Use of vibrations to manipulate the behaviour of the meadow spittlebug *Philaenus spumarius*

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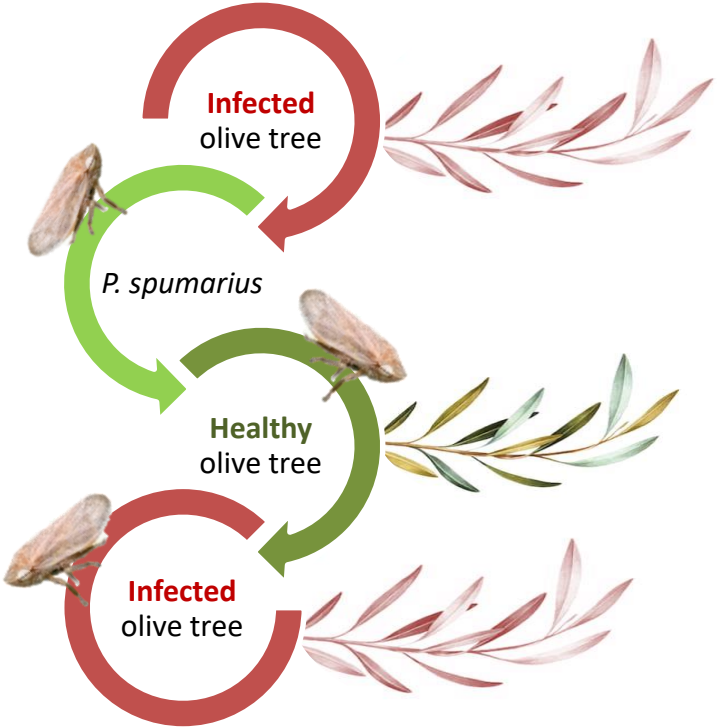
Xylella Fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy

2nd European Conference on *Xylella*, 29-30th October 2019

P. spumarius: a **threat** for the European agriculture



Olive tree affected by OQDS

P. spumarius

- Abundant & widespread
- Highly polyphagous
- Adults: **APRIL-JANUARY**

Applied biotremology

Vibrational pest control

Species-specific vibrations = **manipulation** of the **mating behavior**

Mating disruption

Lure & Kill: **Traps**

Work flow

1
- Mating behavior
- Vibrational signals (VS)

