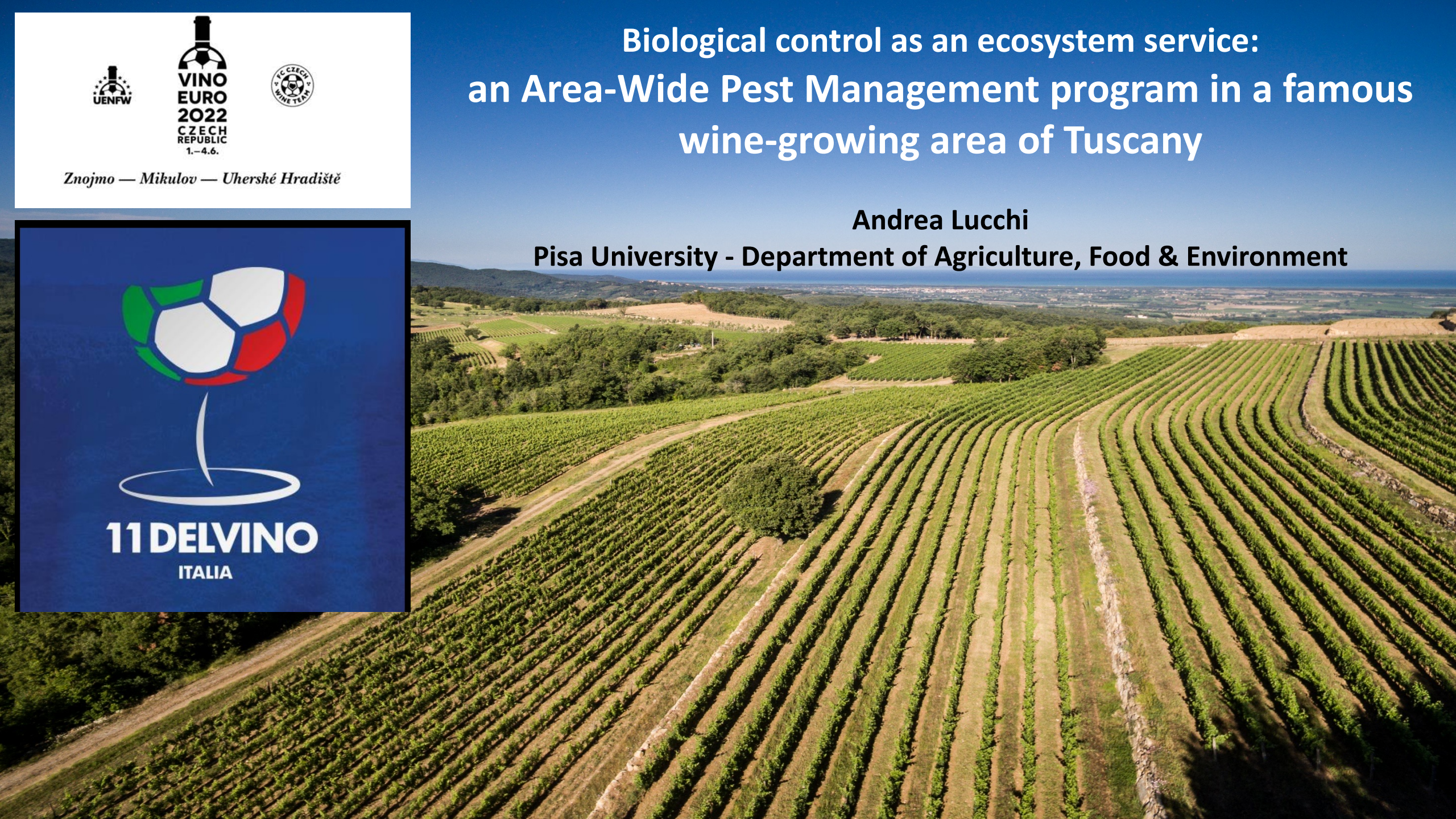


Biological control as an ecosystem service: an Area-Wide Pest Management program in a famous wine-growing area of Tuscany

Andrea Lucchi

Pisa University - Department of Agriculture, Food & Environment

An important ES in agriculture as well as many other production ecosystems is biological control of pests by natural enemies (Oerke, 2006; UKNEA, 2011), which contributes substantially to crop production worldwide (Hill & Greathead, 2000; Oerke, 2006), and also to forest production (Pimentel etal., 1997).

The economic value of such biological control to society is substantial (Fleschner, 1959; Naylor & Ehrlich, 1997; Pimentel etal., 1997). However, surprisingly few studies have actually estimated the value of pest biological control for farmers

Ecological Entomology

Ecological Entomology (2015), **40** (Suppl. 1), 45–55 DOI: 10.1111/een.12247

INSECTS AND ECOSYSTEM SERVICES SPECIAL ISSUE

Biological control as an ecosystem service: partitioning contributions of nature and human inputs to yield

JAN BENGTSSON Department of Ecology, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden

Abstract. 1. The concept of ecosystem services (ES) has rapidly entered policy and planning agendas nationally and globally. However, its usefulness is hampered by, for example, insufficient understanding of underlying ecological processes and poorly developed and competing conceptual frameworks.

2. It is suggested that final ecosystem services, such as yield, can be partitioned into components describing contributions from ecosystems (regulating and maintenance ES as natural inputs) and human inputs. This conceptual framework is tested by examining the relative importance of farming system (conventional vs. organic, indicating human inputs, and management), landscape (field shape and landscape heterogeneity), and biological control of aphids by natural enemies (indicating a regulating ES) for barley yield on 10 fields in central Sweden.

3. Although biological control was related to increased yield, its contribution was relatively small (<20%). The farming system explained most of the magnitude and variation in yield (47% of the variation, of which 34% was unique). Landscape and biological control had the largest shared contribution to variation in yield (14%). Conventional farming management seemed to have a larger effect on yield than biological control. This could be interpreted as indicating that agricultural production should be further intensified to increase yields, but a high dependency on external inputs may cause further environmental problems, such as eutrophication, and may not be sustainable.

4. Although preliminary, the results suggest that partitioning of natural and human inputs is useful to analyse the contribution of regulating ES to final ecosystem services, and how ES are co-produced by ecosystems and humans.

Key words. Additive partitioning, agricultural landscapes, aphids, biological pest control, co-production, ecosystem services, natural enemies, organic farming, variance partitioning, yield.

Introduction

in policy is both welcome and worrying. Welcome because

In plant protection

- Efficient **non chemical methods available,** not used by stakeholders for lack of knowledge and trust.

- Farm managers: aware of the **existence** of non chemical alternatives to pesticides, **don’t know the potency** of a given mean or strategy.

- In USA the gap filled by the University Extension Services, which **support** farmers in implementing innovative methods, specifically for pests and diseases.

