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Pre- and post-harvest management to reduce losses during storage of pome fruits in organic production

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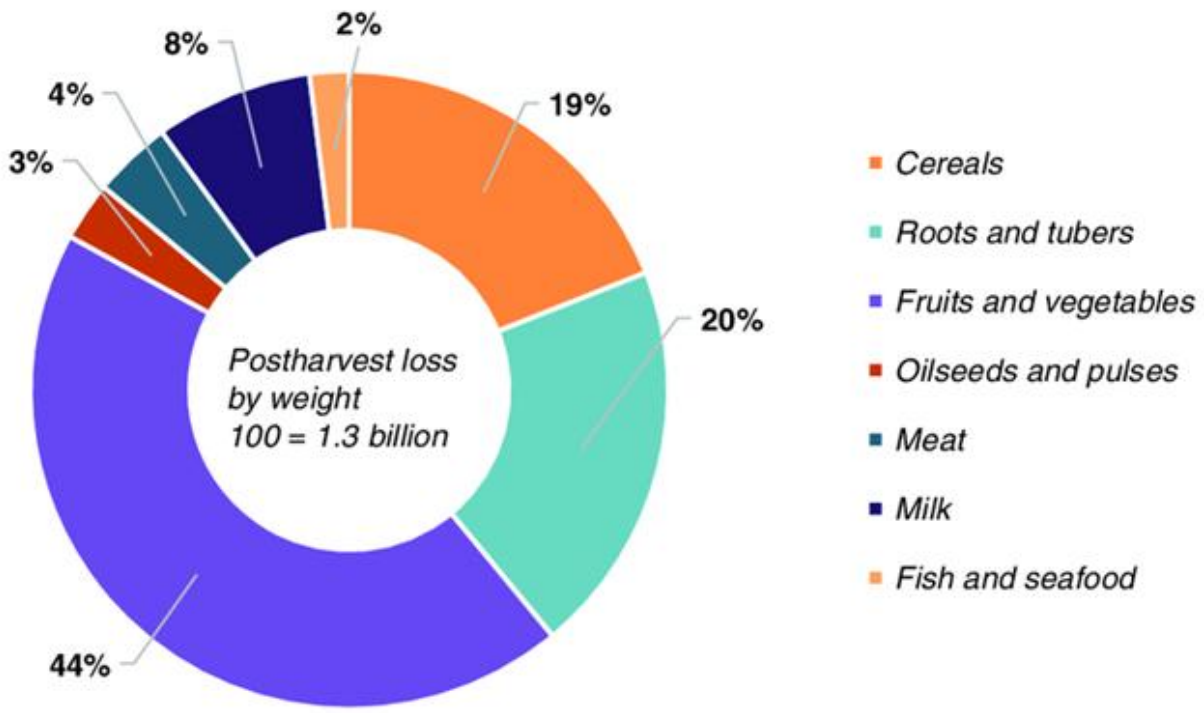
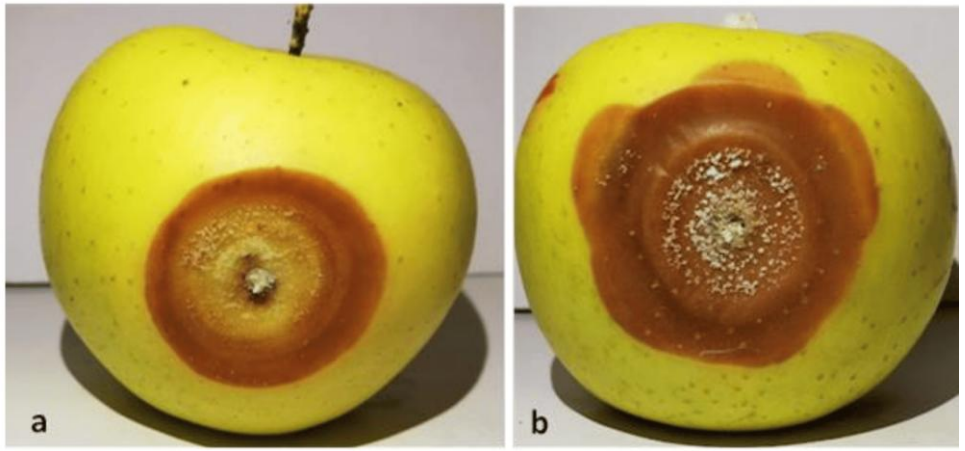
Approximately 40 percent of post-harvest losses consist of fruits and vegetables



Amjad et al. (2023)



Vukotic et al. (2022)

- Storage can lead from 5 to 35% of losses → up to 50%
- One of the most important causes is the bull's eye rot caused by different *Neofabraea* species.

Neofabraea spp.: one of the biggest problems for apple storage

- Ascomycota
- Infections occur during the growing season
- first symptoms → 3-5 months at storage condition
- Circular lesions which are light to dark brown with a lighter brown to tan centre
- **Little is still known about biology, ecology and epidemiology!**

«Bull's eye rot» in apples

Photo: Washington state University

Anthracnose cankers

Research questions

- **Which pre- and post-harvest management reduces losses during storage of pome fruits?**
  - Storage trial 2023 of cultivar Pinova
  - Development and validation of a laboratory inoculation protocol for *Neofabraea*
- **When and where are spores of the pathogen *Neofabraea* dispersed?**

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  - Storage trial 2023 of cultivar Pinova
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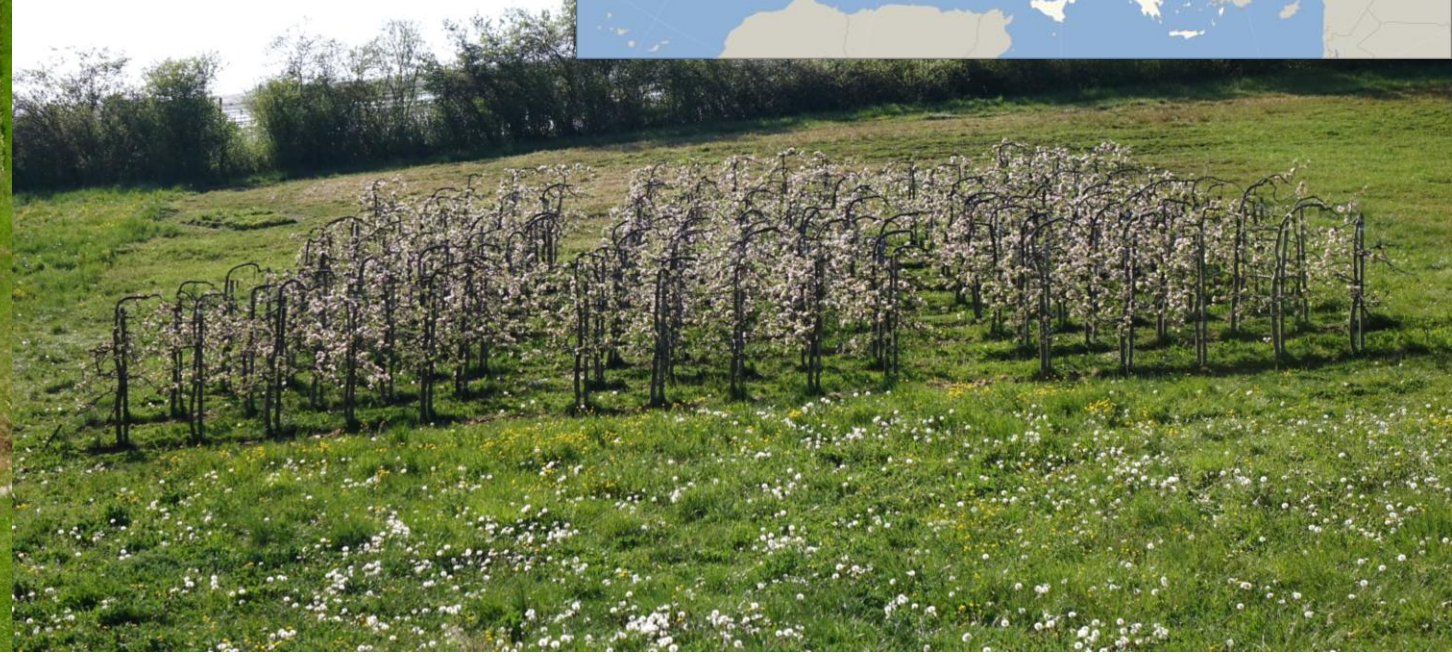
- **When and where are spores of the pathogen *Neofabraea* dispersed?**

