Zoosymposia 22: 279–281 (2022)
https://www.mapress.com/j/zs

Correspondence

ISSN 1178-9905 (print edition)
ZOOSYMPOSIA
ISSN 1178-9913 (online edition)

https://doi.org/10.11646/zoosymposia.22.1.176

Review of predatory mites as biocontrol agents against thrips in China*

XU ZHANG, SHUO ZHANG, ZHITONG ZHU, HAOLIN WANG, YI YAN[#] & LIXIA XIE[#]
Department of Entomology, College of Plant Protection, Shandong Agricultural University; Shandong Provincial Key Laboratory for Biology of Vegetable Diseases and Insect Pests, Taian, 271018, China
Zhang X: 2440559825@qq.com; https://orcid.org/0000-0003-4610-1213
Zhang S: 1959085487@qq.com; https://orcid.org/0000-0003-4640-1275
Zhu ZT: sdklzzt1008@163.com; https://orcid.org/0000-0001-9164-8870
Wang HL: whl06297156@126.com; https://orcid.org/0000-0003-3324-3917
[#] *Corresponding author: Xie LX: xielixia2006@163.com; https://orcid.org/0000-0003-1029-3575*
Yan Y: miteyy@163.com; https://orcid.org/0000-0002-4041-3366

**In*: Zhang, Z.-Q., Fan, Q.-H., Heath, A.C.G. & Minor, M.A. (Eds) (2022) *Acarological Frontiers: Proceedings of the XVI International Congress of Acarology (1–5 Dec. 2022, Auckland, New Zealand)*. Magnolia Press, Auckland, 328 pp.

Thrips are one of the most destructive pests of vegetables, fruits, and ornamental crops worldwide (Wan *et al.,* 2020; Davari *et al.*, 2021). The more severe species include *Frankliniella occidentalis, Frankliniella intonsa, Thrips tabaci, Thrips flavidulus, Pseudodendrotrips mori, Scirtothrips dorsalis*, and *Megalurothrips usitatus* (You *et al*., 2007; Zheng *et al*., 2007; Saito *et al.*, 2022). Many thrips have developed resistance to pesticides. For example, *Frankliniella occidentalis* developed different degrees of resistance to organochlorine, organophosphorus, carbamate, and pyrethroid insecticides and environmentally friendly insecticides (Broadbent and Pree, 1997; Sun *et al.*, 2022). Tobacco thrips have developed resistance to pyrethroid and organic phosphate insecticides (Krob *et al*., 2022). Soybean thrips also developed varying degrees of resistance to emamectin benzoate, beta-cypermethrin, and imidacloprid (Tang *et al*., 2016). Therefore, searching and screening effective natural enemies for biological control of thrips is urgent.

Thrips have many natural enemies, such as *Orius similis*, *Orius bifilarus*, *Harmonia axyridis*, and various predatory mite species (Dlamini *et al.*, 2019; Zhang *et al.*, 2021). Among them, predatory mites, mostly members of Phytoseiidae and Laelapidae, can play a vital role in controlling thrips (Li, 2019; Wang, 2019).

There are several studies on the control of thrips using predatory mites in China. The main native thrips and their mite predators are summarised (Table 1). The survey showed that the main predatory mites were from 2 families and 5 genera. *Amblyseius cucumeris* had the highest number of reported prey of 5 species. *F. occidentalis* had the highest number of reported predators of 11 species. *Thrips flavidulus* was the second favored prey for 4 predatory mite species.

TABLE 1. The control of thrips by predatory mites in China.

Species of thrips	Predatory mites	References
Frankliniella occidentalis	*Neoseiulus barkeri*	Han *et al.*, 2016
	Euseius utilis	Han *et al.*, 2016
	Paraseiulus soleiger	Han *et al.*, 2016
	Amblyseius swirskii	Han *et al.*, 2016
	Amblyseius orientalis	Han *et al.*, 2016
	Neoseiulus cucumeris	Han *et al.*, 2016
	Amblyseius cucumeris	Sun *et al.,* 2009
	Euseius castaneau	Wu *et al*., 2009
	Neoseiulus californicus	Yang, 2020
	Stratiolaelaps scimitus	Zhang *et al*., 2021
	Neoseiulus bicaudus	Zhu *et al.*, 2022

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Submitted: 30 Oct. 2022; Accepted by Zhi-Qiang Zhang: 13 Nov. 2022; published: 30 Nov. 2022

TABLE 1. (Continued)

Species of thrips	Predatory mites	References
Thrips tabaci	*Amblyseius barkeri*	Huang *et al.*, 2012
	Amblyseius swirskii	Quan, 2021
Thrips flavidulus	*Amblyseius barkeri*	Cheng, 2012
	Amblyseius eharai	Yao, 2012
	Euseius nicholsi	Yao, 2012
	Amblyseius cucumeris	Yao, 2012
Pseudodendrotrips mori	*Amblyseius cucumeris*	Chai *et al*., 2013
Scirtothrips dorsalis	*Amblyseius cucumeris*	Zheng *et al*., 2019
	Neoseiulus barkeri	Zhou *et al*., 2020
Frankliniella intonsa	*Amblyseius cucumeris*	Ding, 2011
	Neoseiulus bicaudus	Wang *et al*., 2022
Megalurothrips usitatus	*Neoseiulus barkeri*	Huang *et al*., 2022
Megalurothrips usitatus	*Amblyseius swirskii*	Yu *et al*., 2019

In summary, predatory mites have great application potential in the control of thrips in China. In the future, we need to make greater efforts to explore the biocontrol potential of native predatory mite species.

Acknowledgements. The authors would like to thank Prof. Zhi-Qiang Zhang (School of Biological Sciences, The University of Auckland) and Prof. Keshi Zhang for their helpful comments. This work was supported by the Shandong Provincial Key Laboratory for Biology of Vegetable Diseases and Insect Pests, the National Natural Science Foundation of China (Grant No. 31970401) and the Natural Science Foundation of Shandong Province (Grant No. ZR2020MC046).

Keywords: Predatory mites, thrips, biological control

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