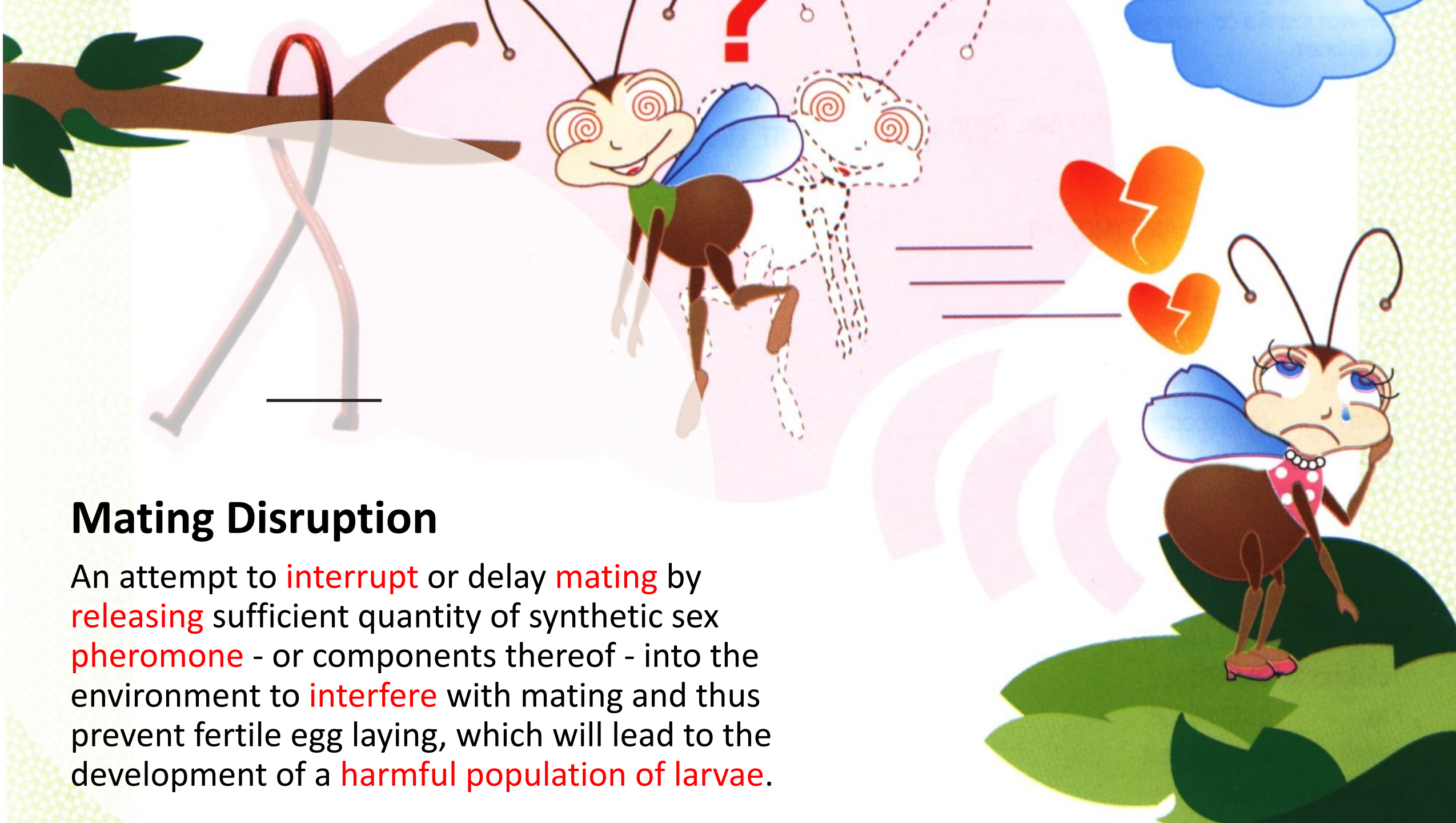
Trentino South Tyrol (Italy): a close cooperation between growers and research Institutions, allowed the establishment of IPM in the Region.

Mating disruption adopted as AW project in the last 20 years against codling moth and leafrollers on apple crop and against the vine moths in the vineyards strongly reduced insecticide use in the Region.

J Chem Ecol (2016) 42:571–583
DOI 10.1007/s10886-016-0722-y

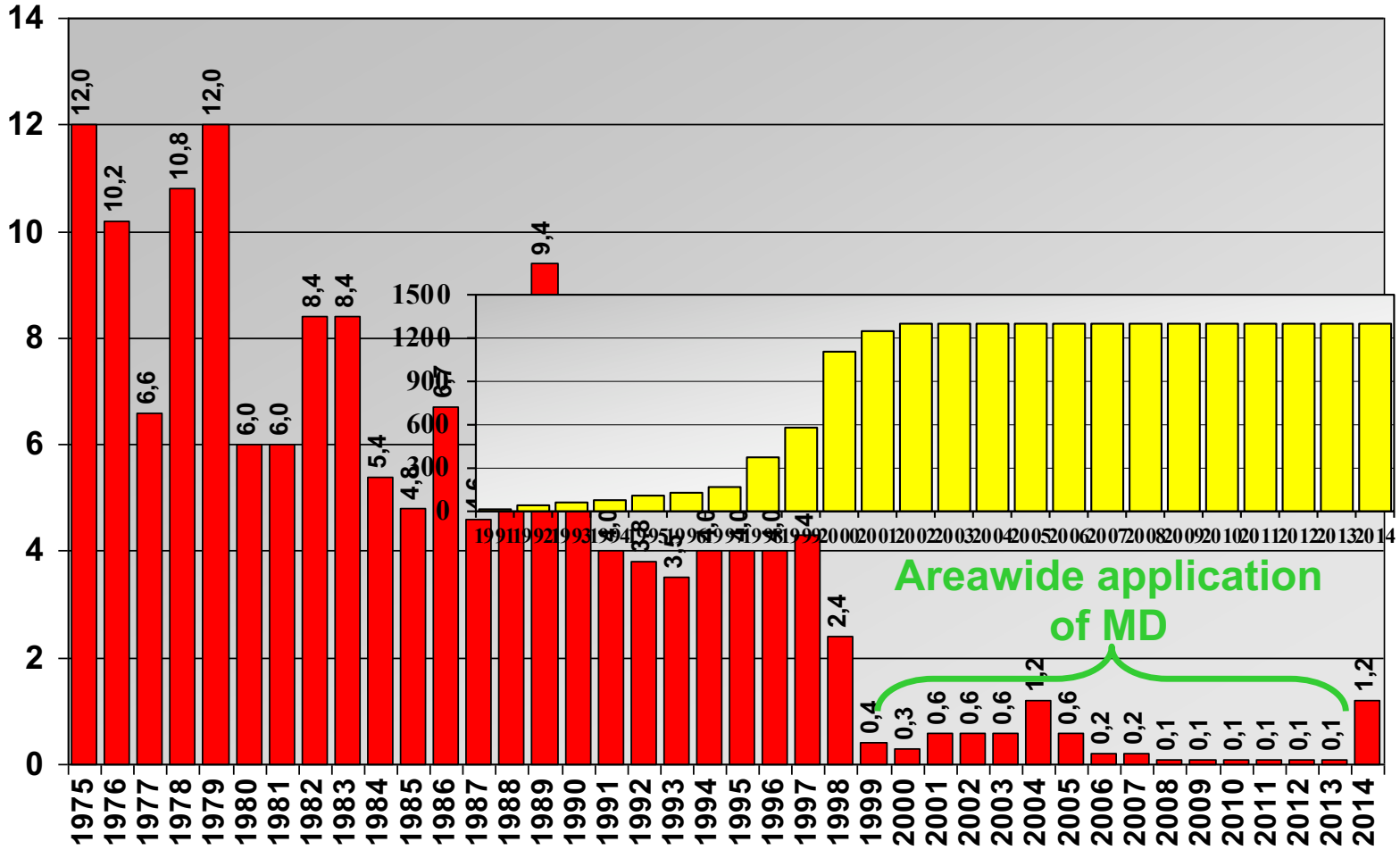
Semiochemical Strategies for Tortricid Moth Control in Apple Orchards and Vineyards in Italy

Claudio Ioriatti[1] · Andrea Lucchi[2]



Mating Disruption

An attempt to interrupt or delay mating by releasing sufficient quantity of synthetic sex pheromone - or components thereof - into the environment to interfere with mating and thus prevent fertile egg laying, which will lead to the development of a harmful population of larvae.



