

Research Article

Insects Associated with Sweetpotato, *Ipomoea batatas* (L.), in Mississippi

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Abstract Seventy-two species or genera of insects collected from or observed in commercial sweetpotato (*Ipomoea batatas* [L.] fields or research plots during a five-year period are listed. Twenty-two species are known to damage sweetpotato storage roots, 13 species are recognized as serious pests of sweetpotato, and 43 species have the potential for feeding on sweetpotato foliage. The primary root-damaging pests are beetles (Coleoptera: Chrysomelidae, Brentidae, Curculionidae, Elateridae and Scarabeidae), and noctuid moth larvae (Lepidoptera: Noctuidae). Other insects from the orders Hemiptera (8 species), Lepidoptera (9 species), Orthoptera (1 species), and Thysanoptera (3 species) are listed. Thrips, aphids, and several beetle species are discussed as possible vectors of viral diseases to sweetpotato.

Key words: sweetpotato, *Ipomoea batatas*, insect pests

Introduction

In Mississippi, sweetpotatoes are often planted in a rotation with cotton, corn, soybeans, pasture, or peanuts. Fields are often bordered by other row crops or mixed hardwood and pine forests. Such a diverse ecosystem provides a complex environment for the establishment of many insect species. Insect feeding might result in damage to both the foliage and the roots of sweetpotato plants, and several insects serve as vectors for viral diseases. Over 20,000 acres of sweetpotatoes were harvested in Mississippi during 2007, with a value of 67.55 million dollars (National Agricultural Statistics Service, 2008). Knowledge of the insects infesting this valuable specialty crop is important to individuals providing crop protection services or conducting research concerning insect management and disease transmission.

Insects known to damage sweetpotato storage roots during the growing season in Mississippi include representatives of several insect orders and families. The most significant pests are within the order Coleoptera. Among these are larvae of several Chrysomelid beetles (Coleoptera: Chrysomelidae), such as spotted cucumber beetle, *Diabrotica undecimpunctata howardi* Barber; banded cucumber beetle, *D. balteata* LeConte (Cuthbert and Reid 1965, Cuthbert 1967); sweetpotato flea beetle, *Chaetocnema confinus* Crotch (Kantack and Floyd 1956, Chalfant et al. 1979); and several flea beetles of the genus *Systema* (Thomas 1927, Schaulk et al. 1991). Other beetles damaging sweetpotatoes in Mississippi include two species of whitefringed beetle, *Naupactus leucoloma* Boheman and *N. peregrinus* (Buchanan) (Coleoptera: Curculionidae) (Zehnder 1997); sugarcane beetle, *Euetheola humilis rugiceps*

(LeConte) (Smith 2006), white grubs of the genus *Phyllophaga* (Coleoptera: Scarabaeidae) (Kantack and Floyd 1956, Cuthbert and Reid 1965); and wireworms primarily of the genera *Conoderus*, *Heteroderes*, and *Melanotus* (Coleoptera: Elateridae) (Griffin and Eden 1953, Fronk and Peterson 1956, Cuthbert 1967, Seal 1990, Chalfant and Seal 1991). The sweetpotato weevil, *Cylas formicarius elegantulus* (Summers), is only rarely found in Mississippi because of a highly effective quarantine imposed by the Mississippi Bureau of Plant Industry. With the exception of white grubs and sugarcane beetle, adults of these insects and numerous other insects including tortoise beetles (Coleoptera: Chrysomelidae) and larvae of several moth species, primarily noctuid moths (Lepidoptera: Noctuidae), feed in the lush foliage of the sweetpotatoes. Many Lepidoptera larvae will also feed on exposed roots.

