

PHYTOPHAGOUS INSECTS ASSOCIATED WITH CULTIVATED MARIJUANA, *CANNABIS SATIVA*, IN NORTHERN MISSISSIPPI

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ABSTRACT

During the growing seasons of 1983 and 1985, a general survey of insects associated with cultivated marijuana, *Cannabis sativa*, on the University of Mississippi campus was conducted. Of the species collected that were using the plants for food, the majority (43) were sap feeders, 15 were leaf chewers, nine ate or gathered pollen and one was possibly a root feeder. Only sap feeders appeared to be successfully reproducing on the marijuana. Species collected in greatest abundance were *Agallia constricta* and *Graphocephala versuta* (Cicadellidae), *Spissistillus festinus* (Membracidae), *Clastoptera xanthocephala* (Ceropidae), *Halticus bractatus* (Miridae), *Systema elongata* (Chrysomelidae) and *Schizocerella pilicornis* (Argidae).

Key Words: Phytophagous insects, Marijuana, *Cannabis sativa*

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INTRODUCTION

In 1968, the National Institute of Mental Health funded the Marijuana Project at the University of Mississippi. The project, administered through the Research Institute of Pharmaceutical Sciences at the University, and funded in later years by the National Institute on Drug Abuse, has continued through the present. Although the project is a multi-faceted research program, one of its primary functions is the production of marijuana, *Cannabis sativa* L., of standardized quality for researchers working with the crude drug. The presence of the garden on campus presents a unique opportunity to study the insect fauna associated with this unusual crop.

Various papers and catalogs contain records of insects feeding on *Cannabis sativa*. In fact, A. R. Mostafa and P. S. Messenger, in an unpublished catalog/bibliography of insects and mites associated with several plant genera, listed 256 species of insects as having been reported from *C. sativa*. Only nine, however, were North American records, and five of these were based on unpublished data or were questionable North American records. Species reportedly attacking the plant on this continent are: *Empoasca fabae* Harris (Homoptera: Cicadellidae) (Dudley 1920; as *E. mali*); *Psylliodes punctulata* Melsheimer (Coleoptera: Chrysomelidae) (Glendenning 1927) and the following Lepidoptera: *Heliothis zea* (Boddie) (Comstock 1879; as *H. armiger*), *Agrotis gladiaria* Morrison, *Papaipema cataphracta* (Grote), *P. nebris* (Guenee) (Noctuidae) (Tietz 1972), *Ostrinia nubilalis* (Hübner) (Pyralidae) (Bottger 1940; Mackie 1918) and *Grapholita delineaana* (Walker) (Tortricidae) (Miller 1982). *Grapholita tristrigana* (Clemens) was reported to attack wild hemp by Smith

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and Haney (1973) and Haney and Kutscheid (1975), but these records are actually for *G. delineana* (Miller 1982). Most of these records are based on collections from "hemp," "wild hemp" or "naturalized hemp," probably referring to cultivated or escaped populations of the varieties of *C. sativa* that were grown throughout much of the United States for fiber production (see Haney and Kutscheid 1975, for a brief history of *C. sativa* in North America). A primary difference between the fiber variety and plants used to produce the crude drug marijuana is the amount of various cannabinoids produced by the plants. Generally fiber varieties, such as wild North American populations, produce low levels of hallucinogenic compounds (there is some disagreement as to why this is true, see Turner et al. 1975); however as levels of these substances increase, the drug potency of the plant material also increases.

The plants grown in the *Cannabis* garden at the University of Mississippi have high levels of the pharmacologically active substances. We are not aware of any studies that have considered the insect fauna associated with cultivated, drug grade *Cannabis*. During the growing seasons of 1983 and 1985, a general survey of the insect community in the marijuana garden was conducted. The following discussion considers the phytophagous species encountered during that investigation.