Insecticides/ha in Trentino vineyards

12 kgs in 1979
4,3 kgs in 1997
0.1 kgs in 2013

The development and **adoption** of **area-wide MD** in Trentino-South Tyrol resulted from the **merging of** several **favorable factors**, which **brought together** PUBLIC INSTITUTIONS, RESEARCHERS, ADVISORS, COOPERATIVES, GROWERS, PHEROMONE DISTRIBUTORS, AND RELATED INDUSTRIES.

Unfortunately, Trentino **achievements** have **not** been **replicated** in other Italian regions, due in part to the **lack of cooperation** between research institutes, industry, and growers though recently, in other Italian regions, **several applied entomologists are doing some work in that direction.**

Here I report of a recent cooperative pilot experience put in place in the wine growing area of Bolgheri (Tuscany), originated from a close partnership between University and growers for the management of 2 feared pests of grapevine.

Bolgheri (coastal Tuscany– Central Italy

The project started in 2015 in the farm GUADO AL TASSO – ANTINORI (vine grown on 300 hectares).

Main reasons

- mistrust on insecticides
- strong interest for possible non-insecticide strategies


Bolgheri wine-growing areas

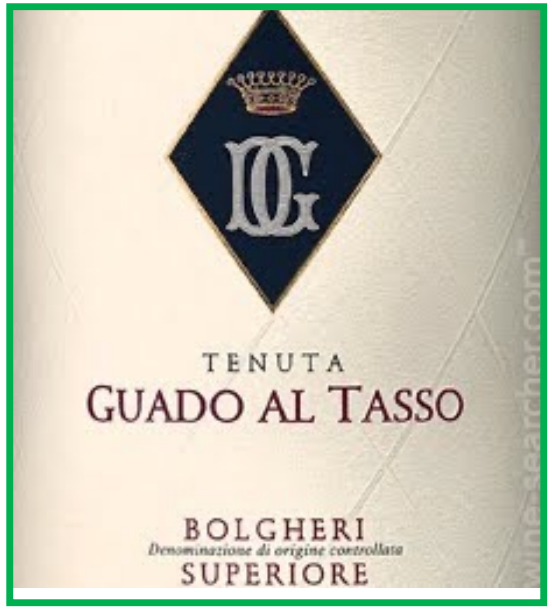

Vineyards in front of the Tirreno Sea

ENVIRONMENTAL CONDITIONS

Mild climate with medium-high rainfall (400-800 mm per year on average)

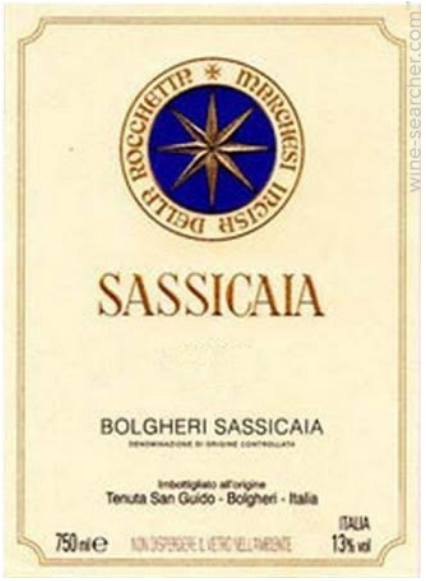
Mostly sandy soil

150 euros

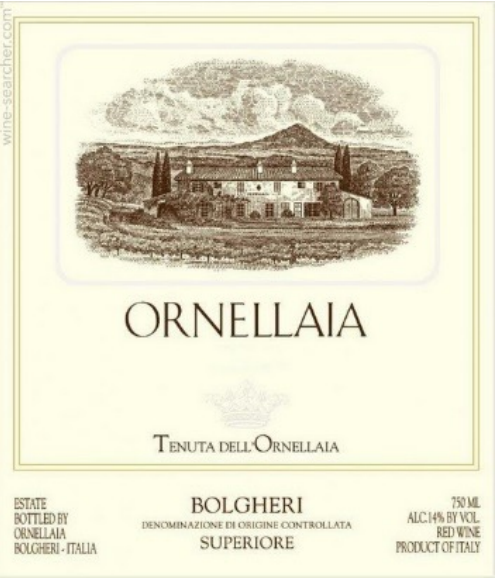


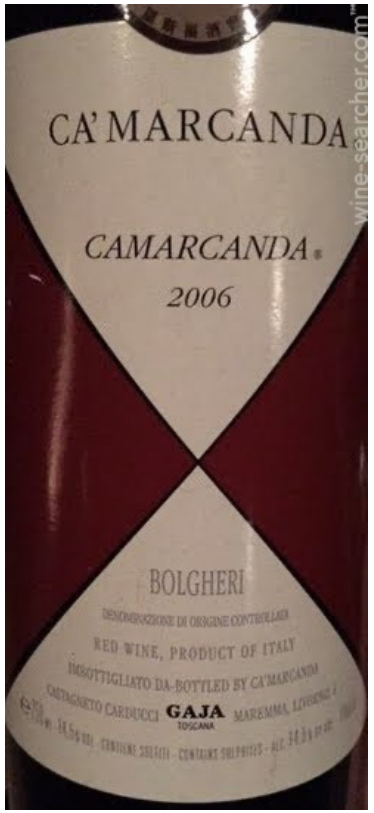
400 euros

200 euros



180 euros





120 euros

One of Italy's most prestigious areas for the production of wines of top quality (http://www.wine-searcher.com/regions-bolgheri)

