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Editorial: Crop pest control and pollination

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Editorial on the Research Topic
Crop pest control and pollination

Crop production meets the basic need of human nutrition. Crop production in increasingly intensive, large-scale and simplified agricultural landscapes often face or suffer from various threats, such as pest damage (caused by insect pests, pathogenic microbes, nematode, weeds, rodents, and so on) or a shortage of pollinators. Crop pests can cause serious loss during crop production and food storage, however, effective pest management benefits to reduce crop loss and pesticide abuse. Moreover, most vegetable and fruit tree crops require insect pollination to ensure high yields and quality. Research on strategies and techniques of pest management and their potential impact on pest control and pollination in agricultural landscapes is of great significance to sustainable crop production (Gurr et al., 2017).

Over the past decades, pest control largely relied on pesticides which can control crop pests and decrease crop losses in the short term (Tilman et al., 2001; Ringland and George, 2011). However, pesticide abuse causes a series of problems in the long run, for example, the risk of development of pesticide resistance by crop pest, as well as pesticides residues in soil, water, and agricultural products (Van Meter et al., 2016). Long-term, improper, and excessive use of pesticides during crop production ultimately harms biodiversity and human health (Larsen et al., 2017). New strategies and techniques for environmentally-friendly pest control should be developed in order to support natural enemy and pollinator diversity while also supporting food production and bolstering food security, food safety and biodiversity protection.

There are ways in which crop pests are regulated from "top down" regulation of pests from natural enemies and biodiversity and from "bottom up" regulation of pests from plant defense mechanisms. Ecological regulation and control of pests in agricultural landscapes are always important frontier areas in science and technology for prevention and management of crop diseases and insect pests (Ouyang et al., 2020). Plant defenses are instinctive adaptations that decrease the damage and mortality caused by pests such as herbivores and pathogens (Coley and Barone, 2001). Omics is applied more and more widespread to illustrate signaling pathways, mechanism and candidate targets of plant immunity system. For instance, transcriptome analysis is an effective strategy to find out which signaling pathway(s) is related to some plant disease resistance, and screen the functional genes related to disease resistance. In addition, clone plant lesion mimic genes which display spontaneous cell death and activated plant disease resistance can also provide gene resource for crops breeding for pest control. Understanding how human activities, agricultural landscape structure and plant defenses influence crop diseases and insect pests and their natural enemies is important for prevention and management of pests (Thies and Tscharntke, 1999; Faulkner, 2016). Likewise, understanding how biodiversity influences ecosystem function and plant defenses can elucidate pest control mechanisms (Duffy et al., 2010).

In this Research Topic, we present nine articles that discuss specific aspects of ecological regulation and control of pests and defenses mechanisms in plant. Three of the articles (Dong et al.; Tripathi et al.; Suprapta) discuss the impacts of habitat management and natural enemies on crop pests. Four articles (Xie, Jiang, Huang, et al., Zhang et al.; Gao et al.; Tang et al.) focus on genome and transcriptome technologies for pest control. The last two articles (Wang et al.; Shen et al.) focus on lesion-specific mutants and the ways in which plant defense can regulate pests. The first article, Dong et al. reported ecological effects of flower and grass strips for increase of natural enemies in apple orchards in Beijing, China Beijing, China. Sowing plants strips that provide food resources (pollen, nectar and alternative prey) in orchards is a potential practice of habitat management for promoting biological control. The second article, Tripathi et al. assessed the impacts of climate-smart agriculture (CSA) on crop yield and biodiversity in the East Usambara Mountains, Tanzania. The study compared the impacts of climate-smart agriculture (CSA) with other agricultural management practices on invertebrate pest and natural enemy diversity, and the associated effects on crop damage and crop yield. The findings illustrate that the CSA practices in the area, terracing and trenching with live and compost mulches, could promote crop production, pest suppression and agricultural income. The third article, by Suprapta reported the biological control of anthracnose disease on chili pepper using a beneficial microorganism formulation containing *Paenibacillus polymyxa* c1. Anthracnose disease on chili pepper has been known to seriously disturb the plant growth and obviously decrease the yield. The disease is caused by *Colletotrichum* spp. In Bali, Indonesia, six species of *Colletotrichum* have been identified: *Colletotrichum scovillei*, *C. acutatum*, *C. nymphaeae*, *C. gloeosporioides*, *C. truncatum*, and *C. fructicola*. The results revealed that the formulation of the beneficial microorganism *P. polymyxa* C1 effectively restraint the anthracnose disease on chili pepper, particularly on chili pepper cultivar Cabe Besar, and thus can be proposed as field testing to confirm its stability under field conditions.

Genome and transcriptome analysis technology is an effective systems-biology method for the investigation of pest and host plant. The two articles in this Research Topic by Xie, Jiang, Chen, et al., Zhang et al. reported the transcriptome profile of the pest *Myllocerinus aurolineatus* Voss in Tea Plants and soybean treated with *Pseudomonas syringae* phytotoxin Coronatine (COR), respectively. According to the reports, the global transcriptome profile of pest and host plant provides a valuable genomic resource and clues for further study the interaction between pest and plant, therefore, transcriptome sequencing promotes the development of new pest management strategies. The article by Gao et al. reported that RNA sequencing analysis of *Metopolophium dirhodum* (Walker) (Hemiptera: Aphididae) reveals the mechanism underlying insecticide resistance. The study identified a total of 5,265 differentially expressed genes (DEGs). And, the transcriptome data generated in this study can be used for functional gene characterization such as aphid development, metabolism, environmental adaptation, and insecticide resistance. The article by Tang et al. reported that genome identification and expression analysis of GRAS family related to development, hormone and pathogen stress in *Brachypodium distachyon* which is a new model system for functional genomics like plant-pathogen interactions in grasses. This study used bioinformatics method to search and found 63 GRAS family genes in *B. distachyon*. These results will provide data source for further study of GRAS gene function in *B. distachyon*.

Furthermore, the another two articles by Wang et al. and Shen et al. reported that the lesion-mimic mutants are useful materials to dissect mechanisms controlling programmed cell death (PCD) and defense response in plants, and the lesion mimic genes are applicable gene resource for pest control. Two lesion mimic rice genes both located on chromosome 12 were mapped/cloned and reported in this Research Topic back to back (Wang et al.; Shen et al.). Interestingly, although both these two lesion mimic genes negatively regulate cell death and antioxidation metabolism, these two genes act opposite effect on disease resistance, which one is negative regulator of plant immunity and the other one is positive regulator (Wang et al.; Shen et al.). These findings further uncover the mechanism of lesion mimic genes regulating plant disease resistance and cell death, and provide valuable gene resource for rice resistance breeding.

Based on these findings in this Research Topic, habitat management could be used to promote the pest control with natural enemies, and plant defense could also be beneficial to suppress the occurrence and damage of pests. New strategies and techniques, which include "top down" regulation of pests from natural enemies and biodiversity and "bottom up" regulation of pests from plant defense, could be incorporated into integrated pest management in increasingly intensive, large-scale and simplified agricultural landscapes.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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.

Publisher's note

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