Pinova storage trial 2023



Experimental Design

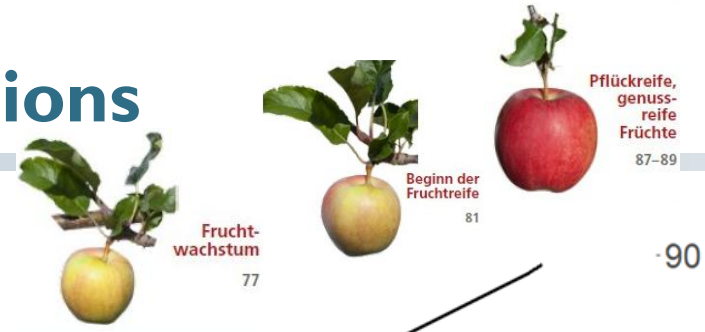
Block 1		Block 2		Block 3		Block 4	
1	16	31	46	61	76	91	106
2	17	32	47	62	77	92	107
3	18	33	48	63	78	93	108
4	19	34	49	64	79	94	109
5	20	35	50	65	80	95	110
6	21	36	51	66	81	96	111
7	22	37	52	67	82	97	112
8	23	38	53	68	83	98	113
9	24	39	54	69	84	99	114
10	25	40	55	70	85	100	115
11	26	41	56	71	86	101	116
12	27	42	57	72	87	102	117
13	28	43	58	73	88	103	118
14	29	44	59	74	89	104	119
15	30	45	60	75	90	105	120

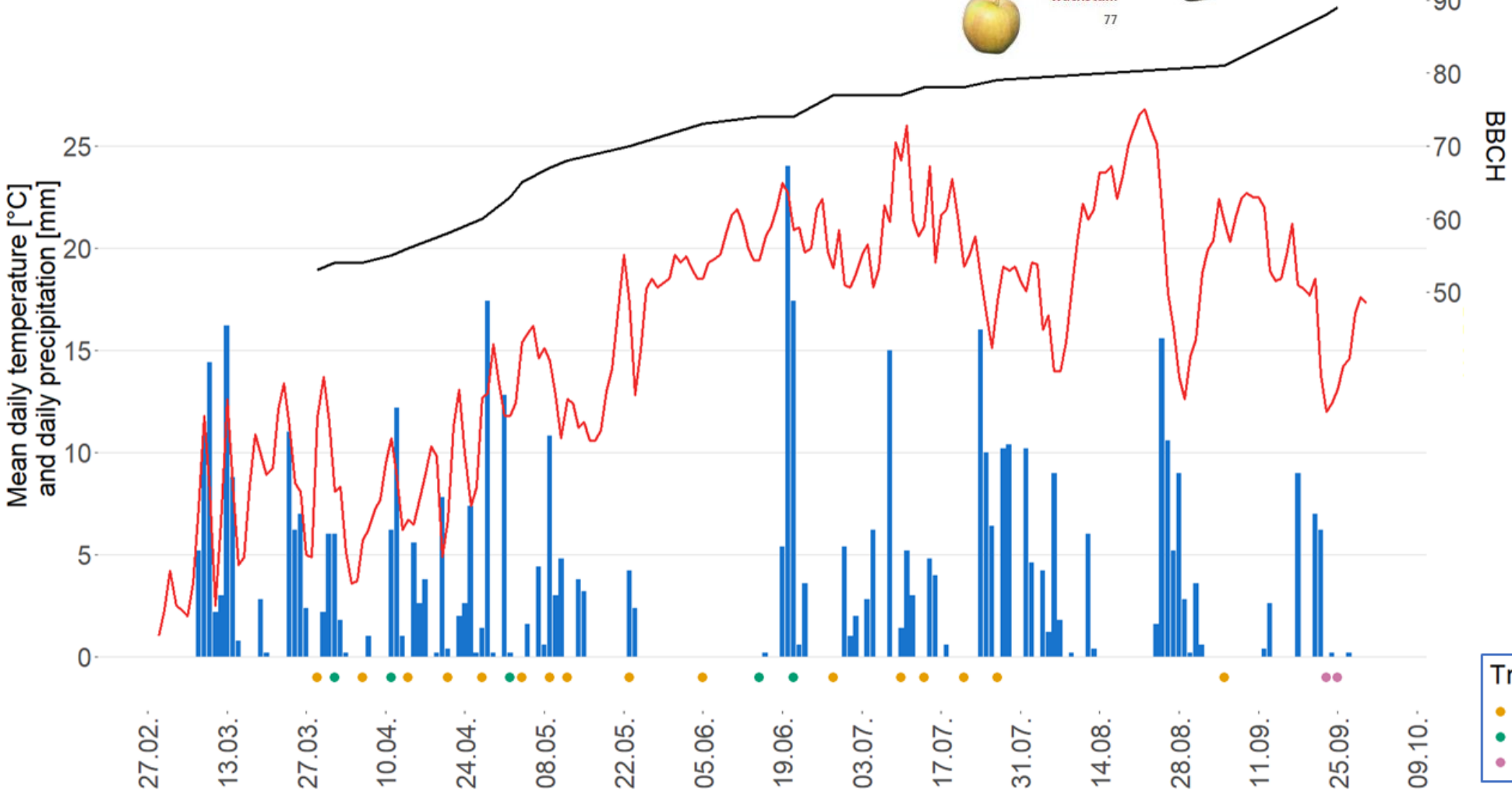
6 treatments in 4 replicates
5 trees per replicate

«Standard-strategy» until development stage 77 or 81. Pre-harvest treatments with chosen products: 7 days and 3 days before harvest.

