College of Agricultural & Life Sciences
UNIVERSITY OF WISCONSIN–MADISON

INSECT AND MITE PESTS OF FIELD GROWN HEMP IN WISCONSIN

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Insect management in Wisconsin grown hemp has more questions than answers. We certainly do not know the full complex of insect pest but have provided these preliminary "insect profiles" based on specimens submitted to the UW-Madison Insect Diagnostic Clinic. We have also provided insect profiles for insects we anticipate could damage hemp. Hemp production is in its infancy stage and several knowledge gaps exist for many insects, especially those insects which are specific to hemp. As we learn more, we will update these profiles.

We strongly encourage you to request help from your county extension agents and educators. Many have direct knowledge of crop management practices and will be able to help with insect identification, management or connect you with resources and staff at the University of Wisconsin-Madison, Division of Extension. There is no charge for these services. Please visit The Division of Extension Website to determine the agent closest to you. Click on your county and a personnel directory for that county will be found in the upper righthand area of each page. Look for people listed with agricultural responsibility. If you are unsure, please contact the support staff for the best contact person.

Identification

You are likely to find a diverse assortment of insect species in hemp fields during the growing season. Some you will recognize and others you will not. In addition to help from your local county extension agent/educator, several out of state resources are available. We encourage you to use these resources with the understanding that Wisconsin's growing conditions are different, and we likely will have different insect pests and/or phenology. Also recognize that not all insects will damage hemp. Some insects are considered beneficial because they may help control insects that can damage hemp. Examples include adult and immature lady beetles, damsel bugs, green lacewings, etc. Furthermore, some insect species may be neither beneficial nor harmful but just happen to be in your field for unknown reasons.

Management

Economic thresholds are an important management tool for many insect pests found on many crops. Economic thresholds are often defined by crop advisors as an insect which has reached a density where it could cause economic loss if not controlled. Economic thresholds are not available for hemp insect pests at this time; however, it is an important concept to consider. You do not want to spend significant resources to control an insect if it will not provide a return on investment. That is, there is no point in spending $50 to control insects which will cause $20 worth of damage.

Controlling hemp insects will require a combination of field scouting, knowledge of insect biology and an understanding of effective control methods that may or may not include insecticides. Please read the following insect profiles for all known management practices that may influence insect or mite populations. There will be times when insect or mite populations flare and you might consider using an insecticide or miticide. There are very few insecticides/miticides that are registered by the Environmental Protection Agency (EPA) for use on hemp. Furthermore, any insecticide used on hemp grown in the state of Wisconsin must also be approved by the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP). This list of products will change over time. A list of currently approved pesticides

can be found on the DATCP website. It is recommended to check DATCP's list of approved products frequently and prior to any applications. If an insecticide is not currently listed on this website, do not use it. There is also confusion that insecticides listed as approved by the Organic Materials Review Institute (OMRI) are legal to use on hemp. If a specific product name is not listed on the DATCP website it is illegal to use—whether it is OMRI approved or not. This practice applies to all substances used to control insects, including alternative or "home" recipes.

DATCP's list of approved insecticides is not considered an endorsement of efficacy. Research trials have not been conducted regarding insect control effectiveness. Do not assume if a specific insect, or group of insects, is listed on the label as being controlled (or suppressed) that it will work. Many factors must first be considered before application including insect stage, crop stage as well as environmental factors. Another aspect to consider is crop safety. Most of the products on DATCP's list have had limited use on hemp, and their plant safety is unknown. Furthermore, sunny, hot and or humid conditions can increase the likelihood of plant injury. Individual varieties may also have unknown sensitivities. Always test a small area on a plant, or plants, to make sure there is little risk of injury. Read each insecticide label thoroughly. You are legally responsible for its proper use.

There are several federal and state laws that regulate pesticide use which are intended to protect human health and the environment. Follow all label restrictions and remember, **the label is the law!** It is your responsibility to comply with all regulations. For more information regarding pesticide application, please contact your county extension agent or educator. The Wisconsin Pesticide Applicator Training Program is also an excellent source of information.

Below are the main insects or related pests that have been observed on hemp or are likely to be found in Wisconsin's hemp fields:

Hemp boring insects spend most of their larval stage within hemp stems and are only susceptible to insecticidal control during a brief period between egg hatch and when that insect bores into the plant. This time period varies by insect species and could be as short as 24 hours or a few days. Once the larvae have burrowed into a stem or stalk, they are not susceptible to control by insecticides.

- **Eurasian Hemp Borer**
- **European Corn Borer**
- **Stalk Borer and Burdock Borer**

Mites and insects with piercing-sucking mouthparts. A common misperception of insects is that you should see physical signs of chewing. Some hemp insects have needle-like "piercing sucking" mouthparts that suck plant sap from leaves, petioles or stems. Feeding symptoms from these insects may include stunting, discoloration and leaf curling. Mites are not insects but are more closely related to spiders. They have small mouth parts that break open macerate individual cell before lapping up cell contents.