MATERIALS AND METHODS

One and one-half acres of marijuana were planted in both 1983 and 1985. During both years, collections were made biweekly from shortly after plant emergence (early May) until harvest (late September). Sampling was generally conducted between 10:00 a.m. and 2:00 p.m. Because the plants are fairly delicate, early season sampling, from emergence until the seedlings were 20 cm tall, was done by hand picking, with aspirators or by careful netting. After that initial period, collections were made with light duty sweep nets. Unlike sweeping in natural vegetation, it was necessary to take care not to damage the plants. Since forceful sweeping was not possible, at least 30 minutes was devoted to sweeping during each visit. Usually an additional 30 minutes was spent walking through the garden observing the behavior of feeding insects and hand picking specimens from parts of plants inaccessible to sweeping. The garden is well manicured, so contamination of the samples with insects actually on other plant species was not a problem. Sampling was not done on field margins to reduce the the chance of such contamination. Voucher specimens have been placed in the University of Mississippi insect collection.

RESULTS AND DISCUSSION

During the course of this study, over 300 species of insects were captured from *Cannabis sativa*. A large portion of this community was composed of predaceous species. Since these are not associated in any particular way with the plant, they are not considered here. To reduce the chance of inferring erroneous relationships that might be drawn from chance visitations or sitting records, most species represented by five or fewer specimens were not included in the following list. The exceptions to this were rarely encountered species that were actually observed feeding (particularly lepidopterous larvae). Polliniferous species are included in order to present the most comprehensive list of insects feeding on the cultivated marijuana.

In the following list, earliest and latest collection dates and an indication of relative abundance are given for each of the 69 species considered. Species considered rare were represented by five or fewer specimens each year; uncommon species, six to twenty specimens; common, twenty-one to fifty specimens; and abundant, more than fifty specimens annually.

List of Species

COLLEMBOLA

Sminthuridae

Bourletiella hortensis (Fitch). 10 May - 17 May. Common on plants up to 15 cm tall.

ORTHOPTERA

Gryllidae

Oecanthus celerinictus Walker. 21 July - 26 Sept. Uncommon.

THYSANOPTERA

Thirpidae

Frankliniella fusca (Hinds). 3 May - 21 May. Common on very small plants. Specimens not seen after May.

HEMIPTERA

Miridae

Halticus bractatus (Say). 3 June - 26 Sept. Abundant, with largest numbers collected late August and September.

Keltonia sulphurea (Reuter). 21 June - 14 Sept. Abundant during 1983 but not collected during 1985 season.

Lygus lineolaris (P. de Beauvois). 4 May - 16 Sept. Abundant.

Neurocolpus nubilus (Say). 7 June - 14 Sept. Common in 1983, rare in 1985.

Pseudatomoscelis seriatus (Reuter). 8 June - 7 Sept. Common in 1983, but not collected in 1985.

Spanagonicus albofasciatus (Reuter). 31 May - 16 Aug. Uncommon.

Pentatomidae

Acrosternum hilare (Say). 25 July - 21 Sept. Uncommon in 1985, not found in 1983.

Euschistus servus (Say). 7 June - 26 Sept. Uncommon.

Oebalus pugnax (F.). 31 May - 14 Sept. Uncommon.

Thyanta custator (F.). 7 June - 7 Sept. Uncommon.

Rhopalidae

Arhyssus lateralis (Say). 7 June - 9 Aug. Uncommon.

HOMOPTERA

Acanaloniidae

Acanalonia conica Walker. 10 July - 3 Aug. Rare.

Aphididae

Hysteroneura setariae (Thomas). 12 May - 7 Sept. Rare, usually on plants less than one meter tall.

Cercopidae

Clastoptera xanthocephala Germar. 4 May - 26 Sept. Abundant.