2
- Ecology
- Phenology/Biology

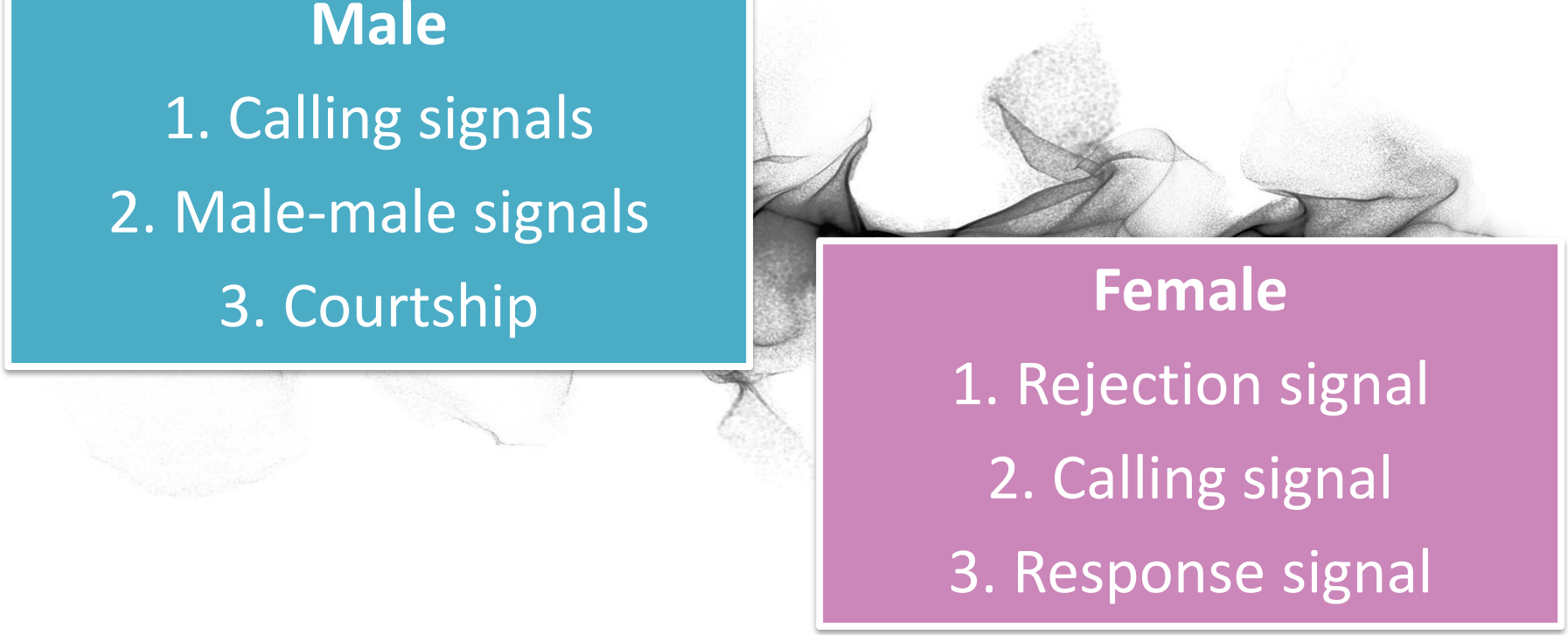
3
- Vibrational manipulation

Design of **vibrational control techniques**

P. spumarius vibrational communication

Male

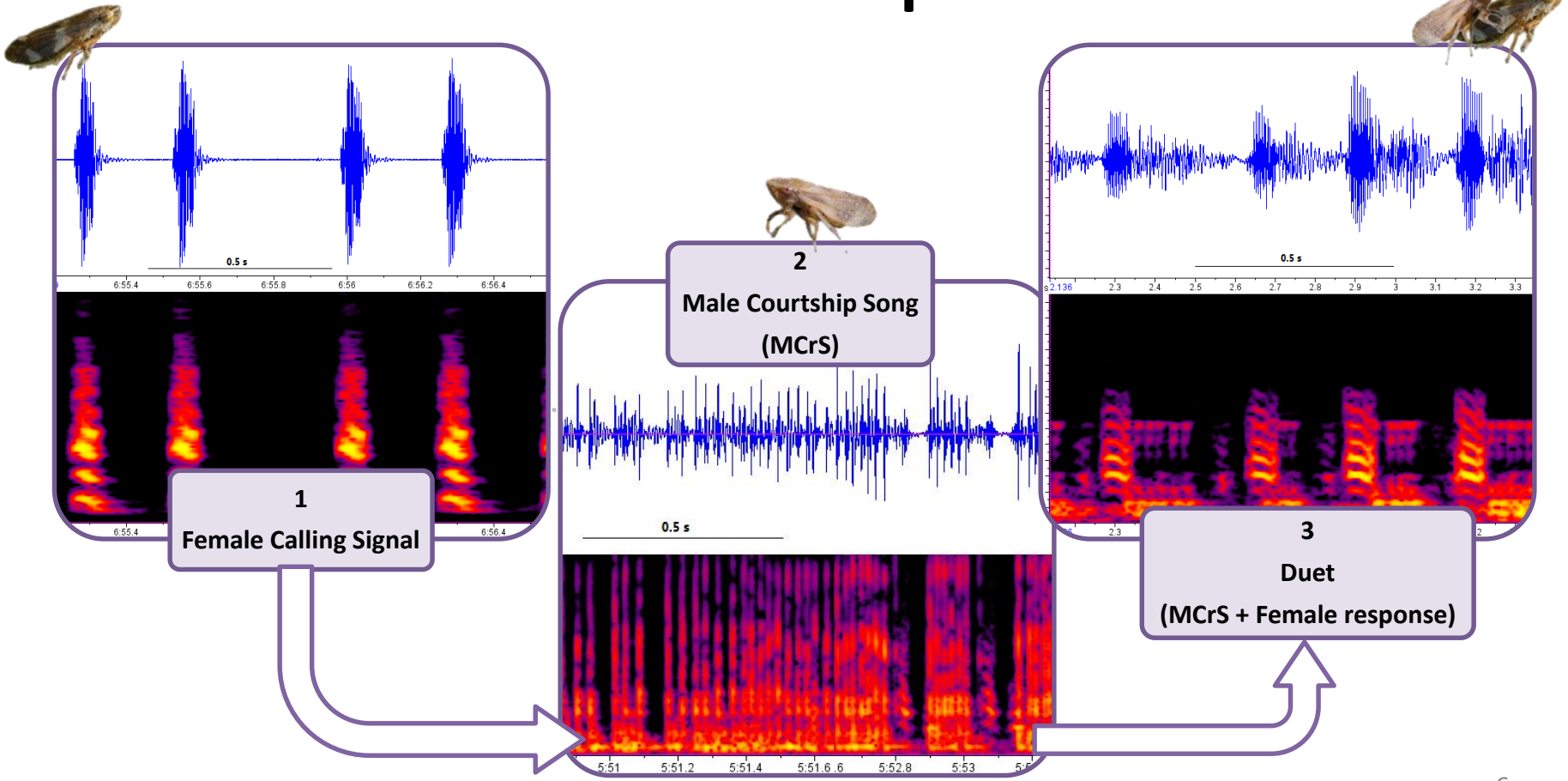
1. Calling signals
2. Male-male signals
3. Courtship



