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Good food, healthy environment

Lukas Jeker & Daniela Grossar

16. October 2024

Trap or haven: Assessing the spray drift deposition of insecticides into flower-strips

Lukas Jeker & Daniela Grossar
16. October 2024

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Overview

- Introduction flower-strip project
- First objective of the flower-strip project
- Second objective of the flower-strip project
- Results, Discussion, Conclusion

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Trap or haven: Assessing the spray drift deposition of insecticides into flower-strips ?

- Increased demand of **Spinosad, Acetamiprid Pyrethroids** as alternative for banned neonicotinoids

- The Federal Office for Agriculture financially supports the cultivation of flower strips in agriculture in order to promote biodiversity in farmland

- Recent bee poisoning incidence with **Spinosad**

- Are current mitigation measures sufficient to adequately safeguard wild and managed bees in non-treated off-crop areas (e.g., flower-strips)?

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Risk assessment for bees: Spray drift into flower-strips

Flower-strip

- Provide habitat and resources for biodiversity
- Directly next to crop, 3-6 m wide
- Financially supported by government

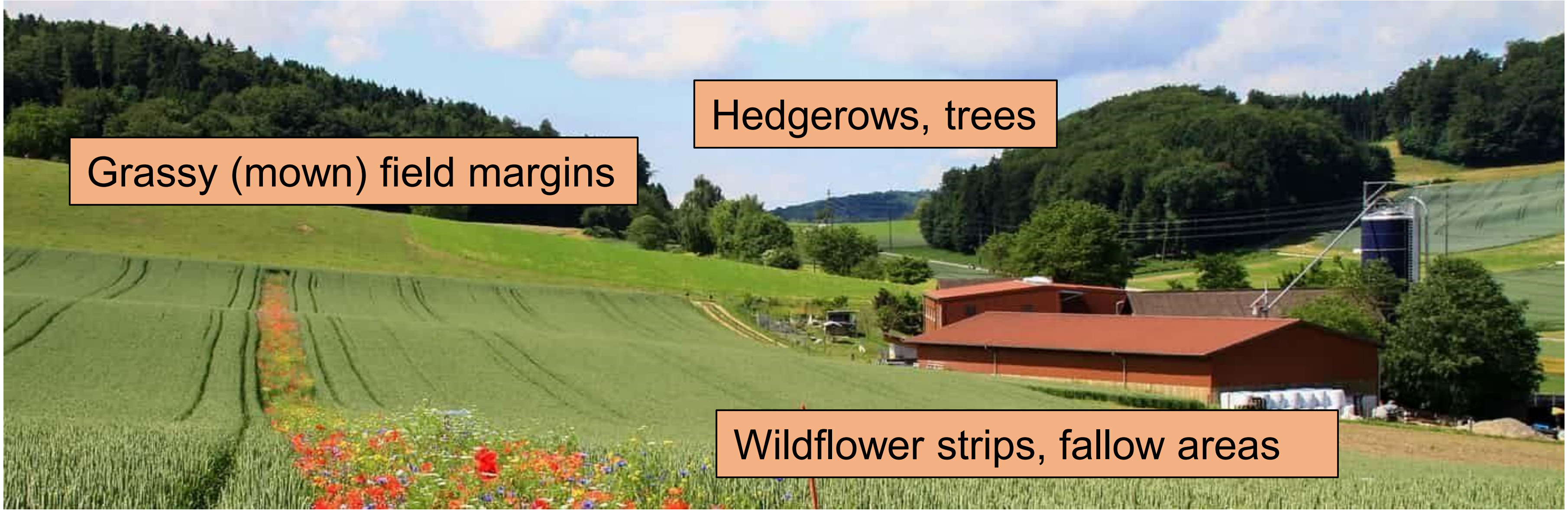
- Flower-strips **encourage beneficial insects** and reduce pests in crops by counteracting habitat loss and thereby **reducing the need for PPPs**

- They also serve as a food source for **pollinators** such as **wild bees and honey bees**

Risk assessment for bees: Spray drift into flower-strips

Introduction

Flower strips – biodiversity promotion in Switzerland



Wildflower strips, which are very close to the crops, or even within the crops → are prone to get in contact with drift of PPPs used to treat adjacent crops

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Risk assessment for bees: Spray drift into flower-strips

