TWOSPOTTED SPIDER MITE MANAGEMENT IN MIDSOUTH COTTON

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Abstract

Spider mites are frequent pests of cotton worldwide, including the U.S. Spider mite infestations are often exacerbated by broad spectrum insecticide applications targeting other pests. Spider mite injury to cotton may result in yield loss, and reduced fiber and seed. There are 19 species of mites in the family Tetranychidae reported as pests of cotton in the United States. Of those mites the most common are the twospotted spider mite, *Tetranychus urticae*, the carmine spider mite, *Tetranychus cinnabarinus*, the pacific spider mite, *Tetranychus pacificus* and the strawberry spider mite: *Tetranychus turkestani*. The strawberry and Pacific spider mites occur primarily in California, whereas the twospotted and carmine spider mites occur throughout the U.S. cotton belt. The twospotted spider mite is by far the most important spider mite pest affecting U.S. cotton. The twospotted spider mite is extremely polyphagous with a cosmopolitan distribution. It is known to feed on over 900 host species including over 150 economically important ornamental and food crops, including grass and broad-leaved crops. Because of its wide distribution and wide host range, the twospotted spider mite is the most economically important phytophagous mite in the world.

The twospotted spider mite and carmine spider mite are identical in their morphology and to date there is not a reliable means to easily distinguish carmine from twospotted spider mite. Additionally, the biology and ecology of these two species is very similar; thus the remainder of this discussion will focus on these two species, but will not differentiate between them. Twospotted, strawberry, and pacific spider mites are similar in appearance with adult females of the species appearing pale greenish with distribution of dark spots within the abdomen. The carmine spider mite females are red. However, when nearing conditions suitable for initiating diapause, the female twospotted spider mite may also be red. Strawberry mites are more common in the western U.S. and can be separated from the other species based cotton plant response and infestation patterns. Adult male spider mites possess a tapered abdomen and are smaller than females. Although spider mites can vary in size due to environmental conditions, mature females are less than 3/64 inch long, and oval shaped. Larval stage spider mites possess 6 legs while both nymphal stages possess 8. All four species of spider mites produce dense webbing underneath the leaf surface which provides a foundation for eggs and protection from natural enemies.

These spider mites are well known for producing profuse webbing. This webbing is thought to serve a number of purposes. However, the primary benefit of webbing is protection. Webbing can hamper predators and will help in repelling precipitation or miticide applications.

The twospotted spider mite can reproduce year round as long as warm temperatures persist. Spider mite females can lay over a 200 eggs, but generally average about 70. They will generally lay 3 to 14 eggs per day. These eggs appear as small pearl to pink colored spheres. Twospotted spider mites exhibit a type of parthenogenesis called arrhenotoky where unfertilized (haploid) eggs will produce males and fertilized (diploid) eggs will produce females and males, at an approximate ratio of 3 to 1. Eggs will hatch in a few days into a 6 legged larval stage. The immature stages look like small adults in shape. The larval stage is extremely small and somewhat translucent in color. Following the larval stage, individuals will develop through two eight legged nymphal stages, protonymph and deutonymph; and finally to the adult which will measure about 0.65 mm in length. Growth and development is temperature dependent and is influenced by the host plant. The entire life cycle requires 7 to 14 days to complete in summer months. Although the life cycle speeds up at higher temperatures (upper 80's and 90's ^{o}F), egg production is maximized in the 70's ^{o}F. Under optimal conditions, overlapping generations can occur every 5 to 7 days.

Spider mites pierce individual leaf cells on the abaxial side of leaves and extract the cellular contents using their stylets. Damage usually occurs in clusters. Damaged clusters appear as a white spec on the leaf, termed stipules. This damage is Phase I damage. As feeding increases and the mites persist a "bronzing" discoloration on the underside of leaves occurs, particularly at the junction of main leaf veins. As the damage spreads and the leaf takes on a reddened appearance (Phase II) and eventually necrosis.

Cotton may be infested with spider mites at any point in the growing season but is most susceptible to spider mite injury during fruiting periods and when the crop is suffering water deficit stress. The susceptibility of cotton to spider mite injury can vary depending on growth stage. Drought stress can also impact susceptibility to injury. Feeding results in water deficit and desiccation of plant tissue. Photosynthesis is reduced due to damage to the chloroplasts in injured plant cells and injured leaf tissue results in less production of photosynthates for developing bolls and squares. Severe spider mite infestations occurring early in the fruiting period results in decreased flower survival, reduced boll number and boll size. When spider mite injury is severe, leaves or parts of leaves turn yellow or red and eventually defoliation and total fruit loss may result. Cotton is susceptible to yield loss from spider mite injury for most of its life cycle. The timing of infestations, with regard to plant growth stage, can influence the severity of yield losses. Yield losses tend to be more severe when infestations occur during the earlier growth stages and are allowed to persist throughout the season. The magnitude of yield loss generally decreases when infestation begin at the flowering or later stages. Thus yield loss is associated not only with the severity of the spider mite infestation, but also the duration of the infestation.