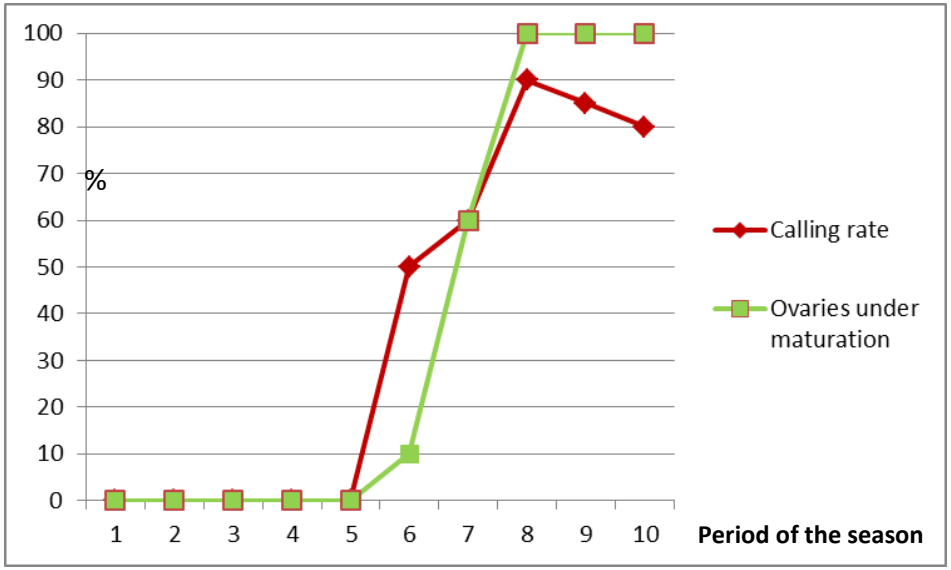
Female

1. Rejection signal
2. Calling signal
3. Response signal

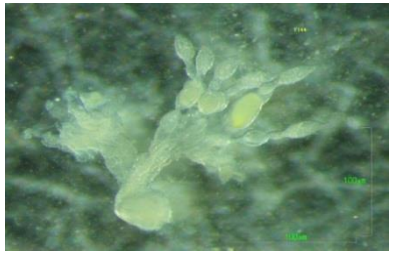
Pair formation process



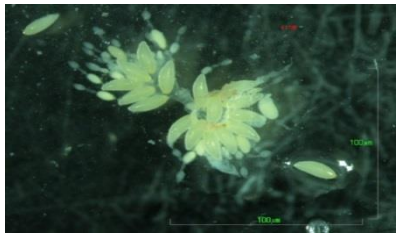
Female **calling rate** correlated with **phenology**