- **Cannabis Aphid**
- **Potato Leafhopper**
- **Tarnished Plant Bug**
- **Two-spotted Spider Mites and Hemp Russet Mite**

Insects that chew on leaves or stem are often called **defoliators.** There are several known hemp insect pests which fit this category. Perhaps several more that are yet unknown. Some defoliating insects can be very host specific; they will only feed on a single or narrow, range host plants. Other defoliating insects feed on a very wide range of host plants. This group provides the greatest unknown for hemp because it is hard to predict if/when this unsuspecting group of insects will feed on hemp.

- **Corn Earworm**
- **Cutworms and Caterpillars**
- **Flea Beetles**
- **Japanese Beetles**

Photo credits: P.J. Liesch, University of Wisconsin

Cannabis Aphid *(Phorodon cannabis)*

Description

Cannabis aphids are small (3/16 inch), slow moving, soft-bodied insects with piercing-sucking mouth parts. Color can vary during the season but most references list cannabis aphids as cream colored early in the growing season then turning light green to pale pink later in the growing season. There may be mixed populations of both winged and non-winged forms on hemp at the same time.

Cannabis aphids are native to parts of Eurasia and only recently arrived in North America. They have quickly moved around parts of the U.S. — possibly through the movement of greenhouse-grown hemp plants. Several other aphid species may colonize hemp including hop aphids (*Phorodon humuli*) and green peach aphids (*Myzus persicae*). It is not known if these species can affect yield or quality.

Life Cycle

Aphid life cycles are complex, and little is known about the cannabis aphid's life cycle in Wisconsin. Cannabis aphids are highly specific to hemp plants and are only known to survive on hemp. We do know they can only survive winters in the egg stage, and eggs are produced late in the growing season. When these eggs hatch, the aphids can move to new hemp seedlings. However, crop rotation, tilling, and other practices make this natural colonization unlikely. Instead, greenhouse-grown hemp plants/seedlings likely maintain populations of this pest. When infested plants are transplanted in the field, it facilitates the movement of cannabis aphids to outdoor settings.

There is no egg stage during the growing season. Instead, females give live birth to immature females through asexual reproduction. These offspring are genetically identical to their mothers. This type of life cycle can lead to a rapid population growth if environmental conditions are favorable.

Late in the growing season, winged females are produced that migrate back to the overwintering host. Once on this overwintering host, the final generation will consist of both males and females, which reproduce sexually to produce eggs that can overwinter. Immature aphids must molt several times until they become adults. This molting process will produce cast skins. During periods of high population growth, these cast skins are easily found on hemp leaves. Many people confuse cast skins with dead aphids. Rather, cast skins are a sign of a healthy and rapidly increasing population.

Damage

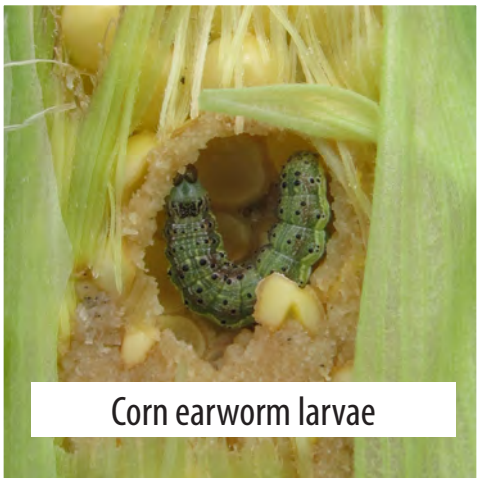
Aphids extract plant sap from their host. This type of feeding causes an indirect yield loss and can compromise plant health. Symptoms of aphid injury includes stunted and unthrifty plants; foliage may also be discolored. During extremely high aphid populations, substantial amounts of a sugary substance called honeydew is excreted on the leaf surface by aphids. A non-plant parasitic mold (sooty mold) may use the honeydew as a food source causing the leaf surface to turn black. However, this sooty mold is not plant parasitic and rarely damages plants. The scientific literature also indicates that cannabis aphids have the potential to transmit certain plant viruses.

Management

Monitor aphid populations on a regular (weekly) schedule. Look for "hot spots" of aphid activity scattered throughout the field. Because of the spotty

nature of infestations, look for aphids on a number of plants in several areas. Repeat checks at weekly intervals to determine the need to treat. Growing a healthy crop is often considered an important aphid management tool. A healthy crop can better cope with injury from aphids as well as other insect and mite pests. Excessive nitrogen application can have a reverse effect and may lead to excessive aphid populations.

