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Twospotted Spider Mite on Sugar Beet:

Importance, Identification and Management

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Introduction

IN THE PAST, twospotted spider mites (TSSM) were a minor but recurring pest problem on sugar beet grown in Idaho, Oregon, and Washington. Since 2012, these production areas have seen a significant increase in TSSM populations resulting in localized, severe crop losses. The increase in TSSM numbers and damage is not fully understood, but a number of factors most likely contributed to the increase in mite populations. These factors include a shift to more corn acres to accommodate the growing dairy industry. Corn is a highly favorable host for TSSM and the majority of the new corn acres are produced to support a growing industry. Treating for TSSM in these fields is generally not cost effective; TSSM populations may build to high populations that then move to other crops. Other contributing factors likely include the use of broad-spectrum insecticides to control other insects, the loss of spider mite-targeted products from the market, potential miticide resistance in TSSM populations, and climate change resulting in warmer springs and summers. TSSM occur in production areas with warm, dry summers such as Europe and parts of North America. Pest pressure and associated damage increase with hot temperatures in combination with dusty conditions and reduced relative humidity or drought conditions. Under severe pest pressure, losses of up to 25–30 percent or more are not uncommon when TSSM are not controlled by acaricide applications. Crop losses include decreased tonnage and decreased percent sucrose.

Symptoms

Because TSSM are small and generally feed on the underside of leaves, populations often go unnoticed until serious damage has occurred. Foliar symptoms caused by TSSM often appear first on field edges and areas close to other infected hosts (alfalfa seed, corn, bean, etc.). Damage initially appears as a light

stippling of leaves caused by TSSM piercing individual cells (figure 1) and sucking the cell content, which allows the cells to be filled with air. Continued feeding results in silvering and bronzing of leaves (figure 2), and, eventually, in dying of affected leaves as well as potential defoliation of the whole plant. TSSM-infested plants show reduced plant vigor, tonnage, and sucrose content as a consequence of inhibited photosynthesis and sugar production. In addition to signs of feeding damage, TSSM produce distinctive webbing on the underside of sugar beet leaves that can hinder control efforts by interfering with natural enemies of TSSM and by preventing good contact of pesticides with plant foliage. Foliar symptoms of bronzing, in conjunction with wilting, can be misdiagnosed as drought stress, especially on field edges.

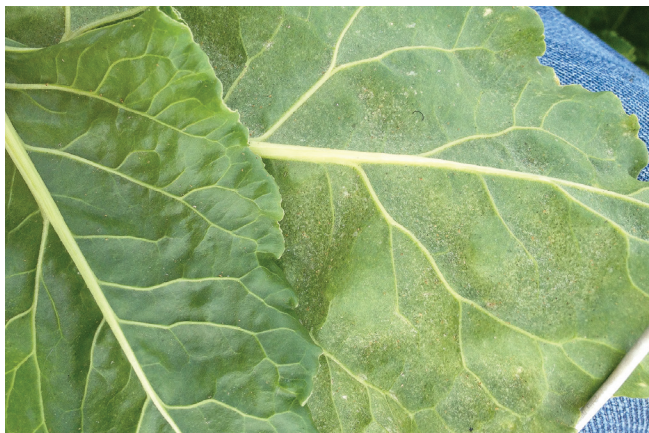


Figure 1. Initial damage caused by twospotted spider mites. Left leaf healthy; right leaf shows signs of stippling caused by pierced plant cells filled with air. Photo by Oliver T. Neher.



Figure 2. Advanced symptoms (silvering and bronzing) of twospotted spider mite feeding damage. Left leaf healthy; right leaf showing bronzing and silvering. Photo by Oliver T. Neher.

