Evaluations of biopesticides for the management of food legume aphids and pod bores in Morocco

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Rational **:** Different Aphid species (*Acyrthosiphon pisum* and *Aphis fabae)* and pod borers are key production constraints on faba bean, field pea, chickpea and lentil in south Asia, north Africa and East Africa. Besides direct economic damage, some aphid species play important roles as vectors of legume viruses like Pea seed-borne mosaic virus (PSbMV). Sources of resistance to aphids and pod borers is not available in temperate food legumes and farmers largely use insecticides to protect their crops. Looking for biopesticides against aphids and pod borers is an important area of research to develop biorational pest management in food legumes.

Objective

- To develop Eco-friendly and climate-smart biopesticides against aphids and pod bores of food legumes

Activity 1.1. *Management of food legume aphids and pod borers using plant extracts and entomopathogenic fungi*

Legume aphids**:** Laboratory screening of essential oils (EOs) extracted from indigenous Moroccan plant species against food legume aphids was tested against Aphids and pod borers. For food legumes Aphid bioassay, a colonies of *A. pisum* and *A. fabae* were collected from Merchouch ICARDA research station in Morocco and were maintained on lentil varieties in the greenhouse and neonate nymphs were used in all bioassays. For green pea aphids on lentil, essential oils extracted from eight plant species were tested at 5000 ppm in Petri dishes (5 aphids/Petri dish)

with five replications. For black aphids, EOs of four plant species were tested using four dosage levels on faba bean plants. The test was replicated five times and five aphids were placed in each petri dish.

***Chickpea pod borer*:** Larvae of *H. armigera* were collected from infested chickpea crops at ICARDA experimental station-Merchouch, Morocco. The larvae were reared on artificial diet under laboratory conditions and the second instar larvae were used in the bioassay. Three Strains (HASS, RFSL10, and SP IR 566) of the entomopathogenic fungus *B. bassiana* were used in the bioassay. The larvae were impressed in 1.10^{8} conidia mL^{-1} fungal spore concentration.

Results

Legume aphids: The essential oil extracted from the two *Salvia* spp was very effective in killing green pea aphids three hours after treatments **(Fig. 1**). The output will be evaluated under field condition in the 2023/24 cropping season. For black aphids, the bioassay showed that at 5000 ppm, EOs from *L. dentata* showed 80% mortality 48h after treatment followed by *A. herba alba* (**Table 1**). The effective EOs will be further evaluated under field condition.

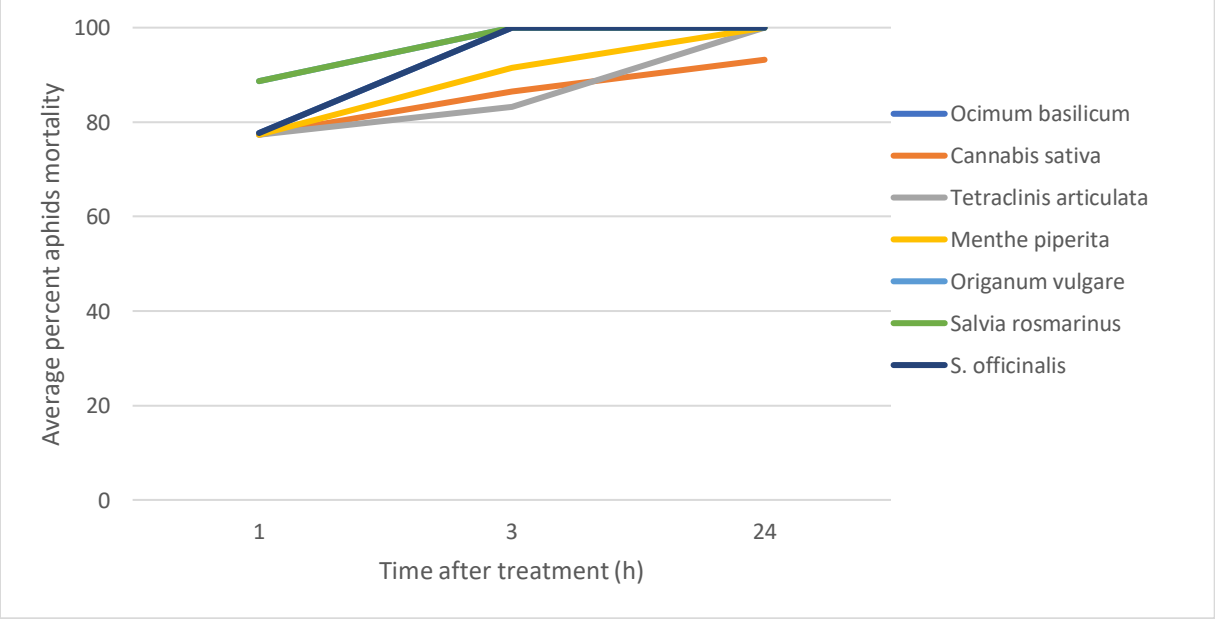

Figure 1. Effects of essential oils on mean percent mortality of green pea aphids on lentil