	Summer (BBCH 77)	Pre-harvest (BBCH 81)
control	-	-
Standard-strategy	Myco-Sin + S	-
Blossom Protect	Myco-Sin + S	Blossom Protect
Blossom Protect - Myco-Sin	Myco-Sin + S	Myco-Sin + Blossom Protect
Product X - early	Myco-Sin + S	Product X + $CaCO_3$
Product X - late	Product X + $CaCO_3$	Product X + $CaCO_3$

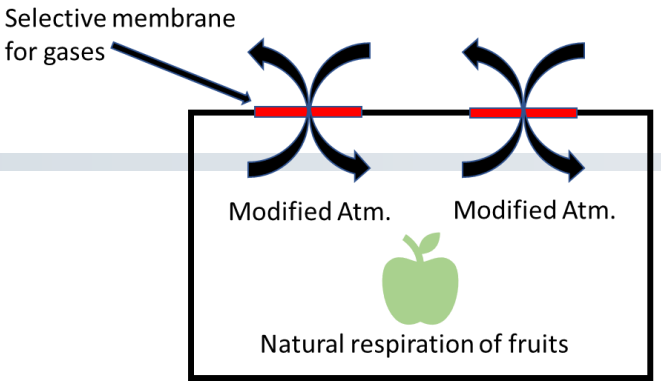
Perfect condition for new infections



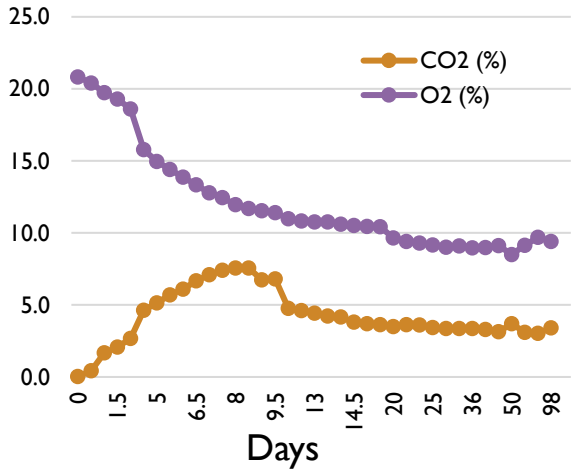


- Spring wet
- June dry
- Wet again from July
- Harvest: end of September 2023

Implementation of the Mat Tiempo box

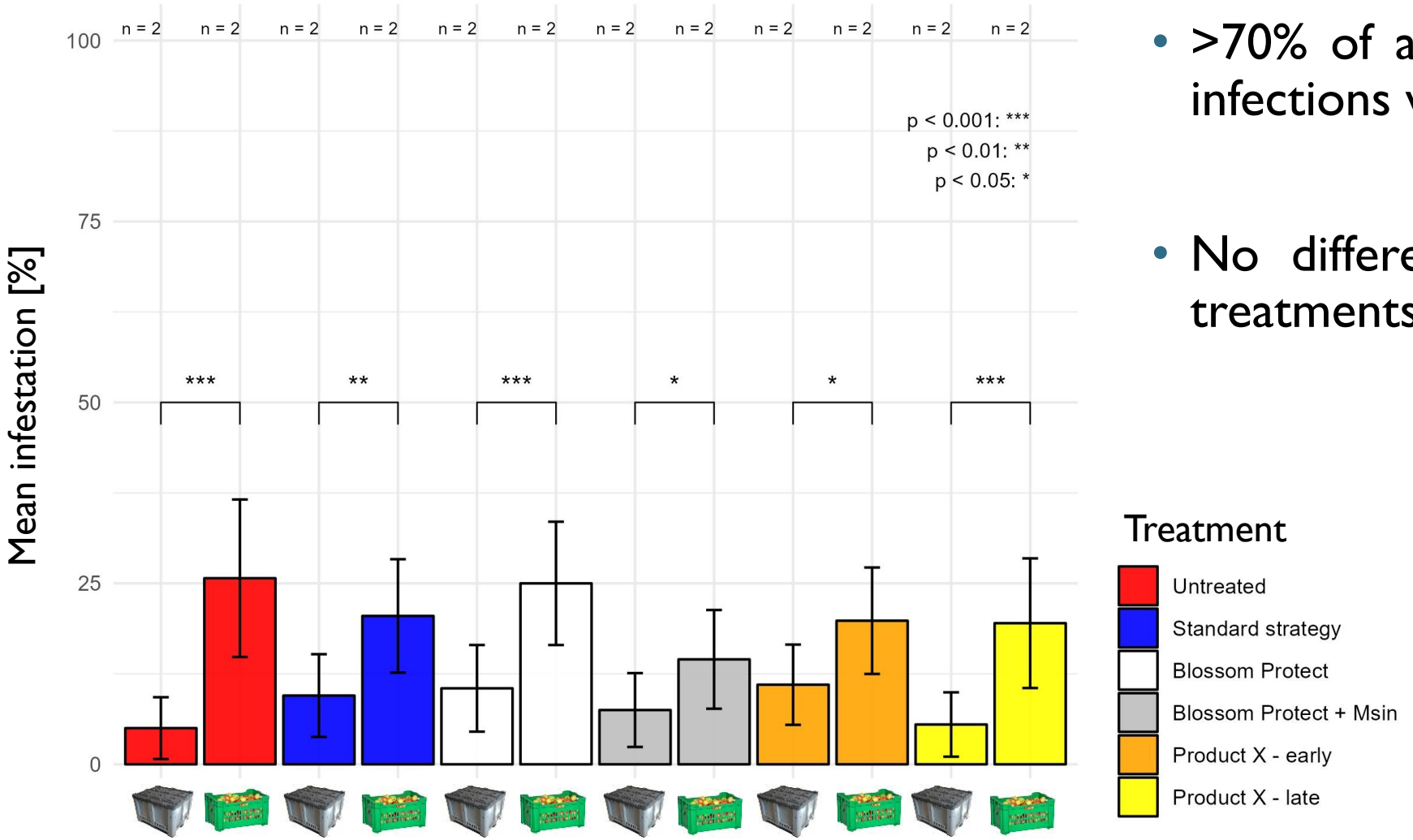


Gas exchange is regulated, not directly controlled!



- Assessment after a storage period of 4 months
- Storage conditions: 4°C
- 2 boxes per treatment (~200 fruits)

