Efficacy of Entomopathogenic Fungi Against *Bruchus rufimanus* (Coleoptera : Chrysomelidae) in laboratory and field trials using dropleg spraying technique

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Introduction & Objectives

- *Bruchus rufimanus* Boheman 1833 (Coleoptera : Chrysomelidae) is the major insect pest of faba bean (*Vicia faba* L.) in temperate regions, due to the significant damage caused to seeds by endophytic larvae in cultivation, impacting seeds quality and their economic value.
- Faced with inefficient chemical control in Europe combined with legislative restrictions on the use of chemical pesticide, and their negative impact on beneficials, alternative solutions are needed.
- This study evaluates the efficacy entomopathogenic Fungi (EPFs) against *B. rufimanus* in the laboratory conditions and faba bean crop using two spraying techniques, the dropleg and anti-drift nozzles (*i.e.*, the conventional technique).

Materials & Methods

- **Laboratory experiments (lethal and sublethal effects)**

➢ **Fungal strains tested :**

○ *Beauveria bassiana* (GHA), *Metarizium brunneum* strains USDA 4556 and V275 (**Figure 1**)

➢ **2 bioassays on 600 adults of *B. rufimanus* :**

○ Evaluation of the lethal effects (LT50 and mortality rate) on 300 sexed adults **(Figure 2 a)**

○ Evaluation of sub-lethal effect (inhibition of oviposition) on 300 sexed adults **(Figure 2 b)**

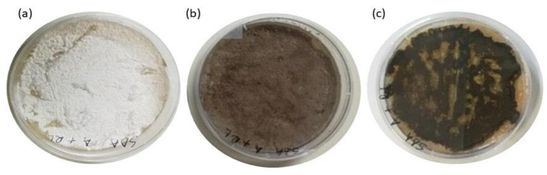

Figure 1: Sporulating EPFs strains used in bioassays against *B. rufimanus* (a) *B. bassiana* (strain GHA), (b) *M. brunneum* strain USDA 4556, and (c) strain V275 after 15 days of incubation

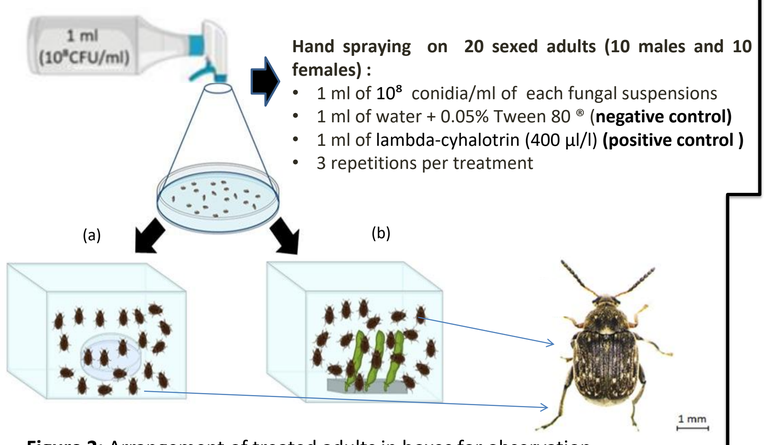

Figure 2: Arrangement of treated adults in boxes for observation of lethal (*i.e.*, LT50, mortalities) (a) and sublethal (oviposition on green pods) effects) (b)

- **Field experiments in faba bean crops**

○ Two spraying technics (conventionnal with anti-drift nozzles and dropleg nozzles) on crops

○ Assesment of the spraying distribution of sprays on the lower and upper parts of faba bean plants by observation of **relative coverage rate** on water sensitive papers (WSPs)

○ Comparison of the plant protective effect of EPF treatment (*B. bassiana* strain GHA) and chemical treatment (lambda cyhalotrine) on faba bean seed quality (**infestation rates**) and **thousand seed weight (TSWs)**

