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FIRST REPORT OF FIELD POPULATIONS OF TWO POTENTIAL APHID PESTS OF THE BIOENERGY CROP *MISCANTHUS* × *GIGANTEUS*

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Sipha flava (Forbes) (yellow sugarcane aphid) and *Rhopalosiphum maidis* (Fitch) (corn leaf aphid) (Hemiptera: Homoptera: Aphididae) are common aphids occurring throughout North America on many host plants, most of which are grasses (Blackman & Eastop 2006). Both aphids are pests of several important food crops, e.g., *Sorghum bicolor* (L.) Moench (sorghum), *Saccharum officinarum* L. (sugarcane), *Triticum* spp. (wheat), and *Zea mays* L. (corn) (Blackman & Eastop 2000). Additionally, both aphids are vectors of potyviruses and *R. maidis* is a vector of luteoviruses in these crops. Until now, to our knowledge, no natural infestations of these aphids have been reported on the grass genus *Miscanthus*.

Miscanthus spp. is a common grass throughout the United States, with ornamental varieties of *M. sinensis* Andersson being the most frequently cultivated species. However, *M.* × *giganteus* Greef and Deuter ex Hodkinson and Renvoize (Liliopsida: Poaceae: Andropogonaeae: Saccharinae) is being evaluated in the United States as a cellulosic feedstock crop (Heaton et al. 2008) primarily to meet production targets for advanced biofuels (e.g., cellulosic ethanol; Energy Independence and Security Act of 2007, 42 U.S.C. § 17001). *Miscanthus* × *giganteus* is a perennial, sterile hybrid (possibly between *M. sinensis* and *M. sacchiflorus* (Maxim.) Hack.) and may exist in nature within a sympatric zone of these 2 species in southeastern Asia (Clifton-Brown et al. 2008).

More than 1,500 insect species reportedly feed on *Saccharum officinarum* (sugarcane) (Long & Hensley 1972), a sister genus of *M.* × *giganteus* (Hodkinson et al. 2002); however, very few insects have been reported to feed on *M.* × *giganteus* (Prasifka et al. 2009). The lack of reported insect herbivory on *M.* × *giganteus* may be related to few extensive survey efforts. However, in a 3-year intensive survey of invertebrates of *M.* × *giganteus* in the United Kindom, Semere & Slater (2007) found "no major pests." A similar 2-year survey in Germany noted 1 arthropod pest, *Tetranychus urticae* Koch (twospottted spider mite), a polyphagous, widespread species that causes damage during dry and hot weather (Gottwald & Adam 1998). The only documentation of an aphid feeding on *M.* × *giganteus* is from a laboratory study of aphid transmission of *Barley yellow dwarf virus* (BYDV) (Huggett et al. 1999); however, they suggest that the genus *Miscanthus* is "nutritionally insufficient" for aphids.

Visual observations and samples were taken from managed *M.* × *giganteus* plots from locations in Illinois, Indiana, Kentucky, and Nebraska in 2008. Samples were collected by hand or by vacuum sampler, (Burd & Porter 2009), and transported to the laboratory for species confirmation.

Sipha flava was collected from 7 locations from 4 states in 2008 (Table 1) and was found on the lower leaves of both young and old plants, from 1- to 21-year old plantings (Fig. 1A). Some populations appeared to be large enough to cause leaf death (Fig. 1B). Generally, leaves infested with *S. flava* were yellow to reddish in color; similar symptoms have been noted in sugarcane (Nuessly 2005) and sorghum (Costa-Arbulú et al. 2001). Ants, *Crematogaster cerasi* (Fitch), were observed tending *S. flava* on 14 Jul 2008 in Champaign, IL, and similar tending activity was observed elsewhere throughout Illinois.

Rhopalosiphum maidis, collected from 4 locations from 4 states (Table 1), was found only within the whorls of young *M.* × *giganteus* in first-year plantings (Fig. 1C, white arrow). In Champaign, IL, *R.* maidis populations occasionally co-infested *M.* × *giganteus* tillers with other recently-identified *M.* × *giganteus* herbivores, e.g., *Spodoptera frugiperda* (J. E. Smith), (Prasifka et al. 2009) (Fig. 1C, black arrow). No conspicuous symptoms were associated with these infestations; however, very young tillers (4-6 expanded leaves) showed some yellowing of uppermost leaves.