Mat Tiempo boxes significantly decreased the level of infection



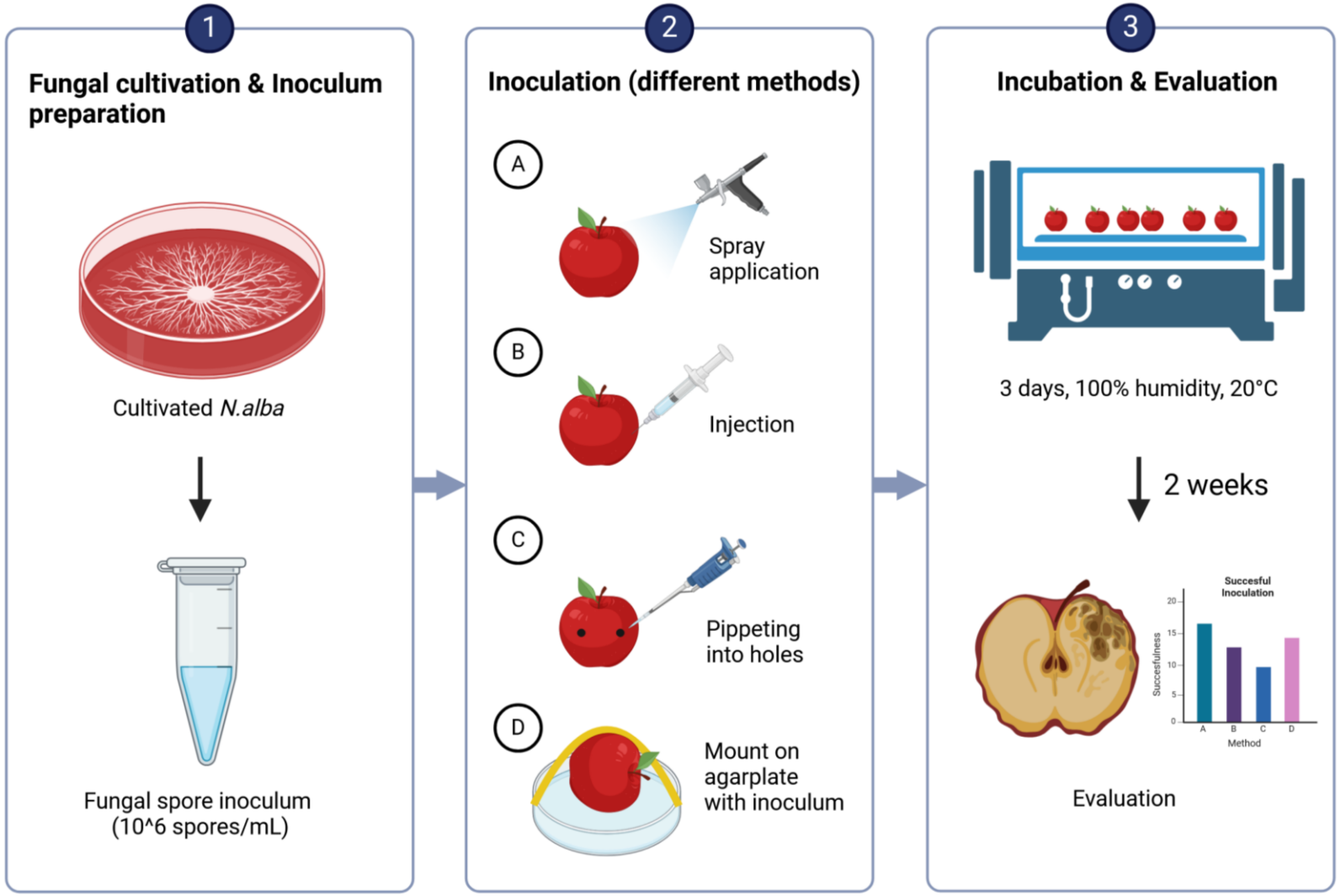
- >70% of all recorded diseases were infections with *Neofabraea*
- No differences between other the treatments
- The second most frequent disease was *Monilia* (>20%)

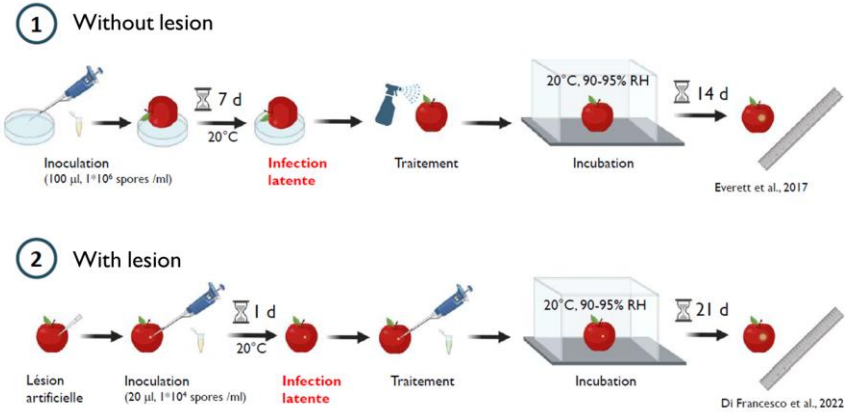
Research questions

- **Which pre- and post-harvest management reduces losses during storage of pome fruits?**
  - Storage trial 2023 of cultivar Pinova
  - Development and validation of a laboratory inoculation protocol for *Neofabraea*

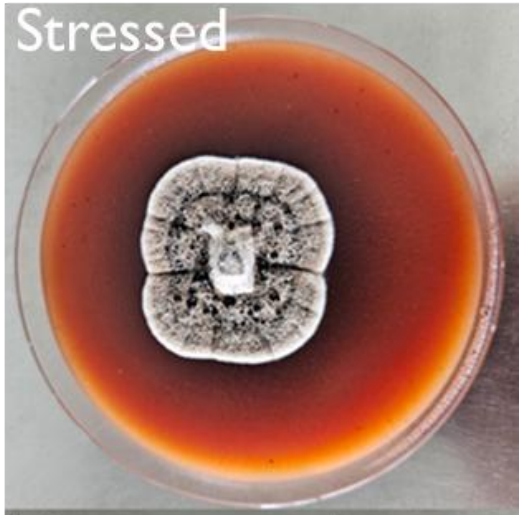
- **When and where are spores of the pathogen *Neofabraea* dispersed?**

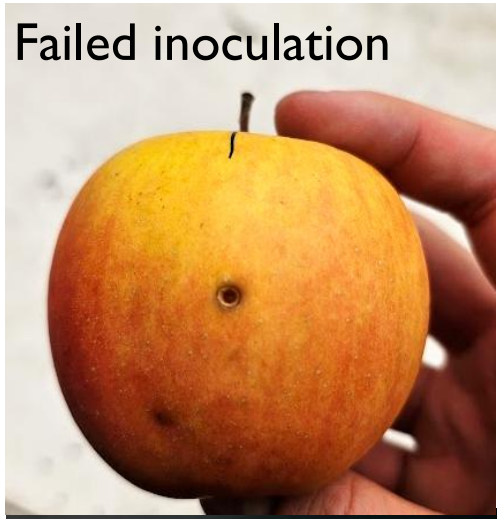
Experimental design: inoculation protocol with and without lesion

