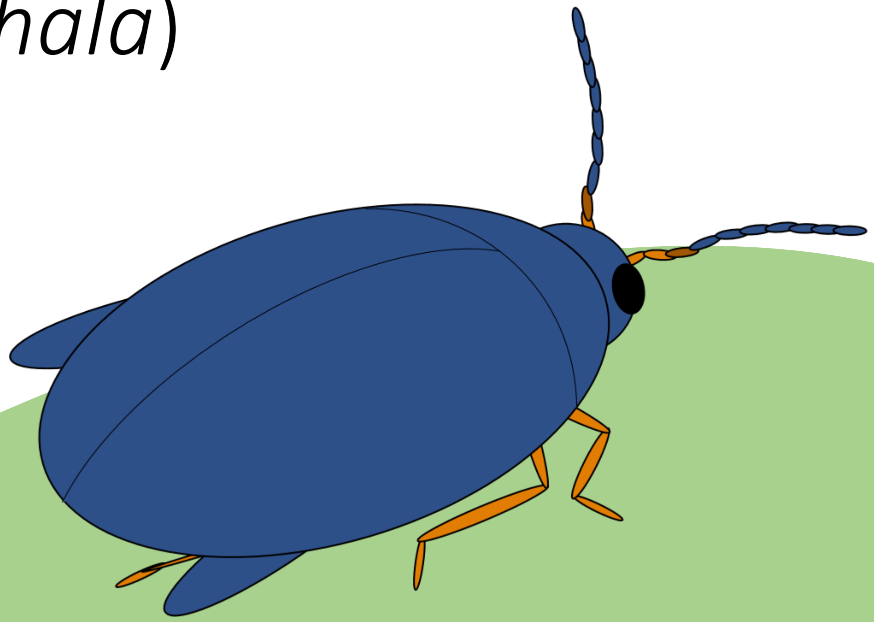
Investigating biopesticides for the control of cabbage stem flea beetle (*Psylliodes chrysocephala*)

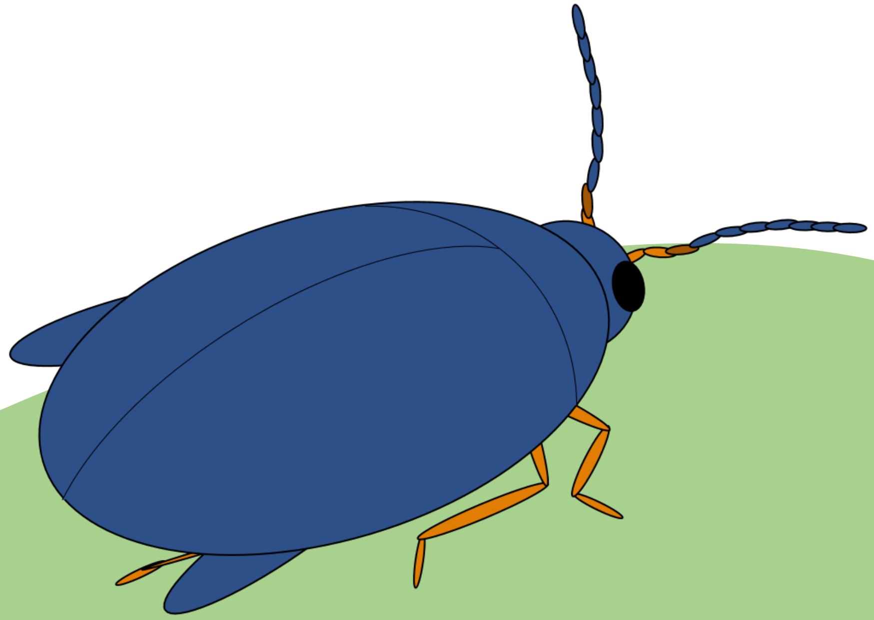
Claire Price

Monday 15th April 2024

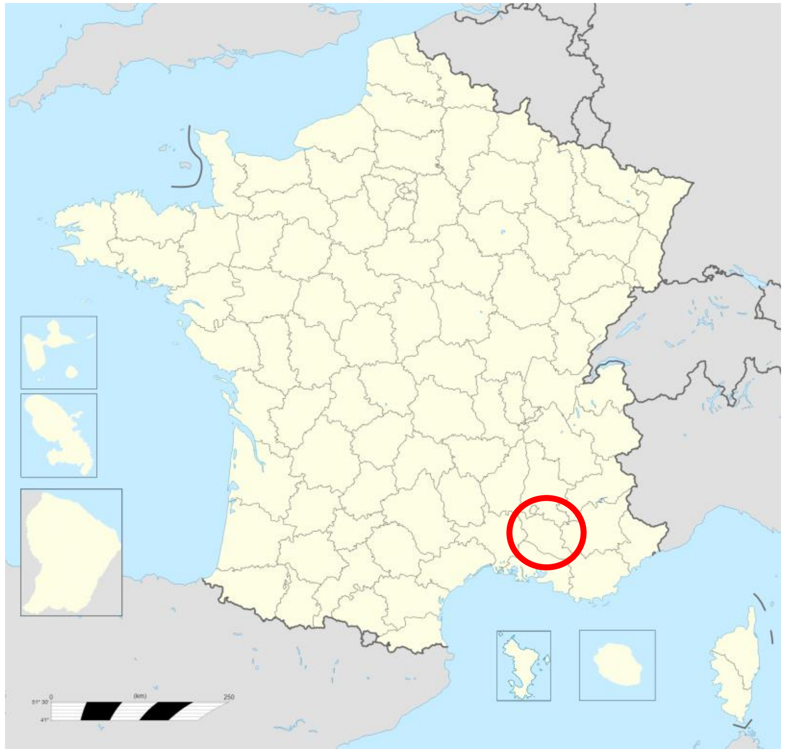


Programme

- A bit about myself
- Project aim and context
- Laboratory experiments
- Field experiments
- Sentiment analysis
- Summary
- What next?



A bit about myself



BSc Life and Earth Science

MSc Plant Production Quality Management

Project aim and context

Cabbage stem flea beetle (CSFB), major pest in oilseed rape crops

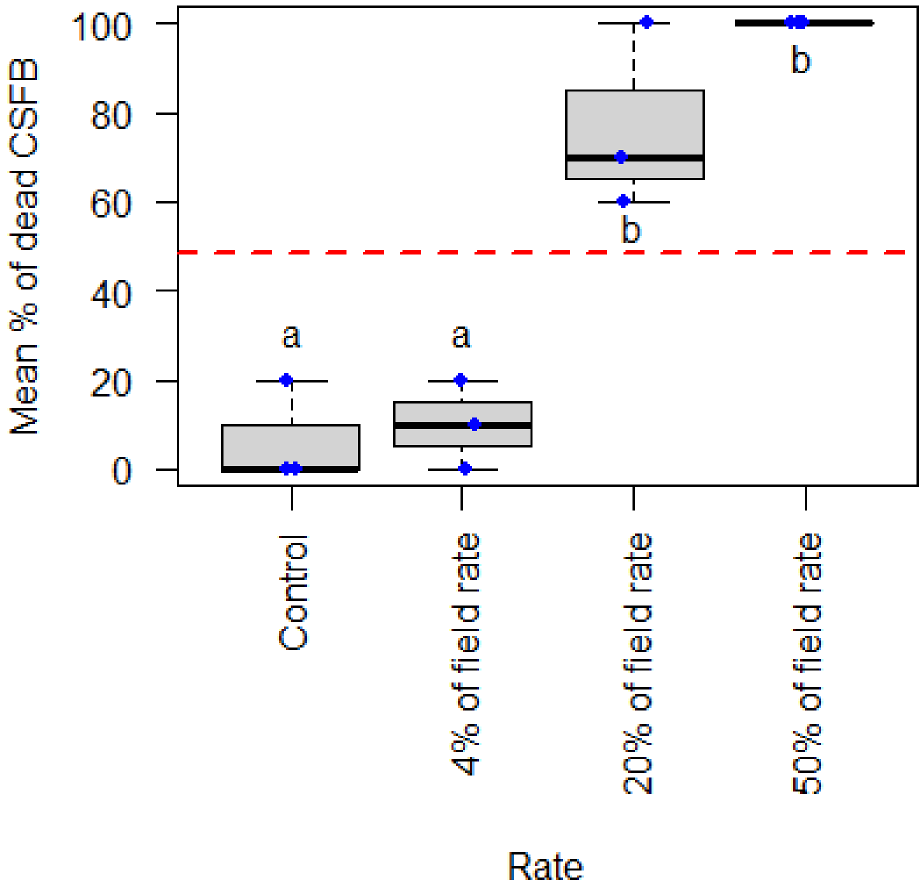
Severe economic damage from reduced yields or total crop failure

Project aim and context

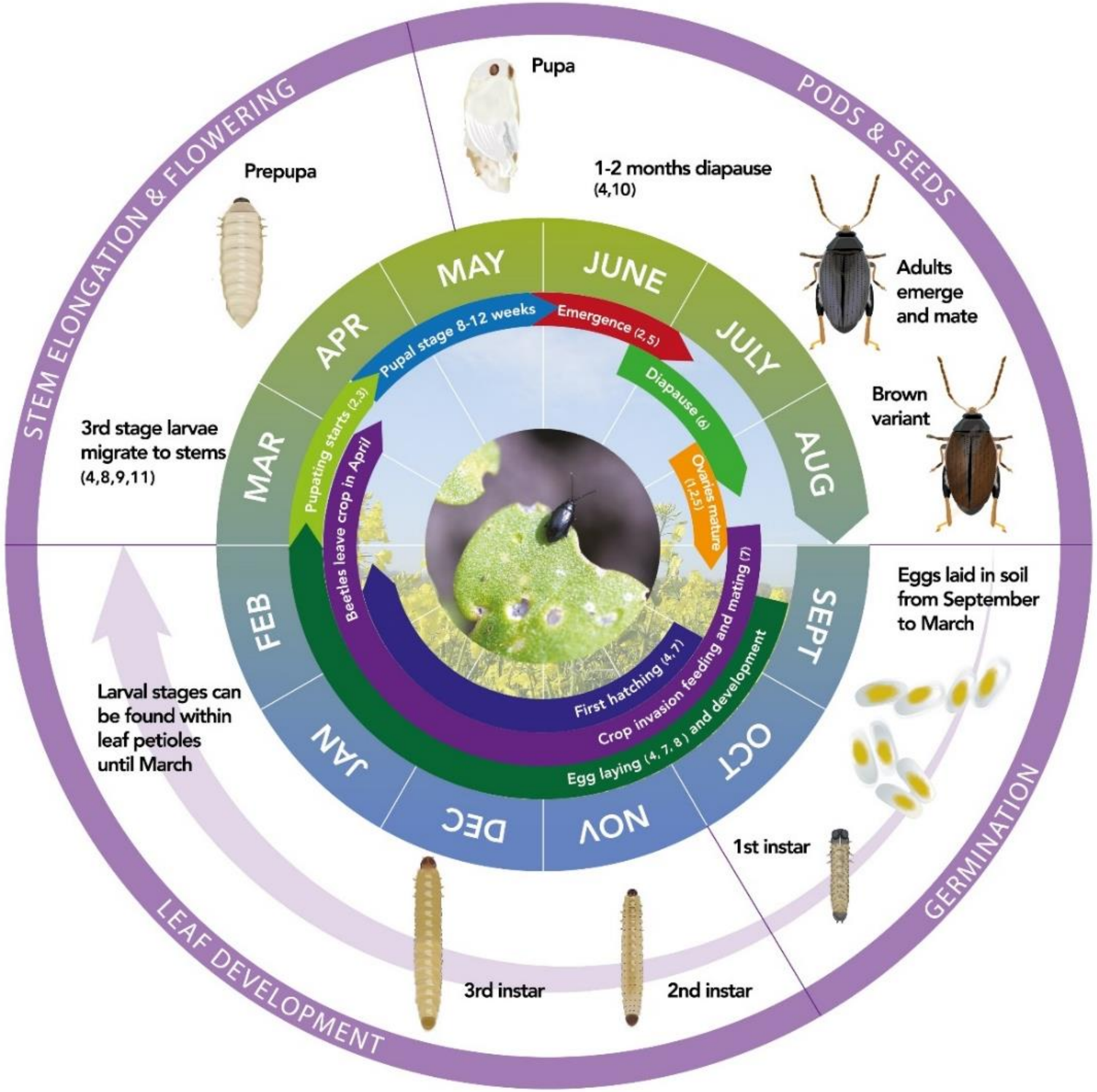
- European Union banned the use of neonicotinoid insecticides >> control of CSFB in oilseed rape relies on pyrethroid insecticides

