Lavandula angustifolia Mill. essential oil exhibits distinct insecticidal activities against pea leaf weevil adults on faba bean under laboratory and greenhouse conditions

Meryem El Fadil [1], Karim El Fakhouri [1], Rachid Boulamtat [2], Fatima Henkrar [3], Chaimae Ramdani [1], Khadija El Bargui [1], Ali Oubayoucef [2], Badreddine Drissi [1], Noamane Taarji [1], Mustapha El Bouhssini [1] and Mansour Sobeh [1]

[1] AgroBioSciences Program, College for Sustainable Agriculture and Environmental Science, Mohammed VI Polytechnic University, Ben Guerir 43150, Morocco.

[2] Laboratory of Entomology, International Center for Agricultural Research in the Dry Areas (ICARDA), P.O. Box 6299- Rabat Institutes, Rabat, Morocco.

[3] Plant Biotechnology and Physiology Laboratory, Faculty of Sciences, Mohammed V University, Rabat 10000, Morocco.

Corresponding author: meryem.elfadil@um6p.ma

Introduction

The pea leaf weevil, *Sitona lineatus* L., (Coleoptera: Curculionidae, PLW) is an oligophagous legume pest that causes huge losses in yield and quality of pea and faba bean crops worldwide **1**. Chemical pesticides are the most used practices to control this pest; however, they are associated with number of adverse effects on health and environment **2**. Botanical-based insecticides, among them essential oils, furnished promising protective effects and gained a considerable attention as an alternative solution to control insect pests **3**. In this context, the present study aims to evaluate the insecticidal activities of seven essential oils (EOs) under laboratory and greenhouse conditions against pea leaf weevil adults.

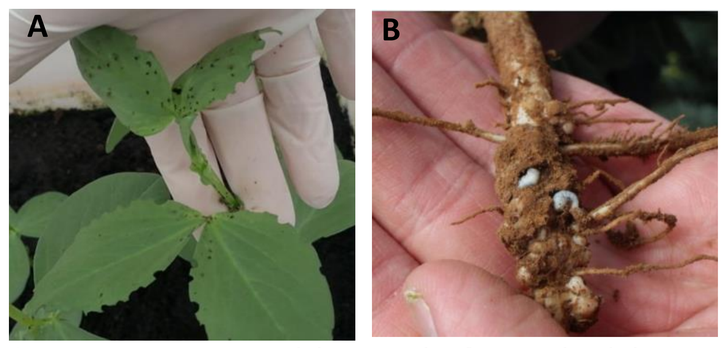

Fig 1. Damage caused by pea leaf weevil adults on leaves (**A**) and larvae on nodules (**B**).

Materials and Methods

- Under laboratory conditions, the toxicity of seven EOs (Lavenders (*Lavandula angustifolia* Mill.), Mugwort (*Artemisia herba alba* Asso.), Mint (*Mentha arvensis* L.), Geranium *Pelargonium graveolens* L'Hér, Clove (*Eugenia caryophyllata* Thunberg), Eucalyptus (*Eucalyptus globulus* Labill), and Red Myrtle (*Myrtus communis* L.)) was performed by direct contact and ingestion application, using five concentrations (0.25, 0.5, 1, 1.5, 2% (v/v)) prepared by dispersing the EO in distilled water containing 0.1% Triton X-100. The mortality was recorded after 1, 2, 3, 24, 48, 72, and 96 h.
- *L. angustifolia* and *Mentha arvensis,* the most active EOs under laboratory conditions, were tested at a concentration of 1.5% under growth chamber conditions and compared with lambda cyhalothrin, Azadirachtin, *Bacillus thuringiensis* var. Kurstaki ABTS-351 at their recommended concentrations.
- The volatile compounds profile of the most effective EO was carried out using gas chromatography coupled to mass spectrometry (GC-MS).
- Lethal concentration for 50% and 90% mortality (LC_{50} and LC_{90} respectively) were determined using probit analysis. The mortality means were compared using Newman-Keuls test at $p < 0.05$ using GenStat (21st Edition).

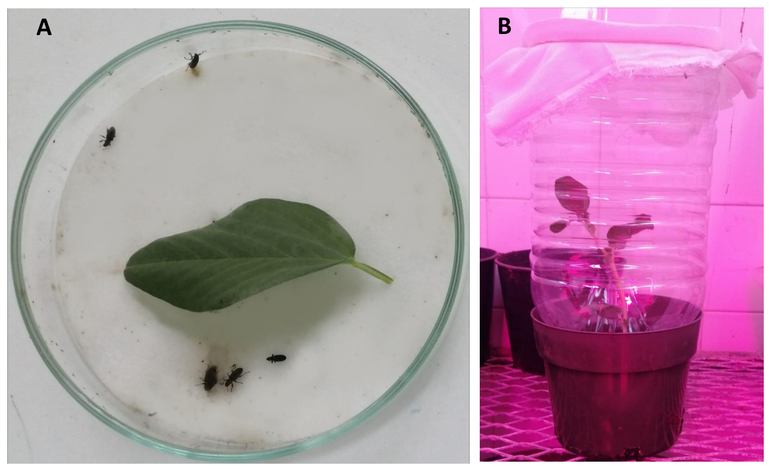

Fig 2. Contact toxicity test (**A**) and toxicity bioassay under growth chamber condition (**B**).