Viral diseases have long been recognized in sweetpotato and 15 viruses have been characterized (Valverde et al., 2007). Primary virus vectors include aphids (Hemiptera: Aphididae) and whiteflies (Hemiptera: Aleyrodidae). Viral diseases found in Mississippi sweetpotatoes include at least the very common sweetpotato feathery mottle virus (SPFMV), sweetpotato virus G (SPVG), and *Ipomoea* vein mosaic virus (IVMV) (Sabanadzovic, 2008). Sweetpotato chlorotic stunt virus (SPCSV) vectored by whiteflies in combination with the aphid-vectored SPFMV results in sweetpotato virus disease (SPVD), a particularly yield-limiting disease. Sweetpotato chlorotic stunt virus has been reported in North Carolina (Abad et al. 2007) and because the associated SPFMV and vectors are present in Mississippi, it is a potential disease for Mississippi sweetpotatoes. Although thrips (Thysanoptera: Thripidae) have not been proven to be vectors of any viral disease to sweetpotato, several species are vectors of tomato spotted leaf wilt virus to several other crops, and the potential exists for thrips to transmit disease pathogens to sweetpotato. About 30 chrysomelid species have been identified as virus vectors to various plant species, and about two thirds of those are in the subfamily Alticinae, that includes the flea beetles (Hull 2002). Many of these insects occur on Mississippi sweetpotato.

During the last several years, insects have been sampled by a variety of techniques on commercial sweetpotato production fields and research plots within the state of Mississippi. A 5-year (2004-2008) research project entitled the Southern Sweetpotato IPM Project, funded by the USDA Risk Avoidance and Mitigation Program (RAMP), was conducted to more completely document parameters associated with sweetpotato production in Alabama, Louisiana, Mississippi, and North Carolina. Insects were collected during the study with sweep-net, vacuum, sticky-card, light trap, pheromone trap, bait or by hand-collecting samples. This paper reports primarily on the sampling results of this study, but includes species collected at various other times from sweetpotato fields in Mississippi.

Materials and Methods

Although some sampling was conducted beginning in 2002, the majority of the sampling reported here occurred during the years 2004–2007. During each of these years, a strip of sweetpotatoes 8–16 rows wide (2004) or 16–32 rows wide (2005–2007) by 91.5 m long were planted in commercial sweetpotato fields without any insecticidal input. Additional treatments included strips of equivalent size with pre-plant incorporated insecticide alone, insecticide applied to the foliage only, or the grower's protocol that included pre-plant incorporated insecticide plus foliar insecticide. Each strip plot was divided into six subplots 15.25 m long. Insects in the subplots were then sampled by making a 25-sweep sample while walking 12 m with a 38 cm (diameter) sweep-net or by vacuuming 12 m of row with a vacuum sampler. Insects were transferred from the sampling device to plastic bags and taken to the laboratory for identification and counting. After 2004, 7.6 by 12.7 cm yellow sticky cards were added to the sampling protocol for insect pests. Some sampling was accomplished by shaking the vines in 3 m of row and scanning the soil under the vines for insects. In 2004 and 2005, wireworm bait (Jansson and Lecrone, 1989) consisting of about 0.2 L of crimped oats soaked in water were placed from 5 to 15 cm in the ground in each subplot prior to planting (when possible) and again during mid-season. These baits were left in the field for 1 week, and were then dug up with a post-hole digger. The bait and soil immediately surrounding the bait were taken to the laboratory and either sifted or mixed with water to break up the soil and assist in filtering out the wireworms. The number of fields that were studied in 2004, 2005, 2006 and 2007 was 19, 19, 18, and 4, respectively, with a minimum of 12 subplots (sample sites) in each field. The total number of samples taken by sweep-net, sticky card and vacuum during the years 2004–2007 was 1684, 5050, 2375, and 767, respectively.

From 2002 to 2004, Japanese beetle pheromone traps baited with 100% isoleucine methyl ester impregnated rubber tabs were placed near sweetpotato fields in the dominant sweetpotato production areas to attract *Phyllophaga ephilida* (Say), the white grub most likely to be a pest in Mississippi sweetpotatoes. Although this pheromone is most attractive to *P. ephilida*, other species were also found in the traps. The adults collected in pheromone traps are listed, whereas grubs of the genus collected during the study were not identified.

Beneficial insects in general were not collected and counted. Coccinellid beetles (Coleoptera: Coccinellidae) and geocorid bugs (Hemiptera: Geocoridae), however, were common but not easily identified to species in the field. Specimens retained from samples during the summer were later identified and included in the listed species.

