

Review

Frontiers Approaches to the Diagnosis of Thrips (Thysanoptera): How Effective Are the Molecular and Electronic Detection Platforms?

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Simple Summary: Thrips are important agricultural and forest pests. They cause damage by sucking plant sap and transmitting several plant viruses. Correct identification is the key for epidemiological studies and formulating appropriate management strategies. The application of molecular and electronic detection platforms has improved the morphological character-based diagnosis of thrips species. This article reviews research on molecular and automated identification of thrips species and discusses future research strategies for rapid and high throughput thrips diagnosis.



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Abstract: Thrips are insect pests of economically important agricultural, horticultural, and forest crops. They cause damage by sucking plant sap and by transmitting several tospoviruses, ilarviruses, carmoviruses, sobemoviruses, and machlomoviruses. Accurate and timely identification is the key to successful management of thrips species. However, their small size, cryptic nature, presence of color and reproductive morphs, and intraspecies genetic variability make the identification of thrips species challenging. The use of molecular and electronic detection platforms has made thrips identification rapid, precise, sensitive, high throughput, and independent of developmental stages. Multi-locus phylogeny based on mitochondrial, nuclear, and other markers has resolved ambiguities in morphologically indistinguishable thrips species. Microsatellite, RFLP, RAPD, AFLP, and CAPS markers have helped to explain population structure, gene flow, and intraspecies heterogeneity. Recent techniques such as LAMP and RPA have been employed for sensitive and on-site identification of thrips. Artificial neural networks and high throughput diagnostics facilitate automated identification. This review also discusses the potential of pyrosequencing, microarrays, high throughput sequencing, and electronic sensors in delimiting thrips species.

Keywords: artificial neural networks; COI; cryptic diversity; differentiation of thrips species; insect taxonomy; molecular markers



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1. Introduction

Thrips are soft-bodied slender insects with fringed wings in the order Thysanoptera with nearly 7700 species and over 1200 genera [1]. The family Phlaeothripidae is the most speciose among the thrips with about 3500 described species followed by Thripidae with 2400 described species [2,3]. The phytophagous thrips cause direct damage by piercing plant tissue and imbibing sap. Thrips feeding makes the plant parts appear silvery as the empty cells are filled with air. As the damaged leaves, flowers, and fruits grow in size, they become scarred, malformed, and distorted [4]. Economic losses due to thrips account for GBP 7–11 million annually in the United Kingdom [5]. In addition, thrips cause indirect damage by transmitting viruses, including tospoviruses, ilarviruses, carmoviruses,