BIOGARD®

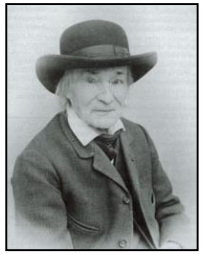
biological First.

MATING DISRUPTION 2.0

VIBRATIONAL COMUNICATION DISRUPTION OF LAEFHOPPERS

VITTORIO VERONELLI - VALERIO MAZZONI - RACHELE NIERI - MARCO BALDO – ABIM 2017

pheromones vs vibrational



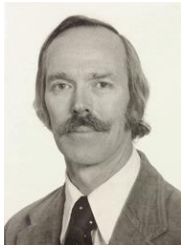
J. Henry Fabre first records insect chemical communication

Bruno Götz hypothesis on MD of Grape moths

Adolf Butenandt Bombykol from *B. mori*

P. Karlson & M. Luscher Suggested Pheromone

Morton Beroza Suggested MD



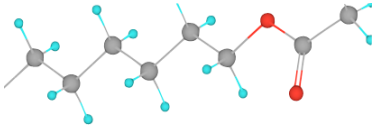
Harry Shorey conducts first MD field trial *(T. ni)*

P. gossypiella first registered in USA

Grape moths trials in Europe

apple field ROPE trials in USA

Tom Baker MSTRS trials in USA



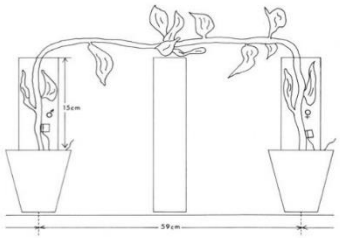
1879 | **1940** | **1959** | **1959** | **1960** | **1967** | **1978** | **1983** | **1986** | **1996**

1870s → **2000**

1949

Ossianilsson hypothesis on **Vibrational communication**

1974



missing instruments…

First demonstration of vibrational communication signals existence by Gogala and Ichikawa

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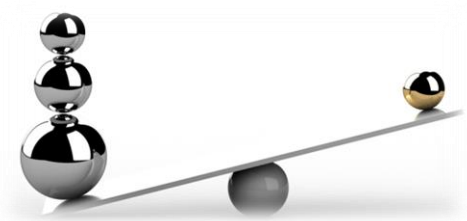
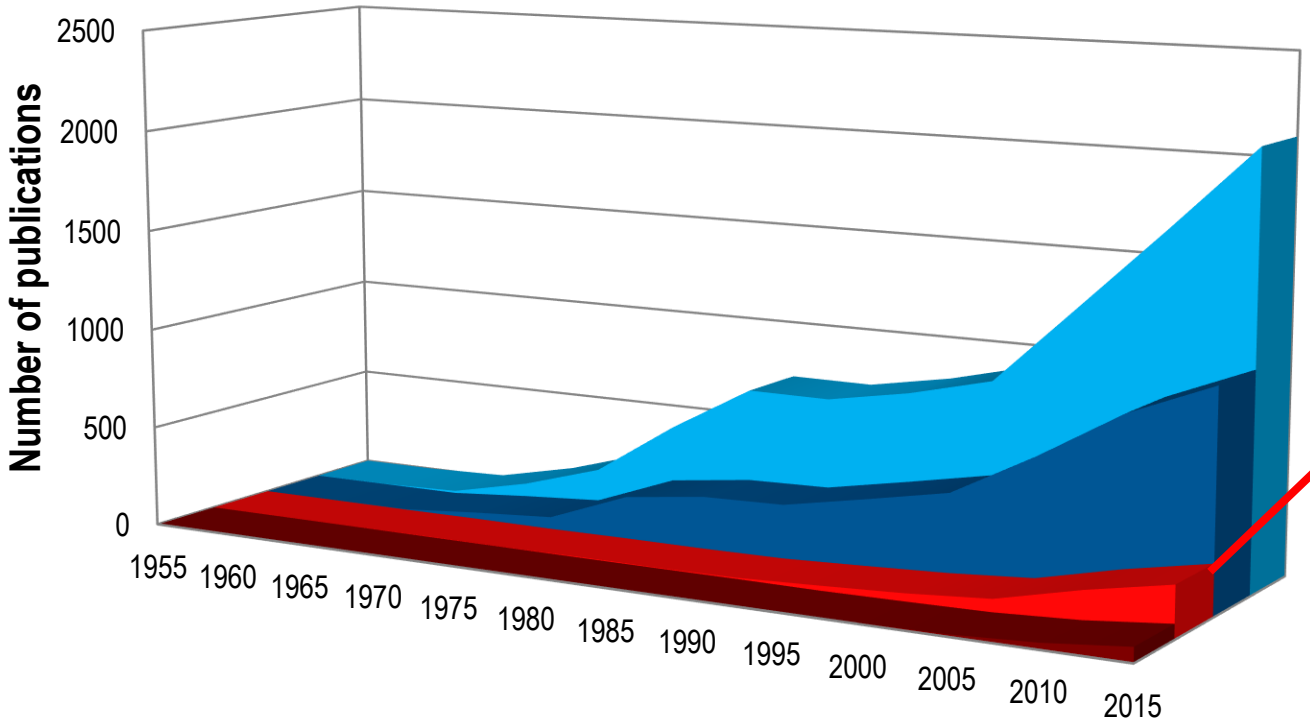
SCIENTIFIC PUBLICATIONS