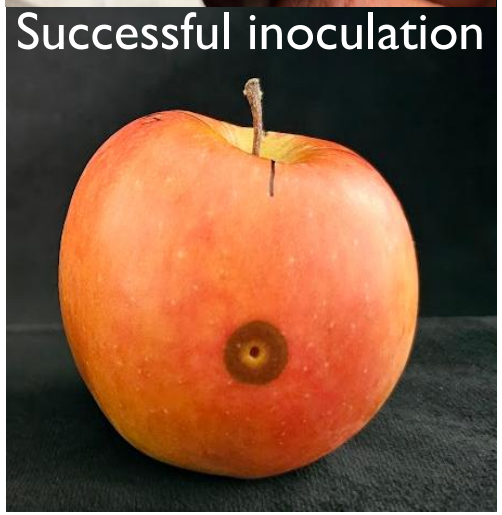


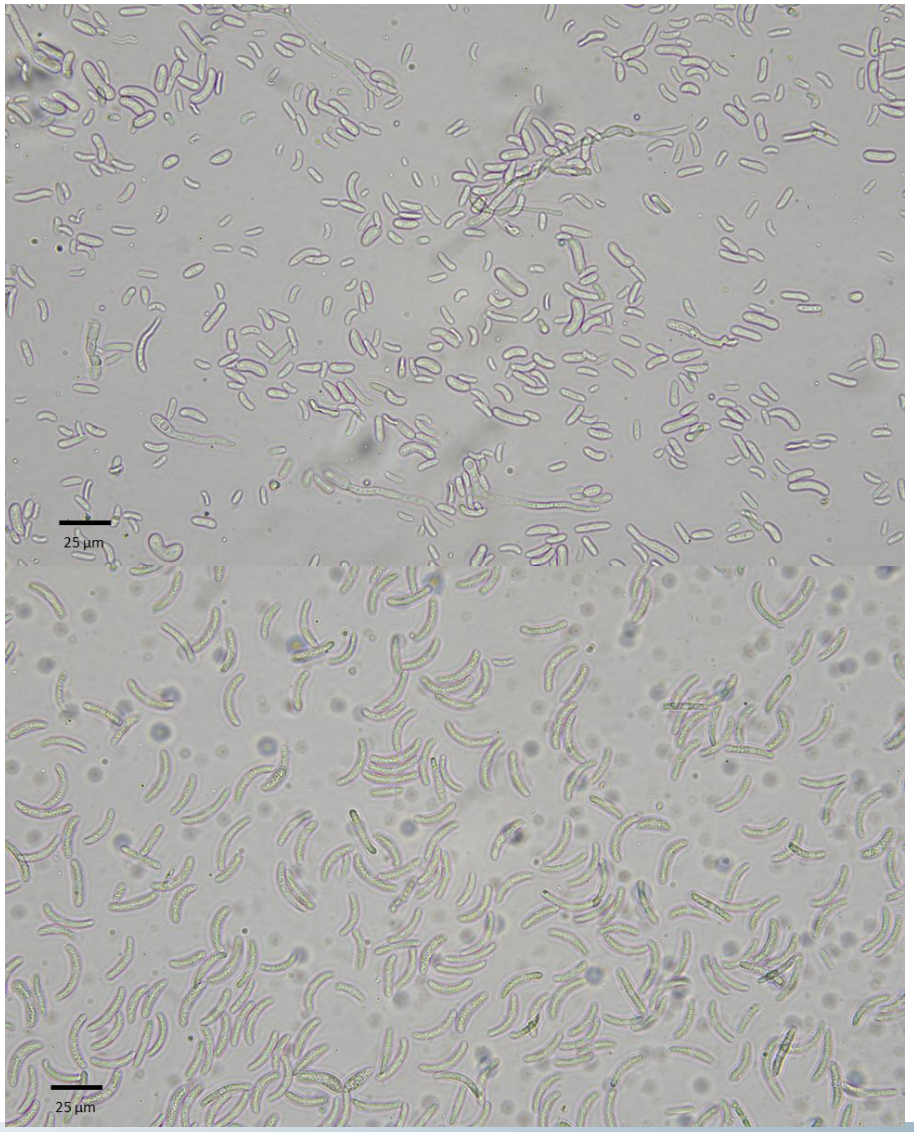


Infection in lab conditions was not as easy as previously thought...





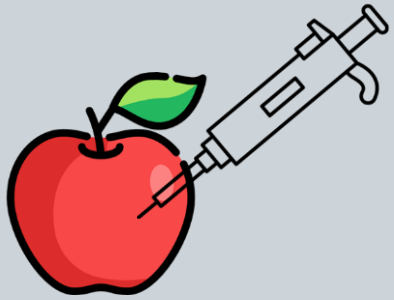
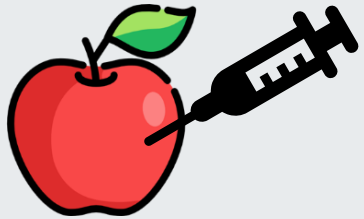
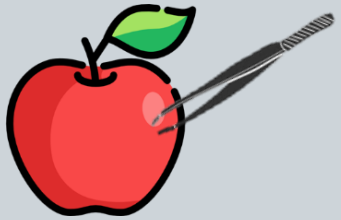




Conidia from Agarplates
→ **microconidia**

Conidia from apples
→ **macroconidia**
(17 - 28 x 4-6 µm)

Wounds ensure a high rate of infection

With wounding		Without wounding	
Inoculum injection with a pipette into a hole (standard method)		Apple mounted on an agar plate inoculated	
Inoculum injection with a syringe		Spray	
Agar plug with fungi into a hole		Agar plug on surface	

Research questions

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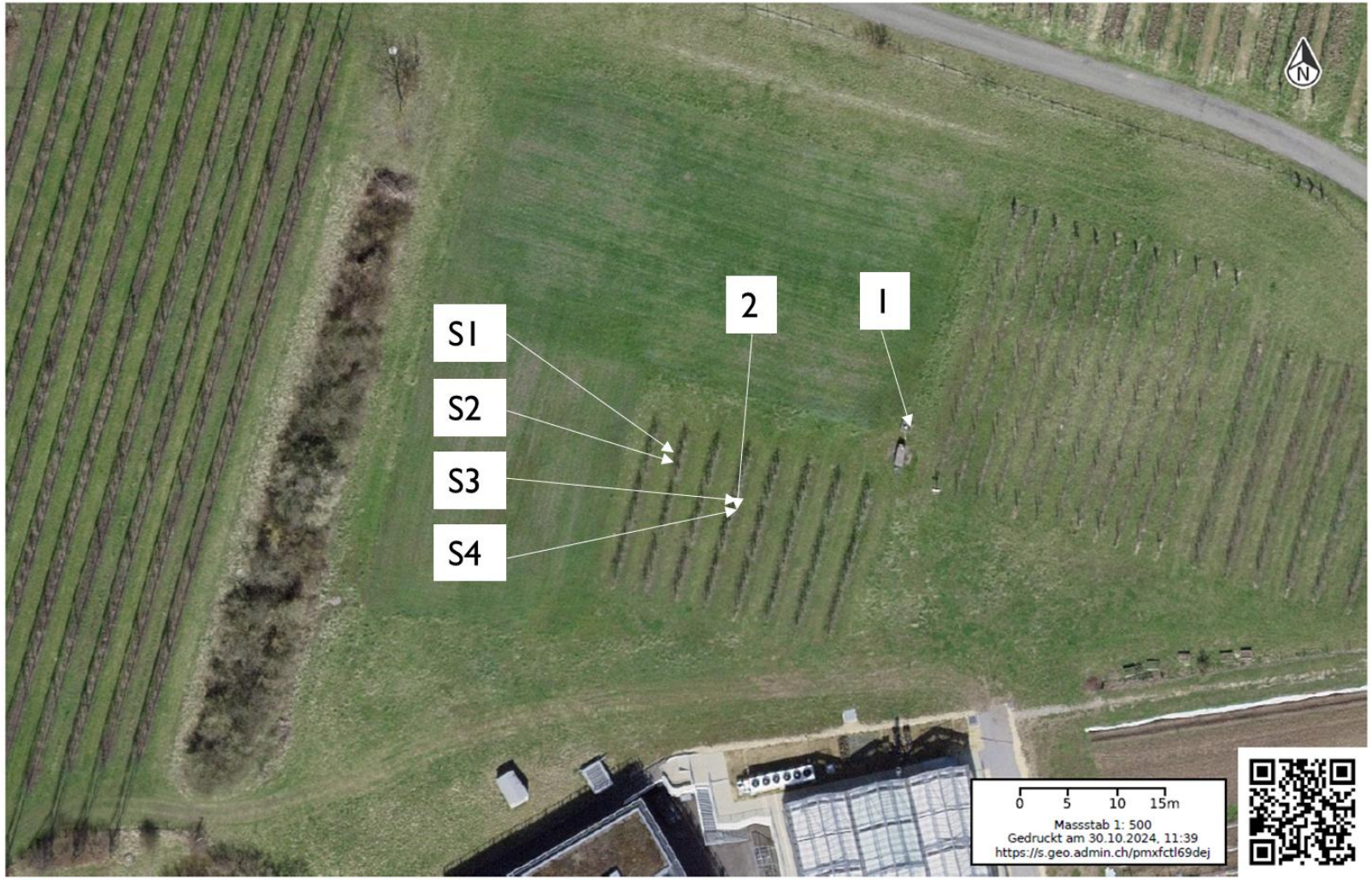
Spore monitoring season 2024