High value of wines, need for healthy grapes, fear to abandon insecticides

PROJECT DETAILS

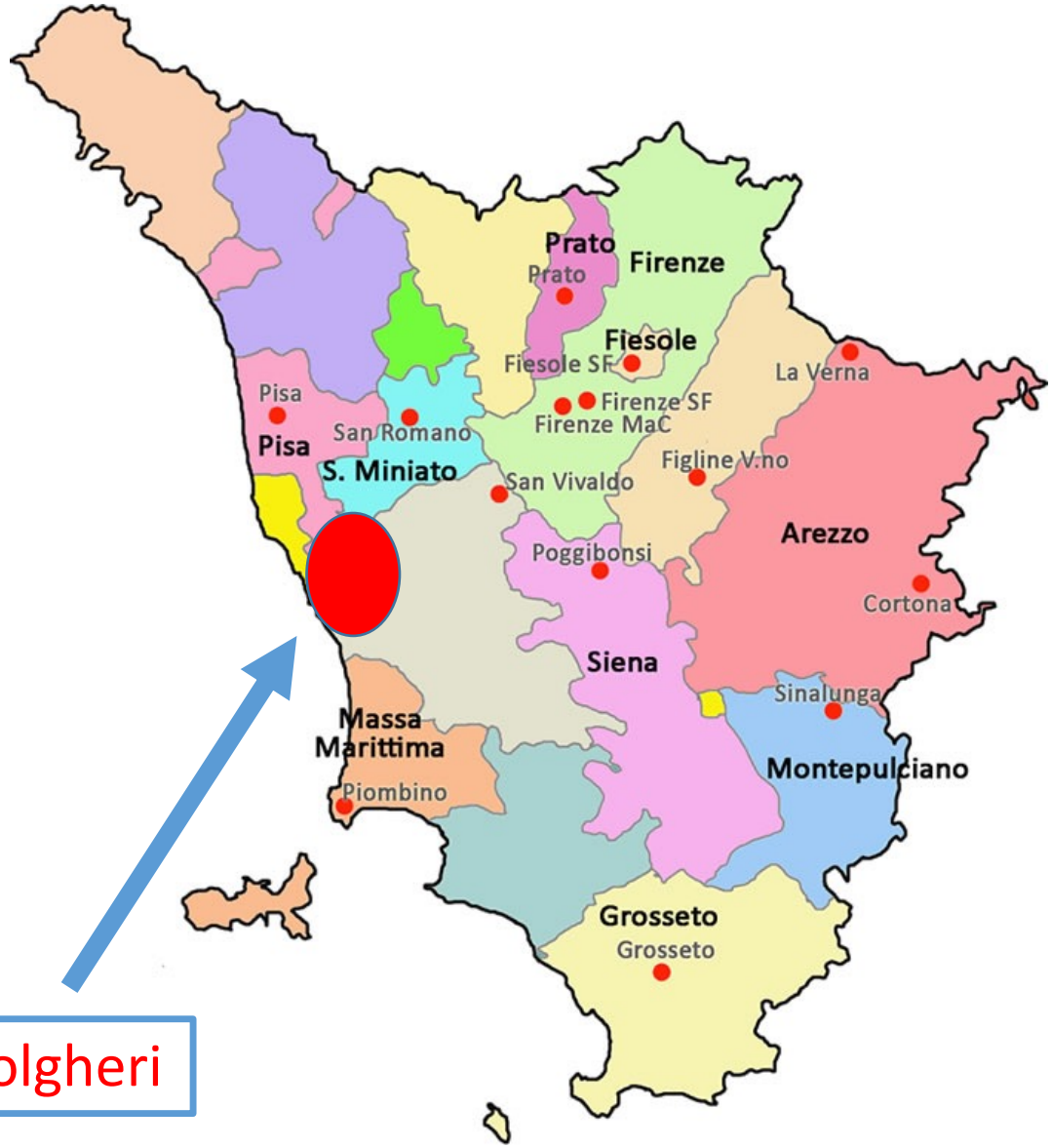
1st YEAR: 2015

1 FARM: Guado al Tasso

1 DISTRICT: Bolgheri

2 PESTS of grapevines: *L. botrana*, *P. ficus*

2 STRATEGIES: mating disruption, BCAs



A case study: the project carried out in Bolgheri

IDENTIFICATION AND DESCRIPTION OF THE MAIN PROBLEMS

The Bolgheri vineyards have historically been affected by heavy infestations of the European Grapevine Moth (EGVM) *Lobesia botrana* (Lepidoptera, Tortricidae) and the Vine Mealy Bug (VMB) *Planococcus ficus* (Hemiptera Pseudococcidae).

EGVM larval feeding causes bunch rot which substantially degrades wine quality.
Infestations must be managed to keep their damage at an acceptable level.

Vine mealy-bug: - vector of grapevine leafroll viruses
- Honey-dew causes the development of sooty mold fungi that can result in serious bunch damage.

PROBLEM IDENTIFICATION in 2015: Insecticide strategies generally adopted by growers (EVERY YEAR IN THE LAST DECADE) included 3 sprayings against EGVM with IGRs or organophosphorate insecticides and 1-2 treatments per year against *P. ficus* with systemic insectides, other neurotoxic products or CSIs.

AIM of the project:

From insecticides to pheromones

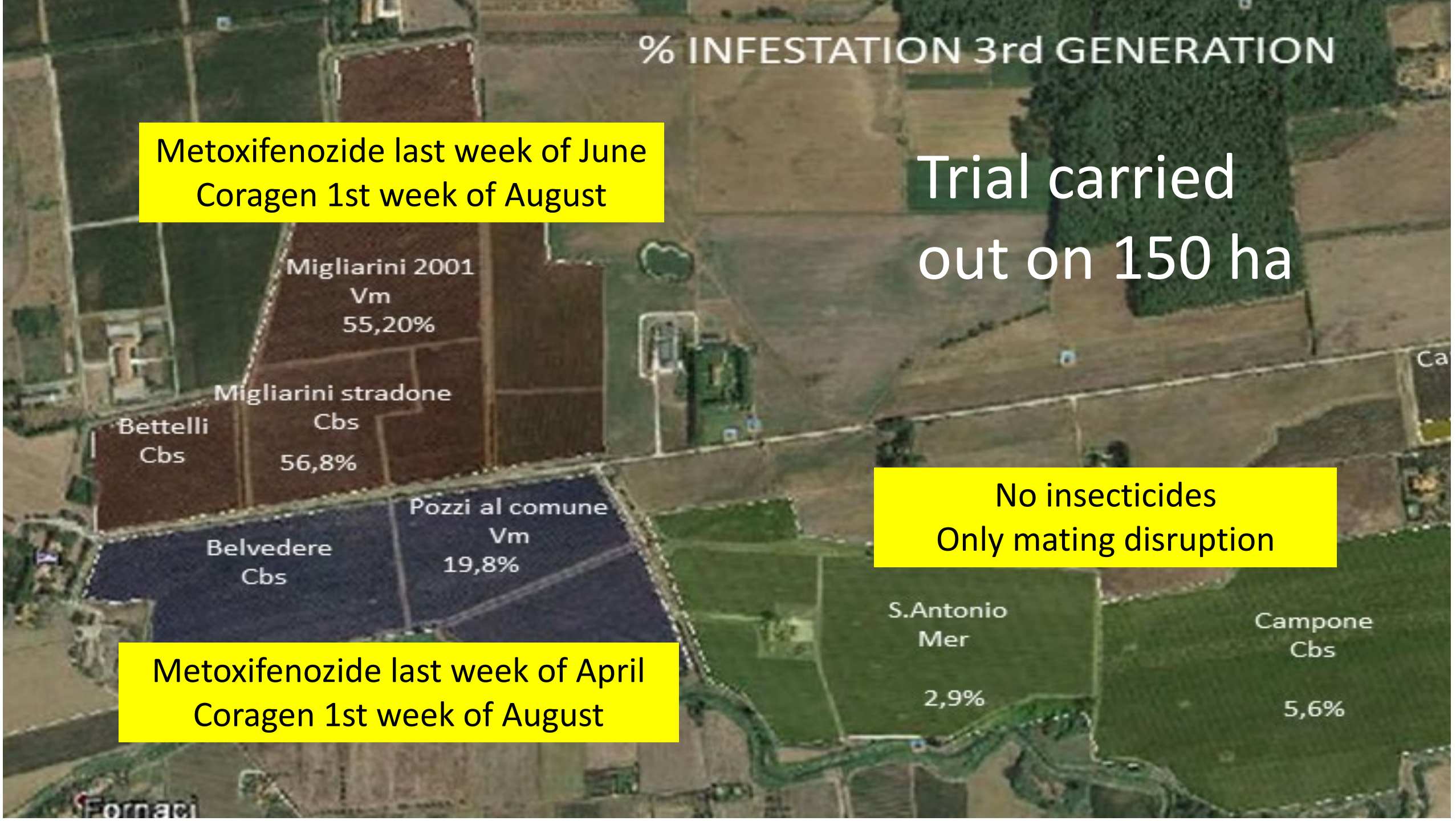
From insecticides to BCAs

Lobesia botrana management in “Tenuta Guado al Tasso”

In 2015 the Pheromone Mating disruption (MD) against *L. botrana* was applied on part of the whole farm surface, to be able to compare obtained results with the conventional insecticide strategy

Objective: making the growers able to directly observe the possible impact of pheromones in comparison with the conventional insecticidal strategy.

(*inductive reasoning*)


% INFESTATION 3rd GENERATION
Metoxifenozide last week of June
Coragen 1st week of August
Trial carried out on 150 ha
Migliarini 2001
Vm
55,20%
Migliarini stradone
Cbs
56,8%
Bettelli
Cbs
Pozzi al comune
Vm
19,8%
Belvedere
Cbs
No insecticides
Only mating disruption
S.Antonio
Mer
2,9%
Campone
Cbs
5,6%
Metoxifenozide last week of April
Coragen 1st week of August
Fornaci

Planococcus ficus

PLANOCOCCUS FICUS MANAGEMENT IN «GUADO AL TASSO» IN 2015

The strategy included the release of two Biological Control Agents (BCAs)

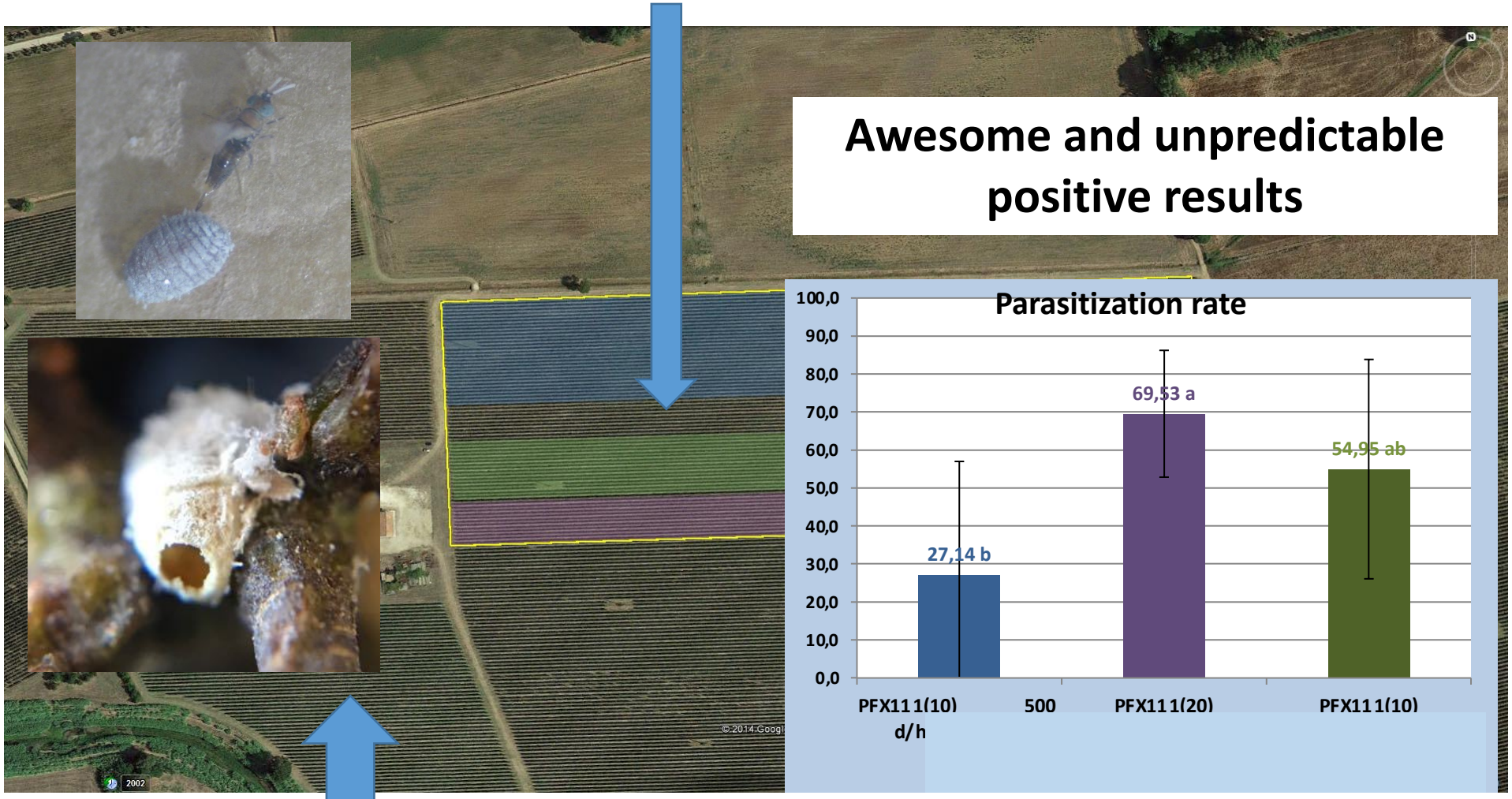
- **the Encyrtid parasitoid *Anagyrus vladimiri* in May (1,000 individuals per hectare) and**
- **the Coccinellid predator *Cryptolaemus montrouzieri* (about 500 individuals x hectare) in June and/or July.**

1st year: release on only 4 hectares to test efficacy and compare obtained results with the conventional insecticide strategy (*inductive reasoning*).

