

Grasshopper Mites in South Dakota

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Introduction

During the growing season, grasshoppers are easily spotted throughout South Dakota. Close inspection of grasshoppers sometimes reveals small red spots on their bodies. These small red spots are actually grasshopper mite larvae (Arachnida: Trombiidae). While the grasshopper mite adults feed on grasshopper eggs within the soil, the parasitic larvae are observed when they are attached to the outer surface of grasshopper nymphs and adults. Research on grasshopper mites suggest that larval infestations can reduce grasshoppers' reproductive ability. Furthermore, severe infestations can interfere with grasshopper mobility, making them more susceptible to predators. Although it is likely that there are several species of grasshopper mites present in South Dakota, we will be discussing grasshopper mites as two species complexes: *Eutrobidium* spp. and *Leptus* spp. This is due to the complexity of identifying grasshopper mites to species. Historically, grasshopper mites have been referred to by many different names (e.g., red mite of grasshopper, grasshopper tick, chigger of grasshopper, louse of grasshopper, etc.)¹. In South Dakota, grasshopper mites are found throughout the state¹. Although grasshopper mites can survive in both wet and dry soil conditions, previous research determined that extreme conditions (e.g., flooding or drought) can negatively affect their populations.

Biology of Grasshopper Mites

Life Cycle. Grasshopper mites are categorized by a complex life cycle with heteromorphic^a parasitic larvae and predatory deutonymphs^b and adults³. The grasshopper mite life cycle can include up to six stages: egg, larvae, protonymph^c (prenymphal pupa), deutonymph (nymph), tritonymph^d (preimaginal pupa),

and adult^{1,4}. A pre-larval stage may also be included as an additional life stage⁵. The pre-larvae, protonymphs, and tritonymphs are considered calyptostaticae (neither mouthparts nor legs are functional), the larvae are ectoparasites^e of grasshoppers, and both deutonymphs and adults are predators of grasshopper eggs⁵.

Adults and deutonymphs appear in the early spring when they search for grasshopper egg-pods to infest. The deutonymphs feed on individual grasshopper eggs until they become sexually mature^{1,6}. Either a single mite or multiple mites may be found within a grasshopper egg-pod². If multiple grasshopper mites are present in a single egg-pod, only one will be a female and the rest will be males¹. Grasshopper mites mate inside the egg-pods, after which the female leaves in search of a suitable place within the soil to lay her eggs. Eggs are laid in cells with approximately 300-600 eggs in each cell⁶. It is estimated that during its lifetime, a single female mite may lay as many as 4,700 eggs. Egg deposition ranges from 1.2-10.2 cm below the soil surface, near grasshopper egg-pods. Grasshopper mite eggs hatch 15 to 30 days later, and the larvae (i.e., six-legged form) emerge from the soil once temperatures reach 65 to 75°F^{1,6}.

The newly hatched larvae have a strong gregarious^f instinct and will quickly attach themselves to any grasshoppers that pass nearby¹. Grasshopper mite larvae can remain alive without a host for approximately 28 days under normal conditions, and two months under cool conditions; however, they can only survive for one to five days under warm and dry conditions. Under normal conditions, grasshopper mite larvae feed for 8 to 14 days¹. When they are fully engorged or they are disturbed after one third engorgement, they will drop off of the grasshopper

host and burrow into the soil¹. If the larvae are disturbed prior to that, they may die while still attached to the grasshopper exoskeleton. Grasshopper mites can be disturbed by molting, death of the grasshopper, or, under rare instances, scraped off. Once larvae attach themselves to a grasshopper to feed, they will not transfer to another grasshopper¹.

When the larvae reach the soil, they will pupate. The next life stage is the protonymph or a prenymphal pupa^{1,4}. The pupation process takes approximately 3 days, and the grasshopper mite will remain in the protonymph stage for 7 to 18 days depending on soil temperature. Following pupation, the deutonymph will emerge (i.e., eight-legged form) that closely resembles an adult mite^{1,6}. The deutonymph stage typically lasts for 27 days. Once a deutonymph has become engorged, it may wander the soil surface until burrowing 2.5 - 11.5 cm into the soil to pupate. Pupation will then take 1 to 5 days. The mite is then referred to as a tritonymph for 9 to 18 days unless colder temperatures delay the process. Adult grasshopper mites first emerge from the tritonymph stage during late summer or early fall. The adults will not breed that year, but instead overwinter and breed during the following spring¹.

Mites that reach the adult stage in early to mid-summer may produce an entire or partial second generation¹. These mites will reach either the deutonymph or adult stage and overwinter before reproducing the following spring. In South Dakota, only one generation is supported under typical weather conditions, although a partial second generation is possible. During favorable weather conditions, a generation may be completed in as quickly as 61 days¹.

Appearance. Deutonymph and adult mites both have eight legs (Fig. 1). Adult male mites are scarlet colored with a triangular body that is covered in plumose⁹ hairs. The adult males range from 1.2-2.7 mm long and 1-1.5 mm wide, reaching up to 3 mm long when engorged¹. A pair of eyes are located near each lateral edge of the cephalothorax^h. The male adults have longer legs, and the posterior region of their abdomens are narrower when compared to female adults². Like the males, the adult females are also scarlet in color but are larger than the males (2.2-3.5 mm long and 1.3-2 mm wide). A fully engorged adult female may be as long as 5 mm and as wide as 2.7 mm¹. Grasshopper mite eggs

are spherical, vary in color from yellow to orange, and range in size from 0.12-0.15 mm¹. The grasshopper mite eggs are typically located in the soil in close proximity to grasshopper egg-pods.

