e-GRO Edible Alert

Gavin N. Saunders

W. Garrett Owen
wgowen@uky.edu

Volume 7 Number 13 September 2022

Spider Mites on Greenhouse Strawberries

Greenhouse-grown strawberries (Fragaria xananassa) with stippled, bronzed, and fully desiccated leaves were observed. These leaves were covered in webs and apparent spider mite populations. This Alert describes and provides photos of signs and symptoms caused by spider mites (Tetranychus sp.) on greenhouse strawberries and suggests options for management and control of two-spotted spider mites (T. urticae) in greenhouse environments.

Strawberries (*Fragaria xananassa*) can be successfully grown in greenhouses in containers (Fig. 1A) or hydroponically (Fig. 1B) for propagule (Fig. 2A), plant (Fig. 2B), or fruit production (Fig. 2C). Recently, a crop of strawberries (*Fragaria ×ananassa*) growing in a greenhouse with a mix of floriculture crops were observed having slight to severe bronzing and stippling leaves wrapped in webs (Figs. 3–4), upon which populations of spider mites were also observed (Fig. 5). Individual leaf condition varied indirectly with leaf age; younger leaves showed less symptomology than older leaves, which had served more time as feeding/breeding grounds for spider mite (*Tetranychus* sp.) populations (Fig. 6). At the time that these spider mites were observed, populations had already exceeded 15-20 mites per leaflet, and overall plant health had drastically declined.

Two-Spotted Spider Mite

Spider mites are tiny arthropods belonging to the class Arachnida, named for the webs that they create on their host plants. The three most common species of spider mites reported to impact strawberry crops are two-spotted spider mites (*T. urticae*), carmine spider mites (*T. cinnabarinus*), and strawberry spider mites (*T. turkestani*; Bolda et al., 2019). However, of these three species, the two-spotted spider mite is the most common spider mite in agriculture with a wide host range of over 1,100 plant species

