Development and evaluation of eco-friendly biopesticides against aphids and pod borer of food legumes in Morocco

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RATIONAL

Temperate food legumes (faba bean, chickpea, field pea and lentil) are important food and feed crops in West Asia, north and East Africa regions**.** The productivity of legume crops is affected by Aphids (*Acyrthosiphon pisum* and *Aphis fabae)* and pod borer (*Helicoverpa armigera*) (Boulamtat *et al*., 2021; El Fakhouri *et al*., 2022). Due to climate and farming systems changes, the impacts of insect pests are increasing, and farmers are discouraged from including food legumes in their cropping systems. Besides direct economic damage, many aphid species play important roles as vectors of legume viruses like Pea seed-borne mosaic virus (Ademe *et al.,* 2023). Sources of resistance to aphids and pod borers are not available in temperate food legume gene-pool and farmers use insecticides to protect their crops. Looking for biopesticides as a component of biorational pest management against aphids and pod borers is a major area of research for development to increase productivity and production and of food legumes in Morocco.

OBJECTIVE

To develop and validate eco-friendly biopesticides against aphids and pod borers on food legumes.

METHODOLOGY

Development and validation of biopesticides against pod borers and aphids were done under laboratory and field conditions in the 2022/23 cropping season.

Bioassay of entomopathogenic fungi on chickpea pod borer

Larvae of *H. armigera* were collected from infested chickpea crops and reared on an artificial diet under laboratory conditions. Two species of entomopathogenic fungi (*Verticillium lecanii* and *Paecilomyces farinosus)* obtained from the Fungal Culture Collection of ICARDA Terbol, Lebanon, were evaluated using second instar larvae. The larvae were treated with 10^6, 10^7, and 10^8 conidia mL^{-1} of each fungus in five replications (5 larvae/Petri dish). The insecticide Proclaim® 05 SG (a.i. Emamectin benzoate) and water treated larvae were used as checks.

The two entomopathogenic fungi and the insecticide Proclaim® 05 SG at 250 g/ha were also evaluated under field conditions. The trial was planted at ICARDA experimental station-Merchouch, Morocco in 2023 in a randomized complete block design with three replications. Spores of the entomopathogenic fungi (10^8 spores mL^{-1}) were applied two times at seven days intervals at the podding stage chickpea. Larval mortality was recorded three times after each spore application.

Effects of essential oil sprays on green pea aphids

Essential oils extracted from *Ocimum basilicum, Origanum vulgare,* and *Mentha piperita* selected under laboratory assays (5000 ppm dose) were validated under field conditions using a susceptible local lentil variety Zaaria in the 2022/23 cropping season. The commonly used insecticide Pirimor (a.i. Pirimicarb) and non-sprayed plots were used as checks. The experiment was arranged randomized complete block design with three replications. Aphid counts were made 1, 2, 3, 4, and 5 days after treatment applications.

RESULTS

Effects of entomopathogen fungi against chickpea pod borer under laboratory and field conditions

Under laboratory bioassay, the mean percent larval mortality was high at the highest spore concentration (108 mL^{-1}) followed by 107 spores mL^{-1} for both entomopathogenic fungi (Fig. 1). The effects of entomopathogenic fungi were about the same with commonly used insecticide Proclaim® 05 SG.

Under field condition, the two fungi showed low number of live larvae as compared to the untreated control and the lowest was from insecticide treated plots (Fig. 2). The lowest live larval count was observed after two applications of the entomopathogenic fungi. The results showed that two applications of entomopathogenic fungi is required for better pod borer management in chickpea.

