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EDITED AND REVIEWED BY
David Gonthier,
University of Kentucky, United States

*CORRESPONDENCE
Xingyuan Men
✉ menxy2000@hotmail.com
Wen Xie
✉ xiewen@caas.cn

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Editorial: Crop pest control and pollination, volume II

Xingyuan Men[1]*, Wen Xie[2]*, Fang Ouyang[3] and Wei Li[4]

[1]Institute of Plant Protection, Shandong Academy of Agricultural Sciences, Jinan, China, [2]Institute of Vegetables and Flowers, Chinese Academy of Agricultural Science, Beijing, China, [3]State Key Laboratory of Integrated Management of Pest and Rodents, Institute of Zoology, Chinese Academy of Sciences, Beijing, China, [4]College of Plant Protection, Hunan Agricultural University, Changsha, China

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Editorial on the Research Topic
Crop pest control and pollination, volume II

In the fascinating realm of agricultural and ecological sciences, a diverse array of organisms play critical roles in maintaining the balance of ecosystems and influencing agricultural productivity. Crops, microbes, bioactive volatiles, nematodes, natural enemy insects, and native pollinators are all key players that impact pests and diseases, biological control, and pollination. Each of these organisms contributes to the intricate web of interactions that shape our environment and influence food production. Exploring the intricate relationships between microbial agents, bioactive volatiles, nematodes, insect-mediated biological control, and pollinators offers a wealth of potential in pest and disease management, promoting sustainable agriculture, and maintaining ecosystem health. In this Research Topic we explore research that harnesses these natural interactions to create more resilient and environmentally friendly approaches to meeting our agricultural and ecological challenges.

Microbes such as bacteria and fungi hold immense potential in controlling pests and diseases (da Silva Folli-Pereira et al., 2022). These strains produce natural substances that can act as deterrents, toxins, or even attractants for harmful insects or pathogens. Harnessing these microbial properties offers a sustainable and environmentally friendly alternative to traditional chemical pesticides, reducing the dependence on synthetic compounds and minimizing negative impacts on ecosystems. *Rhodopseudomonas palustris* belongs to Photosynthetic bacteria, which can decompose various carbon and nitrogen sources, promote plant growth in the rhizosphere of plants, and antagonize crop pathogens. Luo et al. reported that the *R. palustris* strain PSB06 increased the pepper yield by 33.45%, soil nitrogen concentration, and improved pepper rhizosphere bacterial α diversity. Wu et al. reported that the control efficiency of *R. palustris* strain PSB-06 combined with reduced amount of isoprothiolane, a fungicide against rice blast, was higher than the individual efficiency of fungicide, which highlighted the synergistic potential of PSB-06 to control rice blast, providing environmental protection and reducing the use of fungicides.

Bioactive volatiles, volatile organic compounds emitted by plants and microbes, also play a significant role in mediating interactions between organisms. These compounds can serve as chemical cues, attracting or repelling specific insects or other organisms (Das et al., 2013). Bioactive volatiles offer a complex communication network that can be harnessed to manipulate the behavior and distribution of pests or beneficial insects. The South American tomato pinworm, *Tuta absoluta*, is one of the most devastating invasive pests of solanaceous plants worldwide. *T. absoluta* is resistant to many chemical classes of insecticides, leaving

producers with few chemical control options. Chen T. et al. reported that they found two attractants and two repellents for *T. absoluta* from plant released volatiles, which could be useful to develop the trapping and monitoring technology. Guo et al. reported that the microbe *Penicillium digitatum* was an important driver of the interactions between the yellow peach moth *Conogethes punctiferalis* and apple by altering apple volatiles, and these findings may form the basis for developing attractant baits for field trapping the yellow peach moth in the future.

Nematodes, small roundworms that inhabit soil ecosystems, represent another growing biological control option given that some are parasitic to insect pests. These beneficial nematodes can be used as biocontrol agents to control a variety of soil-dwelling insects due to their superior ability to actively search for hosts. By employing nematodes, we can enhance pest control measures while reducing the need for potentially chemical interventions. Root-feeding white grubs are one of the most serious pests of honeysuckle trees (*Lonicera japonica*) in China, Li et al. reported that entomopathogenic nematodes could provide curative efficacy against white grubs and significantly reduce honeysuckle plant death, which provides a biological control method for underground pests of Chinese medicinal materials.

