Special issue on novel management tactics for the Western flower thrips

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Abstract

The Western flower thrips (WFT), *Frankliniella occidentalis*, is a major threat to a wide range of agricultural crops and rapidly spreads throughout the world. Its international importance as a pest has led to tremendous growth in our knowledge of its biology, ecology, and novel approaches for its management. Unfortunately, the literature on WFT is widely dispersed and many researchers, extension specialists, and IPM practitioners are only now becoming aware of WFT, which has meant that management programs are still reliant on intense insecticide use, especially in recently invaded regions. Due to the current high demand in effective and sustainable control tactics for this pest, Journal of Pest Science dedicates a special issue to WFT. This special issue provides a consolidated review of WFT biology and ecology and helps to highlight alternative and novel management techniques to effectively controlling this pest in the future.

Keywords Western flower thrips · Biology and ecology · Novel management · IPM

Western flower thrips (WFT), *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae), is a highly polyphagous herbivore and economically important pest of many crops globally (Kirk and Terry 2003; Morse and Hoddle 2006; Reitz 2009). Economic damage results directly through feeding and oviposition, and indirectly through transmission of plant pathogenic viruses in the genus *Orthotospovirus* (Tospoviridae) (Reitz et al. 2020). The sum of its biological characteristics, including its polyphagy, small size, short developmental times, high reproductive rate, cryptic life style habits, and competitive ability, have combined to promote this species to its current dominant global pest status (Gao and Reitz 2017; Reitz et al. 2020).

Frankliniella occidentalis first arose as one of the world's most important invasive pests of horticultural and

agronomic crops during the 1970s–1980s (Reitz 2009). The recent worldwide growth in the commercial movement of plant materials has allowed for a rapid expansion of its range throughout North America, South America, Australia, Oceania, Africa, Europe, and Asia (Gao et al. 2012). Even in areas where WFT has long been established, it is becoming more prevalent and damaging (Broughton and Harrison 2012).

The economic importance of WFT has generated a tremendous amount of research on its biology, ecology, and management (Reitz 2009; Reitz et al. 2020). As a result, a variety of management tactics for WFT have been explored, the most common of which has been the use of chemical insecticides (Gao et al. 2012). Unfortunately, reliance on insecticides has proven not to be an effective or sustainable approach owing to WFT propensity for evolving resistance to insecticides and their cryptic nature that reduces their exposure to insecticide sprays (Fig. 1). Therefore, effective management programs are ones that integrate diverse tactics, and the tactics themselves often affect WFT populations in multiple, interacting ways. While these interactions confound a simple categorization of approaches, they are critical to successful management.

As guest editors, we are pleased to present 12 papers regarding the biology, ecology, and management of WFT in this special issue of the Journal of Pest Science. These

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Fig. 1 *F. occidentalis* adult feeding on cowpea. Photograph credit: Yulin Gao

articles contribute to our current understanding of the biology of this species, provide guidance for countries to enhance their management of WFT, and offer insight into how climate change may affect our interactions with WFT.

The critical topic of how WFT interact with host plants is examined in three articles. Sampson et al. (2020) reveal how WFT utilize crop and weed hosts to overwinter successfully. Avellaneda et al. (2020) identify volatile organic compounds from roses that WFT may use as host location cues. Alternatively, Escobar-Bravo et al. (2020) demonstrate how plant defenses that make plants less suitable as hosts are mediated by environmental factors, such as ultraviolet light.

Several contributions examine interspecific competition among WFT and other thrips species, and the effect of these interactions on population dynamics. Wu et al. (2020) summarize current knowledge on competitive interactions between WFT and locally present thrips species, and how these interactions affect the invasiveness of WFT. Chen et al. (2020) demonstrate that *Orthotospovirus* infection of a host plant confers a competitive advantage to WFT against *Thrips palmi*. Qian et al. (2020) describe the impacts of elevated CO₂ on a WFT host plant and its succeeding beneficial effects on WFT physiology and life history traits. Cao et al. (2020) found similar results for WFT, but showed that elevated CO₂ levels are detrimental to *Thrips hawaiiensis*, which could affect interspecific interactions among these species in the future.

Given the extensive use of insecticides in attempts to manage WFT, several papers examine insecticide resistance and its impact on WFT management. Gao et al. (2020) assessed variation within and among thrips species in resistance to the commonly used insecticide, spinetoram. Although WFT populations did not always possess the greatest levels of resistance to spinetoram. Wan et al. (2020),

in a separate study, demonstrate how insecticide resistance increases the competence of WFT to acquire and transmit *Tomato spotted wilt orthotospovirus*. These findings support the need for improved management tactics for WFT. Li et al. (2020) demonstrate the efficacy of a novel strain of *Metarhizium anisopliae*. Zhang et al. (2020) also show the compatibility of another fungal pathogen with predatory mites for the control of WFT. Lin et al. (2020) then provide an approach that successfully integrates the use of a conventional insecticide with releases of a predatory bug for management of WFT.

We are thankful to the numerous experts on *F. occidentalis* who responded to our invitation to contribute to this special issue and submitted their work for publication. All manuscripts were processed through the peer-review system of the journal, and we are thus grateful to journal editor in chief, Michael Traugott who agreed to publish this special issue. We are also grateful to the reviewers whose generous commitment of time and effort in critiquing the contributions that now comprise this Special Issue on novel management tactics for the western flower thrips. We thank the National Key Research and Development Program of China (2018YFD0200802) for its support of the publication of this special issue.

Compliance with ethical standards

Conflict of interest Authors Yulin Gao and Stuart Reitz declare that they have no conflict of interest.

Ethical approval All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

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