Spider Mite Management in Corn

Spider mites are not insects, but are tiny arachnids closely related to ticks and spiders. They can be problematic pests for corn producers, primarily in the High Plains and extending through the western US. While high spider mite numbers frequently cause significant damage to corn (grain, silage, and sweet), the level of economic loss is different from season to season. Several factors affect population dynamics from year to year, including temperature, humidity, rainfall, soil type, pesticide applications, host proximity and natural enemies. High temperatures along with drought stress generally accompany high populations of mites. Sandy soil types may also contribute to high populations of spider mites, as these soils typically incur drought stress in western states, even under irrigation.

Two Common Mite Species

The two-spotted spider mite [*Tetranychus urticae* Koch] and the Banks grass mite [*Oligonychus pratensis* (Banks)] are the two most common and widespread mite species causing concern for corn producers across the Western US (Bynum et al., 1997). Spider mites can damage corn from the seedling stage all the way to maturity. Generally, the Banks grass mite (BGM) is predominant earlier in the growing season and the two-spotted spider mite (TSM) extends later into the growing season. Both the BGM and TSM feed primarily on grass species, and differ in their susceptibility and resistance to insecticides. This can lead to difficulty managing the two pests.

Damage to Corn

The BGM and TSM damage plants by using needle-like stylets to rupture leaf cells, pushing their mouth into the torn tissue and drinking the leaf contents. This results in clusters of dead cells, leaving a stippled or speckled appearance on the upper leaf surface. Concentrated chlorotic areas begin along the midrib and folded areas of the leaf spreading to the basal half of the leaf. In instances of severe feeding, leaves become gray, yellow, bronzed, dry or bleached. Loss of vigor and eventual death will occur if high populations of mites are left untreated.

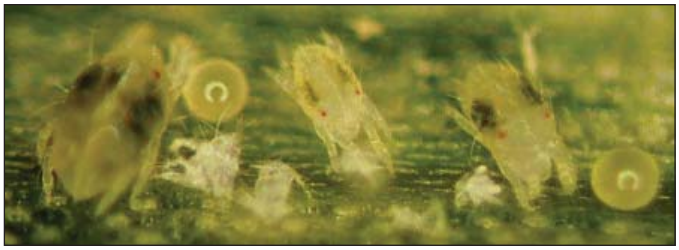
Mottled, discolored corn leaf from spider mite feeding

Webbing and damage on underside of leaf due to spider mites

Mite activity increases under hot and dry conditions. Crop damage is most severe when feeding occurs on the leaves at or above the ear level between tasseling and hard dough. Yield loss attributed to spider mite feeding may be as high as 40 percent (on a dry matter basis) in corn silage, and grain losses may be as high as 47 percent. A long-term university study observed yield losses ranging from 6 to 48 percent, with an 18-year average of 21 percent.

Biology and Life Cycle

Spider mites have four life stages: egg, larva, nymph, and adult. Mites may occasionally overwinter in crop residue, but primarily the BGM will overwinter in crowns of winter wheat and native grasses. The TSM primarily overwinters in alfalfa and other broadleaf species bordering fields. Beyond that the life cycles of the two mite species are quite similar. When conditions are favorable, overwintering adult females will begin to move into the corn crop by crawling short distances or being carried by the wind. Adults are eight-legged and range in color from bright green to red. Females are 1/60 inch long and are slightly larger and more robust than males, which are only 1/80 inch long.



Two-spotted spider mite eggs, larvae, nymphs and adult

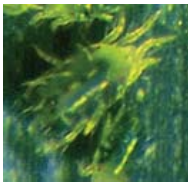
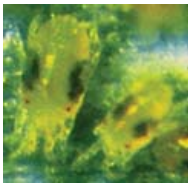
A generation usually proceeds from start to finish in as little as 5 to 20 days, depending on temperature. Hot and dry conditions will increase the rate of development. Optimum temperatures differ slightly for the BGM and TSM. BGM are more fecund in climates with lower humidity and 97° to 98°F temperatures. However, the TSM thrives in climates with a higher percent humidity and 86° to 90°F temperatures. BGM populations have been shown to increase 70-fold in one generation. It is typical for both mite species, and all mite stages, to be present with 7 to 10 generations per season overlapping one another.