If aphid control is being considered, make sure the aphid population is increasing. There are many natural enemies of aphids which can provide long term control. Using a broad-spectrum insecticide may kill these beneficial insects resulting in higher aphid populations than before treatment. Because cannabis aphids are likely introduced into fields from greenhouse-grown hemp plants, obtaining aphid-free plants/seedlings may be a helpful approach.



Corn earworm larvae

Corn Earworm *(Helicoverpa zea)*

also known as cotton bollworm and tomato fruitworm

Description

Adult moths have a 1-¼ inch wingspan. Forewings are light tan/buff color with a faint but darker color band. Hindwings are lighter in color and have a similar band. Larvae grow up to 1-½ inch in length. Coloration of larvae can be variable and includes individuals that are green, tan, brown, reddish and black. The head capsule is tan, and their underside is light colored. Larvae have noticeable dark spots and alternating light to darker colored stripes running the length of their body.

Life Cycle

Corn earworms do not overwinter in Wisconsin. They are a seasonal migrant arriving in Wisconsin as early as June or as late as August. Typically, the most intense migration arrives late July and early August. Eggs are laid individually on plants and are very difficult to find. Eggs hatch in 3-4 days, and larvae go through 6 instar stages (molts) before pupating. The duration of each generation is dependent on temperature but is usually completed within 3 weeks.

Damage

Corn earworm larvae damage hemp by feeding on buds, developing seeds, flowers and foliage. They do not burrow into stalks or stems. Foliage feeding is usually not considered yield reducing, unless the infestation is severe.

Management

Monitor corn earworm flights by using pheromone traps available from several pest management supply companies (Gemplers, Great Lakes IPM, etc.). Follow manufacturer recommendations for trap placement and pheromone (lure) replacement schedule. Adult flights are also monitored by the Wisconsin Department of Agriculture, Trade and Consumer Protection and weekly catch totals are published in the Wisconsin Pest Survey Bulletin. The Pest Survey bulletin is a free electronic newsletter and a subscription is available online.

As mentioned earlier, corn earworms are a seasonal migrant carried to Wisconsin by weather fronts. As a result, migration timing and intensity will vary from year to year, making scouting and pheromone trapping very important. If control is necessary, target insecticide applications for small larvae to get the best results. Depending on the duration of the flight and crop stage, more than one application may be needed.

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Biological Control

Several beneficial insects prey on earworm eggs, providing a small degree of non-chemical control. Trichogramma wasps and a number of chalcid and braconid wasps parasitize earworm eggs. The insidious flower bug, or minute pirate bug (*Orius insidiosus*), seeks out eggs to feed on. Currently, releasing commercially available beneficial insects is too costly and labor intensive to be worthwhile. However, you can help conserve existing populations of beneficial insects by treating fields only when needed and avoiding broad-spectrum insecticides. Earworm eggs may also become infected with a naturally occurring virus.

Black cutworm larvae

Woolly bear caterpillars

Zebra caterpillar

Photo credits: Woolly bear and Zebra, P.J. Liesch, University of Wisconsin University of Wisconsin

Cutworms & other defoliating caterpillars

(Families Noctuidae, Erebidae, and others)

Descriptions

There are several species of caterpillars which could feed on hemp. Black and variegated cutworms, painted lady butterflies, wooly bear and zebra caterpillars are a few that have been identified as foliage feeding hemp pests. Other caterpillar species may feed on hemp but do so on a very inconsistent basis making it difficult to predict timing and severity.

Black cutworm *(Agrotis ipsilon)*: Adult black cutworm moths have a 1-½ inch wingspan, are grayish and have a series of distinctive dagger-like markings on their forewings. Hindwings are lighter colored. Larvae can grow up to 1-½ inches, are dark gray and curl into a tight C-shaped form when disturbed. There are no obvious identifying characteristics for the caterpillars.

Painted lady butterfly, thistle caterpillars (*Vanessa cardui)*: Adults have a wingspan of greater than 2 inches and are orange with black and white markings. Larvae are lighter colored before turning black with yellow markings when mature. Distinctive spines are obvious on mature larvae which often fold leaves around their body and secure them with silk threads. These "silken shelters" are often the first signs of an infestation.

Variegated cutworms *(Peridroma saucia)*: Moths have a 1-½ inch wingspan. Forewings are brown with mottled markings. Hindwings are light colored. Larvae will grow up to 1-½ inches long, have a tan colored head, brown body color and a light-colored underside. A single row of light-yellow dots is a distinguishing characteristic found on the backs of large larvae.

Wooly bear caterpillars (Family Erebida): A group of several caterpillar species but are not usually considered an economic pest. However, outbreaks do occur. Larvae are robust and hairy; hence the name wooly bear caterpillars. Depending on the species present, they may be white, reddish brown, black, yellow, or black at the front and back ends and separated by a reddish-brown band in the middle of the body. When fully grown they are up to 2 inches long.

