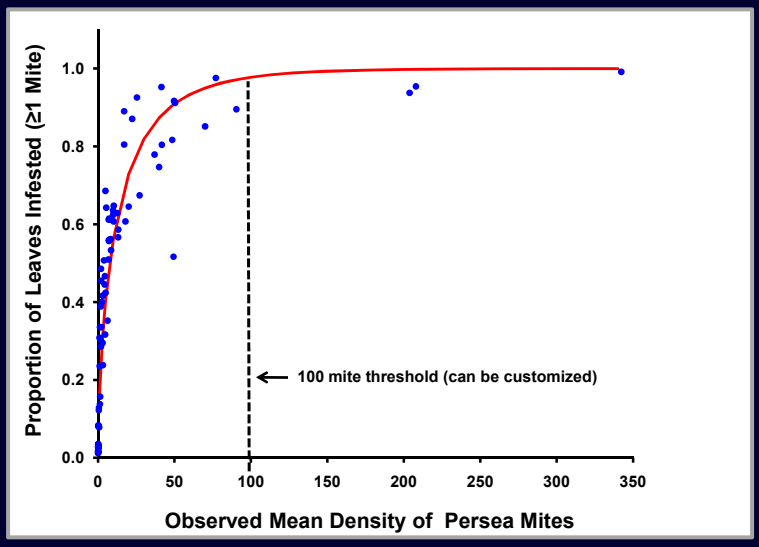
Data Summary

County	Year	Trees	No. of Leaves	No. of Sets	Mites Counted
Ventura	1997	42	6,469	16	88,372
Orange	1999	66	5,280	8	232,548
Orange	2000-01	42	17,220	41	74,267
Orange	2003/05	9-17	4,190	31	151,092
Ventura, Santa Barbara (SB)	2009	30	1,207	5	205,584
Ventura, SB, Orange	2010	30-402	2,348	4	249,350
		Total:	**36,714**	**105**	**1,001,213**

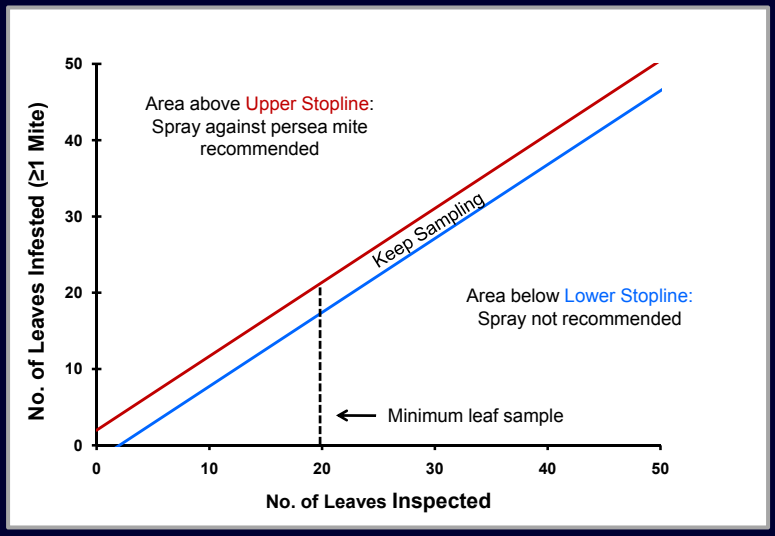
Proportion vs. Mean Density



Mean-Proportion Model



Absence-Presence Sampling Model



How would it work in the field?

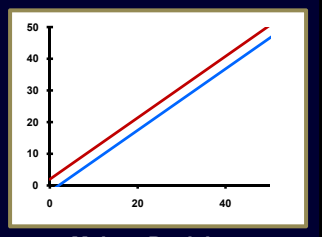
Randomly Select Leaves (20 minimum)