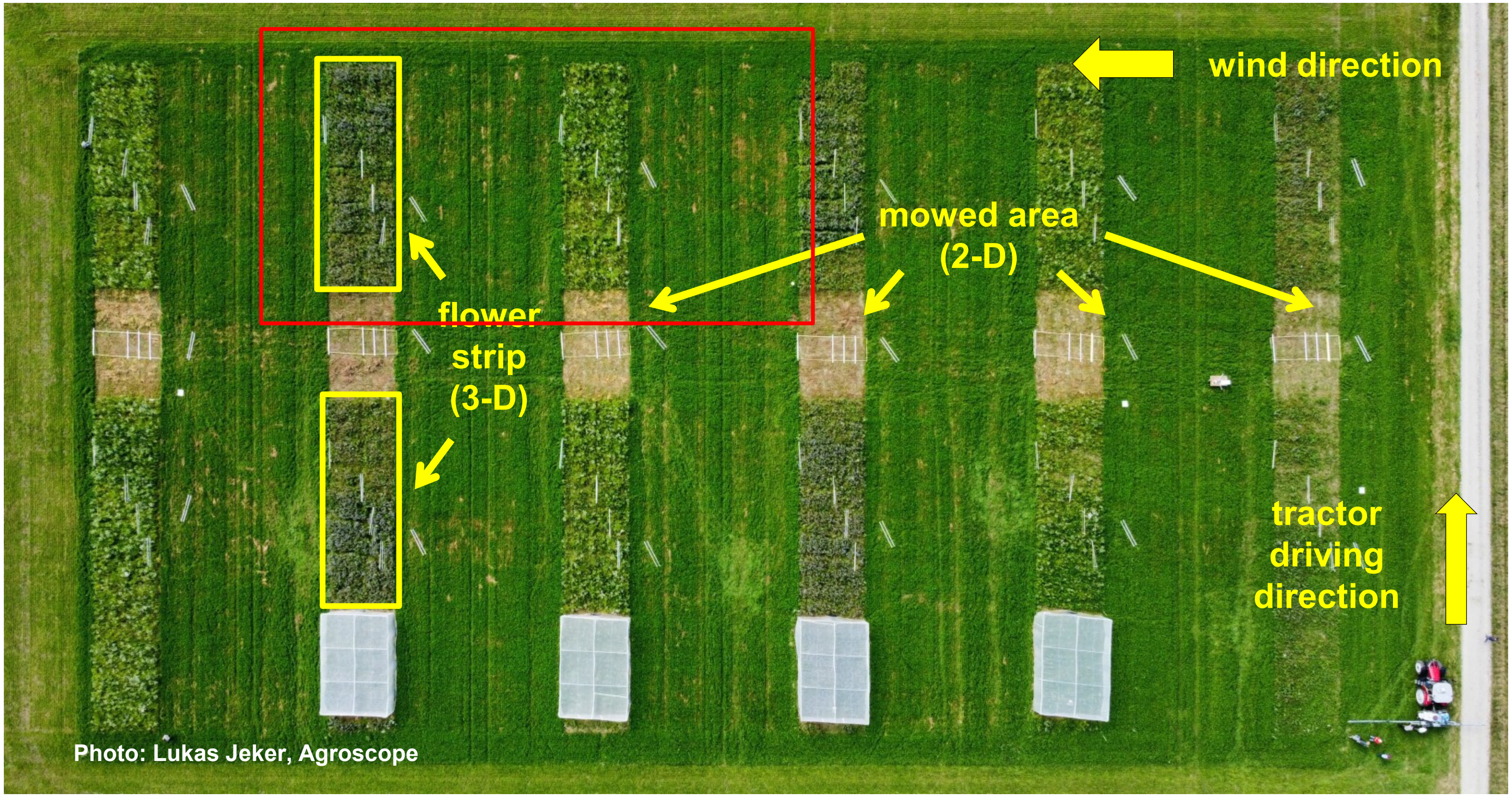
Objectives

Objective 1:

Investigate the horizontal and vertical distribution of spray drift deposits in the off-crop vegetation next to a field during a PPP application using a tracer

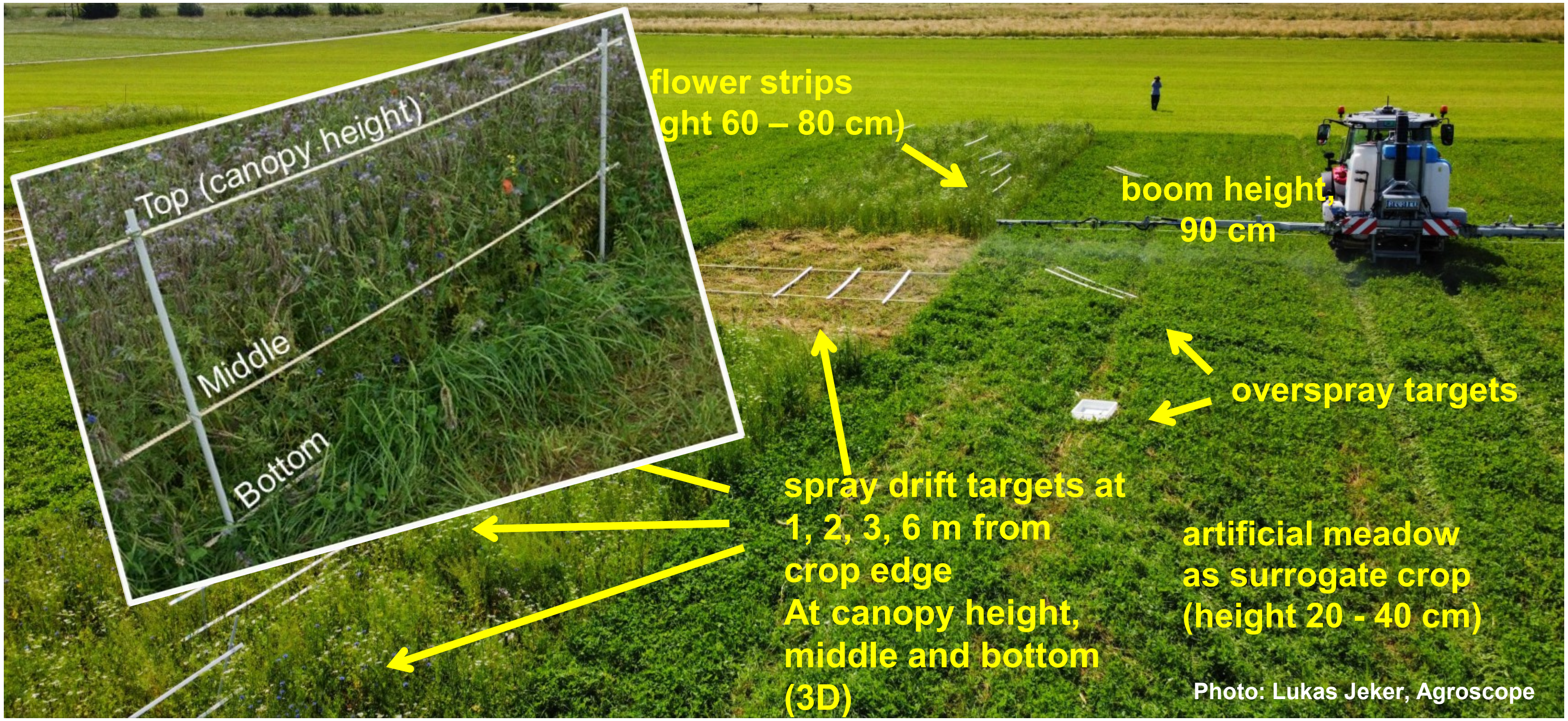
Risk assessment for bees: Spray drift into flower-strips