Photo 1: Toxicity of Essential oils on green pea aphids

Table 1. Effects of Essential oils extracted from different plant species at different dosages on mean percent black aphid mortality on faba bean

Plant species	Dosages (ppm)	Mean percent mortality	
		24 h	48 h
Lavandula dentata	1000	8	12
	2000	8	16
	3000	16	20
	5000	64	80
Artemisia herba alba	1000	0	0
	2000	12	20
	3000	24	36
	5000	40	56
Mentha pulegium	1000	4	4
	2000	4	8
	3000	12	16
	5000	16	28
Cuminum cyminum	1000	4	20
	2000	12	28
	3000	20	24
	5000	24	36

Chickpea pod borer: The different strains of entomopathogenic fungus *B. bassiana* caused different levels mortality (**Fig. 2**). Strains RFSL 10 and HASS caused more than 60% mortality where us the insecticide was effective after one day application.

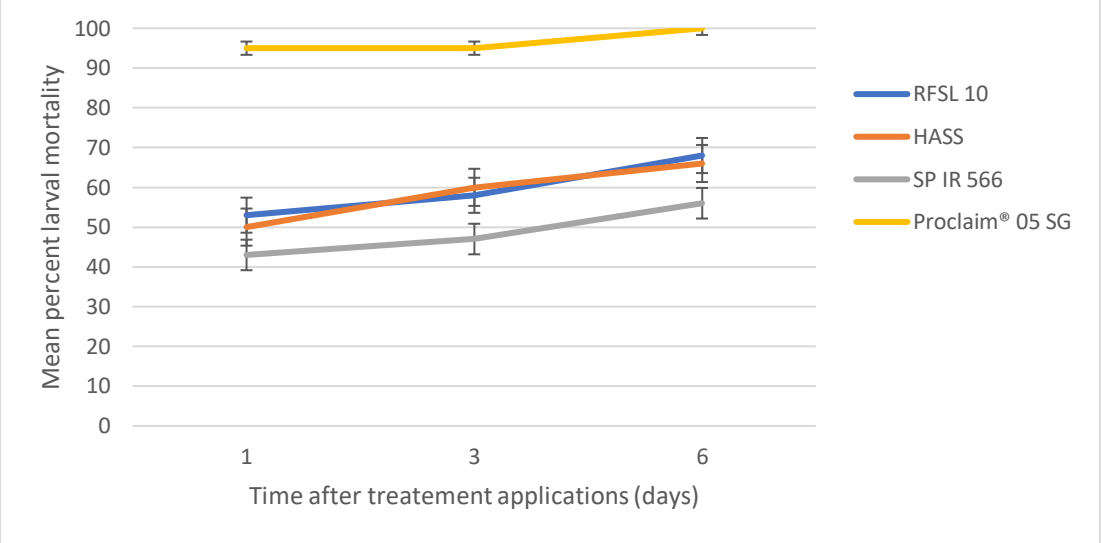

Figure 2. Mean percent mortality of chickpea pod borer larvae treated with strains of entomopathogenic fungus B. *bassiana* **.**

Photo 2: Mortality of pod borer raves with entomopathogenic strains of *B. bassiana*

Field testing of biopesticides against aphids and pod borer

***Green pea aphids*:** Essential oils extracted from local plant species were evaluated under field conditions against green pea aphid on lentil. In the field trial, the commonly used chemical insecticide Pirimor (a.i. Pirimicarb) and the biopesticide Azadirachtin were included for comparison purposes. Aphid counts were made 24 and 48 h after treatment applications.

***Chickpea pod borers*:** Three stains (RFSL 10, HASS SP and IR 566) of the entomopathogenic fungus *B. bassiana* and Proclaim® 05 SG at the rate of 250 g/ha (a.i. Emamectin benzoate) were evaluated using susceptible Kabuli chickpea variety *Farihane* (FLIP-84-79C). The field experiment in randomized complete design replicated three times. The fungal strains were applied two times at seven days intervals. Mortality of larvae was recorded 1, 3 and 6 days after treatment applications.