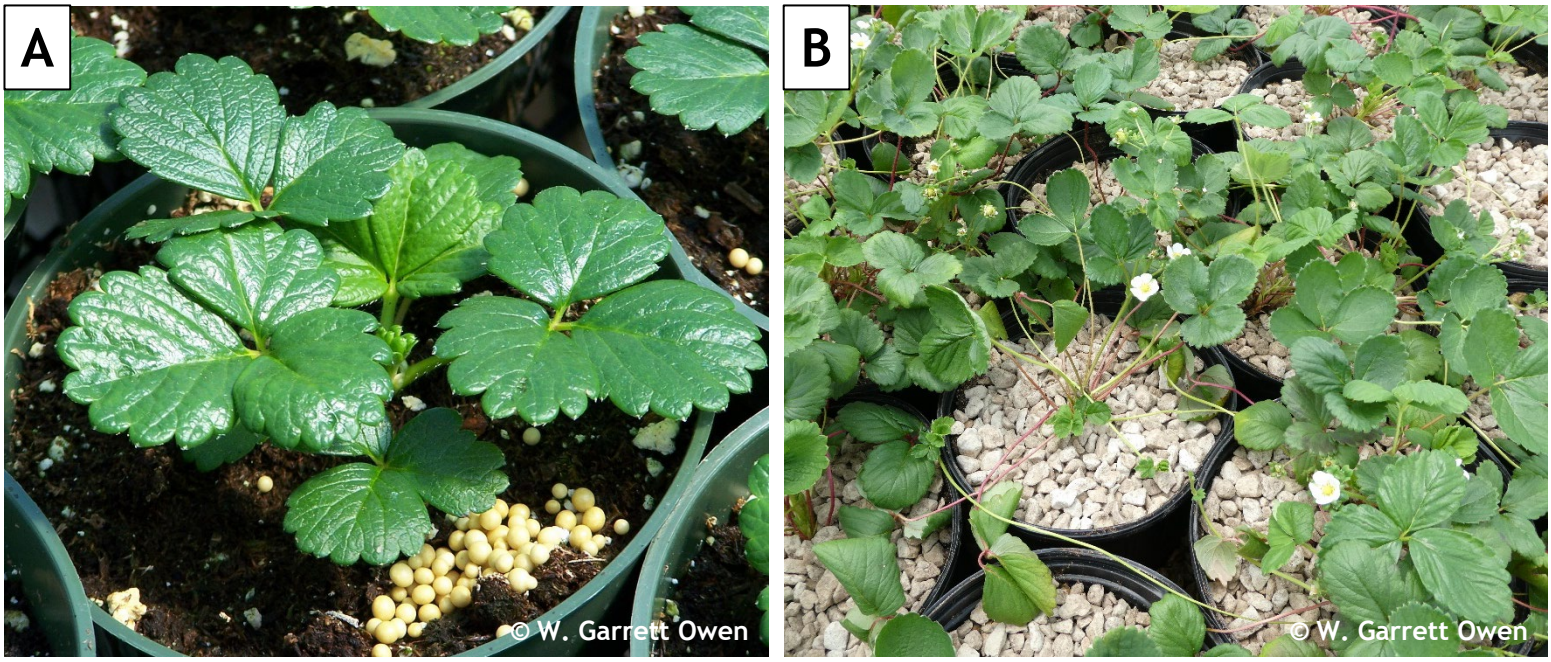

Figure 1. Greenhouse strawberries (*Fragaria ×ananassa*) grown in (A) containers filled with soilless peat-based substrates and (B) hydroponically in pumice. Photos by W. Garrett Owen.

(Grbić et al., 2011). Most readily identified by the dark spots on either side of their abdomens (Fig. 7), these mites will create strands and layers of silky webbing on upper and lower leaf surfaces of their host plants. Once layered thick enough, this webbing also serves as a physical barrier that offers the mites and their eggs some protection from threats like weather, predators, and pesticides.

While this namesake webbing is a clear and distinct indicator of spider mite infestation, it is usually too late to effectively control the pest population by the time that these webs have been constructed. Even in populations as small as one mite per leaflet, spider mites can contribute to noticeable yield loss; once populations grow to exceed 15-20 mites per leaflet, growers will see substantial yield losses (Bolda et al., 2019). These yield losses can generally be attributed to the reduced photosynthetic capacity of infested plants, as spider mites remove chlorophyll from plant cells as they feed. Growers facing a spider mite infestation may see yield losses such as stunted plants, deformed flowers (Fig. 8), delayed flowering and fruit development, and reduced fruit size and quality.

Early signs and symptoms are less noticeable than bronzed leaves and webs, but with careful and trained eyes, scouts may be able to locate pioneer spider mites within days of infestation. The first symptom to appear on newly infested plants comes in as pale white-to-yellow stippling (or speckling) on leaves. This stippling is created as spider mites feed on tissue from leaf surfaces; a few sparse speckles on leaf surfaces would indicate a recent infestation, whereas higher concentrations of speckles on leaf surfaces would indicate that mites had already been feeding for some time. While spider mites typically prefer to reside on and feed from leaf undersides, they can also be found feeding on upper leaf surfaces, especially in higher population densities.

Transmission

One of the primary means of introducing spider mites into the greenhouse is with infested plant material. Since spider mites are so small, it is easy for them to slip past quality control checks and travel from propagation to production greenhouses. Purchasing young plant material from reputable growers, and then inspecting that plant material upon arrival, are the best ways to exclude spider mites from the greenhouse. Furthermore, spider mites can travel great distances by riding on wind currents through a process called "ballooning," (Alston and Reading, 2011) which means that any opening in greenhouse ventilators, sidewalls or roofs could serve as an entry point. One could implement fine insect screens (Fig. 9) on greenhouse vents to deny mites entry, but most insect screens are not fine enough to keep mites out, and not all greenhouses are suited for the installation of insect screens.

In scenarios where the greenhouse has already been infiltrated, spider mites can quickly spread from plant to plant and turn into an annually recurring problem. Spider mites will create thin strands of silk that serve as bridges from one plant to another (Fig. 10), allowing for rapid infestation of healthy plants. These silken bridges can span across rows, connecting plants that would have otherwise not been in the mites' path of travel. As the growing season comes to an end, female spider mites will take up hiding in debris on the greenhouse floor in order to overwinter and return in the spring (Alston and Reading, 2011). Maintaining a clean