Branch

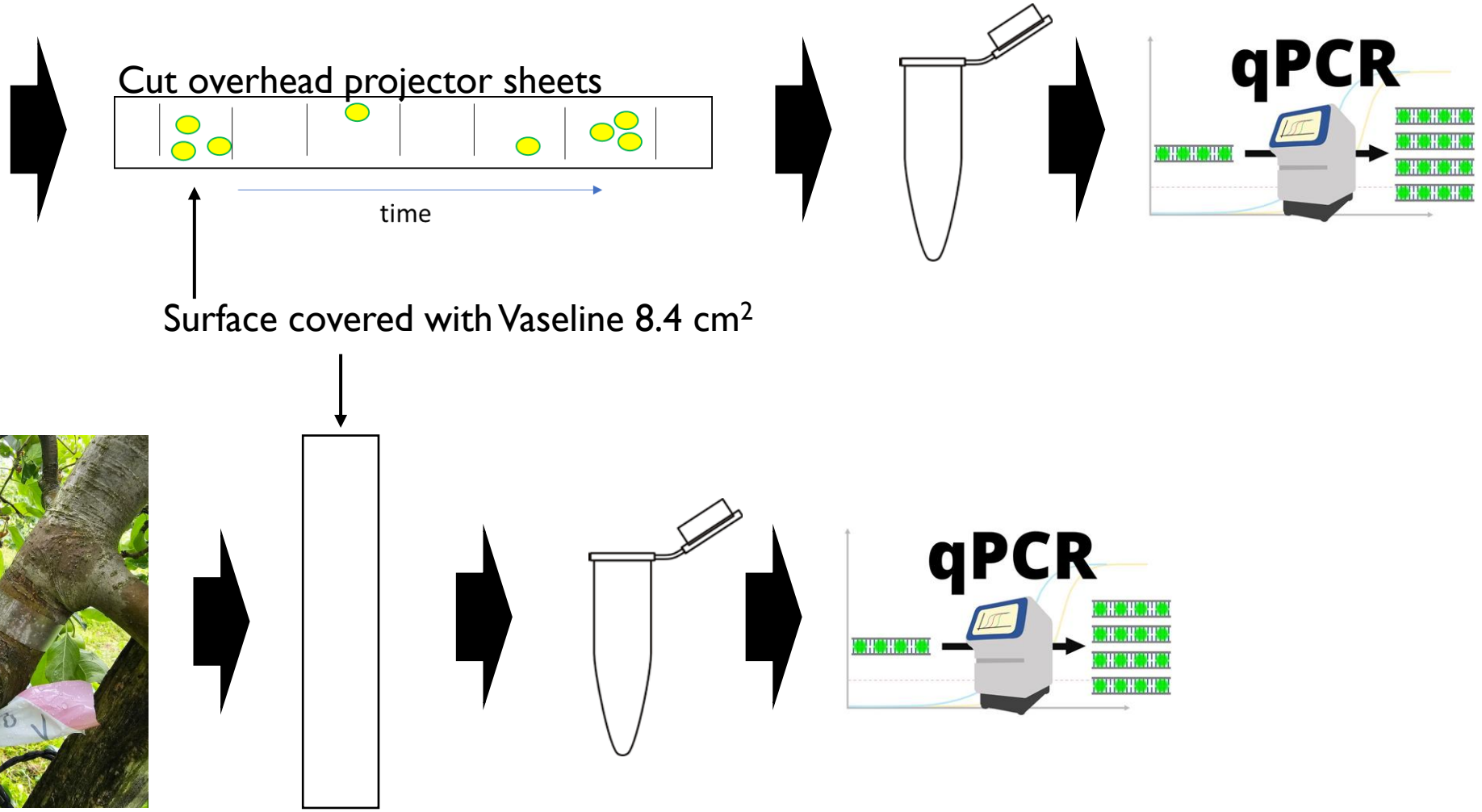
Stem

Legend

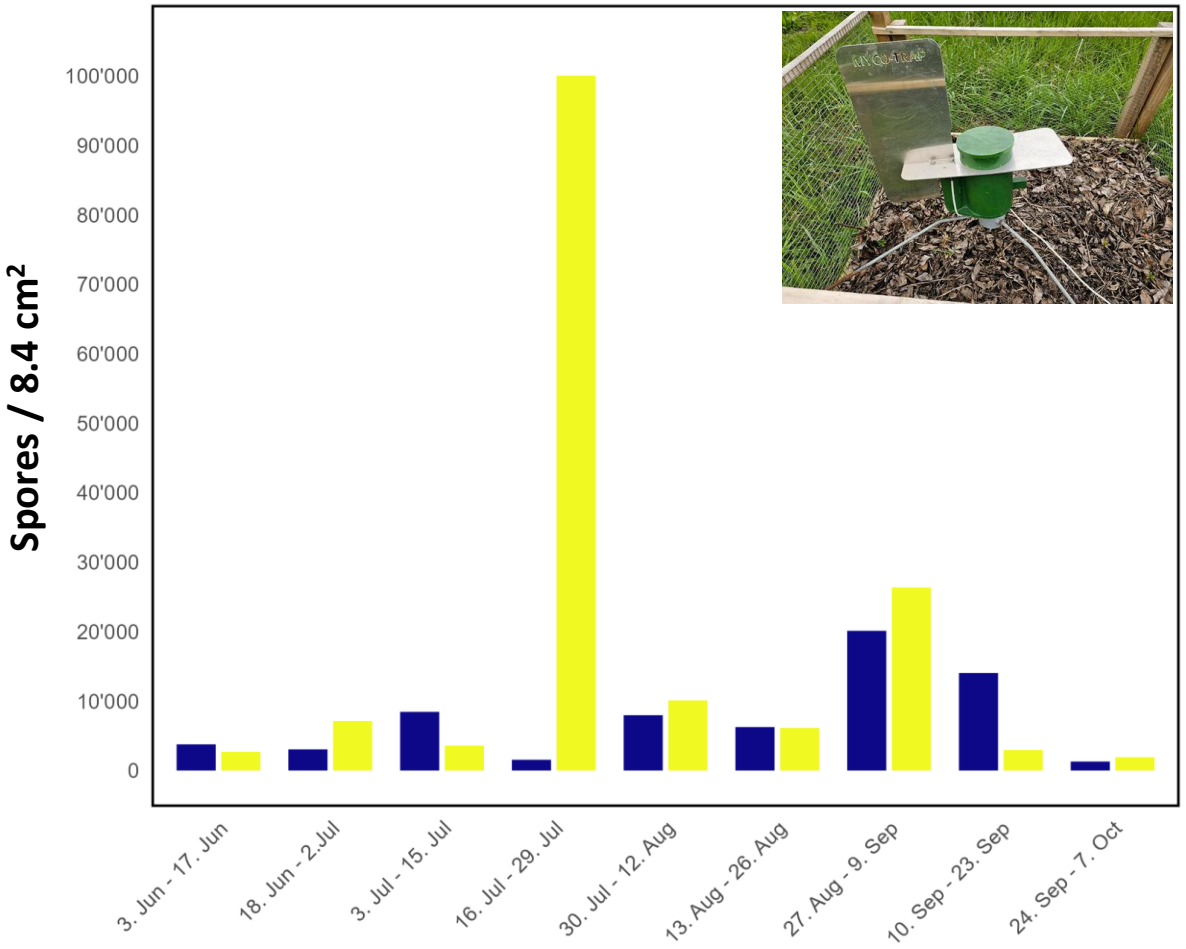
1 = Sporetrap 1
2 = Sporetrap 2
S1 = Stripe 1 (Stem)
S2 = Stripe 2 (Branch)
S3 = Stripe 3 (Stem)
S4 = Stripe 4 (Branch)

