Potential of Volatile Organic Compounds in the management of insect pests and diseases of chickpea

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Introduction

Chickpea (*Cicer arietinum*) is the second legume crop cultivated in Morocco after the Faba bean, and presents economical and nutritional benefits. However, the crop productivity is low due to biotic factors and drought. Ascochyta blight (*Didymella rabiei*), Fusarium wilt (*Fusarium oxysporum* f.sp. *Ciceris*), and leaf miner (*Liriomyza cicerina*) are key production constraints in spring-planted chickpeas.

Didymella rabiei

Fusarium oxysporum f.sp. *ciceris*

Liriomyza cicerina

Absence of resistant varieties

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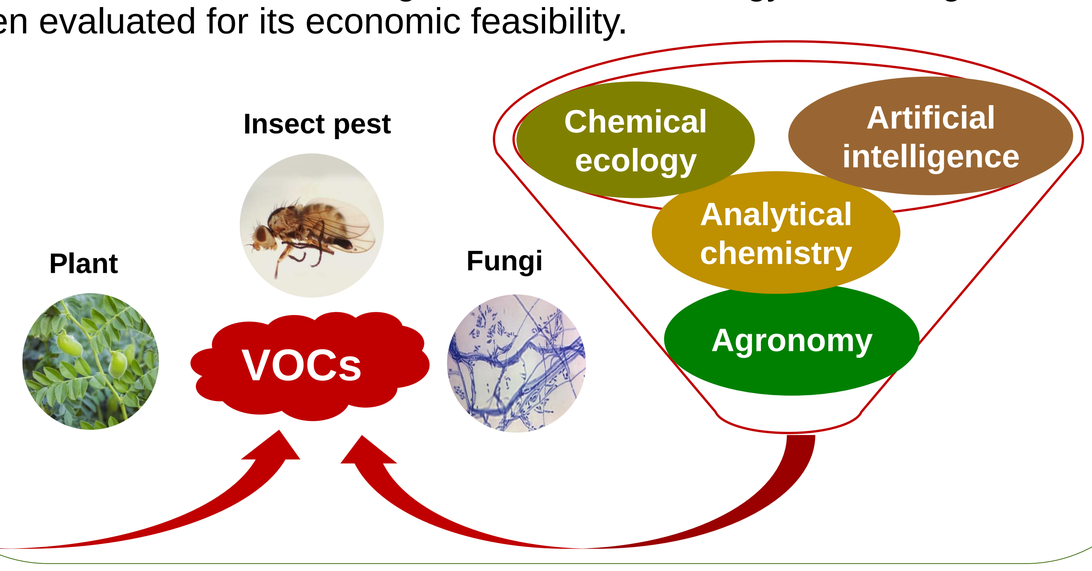
Negative impacts of pesticides

Project aims

The present project aims to explore the role of VOCs released by plants and microorganisms to develop solutions for precision and eco-efficient agriculture, which will be tested and developed using chickpea as a crop model. Based on the study, identification, and multispectral detection of VOCs, an integrated defense strategy is investigated, and then evaluated for its economic feasibility.



Importance of Volatile Organic Compounds

Volatile Organic Compounds are Carbon-based chemicals with low molecular weight and high vapor pressure

VOCs = chemical mediators = infochemicals = semiochemicals

Ensure the interactions of the organism with its environment

A novel approach to improve sustainable and eco-friendly defense strategies for crops

Plant growth regulators

Allelopathy (weed control)

Senescence control

Pathogen growth inhibitors

toxic activity against fungal development

Direct inducers of defenses

Induction of defense proteins and metabolites

VOCs

Insect attractants

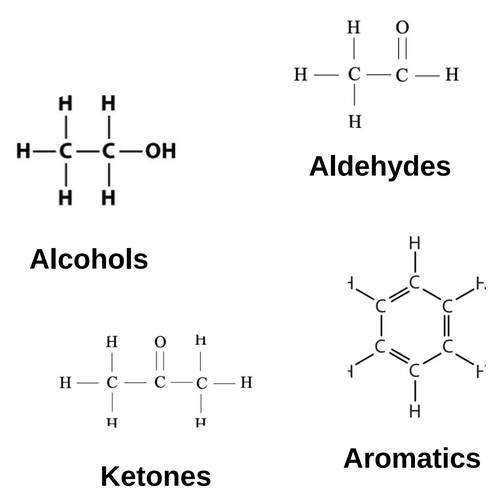
Attract the natural ennemies
Affect the insect pest behavior

