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Diversity of arthropods associated with *Mikania* spp. and *Chromolaena odorata* (Asterales: Asteraceae: Eupatorieae) in Florida

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Mikania micrantha Kunth (Asterales: Asteraceae: Eupatorieae) is native to Central and South America, and because of its negative impacts in adventive regions, is considered one of the world's worst invasive species (ISSG 2014). It was discovered for the first time in North America in Oct 2009 near Homestead, Florida (Weaver & Dixon 2010), and has since been found at > 50 sites in the same area. Plant managers have raised concerns about the potential spread of *M. micrantha* into natural areas, particularly the Everglades National Park, located just a few miles west of the current infestation. The genus *Mikania* belongs to the tribe Eupatorieae in the family Asteraceae. In North America, this tribe is represented by a large number of native species, including *Mikania scandens* (L.) Willd., *Mikania cordifolia* (L. f.) Willd., and *Chromolaena odorata* (L.) R.M. King & H. Rob. These species can be found in wet areas as well as in uplands throughout central and south Florida (Wunderlin & Hansen 2008). Upon their arrival to an adventive region, exotic plants encounter biotic factors including herbivorous arthropods as well as plant pathogens which could prevent their establishment and spread (Levine et al. 2004). The diversity and impact of natural enemies is predicted to be greater in regions containing native species closely related to the exotic plant (Darwin 1859; Ricciardi & Mottiar 2006). Therefore, the objective of this study was to assess the diversity of arthropods associated with *Mikania* spp. and *C. odorata*.

To find arthropods on these plants, we surveyed natural infestations located in central and south Florida. Sites with *M. micrantha* were located only in Homestead, while sites with *M. scandens*, *M. cordifolia* and *C. odorata* were located in Homestead and Fort Pierce, Florida. The distance between Fort Pierce and Homestead is approximately 200 km. Because it mostly occurs near nurseries, the *M. micrantha* sites were disturbed locations along fences or hedgerows. Sites with *M. scandens* were along canals in Fort Pierce and Homestead, whereas sites with *M. cordifolia* and *C. odorata* were in uplands in natural areas and along roadsides in Fort Pierce and Homestead. The collection of insects and mites was opportunistic and conducted in daylight hours from Jul 2011 to Jul 2013. We did not examine roots, flowers or seeds. Most of the adult insects and mites were hand collected and placed in killing jars or in alcohol. Immature insects were reared to adults inside cages on their host plants. Insect rearing was conducted in walk-in rearing rooms maintained at 25–26 °C, 60–70% RH and 14:10 h L:D photoperiod. Adult parasitoids emerging from insects were placed in alcohol for later identification. Identification of insects and mites was conducted using morphological methods by experts at several institutions including the Florida Department of Agriculture and Consumer Services (FDACS),

Gainesville Florida; the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C.; the Systematic Entomology Laboratory, Agricultural Research Service, United States Department of Agriculture; Falkultaet Biologie, Universtaet Bielefeld, Germany; and Agriculture-Agri-Food, Canada. Feeding habits of herbivores were classified as polyphagous, oligophagous and monophagous and were obtained from identification reports of experts and literature.