Look at Undersurface

Search for Persea Mites

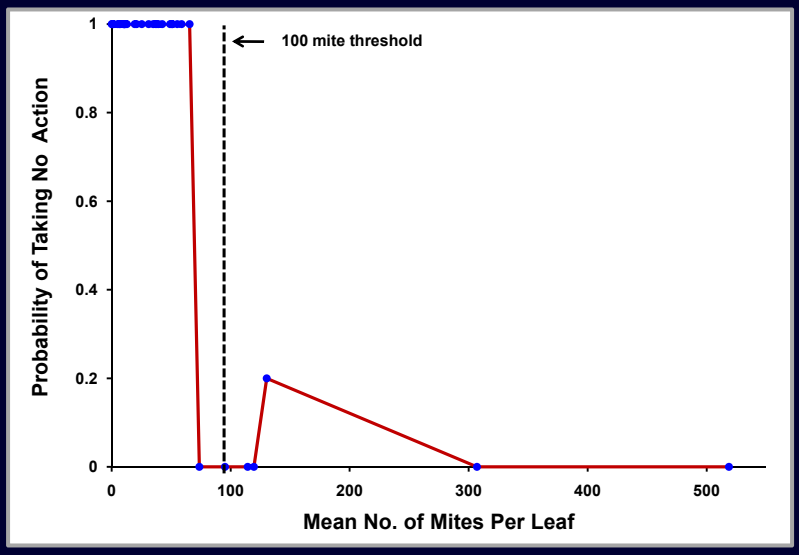
Present: 1 Absent: 0

Calculate Proportion Infested

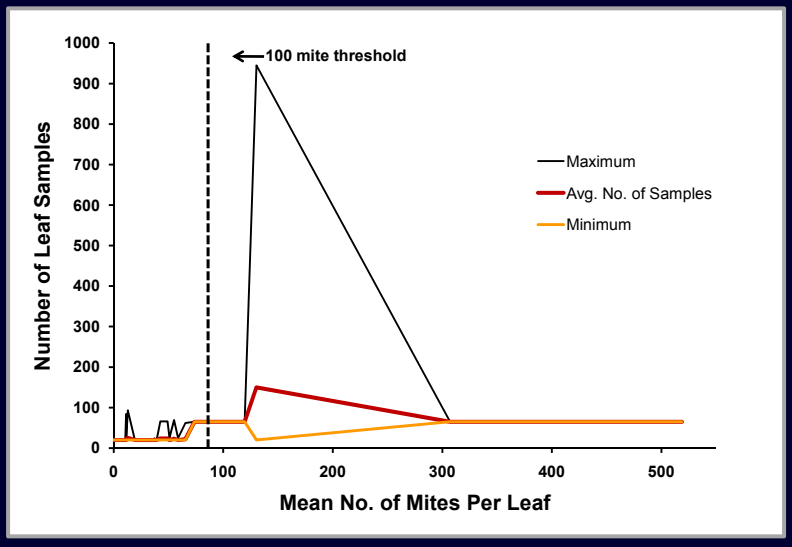


Make a Decision

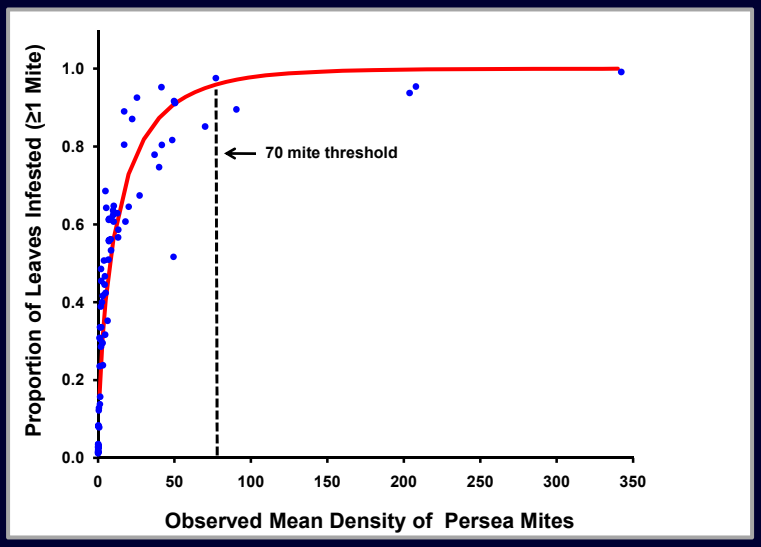
How Reliable Is the Method?



