The Brazilian Peppertree Thrips Pseudophilothrips ichini (Thysanoptera: Phlaeothripidae) as a Biological Control Agent: A Reappraisal of the Timeline of Events and Attribution of Credit

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Source: Florida Entomologist, 99(4) : 799-800

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.099.0440

The Brazilian peppertree thrips *Pseudophilothrips ichini* (Thysanoptera: Phlaeothripidae) as a biological control agent: a reappraisal of the timeline of events and attribution of credit

James P. Cuda

As a scientist who has been involved in research on classical biological control of Brazilian peppertree, *Schinus terebinthifolia* Raddi (Sapindales: Anacardiaceae) (Zona 2015), in Florida for almost 20 yr, I am compelled to respond to an article published in the Mar 2016 issue of *Florida Entomologist* by Wheeler et al. (2016a). The authors described the laboratory biology of *Pseudophilothrips ichini* (Hood) (Thysanoptera: Phlaeothripidae), a South American thrips species that is being considered for release in Florida for biological control of Brazilian peppertree. A petition for field release of *P. ichini* was initially submitted to the Technical Advisory Group for Biological Control Agents for Weeds (TAG) in 2002, and the TAG recommended release from quarantine in 2007 (TAG No. 06-06; Cuda et al. 2008). However, the recommendation was subsequently withdrawn because of a taxonomic concern about a possible cryptic species problem (TAG No. 09-07), described below.

In the article by Wheeler et al. (2016a), the authors neglected the important contributions of Bennett et al. (1990), Habeck et al. (1994), Medal and Habeck (1996), and Cuda et al. (2004) in the history of biological control of Brazilian peppertree in Florida. Involvement by the above researchers in the Brazilian peppertree biocontrol program may be in fact documented in Wheeler et al. (2016b, in press), but this reference was not accessible for review. Bennett et al. (1990), Habeck et al. (1994), Medal and Habeck (1996), and Cuda et al. (2004) addressed *P. ichini* as a potential classical biological control agent in Florida well before Wheeler et al. (2016a), and I cite them specifically in the interest of clarity and historical accuracy.

Regarding the cryptic species issue, Wheeler et al (2016a) further asserted that previous authors applied the incorrect name to the species under investigation. According to Mound et al. (2010), larvae of *P. ichini* are orange in color and those of *Pseudophilothrips gandolfoi* Mound, Wheeler, & Williams are red. Review of an English translation of the thesis by Garcia (1977), originally published in Portuguese, makes it clear that Garcia was aware that the name *P. ichini* possibly referred to 2 species that could be distinguished by larval color. In the section titled "Polymorphism," Garcia stated that "in the immature stages of *L*.[*P.*] *ichini*, the existence of two morphoses is verified, which are differentiated by color (Fig. 13). One of them is represented by the orange color and the other one by the color red." Garcia further stated, "One [. . .] hypothesis to explain the existence of populations formed by only one type of morphous [sic] would be to consider each one of the [color] forms as a different species." From these statements, it is clear that Garcia (1977) correctly applied the name *P. ichini* to some of the specimens he studied. The distribution map of *P. ichini* published by Wheeler et al. (2016a) confirms that both thrips species are sympatric in the state of Paraná, Brazil, where Garcia (1977) conducted his research.

Furthermore, the existence of 2 taxa was recognized by Cuda et al. (2009), but Wheeler et al. (2016a, page 7) asserted that the name had been misapplied by previous authors, writing:

"Previously published literature incorrectly applied the name *P. ichini* to a different species, *Pseudophilothrips gandolfoi* Mound, Wheeler, & Williams (Garcia 1977; Hight et al. 2002; Cuda et al. 2008, 2009)."