Zebra caterpillar *(Melanchra picta)*: Adults have a 1-¼ inch wingspan. Forewings have a reddish to brown coloration and mottled. Larvae are very striking in appearance. The top stripe is black, and larvae will have alternating yellow and black longitudinal stripes along the length of their body.

Life Cycle

Black cutworm moths migrate to Wisconsin from southern states and usually arrive late April or early May. There may be 4-5 generation of black cutworms per summer. Female moths lay hundreds of eggs either singly or in clusters. Egg laying is typically concentrated on low-growing non-crop vegetation, such as chick-


Thistle caterpillar

Photo credits: Whitney Cranshaw, Colorado State University, Bugwood.org

weed, curly dock, mustards or plant residue from the previous year's crop. Hemp planted after soybeans could be a preferred egg laying site. Heavy spring weed growth, newly broken sod and plant debris all increase the risk of black cutworm infestations. Late-planted hemp fields are more likely to be injured by black cutworms as younger plants are more attractive to adult moths for egg laying.

Painted lady butterfly (Thistle caterpillars) do not overwinter in Wisconsin. This adult butterfly also migrates from southern states and occasionally causes economic losses in Wisconsin crops, including hemp. Moths lay a single egg on leaves which hatch in a few days. There are five larval instars that take approximately two weeks to mature.

Variegated cutworms overwinter in southern states and migrate to Wisconsin during the spring and summer months. Typically, there are two or more generations during a Wisconsin summer. There are six different larval instar stages. Two to three weeks are needed to complete larval development.

Wooly bear caterpillars, depending upon the species, overwinter as either larvae or in the pupal stage near or just beneath the soil surface. In the spring, adults lay eggs in spherical patches on leaves and often cover the egg masses with hairs from their bodies. Young larvae feed in clusters on the bottom surface of leaves. As they grow larger, they disperse and feed in more exposed areas on the plant. There are two generations per year.

Zebra caterpillars are believed to overwinter as pupae and caterpillars have been reported on a range of host plants. Adults emerge in late spring and lay egg masses on several hosts including hemp. After hatching, young caterpillars may feed in groups before dispersing. There are likely two generations in Wisconsin.

Damage

Black cutworm damage is most likely to occur on newly planted seedlings as larvae burrow into the main stalk below ground or by cutting small plants off at the soil level. Black cutworms do not usually feed on plant foliage.

Painted lady butterfly (thistle caterpillars) damage is usually very conspicuous because mature larvae will spin a silken shelter around leaves upon which it is feeding. Likely this tactic protects the caterpillar from natural enemies. Outbreaks are sporadic and may occur every 5-10 years.

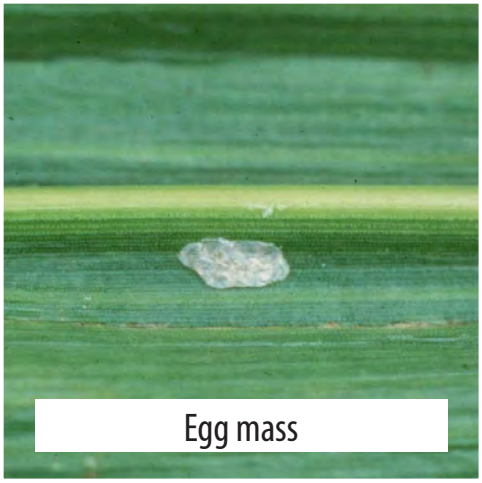
Variegated cutworms are a climbing cutworm and do not cut plants like black cutworms. Larvae feed on the developing leaf tissue.

Wooly bear caterpillars are leaf feeders and can be very conspicuous; they are rarely an economic pest.

Zebra caterpillars may initially feed in groups and young larvae will chew on leaf surfaces creating a "skeleton-like" appearances; mature larvae will chew on leaves leaving a ragged appearance.

Management

Scout hemp at emergence for signs of black cutworm damage. If caterpillars are suspected but cannot be found, consider scouting after dark as black cutworm and some other caterpillars tend to be nocturnal. For all other leaf feeding caterpillars, scout hemp on a regular basis until harvest. If an insecticide is required, target small larvae for best results. Large larvae are usually difficult to kill.


Egg mass


Larave feeding in stalk


Male moth


Female moth

European Corn Borer
(Ostrinia nubilalis)

Description

Eggs are white, overlapped like fish scales and are usually deposited on the lower leaf surface. There can be as many as 30-40 eggs in each mass. As eggs develop, they change to a cream color. Just before hatching, the black heads of the larvae become visible inside each egg. This is referred to as the black-head stage of egg development and usually indicates hatch will occur within 24 hours. Full grown larvae are ¾ -1 inch in length, grey to cream-colored with numerous dark spots covering the body. The pupae are brown, ¾ inch-long and cigar-shaped. The adults are nocturnal, straw-colored moths with a 1inch wing-span. Males are slightly smaller and distinctly darker than females.