Plant phenotyping tool

Fast and non-invasive measure of plant phenotypic traits

Danger presence indicator and defense priming signals

- VOCs are classified into different chemical groups such as :



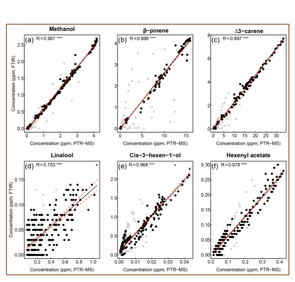
Identification of chickpea VOCs profile

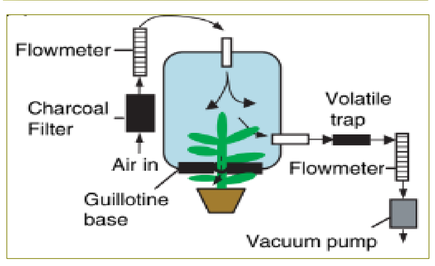
VOCs extraction → **VOCs analysis** → **VOCs identification**

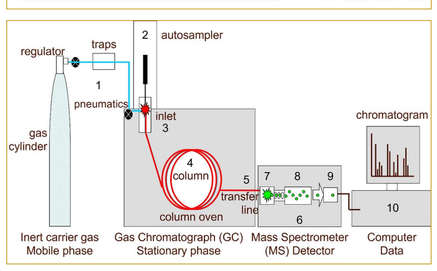
Dynamic headspace collection using Propak Q tubes

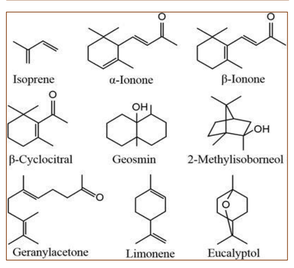
Gas chromatography-mass spectrometry

Standard mass spectral libraries such as Wiley and NIST MS databases





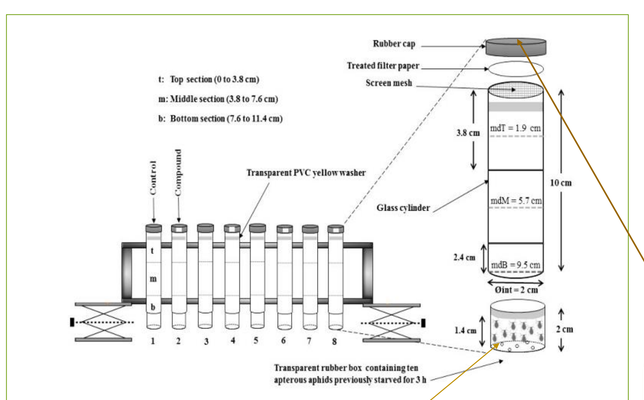




Collection → Desorption → Separation → Quantification/ identification

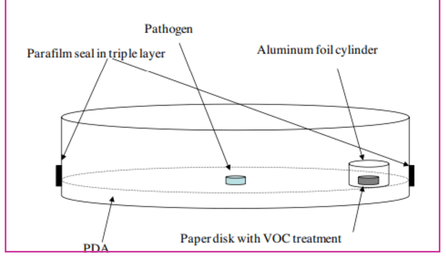
VOCs for disease and pest management

Vertical tube still-air olfactometer used to study the effect of individual volatile compounds on Leafminer olfactory behavior



A rubber box containing adults, previously starved for 3 h, was placed at the bottom end of each olfactometer.

Bioactivity of chickpea VOC on fungal growth



Individual compound solutions for each volatile were prepared in absolute ethanol (as a solvent) on filter paper (odor source), and fixed in the rubber cap

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