Results of our surveys revealed the presence of 16, 11, 34 and 18 species of herbivorous arthropods on *M. micrantha*, *M. cordifolia*, *M. scandens* and *C. odorata*, respectively (Table 1). The proportions of monophagous herbivores were 0, 22, 9 and 25% for *M. micrantha*, *M. cordifolia*, *M. scandens* and *C. odorata*, respectively. The combined proportions of oligophagous and polyphagous herbivores were 100, 78, 91 and 75% for *M. micrantha*, *M. cordifolia*, *M. scandens* and *C. odorata*, respectively. Twelve herbivores reared from *M. micrantha* were classified as polyphagous and included mites and insects, and represented new host records in the state of Florida. Feeding habits of the herbivores collected from all plants included scrapers (Acarina), leaf chewers (mostly Lepidoptera), leaf miners (Diptera and Lepidoptera), stem borers (Diptera), gall inducers (Diptera) and sap-suckers (Hemiptera). Of the herbivores collected from *M. micrantha*, 35% were shared with at least one of the sampled native plants (Table 1). The most speciose insect group reared from *M. micrantha* was leafminer flies. *Mikania micrantha* hosted several crop pests including *Tetranychus* sp. (Trombidiformes: Tetranychidae Acarina), *Aphis spiraeicola* Patch (Hemiptera: Aphididae), *Amorbia* sp. (Lepidoptera: Tortricidae: Tortricinae), *Phenacoccus parvus* Morrison (Hemiptera: Pseudococcidae), *Nemorimyza maculosa* (Malloch) (Diptera: Agromyzidae) and *Bradybaena similis* (Férussac) (Gastropoda: Helicoidea: Bradybaenidae). Two new species were discovered during this survey; the leafminer *Bucculatrix* n. sp. (Lepidoptera: Bucculatricidae) (Donald R. Davis, personal communication) was found on leaves of *M. scandens* in Fort Pierce during the summer of 2011, and a second leafminer, *Cremastobombycia chromolaenae* Davis, (Lepidoptera: Gracillariidae) was found on leaves of *C. odorata* in Fort Pierce late in the fall of 2011 (Davis et al. 2013). The stem galler *Phestinia costella* (Hampson) is a monophagous species on *C. odorata* (Solis et al. 2008) and a new US record (Dr. Alma Solis, personal communication). We did not find *Melanagromyza eupatoriella* Spencer (Diptera: Agromyzidae) and *Pareuchaetes insulata* (Walker) (Lepidoptera: Erebiidae), which are reportedly common herbivores of *C. odorata* in Florida (Zachariades et al. 2011).

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Table 1. Arthropod herbivores collected from *M. micrantha* (exotic), *M. cordifolia*, *M. scandens* and *C. odorata* in Florida during 2011-2013.