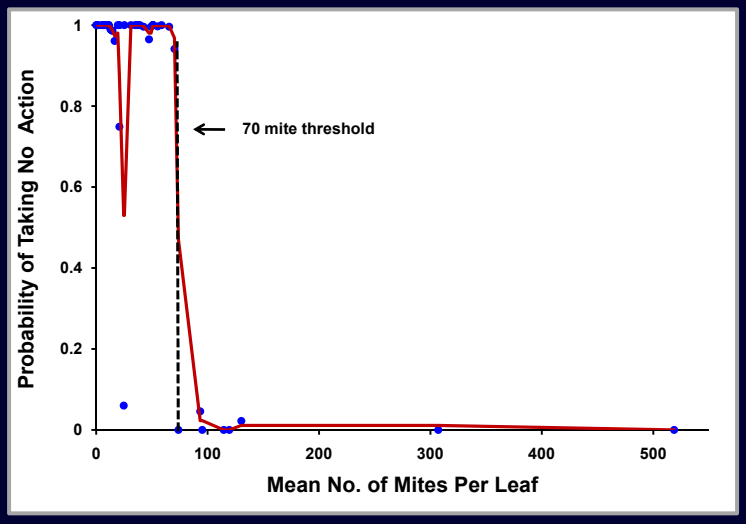
How Many Leaf Samples?



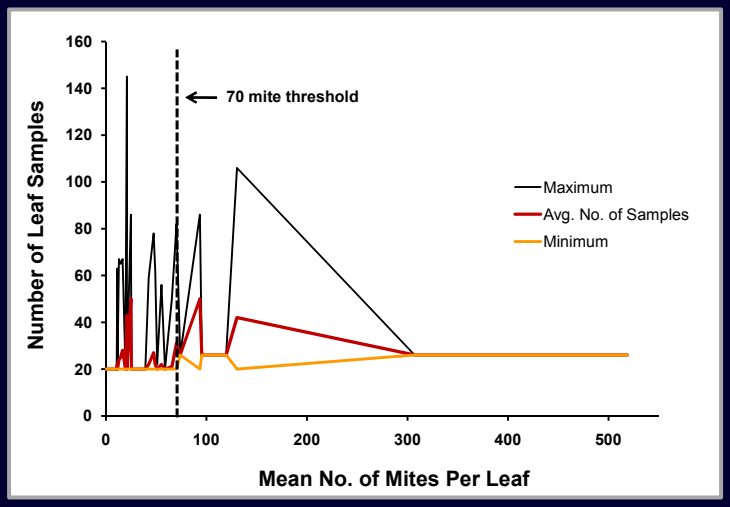
Mean-Proportion Model



Alternate Threshold



Alternate Threshold



Conclusion

3. Is there another method to estimate persea mite densities that involves less counting and is reliable?

Answer: Yes, a reliable absence-presence method can be customized for the avocado system.

↓

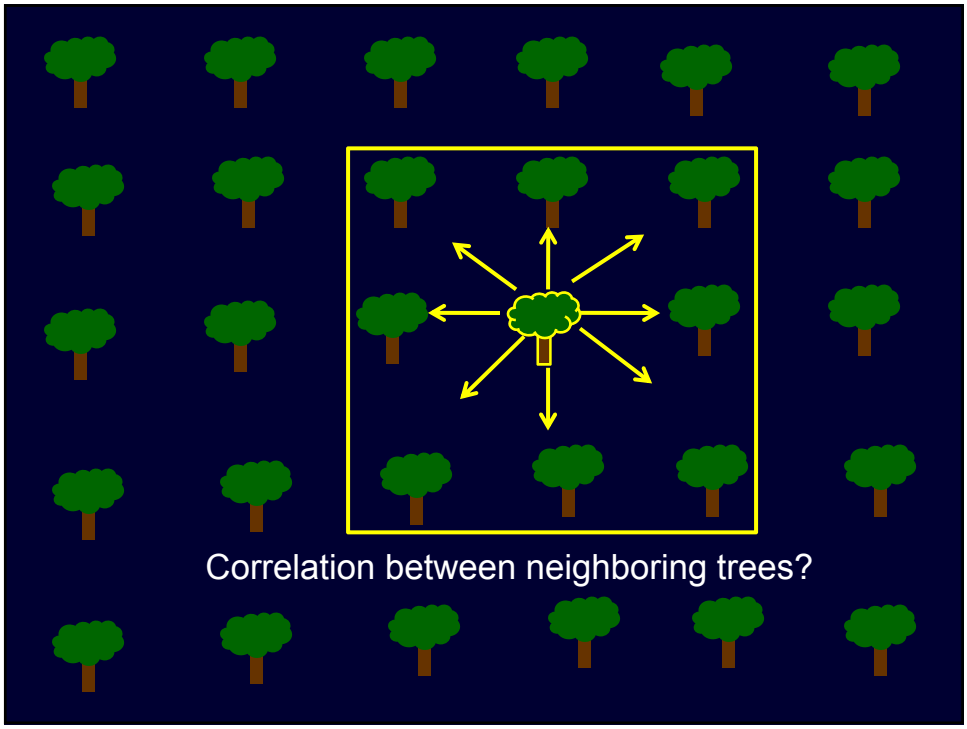
Currently fine tuning the method: How to collect leaves in an orchard?