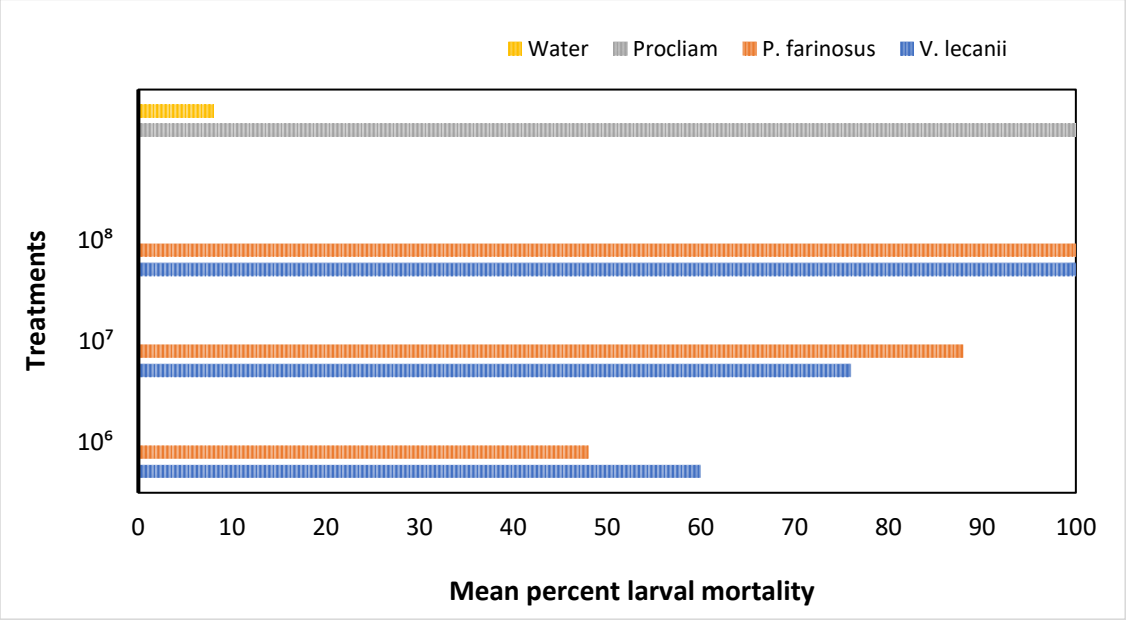

Figure 1. Effects of entomopathogenic fungi on mean larval mortality 15 days after treatment application.

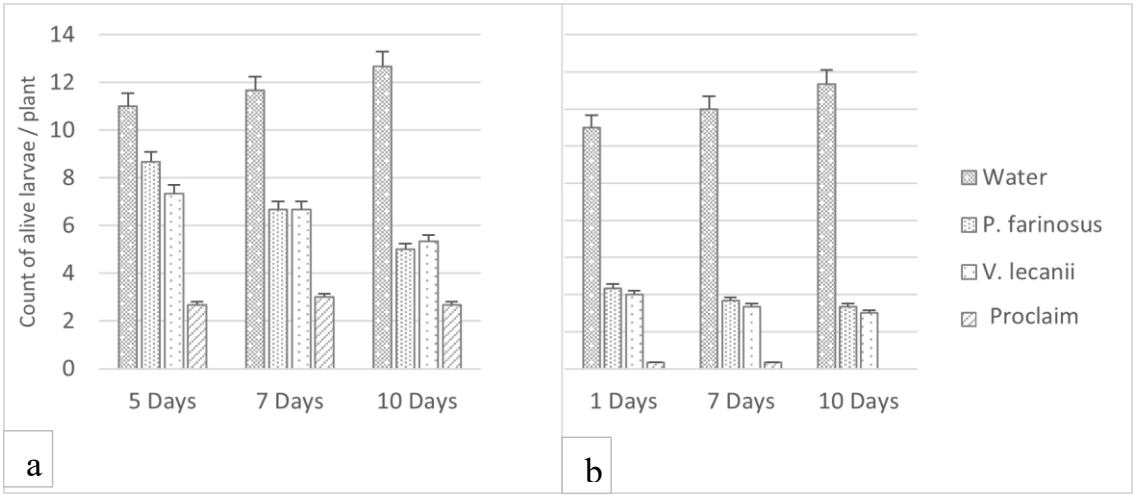

Figure 2. Mean number of live larvae of chickpea pod borer after application of biopesticides (a): First application and (b): Second application.