- CSFB are largely resistant to pyrethroids, which are also harmful to non-target organisms >> **identify alternatives to conventional insecticides**

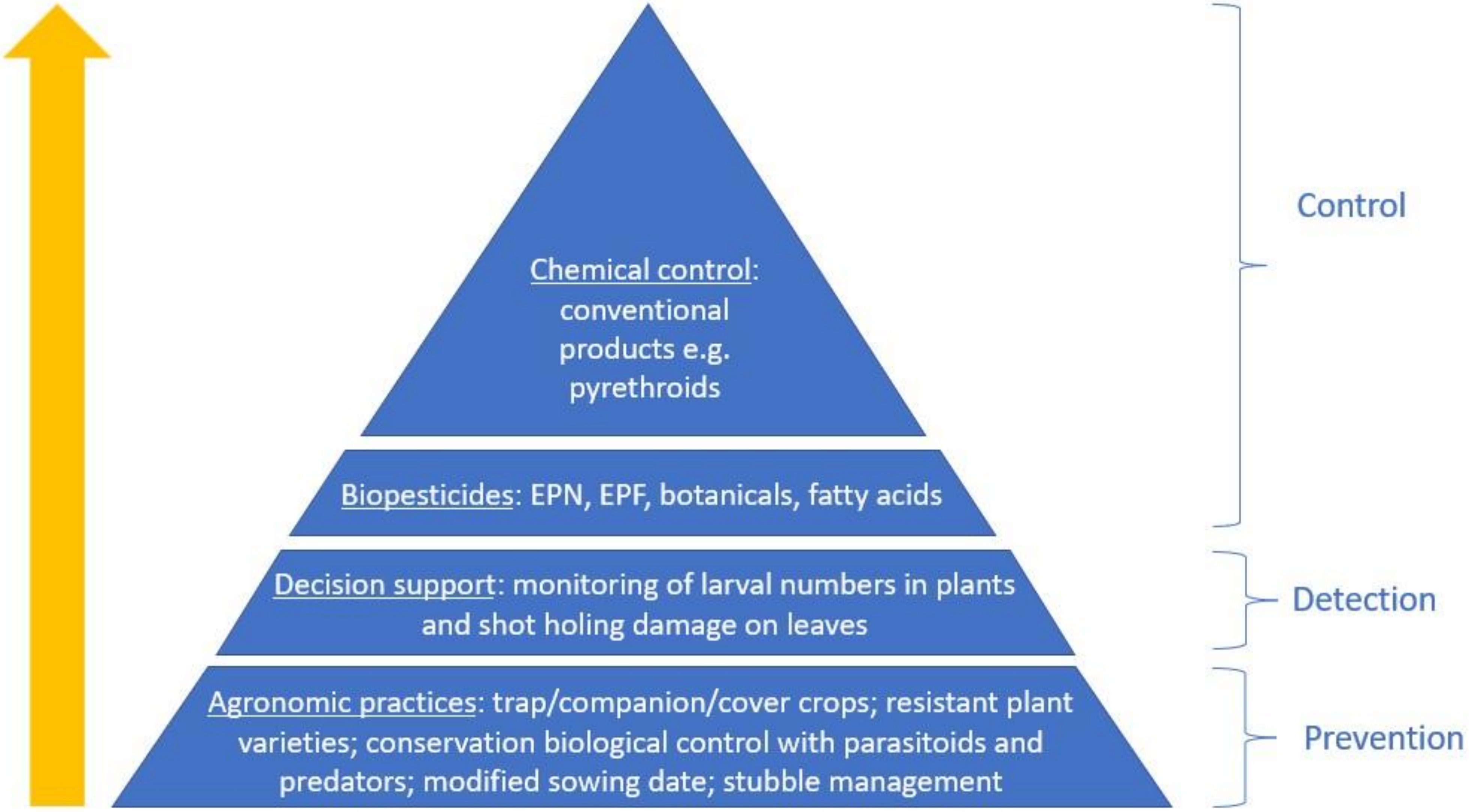
IRAC resistance experiment



Percentage of dead cabbage stem flea beetle (CSFB) (*Psylliodes chrysocephala*) one day after treatment with lambda-cyhalothrin (pyrethroid) and acetone control.



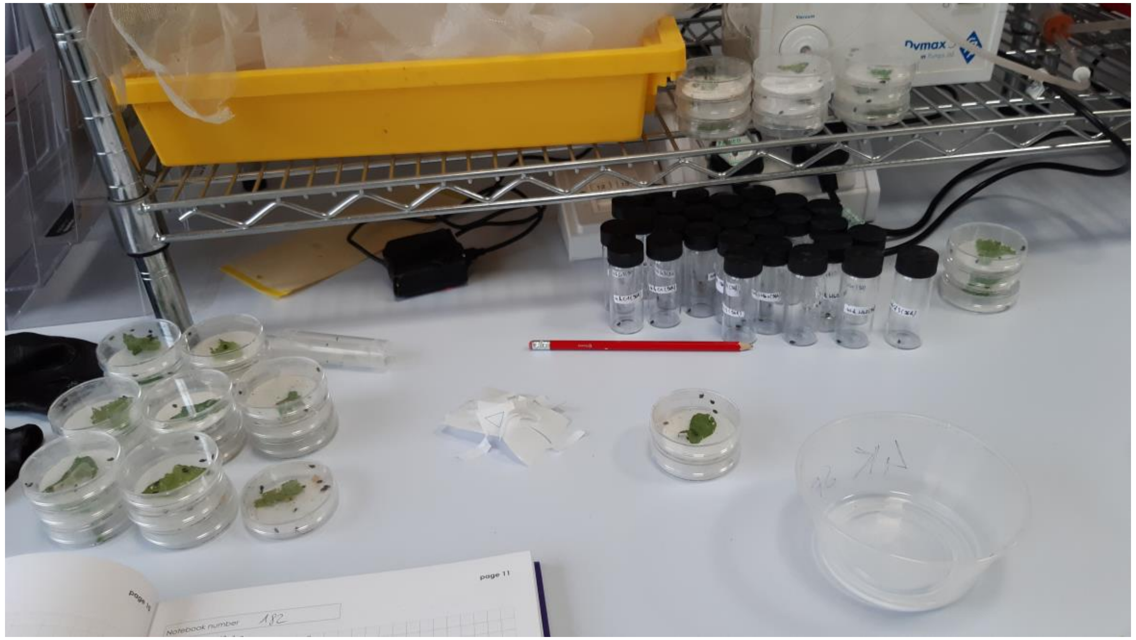
Cabbage stem flea beetle life cycle against oilseed rape growth