To the contrary, Cuda et al. (2009) clearly stated:

"We also found that populations of *P. ichini* **s.l.** [*sensu lato*, emphasis added] from two geographic locations in Brazil differed in their ability to attack Florida genotypes of *S. terebinthifolius* (Manrique et al. 2008). Our laboratory colony was established initially with thrips collected near Curitiba, Paraná state, Brazil. However, contrary to what was reported in Manrique et al. (2008), the colony was later supplemented with thrips obtained from several source populations during the course of this study [. . .] In retrospect, we observed higher survival and reproduction of the thrips on Florida *S. terebinthifolius* plants in the laboratory in 2003 (Cuda et al. 2008), which coincided with the addition of thrips obtained from these other geographic locations [Rio de Janeiro and Minas Gerais states]. Thrips populations from Rio de Janeiro, Minas Gerais, and Paraná states appear to be distinct taxa. The population from Minas Gerais in particular was found to be better adapted to the Florida genotypes yet exhibited the same preference for *S. terebinthifolius* and *S. molle* (Manrique et al. 2008). These findings emphasize the importance of matching the appropriate taxa of *P. ichini* **s.l.** [*sensu lato*, emphasis added] with Florida genotypes of *S. terebinthifolius* to increase the likelihood of establishment and successful biological control of this invasive weed."

Pseudophilothrips ichini s.l. was used in the title and elsewhere in Cuda et al. (2009) because *P. gandolfoi* was not described until the following year (Mound et al. 2010). However, conclusive evidence that the name *P. ichini* was correctly applied in the papers by Cuda et al. (2008, 2009) is based on laboratory rearing data. Cuda et al. (2008) clearly showed that the thrips laboratory colony after Jun 2003 was dominated by *P. ichini*, not *P. gandolfoi*. According to Manrique et al. (2008), survival rate (<1%) and adult longevity (<9 d) of *Pseudophilothrips* sp. near *ichini* on Florida Brazilian peppertree haplotypes and their hybrids was extraordinarily low. Consequently, because *Pseudophilothrips* sp.

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near *ichini* is poorly adapted to the hosts used in that study (Florida Brazilian peppertrees; Peruvian peppertree, *Schinus molle* L.), it would have been impossible to rear in the laboratory over 1,100 adults per month for more than 2 yr. As more than 100 adult thrips per day were produced in Oct 2003 (Cuda et al. 2008), the species concerned must have been *P. ichini* [*sensu stricto*], not the yet-to-be described cyrptic species *P. gandolfoi*.

Wheeler et al. (2016a) further stated that results of quarantine host specificity tests for *P. ichini* and its possible role in the biological control of Brazilian peppertree would be published in a subsequent paper. In retrospect, larval survival and adult development data from the host specificity tests reported by Cuda et al. (2009) suggest that both species of thrips were present and contributed data. Although further host specificity testing of *P. ichini* may be warranted, both thrips are *Schinus* specialists and each appears to have become highly adapted to specific genotypes of Brazilian peppertree (Cuda et al. 2012). However, because *P. ichini* has higher fitness on the Florida Brazilian peppertree genotypes than does *P. gandolfoi* (Manrique et al. 2008), a strong case can be made for its release in Florida as a biological control agent of Brazilian peppertree. Furthermore, recent laboratory cold-tolerance and (host health?) impact studies indicate that *P. ichini* is already adapted both to Florida's climate and to other geographic areas in the continental USA where Brazilian peppertree is invasive, and therefore is likely to reduce the weed's growth and reproduction post-release (Manrique et al. 2014).

Summary

The thrips *Pseudophilothrips ichini* (Hood) (Thysanoptera: Phlaeothripidae), which is native to Brazil, is a candidate for classical biological control of the invasive Brazilian peppertree, *Schinus terebinthifolia* Raddi (Sapindales: Anacardiaceae), in the USA. This paper corrects errors of omission about the history of the Brazilian peppertree biological control program in Florida and several misstatements about the identity of the thrips in previously published literature.

Key Words: *Schinus terebinthifolia*; natural enemy; classical biocontrol; historical record; species identity

Sumario

Los trips *Pseudophilothrips ichini* (Hood) (Thysanoptera: Phlaeothripidae), que es nativo de Brasil, es un candidato para el control biológico clásico del pimentero brasileño invasivo, *Schinus terebinthifolia* Raddi (Sapindales: Anacardiaceae), en los EE.UU. Este documento corrige errores de omisión sobre la historia del programa de control biológico del pimentero brasileño en la Florida y varios errores en la literatura publicada previamente sobre la identidad de los trips.

Palabras Clave: *Schinus terebinthifolia*; enemigo natural; control biológico clásico; récord histórico; identidad de especies

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