Research Progress on Life History Types and Overwintering Hosts of the Cotton Aphid: Post-print

Authors: Chao Wendi

Date: 2019-11-14T00:00:00+00:00

Abstract

Cotton aphid (Aphis gossypii) is a polyphagous agricultural pest with a relatively complex life history. Due to regional differences in meteorological factors and vegetation, its life history types and overwintering host species are constrained. By analyzing global literature on cotton aphid life history strategies, and using the capacity of cotton aphids to overwinter as eggs as the central theme, this study examines the two life history types of cotton aphids in different world regions and systematically reviews the primary hosts of the heteroecious holocyclic life history strategy. Through such analysis of regional life history strategies and overwintering hosts, this work contributes to in-depth research on crop protection strategies and establishes a theoretical foundation for systematic cotton aphid control.

Full Text

Research Progress on Life History Types and Overwintering Hosts of *Aphis gossypii*

CHAO Wen-di[1,2], LÜ Zhao-zhi[1,2], ZHAO Li[1], ZHANG Xin[2], GAO Gui-zhen[3], WANG Pei-ling (1. College of Agriculture, Xinjiang Agricultural University, Urumqi 830052, Xinjiang, China;
2. Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi 830011, Xinjiang, China;
3. College of Forestry and Horticulture, Xinjiang Agricultural University, Urumqi 830052, Xinjiang, China;
4. College of Agriculture, Shihezi University, Shihezi 832003, Xinjiang, China)

Abstract: *Aphis gossypii* Glover is a polyphagous insect species considered one of the most important agricultural pests. Its life cycle type and overwintering host range are determined by geographical and meteorological factors as well as

vegetation variations. This study analyzes global literature on the life history and different life cycle types of cotton aphid from the perspective of overwintering possibilities in the egg stage. Additionally, the primary host range of heteroecious holocyclic populations of cotton aphid is analyzed and discussed. By examining the life cycle strategies of cotton aphid in different regions and their overwintering hosts, this research provides a theoretical foundation for systematic management of cotton aphid and facilitates further study of crop protection strategies.

Keywords: cotton aphid; life history; overwintering host; primary host; secondary host; research progress

1. Life Cycle Types and Global Distribution

Aphis gossypii exhibits remarkable variation in its life cycle strategies across different geographical regions. The species can display both holocyclic (sexual) and anholocyclic (asexual) life cycles depending on environmental conditions. In temperate regions with cold winters, holocyclic populations predominate, producing overwintering eggs on primary hosts. In contrast, tropical and subtropical regions with mild winters typically support anholocyclic populations that reproduce parthenogenetically year-round.

The distribution of these life cycle types correlates strongly with latitude and climate. Holocyclic populations are generally found at latitudes above 30°N, where winter temperatures drop below freezing, necessitating an egg stage for survival. Anholocyclic populations dominate in areas with winter temperatures above freezing, particularly in regions below 25°N latitude. Transitional zones between these latitudes often exhibit mixed populations with both life cycle types.

Tab. 1 Distribution areas of anholocyclic life cycle of *Aphis gossypii* in the world
Tab. 2 Distribution areas of holocyclic life cycle of *Aphis gossypii* in the world

2. Overwintering Hosts

The overwintering success of holocyclic cotton aphid populations depends entirely on the availability of suitable primary hosts. These hosts, typically woody perennials, provide the substrate for oviposition and egg survival through winter months.

Tab. 3 Primary host plants for overwintering of *Aphis gossypii*

Key primary host species include various *Rhamnus* species (buckthorns), which serve as the classical overwintering hosts in many temperate regions. Other documented primary hosts include *Hibiscus syriacus* (rose of Sharon), *Punica*

granatum (pomegranate), and *Zanthoxylum bungeanum* (Sichuan pepper). The suitability of these hosts varies by region and climate.

In Xinjiang, China, research has identified several native and cultivated species that support overwintering aphid populations. The availability and distribution of these primary hosts directly determine the initial population size and distribution of cotton aphid in spring, influencing subsequent infestation levels in cotton fields.

3. Secondary Hosts and Host Plant Range

During the growing season, *Aphis gossypii* exploits a wide range of secondary hosts, including numerous agricultural crops and wild plants. The secondary host range encompasses over 40 plant families, with particular preference for Malvaceae (cotton), Cucurbitaceae (cucurbits), and Solanaceae (nightshades).

Host specialization has been observed among different cotton aphid populations. Some biotypes exhibit strong fidelity to specific host plants, while others display generalist feeding behavior. This host-associated differentiation has important implications for population dynamics and management strategies.

4. Ecological Specialization and Biotype Differentiation

Population genetic studies reveal significant genetic differentiation among *A. gossypii* populations from different host plants and geographical regions. Host-specialized biotypes often show reduced fitness on alternative hosts, suggesting adaptive trade-offs. Temperature and photoperiod are critical environmental cues that trigger the transition between parthenogenetic and sexual reproduction in holocyclic populations.

5. Discussion

Understanding the life cycle strategies and host relationships of cotton aphid is fundamental to developing integrated pest management programs. The persistence of holocyclic populations depends on conservation of primary host plants in agricultural landscapes. Climate change may alter the geographical boundaries between holocyclic and anholocyclic populations, potentially expanding the overwintering range into higher latitudes.

Future research should focus on: - Molecular mechanisms underlying host specialization - Climate-driven changes in life cycle expression - Landscape-level management of primary host plants - Predictive modeling of population dynamics based on host availability

6. Conclusion

The life cycle type and overwintering host range of *Aphis gossypii* represent adaptive strategies shaped by environmental conditions and host plant availability.

Comprehensive understanding of these relationships provides the scientific basis for sustainable management of this important agricultural pest.

References: [The references section contains numerous citations that were preserved in the original format, including studies on cotton aphid biology, ecology, and management from Chinese and international literature. Key references include works on life cycle variation, host specialization, overwintering ecology, and population genetics of *Aphis gossypii*.]

Note: Figure translations are in progress. See original paper for figures.