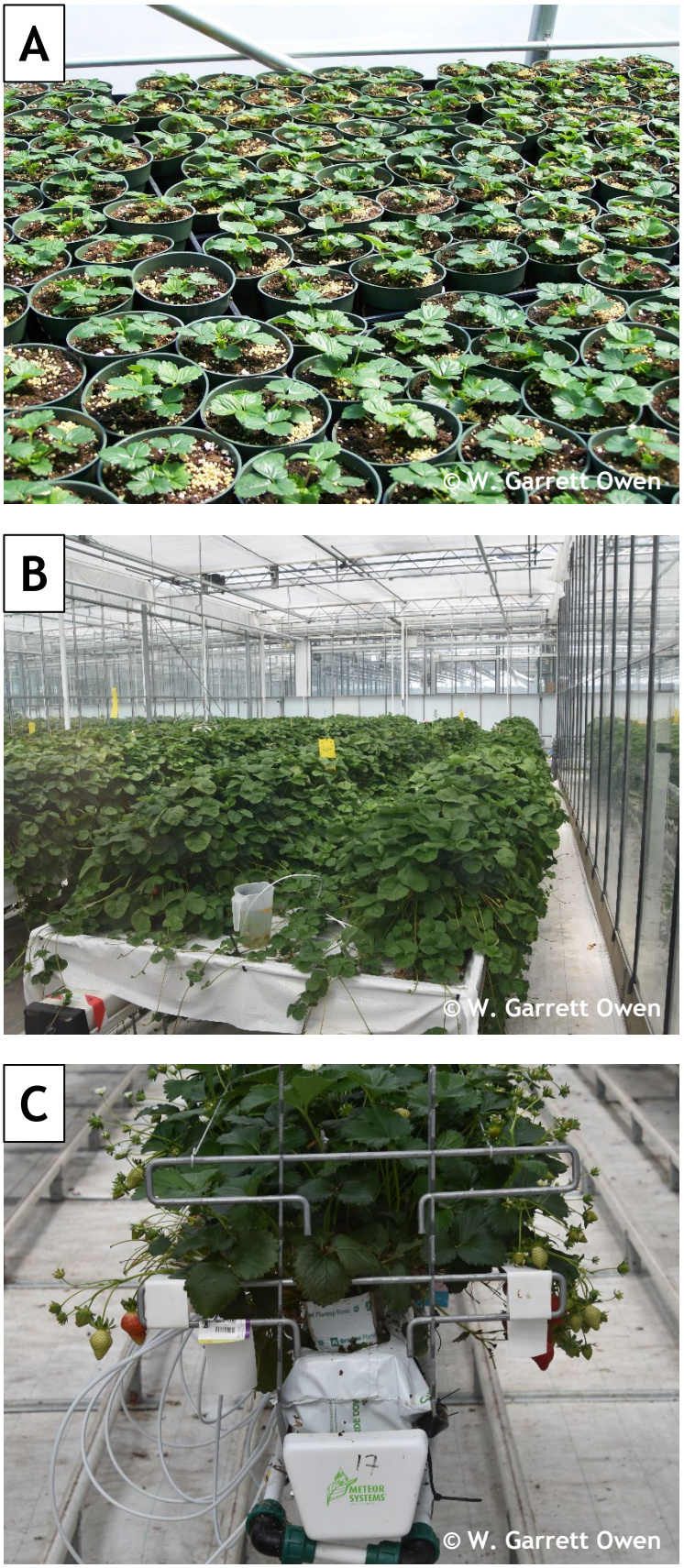

Figure 2. Greenhouse strawberries (*Fragaria ×ananassa*) can be grown for (A) propagules, (B) plants, or (C) fruit production. Photos by W. Garrett Owen.

Figure 3. Greenhouse-grown strawberries (*Fragaria ×ananassa*) with slight bronzing and stippling leaves caused by a spider mite (*Tetranychus* sp.) infestation. Photo by W. Garrett Owen.

Figure 4. Greenhouse-grown strawberries (*Fragaria ×ananassa*) with severely bronzed and stippled leaves wrapped in spider mite (*Tetranychus* sp.) webs. Photo by W. Garrett Owen.

greenhouse—free of debris on the floor and pet plants—will help to eliminate overwintering spider mites and provide a fresh start for the next growing season.

Management

Since established populations are often infeasible to manage, the best practice for avoiding spider mite damage is to prevent infestations in the first place. As they are ubiquitous in agricultural settings around the world and small enough to fit through all but the finest of screens, one must accept that spider mites will likely turn up in their greenhouse at some point or another. With that in mind, growers can deploy any combination of several integrated pest management (IPM) strategies that can help keep spider mites from taking over and decimating valuable crops like strawberries.