Insect-mediated biological control is a strategy that leverages the natural relationships between insects to combat pests. Encouraging the presence and abundance of these natural enemies plays a crucial role in reducing pest populations and managing crop damage without relying on chemical interventions. Understanding the factors that affect insect predator populations, including temperature stress and habitats, is crucial for developing conservation strategies and managing biological control services effectively. Ren et al. reported that temperature not only influenced the population growth parameters, but also the predation rates of *Orius strigicollis* to the western flower thrips *Frankliniella occidentalis*. These results indicated that temperature should be taken into account when releasing *O. Strigicolli* to control *F. Occidentalis*. It is known that diversifying crop species within fields can create a more balanced ecosystem and enhance the biological control of natural enemies to reduce the pest outbreaks. Cui et al. reported that the habitat of natural enemies can be expanded for their preferences to feed and oviposit on different plants to achieve pest control in adjacent cropping systems.

Crop plants serve as both the host, non-host and habitat of various insect pests. Improving crop resistance and modifying the composition of the agricultural landscape are both effective strategies to reduce the harm caused by pests. Chen L. et al. reported that amending soils with a 30:1 ratio of bamboo charcoal and coconut bran induced biosynthesis of flavonoids, terpenoids, and phenolic acids in tomato plants, which improved plant growth and tolerance against South American tomato pinworm, thus reducing the survival of this destructive pests. Modifying the landscape around crop fields can help disrupt the breeding and survival of insect pests. Wen et al. reported that compositional heterogeneity positively affected an invasive pest *Bactrocera dorsalis* and its associator *Drosophila melanogaster*, whereas configurational heterogeneity negative affected *B. dorsalis*. The relative effects of landscape structures are consistent across multiple scales. These results provide new insights into landscape effects on interconnected species using a diverse spatial-scale approach.

Pollinators, such as bees, butterflies, and hoverflies, are vital for successful plant reproduction and food production for 87% of the leading global food crop species (Klein et al., 2007). Understanding the factors that affect pollinator populations, including temperature stress, is crucial for developing conservation strategies and managing pollination services effectively. Native pollinators play a crucial role in pollination, especially in ecosystems where they have co-evolved with native plant species. The decline of native pollinators due to habitat loss, pesticide use, and climate change poses significant challenges to agriculture and biodiversity. Recognizing and promoting the importance of pollinators is crucial to ensure the pollination and reproduction of native plants, maintain biodiversity, and sustain food production. Cortés-Rivas et al. reported that some native bee species can greatly improve the fruit set and fruit quality of the highbush blueberry cultivars in Chile. This research indicates that conservation of native pollinators, would improve blueberry fruit quality and is likely to improve overall crop productivity. The population of *Osmia excavata*, an important native pollinator in China, has been in serious decline over recent years. Song et al. reported that *O. excavata* had a low tolerance to high-temperature stress, and the larvae of *O. excavata* were more sensitive to temperature stress than adults, which provided evidence of causes that could be contributing to the population decline of *O. excavata*. Hoverflies have unique lifecycles that include a larval stage during which they consume aphids and other small insects, benefiting crop health. Cao et al. reported the morphological characteristics and life cycle of the hoverfly *Eristalinus arvorum*, a pollinating agent for crops and flowering plants widely distributed across Chinese agricultural and natural ecosystems. Monitoring and sampling of pollinators allow researchers and practitioners to assess the diversity, abundance, and health of these important species in agricultural landscapes. In oilseed rape fields in China, Shi et al. reported flight interception traps had a greater sampling efficiency than pan traps shedding light on strategies for efficiently monitoring agroecosystems.

Based on these findings in this Research Topic, harnessing the interactions between crops, microbes, beneficial nematodes, natural insect enemies and pollinators in agricultural systems, holds immense potential for agricultural ecosystem service, such as crop production, pest control and crop pollination. Encouraging the presence and manipulating abundance of these beneficial organisms, such as beneficial nematodes, microbes, natural enemies plays a vital role in reducing pest populations and crop damage without relying on chemical interventions. Additionally, methods like enhancing crop resistance and modifying habitats offer effective means to control insect pests. The utilization of bioactive volatiles provides a sophisticated communication network for manipulating the behavior and distribution of pests and beneficial insects. Furthermore, understanding the factors impacting natural enemy and pollinator populations, is essential for developing effective conservation and utilization strategies. By harnessing these

natural interactions, sustainable agricultural systems can be created, promoting ecological balance and reducing reliance on chemical interventions.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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