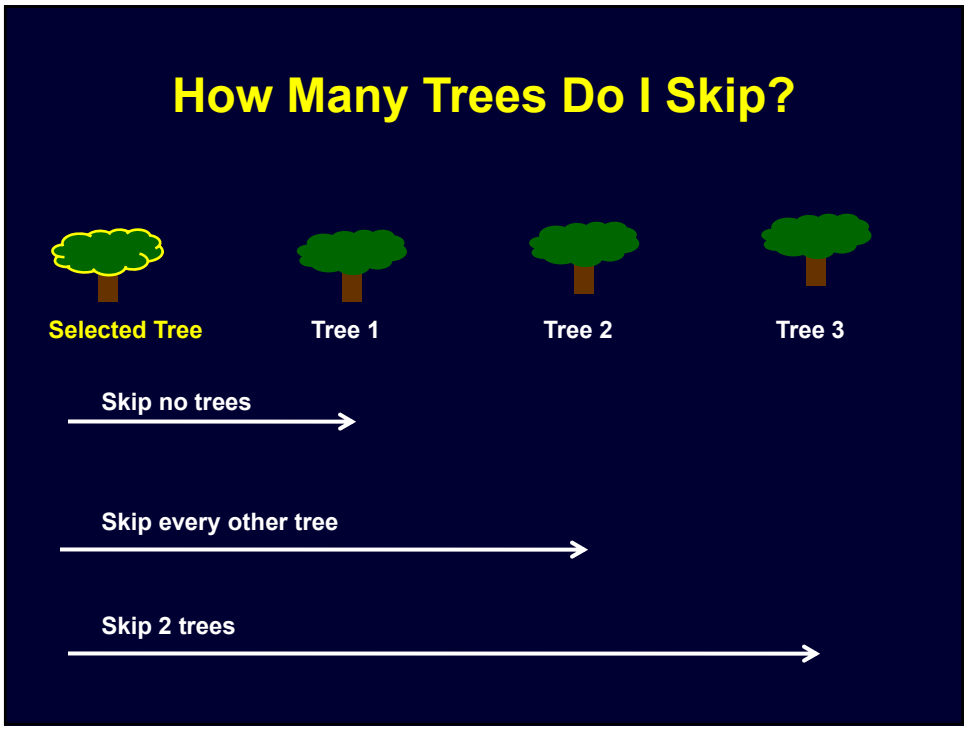
Collecting Avocado Leaves

1. Are mite counts higher on specific cardinal points on a tree (N, E, S, W)?

2. Are mites on a tree influencing mite densities on other neighboring trees?

Goal: Reduce bias in estimating mite densities!


Correlation between neighboring trees?


How Many Trees Do I Skip?
Selected Tree
Tree 1
Tree 2
Tree 3
Skip no trees
Skip every other tree
Skip 2 trees

Results of Spatial Analyses

Orchard	Cardinal Effect?	p-value	Outcome	Spatial Correlation?	Trees To Skip	p-value
7	No	0.30		No	0	0.50
8	Yes	0.004	E>N, W	Yes	1	0.039
4	No	0.21		Yes	1	0.023
3	Yes	0.01	W>N	Yes	3	0.047
6	Yes	0.004	S,W>N	Yes	3	0.0002
9	No	0.080		Yes	4	0.047

Conclusions

1. Are mite counts higher on specific cardinal points on a tree?

   Answer: Yes, in some orchards cardinal directions have higher mite counts but there isn't a consistent pattern across all orchards.