Life Cycle

European corn borers overwinter as mature larvae in stalks and stems of previously infested host plants. Spring development begins when temperatures exceed 50 degrees F. Pupation occurs in May with the first moths emerging in early June. Peak emergence occurs in mid-June at 600 degree days (base 50). Adult moths are nocturnal and spend most of their daylight hours in sheltered areas along field edges. Female moths lay eggs in the evening. The eggs hatch in 3-7 days depending on temperature and associated accumulation of degree days.

Second generation moth's peak in mid-August at approximately 1,700 degree days (Base 50) . All mature 2nd generation larvae cease development in late September and October, and then overwinter.

European Corn Borer Development Using Accumulated Degree Days (DD) base 50 F

1st Generation Adults 375 DD
First eggs 450 DD
Peak moth flight 600 DD
Larvae present 800-1,000 DD
2nd generation adults 1,550-2,100 DD

Damage

Newly hatched larvae may feed on leaves for a short period of time before tunneling into stems. European corn borer was a key insect pest on corn, however, the widespread use of bio-engineered corn hybrids has significantly reduced European corn borer abundance, and their populations are currently at historic lows. However, pockets of above average corn borers populations can still pose a significant threat to local hemp production.

Management

Stalk boring insects, like European corn borers, are difficult to control because larvae feed externally for only a short period of time. Once they have tunneled into the stalk or stem, they are no longer susceptible to foliar-applied insecticides. European corn borer is no exception. Knowing when adult flights are occurring is important when considering timing of control. The Wisconsin Pest Survey Bulletin is a free electronic newsletter published by the Wisconsin Department of Agriculture, Trade and Consumer Protection, which provides growing degree day accumulations for European corn borers from several locations within Wisconsin. If used, insecticides should be timed with first egg hatch. Repeat applications may be necessary especially for second generation larvae.

Chopping or shredding stalks can reduce the overwintering population. Burying crop residue using tillage can also help if erosion is not a concern.

Photo credits: P.J. Liesch, University of Wisconsin

Adult Eurasian hemp borer moth

Leaf wilting associated with larval tunneling by Eurasian hemp borer

Photo credits: Whitney Cranshaw, Colorado State University, Bugwood.org

Eurasian Hemp Borer

(Grapholita delineana)
also called hemp leafrollers and hemp seed eaters

Description

Adult moths have a wingspan of approximately ½ inch and have irregular pale lines on the forewings which resemble a boomerang when the wings are laid back over the body. Eggs are small, light colored and laid individually on hemp. Larvae have dark brown head capsules and are approximately ¼ inch long and orange to reddish orange when mature.

Life Cycle

Little is known regarding the Eurasian hemp borer's life cycle in Wisconsin. It likely overwinters as mature larvae in crop stubble, seed and/or weeds. During spring, larvae will develop into pupae and later into adults, which are nocturnal in activity. Adults are considered weak flyers, so heavy infestations are anticipated to occur close to the previous crop or wild hemp. Literature suggests that eggs hatch in approximately 5 days, but it is temperature dependent. When larvae hatch, they may feed on hemp leaves for a short period of time before burrowing into the stem. Two, maybe three generations are anticipated to occur in Wisconsin, and again this is dependent upon annual temperatures.

Damage

Hemp appears to be the primary host although smartweeds (*Polygonum* spp.) have also been reported. When larvae hatch, they may feed initially on leaves before tunneling into stems. Once tunneled in the stem they are protected against foliar insecticide applications. Tunneled areas of stems may show signs of swelling. Significant damage may occur during mid to late summer when stem tunneling destroys buds. Seeds may be consumed by larvae feeding externally.

Management

Control of Eurasian hemp borer is not well understood. Insecticide treatments, if warranted, must be applied at egg hatch and before larvae tunnel into stems. This treatment period is expected to be short during the first generation, but likely to occur over a longer period during the second and third generations. Pheromone traps are not yet available for this insect. However, black light traps could be used to monitor adult activity. The downside to using black light traps is the expense and difficulty in identify the adult moths from among others captured.

Cultural control methods include destroying overwintering sites (crop residue), planting a significant distance from the previous year's crop, and destroying wild hemp.

Crucifer flea beetle

Flea beetle damage on hemp

Pale-striped flea beetle

Photo credits: Whitney Cranshaw, Colorado State University, Bugwood.org

Flea Beetles *(many species in the Family Chrysomelidae, Subfamily Alticini)*

Description

Adult flea beetles are oval, usually shiny and dark-colored. One of the potential species that could be observed on hemp may also have pale, yellow striping. It is not currently known which of the several flea beetle species that have been observed on hemp may cause economic losses. Adult's hind legs are enlarged which allow them to jump when disturbed. Larvae (grubs) are small, whiteish with a brown head capsule and feed below ground on a variety of plant roots.