First and foremost, adopting a thorough scouting routine will help cue growers in to the presence of spider mites with enough notice to take corrective action before pest populations exceed economic thresholds. Most often found on leaf undersides in the early stages of infestation, spider mites and their eggs are more easily identified with the aid of a hand lens. The eggs, especially, which resemble microscopic clear-to-white pearls (Fig. 11), can usually be found near leaf veins (Cranshaw and Sclar, 2014). For a more rudimentary diagnostic procedure, one can take a white sheet of paper and shake the infested leaf over it; any spider mites that fall onto the sheet will be visible as tiny, dark specks crawling around on their own. Aside from carefully combing through plants in search of spider mites, growers can also take some more general approaches to help deter spider mites from taking up residence in the greenhouse. Spider mites are known to prefer hot and dry climates, and plants under drought stress can be more appealing to hungry spider mites (Cranshaw and Sclar, 2014), so maintaining cooler and/or more humid conditions in the greenhouse (where possible) will help to slow down the pests' feeding and reproductive rates.

Figure 5. Greenhouse-grown strawberries (*Fragaria ×ananassa*) severely infested with a dense population of spider mites (*Tetranychus* sp.). Photo by W. Garrett Owen.

Figure 6. Older leaves of greenhouse-grown strawberry (*Fragaria ×ananassa*) displayed severe bronzing, stippling, and webbing caused by an intense spider mite (*Tetranychus* sp.) infestation. Photo by W. Garrett Owen.

Figure 7. Two-spotted spider mites (*Tetranychus urticae*) are the most common spider mite in agriculture and most readily identified by the dark spots on either side of their abdomens. Photo by W. Garrett Owen.

Figure 8. Strawberries (*Fragaria ×ananassa*) infested with spider mites (*Tetranychus* sp.) may exhibit deformed flowers results in yield losses and fruit quality. Photo by W. Garrett Owen.

Figure 9. A greenhouse deploying fine insect screens to mitigate spider mite (*Tetranychus* sp.), entry via ballooning. Photo by W. Garrett Owen.

Figure 10. Spider mites (*Tetranychus* sp.) can quickly spread from plant to plant. In this instance, spider mites created bridges with thin strands of webbing which allowed movement between infested and healthy strawberries (*Fragaria ×ananassa*) plants. Photo by W. Garrett Owen.

Figure 11. Spider mite (*Tetranychus* sp.) eggs resemble microscopic clear-to-white pearls. Pictured are spider mite eggs on greenhouse-grown strawberry (*Fragaria xananassa*). Photo by W. Garrett Owen.

Perhaps the most effective tool available to growers for the control of spider mites is the wide array of biological control agents (BCAs) known to feed on spider mites. These BCAs include other species of predatory mites, minute pirate bugs, and lacewings, to name a few (Bolda et al, 2019). By introducing some predatory species into the greenhouse environment, growers can help curb rising spider mite populations, and also prevent them from rising again. However, the implementation of BCAs can be tricky, so it is important to consult a variety of resources to determine which species are best suited for individual crops, environmental conditions, and existing pest management strategies.

When all else has failed, or if the crop(s) at stake cannot tolerate any degree of pest damage, growers have the option to resort to chemical control of spider mite populations via the usage of miticides. However, as is the case with many agricultural pests and their associated pesticides, spider mites have begun developing varying degrees of resistance to many of the miticides available on the market. Therefore, in order to ensure the efficacy of miticide applications, growers must take care to use a rotation of miticides with differing modes of action, so that spider mite populations have less opportunity to survive and develop resistance to the chemicals being used (Bolda et al., 2019). Additionally, it is important to recognize that many miticides/pesticides are non-selective in their mode of action, and these chemicals will target BCAs in addition to spider mites; growers should seek to use selective miticides when trying to preserve BCA populations in the greenhouse.

Literature Cited

Alston, D.G. and M.E. Reading. 2011. Web sp nning spider mites: Two spotted spider mites and McDaniel spider mite (*Tetrar ychus urticae* & *Tetranychus mcdanieli*). Utah State University – Utah Pests Exte nsion. https://extension.usu.edu/pests/resea rch/web-spinning-mites.