A. **Immature** ovarioles



B. First stages of **maturation**



C. **Mature** ovaries

Behavioural manipulation

role of the male signals

1. **Male calling signal** _ June vs September

2. **Male-male signal** _ July

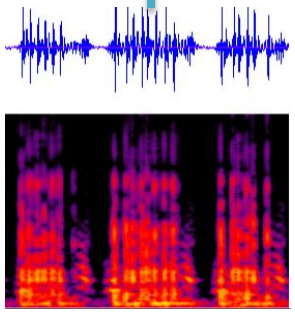
Behavioural manipulation: strategies

3. **Mating disruption** _ August/October

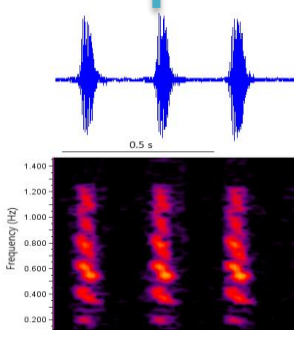
4. **Repellent signals** _ October

Male calling signal (MCS)

MCS



15 min



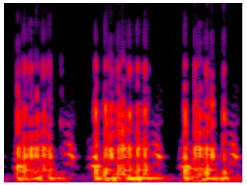
On **males**

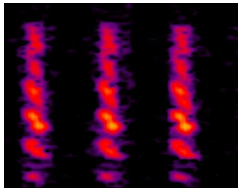
On **females**

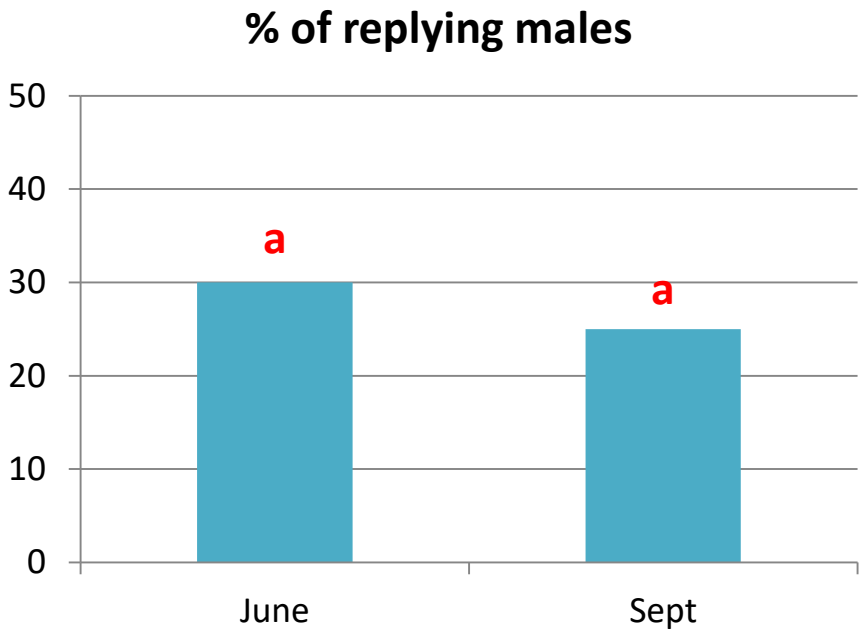
In **June**; n=30

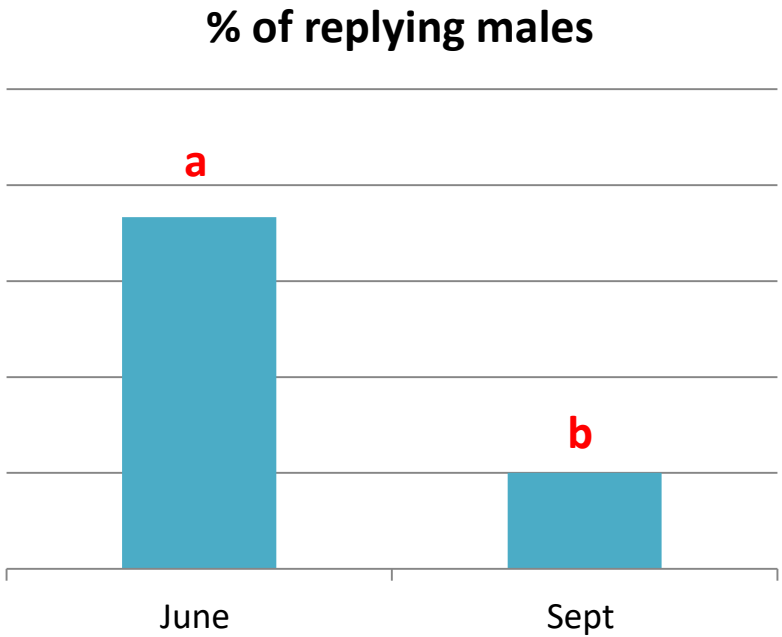
In **Sept**; n=20

MCS: **male replying** activity

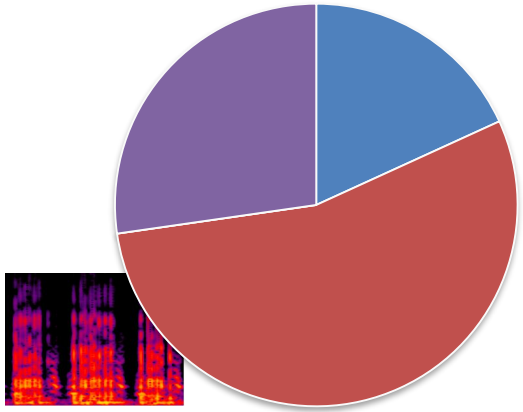




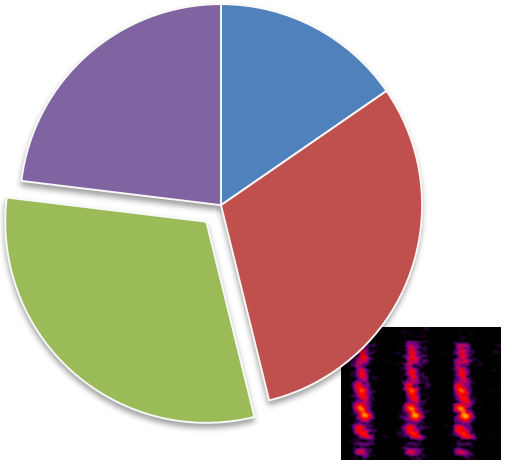




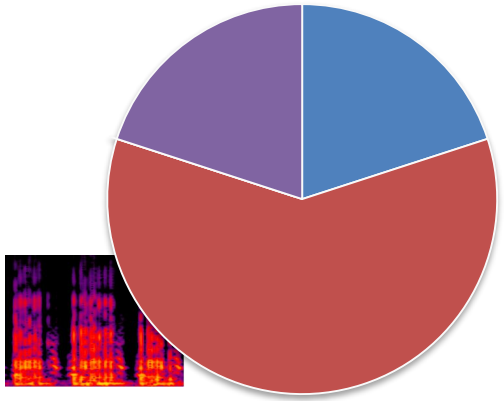
MCS: **type** of emitted signals



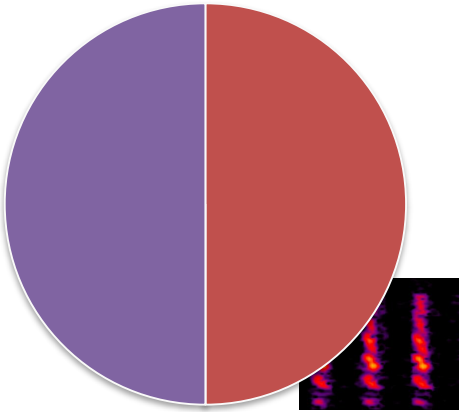
June



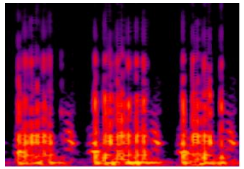
- MCS = 1 sound element
- MCS = 2 sound elements
- Male Courtship Signal
- Pulses