Effects of essential oils against green pea aphids

Essential oils (EOs) effectiveness on aphid mortality increased over time as compared with the synthetic insecticide that caused high mortality one day after application (Fig. 3). Essential oils from *O. basilicum* and *O. vulgare* were effective in causing over 60% mortality after four days of application and can be further promoted using farmer fields.

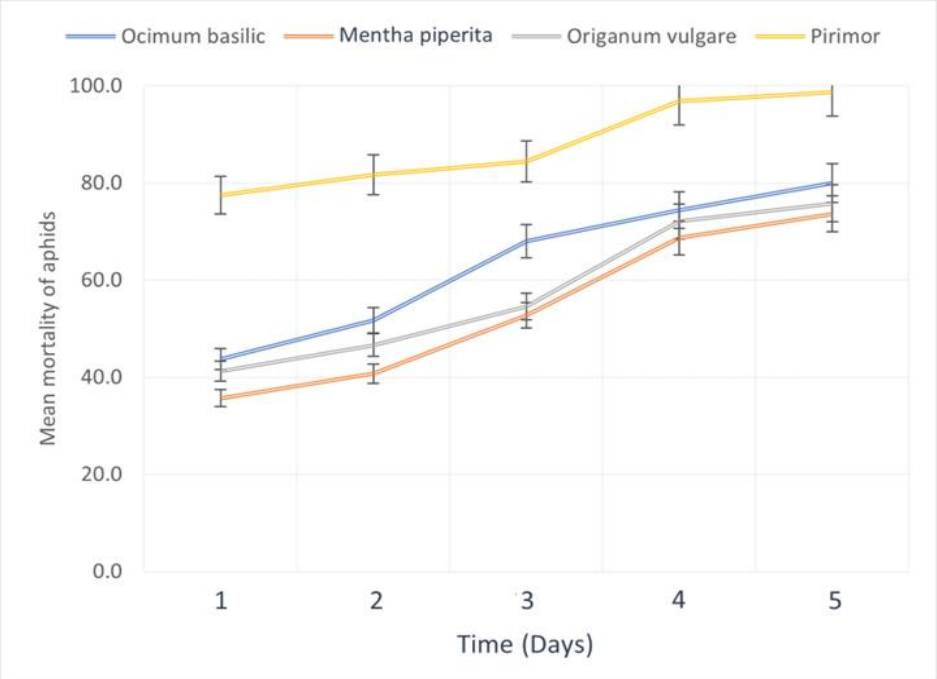

Figure 3. Effects of essential oils and synthetic insecticide on mean aphid mortality in 2022/23 cropping season, Merchouch, Morocco.

CONCLUSION

Pod borer and aphids remain the major threat of chickpea and lentil in Morocco and other countries where the two crops are important. Uses of biopesticides (essential oils and entomopathogenic fungi) evaluated both in the laboratory and under field conditions gave promising results in reducing insect populations. The biopesticides will be promoted as an alternative means on farmer fields and formulations will be started together with advanced research institutions in Morocco.

REFERENCES

Ademe A., S.G. Kumari, T. Alemu, A. Abraham, Y. Aynewa, A. Moukahel, D. Guadie and S. Ahmed. 2023. Spatial distribution and association of biophysical factors with chickpea chlorotic stunt and pea seed-borne mosaic viruses affecting legume crops in Ethiopia. *Journal of Phytopathology,* 171(11-12): 731-743. https://doi.org/10.1111/jph.13236

Boulamtat, R., A. Mesfioui, K. El-Fakhouri, A. Oubayoucef, A. Sabraoui, A. Aasfar and M. El-Bouhssini. 2021. Chemical composition, and insecticidal activities of four plant essential oils from Morocco against larvae of *Helicoverpa armigera* (Hub.) under field and laboratory conditions. *Crop Protection*, 144: 105607. https://doi.org/10.1016/j.cropro.2021.105607

El Fakhouri, K., R. Boulamtat, A. Sabraoui and M. El Bouhssini. 2022. The Chickpea Pod Borer, *Helicoverpa armigera* (Hübner): Yield Loss Estimation and Biorational Insecticide Assessment in Morocco. *Agronomy*, *12*, 3017. https://doi.org/10.3390/agronomy12123017