Results and Discussion

Damaging Insects. Seventy-two species or genera were identified from insects collected from commercial sweetpotato fields or research plots (Table 1). Of these, 22 are known to damage sweetpotato storage roots, and 43 species may feed on sweetpotato foliage. Thirteen species are recognized as major sweetpotato pests.

Forty potentially damaging Coleoptera species were identified in the study including six elaterid species, two curculionid species, one brentid species, 25 chrysomelid species of which 12 were collected rarely, and six scarabaeid species. The most frequently collected wireworm adult was *Conoderus vespertinus* F. Special note should be made concerning the corn wireworm, *Melanotus communis* (Gyllenhal). Only one specimen of adult corn wireworm (species identification not verified) was collected in thousands of insect samples from fields in Mississippi from 2003–2007. Larvae collected from one field that was abandoned because of severe wireworm infestation were identified as a *Melanotus* species, possibly *M. communis*, indicating the obvious potential of the pest within the state. It is a major pest of sweetpotatoes in North Carolina, but has been rarely reported from Mississippi. With the growing acreage of corn in the state, this pest may become more prominent. The two weevils, *Naupactus leucoloma* and *N. peregrinus* may occur in such high numbers in Mississippi as to damage nearly 100% of potatoes within single fields. The sweetpotato weevil, *Cylas formicarius elegantulus* (Summers), is rarely found in Mississippi since a quarantine by the Mississippi Bureau of Plant Industry protects the sweetpotato growing areas of the state. *Phyllophaga ephilida*, a recognized pest of sweetpotato, was collected in high numbers in pheromone traps. It is assumed that *P. ephilida* is the primary grub pest of sweetpotato in Mississippi, but the actual number of species feeding on sweetpotato roots in Mississippi is still conjectural.

Many insects feed on roots that are exposed by soil erosion or cracking of the soil late in the season. Cutworms and several species of armyworms may be present in high numbers in fields when vines are destroyed in preparation for harvest. In absence of foliage, larvae move into cracks in the soil caused by expanding sweetpotato roots or drying soil and feed on storage roots. In addition to the Lepidoptera, crickets of the genus *Gryllus* (Orthoptera: Gryllidae) were observed in sweetpotato fields in Mississippi and will feed on exposed sweetpotatoes. Other Orthoptera, grasshoppers and katydids, were commonly seen on sweetpotato foliage, but were not observed feeding on exposed storage roots.

The two aphid species identified from sweetpotato in this study, *Aphis gossypii* Glover and *Myzus persicae* (Sulzer) (Hemiptera: Aphididae), are both recognized vectors of viral disease to sweetpotato (Vasquez et al. 2008). Two whiteflies, *Bemisia* sp., possibly *B. tabaci* (Gennadius) or *B. argentifolii* (previously *B. tabaci* biotype B) and *Trialeurodes abutilonea* (Haldeman) (Hemiptera: Aleyrodidae), may be present in sweetpotatoes in Mississippi, but are generally in very low numbers. Whiteflies and aphids are vectors of viral diseases to sweetpotato that include sweetpotato chlorotic stunt virus (SPCSV) and sweetpotato feathery mottle virus (SPFMV). Two of the thrips species, *Frankliniella tritici* (Fitch) and *Frankliniella fusca* (Hinds) (Thysanoptera: Thripidae), collected on sticky cards in sweetpotato fields are known vectors of tomato spotted leaf wilt virus (TSWV) in crops other than sweetpotato. These species have not been shown to be vectors of any viral disease to sweetpotato, but, since TSWV has been isolated from sweetpotato (Valverde et al. 2007), there exists the potential for them to transmit this or other diseases to sweetpotato as well. Nine species of alticine flea beetles were identified from sweetpotatoes in Mississippi, and some of these may be vectors of viral diseases. Spotted cucumber beetle and *Ceratoma trifurcata* (Forster), the bean leaf beetle, have also been identified as

Table 1. Insects observed on sweetpotato or collected in sweep-net, sticky card, vacuum, or pheromone trap samples in Mississippi.