Cicadellidae

- Aceratagallia sanquinolenta* (Provancher). 4 May - 7 Sept. Uncommon, but collected consistently throughout both seasons.
- Agallia constricta* Van Duzee. 4 May - 14 Sept. Abundant, highest population numbers were encountered during August.
- Aulacizes irrorata* (F.). 7 June - 26 Sept. Common in 1985, but rare in 1983.
- Balclutha guajanae* (DeLong). 17 Aug. - 16 Sept. Uncommon in 1985, not collected in 1983.
- Carneocephala flaviceps* (Riley). 31 May - 30 Aug. Rarely collected, 10 specimens were taken 16 Aug. 1983, single specimens were taken on all other dates.
- Cuerna costalis* (F.). 11 June - 10 July. Uncommon.
- Draeculacephala balli* (Van Duzee). 15 June - 7 Sept. Uncommon.
- Draeculacephala portola* (Ball). 31 June - 7 Sept. Uncommon.
- Exitamus exitiosus* (Uhler). 11 May - 26 Sept. Uncommon.
- Graminella nigrifrons* Forbes. 11 May - 16 Sept. Common.
- Graphocephala versuta* (Say). 4 May - 26 Sept. Abundant.
- Gyponana octolineata* (Say). 7 June - 21 Sept. Uncommon, most specimens collected in June and September.
- Macrosteles fascifrons* (Stal). 31 May - 30 Aug. Uncommon.
- Neokolla hieroglyphica* (Stal). 21 June - 26 Sept. Unknown.
- Oncometopia undata* (F.). 15 June - 7 Sept. Uncommon.
- Scaphytopius acutus* (Say). 31 May - 26 Sept. Uncommon.
- Scaphytopius frontalis* (Van Duzee). 4 May - 30 Aug. Common, greatest numbers were encountered during June.
- Stirellus bicolor* (Van Duzee). 15 June - 30 Aug. Uncommon.
- Xerophloea viridis* (F.). 30 June - 3 Aug. Uncommon in 1983, not collected in 1985.

Delphacidae

- Delphacodes puella* (Van Duzee). 18 July - 31 Aug. Uncommon.
- Liburniella ornata* (Stal). 24 Aug. - 26 Sept. Uncommon in 1985, rare in 1983.
- Pissonotis piceus* (Van Duzee). 15 July - 21 Sept. Rare in 1985, not collected in 1983.

Flatidae

- Anormenis septentrionalis* Spinola. 10 July - 26 Sept. Common.
- Metcalfa pruinosa* Say. 21 July - 5 Aug. Uncommon in 1983, not collected in 1985.
- Ormenodes venusta* (Melich). 22 June - 7 Aug. Uncommon in 1985, not collected in 1983.

Membracidae

- Campylenchia latipes* (Say). 30 June - 3 Aug. Uncommon.
- Micrutalis calva* (Say). 21 June - 16 Aug. Uncommon.
- Spissistillus festinus* (Say). 31 May - 26 Sept. Abundant.

COLEOPTERA

Cantharidae

Chauliognathus marginatus F. 3 June - 16 Aug. Uncommon.

Chauliognathus pennsylvanicus Debeer. Collected only twice, 30 Aug. 1983 (9 specimens) and 19 Sept. 1985 (1 specimen).

Chrysomelidae

Chaetocnema denticulata (Illiger). 4 May - 16 Aug. Uncommon.

Chaetocnema pulicaria Melsheimer. 3 May - 26 Sept. Common.

Diabrotica undecimpunctata howardi Barber. 4 May - 26 Sept. Common, largest numbers occurred from July through September.

Disonycha glabrata (F.). 3 June - 10 Aug. Abundant during 1983, not collected during 1985.

Epithrix fuscata Crotch. 11 May - 16 Aug. Uncommon.

Luperaltica nigripalpis (LeConte). 7 Aug. - 14 Sept. Uncommon in 1983, not collected in 1985.

Nodonota clypealis Horn. 21 June - 18 July. Uncommon in 1983, rare in 1985.

Nodonota tristis (Olivier). 15 May - 3 Aug. Uncommon.