Description

Despite their name, twospotted spider mites (*Tetranychus urticae* Koch) are not spiders but are only related to them and belong to their own order (Acarina). One of the main distinguishing features of this order is the broad fusion of the head and abdomen to the thorax, giving the body a sac-like appearance. Adult TSSM females are oval, 1/64 inch long (0.4–0.5 mm) whereas males are 1/72 inch (0.34 mm) long with a pointed abdomen. Adult mites have eight legs and two distinct black spots (figure 3) reaching from the middle of the abdomen to its end. The color of TSSM can range from yellow to yellow-green to green-brown. Under drought conditions or in the fall, mites often turn orange or reddish-brown.

Immature TSSM stages include a larva and two nymph stages (protonymph and deutonymph) (figure 3). Larvae possess six legs whereas nymphs have eight legs. Both stages are smaller than the adults. Larvae initially appear translucent with faint or no black spots, but become yellow-green to green with more distinct black spots as they begin feeding. Protonymphs and deutonymphs are progressively larger than the larvae. They are more deeply green and the characteristic black spots on the abdomen are more pronounced.

Eggs are clear to milky-white spheres about 1/150 of an inch (0.18 mm) in diameter (figure 4) and usually laid on the underside of leaves or beneath the protective webbing.



Figure 3. Twospotted spider mites showing characteristic black spots on abdomen of adult male (upper left) and female (upper right) and nymph stages (lower middle). Photo by Oliver T. Neher.



Figure 4. Eggs of twospotted spider mites amid a group of adult mites. Photo by Ken Gray.

Host range and environmental conditions

TSSM have an extensive host range (more than 200 plant species), including many weeds, field and horticultural crops, as well as ornamental plants. A few of the crops grown in Idaho, Oregon, and Washington that can serve as hosts to TSSM include all varieties of beans and corn, sugar beet, hops, mint, potatoes; many seed crops such as alfalfa or carrot; and many fruit trees and shrubs. Perennial crops such as alfalfa or mint may play an important role in the life cycle of TSSM since they serve as an overwintering refuge.

The life cycle (figure 5) of TSSM is highly driven by environmental conditions. A minimum temperature of 55°F (13°C) with an optimum of 63°F (17°C) in combination with low precipitation (1.9–2.7 inches, or 50–70 mm) is needed for TSSM to become active in the spring. Hot, dry (35–40 percent relative humidity) weather favors rapid population increase and increased damage that is exacerbated by water stress and dusty conditions.

Life cycle

TSSM overwinter as dormant (diapausing) adult females on dead vegetation, in cracks and crevices in tree and shrub bark and fence posts and rails, and other protected areas such as soil or plant crowns (figure 5). In the spring, females emerge from overwintering sites as temperatures reach

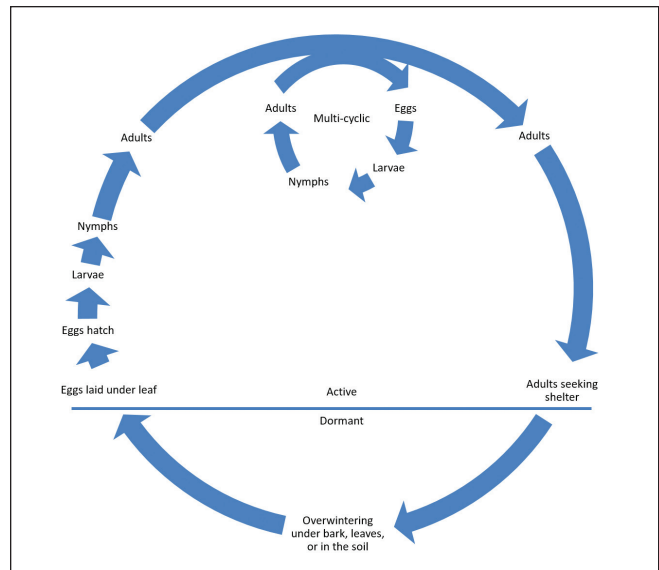


Figure 5. Life cycle of the twospotted spider mite. Adapted from *Fundamentals of entomology and plant pathology*, Louis L. Pyenson, 1977