Semiochemical communication



Vibrational communication



2016
«Biotremology»
Hill & Wessel
Current Biology

Semiochemical communication

Vibrational communication

Semiochemical communication in pest management

Vibrational communication in pest management

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RESEARCH BY NEW TECHNOLOGIES

DEVELOPMENT contribution of

FEM - S. Michele
Valerio Mazzoni
Gianfranco Anfora
Anna Eriksson
Rachele Nieri

University of Pisa
Andrea Lucchi

NIB – Ljubljana
Meta Virant-Doberlet
Jernej Polajnar

CBC Europe Srl
BIOGARD®

Technology Development

- Mating behavior & vibrational signals
- Signal function assessment (signal pb)
- Lab test of mating interference
- Field test of mating interference
- Experiment in commercial orchards
- System prototype in commercial orchards

Portable Digital Laser Vibrometer

2006

2009

2012

2017

ISSUES WITH NEW SCIENCES




What proof do authors have for their claim that vibrations they have recorded in the substrate are actually used by leafhoppers for communication? Why don't they consider more common ways of communication like pheromones?

Anonymous reviewer, 2008

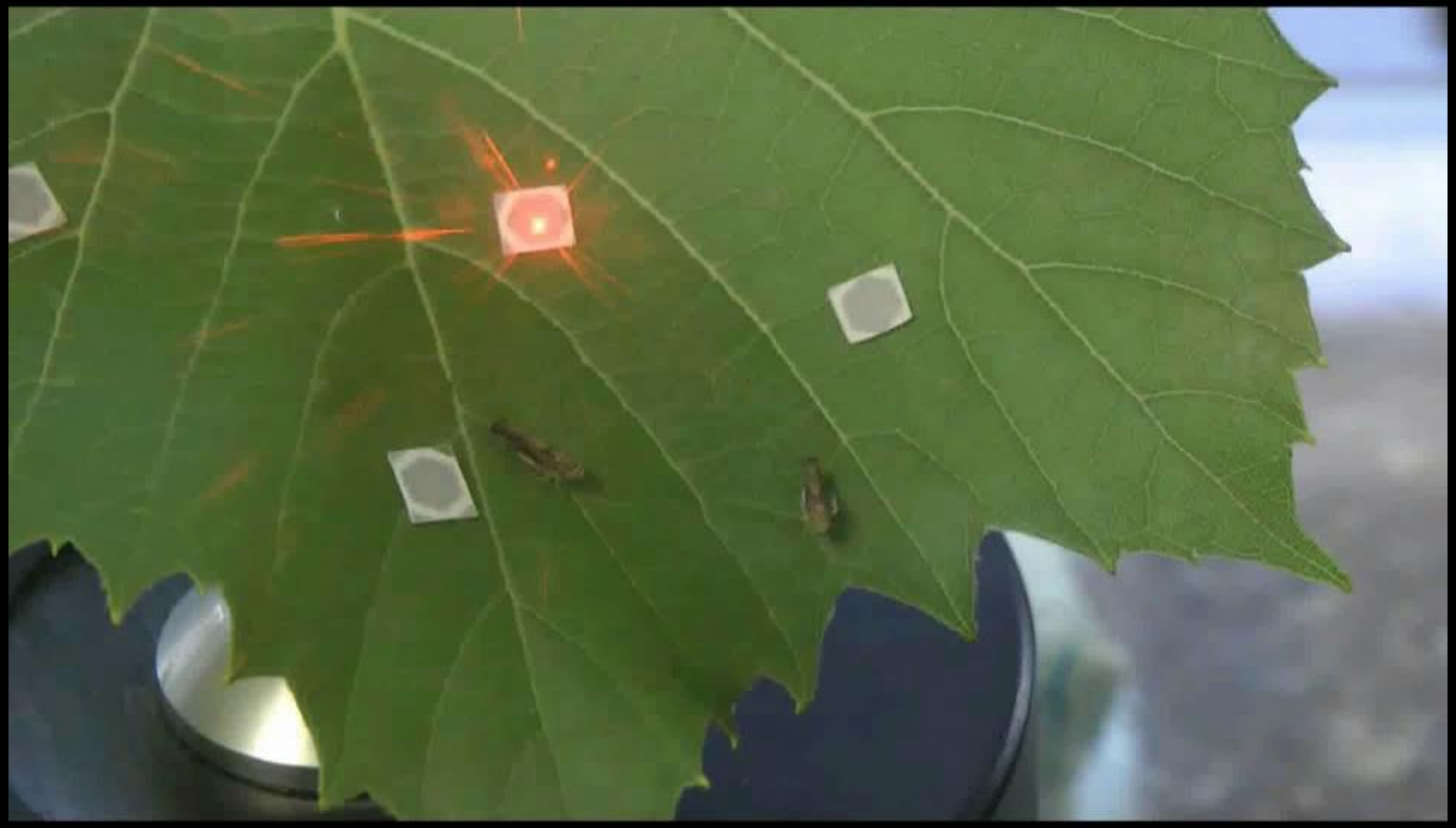
I believe that this approach [*mating disruption by playback of vibrational signals*] is useless in the field and I find it highly unlikely that it can ever be used in pest management.

