Entomology 111

Blister Beetles in Alfalfa

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The information in this leaflet includes details on the life cycle and habits of blister beetles and their importance to agriculture. *Special attention is given to potential adverse effects of blister beetles on horses, signs and symptoms of poisoning, and suggestions for avoiding accidental poisoning.*

Introduction

Insects in the family Meloidae are commonly referred to as blister or oil beetles. Different species vary in size and color, but most are easily recognized by their elongated, narrow, cylindrical, soft bodies. Viewed from above, blister beetles have an accentuated neck, caused by a constriction between the back of the head and the narrow anterior end of the thorax. Although adult blister beetles feed on plant foliage, the larvae of some common species (genus *Epicauta*) feed on grasshopper eggs.

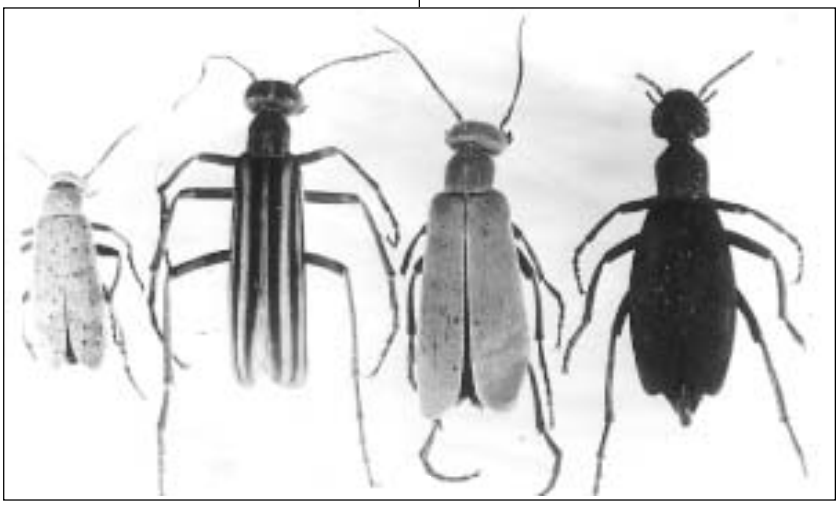
Generalized Life Cycle and Habits

Adult blister beetles are seen after they have emerged from the soil (in early to mid-summer) and have begun foraging. Blister beetles have a complex life cycle that is characterized by several immature forms.

Their life cycle is illustrated in the following description for *Epicauta vittata*, a three-striped blister beetle found in Kansas alfalfa fields. Striped blister beetles, as is true of most other common species, have only one generation per year.

During the summer, egg clusters containing up to 100 eggs are deposited in the ground. Within two weeks the eggs hatch and the tiny larvae, called *triungulins*, search for food, primarily grasshopper egg pods. Triungulins have legs designed for active movement. Within a month of finding suitable food, the larvae go through three more, increasingly sedentary, stages.

To overwinter, the larvae (now called *pseudopupae*) lose their legs and develop a thickened skin, enabling them to withstand adverse weather. They remain in this stage for the next seven months. When favorable moisture and temperature conditions return in the late spring, the final immature stage (the pupa) develops. In two more weeks, new adults emerge (June and July), begin feeding, and lay eggs for the next generation of blister beetles.



Blister Beetles, left to right: Spotted, Three Striped, Clemtis (gray) and Black.

Importance to Crops

Blister beetles occasionally cause localized areas of foliage damage as they feed within soybean and alfalfa fields. However, the threat of inflicting economic damage through leaf feeding alone is questionable. Soybean and alfalfa plants compensate for substantial foliar losses so that little to no yield loss results from blister beetle feeding.

The gregarious nature of the more common three-striped, clematis (gray), spotted, and/or black blister beetles limits the area attacked. Beetles feed and then move about or leave the field.

Importance to Livestock

Blister beetles contain a substance called cantharidin. This chemical is an irritant capable of blistering internal and external body tissues exposed to the chemical. Livestock most frequently come into contact with blister beetles as they consume alfalfa hay containing dead beetles. *Horses are especially susceptible to blister beetle poisoning (cantharidiasis).*

Blister beetles can be crushed and killed as alfalfa is swathed. When the hay is baled, bodies of dead beetles (which still contain cantharidin) sometimes become incorporated into the bales. Cantharidin may contaminate hay without the beetle bodies being evident if the beetles are squashed during haymaking.

