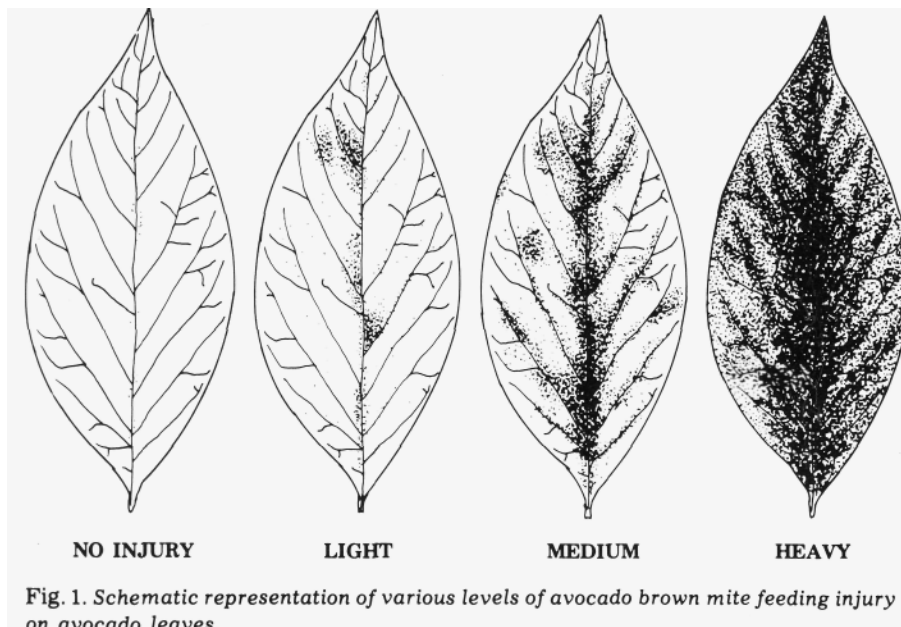


Avocado Brown Mite Feeding Injury on Avocado

F. V. Sanees¹, N. C. Toscano², M. P. Hoffmann⁴, L. F. LaPre³, M. W. Johnson², and J. B. Bailey²

Respectively, Head, Pacific Agricultural Laboratories, Inc., San Luis Rey, Director, Pest Management Programs, Cooperative Extension, University of California, Riverside; Staff Research Associate, Cooperative Extension, University of California, Riverside; Environmental Consultant, Riverside; Postdoctoral Assistant, Cooperative Extension, University of California, Riverside; Extension Entomologist, Department of Entomology, University of California, Riverside, California.

The avocado brown mite, *Oligonychus punicae* (Hirst), is a pest of avocados in southern California where it reaches high population densities in the coastal and intermediate climatic areas. Its feeding on avocado leaves is initially confined to the area surrounding the midrib on the upper leaf surface (Fig. 1). Later, feeding extends along the smaller veins and may eventually cover the entire leaf if spider mite densities become high. The upper surfaces of avocado leaves are the most favorable for adult survival, population increase, oviposition, and development of immatures as compared with new leaves and the undersurface of mature leaves. Many workers have also observed that brown mite population growth can be limited by the accumulation of webbing and mite cast skins on the leaves.



O. punicae feeding results in a brownish discoloration of the leaves and is commonly

referred to as bronzing. Heavy infestations can cause complete bronzing of the upper leaf surface with only small portions of the lower leaf surface showing visible injury. Heavy populations for extended periods of time lead to partial defoliation of the tree. This leaf drop can occur when population densities average 70 adult females/leaf during short time periods or when densities are maintained at 50 females/leaf for several weeks. However, it has not been determined if partial defoliation of the tree affects growth or fruit yields during the season in which the injury occurs.