Objective 1 (2022): Experimental setup



Risk assessment for bees: Spray drift into flower-strips

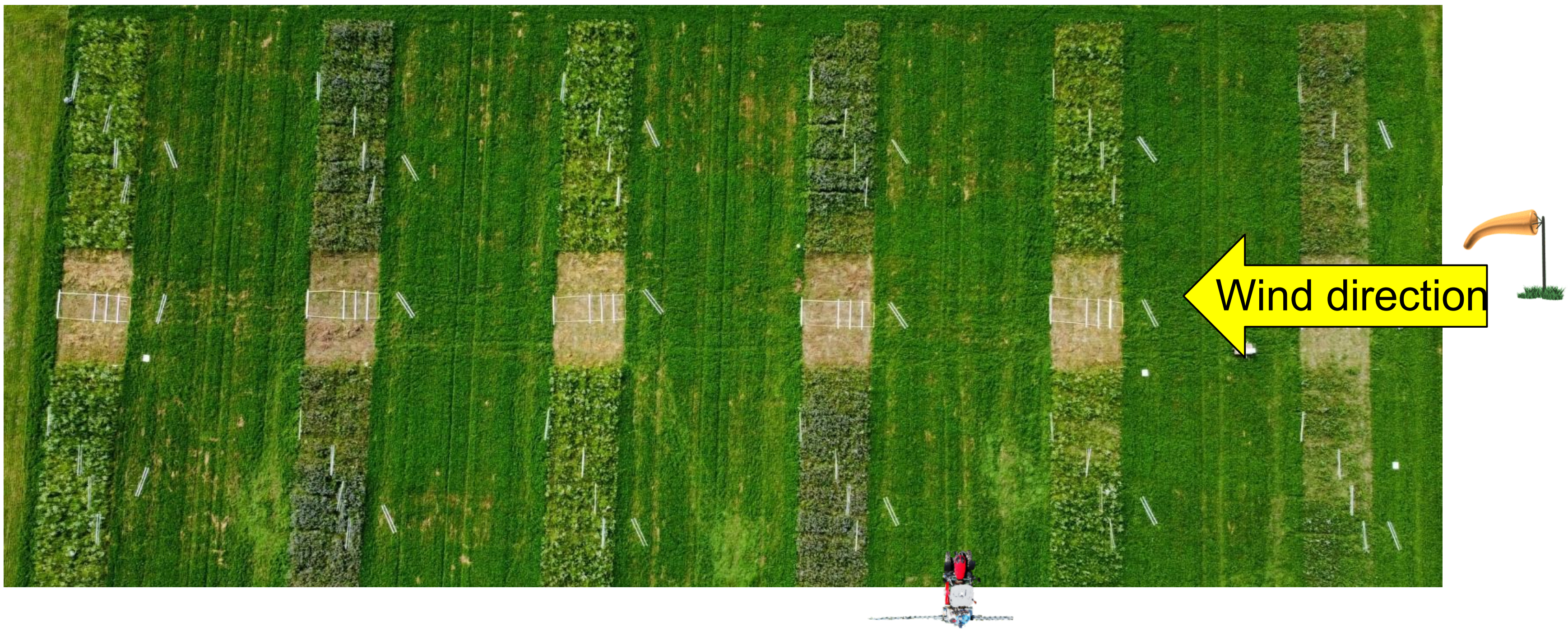
Objective 1 (2022): Experimental setup



Risk assessment for bees: Spray drift into flower-strips

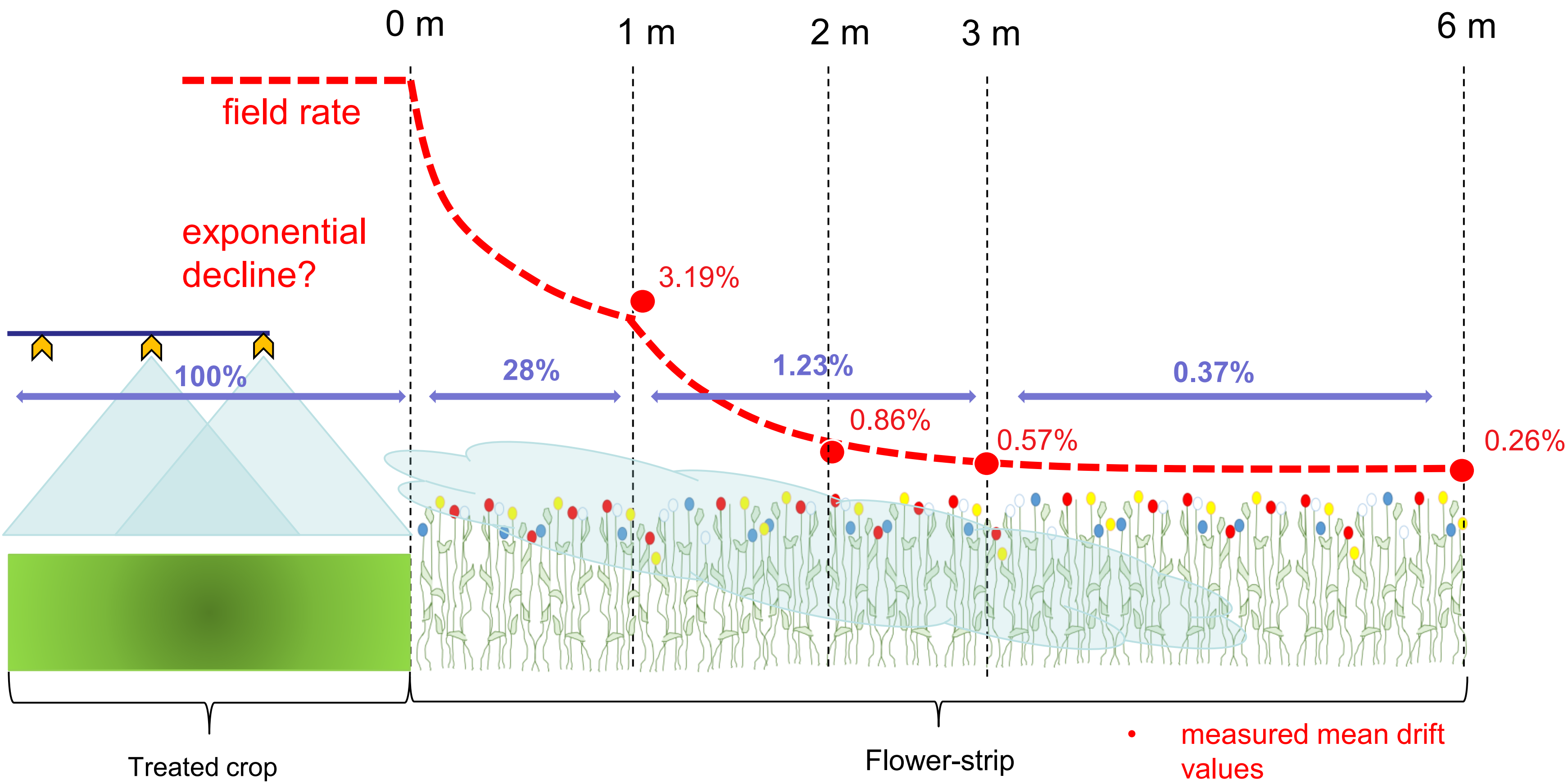
Objective 1 (2022): Experimental setup

3 days, 2 repetitions per day, 1400 targets (2/3 valid)
Tracer (Fluorescent marker)



Risk assessment for bees: Spray drift into flower-strips

Objective 1 (2022): Results – Drift gradient concentration in flower-strip



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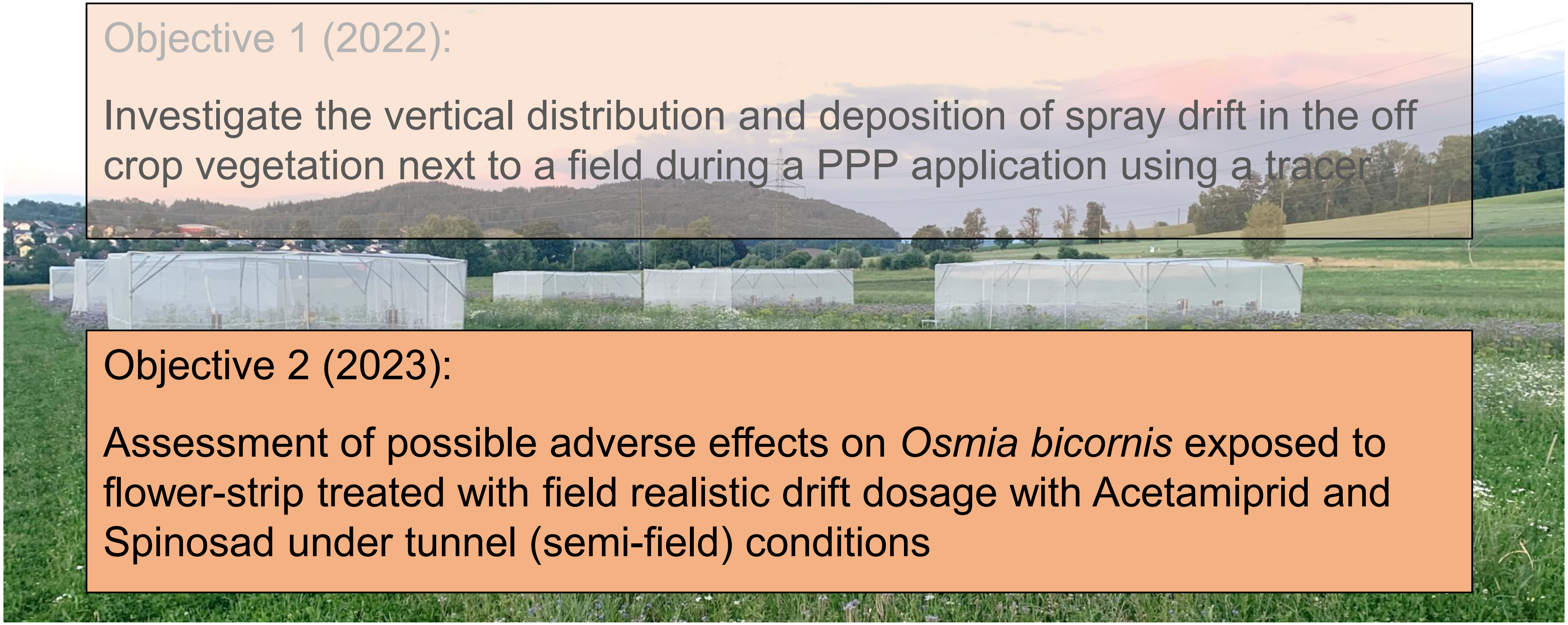
Risk assessment for bees: Spray drift into flower-strips