63°F (17°C). They immediately begin feeding and depending on environmental conditions and availability of food, begin laying eggs within two days of emergence. Fertilized eggs will give rise to female mites whereas males will emerge from unfertilized eggs. Two to five days after eggs are deposited, first instar mites (or, larvae) will emerge from eggs. TSSM develop through two additional molts, the second instar (or, protonymph) and the third instar (or, deutonymph), before becoming adult mites. Each transition between molts is preceded by one to two days of inactivity during which mites are very resistant to chemical control. Under optimum conditions, the development from egg to adult can take six to seven days. Earlier in the season or under cooler conditions, the life cycle can take more than three weeks. In the Treasure Valley of Idaho, reproduction may be continuous from early spring until late fall with each female laying up to 90 to 120 eggs in her lifetime. The eggs hatch in 2 to 10 days, and 8 to 12 overlapping mite generations can develop during the spring and summer months. In late August and September, under the influence of shortening day length, orange-colored, diapause-form female spider mites appear and begin moving to overwintering sites. Male spider mites do not over-winter. Depending on environmental condition, nondiapausing female mites can live up to 5 weeks, whereas males only live for about 3 weeks.

Management

Small mite populations are not a management concern. However, the potentially high reproductive rate of TSSM under optimal environmental conditions can result in very high populations and serious damage and yield loss in a very short period of time. In addition, sugar beet fields can be rapidly infested with damaging levels of TSSM as mites migrate from senescing (dying, either naturally or as a result of spider mite feeding damage) or heavily infested crops from neighboring fields. Regular and frequent monitoring of TSSM numbers is extremely important.

Disease monitoring and timing of control measures

Scouting is an important tool to determine mite pressure and to estimate the need for applications. Sugar beet fields need to be checked as soon as temperatures reach 63°F (17°C) and relative humidity drops below 40 percent in early May in many of the crop producing areas of the Pacific Northwest (figure 6). Fields should be scouted weekly when surrounding crops start to senesce or show signs of mite infestation and hot, dry conditions are predicted. Initially, mites can be found on the underside of lower leaves, but as infestation progresses, mites, webbing, and feeding damage can be observed on all leaf surfaces. A simple method to assess TSSM infestation is to shake a leaf over a white sheet of paper. Using a hand-lens (at least 10x magnification), count the number of TSSM per leaf. It is important to repeat this with multiple leaves across the whole field and to keep records of the

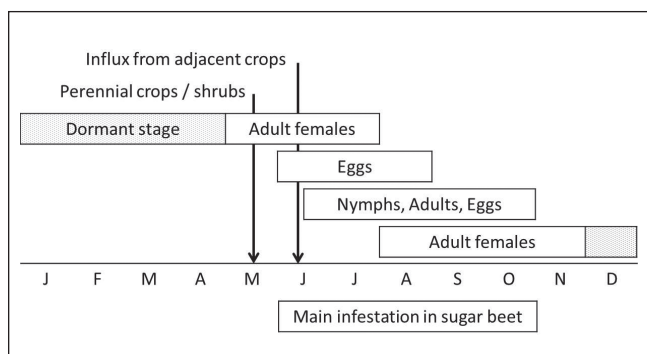


Figure 6. Scouting schedule for the detection of twospotted spider mites in sugar beet.

individual counts. An increase in mite populations, in combination with conducive weather conditions, can warrant miticide applications. However, mite populations can increase as fast as they can decline and it is important to consider future weather patterns (cold and wet conditions can lead to a reduction of the population).

Growing areas in France rely on a threshold based on 10 percent of plants showing silvering or bronzing and the appearance of the pest that will trigger applications. In Turkey, sugar beet growers will start spraying when five TSSM per 100 leaves are observed. However, no economic threshold is established for sugar beet grown under Idaho conditions.

Cultural practices

Cultural practices will only indirectly influence TSSM population dynamics. In general, overhead irrigation (hand or wheel-lines, pivots) often have fewer mites because of less favorable environmental conditions. Efforts to reduce dust and infection with powdery mildew will reduce habitat quality for mites. In addition, avoiding application of excess nitrogen and plant stress caused by drought will help to reduce the infestation by decreasing the reproductive rates and slowing the development of TSSM.