Establishing qPCR method to identify *Neofabraea* spores

Mycotrap: 600 l/min



Neofabraea spores were detected all season



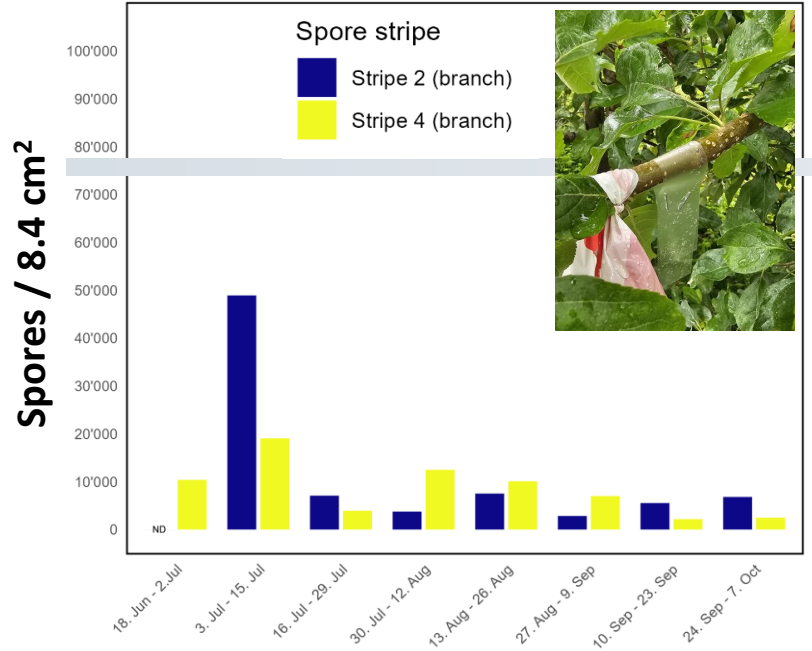
Placed outside the orchard

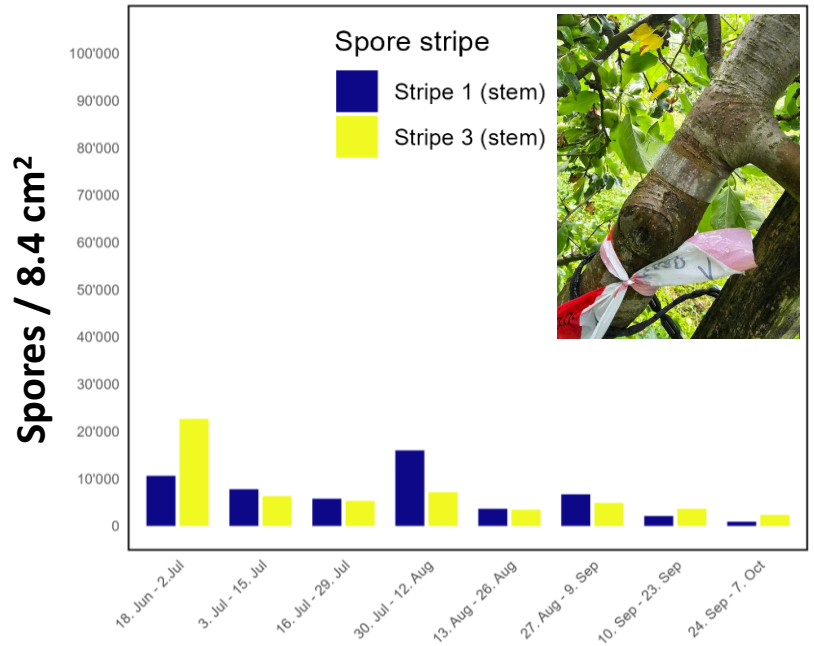
Sporetrap

Sporetrap 1

Sporetrap 2

Placed in the middle of the orchard



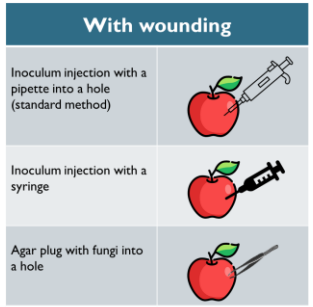


- ***Neofabraea* spores were detected throughout the whole season!**

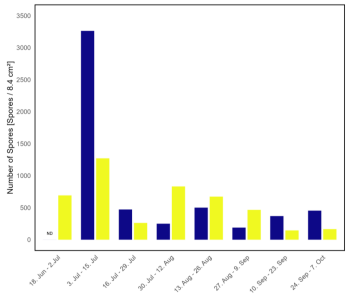
Fruit bags to investigate the infection period during the growing season

General conclusions

- **Mat Tiempo boxes** significantly decreased the level of infection



- In artificial infections, **wounds ensure a high infection rate**



- Spores of *Neofabraea* were detected in the air **throughout the whole season**

Outlook

- Spores are airborne throughout the season, but **when** does fruit infection occur?