Bolda, M.P., G.T. Browne, S.K. Dara, O. Daug ovish, S.A. Fennimore, T.R. Gordon, S. Joseph, S.T. Koike, K.D. Larson, P.A. Ph llips, R. Smith, B.B. Westerdahl, and F.G. Zalom. Revised July 24, 2019. UC IPM P est Management Guidelines Strawberry. UC ANR Publication 3468. https://www2.ipm.ucanr.edu/agricultu re/strawberry/spider-mites/.

Cranshaw, W.S. and D.C. Sclar. 2014. Spider Mites – 5.507. Colorado State University Extension. https://extension.colostate edu/topic-areas/insects/spider-mites-5-507/.

Grbić, M., T. Van Leeuwen, R. Clark, S. Romb auts, P. Rouzé, V. Grbić, E.J. Osborne, W. Dermauw, P.C.T. Ngoc, F. Ortego, P. Hernández-Crespo, I. Diaz, M. Martinez, M. Navajas, E. Sucena, S. Magalhães, L. Nagy, R.M. Pace, S. Djuranović, Y. Van de Peer. 2011. The genome of *Tetranychus urticae* reveals herbivorous pest adaptations. Nature 479: 487-492.

e-GRO Alert

www.e-gro.org

CONTRIBUTORS

Dr. Nora Catlin
Floriculture Specialist
Cornell Cooperative Extension
Suffolk County
nora.catlin@cornell.edu

Dr. Chris Currey
Assistant Professor of Floriculture
Iowa State University
ccurrey@iastate.edu

Dr. Ryan Dickson
Greenhouse Horticulture and
Controlled-Environment Agriculture
University of Arkansas
ryand@uark.edu

Thomas Ford
Commercial Horticulture Educator
Penn State Extension
tgf2@psu.edu

Dan Gilrein
Entomology Specialist
Cornell Cooperative Extension
Suffolk County
dog1@cornell.edu

Dr. Chieri Kubota
Controlled Environments Agriculture
The Ohio State University
kubota.10@osu.edu

Heidi Lindberg
Floriculture Extension Educator
Michigan State University
wolleage@anr.msu.edu

Dr. Roberto Lopez
Floriculture Extension & Research
Michigan State University
rglopez@msu.edu

Dr. Neil Mattson
Greenhouse Research & Extension
Cornell University
neil.mattson@cornell.edu

Dr. W. Garrett Owen
Greenhouse Extension & Research
University of Kentucky
wgowen@uky.edu

Dr. Rosa E. Raudales
Greenhouse Extension Specialist
University of Connecticut
rosa.raudales@uconn.edu

Dr. Alicia Rihn
Agricultural & Resource Economics
University of Tennessee-Knoxville
arihn@utk.edu

Dr. Debalina Saha
Horticulture Weed Science
Michigan State University
sahadeb2@msu.edu

Dr. Beth Scheckelhoff
Extension Educator - Greenhouse Systems
The Ohio State University
scheckelhoff.11@osu.edu

Dr. Ariana Torres-Bravo
Horticulture/ Ag. Economics
Purdue University
torres2@purdue.edu

Dr. Brian Whipker
Floriculture Extension & Research
NC State University
bwhipker@ncsu.edu

Dr. Jean Williams-Woodward
Ornamental Extension Plant Pathologist
University of Georgia
jwoodwar@uga.edu

Cooperating Universities

Cornell CALS College of Agriculture and Life Sciences

Cornell Cooperative Extension Suffolk County

Iowa State University

University of Kentucky

PennState Extension

UTIA Institute of Agriculture, The University of Tennessee

Michigan State University

UConn

College of Agricultural & Environmental Sciences, University of Georgia

Purdue University

NC State University

The Ohio State University

UofA Division of Agriculture, Research & Extension, University of Arkansas System

In cooperation with our local and state greenhouse organizations

Maumee Valley Growers — Choose the Very Best.

Metro Detroit Flower Growers Association

NC Flower Power

Western Michigan Greenhouse Association

Connecticut Greenhouse Growers Association

Indiana Flower Growers Association

LIFGA

Michigan Greenhouse Growers Council

NYSFI — New York State Flower Industries, Inc.

Kentucky Horticulture Council