Scouting and Identification

Scouting for spider mites should begin as soon as wheat, alfalfa, native grasses, and broadleaf weeds bordering fields begin to dry down and continue until corn reaches dent. Early in the season, scout plants next to grass waterways, field edges, or stressed areas. Spider mites will produce fine webbing to protect themselves and their eggs. Check the underside of discolored leaves for both the webbing and mites. Mites are small and sometimes hard to see. Taking a white piece of paper and shaking the leaf over it can help to find them.

Even though the BGM and TSM are similar in appearance and can appear together, they have several different characteristics and differ in their susceptibility to pesticides (Table 1). It is important to note what type of mite species is present when scouting. The BGM will appear earlier in the season from mid-whorl through the early grain filling stages, and feed mostly on the lower leaves before moving to the upper leaves of the plant. The TSM will appear mid to late season, usually after flowering, and feed over the entire plant. To differentiate the two types, use a 10X hand lens to observe 20 adult females, and check in 5 to 10 randomly selected field areas. Females will be the largest individuals present and have rounded bodies, while males have a more slender, tapered body.

Table 1. Banks grass mite vs. two-spotted spider mite[1,2]

Banks Grass Mite 	Produces less webbing Less robust, smaller, pointed rear More susceptible to miticides Burns leaves of plant from bottom up Generalized gut pigmentation
Two-Spotted Mite 	Produces more webbing More robust, larger, rounded rear Less susceptible to miticides May occur without burning leaves Concentrated gut pigmentation

[1]Adapted from Peairs, Colorado State Univ. and Holzer and Kalisch, University of Nebraska. [2]Images courtesy of University of Nebraska

Control

The economic damage spider mites can cause varies from year to year and is dependent on several biotic and abiotic factors. When deciding how best to manage spider mite infestations in a corn crop, one should consider that biological, cultural, and chemical control methods, used individually or in combination thereof, will play into the decision.

Biological and Cultural Control

In some years, fields may not have to be treated, as beneficial predatory insects keep the mite populations below economic injury levels. Various types of predatory insects such as the Stethorus lady beetles, minute pirate bugs, lacewing larvae, and thrips are some main beneficial insects to be aware of. In addition to predatory insects, *Neozygites floridana*, a naturally occurring fungus is a common pathogen that attacks spider mites and can be beneficial in controlling population numbers. Fungal growth on the spider mites is favored when daily temperatures are below 85°F with high relative humidity.

Hot and dry climates tend to have higher levels of spider mite infestations as natural enemies cannot keep up with increasing spider mite numbers, and the fungal pathogen *Neozygites floridana* is not as active. Avoiding drought stress with properly applied irrigations is a key cultural control component. However, once spider mite populations are established, irrigation will not decrease the density of the population. Other cultural components to consider are later plantings or planting a fuller season hybrid if these options are feasible.

Chemical Control with Miticides

Biological and cultural control practices can be beneficial but often unreliable, placing a strong reliance on chemical control. While chemical control can be an effective option, this method does not come without problems or concerns. The TSM is more tolerant to miticides and is harder to control than the BGM. Additionally, spider mites colonize on the bottom side of the leaves leading to difficulties in application coverage. It is recommended to use three or more gallons of water per acre to increase effectiveness. Aerial applications are most effective. More scouting and secondary treatments can usually be expected, as it is difficult to kill eggs with a miticide application. Re-infestation will likely occur within seven to ten days after initial application.

Leaves showing progression of no damage (top) to intense damage (bottom) due to spider mite feeding

Early season preventative treatments can provide some economic benefit. Growers should carefully consider: the amount of plants infested with small colonies of mites, temperature and humidity patterns, any drought stress the crop may be under, predatory insect populations, and field history of mite infestations. Again, this places a high emphasis on properly scouting for the pest.