- With the validated laboratory protocol, we aim to **test the efficacy of various organic products**

Acknowledgements

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Confederaziun svizra

Partner
Agroscope

Storage trial 2024 of cultivar Pinova: Ozone treatment

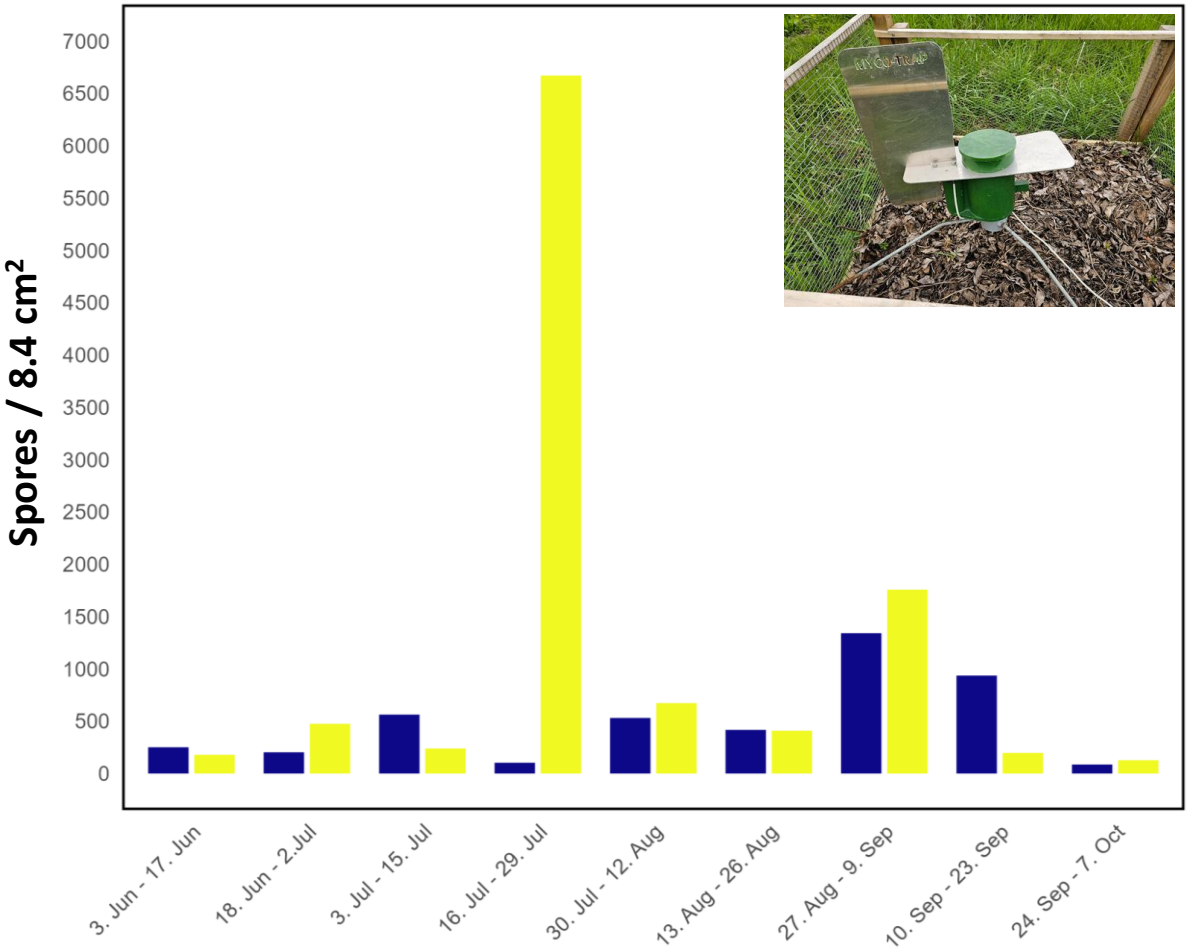
Pre-harvest management:

Untreated
Standard-strategy: Myco-Sin + S
Microbial product
Sulphur

Post-harvest management:

- Ozon: Max ~ 2.2 ppm for 15 min
- Consortia of 3 different *Bacillus*

Neofabraea spores were detected all season



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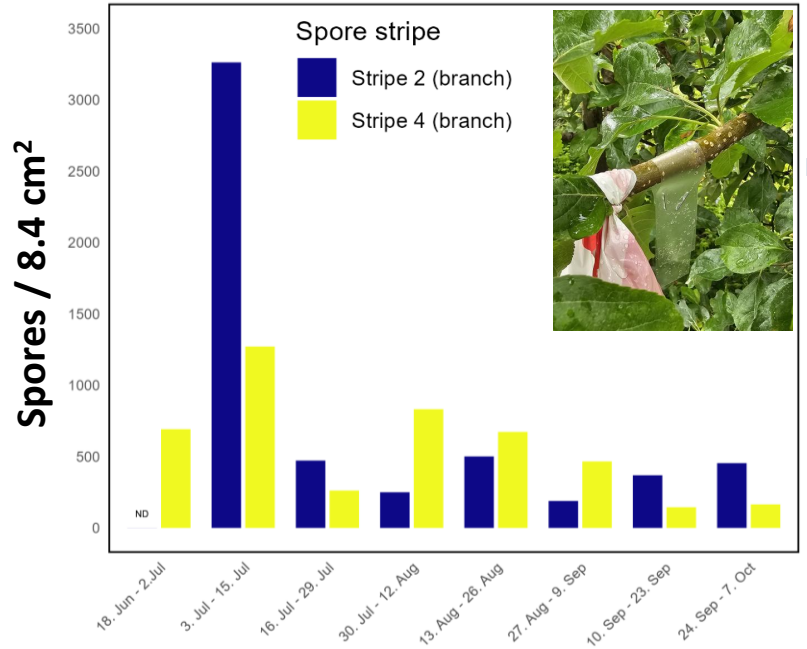

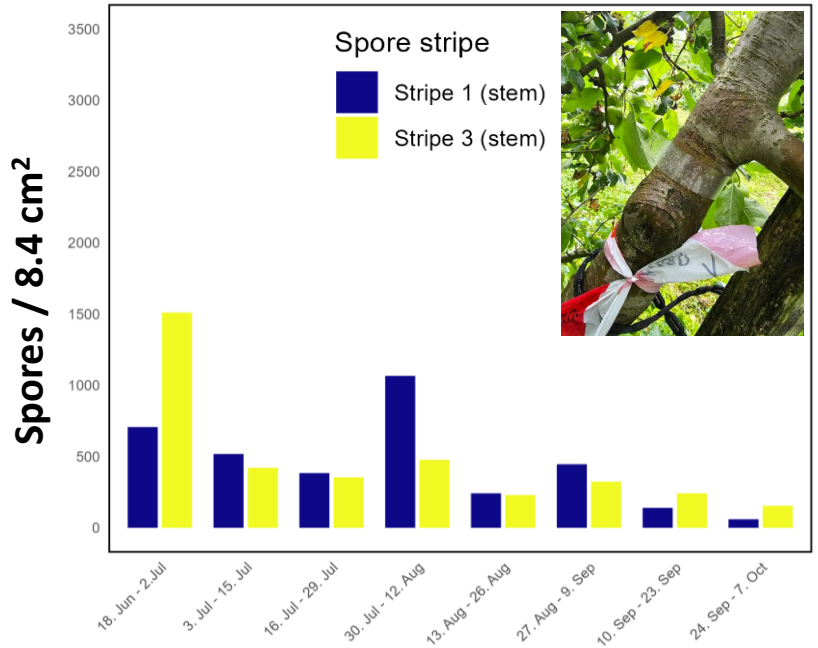

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