Objectives



Objective 1 (2022):

Investigate the vertical distribution and deposition of spray drift in the off crop vegetation next to a field during a PPP application using a tracer

Objective 2 (2023):

Assessment of possible adverse effects on *Osmia bicornis* exposed to flower-strip treated with field realistic drift dosage with Acetamiprid and Spinosad under tunnel (semi-field) conditions

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Risk assessment for bees: Spray drift into flower-strips

Objective 2 (2023): Tested Insecticides

Acetamiprid (40 g a.s./ha)

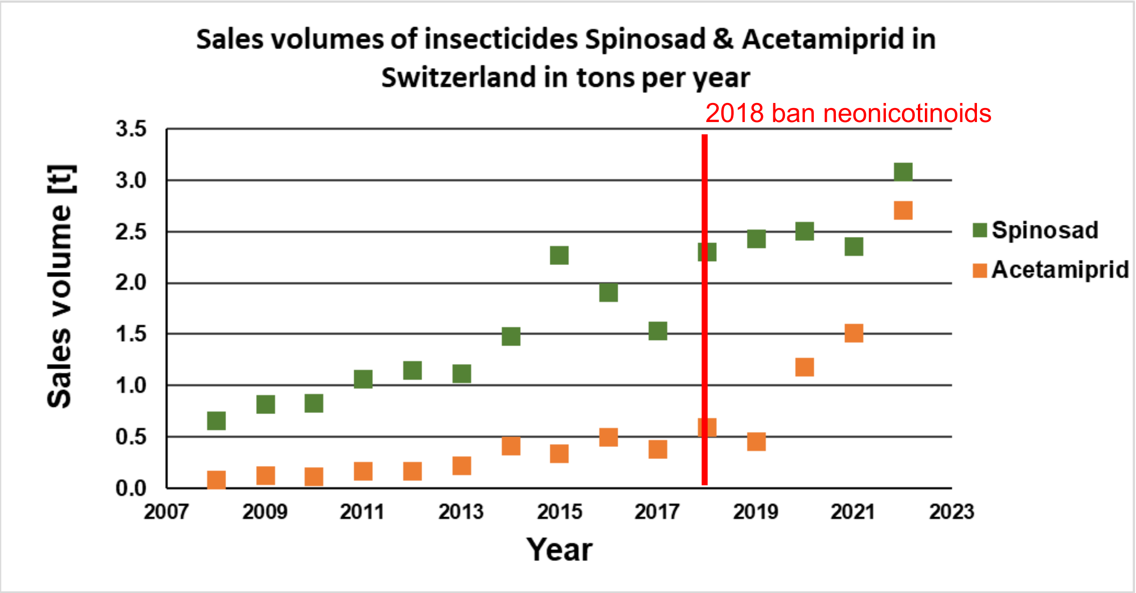
is a systemic insecticide from the active substance group of neonicotinoids

No risk mitigation measures applied (SPe8)

Spinosad (90 g a.s./ha)

is a broad-spectrum contact and oral insecticide derived from the bacterium *Saccharopolyspora spinosa* and is authorised for use in organic farming

Risk mitigation measures must be applied (SPe8) to reduce risk to bees



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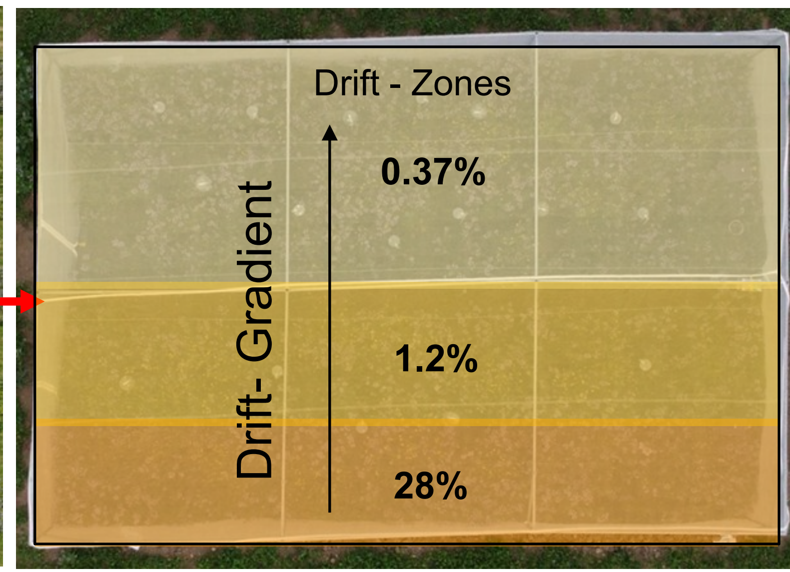
Risk assessment for bees: Spray drift into flower-strips

Objective 2 (2023): Experimental (tunnel) setup with *Osmia*

- 3 flower strips → replicates
- 9 randomized tunnels 54 m^2 (6 x 9 x 2.5 m)
- Artificial meadow and strips with different seed mixture in between
- 3 tunnels per treatment (Untreated Control, Acetamiprid and Spinosad)
- Gradient treatment for Acetamiprid and Spinosad

% Drift Rate	Acetamiprid (PPP Gazelle SG, 0.2 kg/ha)	Spinosad (PPP Audienz 0.19 L/ha)
100% (Field rate)	**40 g a.s./ha**	**90 g a.s./ha**
0.37%	**0.148** g a.s./ha	**0.33** g a.s./ha
1.2%	**0.48** g a.s./ha	**1.08** g a.s./ha
28%	**11.2** g a.s./ha	**25.2** g a.s./ha



