Blister Beetles (Coleoptera: Meloidae) Occurring in Montana Alfalfa[1]

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Abstract Blister beetles (Coleoptera: Meloidae) may be an important pest of alfalfa that reduces the utility and value of forage rather than dry matter yield. Crop utility is compromised because of the threat of toxicity to livestock, particularly horses, if they are fed alfalfa hay that is contaminated with cantharidin. The chemical toxin, cantharidin, is contained in the hemolymph of blister beetles and may contaminate forage directly by beetles killed during harvest and incorporated into baled hay or indirectly by transfer of hemolymph from crushed beetles to forage. Risk of blister beetle contamination varies with blister beetle species and occurrence. Species composition and seasonal occurrence of blister beetles in Montana alfalfa was determined using two approaches: (1) archival information from pinned specimens maintained in the Montana Entomology Collection, and (2) a survey of alfalfa fields in Montana. Label information of museum specimens revealed *Epicauta fabricii* (LeConte), *Epicauta pensylvanica* (De Geer), *Epicauta sericans* LeConte, and *Epicauta maculata* (Say) had been collected or extracted from alfalfa. Four additional species, *Lytta cyanipennis* LeConte, *Epicauta normalis* Werner, *Epicauta ferruginea* (Say), and *Epicauta murina* LeConte were collected during a 4-yr alfalfa field survey. All alfalfa cuttings in Montana potentially contain blister beetles with species composition changing throughout the growing season. However, blister beetle numbers were relatively low and no swarms were detected. Blister beetle species belonging to the Vittata Group, most frequently documented to cause horse death, were not found in the Montana Entomology Collection or collected during the field study. Risks of cantharidin contamination of baled alfalfa hay in Montana is low.

Key Words Meloidae, *Epicauta,* blister beetle, alfalfa, cantharidin.

The economic impact of blister beetles on an alfalfa (*Medicago sativa* L.) crop is not through crop defoliation or yield loss but rather on utility and value of the forage. Crop utility is compromised when beetles killed during harvest are incorporated into baled hay resulting in forage contaminated with the toxin cantharidin, contained in blister beetle body tissues and fluids (Blodgett et al. 1992). Use of crimpers that condition hay have been identified as a source of beetle mortality, and use of a sicklebar mower has been recommended to avoid beetle mortality. However, additional sources of beetle mortality have been identified and include various types of mowers and their operation (Blodgett et al. 1995).

Cantharidin is a sesquiterpenoid derivative thought to have evolved as a beetle defensive mechanism to protect beetles from predation (Carrel and Eisner 1974). The common name, blister beetle, is derived from the blistering reaction that results when

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cantharidin-containing hemolymph is exuded via reflexive bleeding from leg joints and comes into contact with skin or other sensitive mammalian tissues such as mucosal lining of the oral cavity and gastrointestinal tract. Cantharidin contamination of baled hay can have a serious, deleterious effect on livestock, especially horses, that are poisoned when they eat dead, crushed beetles or cantharidin-contaminated baled alfalfa (Oehme 1981). A lethal dose of cantharidin has been estimated to range between 0.5 and 1.0 mg/kg (Oehme 1981, Shawley and Rolf 1984). Alfalfa producers who sell hay to horse owners regard blister beetles as a serious pest problem that can greatly reduce the value of hay and jeopardize their ability to market hay.

The risk of livestock poisoning posed by cantharidin-contaminated hay is strongly related to the species or species complex. Species-dependent characteristics that influence risk include seasonal occurrence, population density, and behavior that influences field distribution. Beetle cantharidin content varies among species and between sexes (Blodgett et al. 1991, Capinera et al. 1985), making the number of beetles comprising a toxic dose variable. During the alfalfa production season, punctuated by periodic harvests, the species composition shifts and beetle population densities fluctuate causing the risks to change through time.

Epicauta vittata (F.) (=*Epicauta lemniscata* of authors) and *Epicauta occidentalis* Werner, 'striped' species belonging to the Vittata Group, are the most frequently cited cause of livestock cantharidiasis (Moore 1963, Bahme 1968, Panciera 1972, Schoeb and Panciera 1978, 1979). The behavior of these species contributes to the risk they pose because of the dense aggregations they have been documented to form (Adams and Selander 1979). Aggregations of *E. occidentalis* were documented to occur in Kansas alfalfa fields (Blodgett et al. 1995). Additionally, *E. occidentalis* was found to have the greatest cantharidin concentration of four species tested (Blodgett et al. 1991).

Blister beetles species occurrence and composition varies by geographical area. While some blister beetle species overlap occurs between Kansas (Blodgett and Higgins 1988) and Colorado (Capinera et al. 1985), there were species differences which have important implications for management. Developing a blister beetle management program for Montana and assessing risks of cantharidin contamination requires knowledge of species composition and seasonal occurrence. The objectives of this research were to determine the species composition, seasonal occurrence, and relative abundance of Meloidae species in Montana alfalfa hay and to determine if any species representing the Vittata Group occur in Montana. A survey of alfalfa fields and examination of label information from species in the Montana Entomology Collection (MTEC) were conducted.