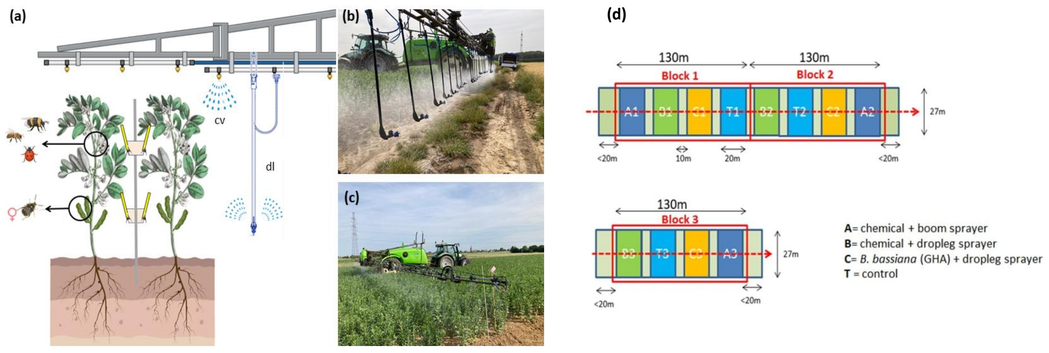

Figure 3: Crop arrangement of WSPs at upper and lower levels of faba bean plants according to auxiliary/*B. rufimanus* behavior and according to the two types of nozzles compared in the trials—anti-drift (cv) and dropleg (dl) nozzles (**a**). Illustration of dropleg nozzles mounted on a 27 m boom (**b**); illustration of anti-drift nozzles mounted on a 27 m boom (**c**) , and experimental design for the comparison of different treatments on *B. rufimanus* infestations**(d)** © A. Segers.

Results

Efficacy of Entomopathogenic Fungi in the laboratory

Table 1: Synthesis of EPF lethality and sublethality (egg-laying inhibition) bioassay results

Treatments	Kaplan–Meier Survival Estimates			Log-Rank Test vs. Control			Total Ovipositions	Oviposition Inhibition Rate
	n	Dead_obs	Median (LT_{50})	Chisq	Df	*p*-Value		
B. bassiana (GHA)	60	58	4	101	1	<0.001	111 eggs	36%
λ-cyhalothrin (40 mg/L)	60	47	2.5	54	1	<0.001	25 eggs	86%
M. brunneum (USDA 4556)	60	55	6	71.4	1	<0.001	151 eggs	12%
M. brunneum (V275)	60	50	8	53.5	1	<0.001	120 eggs	31%
Tween 80 (0.05%)	60	10	>10	/	/	/	174 eggs	-