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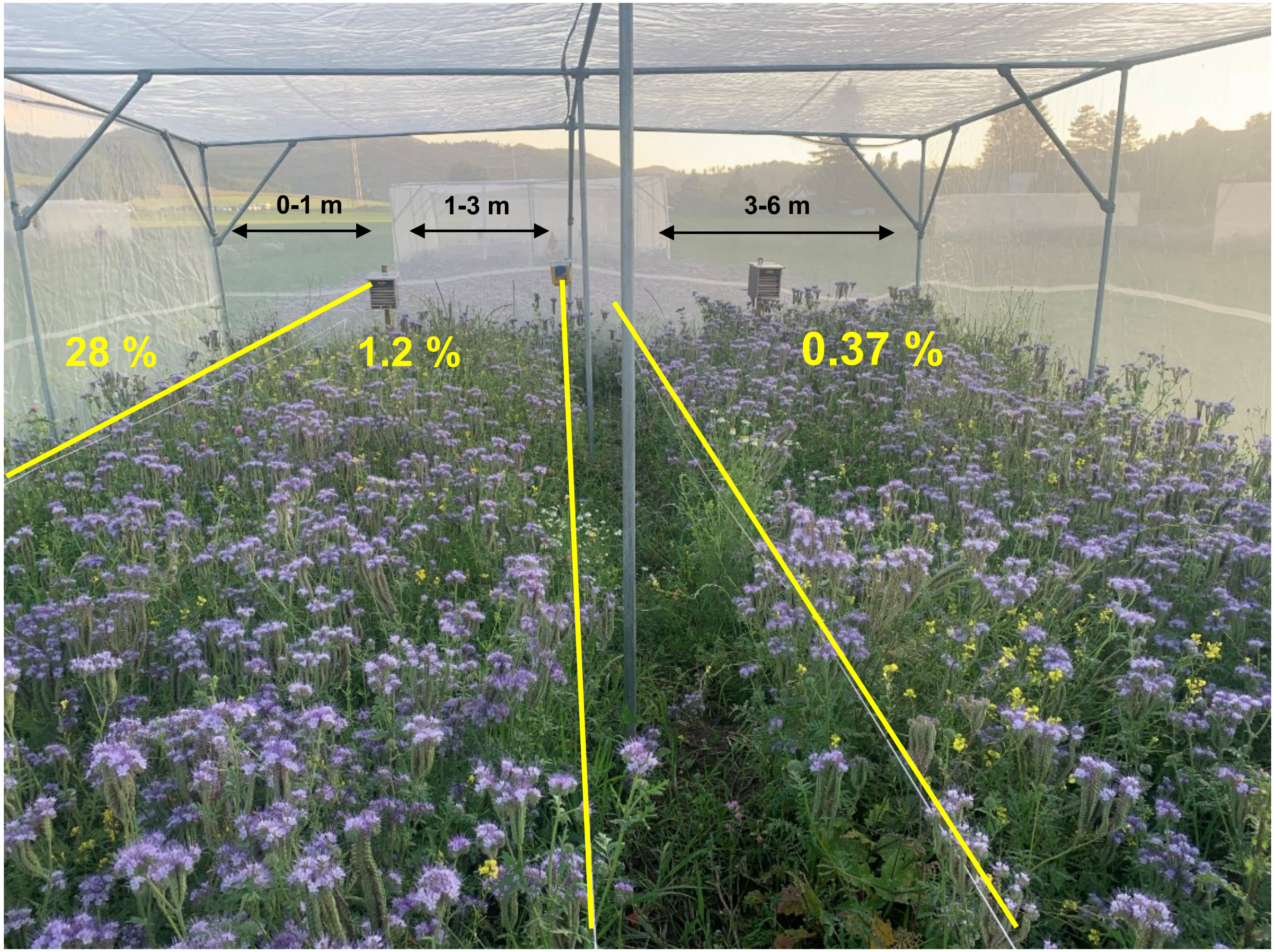
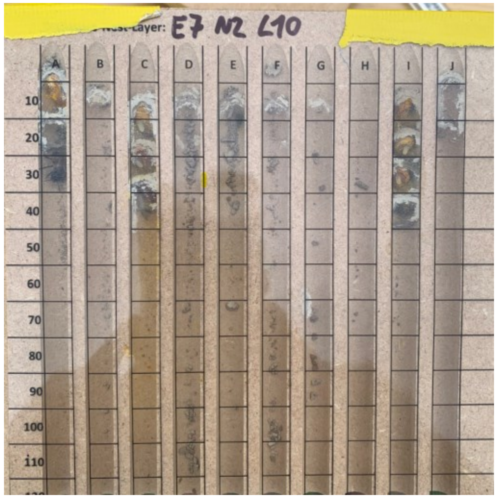
Risk assessment for bees: Spray drift into flower-strips

Objective 2 (2023): Designated drift areas within tunnel



Risk assessment for bees: Spray drift into flower-strips

Objective 2 (2023): Test species *Osmia bicornis* and its nesting units



10 cavities / wooden plate

10 wooden plates / nesting unit

2 nesting units / tunnel

Osmia nesting unit:

- Consisting of ten wooden plates each offering ten nesting cavities 100 nesting cavities per nesting unit
- Per tunnel two nesting units one for reproduction assessment and one for residue analysis

Risk assessment for bees: Spray drift into flower-strips

Objective 2 (2023): Test species *Osmia bicornis* and nesting units

Introduction of synchronized newly emerged *Osmia bicornis* (**65** females and **100** males) **10 days prior** to treatment application or at DAT -10 (Days after treatment)

Density 1.2 nesting female/m^2

ICPPR non-*Apis* working group Franke et al., 2021

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Risk assessment for bees: Spray drift into flower-strips

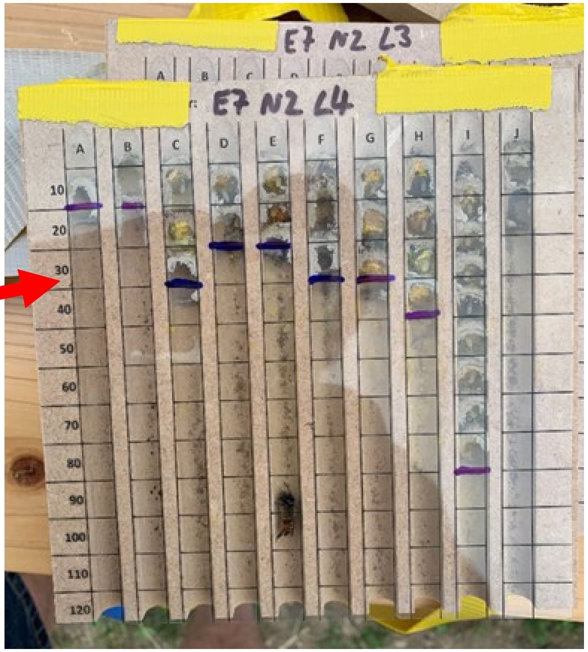
Objective 2 (2023): Application SPe8 after bee flight and after sunset