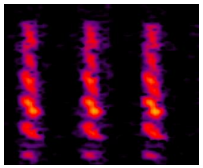


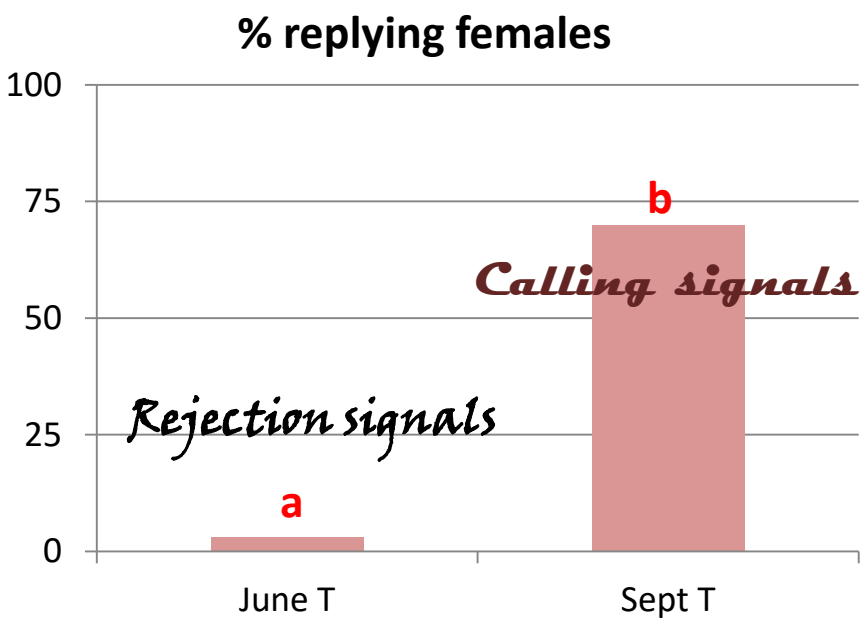
September

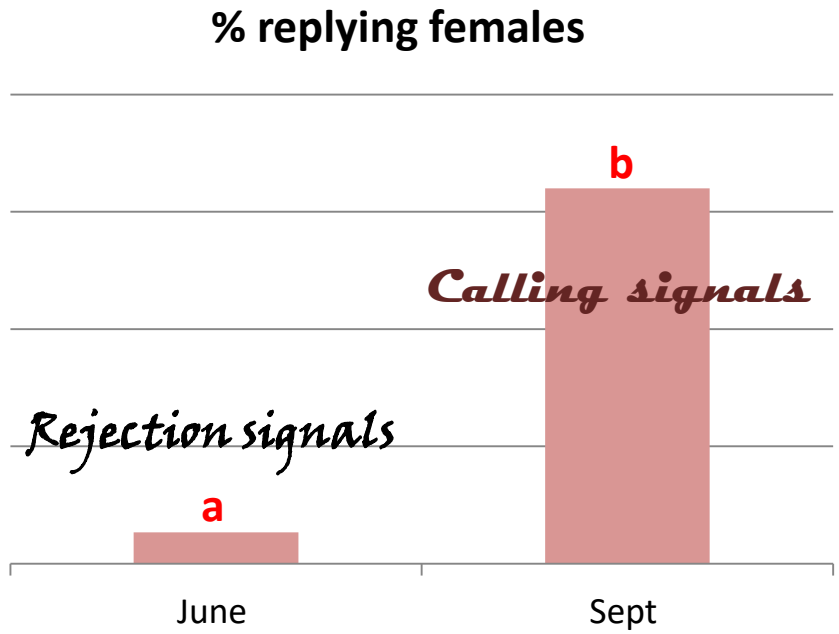


MCS: **female motivation** to mating

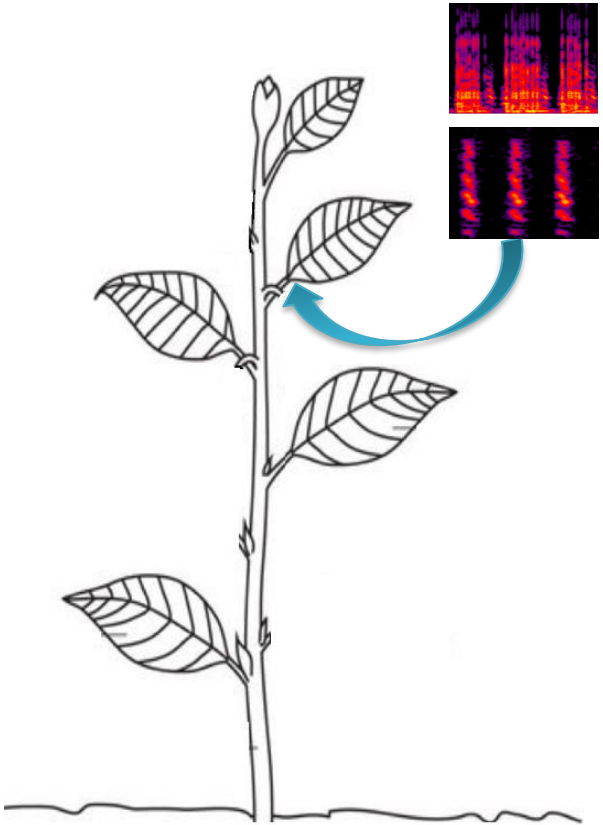






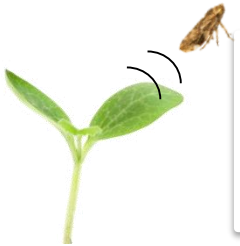


MCS: **aggregation/repellency** signal?



No significant differences between control and treatment

- In June
- In September



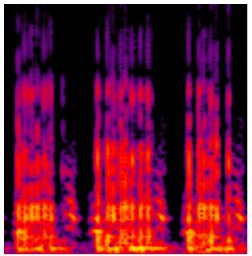
No significant differences in number of males that **left the plant**

Role of MCS
Conclusions

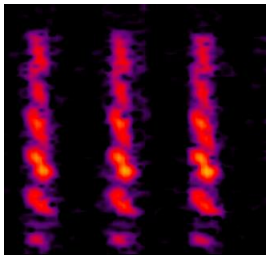
The role is still not clear!