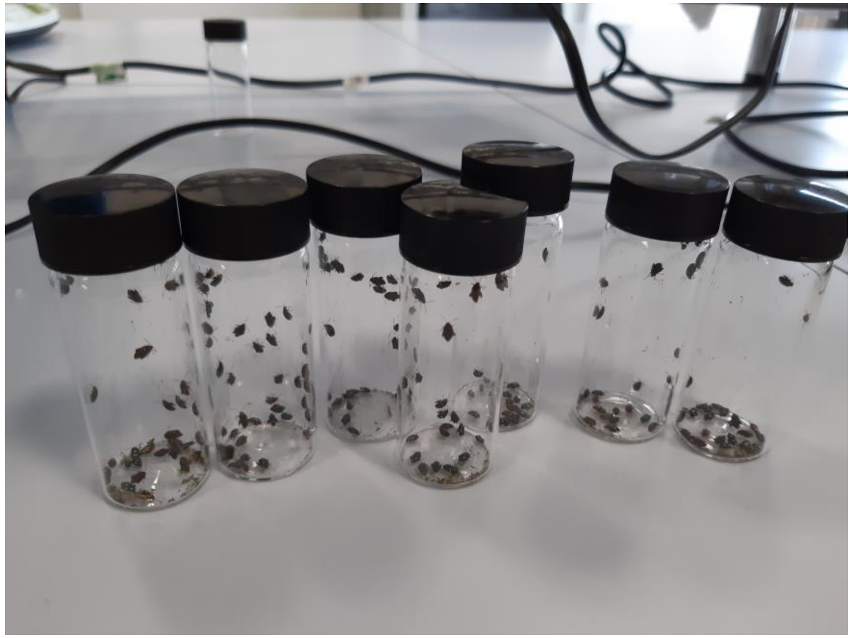


Integrated Pest Management pyramid for oilseed rape

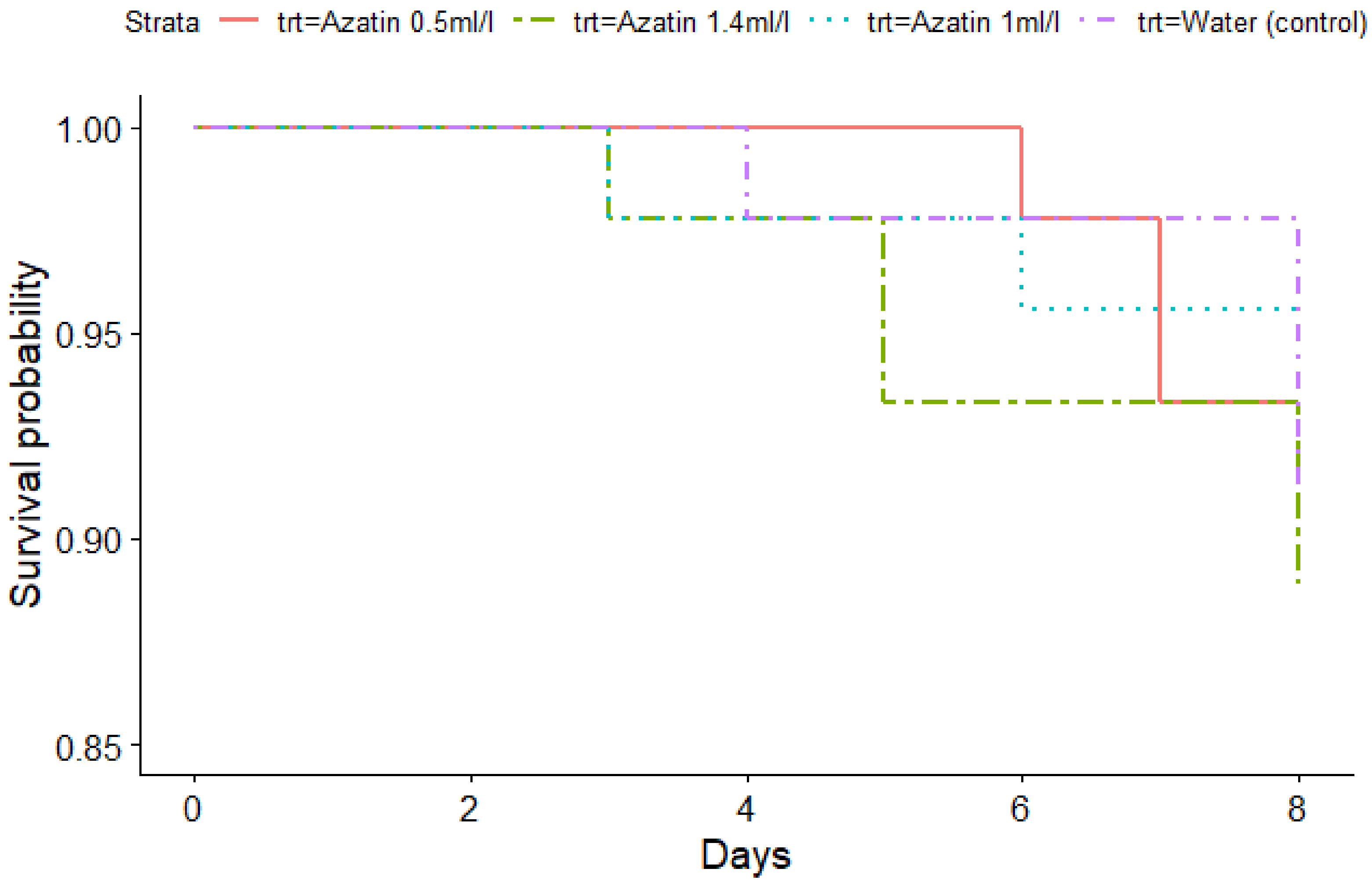
AFCP The AgriFood Charities Partnership

Laboratory experiments



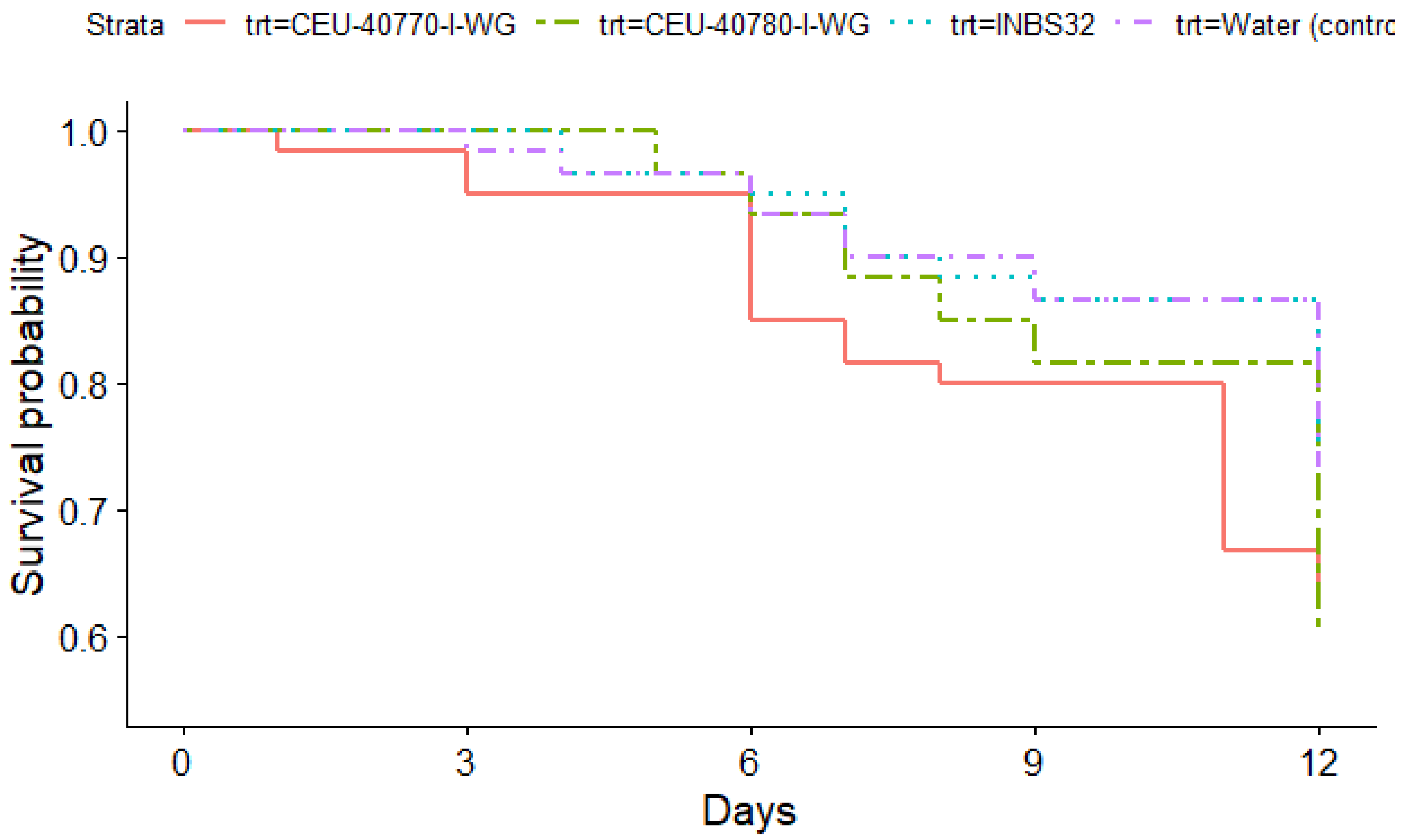


Azadirachtin



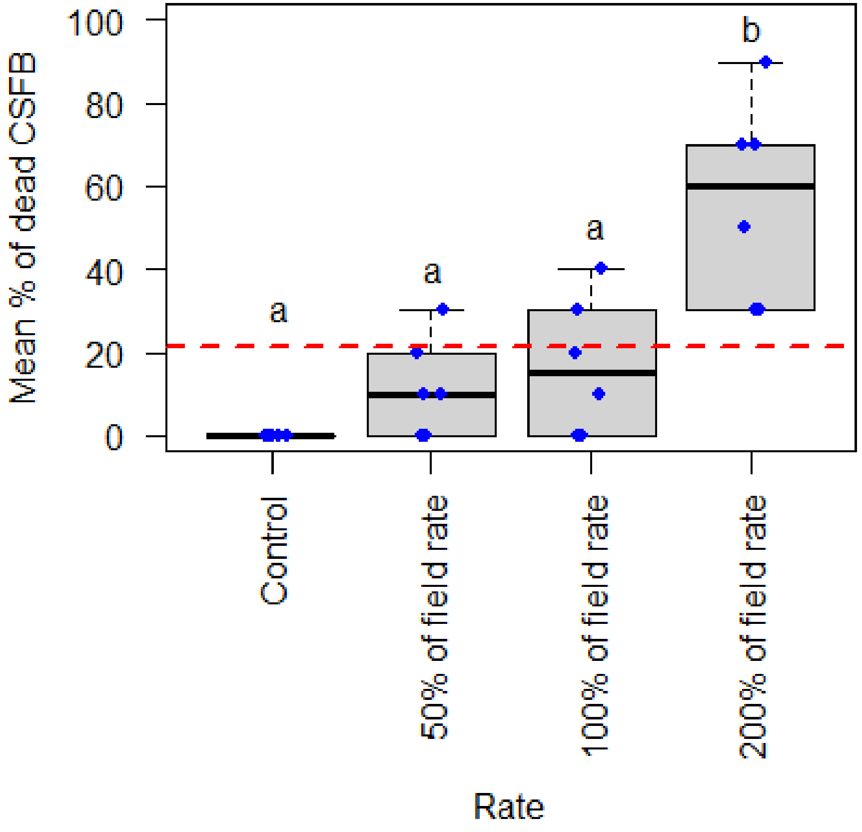
Survival curve of cabbage stem flea beetle (CSFB) (*Psylliodes chrysocephala*) after application of different rates of azadirachtin and water (control).

Entomopathogenic bacteria



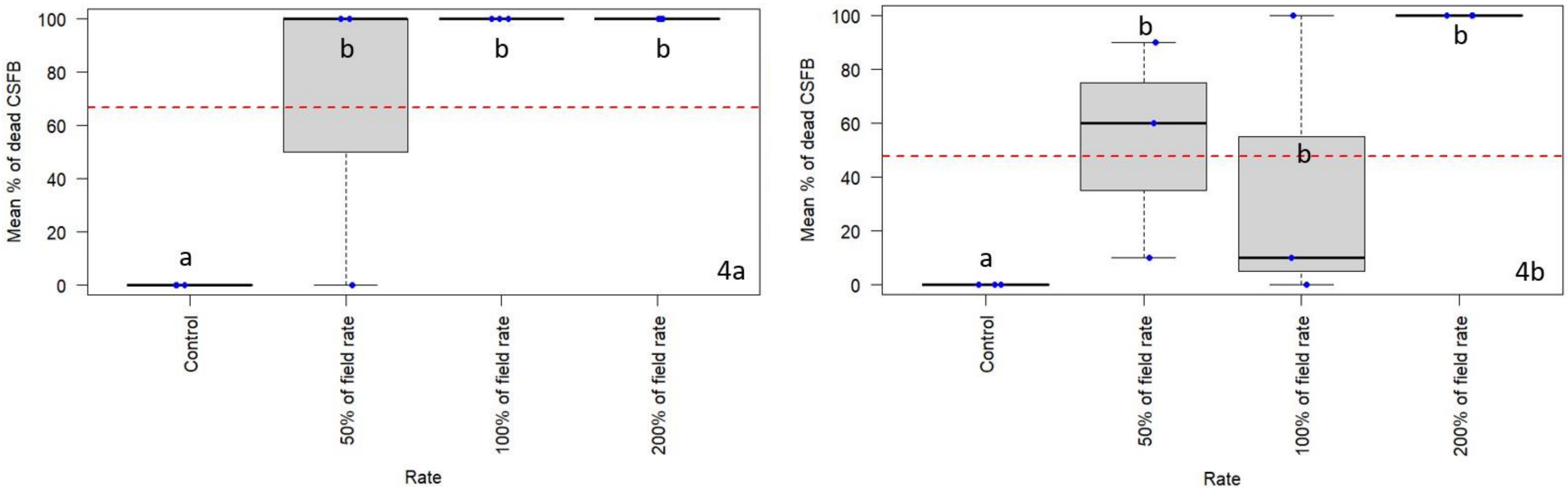
Survival curve of cabbage stem flea beetle (CSFB) (*Psylliodes chrysocephala*) after application of different strains of *Bacillus thuringiensis* sbsp. *tenebrionis* and water (control).