Photosynthesis, Transpiration, and Productivity

Reductions in photosynthesis rates from plants with heavy infestations of spider mites have been reported from apple, citrus, strawberry, and cotton. Photosynthesis is the process by which sugars (photosynthates) are produced by the bonding of carbon and water molecules into carbon-based chains. It occurs within the chloroplasts of leaf cells and is powered by solar energy absorbed by the pigment chlorophyll. The required water is brought up from the roots through a process known as translocation. Carbon dioxide enters the leaf tissue through small closable apertures in the epidermis called stomata. While stomata facilitate movement of carbon dioxide into the leaf, large quantities of water are lost by evaporation to the atmosphere. This process is known as transpiration. When transpiration rates exceed the rate of water uptake by the roots, plants become stressed. Photosynthates are required for respiration, growth of vegetative structures (i.e., leaves, stems, and roots), and fruit production.

Recently, investigations were conducted on five-year-old avocado trees (Hass variety) in a commercial orchard at Highland Valley, San Diego County, California, to determine the effects of avocado brown mite feeding on photosynthesis and transpiration. Additionally, chlorophyll content of the upper and lower surfaces of avocado leaves was determined to evaluate the effect of spider mite feeding on mesophyll cells adjacent to the upper and under surfaces of the leaf. Percent leaf area scarred was also recorded to provide a visual indicator to relate back to physiological measurements.

Brown Mite Injury and Leaf Chlorophyll Content

Measurements were conducted on leaves with pre-established injury levels of no injury, light, medium, and heavy, which corresponded with actual percent bronzing of 5, 46, 91, and 100, respectively, of the upper leaf surfaces. Mean chlorophyll content was consistently high in the mesophyll cells adjacent to the upper leaf surface except in those leaves where 100 percent injury was sustained (Fig. 2). In the upper cell layer, chlorophyll content was decreased by feeding injury levels greater than 65 percent, while the chlorophyll content in the lower cell layer remained the same at all injury levels. This would be expected because avocado brown mite feeding is normally confined to the upper surface of the leaf until spider mite populations become extremely high. Reductions in leaf chlorophyll content (chlorosis) have been associated with spider mite injury on many crops, although the injury is usually noticeable on both leaf surfaces.

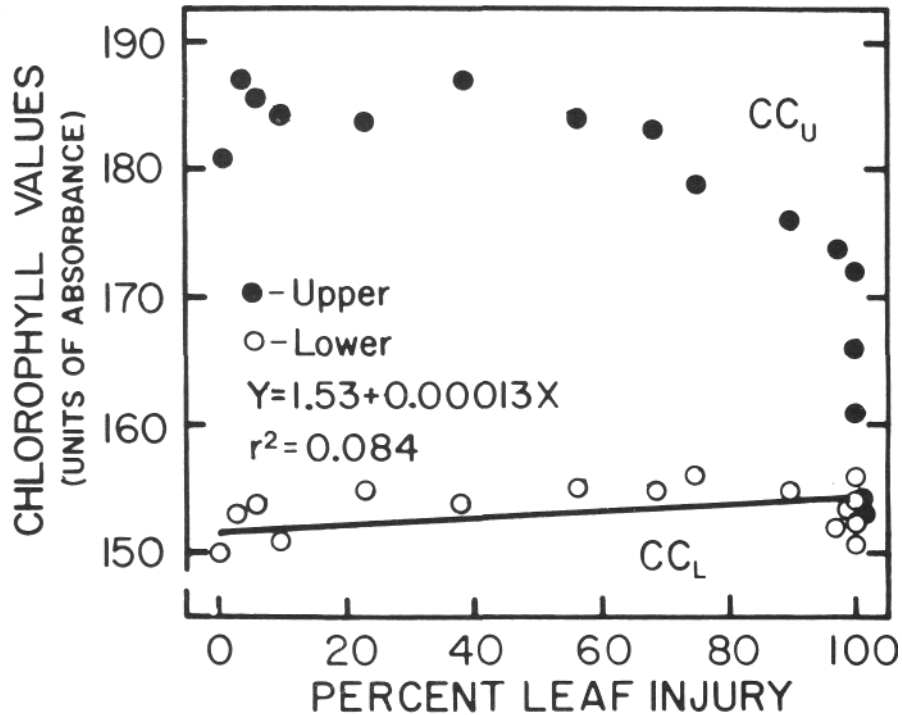


Fig. 2. Influence of avocado brown mite feeding injury on chlorophyll content of the leaf cells adjacent to the upper (CC_U) and under (CC_L) surfaces of avocado leaves. Each point represents the mean of eight readings.

