ESSENTIAL OILS IN PLANT PROTECTION: EFFECTIVE BIOPESTICIDES OR JUST A MYTH?

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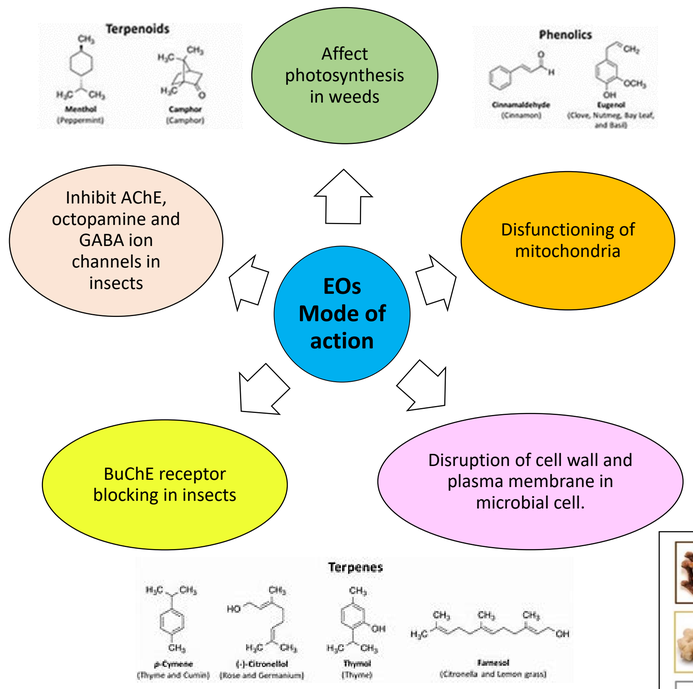
Introduction

The development of biopesticides offers hope that many plant protection issues can be addressed without significantly impacting human health and the environment. Since the first biopesticide based on essential oil (EO), "EcoPCO EC," was released on the market, a considerable amount of research has been conducted on the bioactivity of different essential oils against plant pathogens, pests, and weeds. However, only a small number have obtained commercial approval. The most used and evaluated EOs in plant protection are citronella oil, lavender oil, lemongrass oil, thyme oil, peppermint oil, cinnamon oil, clove oil, eucalyptus oil, sage, tea tree oil, oregano oil, sweet orange oil, and citrus oil. The bioactive properties of EOs are due to the synergistic effect of certain compounds in their composition, mostly terpenes, terpenoids, and phenylpropanoids. Other compounds, such as fatty acids, alcohols, oxides, aldehydes, acyclic esters, lactones, sulfur derivatives, etc., are also present. The specific combination of these compounds contributes to its unique bioactive properties. Knowing the exact composition of the EO is very important for studying its mode of action and harnessing its full potential. However, knowledge about the composition of a particular oil may vary depending on the equipment used, the quality of the raw material, and the technological method used for obtaining the EO.

The term "essential oils" refers to concentrated hydrophobic liquids containing volatile aroma compounds from plants. These oils are extracted through various methods, such as distillation, cold pressing, or solvent extraction.



BIOPESTICIDES BASED ON ESSETIAL OIL

Advantages	Disadvantages
• low persistence in the environment; • Unique mode of action. • Compatible with other methods and pesticides; • Lesser chance to develop resistance; • In most cases posses low toxicity for pollinators; • Positive effect on crop yield;	• Greater application rates; • Frequent reapplication; • Slow mode of action; • Target-specific, which sometimes require an exact identification of the pest/pathogen; • Very high criteria to be produced for commercial use; • May display phytotoxicity effects

Fig. 2 Main antioxidant bioactive compounds found in essential oils

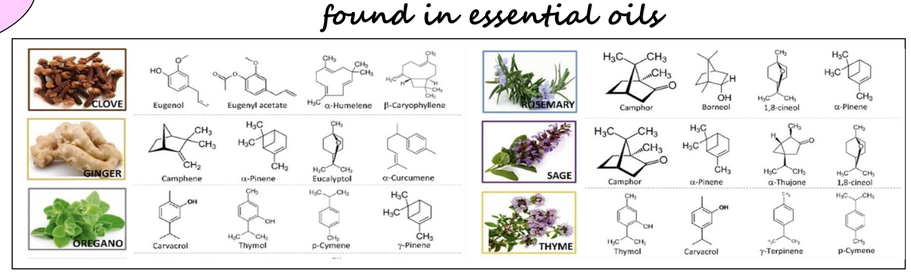


Table 1. Commercially available biopesticides based on EOs

Biopesticide	Essential oils	Target organisms	Biopesticide	Essential oils	Target organisms
BIOMITE	geraniol oil, nerolidol oil, citronellol oil, farnesol oil	mites	WEED SLAYER	clove oil	herbicide
PEST OUT	cotton seed oil, clove oil, garlic oil	miticide and insecticide	NEMA OUT	cinnamon oil, cottonseed oil, clove oil	nematicide
ATPOLAN BIO 80 EC	caraway oil, mentha oil	*Echinochloa crus-galli*	MILDEW CURE	Cotonseed oil, corn oil, garlic oil	Powdery mildew
BIOXEDA	clove oil	nematicide	ASTOUN 50 EC	lemongrass oil	fungicide
LIMOCIDE	sweet orange oil	fungicide, insecticide, acaricide	FERCA 50 EC	Eucaliptus oil	fungicide
OROCIDE	sweet orange oil	insecticide	NECO 50 EC	clove basil oil	fungicide
PREV-AM	sweet orange oil	fungicide (powdery mildew), insecticide, miticide	EcoPCO	peanut oil (2-phenethyl propionate)	crawling and flying insects
GREENMATCH EX	lemongrass oil	herbicide	EcoTrolTM	rosemary oil	insecticide /miticide
MATRATEC	clove oil	non-selective herbicide	*SporanTM*	rosemary oil	fungicide
WEEDZAP	clove oil + cinnamon oil	non-selective herbicide	*MatranTM*	clove oil	herbicide
AVENGER WEED KILLER	citrus oil	non-selective herbicide	BIO REPEL	garlic oil	Insect repellent

CONCLUSION

Many EOs are identified for their insecticidal, herbicidal and antimicrobial properties but only very few meet the necessary criteria to be formulated as commercial products mainly as insecticides and herbicides. The fundamentals of essential oils encompass their definition, extraction methods, chemical composition, and unique properties. In terms of specific constraints, the efficacy of these materials falls short when compared to synthetic pesticides although there are specific pest contexts where control equivalent to that with conventional products has been observed. As the chemical profile of plant species can vary naturally depending on geographic, genetic, climatic, annual or seasonal factors, pesticide manufacturers must take additional steps to ensure that their products will perform consistently which requires substantial cost. It is expected that these pesticides will find their greatest commercial application in urban pest control, public health, veterinary health, vector control vis-a-vis human health and in protection of stored commodities. In agriculture, these pesticides will be most useful for protected crops (e.g. greenhouse crops), high-value row crops and within organic food production systems where few alternative pesticides are available.