There are a number of factors that contribute to spider mite outbreaks including environmental conditions, the landscape and pesticide use. Spider mite infestations usually begin on field edges, often near dusty roads. The populations commonly move into cotton from weedy hosts such as morning glory, palmer amaranth, trees and brush, or other crops such soybeans or corn. Thus, predicting a spider mite outbreak in cotton can often depend on the population in the immediate surrounding habitat. The twospotted spider mite overwinters as an adult female. They like to seek out dark, humid environments in leaf litter or similar habitat to overwinter. When temperatures are warm, diapause may be temporarily broken and reproduction may occur on winter weeds. As warm temperatures are sustained, mite populations will build on spring weeds, and as crowding occurs or with host deterioration, the mites will move into adjacent cotton.

Population dispersal from weeds into cotton may occur as mites crawling from one host to another. This type of dispersal may be most evident in situations where weedy areas are directly adjacent to cotton fields. Thus poor or inadequate fall and spring pre-plant vegetation management also plays a significant role in the occurrence of mites, especially early season. The most common mite stage to disperse by crawling are pre-reproductive females. Mites will also move via the wind. Mites may be carried short distances on the breezes directly, or by ballooning, where the mite spins a strand of silk to catch the wind. This type of dispersal may carry the mite for miles. Mites can also disperse by catching rides on animals or machinery. It is not uncommon for field scouts to spread spider mite infestations among field simply by walking from infested to non-infested fields.

Spider mite infestations are favored by hot, dry weather. Conversely, high relative humidity and precipitation deter spider mite infestations by washing them off leaves and favoring epizootic outbreaks. Dust produced by machine and vehicular movement on unpaved roads, adjacent to and within cotton fields favor spider mite proliferation by possibly interfering with natural enemy efficiency. When spider mite infestations develop in fields, miticide applications are often needed to prevent economic losses. Most miticides are fairly specific towards mites and thus pose little risk of flaring secondary pest outbreaks. However, spider mites have the potential of developing resistance quickly and repeated applications of the same mode of action should be avoided. Spider mite infestations often initiate as spots in the field and treatment of the entire field area may not be warranted.

Management of spider mites requires the preservation of natural enemies and anticipation of outbreaks following broad spectrum insecticide applications for other pests. Preserving beneficial organisms throughout the season may help prevent or delay spider mite infestations. Delaying early season insecticide applications may help preserve beneficial insects including western flower thrips, *Frankliniella occidentalis,* big eyed bugs, *Geocoris* spp.*,* predaceous mites and minute pirate bugs, *Orius* spp. Furthermore*,* the entomopathogenic fungus, *Neozygites floridana*, is an important natural enemy of spider mites that can rapidly reduce spider mite populations under the correct environmental conditions.

Scouting for spider mites should be conducted on weekly basis and action thresholds vary by geographic location. Some states suggest treatment when mite populations are present and damage is occurring. While others such as California and Mississippi suggest evaluating randomly chosen plants for the presence of mites and basing treatment decisions on mite presence and plant injury.

References

Brandenburg, R.L., and G.G. Kennedy. 1982. Relationship of *Neozygites floridana* (Entomophthorales: Entomophthoraceae) to twospotted spider mite (Acari: Tetranychidae) populations in field corn. J. Econ. Entomol. 75:691-694.

Brito, R.M., V.M. Stern and F.V. Sances. 1986. Physiological response of cotton plants to feeding of three *Tetranychus* spider mite species (Acari: Tetranychidae). J. Econ. Entomol. 79: 1217-1220.

Gore, J., D. R. Cook, A. L. Catchot, F. R. Musser, S. D. Stewart, B. R. Leonard, G. Lorenz, G. Studebaker, D. S. Akin, K. V. Tindall, and R. E. Jackson. 2013. Impact of twospotted spider mites (Acari: Tetranychidae) infestation timing on cotton yield. J. Cotton Sci. 17: 34-39.

Lincoln, C., F. J. Williams, and G. Barnes. 1953. Importance of a thrips in red spider control. J. Econ. Entomol. 46: 899–900

Sadras, V.O., and L.J. Wilson. 1997. Growth analysis of cotton crops infested with spider mites: II. Partitioning of dry matter. Crop Sci. 37:492–497.

Smitley, D.R., G.G. Kennedy and W.M. Brooks. 1986. Role of the entomogenous fungus, *Neozygites floridana*, in population declines of the twospotted spider mite, *Tetranychus urticae*, on field corn. Entomol. Exp. Appl. 41: 255-264.

Wilson, L.J. 1993. Spider mites (Acari: Tetranychidae) affect yield and fiber quality of cotton. J. Econ. Entomol. 86: 566–585.

Wilson, L.T., C.H. Pickett, T.F. Leigh, and J.R. Carey. 1987. Spider mite (Acari: Tetranychidae) infestation foci: cotton yield reduction. Environ. Entomol. 16:614–617.

Wilson, L.T., P.J. Trichilo and D. Gonzalez. 1991. Natural enemies of spider mites (Acari: Tetranychidae) on cotton: density regulation or casual association? Environ. Entomol. 20: 849-856.