Multistate agronomic trials of *M.* × *giganteus* (as well as other bioenergy feedstock grasses) are underway in the United States with a renewed interest in both economically and environmentally sustainable energy production. Crops attacked by *S. flava* and *R. maidis* contributed to more than $6.4 billion of the 2007 U.S. sugar and grain production value (about 4% of the 2007 total U.S. crop production value) (USDA 2009).

The broader purpose of this survey was to sample for common insect herbivores from known field establishments of *M.* × *giganteus* in North America. Twenty-one aphids are known to use *Miscanthus* (mostly *M. sinensis*) as a host; therefore, there is potential for aphid damage on *M.* × *giganteus*. This damage potential is especially

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TABLE 1. LOCATION, COLLECTION DATE, CROP STAND SIZE, AND CROP AGE FOR *SIPHA FLAVA* AND *RHOPALOSIPHUM MAIDIS* COLLECTED IN 2008 FROM *MISCANTHUS* × *GIGANTEUS*.

Location	Coordinate (latitude/longitude)	Altitude (m)	Date	Species collected		Stand	
				S. flava	*R. maidis*	size (ha)	age (years)
Mead, NE	N41°10.42' W96°27.92'	360	26-Aug	X	X	0.1	<1
Lexington, KY	N38°07.77' W84°30.15'	275	9-Sep	X	X	0.1	<1
West Lafayette, IN	N40°26.52' W86°55.85'	192	9-Sep	X	X	0.1	<1
Champaign, IL	N40°05.38' W88°13.02'	757	20-Aug	X	X	2.1	2
Fairfield, IL	N38°22.86' W88°23.40'	136	9-Jul	X	—	<0.1	6
Brownstown, IL	N38°57.05' W88°57.56'	182	30-Jul	X	—	<0.1	6
Champaign, IL	N40°06.39' W88°12.25'	742	14-Jul	X	—	<0.1	21

Fig. 1. (A) A small *Sipha flava* colony on the underside of a *Miscanthus* × *giganteus* leaf with associated red stippling and yellowing symptoms of the leaf, Brownstown, IL. (B) Leaf death indicative of a large *Sipha flava* infestation, Mead, NE. (C) *Rhopalosiphum maidis* colony (white arrow) and a larval *Spodoptera frugiperda* (black arrow) co-infesting the terminal whorl of a *Miscanthus* × *gigantues* tiller, Champaign, IL.

concerning because most plant viruses are transmitted by aphids (Hull 2002) and *R. maidis* can transmit the RPV strain of BYDV to *M.* × *giganteus* (Huggett et al. 1999). However, expectations for sampling potential pests of *M.* × *giganteus* were reduced because of repeated references indicating that none should be found (e.g., Semere & Slater 2007; Atkinson 2009).

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Captures of alate *S. flava* occur about 14 d earlier in the growing season than captures of alate *R. maidis* (David Voegtlin, unpublished data); however, infestations of *S. flava* are likely to occur even earlier, relative to *R. maidis*, because *S. flava* overwinter in northern latitudes. Such infestations of *S. flava* in *M.* × *giganteus* appear to have the potential to damage young plants, similar to infestations of *S. flava* in other crops (Long & Hensley 1972; Starks & Mirkes 1979; Breen & Teetes 1990). Indeed all of the surveyed plots, including young, small stands (Table 1), were infested with *S. flava*. Therefore, since aphids can locate these small plots of *M.* × *giganteus*, they inevitably will find larger, commercial-scale fields as well. Broadly speaking, this may result in a need for insect management decisions for this bioenergy feedstock and related crops; potentially resulting in a reevaluation of the input costs for economical bioenergy-crop production.

Summary

Miscanthus × *giganteus* Greef and Deuter ex Hodkinson and Renvoize is being evaluated as a cellulosic feedstock for energy production in the United States. This is the first field report of *Sipha flava* (Forbes) and *Rhopalosiphum maidis* (Fitch) (Hemiptera: Homoptera: Aphididae) on *M.* × *giganteus* and the first report of these aphids on *Miscanthus* in the Western Hemisphere. A qualitative survey of managed *M.* × *giganteus* stands revealed *S. flava* or *R. maidis* populations at 7 sample locations in 4 states. The large populations of *S. flava* observed on young stands of *M.* × *giganteus* suggests their potential for economic importance.

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