frontiers | Frontiers in Agronomy

TYPE Editorial
PUBLISHED 25 October 2022
DOI 10.3389/fagro.2022.1066746

OPEN ACCESS

EDITED AND REVIEWED BY
Murray B. Isman,
University of British Columbia, Canada

*CORRESPONDENCE
Pei Li
pl19890627@126.com

SPECIALTY SECTION
This article was submitted to Pest Management, a section of the journal Frontiers in Agronomy

RECEIVED 11 October 2022
ACCEPTED 18 October 2022
PUBLISHED 25 October 2022

CITATION
Li P, Li H, Zhang J, Liu N and Liu F (2022) Editorial: Advances in novel natural product pesticides. *Front. Agron.* 4:1066746. doi: 10.3389/fagro.2022.1066746

Editorial: Advances in novel natural product pesticides

Pei Li[1]*, Hu Li[2], Jiwen Zhang[3], Nannan Liu[4] and Feng Liu[5]

[1]Qiandongnan Engineering and Technology Research Center for Comprehensive Utilization of National Medicine, Kaili University, Kaili, China, [2]State Key Laboratory Breeding Base of Green Pesticide and Agricultural Bioengineering, Key Laboratory of Green Pesticide and Agricultural Bioengineering, Ministry of Education, Research and Development Center for Fine Chemicals, Guizhou University, Guiyang, China, [3]Key Laboratory of Botanical Pesticide R&D in Shaanxi Province, Northwest A&F University, Yangling, China, [4]Department of Entomology and Plant Pathology, Auburn University, Auburn, AL, United States, [5]Division of Biological Sciences, Cell and Developmental Biology Section University of California, San Diego, CA, United States

KEYWORDS

natural product pesticides, biomimetic synthesis, green synthesis, plant pests and diseases, fruit postharvest

Editorial on the Research Topic
Advances in novel natural product pesticides

Plant pests and diseases pose a serious threat to agricultural production and cause huge economic losses each year (Rosegrant and Cline, 2003; Neeraja et al., 2010; Opara, 2013; Bhattacharjee and Dey, 2014; Liu and Wang, 2021). Use of pesticides is a standard approach to plant protection, however, the frequent use of conventional chemical pesticides has led to many problems such as resistance in bacterial/fungal/pest populations, environmental contamination, and risks to human health (Guo et al., 1998; Lin et al., 2010; Patel et al., 2014). With the improvement of human living standards and health, the demand for high-quality and safe agricultural products as food necessitates limitations on the use of traditional chemical pesticides and poses a challenge to the control of plant pests and diseases. Therefore, use of natural products to control plant pests and diseases is an innovative strategy for sustainable agricultural development because they are generally safer than traditional chemical pesticides due to their rapid environmental biodegradation and low toxicity to natural enemies, humans, and other mammals (Cantrell et al., 2012; Souto et al., 2021). Thus, natural products can be used either directly for pest control or as models for the development of novel synthetic analogs with promising biological and physicochemical properties.

This Research Topic presents a collection of original research and review articles on the synthesis of novel analogs of natural product pesticides, the toxicology/bioactivity of novel natural products and analogs, and the mechanism of action of novel natural product pesticides. Overall, 23 contributions including 5 reviews and 18 original research articles comprise this Research Topic.

A mini-review paper by Quan et al. shows that *Camellia* seed cake contains a large number of tea polyphenols and saponins, showing anti-melanin, hypoglycemic, antibacterial, and insecticidal activitiesy. Lintz et al. briefly review the anti-rust

peptides (ARPs) targeting different rust species, showing studies on ARP properties and activities mainly through *in vitro* assays, sometimes *in planta* assays, but with no explicit mode of action against rust fungi established so far. Terpenoids, one of the most prominent families among various categories of natural products, attract immense attention due to their promising physiological activities. The review by Xiao et al. summarizes recent advances toward the total synthesis of terpenoids by cobalt-mediated asymmetric catalysis, which may help direct future synthetic efforts toward natural pesticides such as celangulin, azadirachtin, etc. Abscisic acid (ABA) is an important plant endogenous hormone and plant stress resistance factor that participates in the regulation of various physiological processes in plants. Research progress on ABA analogues, including mechanism of action, signaling pathways, and ABA functional analogs, is reviewed by Liu et al.