Group	Species	Common name ^a	Abundance
Coleoptera			
Chrysomelidae			
Cucumber beetles	<i>Diabrotica balteata</i> LeConte ^d	Banded cucumber beetle	Fairly common
	<i>Diabrotica undecimpunctata howardi</i> Barber ^d	Spotted cucumber beetle	Common
Flea beetles	<i>Altica litigata</i> Fall ^d	---	Fairly common
	<i>Chaetocnema confinis</i> Crotch ^d	Sweetpotato flea beetle	Common
	<i>Chaetocnema denticulata</i> (Illiger) ^d	Toothed flea beetle	Fairly common
	<i>Disonycha collata</i> (F.) ^d	---	Rare
	<i>Disonycha glabrata</i> (F.) ^d	---	Rare
	<i>Disonycha pennsylvanica</i> (Illiger) ^d	---	Rare
	<i>Epitrix hirtipennis</i> (Melsheimer) ^d	Tobacco flea beetle	Rare
	<i>Kuschelina concinna</i> (F.) ^d	---	Rare
	<i>Lysathia ludoviciana</i> (Fall) ^d	---	Rare
	<i>Nesaecrepida asphaltina</i> (Suffrian) ^d	---	Rare
	<i>Systema elongata</i> (F.) ^d	Elongate flea beetle	Rare
	<i>Systema frontalis</i> (F.) ^d	Red-headed flea beetle	Common
Tortoise beetles	<i>Agroiconota bivittata</i> (Say) ^d	---	Common
	<i>Charidotella sexpunctata bicolor</i> (F.) ^d	Golden tortoise beetle	Common
	<i>Chelymormpha cassidea</i> (F.) ^d	Argus tortoise beetle	Fairly common
	<i>Deloyala guttata</i> (Olivier) ^d	Mottled tortoise beetle	Common
Miscellaneous	<i>Acalymma vittata</i> (F.) ^d	Striped cucumber beetle	Common
	<i>Brachypnoea clypealis</i> (Horn) ^d	---	Rare
	<i>Cerotoma trifurcata</i> Forster ^d	Bean leaf beetle	Common
	<i>Colaspis brunnea</i> (F.) ^d	Grape colaspis	Rare
	<i>Cryptocephalus bispinus</i> Suffrian ^d	---	Rare
	<i>Leptinotarsa decemlineata</i> (Say) ^d	Colorado potato beetle	Rare
	<i>Myochrous denticollis</i> (Say) ^d	Southern corn leaf beetle	Common
Brentidae	<i>Cylas formicarius elegantulus</i> (Summers)	Sweetpotato weevil	Rare
Coccinellidae	<i>Coccinella septempunctata</i> (L.) ^{bd}	Seven spotted lady beetle	Rare
	<i>Coleomegilla maculata lengi</i> Timberlake ^{bd}	---	Common
	<i>Cycloneda munda</i> (Say) ^{bd}	---	Rare
	<i>Diomus terminatus</i> (Say) ^{bd}	---	Common
	<i>Harmonia axyridis</i> (Pallas) ^{bd}	Multicolored Asian lady beetle	Common
	<i>Hippodamia convergens</i> Guerin ^{bd}	Convergent lady beetle	Common
	<i>Psyllobora vigintimaculata</i> (Say) ^{bd}	---	Rare
	<i>Scymnus (Pullus) creperus</i> Mulsant ^{bd}	---	Common
	<i>Scymnus (Pullus) loewii</i> Mulsant ^{bd}	---	Common
Curculionidae	<i>Naupactus leucoloma</i> Boheman ^d	Whitefringed beetle	Common
	<i>Naupactus peregrinus</i> (Buchanan) ^d	Whitefringed beetle	Common
Elateridae	<i>Conoderus vespertinus</i> F. ^d	Tobacco wireworm	Common
	<i>Conoderus bellus</i> (Say) ^d	---	Rare
	<i>Heteroderes falli</i> (Lane) ^d	Southern potato wireworm	Fairly common
	<i>Melanotus communis</i> (Gyllenhal) ^d	Corn wireworm	Rare
	<i>Aeolus species</i> ^d	---	Rare
	<i>Glyphonyx</i> sp. ^d	---	Rare
Meloidae	<i>Epicauta</i> spp. ^d	Blister beetles	Fairly common
Scarabeidae	<i>Eutheola humilis rugiceps</i> (LeConte) ^d	Sugarcane beetle	Common
	<i>Phyllophaga ephilida</i> (Say) ^d	White grub	Common
	<i>Phyllophaga davisii</i> Langston ^d	White grub	Fairly common
	<i>Phyllophaga forbesi</i> Glasgow ^d	White grub	Fairly common
	<i>Phyllophaga gracilis</i> (Burmeister) ^d	White grub	Fairly common
	<i>Phyllophaga bipartita</i> (Horn) ^d	White grub	Fairly common
Hemiptera			
Aleyrodidae	<i>Bemisia</i> sp. probably <i>tabaci</i> (Gennadius) ^c	Sweetpotato whitefly	Fairly common
	<i>Trialeurodes abutilonea</i> (Haldeman) ^c	Bandedwinged whitefly	Fairly common
Anthracoridae	<i>Orius insidiosus</i> ^b	Insidious flower bug	Common
Aphididae	<i>Aphis gossypii</i> Glover ^c	Cotton or melon aphid	Fairly common
	<i>Myzus persicae</i> (Sulzer) ^c	Green peach aphid	Fairly common
Geocoridae	<i>Geocoris punctipes</i> (Say) ^{bd}	---	Common
	<i>Geocoris uliginosus</i> (Say) ^{bd}	---	Common
Miridae	<i>Lygus lineolaris</i> (Palisot de Beauvois)	Tarnished plant bug	Common
Lepidoptera			
Crambidae	<i>Spoladea recurvalis</i> (F.)	Hawaiian beet webworm	Fairly common
Noctuidae	<i>Agrotis subterranea</i> (F.)	Granulate cutworm	Fairly common
	<i>Feltia jaculifera</i> (Guenée)	Dingy cutworm	Fairly common