Anonymous reviewer, 2009





Scaphoideus titanus MATING DUET

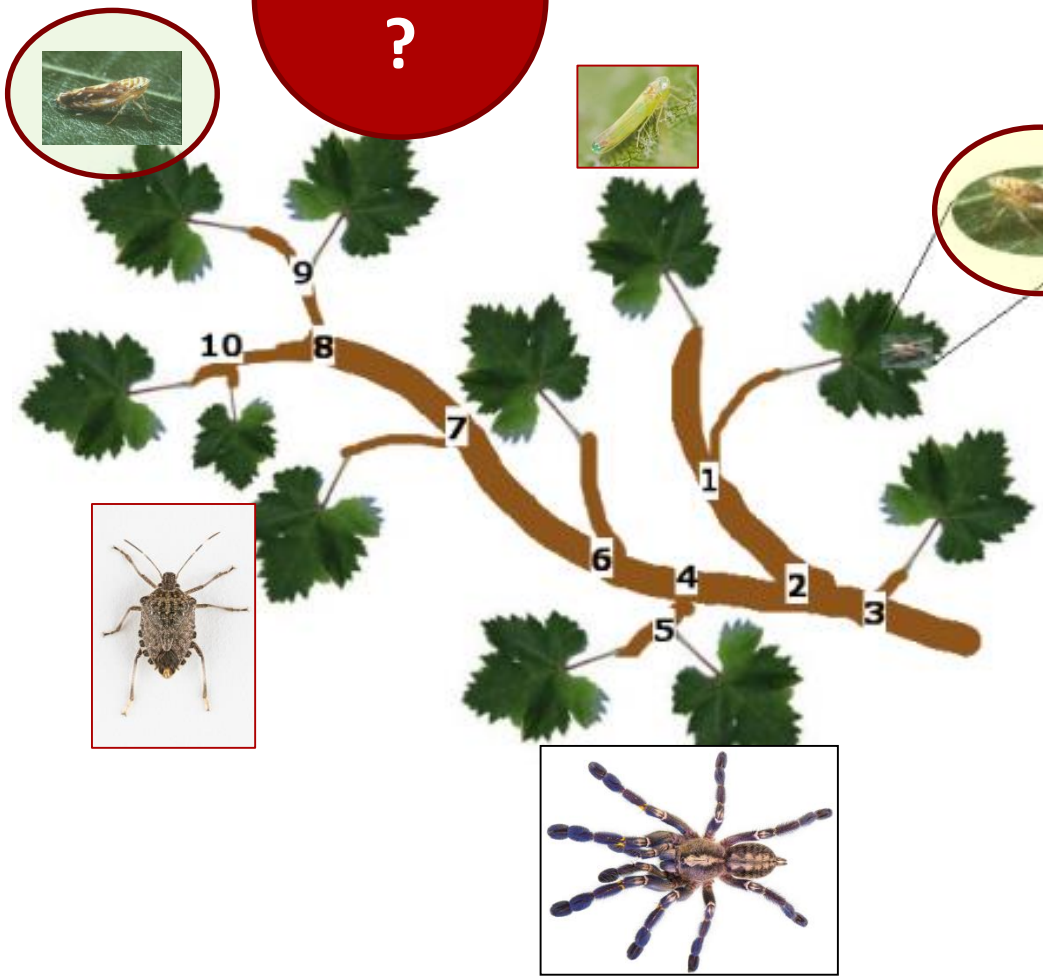


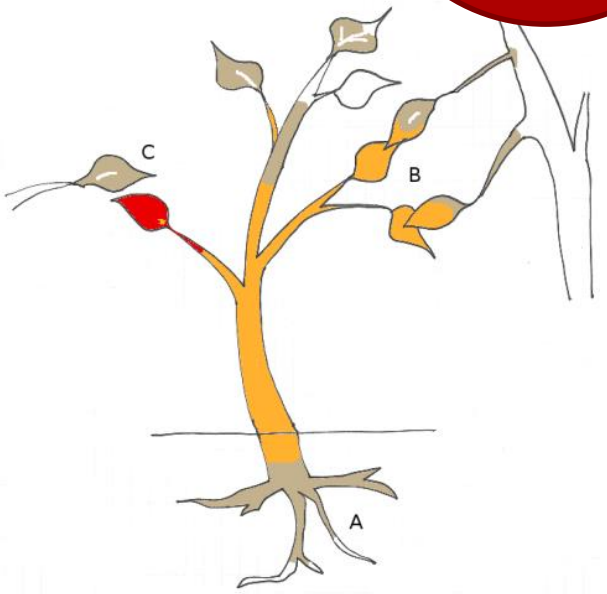
Empoasca vitis MATING DUET

WHO ?

WHERE ?

HOW ?





COMMUNICATION PATTERN

Scaphoideus titanus

long-range mate searching

arrives to new plant

emits calling signal

"call-fly" strategy

leaves the plant

replies → duet

rival → searches

emits disruptive signals

localizes mates

"spiteful" behaviour or "satellite" behaviour

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Mazzoni et al. (2009): Bull Entomol Res 99, 401-413; Mazzoni et al. 2014; Polajnar et al. 2014