Excluded:

- Aggregation signal
- Repellent signal
- Increase female motivation



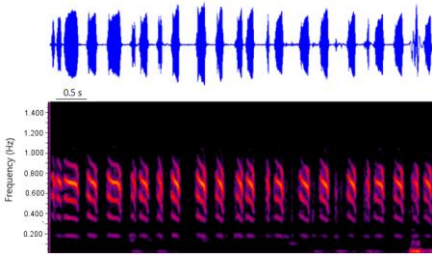
Longer exposure?



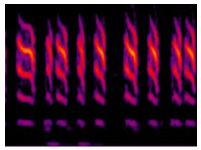
Male-Male Signal

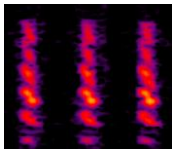
- Single males
- Pair
- Control group
- Trios (2M+1F)

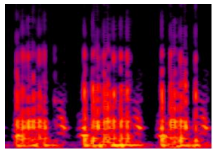
10 minute silence + 5 min loop of a MMS

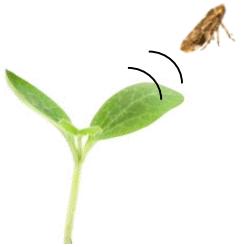


Male-Male Signal (MMS)









Group	n	MMS	MCS 1 element	MCS 2 elements	Male jump
Treated	30	**0**	3	3	2
Control	30	**0**			
Pairs	30	**0**	1	1	4
Trios	30	**3**	9	13	4

