Silphium Civic Science Community

Guide to Known Silphium Pathogens and Pests

Written and compiled by:
Ebony Murrell, PhD, Lead Scientist, Crop Protection Ecology
Kathryn Turner, PhD, Research Associate, Crop Protection Genetics

June 2020

For more information or questions, contact: silphium@landinstitute.org

Photos © The Land Institute except when noted otherwise in photo caption.
Goldenrod Leafminer Beetle
(Microrhophala Vittata)
Adult size: 6 mm (1/4 inch)

Field Notes
One of the earliest seasonal pests, the goldenrod leafminer beetle emerges as an adult in May. It can be found alone or in groups on the tips of growing silphium stems. When disturbed they fall to the ground. Females lay brown eggs at the tips of silphium leaves and cover them with black frass (insect excrement). Once hatched, the larvae burrow inside the leaf and feed, creating a dead hollowed-out leaf tip. The larvae then pupate and emerge as the next generation of adults inside the leaf tips.

The leaf damage that this pest causes is thought to be mainly cosmetic. However, when adults aggregate early in the season they can feed heavily enough on the developing stem tips to cause significant leaf damage and occasionally can kill the meristems, which prevents flower development.

Goldenrod leafminer beetles also feed on other plant species, including their namesake plant goldenrod.
Ironweed Weevil  
(*Rhodobaenus tredecimpunctatus*)  
Adult size: 7-11 mm long (5/16 inch)

**Field Notes**
Adults emerge in Kansas late May-June. Eggs are deposited in or near the stem. The larvae then bores into the stem and eats its way down to the root crown. The larvae then pupate in the root crown and emerge the next year.

The tunnels bored inside the stems can sometimes cause silphium stems to lodge (fall over), which can decrease the seed that can be harvested from the plant. Therefore where ironweed weevil is common, is it likely to be a serious economic pest of silphium.

Ironweed weevils feed on other thick-stemmed asters, including annual sunflower.
Silphium Stem Gall Wasp  
*(Anistrophus silphia)*  
Adult size: 3-4 mm (1/8 inch)

**Field Notes**  
Adult wasps emerge in early-mid May in Kansas, and females lay their eggs in tip of the growing stems (the apical meristem). As the larvae hatch and feed, the stem swells to form a large gall of 1-2 inches in diameter in June. The larvae feed inside the gall until October, then overwinter before becoming adults and emerging the following spring.

The formation of the gall causes the stem to divide into multiple branches above the gall. Flower heads on these branches are often smaller or absent compared to flower heads on uncolonized stems.

The silphium stem gall wasp and the galls it forms can become more numerous over the years, especially in locations where silphium is already common.
Silphium Flower Gall Wasp
(Anistrophus laciniatum)
Adult size: 3-4 mm (1/8 inch)

Field Notes
Adult wasps, which resemble small flies, have a distinct black head and thorax with a red abdomen.

Adults emerge in June-July in Kansas and lay eggs in the central florets of the flower heads, most often in the central male florets. The florets swell later in the season as the larvae hatch and grow. Most damage is done to male florets although female florets and seeds can also be affected.
**Giant Eucosma Moth**  
*Eucosma giganteana*

Adult size: 19 mm (3/4 inch)  
Wingspan: 1.5 inches

**Field Notes**
This moth is a specialist pest of silphium. Adults appear when silphium begins to flower, in late June-early July in Kansas. Eggs are laid on the flower heads, and caterpillars burrow into and feed on the flower heads. Caterpillars are white or pinkish-brown with a dark brown head. Beginning in late August the caterpillars drop from the flower heads to the grown, where they burrow into the silphium root crown to feed and overwinter. There is one generation of moths per year.

This is currently considered the most serious silphium pest, as it specifically targets silphium plants and consumes both the flower heads and the root crowns. Heavily infested plants lose vigor over multiple growing seasons and can eventually die.
Sunflower Head Clipping Weevil
(*Haplorhynchites aeneus*)
Adult size: 3-4 mm (1/8 inch)

Field Notes
Adults emerge in Kansas in July and tend to cause the most damage later in the flowering season, August-September. Female weevils feed around the stems of flower heads, causing them to wilt and turn brown. The female weevil then lays eggs inside the wilted flower head where the larvae hatch and develop overwinter.

As its name implies, the sunflower head clipping weevil feeds on annual sunflowers as well as other large asters (*Silphium* genus plants, coneflowers, etc.).
Sunflower Seed Maggot  
(*Neotephritis finalis*)  
Adult size: 6 mm (1/4 inch)

**Field Notes**  
Adults emerge in July in Kansas. There are two generations of flies per year. Females lay eggs in July-August on the flower heads. Larvae hatch and feed on male and female florets, though in silphium the male (central) florets seem to be eaten most often. Unlike the flower gall wasp, the larvae of this fly do not cause the flower to develop galls. The most notable signs that this pest is present are small dark holes in the flower head and the presence of brown oblong pupae.

As its name implies the sunflower seed maggot can be found on annual sunflower and a variety of large asters. It generally does not cause economic damage in sunflowers but may be harmful if present in very large numbers.
**Silphium Rust**

caused by the fungal pathogen *Puccinia silphii*

Size of pustules: <1 mm (0.04 inch) – 2.5 mm (1 inch). The largest pustules have been observed on stems.