A simple guideline in determining treatment thresholds is to treat when damage is visible in the lower third of the plant, colonies are present in the middle third of the plant, and the corn has not yet reached hard dough stage. Once the corn crop has reached the hard dough to dent stage, no economic benefit will be gained from a miticide treatment.

Another more sophisticated guideline also takes into account the cost of treatment and expected crop value based on the percent of infested leaves and the amount of leaf area damaged (Table 2). To use this table, the control cost (miticide + application cost) and the expected crop value (grain bu/acre x market price) must be determined. Then a two-step sampling method is used. First, an individual plant is selected, green leaves are checked for presence or absence of mites and the percentage of infested green leaves (first value listed in table) is calculated. This should be done ten times in different portions of the field. If percent of green leaves infested exceeds that of the control cost and crop value, then the percent of leaf area damaged will need to be determined.

Table 2. Economic injury threshold for BGM and TSM in corn*

Cost/ Acre	Crop Value per Acre						
	$250	$300	$350	$400	$450	$500	$550
	- % infested leaves per plant / % leaf area damaged -						
$ 5	12/6	10/5	8/5	7/4	7/3	6/3	5/6
$ 10	24/13	20/10	17/9	15/18	13/7	12/6	11/6
$ 15	35/19	29/16	25/13	22/12	20/10	18/9	16/9
$ 20	47/25	39/21	34/18	29/16	26/14	24/13	21/11
$ 25	59/31	49/26	42/22	37/20	33/17	29/16	27/14

Developed by Archer and Bynum[5]

Example – If the estimated control cost is $20/acre, the crop is valued at $300/acre and the percent of green leaves infested exceeds 39, then the percent leaf area damaged needs to be estimated. If the percent leaf area damaged exceeds 21, then it will likely pay to apply a miticide treatment.

Resistance Management

Due to the ability of spider mites to develop resistance to miticides, resistance management is a key issue of concern for growers. Continued use of any one miticide will naturally select against susceptible mites, and increase the number of tolerant mites in each subsequent generation. In areas where spider mites are a consistent problem, the use of the following resistance management strategies can be extremely helpful.

- If able, keep corn well watered and avoid drought stress.
- Avoid planting corn next to winter wheat and alfalfa fields, particularly if mite infestations are known.
- Use insecticides only when faced with serious yield loss.
- Beneficial insects that are predatory on spider mites are better able to thrive when insecticides are not used on corn. Planting Pioneer® brand hybrids with YieldGard® Corn Borer or Herculex® technologies can help preserve yield potential while reducing or eliminating the need for insecticides.
- Only apply miticides when yield is threatened based on treatment thresholds and application guidelines.
- When miticide applications are necessary, be sure to maximize miticidal activity by applying with the proper carrier volumes and appropriate adjuvants (Table 3).
- Do not consistently use the same miticide year after year

Table 3. Spider mite management options[6]

Insecticide**	Trade Name	Rate
Bifenthrin	Annex®, Bifenthrin Brigade®, Capture® LFR, Discipline®, Empower®, Fanfare®, Sniper®, Tundra®	0.08 to 0.10 lb. a.i./acre (5.1 to 6.4 fl. oz.)
Hexythiazox	Onager®	0.073 to 0.176 lb. a.i./acre (10 to 24 fl. oz.)
Propargite	Comite® II	2.25 pt. per acre
Spiromesifen	Oberon® 4 SC	0.09 to 0.25 lb. a.i./acre (2.85 to 8.0 fl. oz.)
Zeta-cypermethrin + Bifenthrin	Hero®	10.3 fl. oz. of product/acre
Dimethoate	Dimethoate, Dimate®	0.33 to 0.5 lb. a.i./acre

[6]*Adapted from Kansas State University*

***Always read and follow manufacturer's label, directions, and recommendations*

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