Disturbance Noise

Technology Development

STEP 1

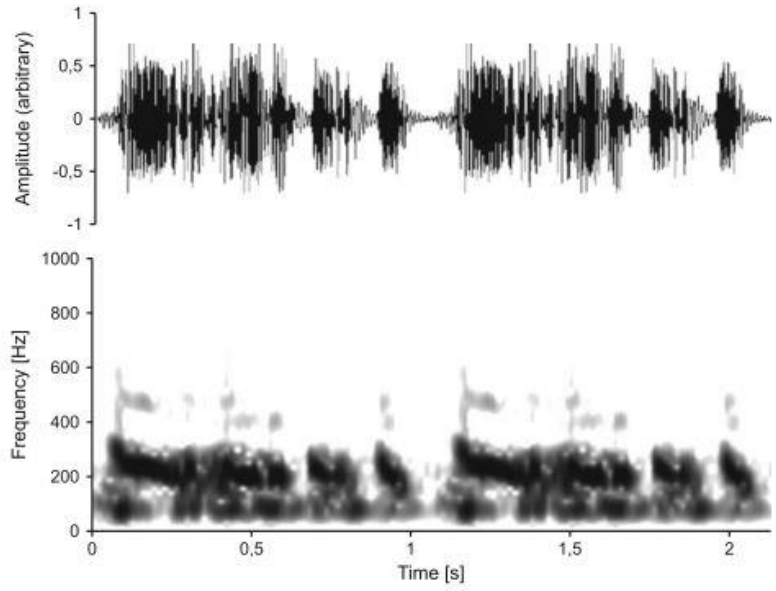
Mating behavior & vibrational signals

STEP 2

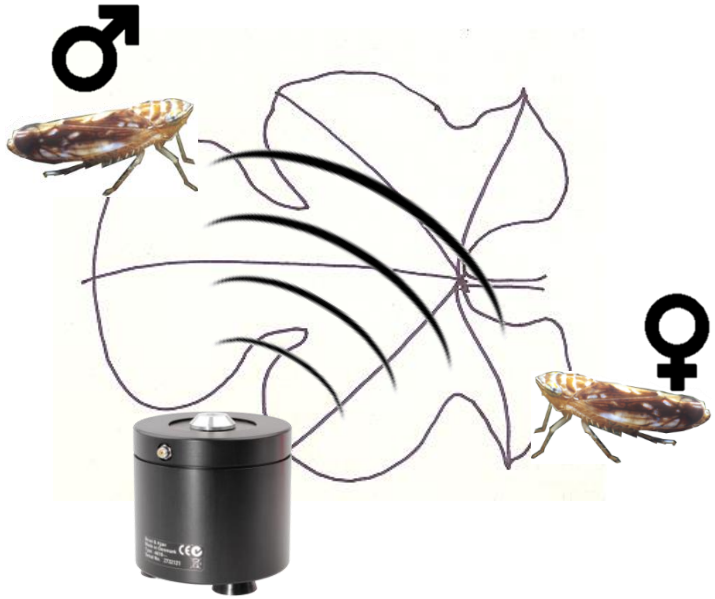
Signal function assessment (playback test)

STEP 3

Lab test of mating interference



1. Species-specific
2. Masking signal
3. In laboratory, *S. titanus* mating can be disrupted by DN playback

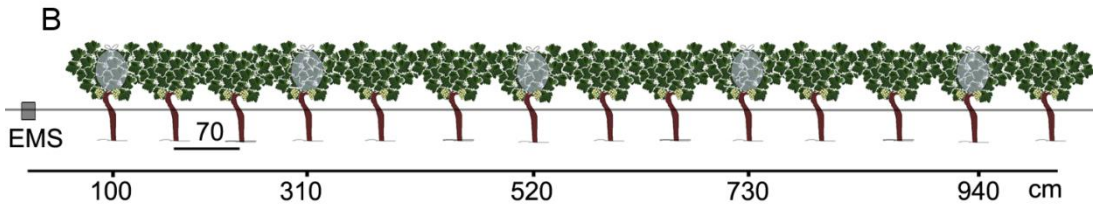


(Mazzoni et al. 2009)

Applied biotremology

Technology Development

The shaker transmits the DN into all plants through the wires.



- The DN succesfully disrupts *S. titanus* mating in semi-field conditions.
- To be effective the DN amplitude must be above:
  - 15 µm/s → individuals on the same leaf
  - 1,5 µm/s → individuals on different leaves
- The DN must be continuously played onto the plants.

STEP 4

Field test of mating interference

STEP 5

Experiment in commercial orchards

STEP 6

System prototype in commercial orchards

(Eriksson et al. 2012, Polajnar et al. 2016)

FIRST «VIBRATIONAL VINEYARD»

TREMOS®

Location:
San Michele all'Adige (Italy)