Materials and Methods

Museum survey. Collection date, host association and other information from pinned specimens in the MTEC were examined to determine Meloidae species that were extracted from alfalfa and their seasonal occurrence. Additionally, label data were summarized from species that were detected in the alfalfa field survey. Seasonal occurrence was determined using the first and last date of collection. Relative abundance is indicated by the frequency of collection and compared with the field survey information, representing beetles extracted solely from alfalfa.

Alfalfa field survey. One to two fields from four major Montana alfalfa production areas were monitored at least once per cutting for a 4-yr period (1994 to 1997).

Sampled fields were produced using supplemental irrigation (representing about 70% of alfalfa in Montana) and ranged in size from 8 to 32 ha. County Extension faculty helped to identify cooperators in Broadwater, Gallatin, Stillwater, and Roosevelt counties. Samples consisted of 25, 180° sweeps using a 38-cm diam sweep net. Sweep samples were held in resealable plastic bags, returned to the laboratory, and held in the freezer until they could be sorted and identified. Blister beetle specimens were identified to species using a key to the *Epicauta* (Pinto 1991) and for the single specimen of genus *Lytta,* the key of Arnold (1976). Identifications were verified by J. Pinto (University California-Riverside) and placed in the MTEC as voucher specimens.

Seasonal occurrence was the period from the first to last detections of that species during the 4-yr field survey. Relative abundance was indicated by the total number of specimens collected over the 4-yr period of the field survey. Frequency of occurrence was expressed as the total number of beetles per infested field. The seasonal occurrence and frequency of occurrence for species detected in the field survey was compared with data from specimens in the MTEC.

Results and Discussion

Museum survey. There are 77 Meloidae species in 19 genera held in the MTEC. Museum records indicate 4 species were collected or extracted from alfalfa - *Epicauta fabricii* (LeConte), *Epicauta pensylvanica* (De Geer), *Epicauta sericans* (LeConte), and *Epicauta maculata* (Say). These species have also been reported to occur in other Rocky Mountain states including Wyoming (Bomar 1993), Colorado (Capinera

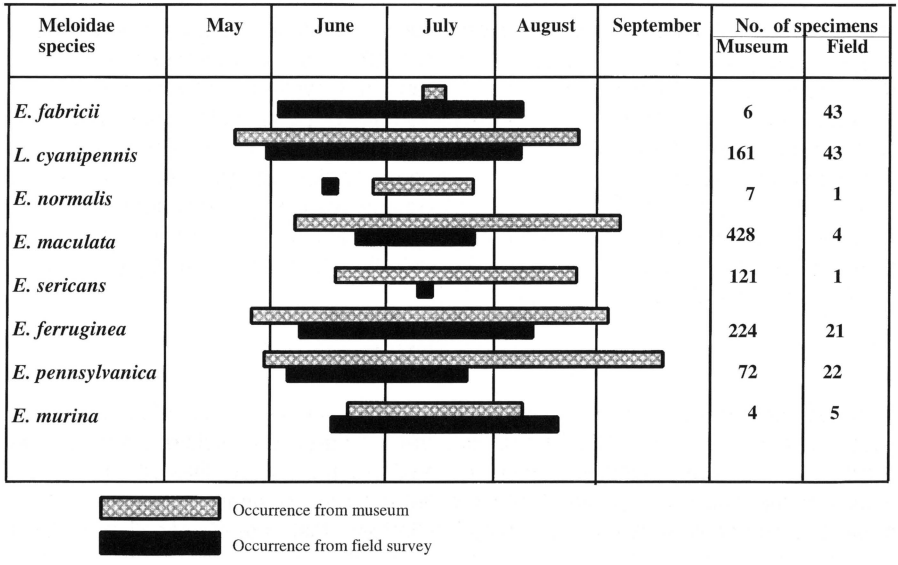

Fig. 1. Museum and field survey based seasonal occurrence of eight Meloidae species found in Montana alfalfa, 1994-1996.