Life Cycle

Adults overwinter in the soil and emerge on warm spring days to feed on seedling hemp plants. Depending upon flea beetle species, there are usually two generations per year. Towards the end of the production season, larvae remain in the soil as grubs and overwinter. In the early spring, grubs continue to feed on plant roots before they pupate and emerge again as adults the following year.

Damage

Adults can be very active when disturbed and readily jump; they can be hard capture and identify. They feed on foliage and potentially flowers. Leaf defoliation caused by flea beetles is very characteristic and is best be described as small round holes. This feeding pattern is not usually considered an economic concern, however, some references suggest damage can be severe on seedling plants. Flea beetle damage is usually diagnosed by the small holes chewed in leaves, not by observing the adults.

Management

Natural control factors exist for flea beetles, however, breakout populations may happen periodically and are mostly likely influenced by weather (drought). If flea beetle populations are high in a field, consider rotating out of hemp the following year. Early season damage on young plants or transplants can coincide with the spring emergence of adult flea beetles, resulting in increased risk of damage.

Adult Japanese beetle

Japanese Beetle *(Popillae japonica)*

Description

Adults are approximately ⅜ inch long, metallic green with bronzed wing covers. Six white spots are found on each side of their abdomen. Immature larvae (grubs) are C-shaped, up to ¾ inch long and white in color.

Life Cycle

Japanese beetles complete one generation per year. They overwinter in the soil as mature grubs, which are often found in grassy areas. Adults begin to emerge in mid- to late June and into July. Peak feeding occurs in early to mid-July. Adults remain active through late summer where they will mate and lay eggs on the soil surface (often associated with grassy areas in and around fields).

Damage

The adult beetle feeds on over 300 plant species including hemp leaves, flowers and pollen. Japanese beetles tend to chew around tougher veins in leaves, resulting in "lacy" or "net like" damage referred to as "skeletonization". However,

significant leaf defoliation would be necessary before yield loss occurs. Feeding on flowers is of greater concern for oil producers.

Immature grubs damage roots of cool season turfgrasses and ornamentals. They are not known to damage hemp roots.

Management

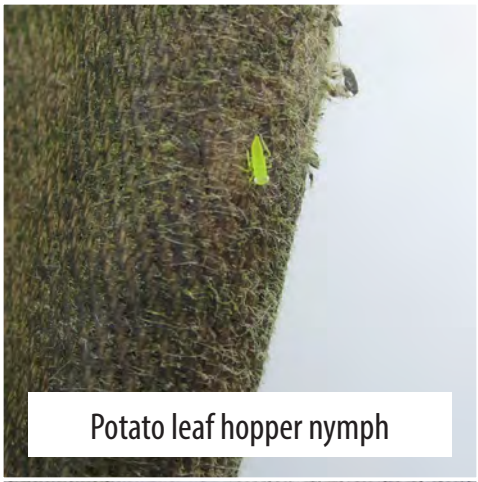
Japanese beetle adults are very showy and easily noticed on hemp. Perhaps attracting more attention than necessary. Their presence does not automatically indicate significant yield loss. There are no biological, cultural or mechanical control methods that can effectively manage their populations in hemp. Although pheromone traps are often sold at hardware stores and garden centers, these traps have not been shown to reduce plant damage and can draw additional adults to the area.

Management using insecticides is difficult because adults are mobile and approved insecticides have short residuals.

Potato Leafhopper *(Empoasca fabae)*

Description

Adult potato leafhoppers are ⅛ inch long, wedge shaped, fluorescent green and have translucent wings. Nymphs are similar in appearance except they are smaller, range in color from yellowish green to fluorescent green and do not have fully formed wings.



Potato leaf hopper nymph

Potato leaf hopper adult

Life Cycle

Potato leafhoppers do not overwinter in Wisconsin. Each year they migrate on spring weather fronts from the Gulf States. This migration pattern is variable and not consistent from year to year. This migration is the reason why it is difficult to predict the timing and magnitude of potential damage each year.

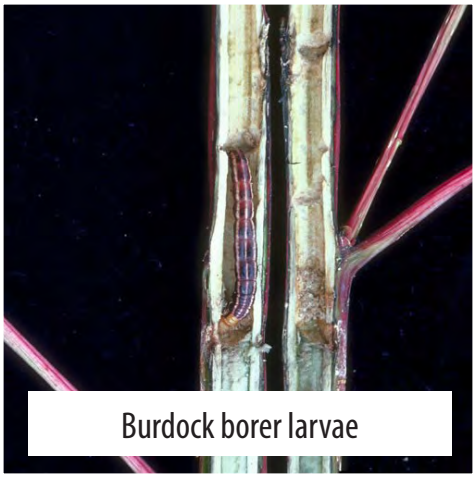
Damage

Potato leafhoppers have a wide host range of over 200 plants, however, it is unknown if they are an economic pest on hemp. Potato leafhoppers and their associated damage can be difficult to spot so we want people to be aware of their potential as a pest. Initial damage symptoms are likely to appear as stunting and yellowing of the leaves. As potato leafhoppers continue to feed, leaves would be expected to develop brown leaf edges; this necrosis may continue to coalesce over the entire leaf if infestations remain high.