Development of new botanical pesticides using plant active components has become an important direction. Original research by Cai et al. demonstrates that the active compounds alantolactone, dehydrocostus lactone, and costunolide from the root of *Aucklandia lappa* Decne (Radix Aucklandiae) have different inhibitory effects on *Botrytis cinerea*, *Sclerotinia sclerotiorum*, *Colletotrichum gloeosporioides*, *Fusarium oxysporum*, *Alternaria alternata*, *Fusarium graminearum*, and *Didymella glomerata*. Yi et al. report that 2,4-di-tert-butylphenol, *N*-acetyl-5-methoxytryptamine, and *p*-hydroxybenzoic acid isolated from *Paenibacillus polymyxa* Y-1 fermentation broth have excellent *in vitro* antibacterial activity against *Xanthomonas oryzae* pv. *oryzicola* and *Xanthomonas oryzae* pv. *oryzae*. Meanwhile, the work of Ren et al. demonstrates that plant essential oils and their combinations with synthetic pesticides possess good bioactivity against tobacco beetle (*Lasioderma serricorne* [F.]) adults, demonstrating that plant essential oils could be developed as environmentally friendly insect control agents. The work of Li et al. indicates that diamide and neonicotinoid mixtures as a corn seed treatment could be effective for control of fall armyworm (*Spodoptera frugiperda*) larvae over a relative long period without compromising plant growth and development. *Eucommia ulmoides* Oliv. (Duzhong), a valued traditional herbal medicine in China, is effective against a variety of plant pathogens. Lu et al. report that proteome and transcriptome association analyses and RT-qPCR results suggest that the response of *F. oxysporum* to *E. ulmoides* is likely related to the endoplasmic reticulum pathway.

Structural optimization of natural products is becoming one of the most effective ways to develop novel pesticides. In this Research Topic, several series of novel active compounds are reported by Tian et al., Shu et al., Xie et al., Pan et al., Lei et al., Liu et al., Luo et al., and Zhang et al. Original research by Tian et al. documents a series of novel α-aminophosphonate derivatives containing a hydrazone moiety possessing good *in vivo* antiviral activity against tobacco mosaic virus (TMV). Shu et al. synthesized a series of novel galactoside derivatives containing an 1,3,4-thiadiazole moiety, and their bioassays indicate that the target compounds had good *in vitro* antifungal activity against *Gibberella zeae*, *Botryosphaeria dothidea*, *Phytophthora infestans*, *Thanatephorus cucumeris*, and *Phompsis* sp. as well as *in vitro* antibacterial activity against *Xanthomonas axonopodis* pv. *citri* and *X. oryzae* py. *oryzae*. Two series of sulfonic acid esters with significant *in vitro* antibacterial activity against *Pseudomonas syringae* pv. *actinidiae* and moderate insecticidal activity against *Spodoptera frugiperda* are reported by Xie et al. Pan et al. prepared a series of novel pyrimidine derivatives bearing an 1,3,4-thiadiazole skeleton, and their bioassays show moderate to good *in vitro* antifungal activity against *B. cinerea*, *Phomopsis* sp., and *B. dothidea*. Liu et al. prepared a series of novel 1,2,4-triazolo[4,3-*c*]trifluoromethylpyrimidine derivatives bearing a thioether moiety. Their bioassays show that most compounds exhibit obvious *in vitro* inhibitory activity against *B. cinerea*, *P. infestans*, and *Pyricularia oryzae* (*P. oryzae*). A series of novel pyrazolecarbamide derivatives bearing a sulfonate fragment were synthesized by Lei et al, with good *in vitro* antifungal activity against *Colletotrichum camelliae*, *Pestalotiopsis theae*, *G. zeae*, and *Rhizoctonia solani*, as well as moderate to good *in vivo* antiviral activity against TMV. Luo et al. report that chalcone derivatives containing an 1,2,4-oxadiazole moiety have good nematocidal activity against *Bursaphelenchus xylophilus*, *Aphelenchoides bessey*,. and *Ditylenchus dipsaci*, and antiviral activity against TMV, pepper mild mottle virus (PMMoV), and tomato spotted wilt virus (TSWV). Using piperine as the lead structure, Zhang et al. synthesized a series of piperine derivatives containing a linear bisamide moiety, with good insecticidal activity against *Plutella xylostella*.