Order: Family	Species	Plant host ²					Reared? ³	Feeding habits ⁴	Host Range ⁵	Reference for host range
		Distrib. ¹	Mi	Cor	Sca	Odo				
Trombidiformes: Tarsonemidae	<i>Polyphagotarsonemus latus</i> (Banks)	HO	+				Yes	Sucking-scrapping	P	Gerson 1992
Trombidiformes: Tenuipalpidae	<i>Brevipalpus californicus</i> (Banks)	HO			+		Yes	Sucking-scrapping	O	Childers et al. 2003
	<i>Brachytdeus formosa</i> Cooreman	HO			+		Yes	Sucking-scrapping	O	Da Silva et al. 2014
	<i>Brachytdeus</i> sp.	HO			+		Yes	Sucking-scrapping	U	
	<i>Tetranychus</i> sp.	HO	+			+	Yes	Sucking-scrapping	P	
Coleoptera: Chrysomelidae	<i>Exema dispar</i> Lacordaire	FP			+		No	leaf chewer	P	Karren 1966
Coleoptera: Bruchidae	<i>Acanthoscelides tenuis</i> Bottimer	FP			+		No	leaf chewer	U	
Coleoptera: Curculionidae	<i>Artipus floridanus</i> Horn	FP			+	+	No	leaf chewer	P	McCoy et al. 1985
	<i>Conotrachelus coronatus</i> LeConte	HO			+		No	leaf chewer	U	
	<i>Lachnopus floridanus</i> Horn	HO			+		No	leaf chewer	P	Carrillo 2007
	<i>Lixus</i> sp.	FP				+	No	leaf chewer	O	
Coleoptera: Scarabaeidae	<i>Myliocerus undecimpustulatus</i> undatus Marshall	FP				+	No	root and leaf chewer	P	O'Brien et al. 2006
	<i>Naupactus</i> sp.	HO	+				No	root and leaf chewer	P	
	<i>Notalamus basalis</i> LeConte	FP			+		No	leaf chewer	U	Fontes et al. 1994
	<i>Sibriopsis</i> sp.	FP			+		No	seed feeder	U	
Coleoptera: Tenebrionidae	<i>Euphoria sepulcralis</i> (Fabricius)	FP				+	No	leaf chewer	P	Woodruff 2006
	<i>Strigoderma pygmaea</i> (Fabricius)	FP				+	No	leaf chewer	P	Bader 1992
	<i>Bothrotes canaliculatus</i> (LeConte)	FP			+		No	leaf chewer	U	
	<i>Calycomyza mikaniae</i> Spencer	HO	+				Yes	leafminer	O	Cock 1981
Diptera: Agramyziidae	<i>Calycomyza eupatoriava</i> Spencer	FP				+	Yes	leafminer	M	Zachariades et al. 2002
	<i>Calycomyza platyptera</i> (Thompson)	FP, HO	+		+		Yes	leafminer	O	Gratton and Welter 2001
	<i>Liriomyza eupatorii</i> Kaltenbach	HO	+		+		Yes	leafminer	O	Spencer and Steyskal 1986
	<i>Liriomyza</i> sp.	FP		+			Yes	leafminer	U	
Diptera: Cecidomyiidae	<i>Melanagromyza</i> sp.	FP		+			Yes	stem borer	U	
	<i>Nemorimyza maculosa</i> (Malloch).	HO	+				Yes	leafminer	P	CABI 1999
	<i>Mycoplasmosis</i> sp.	FP			+		Yes	feeds on rust	M	Gagné 2010
	<i>Neolasioptera perfoliata</i> (Felt)	FP			+		Yes	gall maker	O	Gagné 1989
Diptera: Tephritidae	<i>Xanthaciura chrysur</i> (Thompson)	FP		+			Yes	flower-feeder	O	Prado and Lewinsohn 2004
Hemiptera: Aleyrodidae	<i>Aleurotrachelus trachoides</i> (Back)	HO	+				Yes	sap-sucking	P	Evans 2007
	<i>Aphis coreopsisidis</i> (Thomas)	FP			+		Yes	sap-sucking	O	Susan Halbert personal communication
	<i>Aphis gossypii</i> Glover	HO, FP				+	Yes	sap-sucking	P	Ebert and Cartwright 1997
	<i>Aphis spiraeicola</i> Patch	HO, FP	+	+		+	Yes	sap-sucking	P	Tsai and Wang 2001
Hemiptera: Cercophidae	<i>Uroleucon ambrosiae</i> (Thomas)	HO	+				Yes	sap-sucking	P	Funk and Bernays 2001
	Cercophidae unidentified	FP			+	+	Yes	sap-sucking	U	
	<i>Empoasca solana</i> DeLong	FP		+			No	sap-sucking	P	Moffitt and Reynolds 1972
	<i>Protalebrella brasiliensis</i> (Baker)	HO, FP	+	+			No	sap-sucking	P	Susan Halbert personal communication
Hemiptera: Coccidae	<i>Ceroplastes</i> sp.	HO			+		No	sap-sucking	U	
	<i>Coccus hesperidum</i> (L.)	FP			+		Yes	sap-sucking	P	Ben-Dov 1993

¹FP: Fort Pierce, HO: Homestead; ²Mi: *M. micrantha*, Cor: *M. cordifolia*, Sca: *M. scandens*, Odo: *C. odorata*; ³Reared from the host plant during this study; ⁴Feeding habits of the stage collected; ⁵P: polyphagous, O: oligophagous, M: monophagous, U: unknown.

Table 1. (Continued) Arthropod herbivores collected from *M. micrantha* (exotic), *M. cordifolia*, *M. scandens* and *C. odorata* in Florida during 2011–2013.