Management: Organic

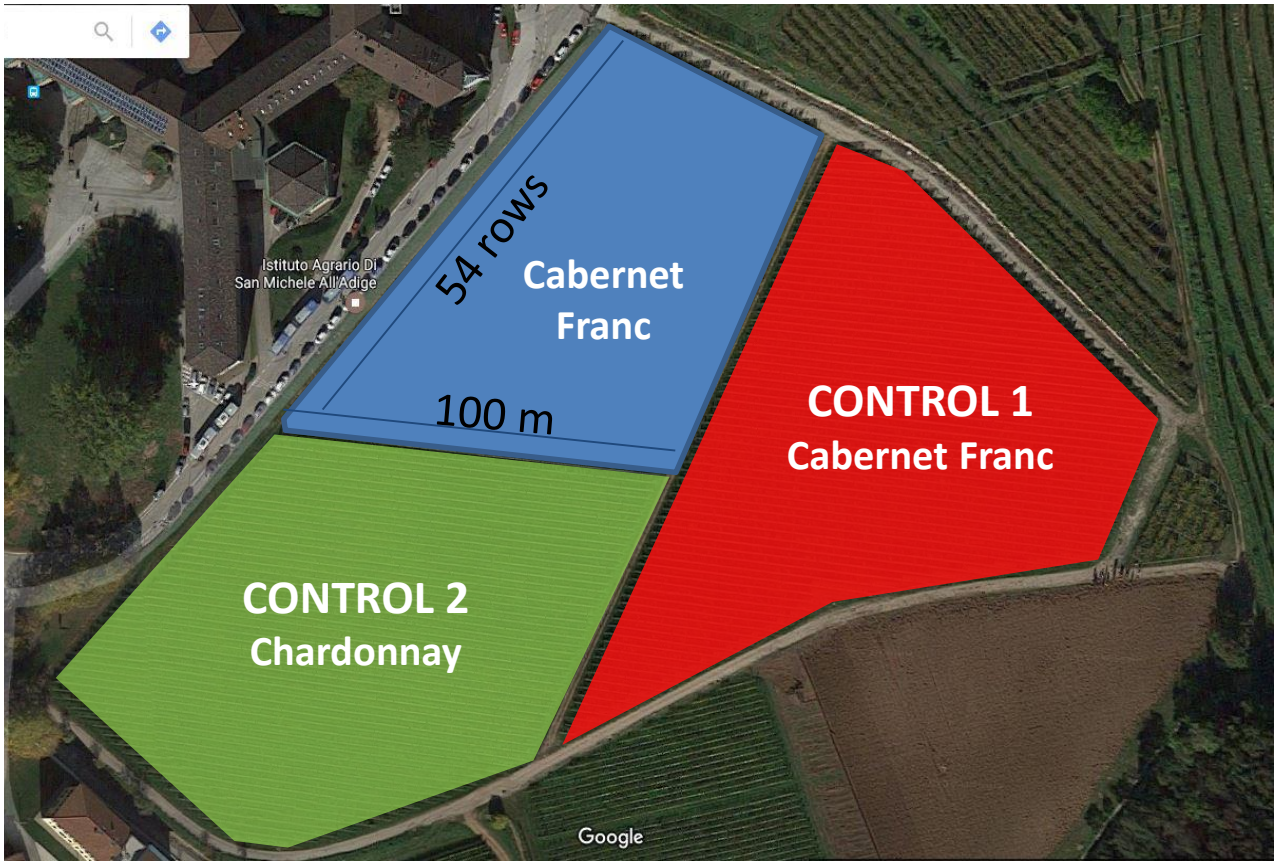
Trellis system: Guyot

Variety: Cabernet Franc

Surface: 1.5 Ha

Layout:
2 shakers/row (110 shakers)