Entomopathogenic fungus



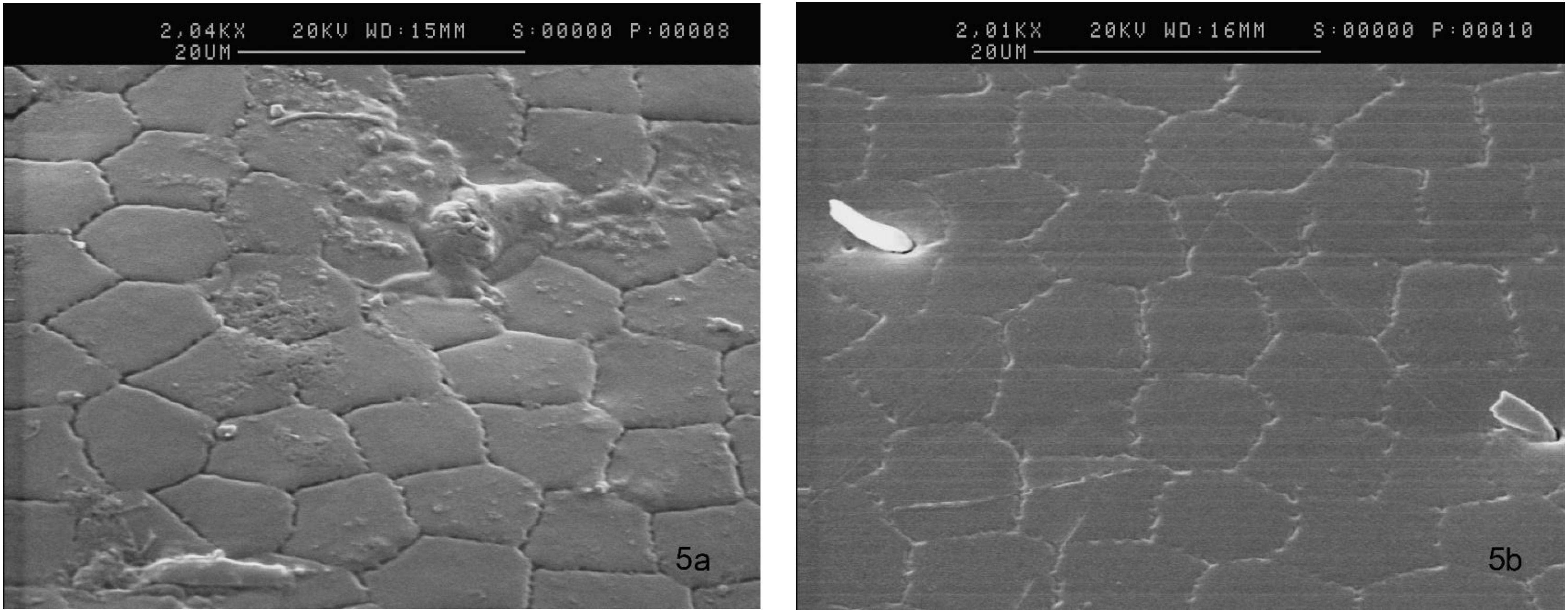
Percentage of dead cabbage stem flea beetle (CSFB) (*Psylliodes chrysocephala*) after 14 days of contact with entomopathogenic fungi *Beauveria bassiana* strain GHA and water (control).

Fatty acids



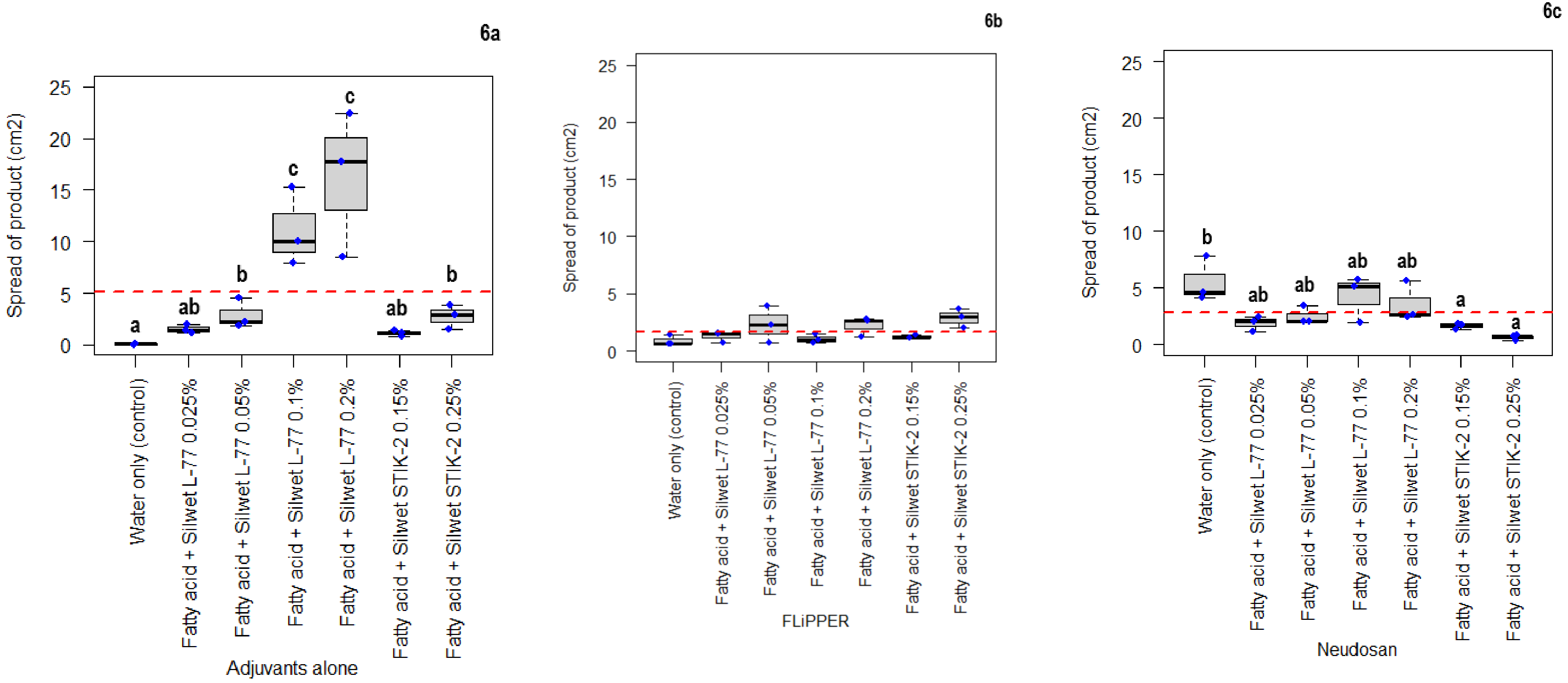
Percentage of dead cabbage stem flea beetle (CSFB) (*Psylliodes chrysocephala*) after 4 days of contact with fatty acid products FLiPPER (4a), Neudosan (4b).

Fatty acids – effect on insect cuticle



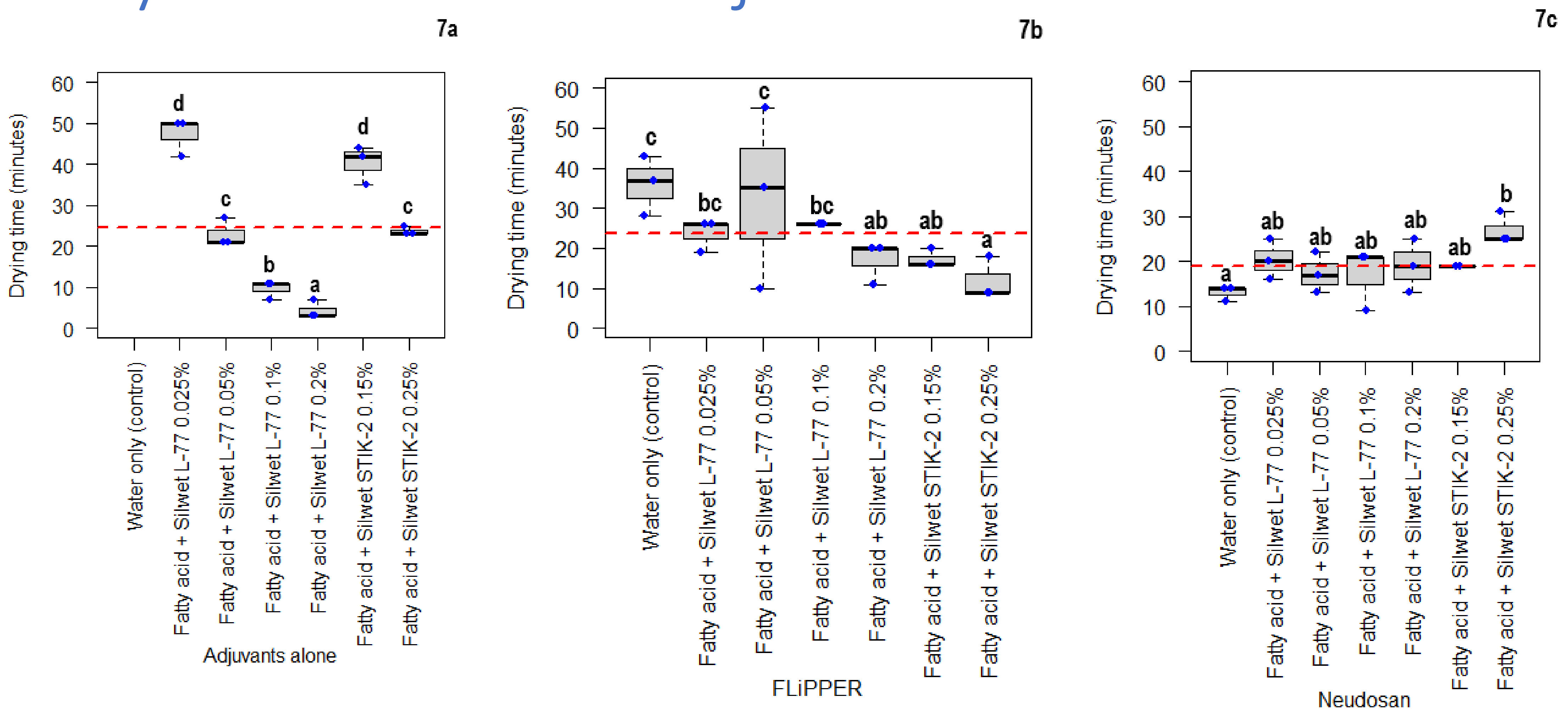
Cabbage stem flea beetle (*Psylliodes chrysocephala*) elytra cuticle observed through a scanning electron microscope, (x2000) after treatment with (a) fatty acids and (b) water.