Risk assessment for bees: Spray drift into flower-strips

Objective 2 (2023): Assessment and Sampling in the Field

- **DAT 0, 1, 3 and 7**: Assessment: Established provisions and presence of female in nesting unit
- **DAT 7:** Removal of one *Osmia bicornis* nest for residue analysis
- **DAT 14, 21, 30 and 41:** Further monitoring of development of *O. bicornis* larvae/offspring within the nesting units

Daily marking and photo shooting of each nest layer (new provisions) and females



Nesting cavities covered with acetate sheet: Marking of new pollen provisions and assessment of *O. bicornis* <u>females</u>

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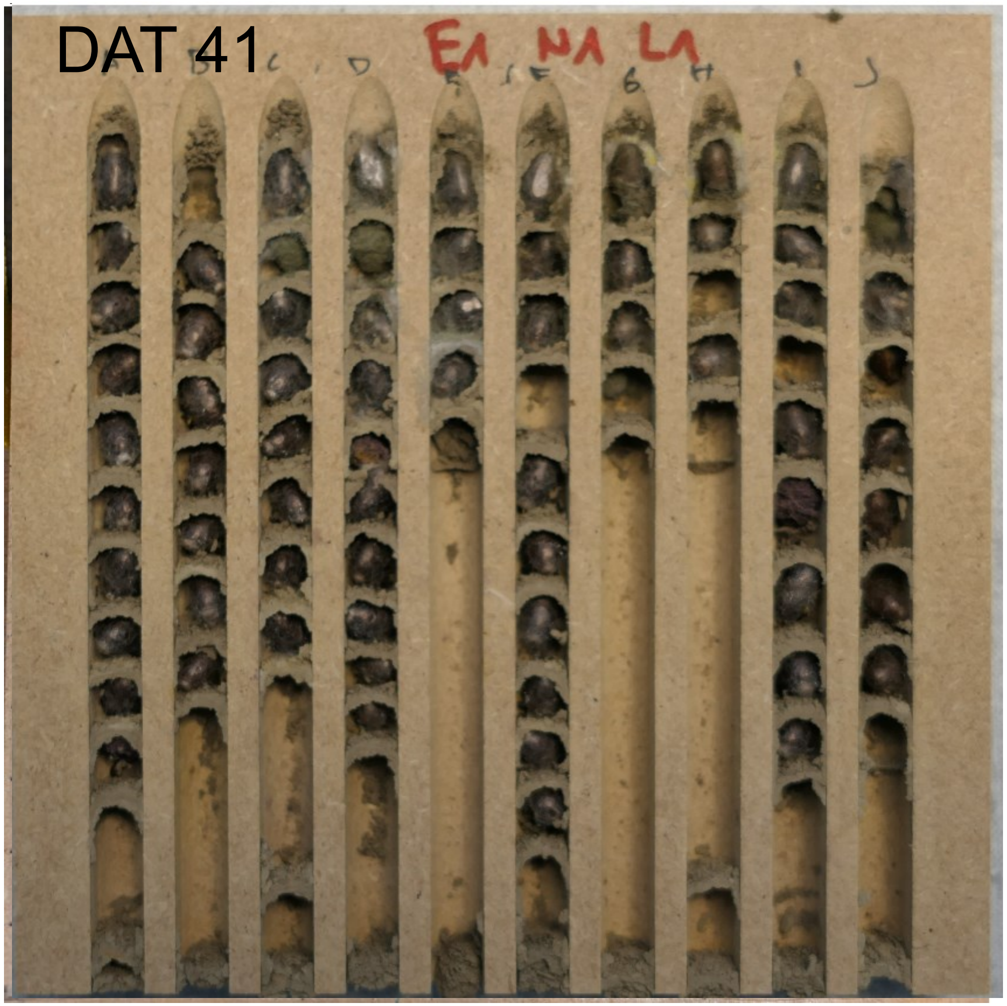
Risk assessment for bees: Spray drift into flower-strips

Objective 2 (2023): Brood development assessment



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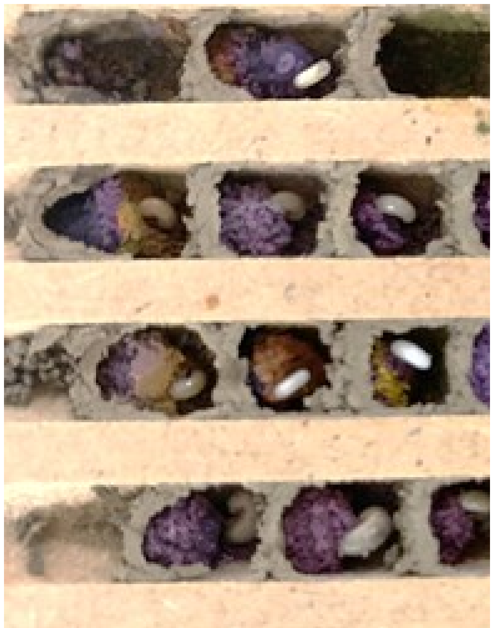
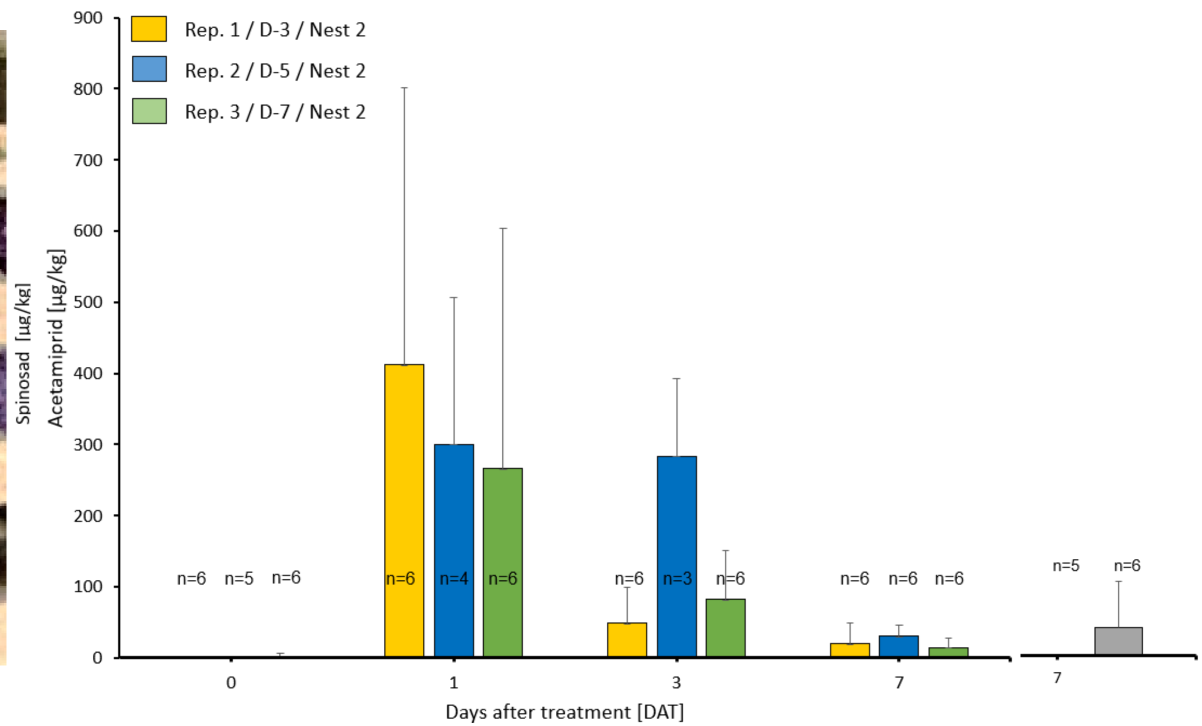
Risk assessment for bees: Spray drift into flower-strips

