Botanical Pesticides as Biocontrol Products

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I. Introduction

Continuous exposure to pests poses a significant challenge to agricultural crops, impacting their growth and later quality. While there has been a widespread adoption of chemical pesticides since the Second World War, the focus is now shifting towards sustainable and environmentally friendly solutions for pest management. This transition is driven by a growing recognition of the detrimental effects posed by synthetic plant protection products on both the environment and human health. Furthermore, the proliferation of resistant pests (insects, fungal pathogens and weeds) highlights the pressing demand for novel and safe products. Among the most extensively researched natural alternatives are botanicals.

Examples of pests :

Any species, strain, or biotype of plant, animal, or pathogenic agent that causes harm to crops, livestock or food [1]

Weed-infested field

Septoria (wheat)

Flea beetles (cabbage)

II. What are botanicals ?

Botanical pesticides (“botanicals”) are characterized by bioactive mixtures/extracts/compounds from plant materials, which serve as insecticides and repellents but also as bactericides, fungicides, herbicides and nematicides [2]. The wide range of compounds within the botanicals present highly versatile chemical structures that arise from the enormous biosynthetic capabilities of plants.

Low persistence and residuality, preventing environmental pollution

Various modes of action, limiting the development of resistant pests

Pose fewer risk to human and animal health

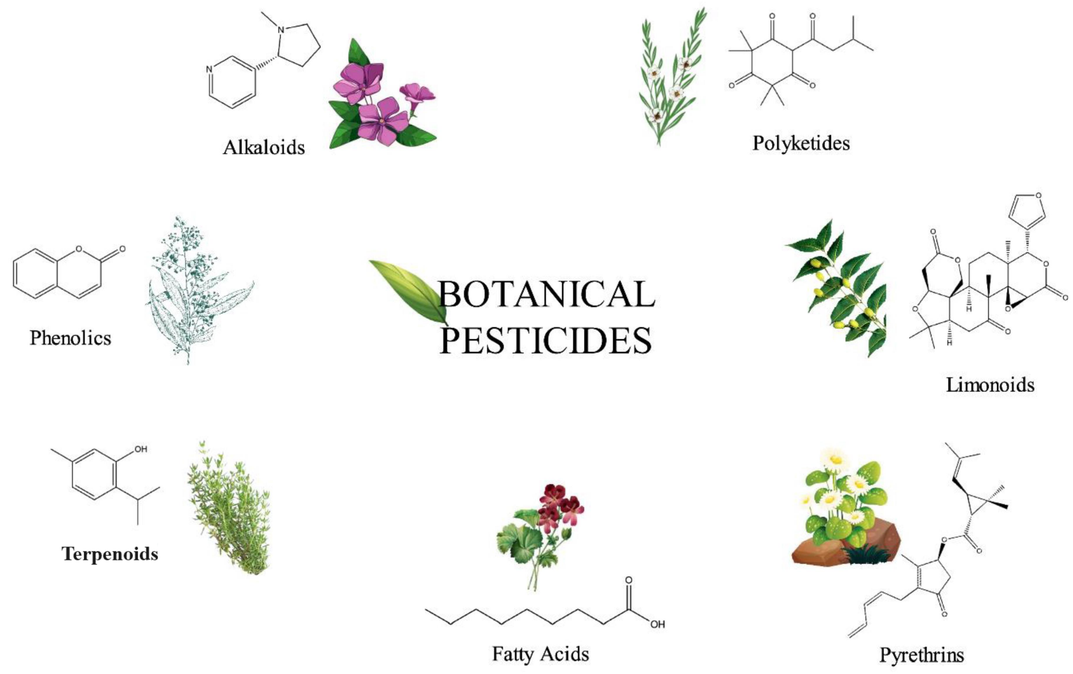


Fig 1 : Structural diversity of bioactive compounds in plant-based pesticides (adapted from Acheuk et al., 2024).

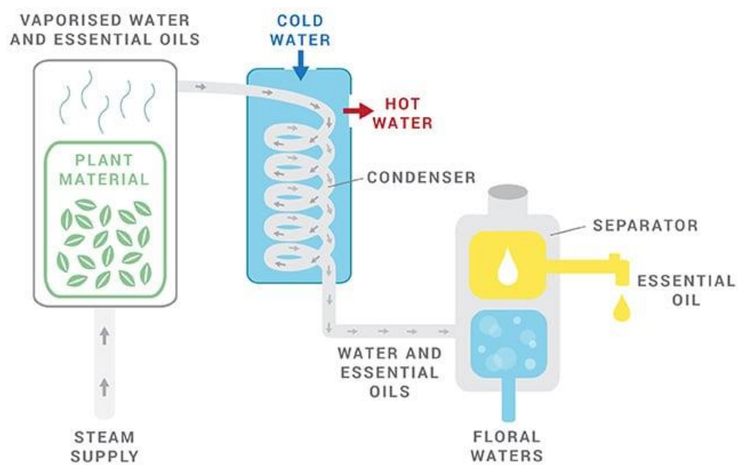
III. Essential oils as pesticides

Essential oils show significant promise in the domain of botanical biopesticide. Their bioactivity is due to their complex mixture of secondary metabolites, mainly terpenoids and phenylpropanoids.

More than 3000 species of aromatic plants are known to date. They can generally yield around 0.5-2% essential oils, making them highly concentrated plant extracts compared to other plant sources [3].

Several extraction processes exists but steam distillation is the most popular method used to extract and isolate essential oils.

Steam distillation



Affect pest behavior (attraction, repulsion, inhibition of feeding and reproduction)

Affect metabolism or nervous system activity

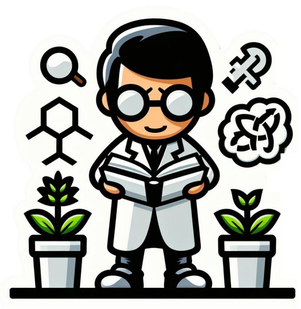
Disruption of cell membranes and induce desiccation

Disruption of growth and development

Inhibition of cell wall formation

Disruption of cell membranes, causing cell death or inhibiting the sporulation and germination

IV. Main academic challenges in developing new botanical biopesticides



- **Creating innovative research methods to identify relevant biopesticide-pest-crop combinations**
- **Improving formulations to ensure better product effectiveness and stability over time**
- **Testing its efficacy and economical viability through greenhouse and field trials**

V. References

[1] : Food and Agricultural Organization. (2024) FAOLEX Database Glossary. Available at https://www.fao.org/faolex/glossary/en/ accessed on 16th May 2024

[2] : Acheuk, F., Basiouni, S., Shehata, A. A., Dick, K., Hajri, H., Lasram, S., Yilmaz, M., Emekci, M., Tsiamis, G., Spona-Friedl, M., May-Simera, H., Eisenreich, W., & Ntougias, S. (2022). Status and Prospects of Botanical Biopesticides in Europe and Mediterranean Countries. *Biomolecules*, *12*(2), 311. https://doi.org/10.3390/biom12020311

[3] : Siegwart, M., Lavoir, AV. (2022). Botanical Pesticides as Biocontrol Products. In: Fauvergue, X., et al. Extended Biocontrol. Springer, Dordrecht. https://doi.org/10.1007/978-94-024-2150-7_13