Fatty acids + Silwet adjuvants



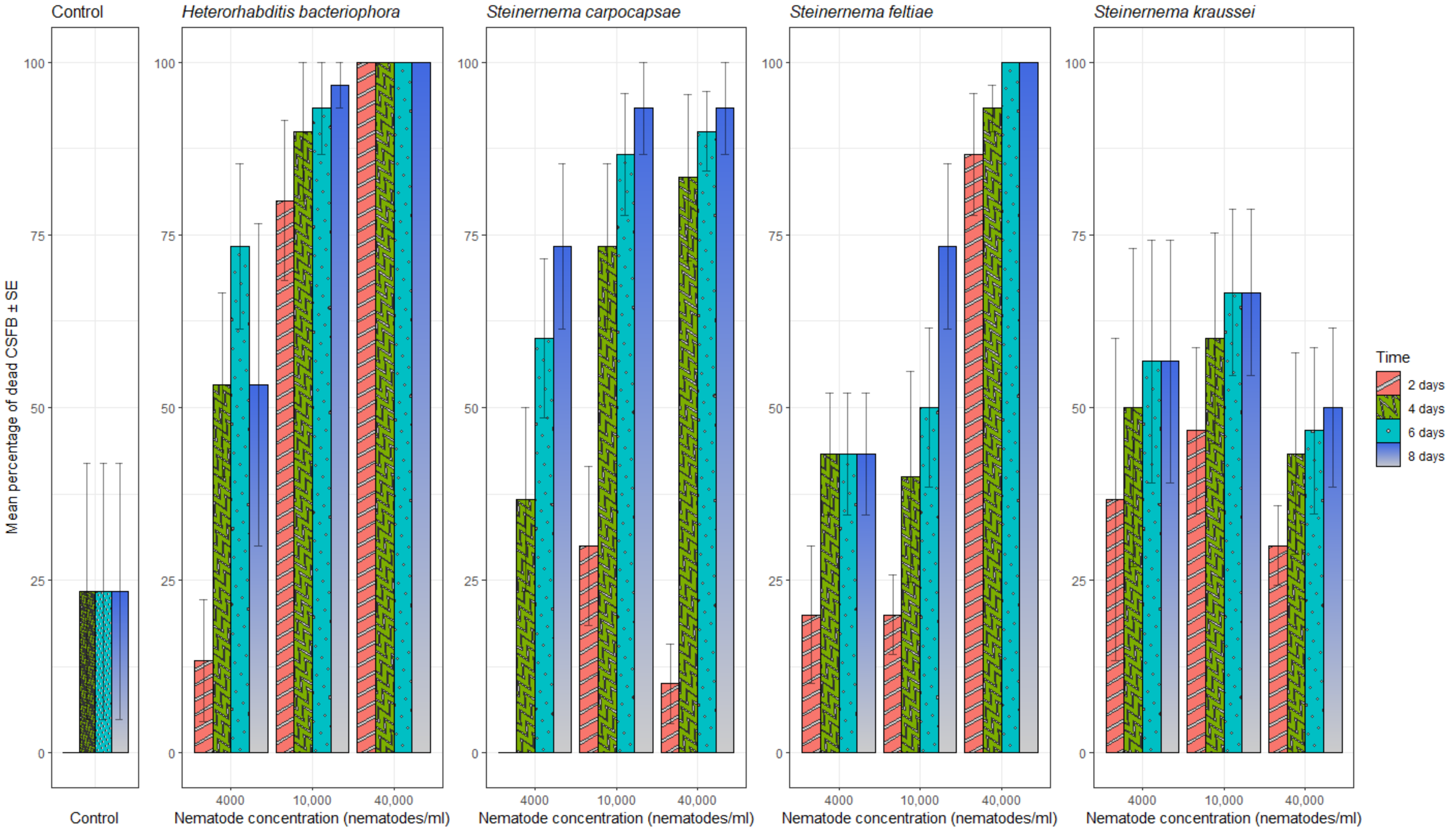
Spread of various concentrations of adjuvants Silwet L-77 and Silwet STIK-2 alone (a) and when combined with fatty acids products FLiPPER (b) or Neudosan (c).

Fatty acids + Silwet adjuvants



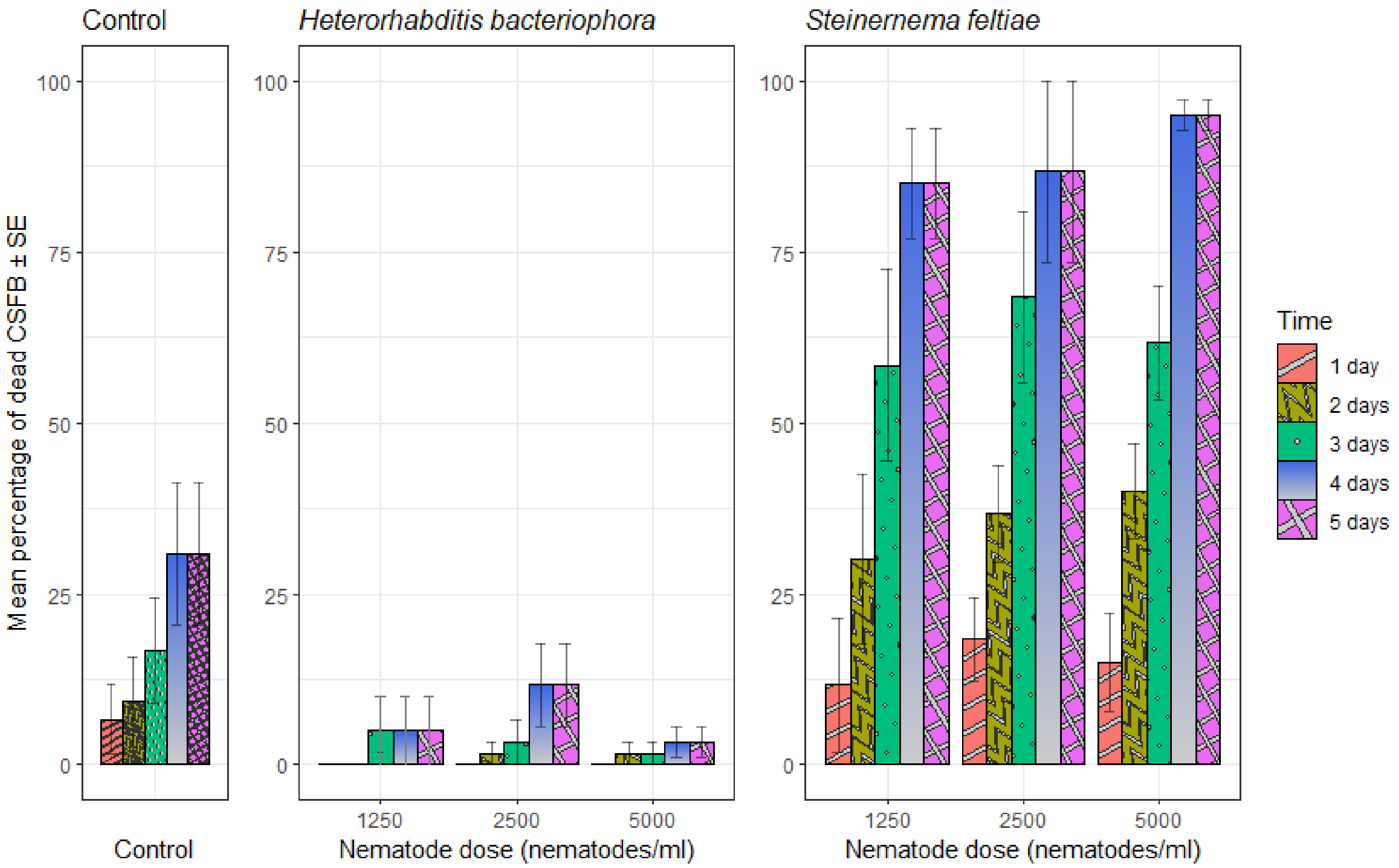
Drying time of various concentrations of adjuvants Silwet L-77 and Silwet STIK-2 alone (a) and when combined with fatty acids products FLiPPER (b) or Neudosan (c).

Entomopathogenic nematodes



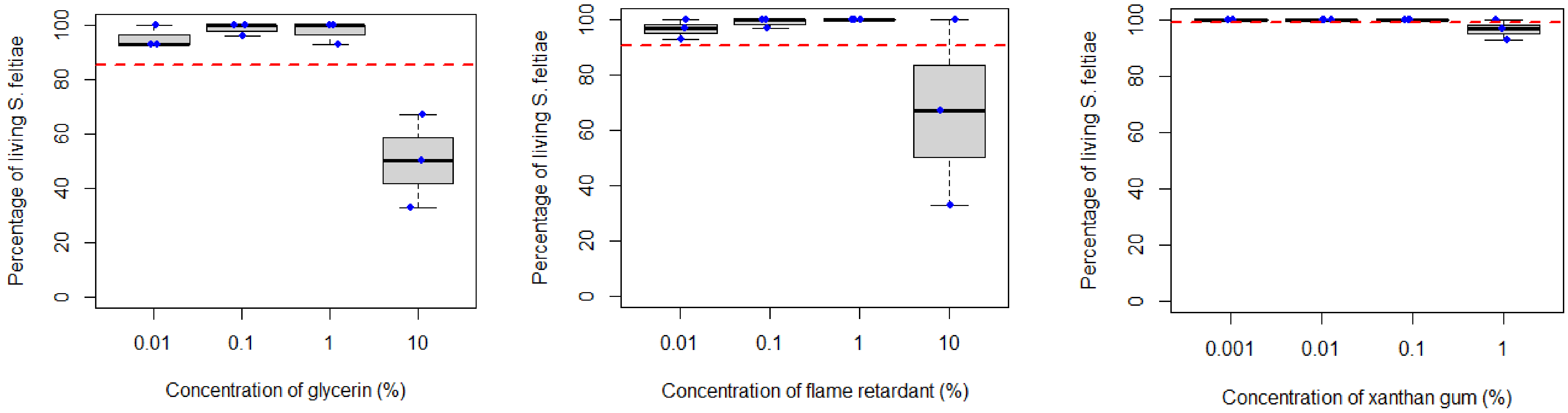
Mean percentage of dead CSFB after two, four, six and eight days of contact with four different species of entomopathogenic nematodes at three different concentrations or water (control).

Entomopathogenic nematodes



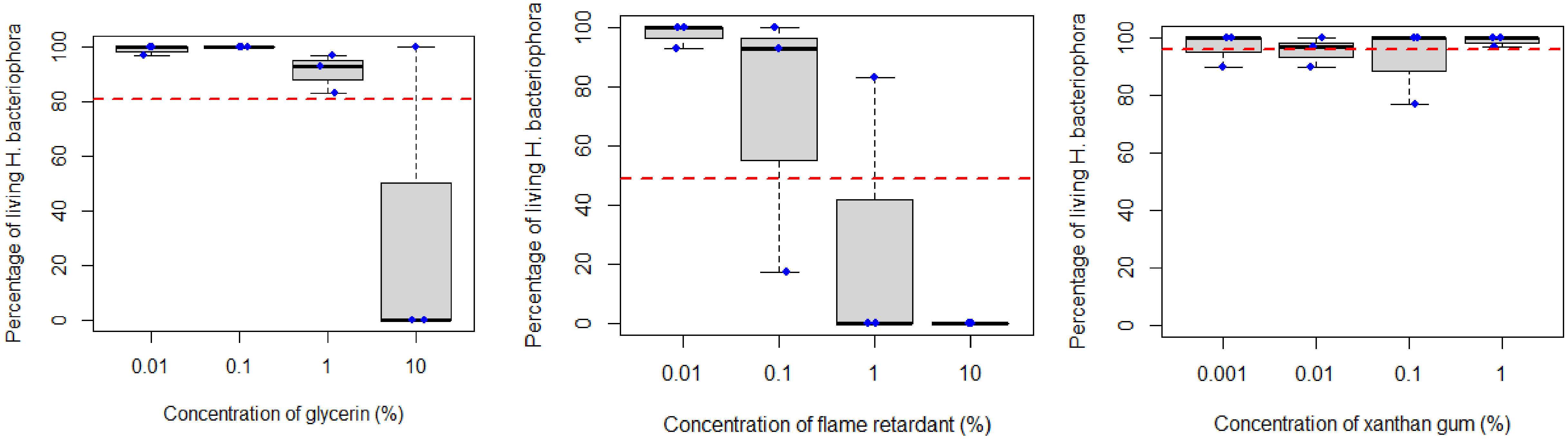
Mean percentage of dead CSFB recorded daily for five days of contact with two different species of entomopathogenic nematodes at three different concentrations or water (control).