Results: Residues in pollen provisions

Pollen provision (*O. bicornis*)

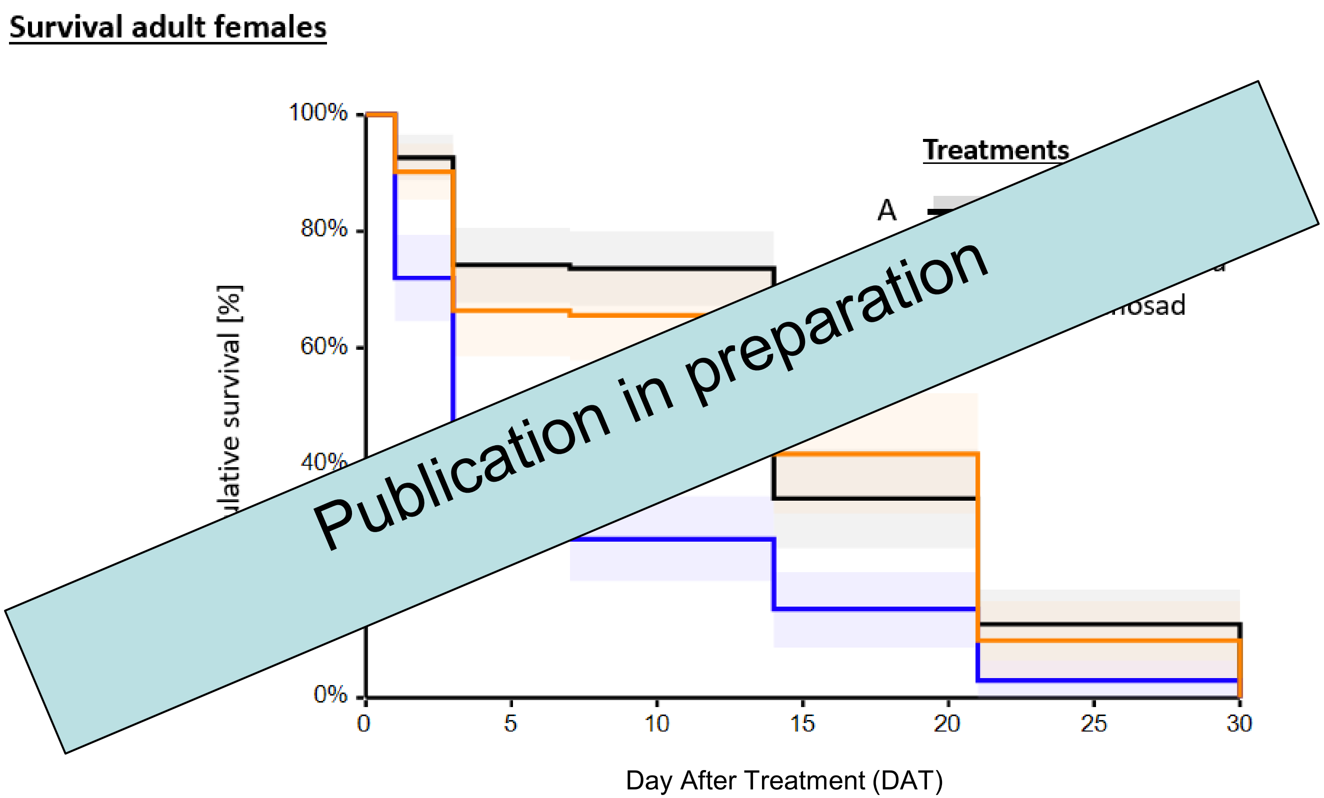


Acetamiprid / Spinosad



Risk assessment for bees: Spray drift into flower-strips

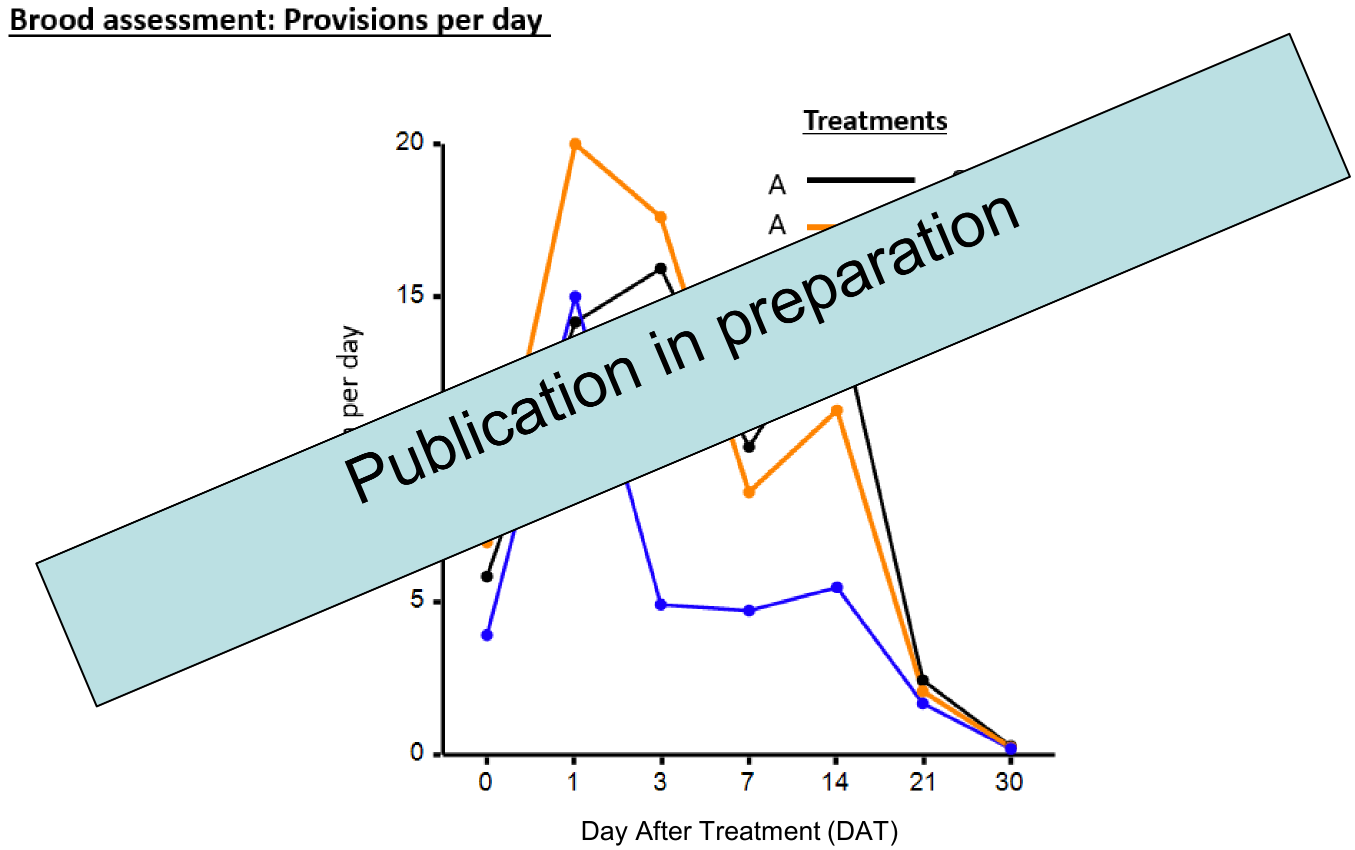
Results: Survival adult females / presence in nesting units