Only the larvae of grasshopper mites are observed on grasshoppers. Newly hatched larvae range in color from yellow to orange or scarlet and have eyes



Figure 1. Grasshopper mite deutonymph or adult. Photo courtesy of Erica Anderson.



Figure 2. *Eutrobidium* spp. larvae attached to grasshopper wing veins. Photo courtesy of Erica Anderson.



Figure 3. *Leptus* spp. larvae attached to a foot segment of a grasshopper leg. Photo courtesy of Erica Anderson.

on each side of their body¹. Larvae have irregularly shaped bodies that range from 0.17-0.22 mm long and 0.11-0.13 mm wide. A fully engorged larvae is scarlet-colored and ranges in size from 1.8-2.2 mm long and 0.9-1.2 mm wide. Once the grasshopper mite larvae drop from the grasshopper host, they burrow approximately 2.54-10.16 cm into the soil^{1,2}. Larvae of *Eutrobidium* spp. are more commonly found attached to the leathery fore wings or veins of hind wings of adult grasshoppers or wing pads of nymphs (Fig. 2). Larvae of *Leptus* spp. are more commonly observed attached to the antennae, legs or thorax (Fig. 3). In addition, the head of *Leptus* spp. larvae is protruded in front of the body, whereas than the head of *Eutrobidium* spp. is nearly flush with the body (Fig. 4).

Deutonymphs have abdomens that are pointed posteriorly and are about 1.3 mm long and 0.8 mm wide. However, the size of newly emerging nymphs will depend greatly on how long the larvae fed on their host¹. As previously mentioned, if larvae are disturbed while attached to a grasshopper, they may drop off and proceed to the next life stage, which results in initially smaller deutonymphs.

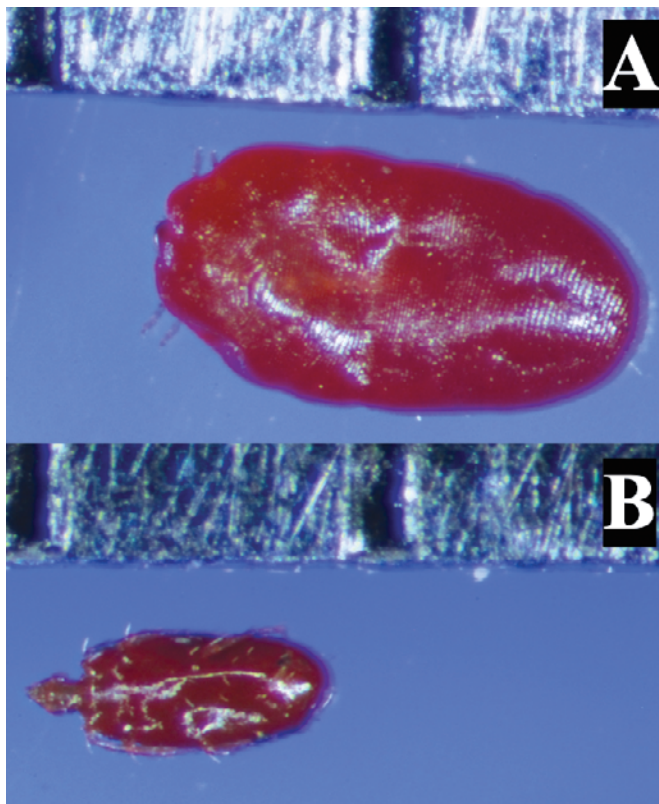


Figure 4. A) *Eutrobidium* spp. larvae with head nearly flush with body (located on the left side of the image). B) *Leptus* spp. larvae with head protruding forward (located on the left side of the image). Photo courtesy of Erica Anderson.

Feeding and Impact on Grasshoppers

The impact of grasshopper mites on grasshopper survival and reproduction is dependent on the mite species complex, host size, and the total number of mites present per grasshopper⁵. The impact that mites have through egg predation is not fully understood, but based on both deutonymph and adult consumption needs, it could be substantial^{1,7,8}. Although grasshopper mite larvae will not prevent a grasshopper nymph from developing into an adult, they may weaken the grasshoppers that are infested¹. For instance, during a heavy infestation of grasshopper mites, an adult grasshopper may be unable to completely fold its wings. This could cause the grasshopper's wings to eventually become damaged and disrupt or prevent flight. As a result, these grasshoppers may have higher mortality rates because they are unable to escape their predators. Severe, prolonged infestations on female grasshoppers can reduce their reproductive potential and disrupt egg laying. Grasshopper mites have been found to reduce nymph and adult survival by an average of 29%⁹. They can also reduce female reproductive output by approximately 47%, which can result in an entire population reduction of approximately 62%⁹.

During an infestation it is possible that both species complexes of grasshopper mites may be infesting a single grasshopper nymph or adult. The grasshopper mite larvae search over vegetation and soil for grasshopper hosts^{1,6}. Any species of grasshopper can be a suitable host for mite larvae; however, species whose forewings and wings are shorter are less frequently infested¹. Generally, grasshopper mite larvae can be found attached to grasshoppers from late June to mid-July and even into early October². In South Dakota, grasshopper mite larvae are typically observed from mid-July to late September¹.

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Entomological or Related Terms

- ^a *Heteromorphic* – Occurring in two or more different forms
- ^b *Deutonymph* – The second larval form of mites
- ^c *Protonymph* – First developmental stage of mites
- ^d *Tritonymph* – The third larval form of mites
- ^e *Calyptostatic* – Legs and mouthparts are non-functional
- ^e *Ectoparasite* – A parasite that lives on the outside of its host
- ^f *Gregarious* – Living in flocks or loosely organized communities
- ^g *Plumose* – Feathery appearance
- ^h *Cephalothorax* - Fused head and thorax