NOTE

Epizootics of the Entomopathogenic Fungus *Lecanicillium lecani* (Hypocreales: Clavicipitaceae) in Sugarcane Aphid (Hemiptera: Aphididae) Populations Infesting Grain Sorghum in Georgia and Texas[1]

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The sugarcane aphid, *Melanaphis sacchari* (Zehntner) (Hemiptera: Aphididae), occurs worldwide on a variety of grass species (Poaeceae), sugarcane (*Saccharum officinarum* L.), and several species of *Sorghum* (Singh et al. 2004, Crop Prot. 23: 739–755). The sugarcane aphid was first reported in the United States on sugarcane in Florida (Mead 1978, Coop. Plant Pest Rep. 3: 4785) and later in Louisiana (White et al. 2001, Fla. Entomol. 84: 435–436). While it was reported on sorghum in Florida (Denmark 1988, Florida Dept. Agric. Cons. Serv. Div. Plt. Indust. Entomol. Circ. 302), it had not been recognized as an economic pest of grain sorghum, *Sorghum bicolor* (L.) Moench, until 2013 when Villanueva et al. (2014, Texas Agrilife Ext. Ento-035, College Station, TX) reported yield losses due to sugarcane aphid infestations along the Texas Gulf Coast and Louisiana. The pest rapidly spread into 15 other U.S. states and all sorghum production regions in Mexico by the fall of 2015 (Bowling et al. 2016, J. Integr. Pest Manag. 7: 12).

Yield losses in sorghum caused by sugarcane aphid are attributed to extraction of plant nutrients and sap when infestations of the aphid feed on the ventral surface of the leaves and along the stalk (Bowling et al. 2016). Losses are greater when large infestations are present during preflowering grain development. To date, there is no evidence of sugarcane aphid transmitting plant pathogens. Sooty mold growth on the honeydew produced by the aphids also reduces photosynthetic activity in the leaves and can reduce harvest efficiency (Singh et al. 2004).

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When warranted by market conditions and infestation levels, two insecticides are currently available for use by growers to manage sugarcane aphid infestations on sorghum (Bowling et al. 2016). Results of initial testing of sorghum lines and hybrids for genetic resistance to the sugarcane aphid are promising and could be a viable management tactic (Armstrong et al. 2015, J. Econ. Entomol. 108: 576–582). The presence of immature and adult stages of a variety of generalist aphid predators on sugarcane aphid–infested sorghum indicates that these predators are successfully using the aphids as prey. Aphelinid and braconid parasitoid wasps also have been detected and reared from aphid mummies. However, these natural enemies have not been recognized as significant natural mortality factors for the aphid pest (Bowling et al. 2016).

No naturally occurring entomopathogens had been reported from sugarcane aphids infesting sorghum in the United States until the observations reported herein. In February 2015, a fungus was observed on overwintering sugarcane aphids in an abandoned sorghum field at Odem, TX (San Particio Co.; N 28°0′11.43″ ; W 97°32′12.18″). In September 2016, an epizootic of the same fungus was identified as the cause of an observed "crash" in the population of sugarcane aphids on sorghum in Beasley, TX (Fort Bend Co., N 29 49′ 11.05″ ; W 95 99′ 01.70″). Fungal epizootics were subsequently observed in sugarcane aphid populations in sorghum plantings at three locations in Georgia in September 2017: the University of Georgia (UGA) Bledsoe Research Farm (Williamson, Pike Co., N 33 17′ 73″ ; W 84 49′ 84″), the UGA Southwest Research and Education Center (Plains, Sumter Co., N 32 03′ 61″ ; W 84 36′ 92″), and the UGA Lang Research Farm (Tifton, Tift Co., N 31 52′ 02″ ; W 83 55′ 06″).

Examination of aphid cadavers on the sorghum leaves collected from the three Georgia locations showed that aphid cadavers were often anchored to the leaf substrate by the fungal mycelia emerging from the cadaver. As is frequently symptomatic of fungal infections in insects and other arthropods, the cadavers were hardened but appeared in pristine state, sometimes with the proboscis inserted into the plant tissue. The sporulating fungus on the cadavers was white (void of hue or grayness) in coloration with globular collections of spores on the cadaver surface (Fig. 1). Microscopic examination of the spores revealed them to be short and ellipsoidal in shape, and all were homogenous in size and shape. Using an ocular micrometer, the mean ($\pm$SE) measurements of 100 spores from the locations in Texas and Georgia were 2.46 ± 0.12 μm long $\times$ 1.0 ± 0.01 μm wide. The fungus was identified as *Lecanicillium lecanii* (Zimmerman) Zare & Gams (Hypocreales: Clavicipitaceae) using the key of Humber (1997, Fungi: Identification, Pp. 153–185 *in* Lacey, L. [ed.], Manual of Techniques in Insect Pathology, Academic Press, San Diego, CA) and the descriptions based on the taxonomic revision of *Verticillium* by Zare and Gams (2001, Nova Hedwigia 73[1–2]: 1–59).

Lecanicillium lecanii, formerly known as *Verticillium lecanii* (Zimmerman) Viegas, is now phylogenetically considered to be the type species of a complex including *L. lecanii*, *Lecanicillium muscarium* (Petch), and *Lecanicillium longisporum* (Petch) (Zare and Gams 2001). Research with *V. lecanii* prior to the taxonomic revision found that naturally occurring infections of insects via airborne spores are not likely and that epizootics of the fungus probably originate from fungal spores residing in the crop soils that are splash-dispersed onto the crop foliage (Hall 1981, Fungi: *Verticillium lecanii*, Pp. 483–498 *in* Burges, H.D. [ed.], Microbial Control of Pests

Fig. 1. Sugarcane aphid cadaver covered with sporulating *Lecanicillium lecanii.* (Image provided by Margarita Martinez.)

and Plant Diseases 1970–1980, Academic Press, London). Previous research with *V. lecanii* also shows that successful infection and epizootic initiation are highly dependent upon temperature and humidity. Hall (1981) reported that the optimal temperature range for *V. lecanii* is 18–31°C, depending on the source of the fungal isolate, and that *V. lecanii* spores require high levels of humidity (near saturation) in the microhabitat for successful germination.

The observed epizootics of *L. lecanii* in sugarcane aphids infesting sorghum in Texas and Georgia reported herein followed periods of precipitation and accompanied temperatures within the optimal temperature range for the fungus. The crop canopy also likely contributed in retaining high levels of humidity under the canopy and on the ventral surfaces of leaves where sugarcane aphids were feeding. The future occurrence of epizootics of this fungus in sorghum cropping systems will depend upon the proper combination of abiotic and biotic conditions (i.e., temperature, humidity, precipitation, aphid population density, etc.). The impact that any epizootic may have on crop protection will depend upon aphid mortality levels and the timing of the event in relation to critical growth stages of the crop.

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