500 adults per ha of ***Anagyrus vladimiri***

Guado al Tasso

Control at harvest on 600 clusters



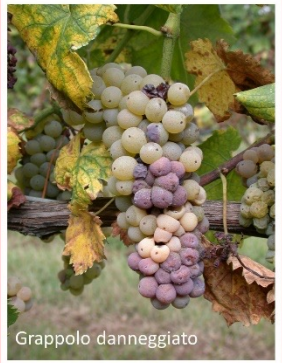
1000 adults per ha of ***Anagyrus vladimiri***

In 2016 our project was funded by the REGIONAL GOVERNMENT OF TUSCANY under the name BIOCONVITO (225,000 euros for 18 months) within an EU PROGRAMME of Rural development for agricultural technological innovation, entitled "Introduction and testing of biological control techniques for effective and sustainable control of insects harmful to the vine in Tuscany"

PROGETTO INTEGRATO DI FILIERA «ARTIGIANI DEL VINO TOSCANO»
SOTTOMISURA 16.2 - BIOCONVITO

Lobesia botrana

Aziende coinvolte
Le Mortelle
Guado al Tasso
Avignonesi



Strategia adottata
Applicazione di tecniche di Confusione sessuale

PSR 2014-2020 Programma di Sviluppo Rurale Regione Toscana

Cryptoblabes gnidiella

Aziende coinvolte
Le Mortelle

Strategia adottata
Applicazioni di *Bacillus thuringiensis*

Planococcus ficus

Aziende coinvolte
Le Mortelle
Guado al Tasso

Strategia adottata
Controllo biologico mediante rilascio di insetti utili

By Andrea Lucchi, DISAAA - UNIPI

In 2016

Two other big farms (Cà Marcanda and Ornellaia) took up the philosophy of the project and MD against EGVM and BCAs against VMB were applied respectively on 600 and 300 ha in that area, with satisfactory results in terms of efficacy.

The substantial decrease in the amount of insecticides due to MD and BCAs use was perceived as the first major step forward, that improved the public perception that wine was produced with high environmental safety standards.

The action plan drastically reduced insect populations, so that other farms took up the project in 2017 and the BC managed area raised further.

Strengths of Bioconvito

PROVIDE INFORMATION AND TRAINING

Strengths of the project

Workshops for growers

PROVIDE INFORMATION AND TRAINING

Sharing information with the farm managers in the field

Producing ad hoc informative booklets

Progetto integrato di filiera «Artigiani del Vino toscano»
Sottomisura 16.2 - Bioconvito

La gestione di tre importanti insetti dannosi alla vite è stata attuata in una proficua collaborazione tra l'Università di Pisa ed alcune aziende toscane, nell'ambito di un PIF (Progetto Integrato di Filiera - PSR 2014-2020) dal titolo «Artigiani del Vino Toscano» (capofila Marchesi Antinori). La misura 16.2 del progetto menzionato, denominata «Introduzione e collaudo di tecniche di lotta biologica per un controllo efficace e sostenibile di insetti dannosi alla vite in Toscana» (acronimo BIOCONVITO) aveva lo scopo di contenere le infestazioni di tignoletta, criptoblabe e cocciniglia farinosa, utilizzando strategie a basso impatto ambientale e puntando su una netta riduzione delle molecole di sintesi a favore di feromoni, insetti utili e microrganismi entomopatogeni.

L'intensa attività di trasferimento delle conoscenze disponibili – arricchita dal forte spirito collaborativo di tutti gli attori in gioco – ha portato in un biennio all'adozione delle strategie proposte da BIOCONVITO su gran parte dei vigneti del Bolgherese e in alcune aziende della Maremma grossetana e della DOC del Vino Nobile di Montepulciano.

A sostegno delle attività intraprese, abbiamo ritenuto utile pubblicare questo manuale, per fornire agli operatori del settore viticolo informazioni utili, corredate da una estesa rassegna fotografica, che possa aiutarli nell'identificazione dei diversi stadi vitali degli insetti in questione e dei tipici danni che essi arrecano alla vite.

PSR Programma di Sviluppo Rurale

Regione Toscana

LEPIDOTTERI ED EMITTERI DANNOSI ALLA VITE IN TOSCANA

Lobesia botrana, Cryptoblabes gnidiella, Planococcus ficus

A cura di:
Andrea Lucchi, Renato Ricciardi, Francesca Cosci, Giovanni Benelli

CAMPANO EDIZIONI

PROVIDE INFORMATION AND TRAINING

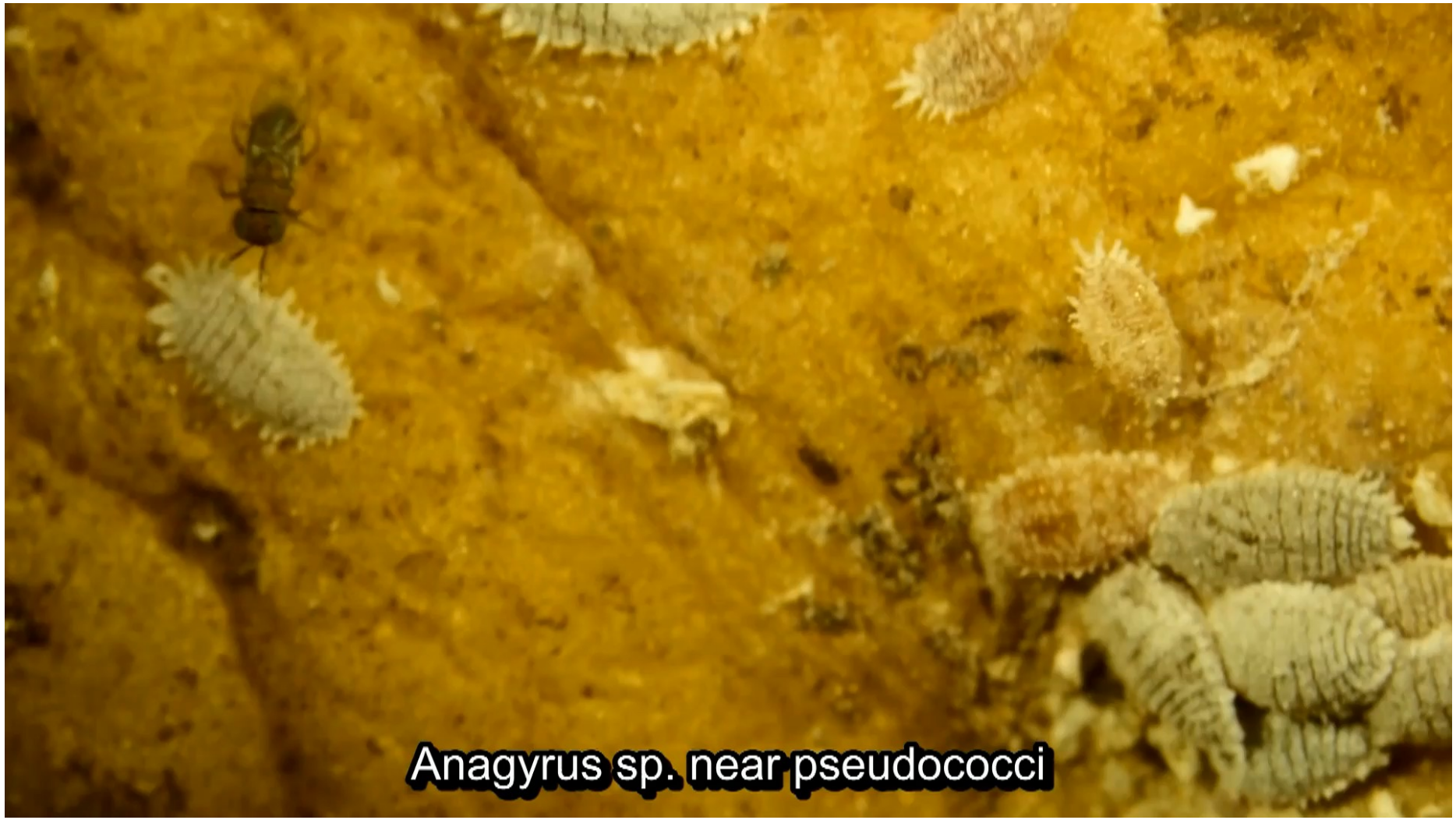
A dedicated website

Strengths of the project

www.bioconvito.it

Producing *ad hoc* informative videos

https://www.youtube.com/watch?v=ILa2ZawSBHc&t=67s



MAIN RESULTS of Bioconvito

After 7 years the project Bioconvito is in very good health.