Entomopathogenic nematodes + adjuvants



Percentage of living *Steinernema feltiae* after exposure to various concentrations of glycerin, flame retardant and xanthan gum.

Entomopathogenic nematodes + adjuvants



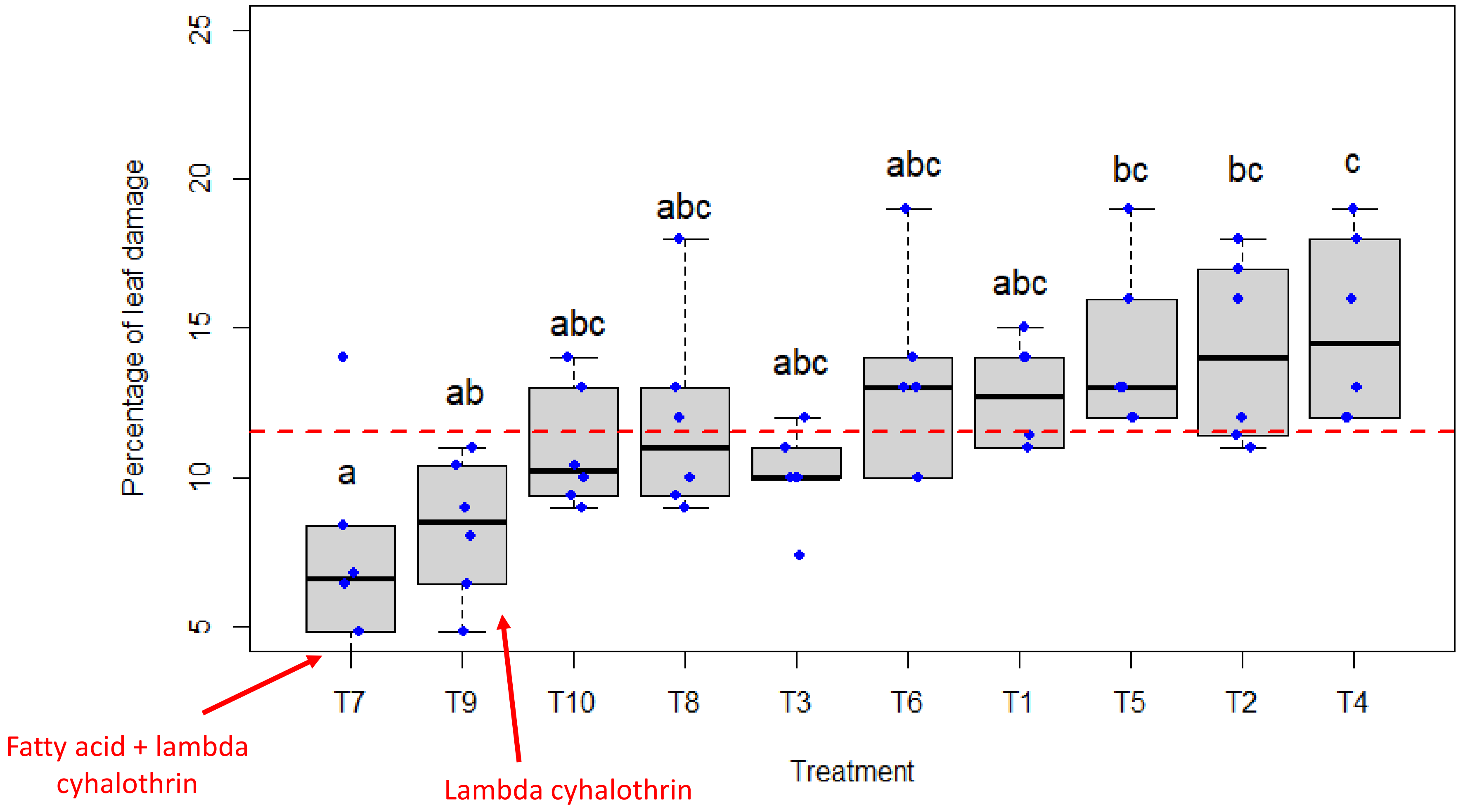
Percentage of living *Heterorhabditis bacteriophora* after exposure to various concentrations of glycerin, flame retardant and xanthan gum.

Field experiment

Treatment (T) code & Product Name	Active ingredient	Rates tested
T1: FLiPPER™	Fatty acids C7-C20	1.6L/100L
T2: CEU-40640-I-SL	Confidential	2L/100L
T3: Hallmark with Zeon technology	Lambda-cyhalothrin (pyrethroid)	0.05L/ha
T4: Botanigard® WP	*Beauveria bassiana* strain GHA (entomopathogenic fungus), 4.4 x 10^{10} spores/g	62.5g/100L
T5: Azatin®	217g/l azadirachtin	0.46L/100L
T6: Botanigard WP + Azatin	*Beauveria bassiana* strain GHA, 4.4 x 10^{10} spores/g + 217g/l azadirachtin	62.5g/100L + 0.46L/100L
T7: FLiPPER + Hallmark Zeon	Fatty acids C7-C20 + Lambda-cyhalothrin (pyrethroid)	1.6L/100L + 0.05L/ha
T8: Water	N/A	300L/ha
T9: Hallmark with Zeon technology	Lambda-cyhalothrin (pyrethroid)	0.05L/ha
T10: Untreated	N/A	N/A
TA: Nemasys	*Steinernema feltiae* (entomopathogenic nematode)	125,000, 250,000, 500,000 and 1,000,000 IJ/m^2
TB: Nemasys H	*Heterorhabditis bacteriophora* (entomopathogenic nematode)	125,000, 250,000, 500,000 and 1,000,000 IJ/m^2

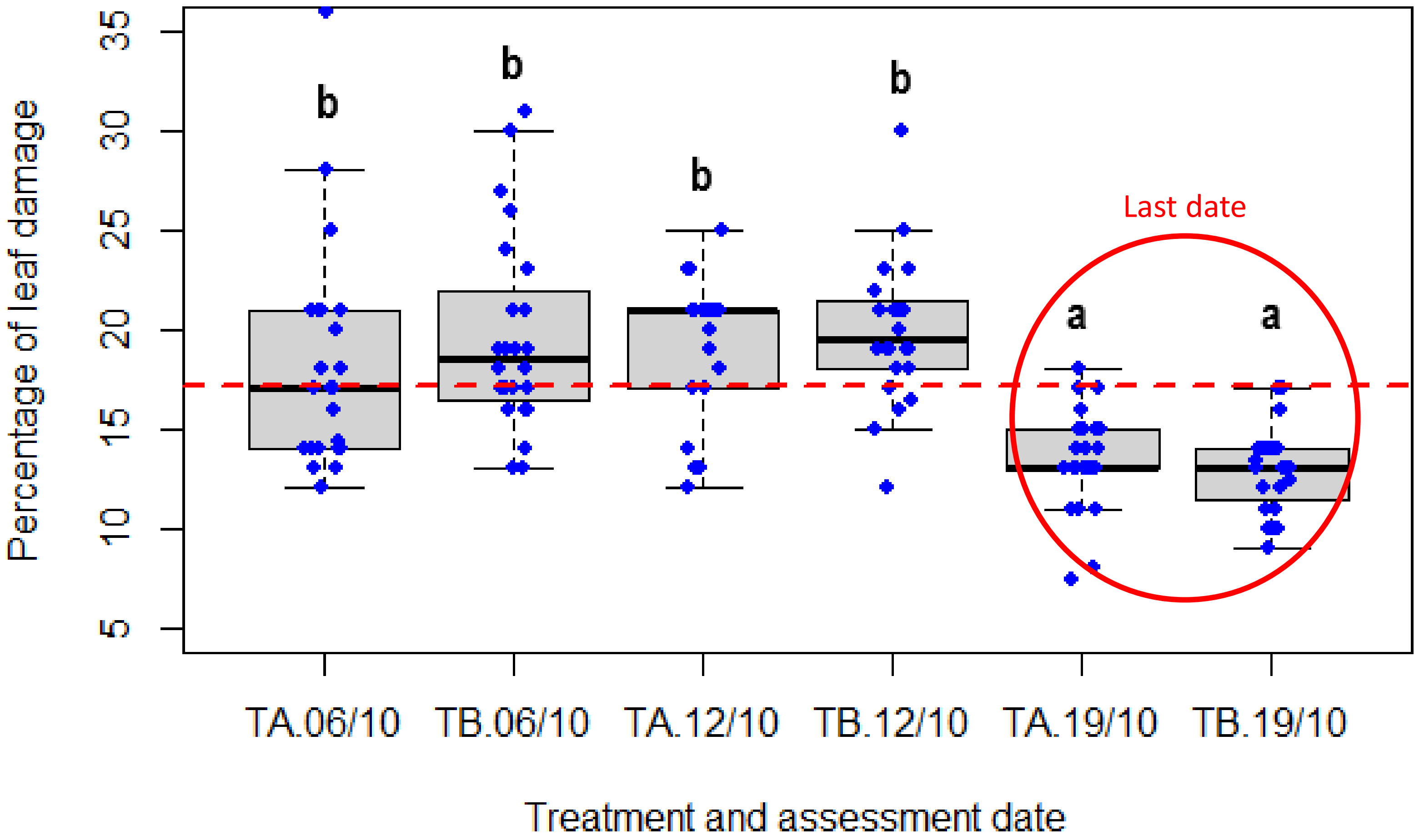



Field trial – leaf damage



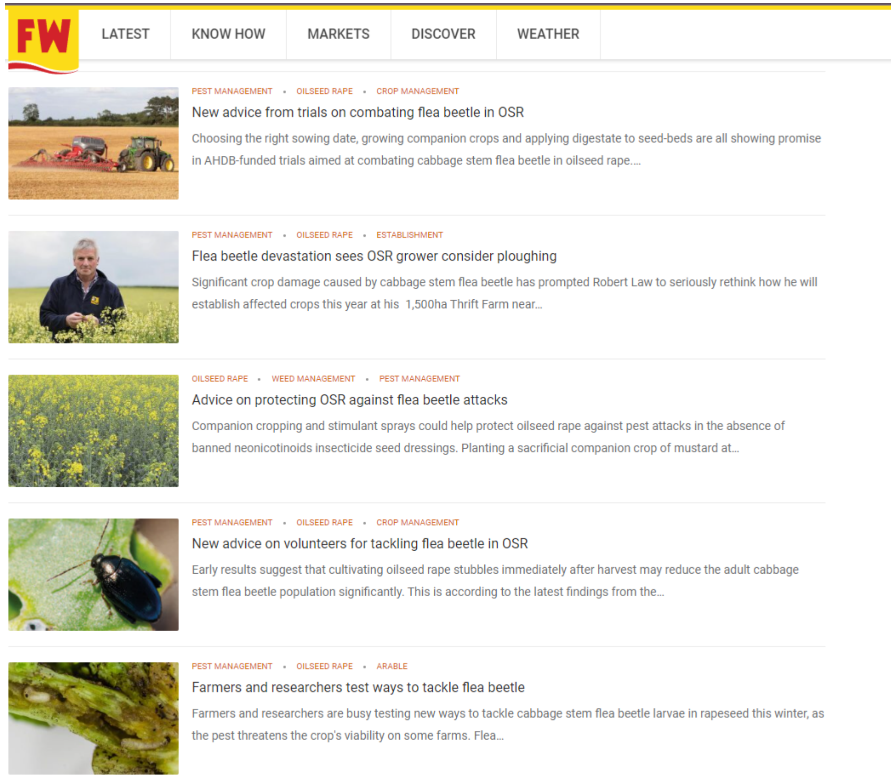
Percentage of oilseed rape leaf damage on the 19th October (last of four assessment dates) (T1: FLiPPER; T2: CEU-40640-I-SL; T3: Hallmark with Zeon Technology applied three times; T4: Botanigard WP; T5: Azatin; T6: Botanigard WP + Azatin; T7: FLiPPER + Hallmark with Zeon Technology; T8: Water; T9: Hallmark with Zeon Technology applied once; T10: Untreated).