Systema blanda Melsheimer. 3 May - 17 Aug. Common.

Systema elongata (F.). 18 May - 19 Sept. Abundant.

Curculionidae

Cyrtopistonmus castaneus (Rolofs). 25 May - 3 Sept. Uncommon.

Scarabaeidae

Phyllophaga tristis (F.). Oct. Several larvae collected from roots following harvest in 1985.

LEPIDOPTERA

Arctiidae

Spilosoma virginica (F.). September. Rare. Several larvae observed feeding.

Noctuidae

Spodoptera ornithogalli (Guenee). June - Sept. Uncommon. Larvae observed feeding.

Tortricidae

Platynota sp. (prob. *flavedana* Clemens). 31 Aug. One larva observed feeding.

HYMENOPTERA

Apidae

Apis mellifera L. 25 July - 7 Aug. Rare.

Bombus impatiens Harris. 20 July - 14 Sept. Uncommon.

Argidae

Schizocerella pilicornis (Holmgren). 4 May - 16 Aug. Abundant.

Halictidae

Dialictus imitatus (Smith). 15 June - 7 Sept. Uncommon.

Scoliidae

Scolia nobilitata F. 30 June - 30 Aug. Rare.

Tiphidae

Myzinum obscurum (F.). 15 June - 7 Aug. Uncommon.

Myzinum quinquectinctum (F.). 30 June - 28 July. Uncommon in 1983, not collected in 1985.

As is indicated by the preceding list, the insect fauna associated with the cultivated marijuana here is quite diverse. According to Strong et al. (1984), most insects that colonize an introduced plant are "new recruits," species not originally associated with the plant. Characteristically, recruitment of a diverse fauna occurs quickly, many recruits are polyphagous, and chewing and sucking insects are more likely to be colonists than are miners or gall formers. This seems to accurately describe the insect fauna associated with cultivated marijuana here. The majority of the species, as well as those that were most abundant, possessed piercing-sucking mouth parts (43 species). Among the remaining species, 15 were leaf chewers, nine ate or gathered pollen and one was possibly a root feeder.

Although leaf chewing adults of several species were fairly common on the marijuana, there was no evidence that any of these species were reproducing on the plants. The only chewing immatures found were lepidopterous larvae, but they were never common. *Spodoptera ornithogalli* larvae were present consistently through the growing season, but feeding activity was restricted primarily to smaller plants (under 1 m tall). Early to late instars were observed and larvae were able to complete development. Larvae often did moderate damage to seedlings or small plants, but overall damage to the crop was insignificant due to the relative scarcity of caterpillars. Interestingly, the cannabinoids characteristic of marijuana are not produced in quantity for several weeks following germination (Turner et al. 1975), and the presence of these substances later in the season may affect palatability of the plant to the caterpillars (as well as several other species encountered during this study).

The least expected chewer encountered was the collembolan *Bourletiella hortensis*. Individuals were fairly common on seedlings up to 15 cm tall, where they ate holes in the leaves. Often three or four could be seen feeding around the same hole. Both years, they disappeared from the plants shortly after mid-May. This rather sudden disappearance would seem to indicate that early cannabinoid production adversely affected palatability of the marijuana to the point where it was not suitable as a food plant for the species. The same is probably true for the only thrips encountered, *Frankiniella fusca*, individuals of which were not found after May.

By contrast, most of the sap feeders appeared early and remained active in the garden throughout the growing season, and many were reproducing on the plants. Leaf hoppers were particularly abundant. Collections were dominated by *Graphocephala versuta* (2155 specimens) and *Agallia constricta* (894 specimens), with an additional 30 species represented in varying quantities (13 rare and not listed). Nymphs were common, but difficulty in identification of immatures precludes presenting a list of species. The only nymphs associated at the generic level represented species of *Aulacizes*, *Cuerna*, *Gyponana* and *Scaphytopius*. Other homopterans that were particularly abundant and were reproducing were *Spissistillus festinus* (Membracidae) and *Clastoptera xanthocephala* (Cercopidae). Immatures of the remaining species of Homoptera were not present in the collections.