Chemical control

Twospotted spider mite populations cannot be effectively managed using the broad-spectrum insecticides currently available because of mite resurgence. Resurgence occurs when a pesticide treatment initially reduces a pest population, but causes a subsequent increase in the pest population. Pest resurgence may result when a pesticide kills, repels, irritates, or otherwise reduces populations or effectiveness of natural enemies of TSSM or other pests. As the residual activity of an insecticide decreases, the pest population is able to increase rapidly and to a level of higher abundance because natural enemies are absent or in low abundance or effectiveness.

Resurgence also can result from exposure to sub-lethal doses of insecticides that cause an increase in TSSM fertility or oviposition and thus lead to a significant increase in mite abundance.

Resurgence is a general phenomenon that can be related to the use of broad spectrum insecticides such as organophosphates (e.g. chlorpyrifos, methyl parathion, naled, oxydemeton-methyl or phorate) to control TSSM and insect pests of sugar beet, or the use of “softer” insecticides to control already high TSSM populations (e.g. azadiractin, garlic oil, paraffin oil, potassium salts of fatty acids, and sorbitol or sucrose octanoate). Even sulfur, labeled for control of TSSM in sugar beet, is known to cause resurgence of mite populations.

Generally, resurgence is not seen when effective, selective miticides such as hexythiazox are used. Hexythiazox is a selective growth-regulator miticide specifically targeting mites that has not been observed to cause mite resurgence. If broad spectrum insecticides need to be used, only field edges or hot spots should be treated to reduce or prevent further spread in the field.

Biological control

Low numbers of TSSM might be controlled by using soft or biological products such as azadiractin, garlic oil, paraffin oil, potassium salts of fatty acids and sorbitol or sucrose octanoate. In addition, many natural enemies can help to either keep TSSM numbers low or to slow down the population increase. Beneficial insects can

include green lacewing (*Chrysoperla carnea*), ladybeetle/mite destroyer (*Stethorus punctillum* and *S. picipes*), minute pirate bugs (*Orius* spp.), predatory mites such as the western predatory mite (*Galendromus occidentalis* and *Neoseiulus fallacis*), and thrips (*Cryptothrips nigripes* and *Scolothrips longicornis*). Note, if natural enemies are desired in the field, broad spectrum insecticides such as organophosphates, carbamates, and pyrethroids need to be avoided.

Further Reading

Harveson, R. M., Hansen, L. E. and Hein, G. L., eds. 2009. *Compendium of Beet Diseases and Pests*, 2d ed. American Phytopathological Society Press, St. Paul.

ALWAYS read and follow the instructions printed on the pesticide label. The pesticide recommendations in this UI publication do not substitute for instructions on the label. Pesticide laws and labels change frequently and may have changed since this publication was written. Some pesticides may have been withdrawn or had certain uses prohibited. Use pesticides with care. Do not use a pesticide unless the specific plant, animal, or other application site is specifically listed on the label. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Trade Names—To simplify information, trade names may have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

Groundwater—To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

Glossary

acaricide. A pesticide that specifically targets members of the arachnid subclass Acarina (mites and ticks).

Acarina. A subclass under the Arachnida class which includes mite and ticks.

Arachnida. A class of joint-legged invertebrates that have eight legs. The class Arachnida includes spiders (Araneae), scorpions, ticks, mites (Acarina), etc.

Araneae. An order within the Arachnida class including spiders.

deutonymph. Third motile immature (instar) stage of twospotted spider mites.

diapause. A period of dormancy regulated by physiological processes.

instar. A life stage between two successful molts.

larva. First motile immature (instar) stage of twospotted spider mites.

oviposition. Verb: oviposit, to lay (insect or mite) eggs.

protonymph. Second motile immature (instar) stage of twospotted spider mites.

thorax. The middle section of an arthropod's body between the head and abdomen.