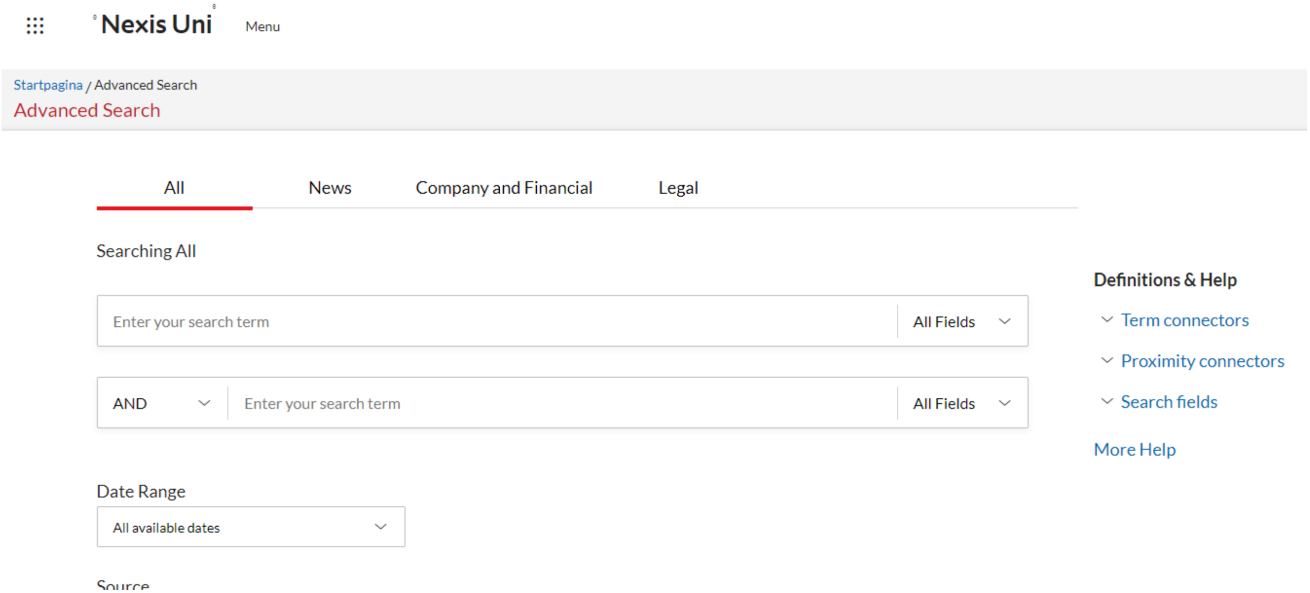
Field trial – leaf damage



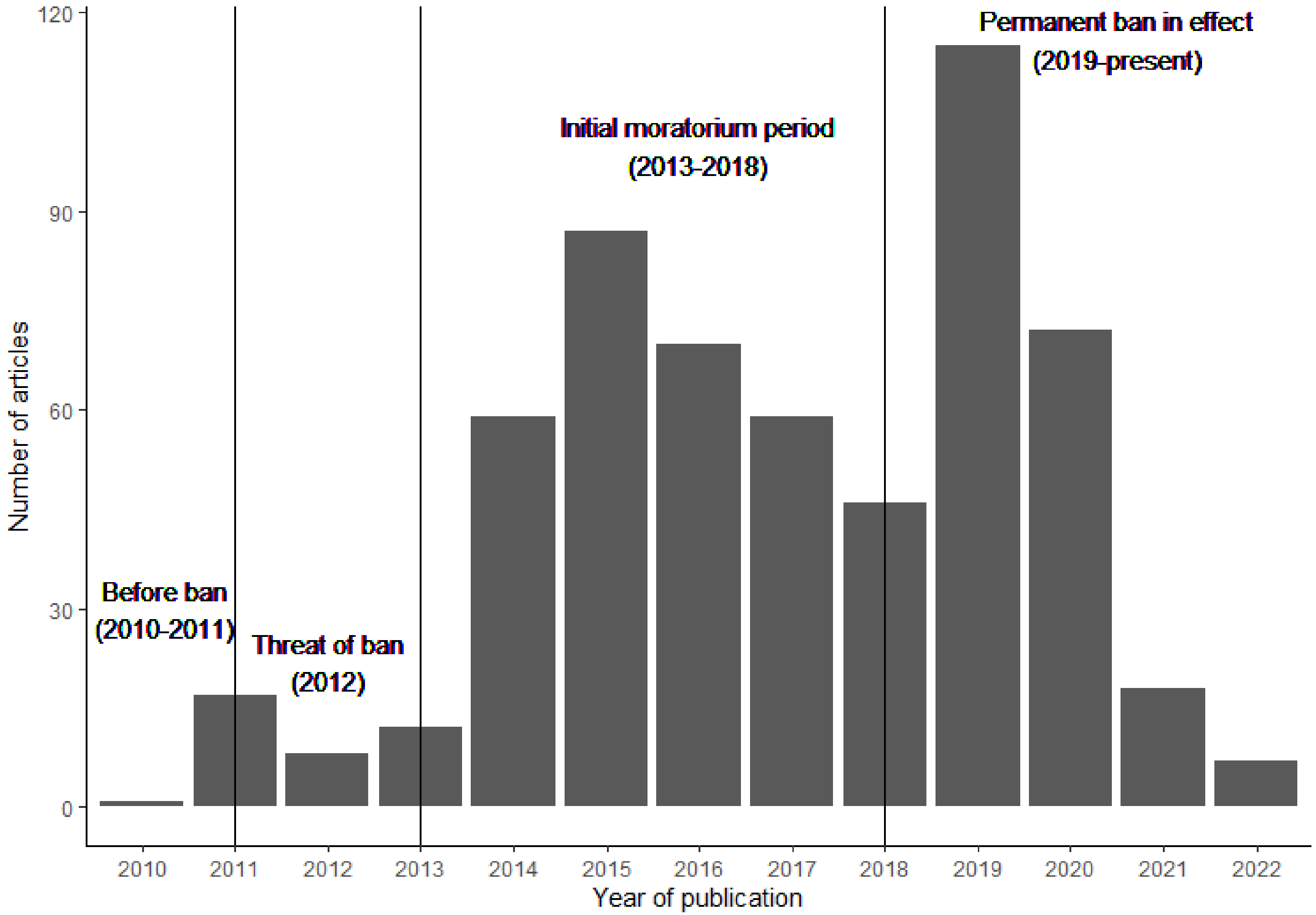
Percentage of leaf damage based on entomopathogenic nematode species applied and assessment dates (6TH October, 12th October and 19th October); TA: Nemasys (*Steinernema feltiae*); TB: Nemasys H (*Heterorhabditis bacteriophora*)).

Sentiment analysis of the farming press about CSFB management before and after the neonicotinoid seed treatments ban