Order: Family	Species	Plant host ²				Reared? ³	Feeding habits ⁴	Host Range ⁵	Reference for host range
		Distrib. ¹	Mi	Cor	Sca	Odo			
Hemiptera: Flatidae	<i>Cyrtus</i> sp.	FP				+	sap-sucking	U	
	<i>Melormenis basalis</i> (Walker)	HO	+				sap-sucking	P	Wilson et al. 1994
Hemiptera: Lygaeidae	<i>Xyonysius californicus</i> (Stål)	FP			+		sap-sucking	P	Palmer and Pullen 2001
	<i>Xyonysius basalis</i> (Dallas)	FP			+		sap-sucking	U	
Hemiptera: Margarodidae	<i>Crypticeria genistae</i> (Hempel)	HO			+		sap-sucking	P	Hodges et al. 2008
Hemiptera: Miridae	<i>Reuterococcus ornatus</i> Reuter	HO	+				sap-sucking	O	Snodgrass et al. 1984
	<i>Rhinachloa basalis</i> (Reuter)	FP		+			sap-sucking	P	Susan Halbert personal communication
Hemiptera: Orthoptidae	<i>Praelongorthezia praelonga</i> (Douglas)	HO			+		sap-sucking	P	Kondo et al. 2013
Hemiptera: Pseudococcidae	<i>Phenacoccus</i> sp.	FP			+		sap-sucking	U	
	<i>Phenacoccus multicerii</i> Granara de Willink	FP		+			sap-sucking	P	Stocks 2013
	<i>Phenacoccus parvus</i> Morrison	HO, FP	+	+			sap-sucking	P	Marohasy 1994
	<i>Pseudococcus jackbeardsleyi</i> Gimpel & Miller	HO, FP				+	sap-sucking	P	Mani et al. 2013
	<i>Corimelaena lateralis</i> (Fabricius)	FP			+		sap-sucking	P	McPherson and Mohlenbrock 1976
Lepidoptera: Gracillariidae	<i>Leucospilapteryx venustella</i> (Clemens)	HO, FP			+		leafminer	P	Diaz et al. 2014
Lepidoptera: Bucculatricidae	<i>Bucculatrix</i> n.sp.	FP			+		leafminer	M	R. Diaz unpublished data
Lepidoptera: Arctiidae	<i>Cosmosoma myrodora</i> Dyar	FP		+			leaf chewer	M	Moscoso et al. 2013
	<i>Estigmene acrea</i> (Drury)	FP			+		leaf chewer	P	Capinera 2005
Lepidoptera: Elachistidae	<i>Elachista</i> sp.	FP			+		leaf chewer	U	
Lepidoptera: Geometridae	<i>Synchlora frondaria</i> Guenee	HO, FP			+		leaf chewer	P	Canfield et al. 2009
Lepidoptera: Gracillariidae	<i>Cremastobombycia chromolanae</i> Davis	FP				+	leaf chewer	M	Davis et al. 2013
Lepidoptera: Noctuidae	<i>Condica cupentia</i> (Cramer)	FP	+				leaf chewer	O	Torres 1992
Lepidoptera: Pterophoridae	<i>Adaina primulae</i> Meyrick	FP				+	leaf chewer	M	Matthews and Maharajh 2009
Lepidoptera: Pyralidae	<i>Glaphyria basiflavialis</i> Barnes & McDunnough	HO	+				leaf chewer	U	
	<i>Herpetogramma bipunctalis</i> (Fabricius)	FP			+		leaf chewer	P	Ruberson et al. 1994
Lepidoptera: Tineidae	<i>Phestinia costella</i> (Hampson)	FP				+	stem galler	M	Solis et al. 2008
	<i>Omiodes indicata</i> (Fabricius)	HO			+		leaf chewer	P	Soe 2011
	<i>Coleophora</i> sp.	HO			+		leaf chewer	U	
	<i>Amorbia concaviana</i> (Zeller)	HO	+				leaf chewer	P	Hayden 2012
Lepidoptera: Tortricidae	<i>Platynota rostrana</i> (Walker)	FP				+	leaf chewer	P	Fontes et al. 1994
	<i>Platynota stultana</i> Walsingham	FP			+	+	leaf chewer	P	Powell 1983
Gastropoda: Bradybaenidae	<i>Bradybaena similis</i> (Férussac)	HO	+				leaf chewer	P	Capinera and White 2011

¹FP: Fort Pierce, HO: Homestead; ²Mi: *M. micrantha*, Cor: *M. cordifolia*, Sca: *M. scandens*, Odo: *C. odorata*; ³Reared from the host plant during this study; ⁴Feeding habits of the stage collected; ⁵P: polyphagous, O: oligophagous, M: monophagous, U: unknown.