Results

- The mortality rates of pea leaf weevil adults using contact toxicity after exposure to EOs reached 100% at different concentrations and exposure times. These include *L. angustifolia* at 1.5 and 2% , *Artemisia herba alba* at 2%, and *M. arvensis* at 1.5% after 3h.
- The probit analysis indicated that *M. arvensis* was the most effective EO against the pea leaf weevil and its LC_{50} and LC_{90} values were 0.02% and 1.29% at 48h after application respectively, followed by *L. angustifolia* with LC_{50} and LC_{90} of 0.27% and 1.11% 96 h after treatment.
- *L. angustifolia*, at a concentration of 1.5%, displayed the highest activities among the tested EOs at all time points and reached 70% mortality rate at 96h.
- *L. angustifolia* exhibited better activities than the bioinsecticide azadirachtin (30%), while lower activities than the chemical insecticide Lambda-cyhalothrin with 80% mortality.
- GC-MS analysis showed that linalool acetate (32.91%) and linalool (26.69%) were the major compounds of *L. angustifolia*.

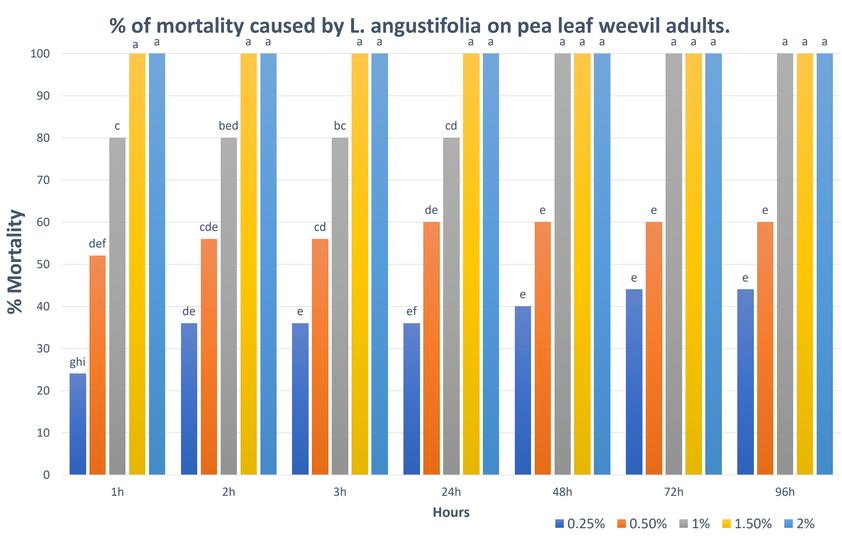

Fig 3. Contact toxicity of *L. angustifolia* against pea leaf weevil adults at different concentrations and exposure time under laboratory conditions.

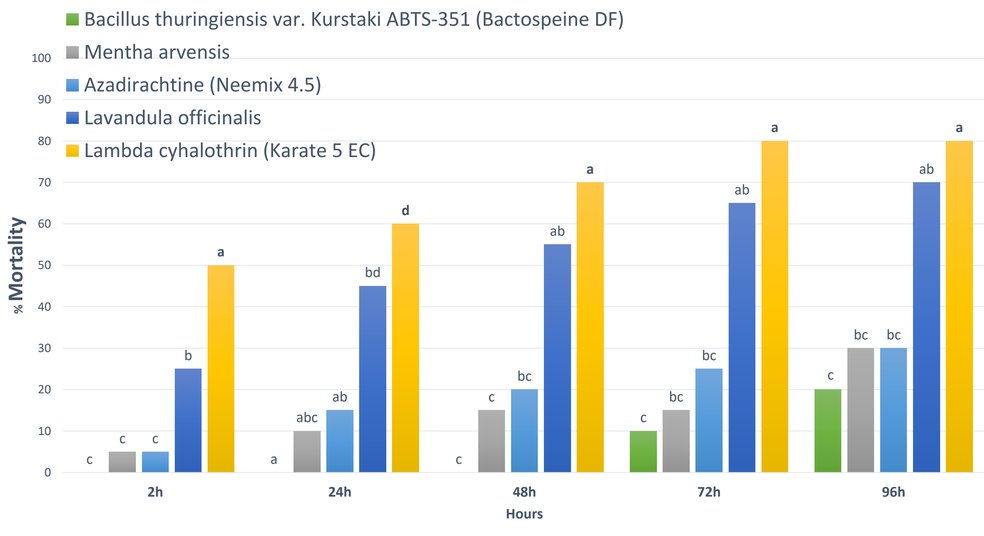

Fig 4. Contact activity of the most effective EOs and tested insecticides at different exposure times against pea leaf weevil adults under the growth chamber conditions.

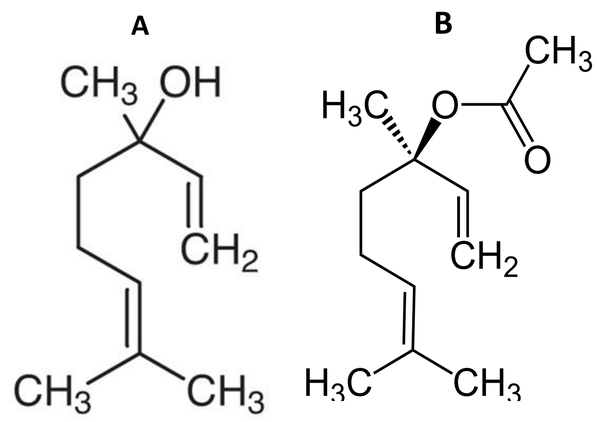

Fig 5. Major compounds of *L. angustifolia*. **A.** Linalool and **B.** Linalool acetate.

Conclusion

L. angustifolia essential oil is a promising bioinsecticide against pea leaf weevil; however, more research is needed to explore its major compound and develop formulation to be tested under field conditions as a safe and sustainable alternative to chemical insecticides with less impact on natural enemies.

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