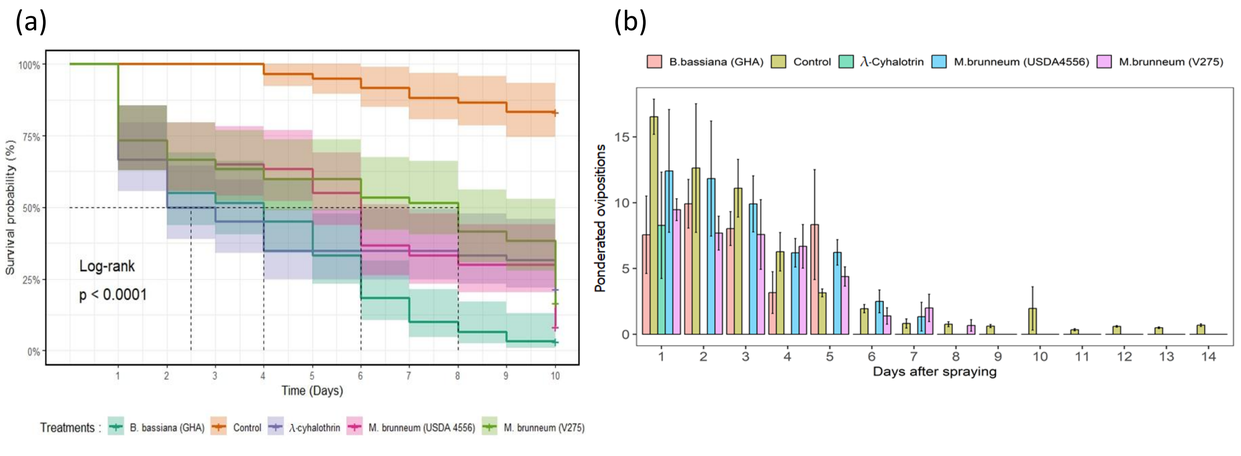

Figure 4: Survival curves after treatments performed on *Bruchus rufimanus* during laboratory experiments. LT_{50} estimations are reported by the dotted lines (a) and Evolution of *Bruchus rufimanus* punderated ovipositions according to applied treatments during 14-day of monitoring (b),

Field trials Results

Repartition of spray density on faba bean crop with dropleg and conventional nozzles

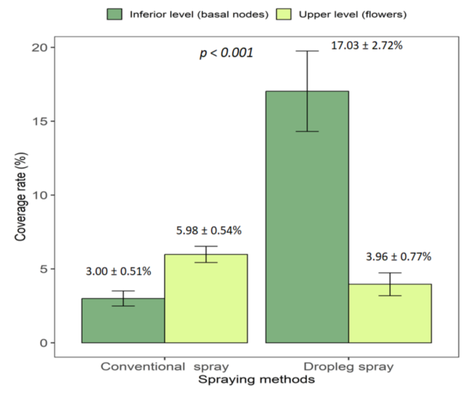

Figure 5: WSP coverage rate (average ± standard deviation).

Plant protective effects against *B. rufimanus* Infestations (infestation rates %) and faba bean TSWs

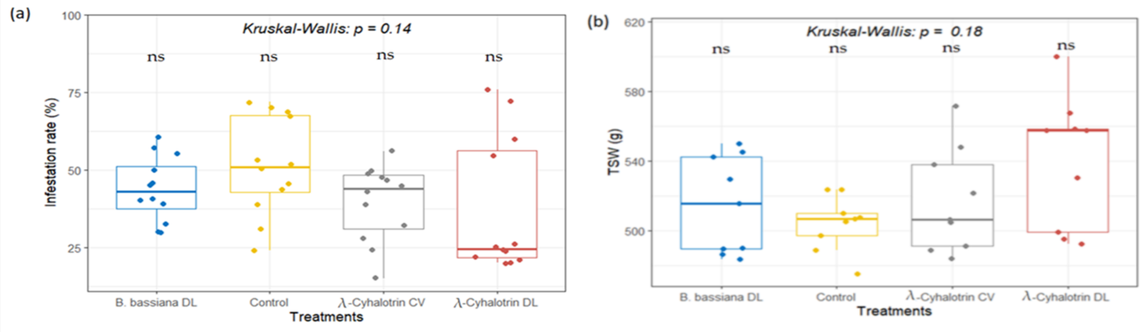

Figure 6: Infestation rate (%) (a) and TSW (Total seeds weight) (b) observed with different field treatments (cv = anti-drift nozzles, dl = dropleg nozzles, ns = not significant).(ns =not significant)

Conclusion & perspectives

- Entomopathogenic fungi are promising biocontrol agents to be incorporated into biopesticides to control *B. rufimanus*
- Fungal and chemical treatments provided limited seed protection against *B. rufimanus*, reducing infestation rates by 7% and 14%, respectively
- Large-scale spraying of chemical or fungal active ingredients, such as inundative application of *B. bassiana* GHA, is not an optimal approach to implement effective integrated pest management (IPM) strategies against *B. rufimanus in faba bean crops.*
- Further studies should be performed on other strategies of use of fungal biopesticides such as the attract and infect strategy that may improve the efficacy of entomopathogenic fungi in the field combined with the selection of appropriate cultivars.

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