Some details have been reported in this Trend Editorial available at:

https://link.springer.com/article/10.1007/s11356-018-1919-0

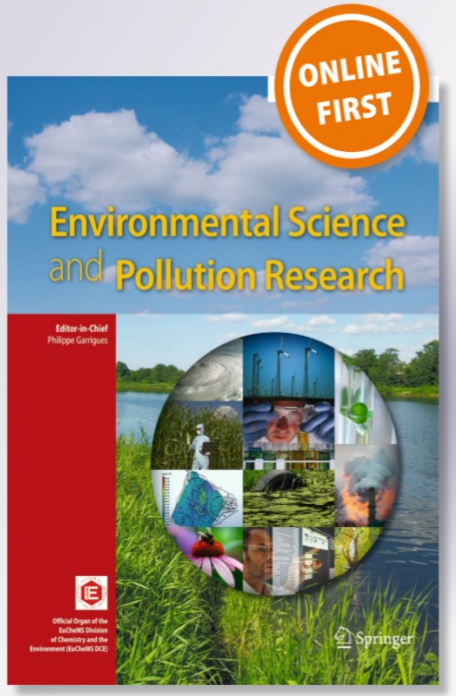
Towards pesticide-free farming? Sharing needs and knowledge promotes Integrated Pest Management

Andrea Lucchi & Giovanni Benelli

Environmental Science and Pollution Research

ISSN 0944-1344

Environ Sci Pollut Res
DOI 10.1007/s11356-018-1919-0



Springer

Environmental Science and Pollution Research
https://doi.org/10.1007/s11356-018-1919-0

TREND EDITORIAL

CrossMark

Towards pesticide-free farming? Sharing needs and knowledge promotes Integrated Pest Management

Andrea Lucchi [1] · Giovanni Benelli [1,2]

Received: 3 January 2018 / Accepted: 2 April 2018

Introduction

The overuse of chemical pesticides led to the fast-growing development of resistance in targeted insect pests, as well as to severe effects on non-target organisms and human health as well (Desneux et al. 2007; Benelli 2015, 2018a,b; Naqqash et al. 2016; Pavela and Benelli 2016; Guedes et al. 2016). In plant protection, a number of eco-friendly methods to manage insect pest populations have been developed with the aim to reduce the employ of synthetic pesticides (Gut et al. 2004; Millar 2007; Welter et al. 2005; Witzgall et al. 2010; Brockerhoff et al. 2012; Daane et al. 2012; Miller and Gut 2015). Unfortunately, they are still underused by a substantial number of Mediterranean stakeholders, due to lack of knowledge and trust. Indeed, farm managers are often aware of the existence of alternatives to pesticides. However, they do not know exactly the potency of a given mean or strategy and/or do not have full confidence in their effectiveness (Cooper et al. 2014). This can be partially due to a communication gap among researchers, policy makers, and farmers at country or regional level (Lamichhane et al. 2016).

In the USA, this gap is filled by the University Extension Services, which support farmers disseminating research-based information, to implement innovative methods for pests and diseases (Gadino 2012; Gadino et al. 2016). In recent years, the public Extension network experienced a fruitful cooperation with the private sector, encouraging and delivering effective and implementable solutions leading to substantial benefits to farmers (Krell et al. 2016). But what happen in European countries hosting important agricultural activities, like Italy? The scenario is patchy and confused. For instance, Trentino South Tyrol (Italy) hosts a good example of close cooperation between growers and research institutions, which allowed establishment of Integrated Pest Management (IPM) in the Region. Notably, the driving force for IPM implementation was the adoption in the last 20 years of the pheromone-mediated mating disruption (MD), which strongly reduced insecticide use in that Region. MD has been applied from the 1990s with an area-wide approach against the codling moth and the leafrollers on apple crop, and against the vine moths in the vineyards (Ioriatti and Lucchi 2016). Although the mountainous terrain of the area was not optimal for the efficacy of MD, grower cooperatives and their field consultants were strongly influential in convincing growers to accept MD technology. Public research institutions conducted extensive research and education, and provided credible assessments of various MD formulations (Ioriatti et al. 2011, 2012). Thus, the development and adoption of area-wide mating disruption in Trentino-South Tyrol resulted from the merging of several favorable factors, which brought together researchers, advisors, cooperatives, growers, pheromone distributors, and related industries.

The results achieved in Trentino-South Tyrol have not been replicated in the rest of Italy, due in part to the lack of cooperation between research institutes, industry, and growers. On the other hand, some promising signals have been recently noted. Here, we focused on a fruitful cooperation between University and farms, which recently led—in less than 4 years—to the adoption of pesticide-free IPM approaches in about 1200 ha of highly valued Tuscan vineyards.

Responsible editor: Philippe Garrigues

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What we are talking about: top-quality vineyards in the hearth of Tuscany

We share facts and challenges arising from a recent cooperative pilot experience carried out in the wine growing area of

Published online: 13 April 2018

In the last few years other farms of the Bolgheri district adopted the BIOCONVITO proposal

In 2020 MD was applied on about 1,000 hectares and BCAS on about 600 hectares

Total vineyards surface in the Bolgheri district: 1263 hectares

Positive impact on the grape and wine quality

Main results

«Insect killers save the wine Bolgheri says goodbye to pesticides»

Local Press
Livorno province
(Tuscany)
June 2018

Cecina Rosignano
www.iltelegrafolivorno.it
e-mail: cronaca@iltelegrafolivorno.it

IL COLOSSO TERRE DELL'E

TERRE DELL'ETRURIA, SOCIETÀ C
AGRICOLA TRA PRODUTTORI, CON
AGRICOLE ASSOCIATE, RAPPRESE
IMPORTANTE REALTÀ IMPRENDIT

Gli insetti killer salvano il vino Bolgheri dice addio ai pesticidi

Donoratico, l'agronomo Paolo Granchi: «Ecco come facciamo»

SE IL VINO di Bolgheri è uno dei migliori del mondo lo dobbiamo anche a dei minuscoli insetti. Insetti che eliminano altri insetti parassiti con più accuratezza e senza gli effetti secondari dei pesticidi. «Ormai sono cinque anni che adottiamo queste pratiche con successo – spiega Paolo Granchi agronomo della Cooperativa Terre dell'Etruria – non sta a me dire i nomi, ma riforniamo tutte le più grandi e note aziende vitivinicole di Bolgheri. La lotta ai parassiti con metodi naturali è applicata su un territorio di 600 ettari e i risultati sono notevoli».