Management

Use an insect sweep net to monitor potato leafhopper populations. If damage symptoms are present, which are not consistent with other insects, plant pathogens or nutrient deficiency symptoms, consider using an insecticide. There are few alternatives available for potato leafhopper control which should primarily target the immature, or nymph stages.

Stalk borer larvae



Burdock borer larvae

Photo credit: James Solomon, USDA Forest Service, Bugwood.org

Stalk Borer *(Papaipema nebris)*

Burdock Borer *(Papaipema cataphracta)*

Description

Stalk borer larvae have a tan head and alternating dark and white stripes running the length of their body. There is also a dark colored band located behind the legs and is a diagnostic characteristic used to separate larvae of the stalk borer from burdock borer. Caterpillars range from ½ to 1-½ inches long and are active (wiggle) when disturbed. Adult moths have dark grey-brown forewings with numerous small, white spots. The wingspan is approximately 1- ¼ inches.

Burdock borer larvae have a light tan head with alternating pale white and dark purplish longitudinal stripes running the length of the body. The caterpillars are very similar to stalk borer. However, unlike stalk borer, the stripes on burdock borer caterpillars are not interrupted by a dark-colored band. Adults have a 1- ¼ inch wingspan. Forewings are a light tan to straw colored, with numerous small white spots.

Life Cycle

Adult female stalk borers lay up to 2,000 eggs in late August and September on grassy weeds (especially quackgrass and wirestem muhly), ragweed, pigweed, curlydock and burdock. These eggs overwinter and hatch in early spring (mid-April to early May). Larvae usually tunnel into perennial grasses immediately after hatching. As the larvae grow, the grass stems become too small. By late May to early June, larvae begin to migrate from these grassy field borders into an alternate host crop. Larvae are fully grown by early August and may bore into several stems before pupating in the soil. Adults emerge two to six weeks later and seek grassy areas to lay eggs. There is one generation per year.

Timing and life cycle of the burdock borer is very similar to the stalk borer. However, burdock borers are also a pest on seedling hardwood trees and shrubs. Pay close attend to hemp fields near wood lots.

Damage

Stalk borer and burdock borer damage is usually found along field edges, fence rows and grassy waterways. Symptoms will include wilted or dead plants or stems. Once larvae have tunneled into a stem, they are not susceptible to control practices.

Management

Monitor for stalk and burdock borer damage in the previous year's crop. This can help predict the damage potential for hemp the following year. Avoid rotating to hemp if significant damage has been observed. Also, control perennial grassy weeds which serve as egg laying sites in late summer the year before planting hemp.

Both stalk and burdock borers are susceptible to insecticidal control, but only during their migration from grassy weeds to hemp. Because this migration occurs over a short period of time and the residual activity of hemp approved insecticides is short, application timing will be critical.

Tarnished plant bug nymph

Tarnished plant bug adult

Four-lined plant bug

Four-lined plant bug damage

Photo credits: P.J. Liesch, University of Wisconsin

Tarnished Plant Bug *(Lygus lineolaris)*
Four-lined Plant Bug *(Poecilocapsus lineatus)*

Descriptions

The tarnished plant bug adult is approximately ¼ inch long, oval and brown with light yellow geometric markings on their wings. Newly hatched nymphs are approximately 1/16 inch long and pale green. When half grown, (3rd instar larvae) you can see five black spots on their backs.

Another plant bug, the four-lined plant bug can also be found in association with hemp plants. Adults are approximately ¼ inch long, oblong in shape, and have an orange head with alternating black and yellow stripes on the body. Juveniles (nymphs) are slightly smaller and are red and black in color.

Life Cycle

The tarnished plant bug overwinters as an adult and begin laying eggs in the spring. There are two generations per year. Tarnished plant bug nymphs must go through five instars (stages) before becoming adults.

The first nymphs of the year appear in mid-May. First-generation adults peak by the end of June to mid-July. The second-generation peak occurs from the end of August to early September.

Four-lined plant bugs overwinter as eggs and hatch in spring. There is only one generation per year, with adults seen in late spring and early summer.