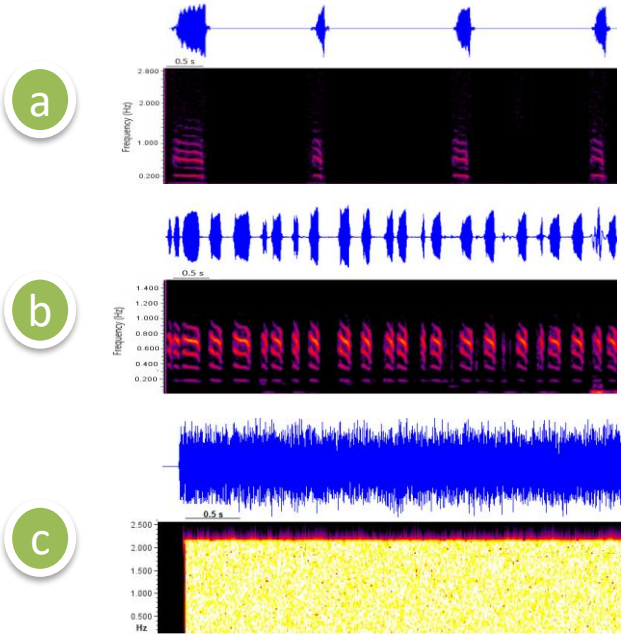
No significant differences

The vibrational signal alone did not triggered a MMs from the tested males: **physical presence necessary**

Mating disruption

End of August

a) Female rejection signal
b) Male-male signal
c) White noise + silence
d) Control



Mating disruption

	n	Female calling	Duet	Copula	Jump
Ctrl	20	11	9	**5**	2
FRjS					3
MMS					4
WN	20	9	6	**2**	3
Trio	30	11	4	**4**	4

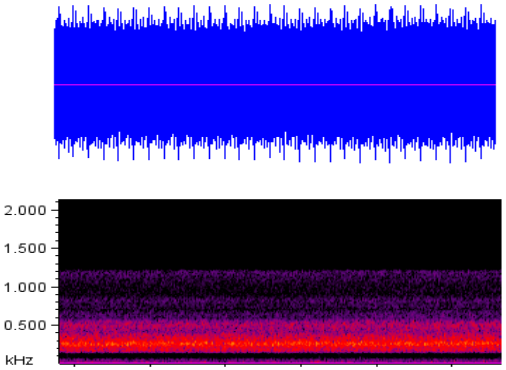
No significant differences

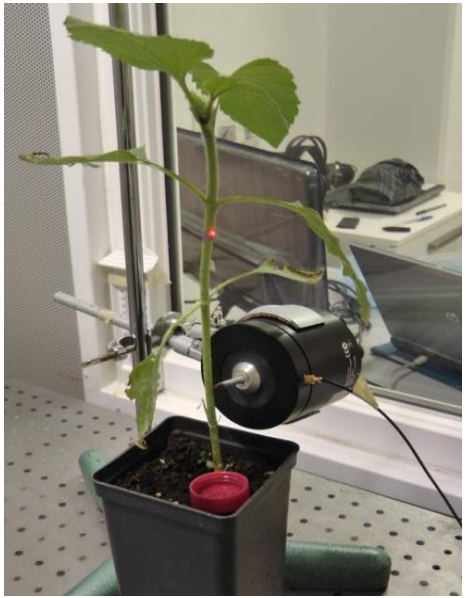
- Control group = Ctrl
- Female rejection signal = FRjS
- Male-male signal = MMS
- White noise = WN

Mating disruption

October

- Control
- Continuous noise (freq range :)





n=20 pairs
20 min

Mating disruption

Oct	n	FCS	Duet	Copula
Ctrl	20	15	13	12
WN_2	20	12	3	1

p<0.001

Mating disruption
Conclusions

- Interference with male-female communication

Efficiency likely depends on

- **Frequency range**: female reply
- **Duration:** no silent gaps

Repellency

- 2 treated plants
- 2 control plants
- Repellent playbacks

24 hours

4 individuals per plant

Repellency

No significant differences between treated and control plants

Most suitable signal?

Discussion and conclusion

- **Mating** relies on **vibrational signals**
- **Manipulation** by means of vibrations: **feasible** approach

Future perspectives:

- Most **suitable signals**
- Different **strategies** depending on the mating season

(i.e. mating disruption = end season)

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Thank you for your attention

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