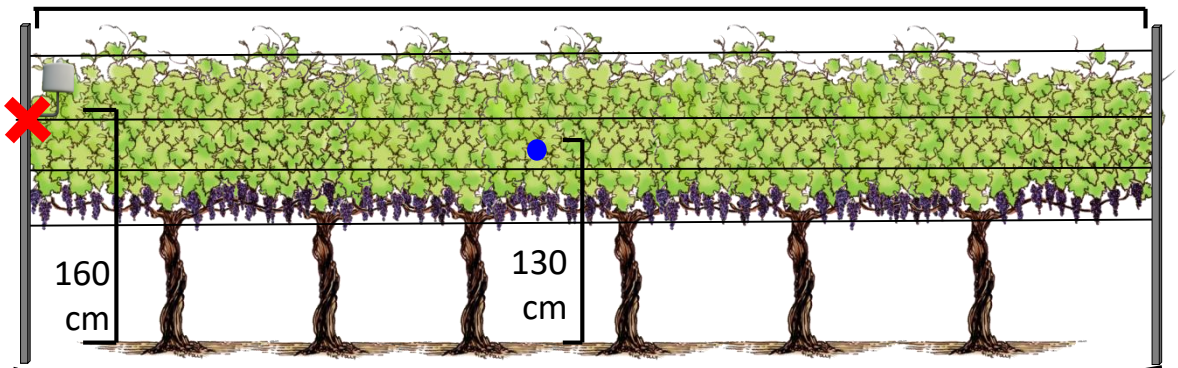
Total power: 270 W



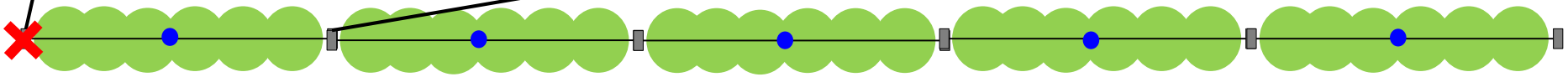
Power wired vineyard

Power needs
~180 W/ha

Monitoring the vineyard



Laser vibrometer measurement



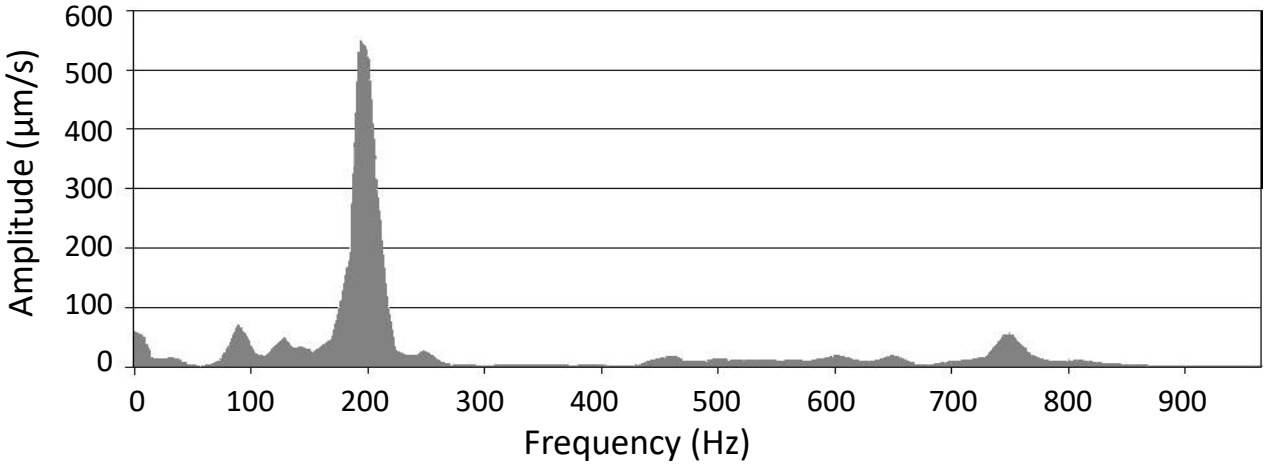
Emitters performance

- N = 8 shakers
- Laser vibrometer
- Check repeated in 3 weeks

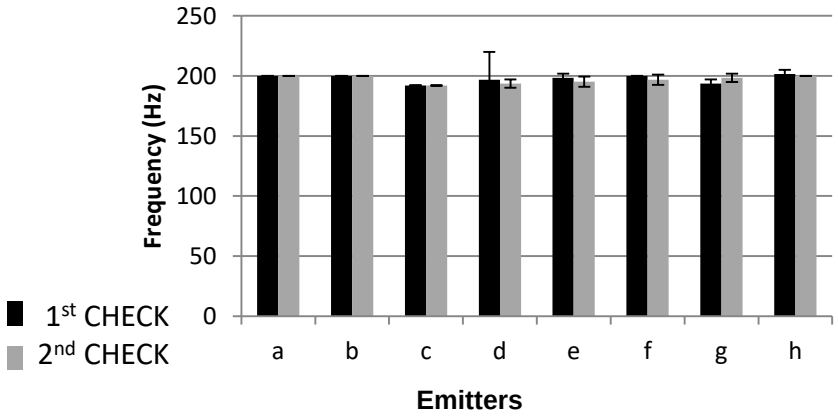
Transmission through the rows

- N = 8 rows
- Laser vibrometer
- On leaf of each section
- Check repeated in 3 weeks