Table 1. continued
Group

Group	Species	Common name ^a	Abundance
	<i>Psuedoplusia includens</i> (Walker)	Soybean looper	Common
	<i>Spodoptera exigua</i> (Hübner)	Beet armyworm	Common
	<i>Spodoptera frugiperda</i> (J. E. Smith)	Fall armyworm	Common
	<i>Spodoptera ornothogalli</i> (Guenée)	Yellowstriped armyworm	Common
	<i>Trichoplusia ni</i> (Hübner)	Cabbage looper	Common
Sphingidae	<i>Agrius cingulata</i> (F.)	Sweetpotato hornworm	Fairly common
Orthoptera			
Gryllidae	<i>Gryllus</i> spp.	Field crickets	Common
Thysanoptera			
Thripidae	<i>Frankliniella fusca</i> (Hinds) ^{c?}	Tobacco thrips	Common
	<i>Frankliniella tritici</i> (Fitch) ^{c?}	Flower thrips	Fairly common
	<i>Neohydatothrips variabilis</i> (Beach)	Soybean thrips	Fairly common

Genus and species names in **Bold**: Insects with potential to damage harvestable roots.

^a According to Bosik 1997, with exception of redheaded flea beetle, southern corn leaf beetle, and general groupings (white grub, field cricket and bigeyed bug).

^b Beneficial insect.

^c Virus vectors.

^{c?} Potential virus vector.

^d Voucher specimens on deposit at the Mississippi Entomological Museum.

virus vectors in other host plant systems (Wang et al. 1994a, b). It is possible that several of the 25 chrysomelid species found on sweetpotato in this study could be added to the potential vector list. Thus many of the insects found in sweetpotato may be able to diminish yield, quality, or both by physical damage and by disease transmission.

Beneficial Insects. Nine coccinellid species (Coleoptera: Coccinellidae) were identified from insects collected from sweetpotato foliage. These are well known as predators of aphids. In Mississippi, aphids are present in very low numbers in sweetpotato, possibly because they are not well adapted to sweetpotatoes, and perhaps because of continual presence of several species of lady beetles in relatively high numbers in sweetpotato foliage.