Once contaminated, the hay probably does not lose its toxicity since cantharidin is a stable compound, withstanding degradation by heating or drying.

Questions and Answers

Q: How many blister beetles does it take to kill a horse?

A: *There is no precise answer to this question.* Various factors contribute to the severity of cantharidiasis. Different species of blister beetles contain different concentrations of cantharidin. The adult males appear to be responsible primarily for the production of cantharidin, which they transfer to females during mating.

The size and overall health of the individual horse and the amount of cantharidin ingested influence the onset of symptoms. Calculations determine that somewhere between 25 and 300 or more beetles, (depending on the beetle species, cantharidin content and body mass of the horse) may kill a horse in a single feeding.

Consuming from 2.1 to 8.3 flakes of alfalfa, contaminated at levels actually found in bales of infested hay, could theoretically kill horses weighing from 275 to 1,100 pounds. Another study concluded that 5 grams of blister beetles were enough to kill some horses (roughly equivalent to 30 striped blister beetles). Cattle are much less susceptible, but a laboratory study shows that cantharidin can reduce the di- gestibility of certain forages.

Q: What are some signs and symptoms of blister beetle poisoning?

A: Cantharidin is responsible for the formation of blisters and ulcerations on body tissues contacting the chemical. Colic and diarrhea, accompanied by blood and/or discarded intestinal tract mucosal linings in the stool, also may be noted. Signs associated with disorders of the urinary system include frequent attempts to urinate, the voiding of only small amounts of urine, pain while urinating, and blood in the urine.

Lowered calcium levels (hypocalcemia) may result in body tremors and a peculiar calcium-deficient associated breathing pattern characterized by periodic jerking contractions of the diaphragm, synchronized with the heartbeat (synchronous diaphragmatic flutter).

Other signs or complications associated with any of these disorders may include the horse placing its muzzle in water without drinking, congested mucal membranes, elevated temperatures, increased pulse and breathing rates, dehydration, depression, and shock.

Q: What are the physiological effects of cantharidin on horses?

A: Significant portions of the horse digestive tract may be affected. Secondary infections and bleeding also may occur.

Cantharidin is absorbed and excreted through the kidneys, thus irritation of the kidney, ureter, urinary bladder, and urethra could be followed by secondary infections and bleeding. For unknown reasons, calcium levels in horses may be drastically lowered and heart muscle tissue destroyed following blister beetle ingestion.

Q: How soon after the ingestion of blister beetles will a person be able to observe signs and symptoms of poisoning?

A: There is no set time limit defining response to blister beetle poisoning. The number of blister beetles ingested and the size of the horse should influence first expression of poisoning symptoms. However, sudden death may occur without the appearance of any obvious signs or symptoms of poisoning.

In other instances, signs and symptoms of blister beetle poisoning have appeared 4 to 6 hours after ingestion of the beetles (horses may be ill for hours to days before death occurs or horses may recover).

Q: What should I do if I suspect that my horse has been poisoned by eating blister beetle-infested hay?

A: Many horses exhibit a relatively low threshold for pain and discomfort, which can indicate that something is wrong soon after beetle infested hay is ingested.

Treatment may depend on the severity of the case. Digestive tract protectants can be administered to sooth irritated linings. Mineral oils have sometimes been given to dilute the oil-soluble cantharidin. Laxatives may aid in elimination of the toxin from the animal. Intravenous medications might be used to restore fluids and vital components lost through urine and diarrhea. Horses should have fresh water and be allowed freedom of movement to minimize colic injury.

A VETERINARIAN SHOULD BE CONSULTED.

Good care and a long period of convalescence might result in an animal's recovery, which could vary from partial to complete.

Q: Can I do anything to confirm whether blister beetle poisoning is a possibility if my horse displays these symptoms?

A: If poisoning is suspected, inspection of the hay and hay feeder may reveal the presence of dead beetles. However, recent research indicates that it is difficult to determine visually whether or not hay contains a toxic amount of cantharidin.

Beetles and body fragments are hard to locate and need not be present since cantharidin may contaminate the hay through crushing during harvesting. Save the suspect hay so a qualified professional can inspect it. All old hay should be removed and replaced with new feed that is less likely to have blister beetle contamination.