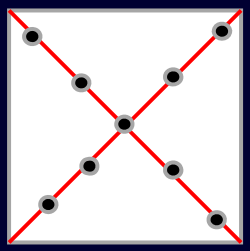
2. Are mites on a tree influencing mite densities on other neighboring trees?

   Answer: Yes, in some orchards there is spatial correlation. To obtain an independent sample you should skip at least 4 trees.

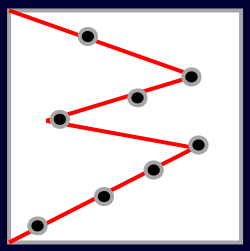
Future Research

- Combine the absence-presence method with the spatial work to design a cost-effective sampling scheme:
- Invest less time counting mites and have a reliable estimate of persea mite levels during the growing season

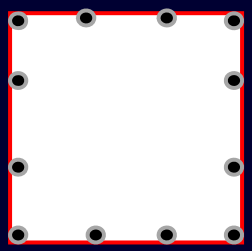
Potential Sampling Schemes



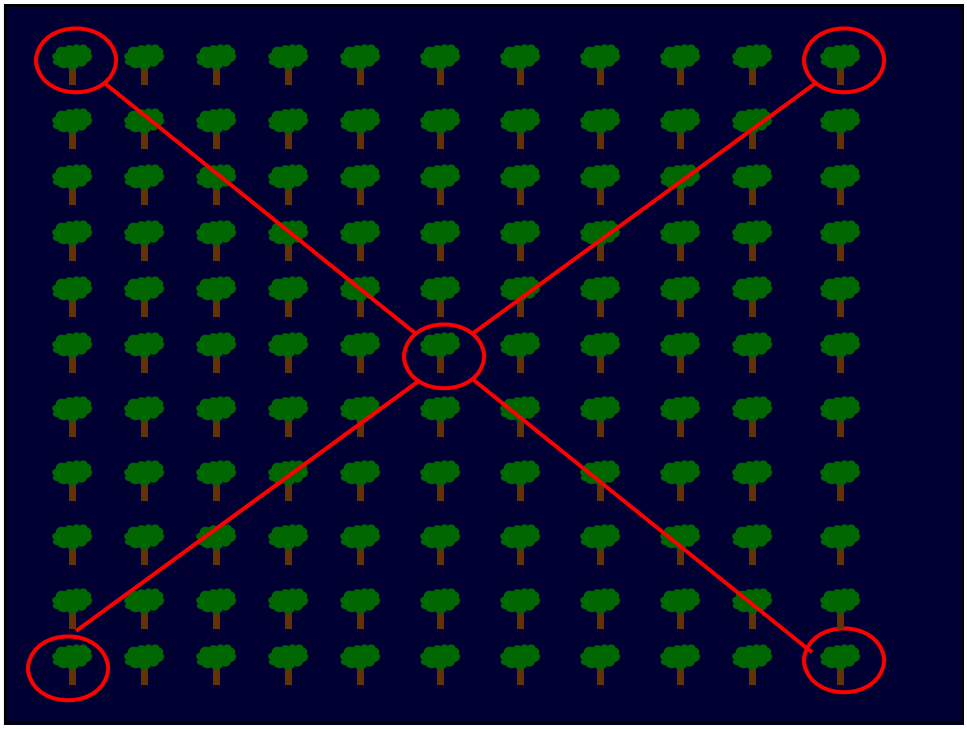
Corner to Corner

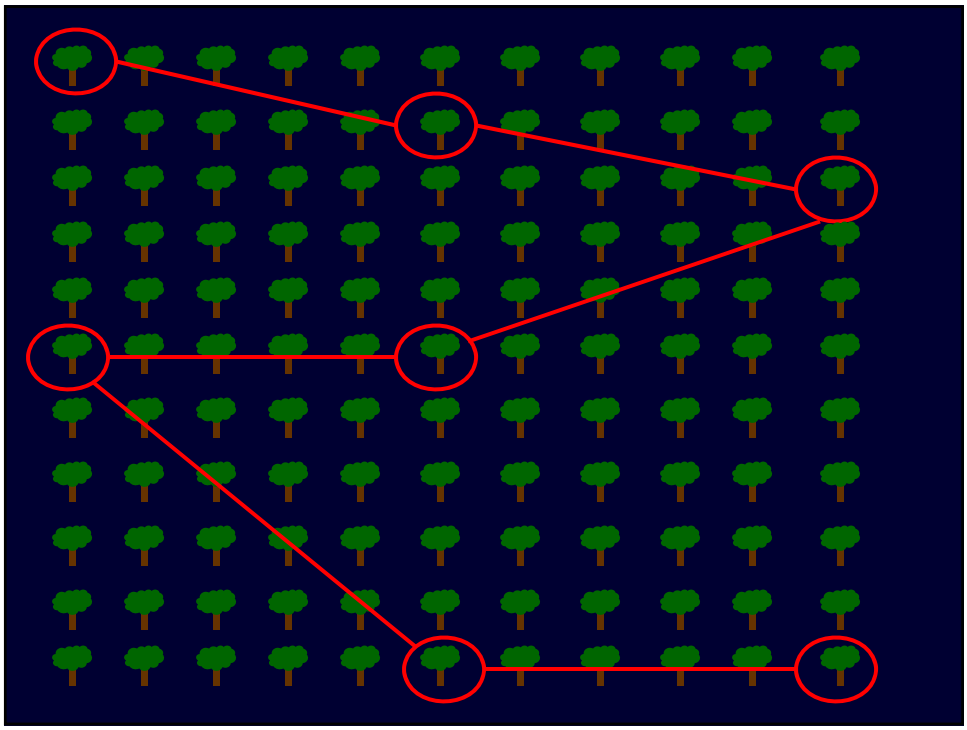


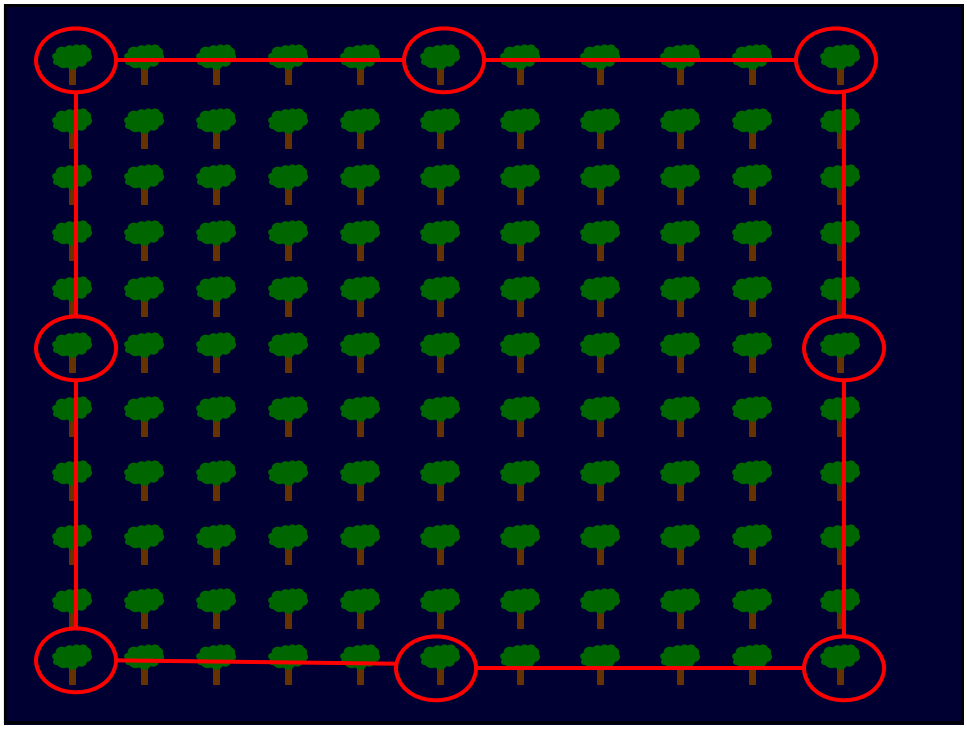
Zig-Zag



Perimeter







Take Home Message

- Counting persea mites on leaves is a tedious process!
- The Half-Vein method underestimates mean mite densities
- A statistically reliable Absence-Presence method can reduce the counting effort in the field
- Mite counts can influence densities on other trees and this needs to be accounted for in the sampling scheme

Thanks

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