Physiological Responses

Physiological processes were measured with a dual isotope porometer which utilizes radioactive isotopes (¹⁴C₂ and tritiated water vapor) in an airstream. An artificial atmosphere was established around the tested leaves in the field and taken to the laboratory for analysis. Levels of these isotopes in leaf tissue reflect the rate of photosynthesis and transpiration occurring at the time the sample was taken. Photosynthesis was found to be negatively correlated with mite damage (Fig. 3). Leaves sustaining 46 percent leaf damage on the upper leaf surface exhibited a 30 percent reduction in photosynthesis rates, as compared to leaves with 91 percent damage where rates decreased 41 percent. Similarly, transpiration was negatively correlated with mite injury (Fig. 3). Reduced transpiration not only indicates decreased loss of water from the leaf, but signifies reduced uptake of CO₂ through stomata, which also limits photosynthesis. It was further found that photosynthesis was reduced not only by decreased stomatal opening, but also by the destruction of mesophyll cells and reduction of chlorophyll content of injured leaves.

These results indicate that avocado brown mite feeding injury on avocado leaves results in reduced rates of important processes in the plant. The extent of feeding and time of season that injury is incurred is important when considering chemical control applications for this pest. Although this study indicates the physiological stress caused by various infestation levels of avocado brown mite, the relationship between mite-induced stress to leaves and avocado yield reduction has not been demonstrated.

These critical pest levels probably vary with avocado variety, overall plant condition, and environmental factors. Information of this type is thus necessary before accurate economic threshold levels can be established.

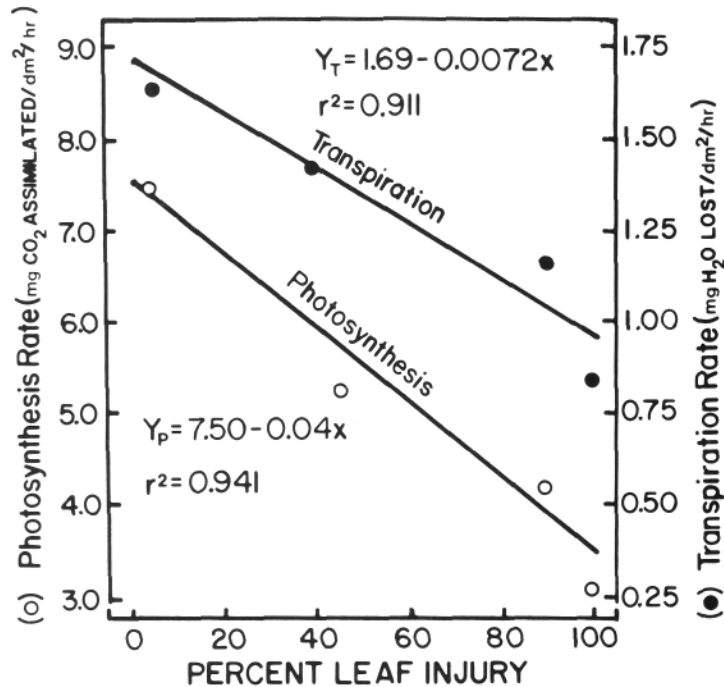


Fig. 3. The effects of avocado brown mite feeding injury on photosynthesis and transpiration of avocado leaves. Each data point represents a mean of 20 readings.

Footnotes

¹Present address: Pacific Agricultural Laboratories, Inc., P.O. Box 439, San Luis Rey, CA 92054

²Cooperative Extension

³Present addresses: P. O. Box 5051, Riverside, CA 92517

⁴Present address, Department of Entomology, University of California, Davis.