Cox-regression with Bonferroni corrections: Letters indicate significant differences (i.e., $p < 0.01$).

Risk assessment for bees: Spray drift into flower-strips

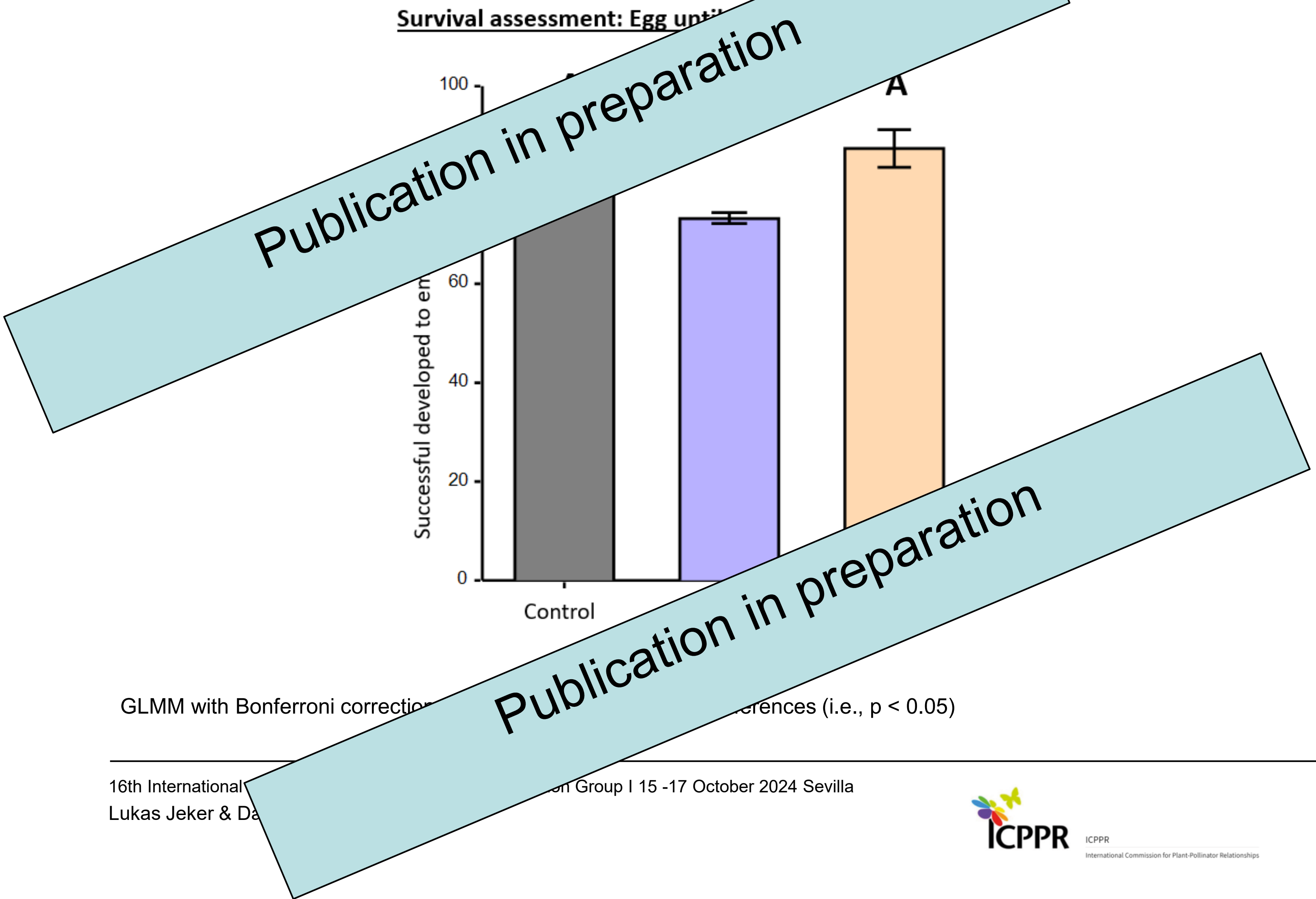
Results: Reproduction / Provisions per day



Generalized linear regression mixed model (GLMM); Letters indicate significant differences (i.e., $p < 0.05$)

Risk assessment for bees: Spray drift into flower-strips

Results: Successful brood development / egg to emergence



GLMM with Bonferroni correctio ... erences (i.e., $p < 0.05$)

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Risk assessment for bees: Spray drift into flower-strips

Discussion: Pollen foraging behaviour solitary and eusocial bee

Osmia, legs and body covered with pollen during nest-building. The surface of physical contact with contaminated pollen is increased and prolonged

Increased and prolonged contact exposure of *Osmia* with Spinosad residues via pollen and mud for nest building

Honeybees carry contaminated pollen in pollen baskets on their hind legs. The surface area of physical contact with contaminated pollen is small and temporary

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Risk assessment for bees: Spray drift into flower-strips

Conclusion

Spinosad treatment: Female survival, reproduction performance and brood development statistically significantly reduced

Acetamiprid showed no adverse effects

Based on our data and available honey bee data, the SPe8 mitigation measure for Spinosad (night application, after bee flight) is not sufficiently protective for solitary bees

Buffer zones to adjacent crops/flower strips must be applied

Further studies with non-*Apis* bees are needed to develop and issue sufficient protection measurements for the safe use of Spinosad

Beside the positive aspects (e.g, food source for bees), drift contaminated flower-strips can also adversely affect bees

A detailed publication of our data is in preparation

Acknowledgments

- Firstly I would acknowledge all the people that assisted in preparing and collecting data
  Daniela Grossar, Benoit Droz and Domenic Camenzind (Agroscope)

- Those that analyzed our data and helped to prepare the presentation
  Daniela Grossar, Thomas Poiger, Christina Kast, Marion Fracheboud, Michael Meissle, Jean-Daniel Charrière (Agroscope), Lars Straub (IBH)

- All the funding bodies that enable us to work daily, financed our projects (Swiss Federal Office for Agriculture and Agroscope)

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