Q: What is known about the occurrence of blister beetles in alfalfa fields in Kansas?

A: During a 5-year study, seven species of blister beetles have been recovered from Kansas alfalfa fields. However, only five species are considered to be potentially hazardous. Two of these species (*E. vittata* and *E. occidentalis*, both striped) pro- bably contribute the most to increasing the risk of poisoning.

These striped species have tendencies to form dense swarms or aggregations and have been associated with most incidences of cantharidiasis.

Thus, there is a greater probability with these species that enough cantharidin could be incorporated into hay bales to cause a horse health problems. Striped blister beetles have been found in Kansas alfalfa fields from mid-June through mid-September. Peak populations occurred from the end of June through the end of July. Overall, it should be apparent that second through fourth cuttings are at relatively greater risk than other cuttings.

The figure (below right) illustrates the first, peak and last appearances of those species of primary importance that are known to occur in Kansas alfalfa. Nationwide, blister beetles appear to occur throughout all alfalfa growing regions. Species composition, seasonal occurrence, and abundance vary widely among geographic production regions.

Q: Can any hay cutting be guaranteed absolutely "blister beetle-free"?

A: Probably not. Figure 1 shows that cuttings 2 through 4 have the greatest risk of blister beetle contamination. Ashgray blister beetles have been collected from alfalfa as early as the beginning of May.

Although populations did not peak until June and this species wasn't noticed aggregating in large numbers, they could occur in numbers sufficient to cause horse poisonings. Margined and black blister beetles also have not been observed swarming. Thus, there is less like- lihood that these species are responsible for many horse poisonings.

Q: Can field inspections be used to determine the presence of blister beetles (hence guaranteeing hay to be "blister beetle-free?")

A: Because blister beetles congregate and are quite mobile, detecting potentially harmful concentrations is not easy. For instance, an aggregation estimated to contain at least 60,000+ beetles was encountered during harvest in a field that had been intensively scouted by trained individuals only a few hours earlier.

The swarm was dense enough to bend the standing hay over from the weight of the beetles. The aggregation apparently flew into the field after scouting was finished, but before harvesting occurred.

Research shows that blister beetles do seem to be encountered more frequently within about 100 feet from the edge of the field than farther out into the field. Yet in several instances, significant populations were located deep within the field.

It could be risky to guarantee that hay will be free of blister beetles even with intensive searching.

Q: Can the type of equipment used in haying operations influence the likelihood that blister beetles will be present in the hay?

A: Several types of equipment (and modifications thereof) have been evaluated recently to establish their potential for incorporating blister beetles in hay bales. Among those examined were sicklebar mowers, pull-type swathers with conditioning rollers, and various types of self-propelled mowers.

The least blister beetle mortality was detected when a **self-propelled mower/windrower (without conditioning rollers)** was used. This de- vice produced windrows which were straddled by the wide-set wheels.
Almost all blister beetles passed through the machine virtually unscathed and left the windrow and the field before the loose hay was baled. However, problem bales could be produced using this equipment. If the blister beetle swarm was located in the alfalfa at the end of the field, the beetles could still be crushed and killed by tire traffic caused by passage of the swather wheels over the fallen hay when the machine was turning around. Therefore, bales consisting of *hay from "turn areas" is at higher risk* (in terms of potentially containing blister beetles) than are bales made from hay picked up from the field proper.

As might be expected, substantially more beetles were killed and included in hay bales if alfalfa was cut with a **self-propelled mower conditioner**. Additional mortality and risk occurred where **pull-type mower conditioners** were used. Tires running over the fallen hay as the mowing continued increased the risk of contamination.

Sicklebar mowers often have been suggested as the implement of choice to minimize killing blister beetles during the swathing process. *It has recently been demonstrated, however, that the tractor's tires frequently crush a significant percentage of beetles when the mowing equipment passes over the previously cut swath on the next pass around the field.* In some instances, this mortality rate approached that from self-propelled mower/conditioners.