**ID tips:** The spores are attached firmly and do not dust off. Lesions form on both the underside and top side of leaves and on the stems.

**Field Notes**

Silphium rust has appeared as early as April, but typically the infection peaks in July.

Development of this disease is dependent on moisture for spore germination. Pustules can appear on leaves, leaf veins, and stems. The color of lesions can be yellowish-orange, bright orange, brick red, or chocolate brown, and may mature to cinerous black and grey later in the growing season. High humidity and temperatures around 20 C (68 F) enable spore germination and infection.

Rust lesions on the leaves greatly reduce the photosynthetic capacity of the plant and can result in lower head weights and yield reduction. Stem infection also has been linked to lower seed weight. Very severe infections may prevent flowering and seed production. This rust caused by *P. silphii* is expected to occur throughout the central US and is one of the more common and severe diseases of silphium. Silphium rust caused by *P. silphii* infects plant species in the Silphium genus, including *S. perfoliatum*, *S. lacinatum*, and *S. terebinthinaceae*.
**Black Leaf Blotch**
caused by the fungal pathogen *Colletotrichum dematium*
Size of pustules: 2 mm (0.08 inch) – 4 cm (1.6 inch) in diameter, often coalescing to cover greater areas.

**ID tips:** Lesions often have concentric rings and spread along the leaf veins, past the diameter of the main lesion. The lesions are usually visible on the upper and lower sides of the leaves.

**Field Notes**
*Colletotrichum dematium* (synonymous with *Colletotrichum silphii*) is a fungus that typically colonizes damaged or senescing tissue but can also be parasitic on some species. Leaf infection occurs in warm conditions with prolonged high humidity.

In silphium, this pathogen causes dark brown and black lesions on the leaves. Often the lesions have a concentric pattern of rings that look similar to tree rings. Sometimes the leaf veins beyond the perimeter of the lesion are also black. Severe infections can result in premature senescence of all the leaves on a plant. Black leaf blotch has been the most severe foliar pathogen of silphium in our research plots at The Land Institute in 2018 and 2019, when high rainfall has coincided with warm temperatures in the late summer.

*Colletotrichum dematium* has a large range of potential hosts; a few examples include spinach, onion, tomato, soy, and alfalfa.
**Orange Rust**
caused by the fungal pathogen *Coleosporium terebinthinaceae*
Size of pustules: <1 mm (0.04 inch) – 2 mm (0.08 inch) in diameter

**ID tips:** The spores are very loosely attached to the underside of the leaf and easily dust off when mature. The clusters of spore form very small pustules smaller than the head of a pin.

**Field Notes**
Orange rust caused by *C. terebinthinaceae* is a relatively recently observed disease in our research plots in Salina, KS in the late summer-fall and has been very localized. In places where it occurs, it can spread quickly through wind dispersal of the spores. The clusters of spore form very small pustules smaller than the head of a pin. The color of the spores is usually bright orange, but can be yellow or dark red.

This species is expected to be more common in the southeastern US, but has been documented as far north as Pennsylvania. We have also observed it in research plots in Texas, and native prairies in Illinois and eastern Kansas. It’s likely a widespread disease but has unknown agronomic impact on seed yield. This species also infects other *Asteraceae* species including annual sunflower, but is not considered an important pathogen of annual sunflower. It reproduces asexually on silphium species and uses species in the *Pinus* (pine) genus to complete the other spore stages of its life cycle.
**Downy Mildew**
caused by the fungal pathogen
*Plasmopara halstedii*
Size of pustules: ~2 mm (0.08 inch) in diameter initially, but can spread to cover the whole leaf

**ID tips:** Fuzzy white or grey angular lesions, give the diseased spots a ‘downy’ appearance. This disease is more common on the underside of leaves, close to the ground.

**Field Notes**
Downy mildew is a fungal disease of the Silphium genus. It can be identified by its white "downy" growth on the underside of the leaf and corresponding chlorotic (pale, yellow) spots on the upper side of the leaf. *P. halstedii* requires cool temperatures (15-23°C/59-73°F) and a high relative humidity (>85%) to infect the plants.

This disease may have a small effect of reducing grain yield or reducing seedling establishment, particularly in cool environments where there is high humidity. We’ve observed downy mildew in The Land Institute’s silphium plots in Kansas in early spring and late fall, but infection has not occurred every year and the infection levels have been very low. Downy mildew (caused by *Plasmopara halstedii*) affects a wide range of plants in Asteraceae (the sunflower family)--including ragweeds, thistles, fleabanes, sunflowers, lettuces, coneflowers, goldenrods, and ironweeds to name a few -- as well as plants in the genus *Verbena*. 
**Silphium Virus**  
caused by species closely related to Dahlia endogenous plant pararetroviral sequence (DvEPRS)

**ID tips:** Twisted or wiry leaves, sometimes with a bent leaf tip. These symptoms are usually most pronounced near the top of the stalk in 2nd year plants that are bolting.

**Field Notes**  
We are in the process of determining whether silphium plants are infected with DvEPRS or another viral strain that is closely related. Symptoms of this virus in silphium include vein banding (lighter color along the veins), leaf distortion (constriction and twisting), and stunting (shortened plant height). Symptoms may be present at any time during the growing season when the plants have bolted.

This virus can prevent flowering in extreme cases. This is one of the most severe diseases in silphium and can result in high yield losses. It is possible that only some of the stalks of a plant will display viral symptoms.