Aphid control*:** Over 90 percent mortality was caused by the synthetic insecticide Pirimor. However, the EOs extracted from caused over 60% aphid mortality as compared with the widely used ***Azadirachtin *biopesticide (***Fig.2***).*

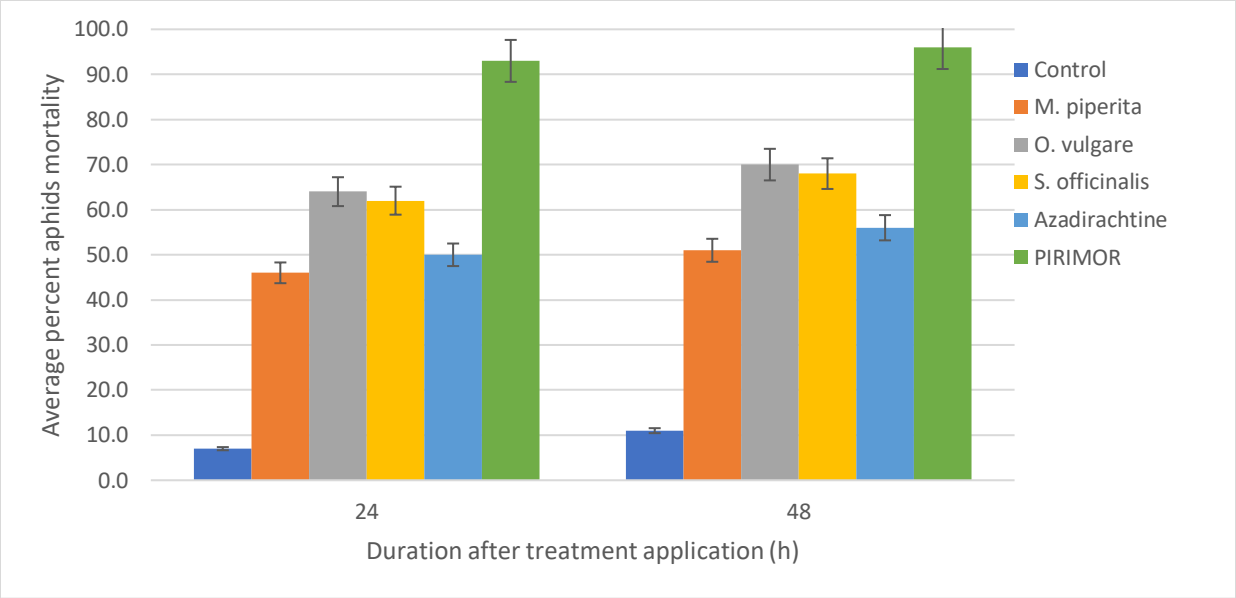

Figure 2. Effects of essential oils extracted from local plant species on mean mortality of green pea aphids

***Chickpea pod borer control*:** After six days of application, strains RFSL 10 and HASS gave over 60% mortality while the insecticide was effective after one day of the second application (**Fig. 3**). The two strains showed good promise in protecting chickpea from pod bore and can be further evaluated on large plots.

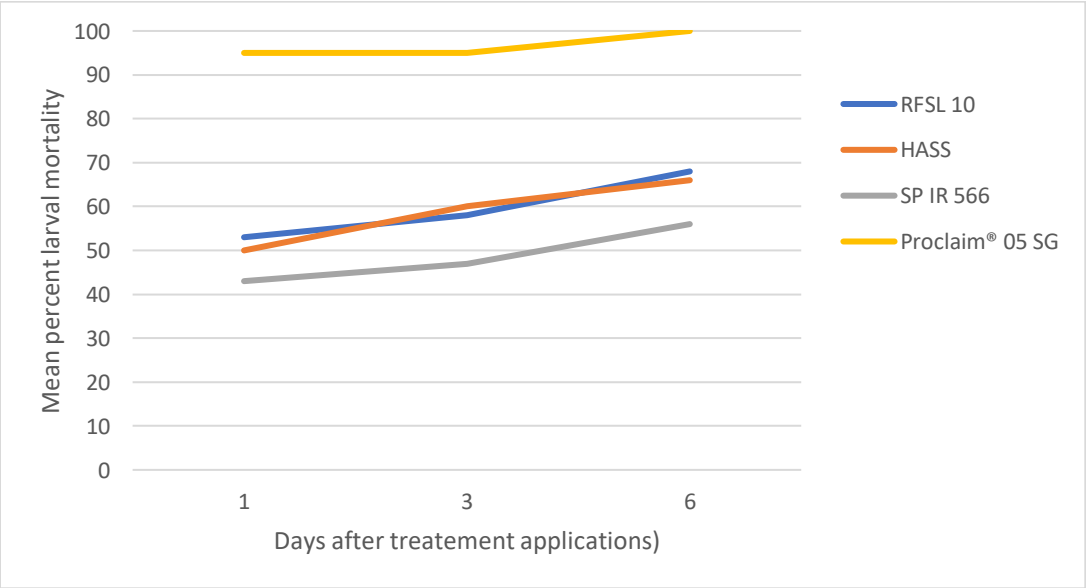

Figure 3. Effects of *B. bassiana* strains on mean percent mortality of chickpea pod borer, 2021/22 cropping season, Merchouch station, Morocco