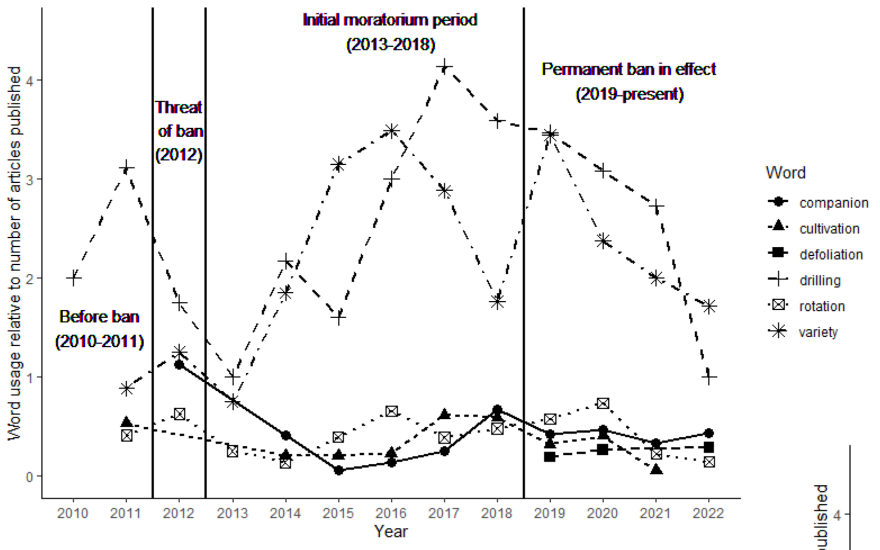


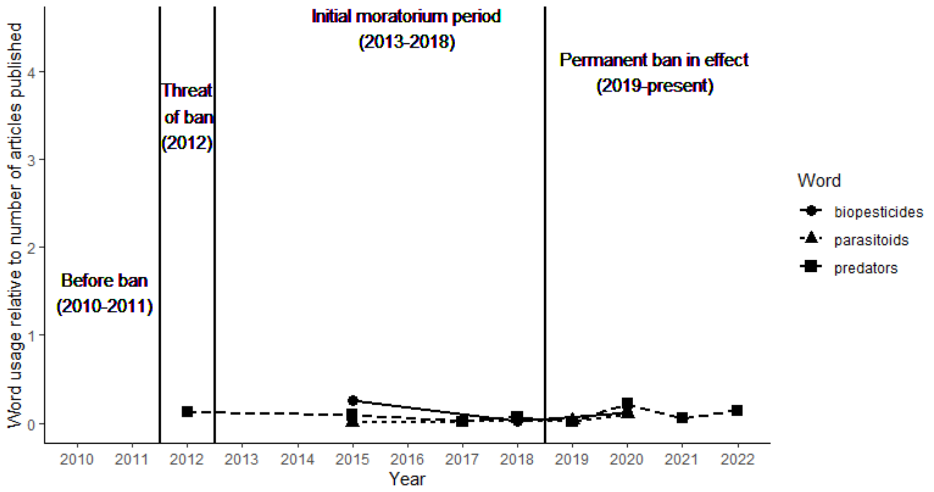
Number of articles published

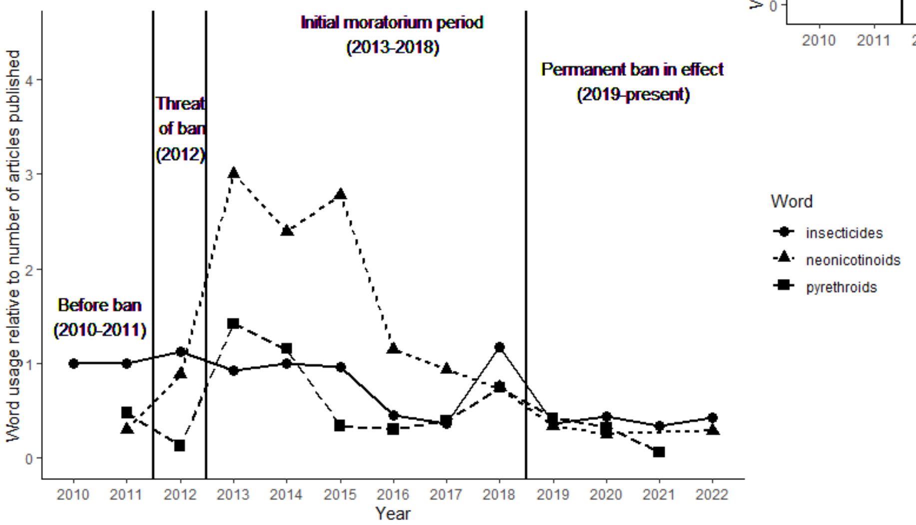


Number of Farmers Weekly and Farmers Guardian articles used published each year between the 1st of April 2010 and the 31st of December 2022 and containing the words: ‘Oilseed rape’ AND ‘flea beetle’ AND ‘control’ OR ‘pressure’ OR ‘damage’ OR ‘pest’ OR ‘insecticide’ OR ‘losses’ OR ‘lost’ OR ‘attacks’ OR ‘neonicotinoid’.

IPM methods word usage

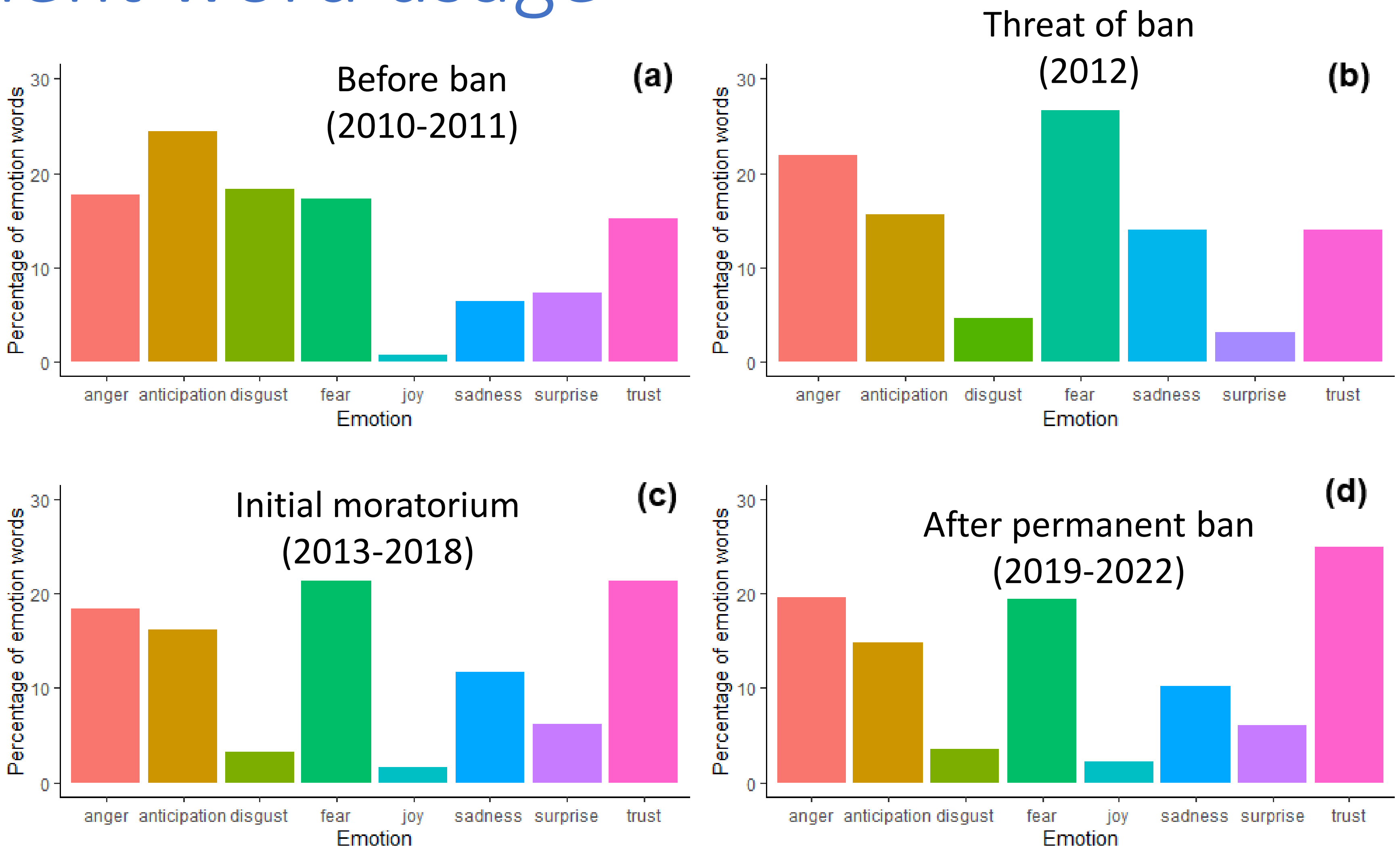






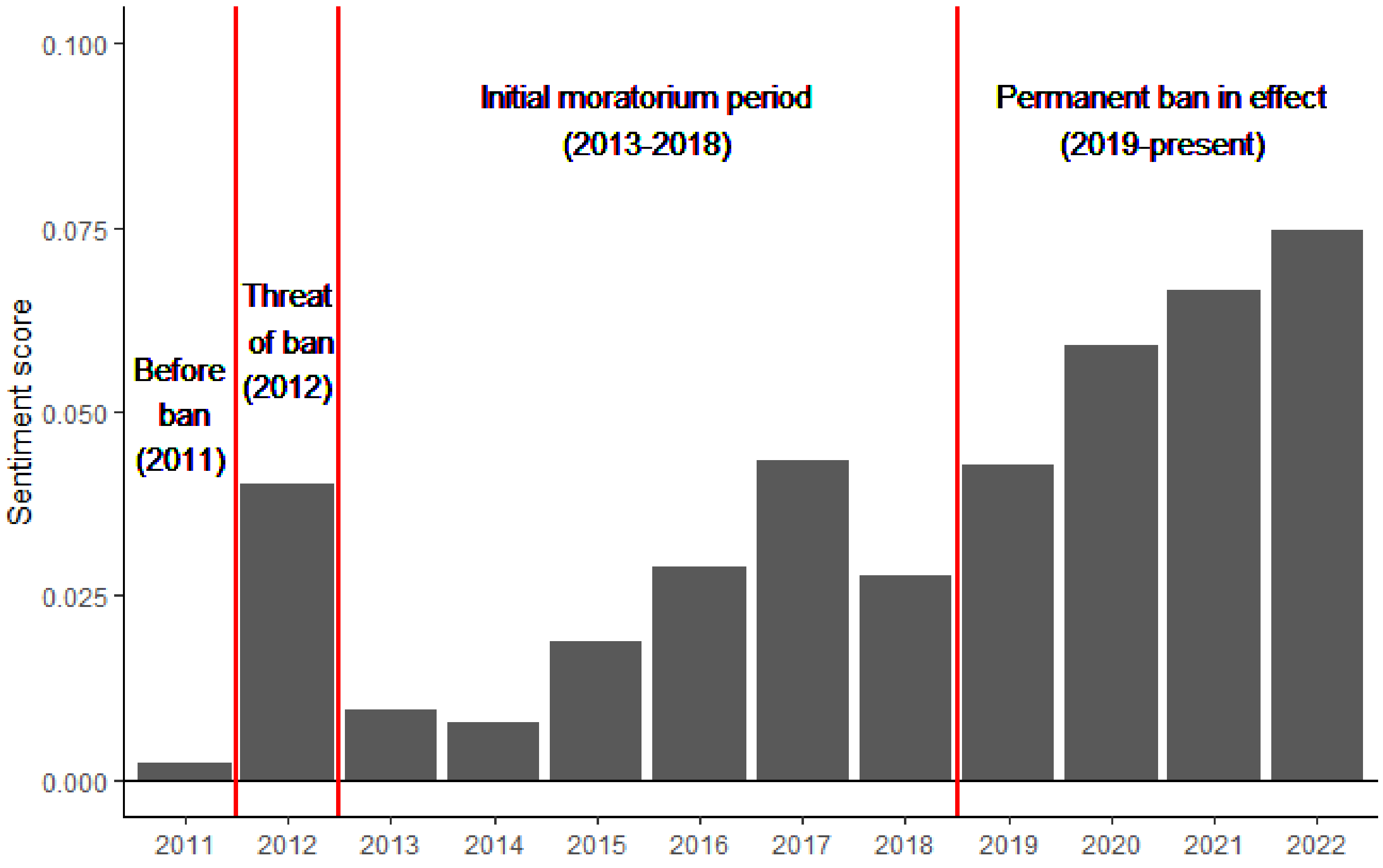
IPM methods word usage over the years, between the 1st of April 2010 and the 31st of December 2022.

Sentiment word usage



Percentage of sentiment words used associated to selected sentiments.

Sentiment score of articles



Sentiment score of articles, shown per year of publication (positive sentiment when y > 0, negative sentiment when y < 0).

AFCP The AgriFood Charities Partnership

Summary

This study is the first to investigate the efficacy of a variety of biopesticides to control CSFB under laboratory conditions and field conditions.

Entomopathogenic fungi, nematodes and fatty acids could potentially be used to control CSFB as part of an Integrated Pest Management (IPM) programme based on laboratory results.

Only the physically acting product FLiPPER, when combined with Hallmark significantly reduced CSFB adult leaf damage compared to the water treatment and untreated plots. Larval density did not vary significantly among the treatments tested.

Sentiment analysis showed an increased interest in topics related to oilseed rape and cabbage stem flea beetle control after the initial moratorium of neonicotinoids in 2013, and an increased use of terms related to cultural control methods, while the use of terms related to conventional control methods decreased. The words parasitoids, biopesticides and predators however have not seen their use increase over the years.

What next?

The biopesticides tested in this study require further testing to optimise formulation, application methods and to assess impact on non-target organisms.

Further research to evaluate the efficacy of EPN and adjuvants under field conditions is necessary.

The field experiment did not yield concluding results, but assessment methods could be improved, as the timing of treatment application and the formulation of these biopesticides, particularly those based on entomopathogens, may be important.

Future work is necessary to improve the sentiment analysis methods and confirm this study's findings.

Thank you for your attention

I would like to also thank:

- *my sponsors:* AHDB, Certis, AFCP
- *my supervisors:* Tom Pope, Heather Campbell (Harper Adams University)
- *my collaborators:* Dave Chandler, Gill Prince (University of Warwick)