Table 2. Predators and parasitoid collected from *M. micrantha*, *M. cordifolia*, *M. scandens* and *C. odorata* in Florida during 2011-2013.

Order: Family	Species	Distrib. ¹	Plant host ²				Reared? ³	Host ⁴	Feeding habits	Reference
			Mi	Cor	Sca	Odo				
Trombidiformes: Anystidae	<i>Anystis</i> sp.	FP	+				no	U	Predator	Cal Welbourn ⁵
Trombidiformes: Phytoseiidae	<i>Typhlodromalus peregrinus</i> (Muma)	FP		+			no	U	Predator	Cal Welbourn ⁵
	<i>Galendromus</i> sp.	FP			+		no	U	Predator	Cal Welbourn ⁵
Coleoptera: Coccinellidae	<i>Diomus roseicollis</i> (Mulsant)	FP			+		no	U	Predator	
Coleoptera: Coccinellidae	<i>Cycloneda sanguinea</i> (L.)	FP			+		no	U	Predator	Cardoso and Lázzar 2003
Diplopoda: Polyxenidae	<i>Polyxenus fasciculatus</i> (Say)	HO	+				no	U	Scavenger	G. B. Edwards ⁵
Diptera: Cecidomyiidae	<i>Mycodiplosis coniothra</i> (Winnertz)	FP			+		no	U	Rust feeder	R. Gagné ⁵
Diptera: Tachinidae	<i>Hyphantrophaga sellersi</i> (Sabrosky)	FP		+			yes	<i>C. myrodora</i>	Parasitoid	N. E. Woodley ⁵

¹FP: Fort Pierce, HO: Homestead.
²Mi: *M. micrantha*, Cor: *M. cordifolia*, Sca: *M. scandens*, Odo: *C. odorata*.
³Reared from the insect host during this study.
⁴U: unknown.
⁵References were personal communications.

We identified 4 predator species and 1 parasitoid species associated with insect herbivores on these plants (Table 2). The parasitoid *Hyphantrophaga sellersi* (Sabrosky) (Diptera: Tachinidae) was reared from the pupae of the specialist herbivore *Cosmosoma myrodora* Dyar (Lepidoptera: Erebiidae) and represented a new host record. Because of the recent arrival and the limited distribution of *M. micrantha*, further studies are needed to assess whether local specialist insect herbivores will utilize this exotic weed in Florida. This study demonstrated that *M. micrantha* not only lacks specialist herbivores but also is a host of pests of agricultural and ornamental crops. Funding for this study was provided in part by the Animal Plant Health Inspection Service, United States Department of Agriculture.

Summary

Field surveys revealed that in south Florida the recently established *Mikania micrantha* Kunth (Asterales: Asteraceae: Eupatorieae) had a lower diversity of monophagous insect herbivores compared to the native *Mikania* spp. or *Chromolaena odorata* (L.) R. M. King & H. Rob. (Asterales: Asteraceae: Eupatorieae). In addition, *Mikania micrantha* served as a host for pests of agricultural and ornamental crops in Florida.

Key Words: *Chromolaena odorata*, herbivore diversity, *Mikania cordifolia*, *Mikania scandens*

Sumario

Muestreos de campo en el sur de Florida demostraron que la recientemente establecida *Mikania micrantha* Kunth (Asterales: Asteraceae: Eupatorieae) tenía una baja diversidad de insectos herbívoros monófagos comparado con las especies nativas *Mikania* spp. o *Chromolaena odorata* (L.) R.M. King & H. Rob (Asterales: Asteraceae: Eupatorieae). Adicionalmente, *Mikania micrantha* sirvió como hospedero de plagas de cultivos agrícolas y ornamentales en Florida.

Palabras Clave: *Chromolaena odorata*, diversidad de herbívoros, *Mikania cordifolia*, *Mikania scandens*

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