This Research Topic includes some research on the postharvest protection of fruit. Qu et al. show that melatonin can enhance the postharvest disease resistance of blueberry fruits by mediating the jasmonic acid (JA) signaling pathway and the phenylpropane pathway. Meanwhile, in the study of Li et al., *Penicillium spinulosum*, *Phoma herbarum*, *Nemania bipapillata*, and *Aspergillus oryzae* were first isolated from dragon fruits with postharvest disease. Their bioassays reveal that some of the tested chemical pesticides and plant extracts have potent inhibitory activity against *Alternaria alternata* and *Fusarium proliferatum*. In addition, Yan et al. report that ethylene and 1-MCP can reduce the harvested time of kiwifruit to reach the "edible window" and prolong the "edible window" of kiwifruit.

We hope this Research Topic will attract attention to this area of researcher and inspire further investigation toward the development of novel natural product pesticides.

Author contributions

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

Funding

This research was funded by the Science and Technology Foundation of Guizhou Province, grant number ZK[2021]137.

Acknowledgments

Special thanks to the editorial teams at Frontiers for supporting and assisting the Guest Editors in organizing this Research Topic.

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

References

Bhattacharjee, R., and Dey, U. (2014). An overview of fungal and bacterial biopesticides to control plant Pathogens/Diseases. *Afr. J. Microbiol. Res.* 8 (17), 1479–1762. doi: 10.5897/AJMR2013.6356

Cantrell, C. L., Dayan, F. E., and Duke, S. O. (2012). Natural products as sources for new pesticides. *J. Nat. Prod.* 75 (6), 1231–1242. doi: 10.1021/np300024u

Guo, F., Zhang, Z. Q., and Zhao, Z. (1998). Pesticide resistance of *Tetranychus cinnabarinus* (Acari: Tetranychidae) in China: A review. *Syst. Appl. Acarol.* 3 (1), 3–7. doi: 10.11158/saa.3.1.1

Lin, Y. J., He, Z. L., Rosskopf, E. N., Conn, K. L., Powell, C. A., and Lazarovits, G. (2010). Nylon membrane bag assay for determination of the effect of chemicals on soilborne plant pathogens in soil. *Plant Dis.* 94, 201–206. doi: 10.1094/PDIS-94-2-0201

Liu, J., and Wang, X. W. (2021). Plant diseases and pests detection based on deep learning: A review. *Plant Methods* 17, 22. doi: 10.1186/s13007-021-00722-9

Neeraja, C., Anil, K., Purushotham, P., Suma, K., Sarma, P., Moerschbacher, B. M., et al. (2010). Biotechnological approaches to develop bacterial chitinases as a bioshield against fungal diseases of plants. *Crit. Rev. Biotechnol.* 30 (3), 231–241. doi: 10.3109/07388551.2010.487258

Opara, U. L. (2013). Perspective: The evolving dimensions and perspectives on food security – what are the implications for postharvest technology research, policy and practice? *Int. J. Postharvest. Technol. Innov.* 3 (3), 324–332. doi: 10.1504/IJPTI.2013.059340

Patel, N., Desai, P., Patel, N., Jha, A., and Gautam, H. K. (2014). Agronanotechnology for plant fungal disease management: A review. *Int. J. Curr. Microbiol. App. Sci.* 3, 71–84.

Rosegrant, M. W., and Cline, S. R. (2003). Global food security: Challenges and policies. *Science* 302 (5652), 1917–1919. doi: 10.1126/science.1092958

Souto, A. L., Sylvestre, M., Tölke, E. D., Tavares, J. F., Barbosa-Filho, J. M., and Cebrián-Torrejón, G. (2021). Plant-derived pesticides as an alternative to pest management and sustainable agricultural production: Prospects, applications and challenges. *Molecules* 26 (16), 4835. doi: 10.3390/molecules26164835