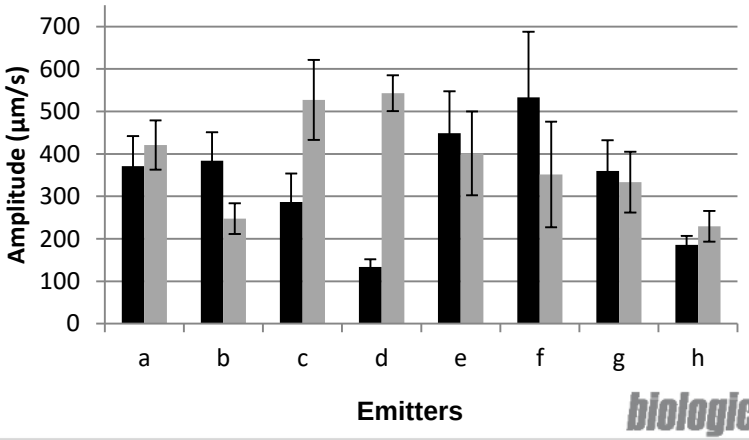
Emitters check



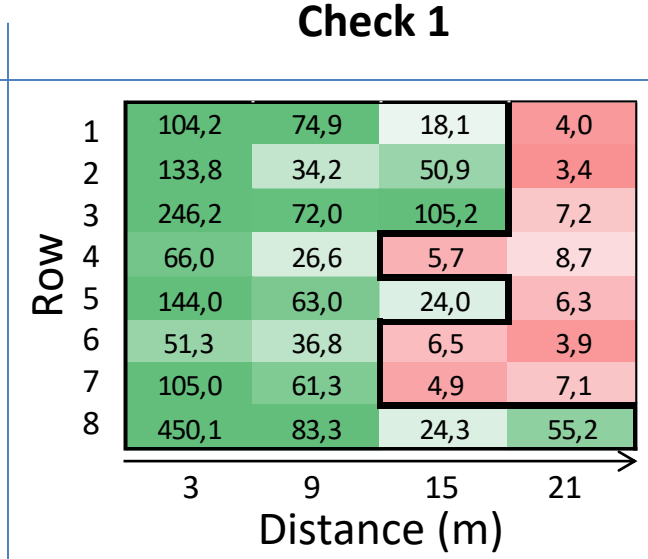
Dominant vibrational frequency

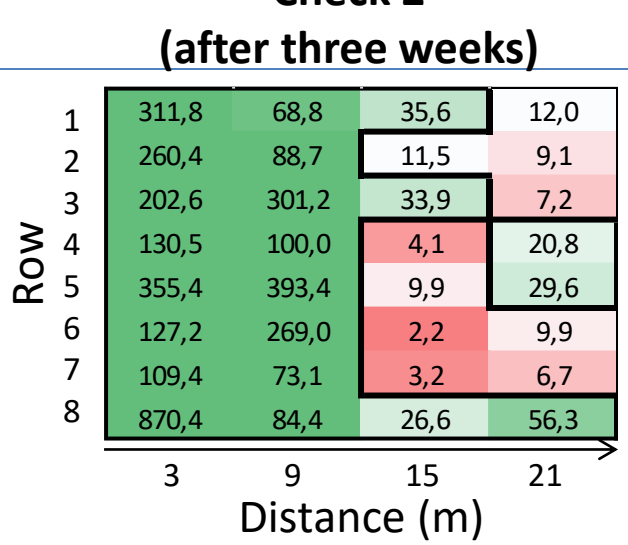


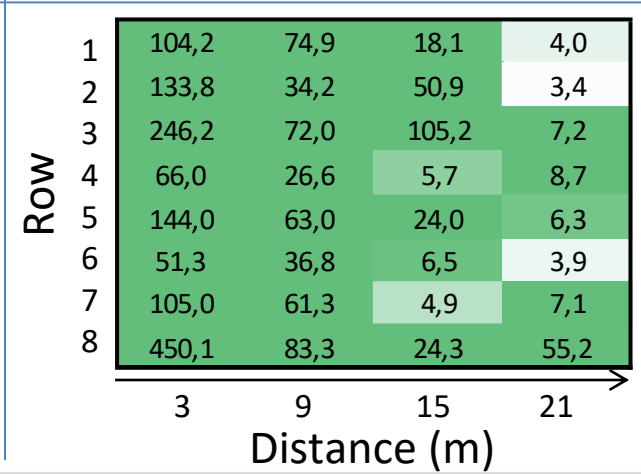
Amplitude dominant frequency

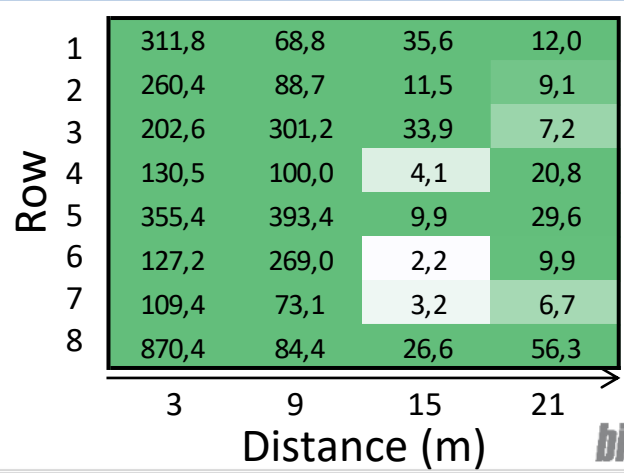


Amplitude (µm/s) through the rows





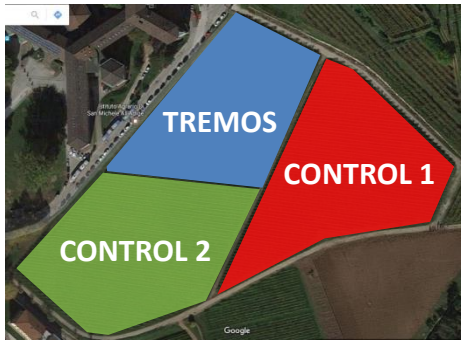




Population density and trend

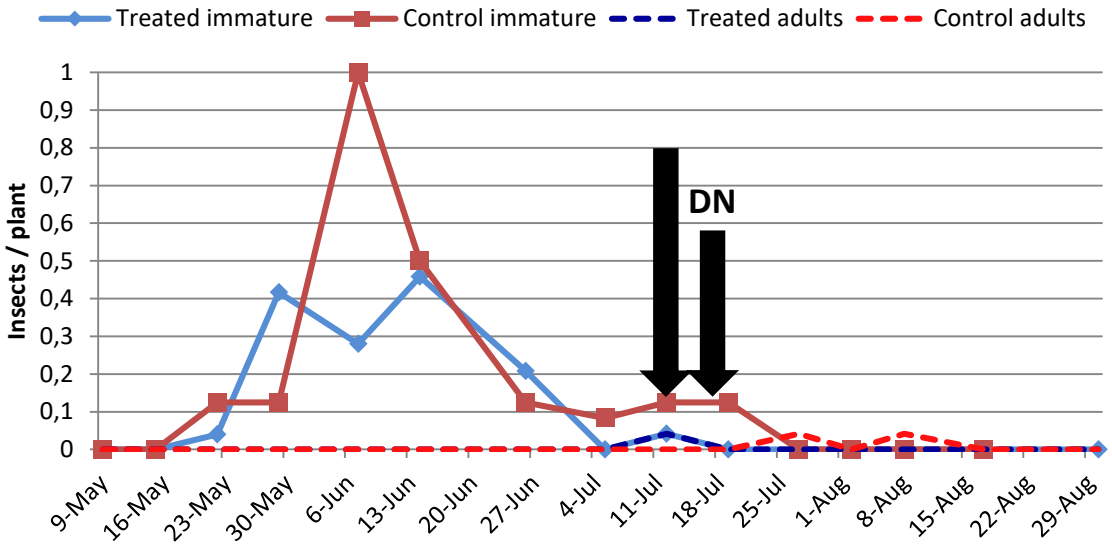
Check

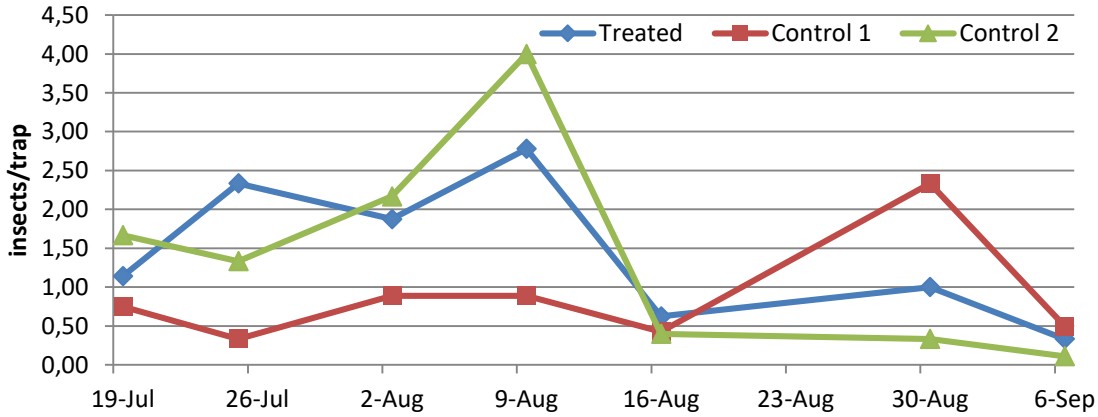
- Once a week
- 20 leaves/30 plants/plot



