Presence-absence sampling of spider mite densities on cotton

Lloyd T. Wilson □ Thomas F. Leigh □ Victor Maggi

A simple, practical plan for reliably estimating mite densities overcomes problems of quantitative sampling.

The spider mite *(Tetranychus)* complex found in San Joaquin Valley cotton receives more pesticide applications per year than all other cotton arthropod pests combined. The damage mites cause to a cotton crop depends on the species of spider mite present, timing and intensity of the infestation with respect to the crop growth stage, the presence of predators able to suppress the mites, temperature, and other factors. Research findings from other parts of the United States have shown that, under extreme conditions, spider mites can reduce yields by as much as 44 percent. However, the numerical relationship between mite numbers and yield reduction is not well understood.

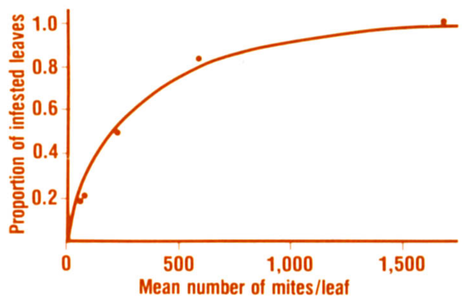
This lack of information is primarily a result of the difficulty in sampling mites. Unlike most pest species, spider mites can and do reach levels exceeding tens of thousands per plant. Counting all the mites on a single cotton leaf often takes an hour or more, whereas only a few minutes at most are required to thoroughly examine the total surface area of a plant for all other arthropods. Few researchers and no commercial scouts have the time for a program of carefully sampling each plant for mites.

We have devised a simple, practical sampling plan for reliably estimating mite densities. The method was developed from extensive data sets but in practice now only requires that the presence or absence of mites on each sampled cotton leaf be recorded to predict the number of mites.

Methods

We selected as the sample unit one mainstem node leaf from the middle of the plant based on the research of Dr. J. Carey, University of California, Davis (personal communication), who showed that most spider mites are found on mainstem node leaves in that area. During each sampling period, one leaf from each of 25 randomly chosen plants was examined.

After each leaf was scored as infested (one or more mites) or uninfested, the mites were processed through a commercial bleach preparation of sodium hypochlorite in a rinse machine that separated mites from their webbing and from dust or sand on the leaves. This procedure made it much easier to count the mites (eggs, immatures, adult males and females) and is of practical value in integrated pest management (IPM) projects. On two sampling dates, the efficiency of the rinse machine was tested by counting all mites on the leaves before rinsing.



Proportion of cotton leaves infested with spider mites (P[I]) and the mean number of mites per leaf are closely related.

Results show a shift in efficiency between our two leaf-count sampling dates, July 14 and 28. On July 14, the rinse machine recovered 55 percent of the spider mites. On the July 28 sample, the machine was more efficient, largely because we could not count mites accurately on leaves with high densities; several layers of webbing were present under these conditions, and counting the actively moving mites proved difficult. For this reason, the 55 percent efficiency estimate obtained at the lower density from the July 14 sample was used to scale the rinse counts to field counts.

The studies indicate that the number of mites per leaf is closely related to the proportion of infested leaves at a particular time. Previous studies of other cotton arthropods by the first author have shown a strong relationship between the mean numbers of pests, the variance, and the proportion of infested sample units (leaves). A similar relationship was found for mites. For example, the graph shows that a 20 percent infestation of mainstem leaves in the middle of the plant corresponds to a mean of 50 mites per leaf, whereas 50 percent infested leaves equals 200 mites per leaf. Counting the proportion of infested leaves in a sample takes only minutes as compared with hours required to count the mites.

Conclusion

The initial results from this study are encouraging. In the past, quantitative sampling of mites has seldom been attempted, because it takes hours and the counts are inaccurate. The presence-absence sampling method overcomes these problems and is practical for use in cotton IPM.

Further components of this study are aimed at determining the best leaves to sample. Previous studies on several cotton arthropods indicate that the vertical distribution of mites on leaves arising from mainstem nodes changes as the plants grow. Mites are found higher on the plant later in the season. Although we are sampling only one mainstem node leaf per plant, a larger number may be preferable.

The eventual aim of these studies is to obtain a mite density estimate on a unit area, such as per meter-row, for use in evaluating mite damage and economic thresholds. Approximately 60 percent of the mites occur on mainstem leaves (Carey, personal communication), and a preliminary analysis of the vertical distribution data indicated that 15 percent of these occurred on the leaves we sampled. This equates to 9 percent (0.6 x 0.15) of the mites on each plant being on the leaves sampled. The number of mites per plant or meter-row of plants can be easily estimated by scaling appropriately. If more leaves per plant are eventually sampled, plant or meter-row estimates can be made by scaling accordingly. In its final form, the mite density information will be combined with damage data to assist in developing spider mite treatment decision thresholds.

Lloyd T. Wilson is Research IPM Analyst, Systemwide, University of California, San Joaquin Valley Agricultural Research and Extension Center, Parlier; Thomas F. Leigh is Entomologist, and Victor Maggi is Staff Research Associate, Department of Entomology, U.C., Davis. This report was prepared from studies carried out under the California Systemwide project.