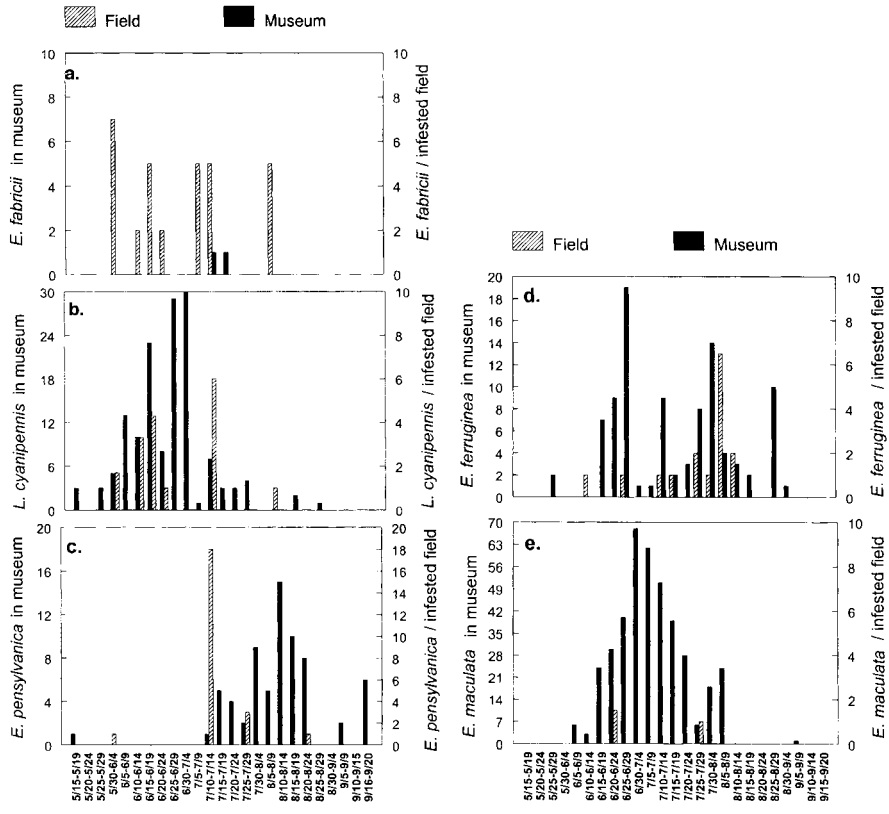

Fig. 2. Seasonal distribution of (a) *E. fabricii,* (b) *L. cyanipennis,* (c) *E. pensylvanica,* (d) *E. ferruginea,* (e) *E. maculata* from an alfalfa field survey and data contained in the Montana Entomology Collection.

et al. 1985), and, with the exception of *E. maculata,* in Kansas (Blodgett and Higgins 1988).

Alfalfa field survey. Eight species of Meloidae in 2 genera, *Epicauta* and *Lytta* were collected from Montana alfalfa during the 4-yr field survey. Seasonal occurrence is summarized for the alfalfa field survey and for specimens included in the MTEC (Fig. 1). For all species except *E. murina* LeConte and *E. fabricii,* the seasonal occurrence from the museum specimens was much broader than for the field survey. This may indicate that many species that occur in alfalfa are able to utilize other plant hosts.

Epicauta fabricii and *L. cyanipennis* LeConte were the most abundant species followed by *E. pensylvanica* and *E. ferruginea* (Sox). The remaining species were uncommon, with 5 or less specimens of *E. normalis* Werner *E. maculata, E. sericans,* and *E. murina* found in the alfalfa fields surveyed during the 4-yr period. The pattern of occurrence is indicated for the more abundant species represented in the field survey (>5 specimens collected) including, *E. fabricii, L. cyanipennis, E. pensyl-*

vanica, and *E. ferruginea* or held in the museum (>100 specimens) including *E. maculata* (Fig. 2a-e). Although densities of the more frequently detected species in the field survey appear to be lower than the same species reported in other field surveys, this is at least partially due to differences in sample size and method (Capinera et al. 1985, Blodgett and Higgins 1988). Additional sampling effort would be needed for better resolution of seasonal occurrence and frequency patterns of uncommon species infrequently detected in this survey.

Members of the genus *Epicauta* are the blister beetles most commonly implicated in horse deaths. The 'striped' species belonging to the Vittata Group were the most commonly cited in cases of horse deaths (Moore 1963, Bahme 1968, Panciera 1972, Schoeb and Panciera 1978, 1979). The Vittata Group, defined by Adams and Selander (1979), included 8 species that occur in North and Central America. The North American distribution of these species does not include Montana but one of the 'striped' species, *E. occidentalis,* is found as far west as South Dakota and eastern Colorado (Pinto 1991). *Epicauta occidentalis* was found to aggregate in Kansas fields resulting in local, high concentrations of dead beetles within individuals bales (Blodgett et al. 1991). Single flakes from alfalfa hay bales have been shown to approach the acute toxic threshold for cantharidin ingestion. In addition, *E. occidentalis* had the highest cantharidin concentration of 4 blister beetle species tested including *E. fabricii* and *E. pensylvanica* (Blodgett et al. 1991). In one veterinary case, *E. pensylvanica* was responsible for two horse deaths in Illinois (Beasley et al. 1983). Although *E. pensylvanica* is found in Montana, it is considered to be of low risk to livestock health because it has low cantharidin concentration and does not tend to form dense aggregations. Risks posed by *L. cyannipennis* and *E. ferruginea* are not completely known because cantharidin contents have not been determined, although these species are not known to aggregate and have not been implicated in livestock deaths. Blister beetle management in Montana should focus on completing the risk assessment by determining cantharidin contents of Meloidae species known to occur in alfalfa.

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