Sticky traps for adults

- Weekly
- TOT 24 traps in 3 plots

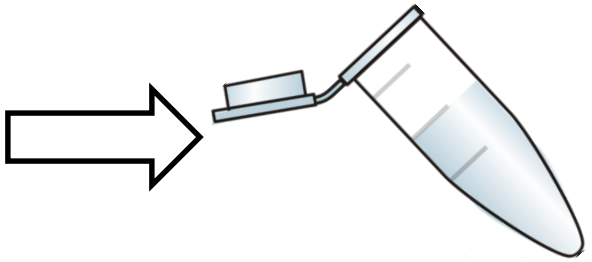




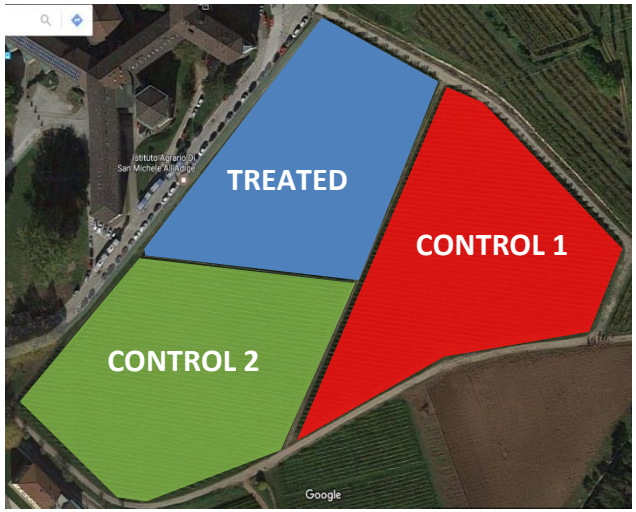
Spiders population density and trend

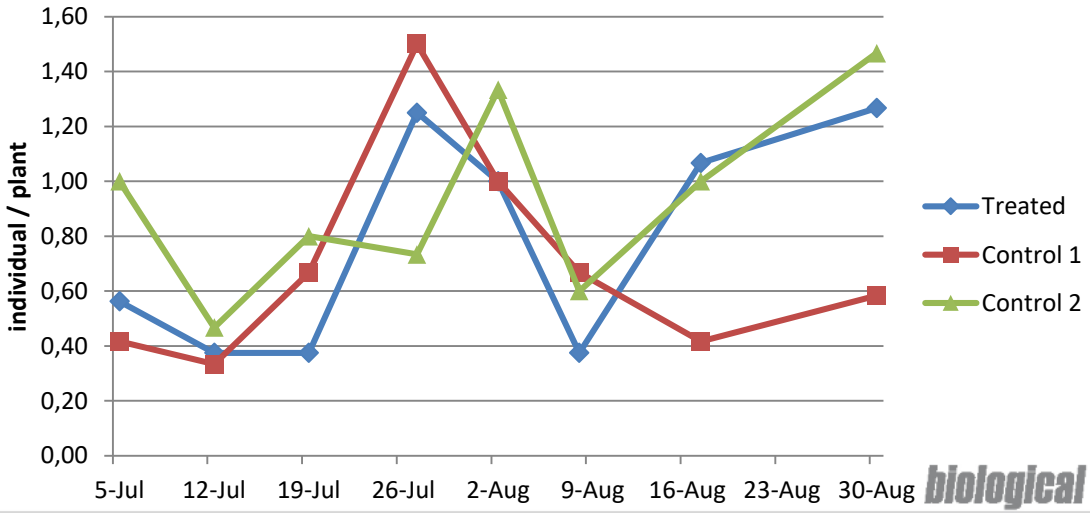
Frappage

- Weekly
- 10 s
- 15 plants each plot



ethanol 70%





Perspectives

- layout improvements to reduce dissipation and to further enhance emitters performances.

UNIVERSITY OF TRENTO - Italy
Department of Civil, Environmental and Mechanical Engineering


Ph. U. Salvagnin

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- **There seems no dispersive effect** on *S. titanus* adults as well as on spiders.
- **Mating disruption efficacy**:
  - The effect on leafhopper population density will be assessed in **Spring 2018**.
- Other sides effect on:
  - Other target and non-target species
  - Plant physiology

new vineyards installations to foster know-how accumulation

Acnowledgments to scientists and R&D teams

Valerio Mazzoni
Gianfranco Anfora
Anna Eriksson
Elisabetta Leonardelli
Marco Deromedi
Marco Valerio Rossi Stacconi
the students of the BS in viticulture and enology

FONDAZIONE EDMUND MACH

C3A CENTRO AGRICOLTURA ALIMENTI AMBIENTE

TREMOS®

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CBC GROUP

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& THANKS FOR YOUR ATTENTION