Geocoris punctipes (Say) and *G. uliginosus* (Say) (Hemiptera: Geocoridae) were common in insect samples from sweetpotato throughout the growing season. *Orius insidiosus* (Say) (Hemiptera: Anthocoridae) was also commonly present in sweetpotato fields. Several species of nabids (Hemiptera: Nabidae) were also observed in the field, but were not collected and identified.

Many other species of insects were observed in sweetpotato fields. Fire ants were plentiful late in the season, and numerous species of ground beetles (Coleoptera: Carabidae), including tiger beetles, were present under the leaf canopy. These insects in conjunction with many species of spiders serve as a formidable beneficial arthropod group to help suppress Lepidoptera larvae and other insects within and beneath the sweetpotato canopy.

Comments. As listed in Table 1, the abundance of insects in the field (common, fairly common, and rare) serve only as general indicators of frequency of collection or observation. Insects that occur sporadically in high numbers in the field, those that occur at consistently low levels, or those that occur annually for a short period of time during the season may all be considered fairly common. The percentage of sweep-net samples in which 1 or more of the listed insects or insect groups were collected during early, mid- and late season helps to demonstrate this commonality (Table 2). All of these insects are considered common in sweetpotato fields, even though they are represented by vastly different numbers in sweep-net collections.

There is a general lack of knowledge concerning beneficial insects in production sweetpotato fields and their value, and much remains to be determined about the pest status of many insects. The identification of both beneficial and pest insects is essential for the interpretation of predator-prey relationships and for the development of integrated pest management criteria. Further identification of the insect complex in sweetpotatoes is needed to ascertain value or risk of each species and incorporate such knowledge in pest management recommendations. This paper serves as a contribution to the science of integrated pest management by providing a list of insects associated with the sweetpotato crop in Mississippi.

Table 2. Percentage of sweep-net samples in which 1 or more of listed insects or insect groups were collected in early, mid- and late season for years 2004-2007 (Southern Sweetpotato IPM Project).

Group	Species	Early Season ^a	Mid-Season ^b	Late Season ^c
Coleoptera				
Chrysomelidae				
Cucumber beetles	<i>Diabrotica balteata</i> LeConte	0.3	0.9	1.5
	<i>Diabrotica undecimpunctata howardi</i> Barber	4.3	7.4	9.2
Flea beetles	<i>Chaetocnema confinis</i> Crotch	43.7	56.2	51.5
	<i>Chaetocnema denticulata</i> (Illiger)	0.8	0.6	0.7
	<i>Systema elongata</i> (F.)	1.6	1.6	0.9
	<i>Systema frontalis</i> (F.)	9.9	15.1	0.9
Tortoise beetles	<i>Agroiconota bivittata</i> (Say)	1.8	6.8	3.7
	<i>Charidotella sexpunctata bicolor</i> (F.) and <i>Deloyala guttata</i>	3.2	8.3	7.5
	<i>Chelymorpha cassidea</i> (F.)	0.1	0.1	0.4
Curculionidae	<i>Naupactus leucoloma</i> Boheman and <i>N. perigrinus</i> (Buchanan)	1.1	1.5	0.8
Elateridae	<i>Conoderus vespertinus</i> F.	1.7	1.4	0.4
Lepidoptera				
Noctuidae				
	<i>Spodoptera exigua</i> (Hübner)	0.1	0.3	0.7
	<i>Spodoptera frugiperda</i> (J. E. Smith)	0.1	0.2	0.3
	<i>Spodoptera ornothogalli</i> (Guenée)	2.5	1.4	0.3
Beneficials				
Coccinellidae	All species	24.6	34.2	30.4
Geocoridae	<i>Geocoris punctipes</i> (Say) plus <i>G. uliginosus</i> (Say)	3.4	12.3	10.1
Total number of sweep net samples:		1749	3112	1134

Genus and species names in **Bold**: Insects with potential to damage harvestable roots.

^a Early season = 1–4 week after planting (WAP).

^b Mid-season = 5–9 WAP.

^c Late season = 10–13 WAP.

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