Mites as Ecological Indicators in Michigan Tree Fruit

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INTRODUCTION

An ecological indicator is a tool that can be used to detect disruption in the environment. In agricultural landscapes, it can be used to determine the relative sustainability of an ecosystem exposed to various combinations of management strategies. Ecological indicators give a robust picture of sustainability because, although they focus on ecological sustainability, they are designed to include economic, social and environmental sustainability.

Mites are microscopic, chelicerate arthropods. They fill a large number of terrestrial niches as predators, herbivores, detritivores and fungivores. In the orchard ecosystem, members from each niche can be found at varying times throughout the growing season. Mites are good indicators of agricultural sustainability for many reasons. Perhaps most importantly is the fact that mites are ubiquitous, occurring in some capacity in every management strategy of Michigan orchards. Different management strategies produce different assemblages of mite species, allowing the researcher to draw conclusions about the effectiveness of management in determining mite diversity. Mites are also known to be affected by many management practices and ecosystem characteristics, including leaf hairiness and surrounding habitat, pesticide use, mowing and rainfall. Sensitivity to environmental changes and management practice is due to the mites' small size, inability for quick evacuation and short generation time, positioning them as good candidates as ecological indicators.

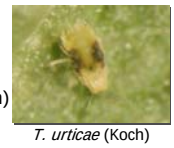
In Michigan apple orchards there is a distinct relationships between orchard management strategies and mite presence, abundance, and seasonal occurrence (Strickler et al. 1987). A mite index has been developed to classify orchards based on management practices. The index fits a model that describes orchard management. This model will allow mites to be used as ecological indicators of orchard sustainability.

STATEMENT OF WORK

In the early 1980s research was conducted to determine the effect of a range of orchard management strategies on mite species composition. The data exhibited trends in the relationship between mite species presence and pest management practices. We are reexamining this data to show a statistical relationship between mite populations and environmental sustainability.

Table 1. Mite species found in MI apple orchards.

Pest Mites
Tetranychus urticae (Koch)
Tetranychus spp.
Panonychus ulmi (Koch)
Bryobia rubrioculus (Scheuten)
Aculus schlectendali (Nalepa)



T. urticae (Koch)

Predatory Mites
Neoseiulus fallacis (Garman)
Other Phytoseiidae
Cheyletidae
Erythraeidae
Stigmaeidae

C. lordi Nesbitt

Other Mites
Tydeidae
Acaridae
Oribatidae
Czenspinskia lordi Nesbitt
Tarsonemidae

Tydeidae

MATERIALS AND METHODS

Seventeen orchards throughout southern Michigan were sampled for this study. At each site 5 leaves were collected from 20 trees in a diagonal transect across the orchard block. Leaf samples were taken 8 times per season. Collected leaves trees in a trees in a diagonal transect across the orchard block. Leaf samples were taken 8 times per season. Collected leaves were brought back to the laboratory and identified and counted under a microscope for a list of mite species found). To aid in identification, adult mites were slide mounted using Hoyer's solution after being cleared with lactic acid. Mites were counted to estimate relative abundance in the orchard.

Sampling for mites in an apple orchard.

Each mite is given a season rating based on their effect on the orchard during the sampling time period. The season rating changes depending on when the sample was collected. For each mite species, a seasonal abundance rating is calculated based on the relative abundance of a given species and the season rating. The mite index is the sum of all species values for a particular orchard site. The mite index is used to characterize the sites along a disturbance continuum based **(Figure 2)**.

Logistic regression for discriminate analysis of more than two groups is used to model the probability that response variable (mite index) falls within different pest management categories.

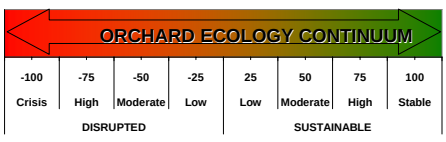


Figure 2. Possible mite index values range from –100 to 100. These values fall along an orchard ecology continuum. Negative values represent orchards that are disrupted while positive values are reported for more sustainable orchards.

Results

Figure 3. shows a trend of increasing mite index values from disrupted orchards (i.e., high input conventional) to more sustainable orchards (i.e., abandoned orchards). A logistic regression was fit (**Table 2**) with 90.3 and 91.1% concordance in year 1 and 2, respectively.

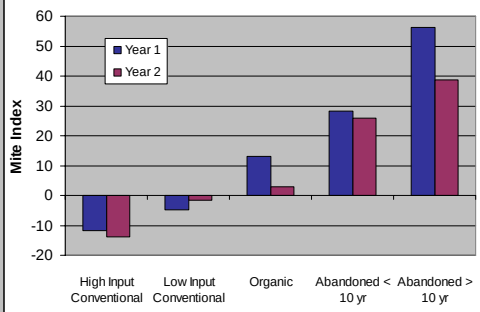


Figure 3. Mite index values for apple management practices.

Table 2. Parameter estimates for logistic regression results.

Parameter Estimate	Year 1	Year 2
Intercept 1	0.5719	0.0449
Intercept 2	2.6307	2.0046
Intercept 3	3.2289	2.7372
Intercept 4	5.6693	7.1506
Index	-0.1045	-0.1471
Percent Concordant	90.3	91.1

IMPLICATION FOR FUTURE RESEARCH

This research has potential for future studies. Currently, we are working on refining the mite index for apple and converting it to be used on other tree fruit. The general concept can be further extended to annual crops and non-agricultural landscapes.

Ecological indicators are used to assess landscape structure, transformation, and fate and can be a valid component of policy development and evaluation (Paoletti 1999). Using mites a ecological indicators will not only be available to policy maker but it will also be available to growers to make more sustainable pest management decisions.

ACKNOWLEDGEMENTS

We would like to thank the following people: Xuewen Huang, Dave Epstein, Ben Nessia, Byron Wingerd, Eric Hoffmann, Johanna Nugent, Brent Nielubowicz, Andrea Beebe, Jim Laubach, Romain Lalone, Creela Overton and James McMurtry.

FUNDING

This and future work on ecological indicators is funded by Environmental Protection Agency, American Farmland Trust, and the US Department of Agriculture.

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