Mowing patterns also affected blister beetle contamination risk. Mowing the field in sections may have some previously unrealized disadvantages. Substantially greater concentrations of blister beetles in the edges of the standing hay were observed the day after some of the

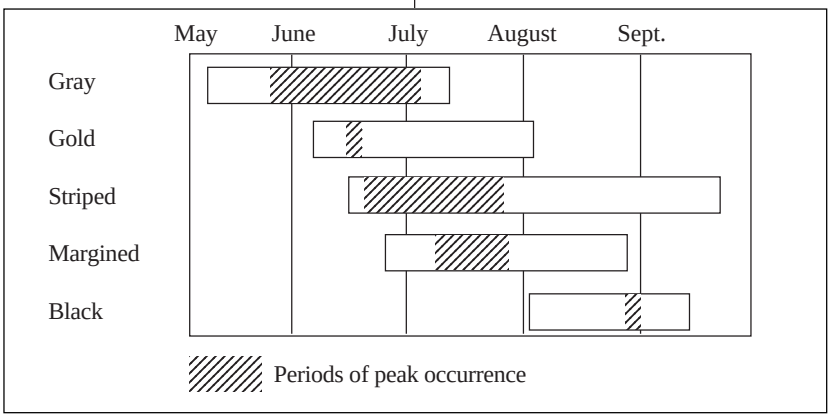


Figure 3. Seasonal and peak occurrence of blister beetles in Kansas alfalfa.

field was cut. Presumably, blister beetles surviving the mowing operation moved from the fallen hay to the edge of the standing hay, creating an artificially high concentration of blister beetles.

Raking and baling dislodged beetles from the hay. Realize that dislodging bodies may not eliminate the contamination, however, since some toxin from smashed beetles is known to be transferred to the hay.

Another point to consider is that in the process of baling, the contaminated hay may end up in widely scattered bales. This occurs because swarms often occupy an area greater than the width of a single windrow. As the baler passes up and down the field, large amounts of uninfested hay are picked up between the times that the swarm area is encountered. Further scattering of the bales may occur during **loading and stacking** operations.

Q: Could mechanical conditioning be replaced with chemical conditioning and thereby avoid killing the beetles?

A: This approach has limitations. Efforts to dessicate hay with one commercial product succeeded in killing approximately a third of the beetles. Killing beetles, chemically or mechanically, is undesirable because it increases the likelihood that some cantharidin will end up in the hay. However, several different chemical hay drying products are available. Some may not be as insect toxic.

Q: What about controlling blister beetles with insecticidal sprays?

A: Due to the aggregative and restless nature of blister beetles, it is questionable whether chemical control of blister beetles in alfalfa is desirable. Although it may be possible to locate a concentration of blister beetles as a field is scouted, there is little reason to suspect that other swarms do not occur or that new swarms would not enter the field after the spray has lost its toxic properties.

Carbaryl and parathion are effective in rapidly killing blister beetles. However, these products have 7-day and 15-day preharvest waiting intervals, respectively. Neither insecticide has adequate residual activity to kill blister beetles which enter fields for the entire time from when sprays have been applied until just before harvest is permitted.

Additionally, enough dead beetles may remain in alfalfa foliage to render the hay toxic. As mentioned, dead beetles on the ground also may be transferred (or have their cantharidin transferred) back into the hay.

Q: What about inspecting hay prior to its being used as horse feed?

A: Although **inspection of hay bales** prior to their use as horse feed could reduce the possibility of blister beetle poisoning, it might prove difficult and time-consuming at best. Difficult because blister beetles are hard to spot, and time consuming because all flakes in all bales should be inspected.

Since blister beetle swarms are relatively rare events, only a small area(s) within any given field will probably be seriously infested. All the problems may become concentrated within individual flakes of a single bale. For instance, one particular 5-pound flake of alfalfa hay contained 145 grams of dead blister beetles. Statistically, there were enough blister beetles in that flake to kill 29 horses. In practice, however, it is more likely that a single horse would have consumed that flake of hay.

To Summarize

Blister beetles are of most concern to alfalfa producers selling to the horse hay market and to those buying hay for horse feed.

■ Signs and symptoms of blister beetle poisoning are varied. If cantharidiasis is suspected, Consult a veterinarian experienced with this diagnosis.

■ Species of blister beetles vary in their seasonal occurrence, cantharidin content, geographic distribution, and propensity to aggregate or swarm.

■ Selection and application of alfalfa harvesting operations can influence the risk that the baled hay will contain blister beetles or cantharidin.

It seems prudent to minimize operations which kill blister beetles. Keeping the beetles alive and healthy means that they can remove themselves (and the cantharidin) from the field, thereby minimizing contamination of the hay.

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