PE&RC INSTITUTIONAL COLLABORATION PROJECT PROPOSAL

Enhanced biological pest control by intercropping – a challenge in spatial data analysis

Focus and aim of the project

The cotton aphid, *Aphis gossypii* Glover, is a highly destructive pest in cotton (Eastop 2000, Lv et al. 2023). Intercropping is widely applied as a strategy to promote sustainable agriculture, and has been demonstrated to have positive effects on pest management (Vandermeer 1992, Brooker et al. 2015, Lichtenberg et al. 2017, Arsyad et al. 2020). Experiments in the North China Plain in the 1990s (Xia, 1997) indicated that natural enemies spill over from wheat to cotton after wheat harvest, thereby suppressing the cotton aphid. Spillover of natural enemies from wheat to cotton fields has recently been demonstrated in Xinjiang (Shuangshuang Jia, unpublished data), but intercropping has not been tested in this region.

The overall objective of this project is to study the efficacy of intercropping (cotton-wheat and cotton-maize) for enhancing predatory natural enemies (ladybeetles, lacewings, and hoverflies) to attain biological control of *Aphis gossypii* in cotton, using field experiments and spatial statistics. Aphid abundance and natural enemy abundance and diversity will be measured in sole cotton and in cotton that is intercropped with wheat or maize during the main period of aphid infestation in cotton. The experiment will be laid out as a randomized complete block design. As the studied insects are mobile, interplot interference is expected and this needs to be accounted for in the sampling design and data analysis. We will exploit advanced spatial statistical methods (e.g. Stein and Ettema 2003, Bouwmeester et al. 2016) to account for spatially confounding effects when designing the experiment and analysing the experimental data.

Relevance given the PE&RC mission

The cotton aphid is routinely controlled by regular sprays with broad spectrum insecticides such as Imidacloprid, a systematic neonicotinoid insecticide. These regular sprays impair agricultural sustainability and hamper the natural biocontrol services provided by natural enemies. There is an urgent need to develop more sustainable and ecological-based pest management practices. We aim to develop an eco-friendly intercropping approach that takes away the need for intensive pesticide use while promoting the preservation of ecosystems and the environment and improving the quality of life.

Institutional collaboration, the role of the proposed candidates and including the expected output of the project

The project will be carried out as a cooperation of WUR-PSG and WUR-ESG. PhD candidate Shuangshuang Jia from the Crop Systems Analysis chair group (WUR-PSG) will be responsible for the experimental design, carry out the field experiment in Xinjiang Uygur Autonomous Region (Xinjiang) and interpret the outcomes of the data analysis. PhD candidate Qiuhong Huang from the Soil Geography and Landscape group (WUR-ESG) will be responsible for the experimental design, associated statistical inference and spatial data analysis. WUR-PSG and partners in China will cover the research expenses.

This project will uncover the influence of cotton-wheat and cotton-maize intercropping on *Aphis gossypii* Glover and its predatory natural enemies and will show the biological control potential of intercropping. The project will act as a path finder project to apply spatial statistical techniques for the collection and analysis of data from biological field experiments with interplot interference, a common occurrence in field trials with pests and diseases, and their natural antagonists.

Groups involved: Centre for Crop Systems Analysis (CSA; PSG), Soil Geography & Landscape (SGL; ESG)

Scientists involved: Wopke van der Werf (CSA), Gerard Heuvelink (SGL)

PhD candidates involved: Shuangshuang Jia (CSA) & Qiuhong Huang (SGL)

Time to be spent on the project by the PhD candidates

The PhD candidates will jointly develop the sampling design for the experiment. The field experiment will be conducted in June and July 2024 by Shuangshuang Jia. Qiuhong Huang will analyse the data in August and September 2024. Interpretation of the results will again be done by both PhD candidates Both will work for two months on the project (total: 4 months).

Appointment details

Candidate 1:

Name: Shuangshuang Jia

Employment period: From 1/09/2020 to 31/08/2024

Chair group: Crop Systems Analysis

Candidate 2:

Name: Qiuhong Huang

Employment period: From 1/09/2022 to 31/08/2026

Chair group: Soil Geography and Landscape

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