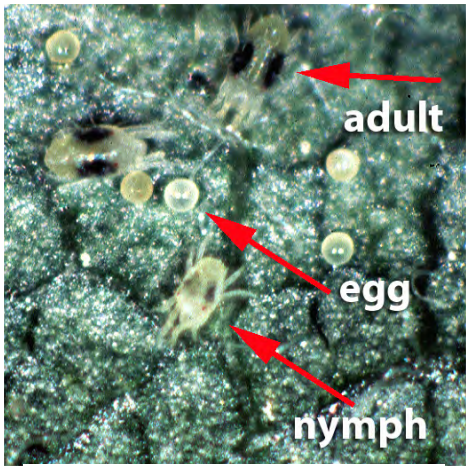
Damage

Adults and nymphs have piercing-sucking mouthparts and can damage hemp by feeding on flowers, stems and seeds. Plant bug injury symptoms can be quite variable and appear as stunted plants, malformed/misshapen leaves, aborted flowers and/or deformed seed. The feeding of the four-lined plant bug can cause small brownish lesions resembling some foliar plant diseases.

Management

Tarnished plant bugs feed on alfalfa and may migrate to hemp after each cutting (of alfalfa) is harvested. The extent of damage caused by both adult and nymphal tarnished plant bugs in Wisconsin grown hemp is unknown, however, hemp grown for seed or oil is likely to be more vulnerable to economic loss.

Monitor tarnished plant bug presence by using an insect sweep net. Economic thresholds have not been determined for hemp, but sweeping hemp foliage will give you an indication if populations are increasing.



Two-spotted spider mites

Photo credits: Whitney Cranshaw, Colorado State University, Bugwood.org

Photo credit: P.J. Liesch, University of Wisconsin

Two-spotted Spider Mite
(Tetranychus urticae)

Hemp Russet Mite
(Aculops cannibicola)

Description

Mites are technically arachnids rather than insects, but some species can be plant pests. Adult two-spotted spider mites are minute (< .02 inch), yellow green in color, have eight legs with dark pigmented spots on each side of their oval bodies. The adult female is slightly larger than the male. Nymphs look like the adults but are generally smaller in size. Larvae are smaller than nymphs, have six legs and are almost colorless. Eggs are small, round and light yellow.

Hemp russet mites are smaller (~1/100th inch long) than the two-spotted spider mite and their body is more elongate. Individual mites cannot be seen without magnification. Unlike the two-spotted spider mite, adult hemp russet mites only have four legs, although a high-power microscope is needed to see this trait.

Life Cycle

The two-spotted spider mite overwinters as fertilized females in loose soil or plant debris at or near the soil surface. After temperatures start to warm in the spring, the overwintering females seek out growing plants and begin to lay eggs. Under optimal environmental conditions (drought and low humidity), two-spotted spider mites may complete a generation is less than one week. Under more normal summertime conditions, it may take more than two weeks to complete a single generation.

If a heavy infestation has developed, plants may become completely covered with webbing. If mites need to move to another area because of a diminishing food supply or other undesirable situation, they will climb to the top of the plant and spin tiny strands of silk that, when caught by breezes, will allow the mite to drift to new host plants; a process called ballooning.

Hemp is the only know host of the hemp russet mite. Little is known about its biology, although it is suspected to survive indoors on hemp plants year-round.

Damage

Two-spotted spider mites have a wide host range and damage plants by penetrating plant tissue with their stylets (mouthparts) and remove cell contents. The collection of emptied cells appear to have a silvered (stippled) sheen or color in the areas where significant feeding has taken place.

Significant two-spotted spider mite damage occurs during growing seasons with severe moisture stress or drought for several days. Damage usually starts at field edges where mites have moved into fields from overwintering sites. Damage can also be observed in portions of a field with coarse textured soils. Dry weather, low humidity and stressed plants provide optimal conditions for mite reproduction and development.

Symptoms of two-spotted spider mite infestations may include small, light colored specks on leaves (stippling). This can give foliage a sandpaper-like appearance. If two-spotted spider mite populations continue to increase, leaves may turn brown and fall off.

Hemp russet mites can cause slight upward curling of leaves. When populations are heavy, leaves may become off colored and brittle. High populations on flower may decrease size.

Management

When drought-like conditions exist for more than 1-½ weeks, scout hemp fields for presence of two-spotted spider mites and their damage. Damage usually begins at field edges, on sandy soils, south facing slopes or wherever plants may show drought stress. Two-spotted spider mites are small and hard to find. Scouting may be aided by holding a white sheet of paper under leaves while tapping them. Two-spotted spider mites will be dislodged and more readily seen on the white paper. Also look for damaged leaves and/or delicate webbing.

Adequate rainfall or overhead irrigation can be a useful crop management strategy to minimize two-spotted spider mite damage. A fungal pathogen can also be effective when temperatures are cool and high humidity exists for 12-24 hours. Infected mites will be discolored within 1-3 days after infection.

Two-spotted spider mites are best controlled by miticides before populations become excessive. Effective control may be difficult with approved miticides and thorough plant coverage is very important. Re-scout after the miticide's reentry period has expired and look for living mites. Determine if additional applications are necessary and remember that eggs are often not controlled by miticides.

Very little is known about conditions that favor hemp russet mite outbreaks or if there are viable cultural or chemical control practices.

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