Although a few nymphs of mirids and pentatomids were collected, there was little evidence of reproduction by the phytophagous Hemiptera. Most of the nymphs collected were pentatomids (*Euschistus servus* and *Acrosternum hilare*). A few immature tarnished plant bugs (*Lygus lineolaris*) were collected, but the number was totally out of proportion when compared to the consistently high population levels of adults. No other mirid nymphs were found.

Since marijuana is wind pollinated (Haney and Kutscheid 1975), it was not surprising that few pollen feeders and gatherers were collected. Of the pollen-feeding beetles, only *Diabrotica undecimpunctata howardi* was common, and none of the polliniferous Hymenoptera were consistently encountered. The few bees and wasps that were collected, however, were observed on flowers apparently eating or gathering pollen.

Examination of roots following harvest in 1985 revealed very few insects. Second and third instar larvae of *Phyllophaga tristis* (F.) (Coleoptera: Scarabaeidae) were collected under plants and a series of maggots was taken from crevices between roots. The scarab larvae were probably feeding on the marijuana roots, but the relationship between the maggots and the plant is not as apparent. Nor is their identity. The larvae run to the second part of the couplet 95 in Teskey's (1981) key, where 13 families are listed. Representatives of three of those families, Chloropidae (4 sp.), Otitidae (2 sp.), and Platystomatidae (1 sp.), were present in the sweep net collections. Rearing will be necessary in order to determine the identity of the maggots but no additional larvae have been found. Closer examination of the "infested" roots will be necessary to determine the relationship between the maggots and the plants.

Adult *Schizocerella pilicornis* (Holmgren) (Hymenoptera: Argidae) were abundant on the marijuana during both seasons; however, no larvae were collected during this study (the immatures are suspected to be miners in *Portulaca* leaves (Krombein et al. 1979)). Adults were most often observed as they moved up and down stems and were also frequently seen on leaves; however, they did not appear to be consuming plant material. This species is rarely encountered in northern Mississippi, but nearly 300 specimens (10 males: 1 female) was collected from the marijuana. Obviously the plants are attractive to the sawflies, but the reason for this attraction remains unknown.

According to Dewey (1913), few insects can be considered pests of "hemp" in North America. In their study of the ecology of hemp in Illinois, Haney and Kutscheid (1975) reported only caterpillars of *Grapholita delineana* (as *G. tristrigana*) as having a significant impact on seed production. The larvae fed on seed clusters. This apparently introduced Eurasian species attacks *Cannabis* and related plants in its ancestral range, and is considered a pest of hemp in some areas (Miller, 1982). The moth is only one of a diverse group of species that damage *Cannabis* crops in Europe and Asia (the probable origin of marijuana), and appears to be the only true pest of *Cannabis* that has been introduced into North America along with the plant. The distribution of *G. delineana* in the United States includes northeastern and midwestern states at least as far south as Missouri and Kentucky (Miller 1982), and this southern limit roughly corresponds to that found for naturalized hemp populations by Haney and Bazzaz (1970). The rather disjunct location of the marijuana garden at the University of Mississippi probably explains the absence of *G. delineana* during this study, but the species certainly may appear in the future.

A large and diverse insect fauna occurs on the marijuana in the 20-year old garden, and the fauna is dominated by polyphagous sucking and chewing insects, with few potential miners present. Observable insect damage was very minor. Although some species were common during one season and not encountered during the other, the majority that were considered common or abundant were consistently collected both years; consequently, the fauna appears to be fairly

stable. Monitoring the insects in the marijuana garden periodically in the future should give a better estimate of this stability, as well as provide additional information on the relationship between this interesting plant and the insects it hosts.

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