TUTTO è iniziato un po' di tempo fa con il cambiamentio climatico che progressivamente ha permesso a nuove specie di parassiti subtropicali di svilupparsi anche qui. In particolare la cocciniglia Planucoccus Ficus che attacca i grappoli d'uva e li danneggia gravemente con formazione di melata e funghi. Il vecchio sistema prevedeva una serie di trattamenti chimici. Ma gli insetti antagonisti che si cibano della cocciniglia sono killer spietati e funzionano meglio. L'Anagyrus Pseudococci assomiglia ad un moscerino che inocula nella cocciniglia le sue larve. Le quali sui cibano della cocciniglia. Ogni moscerino ne produce alrtri 200 con una proliferazione esponenziale che in pochi giorni ripulisce il vigneto senza spargere veleni. Il Criptolemus invece si ciba direttamente delle cocciniglie. «Il trattamento tipo – spiega Granchi – prevede l'impiego di 6 confezioni di Anagyrus per ettaro, basta aprirle e i moscerini volano a caccia dei parassiti. Il costo è un poco più alto rispetto ai pesticidi (circa 200 euro ad ettaro contro i 150 dei pesticidi, per i quali però occorre un trattore attrezzato e protezione per gli operatori), ma consente di avere un vino senza nessuna traccia anche residuale minima di veleni e risultati veramente validi sotto il profilo della protezione del raccolto». Si calcola che su 600 ettari, l'utilizzo degli insetti killer permette di non disperdere nell'ambiente 2400 litri di pesticidi. Pesticidi che poi inevitabilmente contaminano anche le falde e indeboliscono l'ecosistema danneggiando ad esempio insetti impollinatori utili come le api. «E' una nuovo modo di fare agricoltura – sintetizza Paolo Granchi – molto più rispettoso dell'ambiente che permette di innalzare la qualità dei prodotti e aumentare la nostra salute».

Paolo Granchi non lo dice, ma ad utilizzare gli insetti killer sono ormai tutte le aziende più blasonate. Quando una bottiglia di vino di qualità costa alcune decine di euro (sopra i 100 per le più quotate) è chiaro che la clientela richiede il massimo. E alla fine il beneficio si estende a tutti, perché la lotta ai parassiti consente di ridurre la proliferazione, se viene compiuta in modo omogeneo. Come una sorta di vaccino che immunizza un territorio.

Luca Filippi

L'ESPERTO Paolo Granchi, agronomo e nell'altra foto uno degli insetti killer che salvano i grappoli d'uva

LA COCCINIGLIA
Il parassita dell'uva viene attaccato dai moscerini

ECONOMIC IMPACT OF THE PROJECT AT FARM LEVEL

Main results

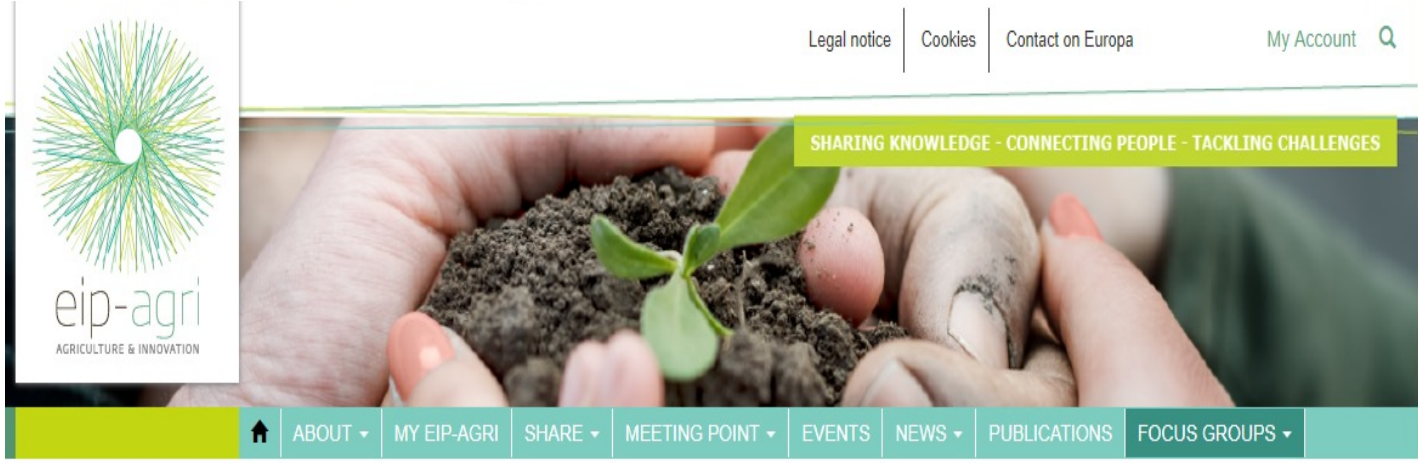
Table 1 Economic evaluation of biological vs. chemical control strategies considering routine choices by the agronomists of Guado al Tasso, Marchesi Antinori® (Bolgheri, Tuscany) to manage the European grapevine moth and the vine mealybug

Pest management strategy	Description	No. of treatments	Cost €/ha	Notes
Biological control	EGVM MD dispenser Isonet® L TT 250 (Shin-Etsu)	1	110.00 €	250 dispensers Isonet L TT/ha
	Deployment of the MD dispensers in the field	1	28.00 €	–
	Anagyrus sp. near *pseudococci* (Bioplanet®, VMB parasitoid)	1	130.00 €	1000 parasitoids/ha
	Cryptolaemus montrouzieri (Bioplanet®, VMB predator)	1	135.00 €	500 beetles/ha
	BCA field release	2	14.00 €	7 €/ha per each BCA release
	Total		417.00 €	–
Chemical control	Spirotetramat (Movento®, Bayer) against VMB	1	50.00 €	–
	Chlorpyrifos-methyl (Reldan®, Dow AgroSciences) against VMB	1	16.00 €	–
	Chlorantraniliprole (Coragen®, DuPont) against EGVM	1	40.00 €	–
	Metoxifenozide (Prodigy®, Bayer)	1	33.00 €	–
	Cost of insecticide-based treatment/ha	4	80.16 €	20.04 €/ha per each treatment
	Total	–	219.16 €	–

Biological control per ha: 417 €, Chemical control per ha: 219 €

After 3 years BCAs are established and the farm can save 279 €, so the cost of BC is 417-279 = 138 €

The project has been presented in 2 meetings of EIP-Agri Focus group and spread among Member States as a positive experience of **connecting people to speed-up innovation**



Main results

ENRD AWARDS 2020 selected, in the category "adaptation to climate change," our project "Bioconvito"

European Commission > The European Network for Rural Development (ENRD) > News & Events > News > Rural Inspiration Awards 2020

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Rural Inspiration Awards 2020

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Our Rural Inspiration Awards 2020 competition (#RIAwards2020) received 71 entries this year and we thank everyone involved who submitted the projects.

Climate change mitigation projects received the most entries (30), followed by Bioeconomy (23) and Climate change adaptation (18).

RURAL INSPIRATION AWARDS

Results far above expectations

An American proverb states, "*From the tiny acorn grows the mighty oak*."

The tiny acorn of the Bolgheri project was the strong **sharing**, among producers and researchers:

- of the initial needs,
- of the available knowledge,
- of the difficulties encountered and the successes achieved.

Acknowledgements

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Thanks for your kind attention

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