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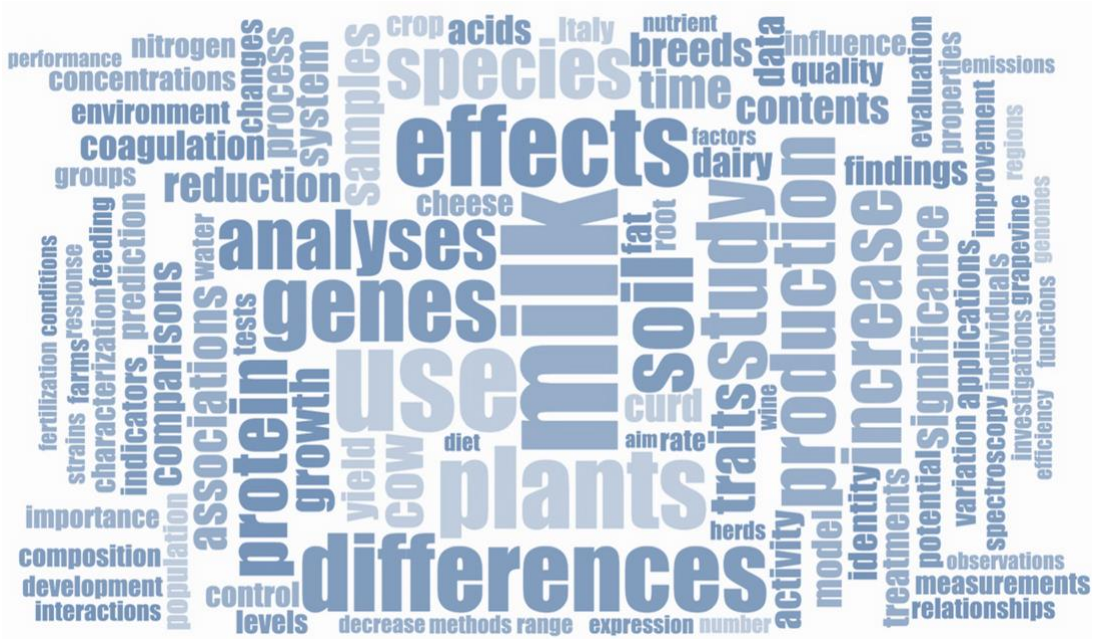

Issues with old and new pests in European vineyards: does biological control works against *Planococcus ficus* and *Erasmoneura vulnerata?*

Carlo Duso

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UNIVERSITÀ DEGLI STUDI DI PADOVA

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Outline

1. The vine mealybug *Planococcus ficus*

- Why we are looking for alternatives to insecticides in controlling this pest?
- Do biological control agents work?

2. The American leafhopper *Erasmoneura vulnerata*

- Why has this species become so invasive?
- Do native biocontrol agents respond to *E. vulnerata* spread?

A number of scale species colonise European vineyards but only some of them are real pests

Pseudococcidae

- ***Planococcus ficus***
- *Planococcus citri*
- *Heliococcus bohemicus*
- ***Pseudococcus comstocki* (?)**
- *Pseudococcus longispinus*
- *Phenacoccus aceris*

Coccidae

- ***Parthenolecanium corni***
- *Neopulvinaria innumerabilis*
- *Pulvinaria vitis*
- *Parthenolecanium persicae*

Diaspididae

- *Targionia vitis*

Parthenolecanium corni

- Polyphagous species, very common from the 90s.
- Factors probably involved in *P. corni* outbreaks: use of non-selective pesticides, drip irrigation and nitrogen fertilization (?).

Parthenolecanium corni

- Direct damage: sap feeding, excretion of honeydew and development of sooty molds on leaves and berries.

- Virus transmission:
  - Leafroll complex (GLRaV-1)
  - Rugose wood complex (GVA)

- Currently, it occurs at low to moderate densities.

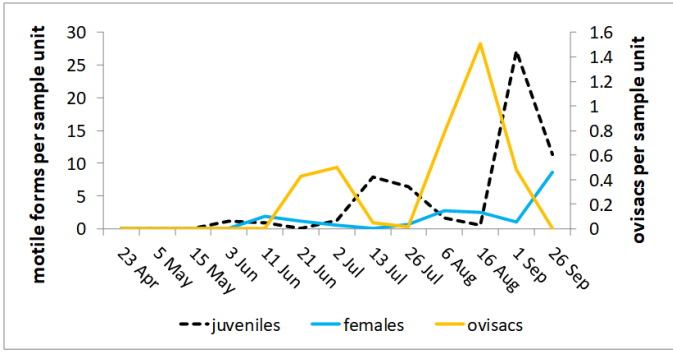
The vine mealybug *Planococcus ficus* feeds on phloem, dense honeydew favors sooty molds and the spread of fungi producing **ochratoxins**

The vine mealybug *Planococcus ficus*

- In Europe, direct damage is more crucial than indirect damage (Leafroll and Rugose wood viruses transmission).
- Native to the Mediterranean Basin this pest is increasing in importance in temperate regions (e.g. Northern Italy).

Issues in *Planococcus ficus* control in Europe

- **Pest phenology** is unpredictable with problems for insecticide application timing.
- **Cryptic behavior** reduces the exposure to control tools.
- **Restrictions** in insecticide use (e.g., buprofezin and imidacloprid removed)
- **Drench application** is not allowed.



Issues in *Planococcus ficus* control in Europe

- Some of conventional insecticides are not very **effective** (e.g. chlorpyriphos-methyl).
- There are no insecticides registered to control **ants** in vineyards…
- **Organic farmers** have soft control tools.
- Knowledge about **naturally occurring** biological control agents is still limited.

Biological control as an alternative to chemicals

- **Generalist predators** (lacewings, coccinellids, cecidomyiids) can prey upon mealybugs but their impact seems to be limited.
- ***Cryptolaemus montrouzieri***, native to Australia is exported throughout the world as a predator of mealybugs.
- ***Nephus includens*** is another coccinellid native to Mediterranean Basin.
- Their larvae are **mealybug mimics**

  → low disturbance from ants.

The role of parasitoids

- Some **parasitoids** are specialised on mealybugs.
- *Anagyrus pseudococci* naturally occurs in the Mediterranean Basin where attacks various mealybugs, included *P. ficus*.
- Another species, *Anagyrus* nr. *pseudococci* is associated to vine mealybugs in Mediterranean countries.
- Both species have been **introduced** in California while *A.* nr. *pseudococci* is currently mass reared and released in vineyards (Daane et al. 2004).

Mating disruption

- Mating disruption against *P. ficus* was attempted first in North America, then in Europe (Walton et al. 2006; Cocco et al., 2014).

- *P. ficus* overwinters as mated female: the effect of mating disruption is expected to be higher in the second year of application (Cocco et al., 2014).

- Others control tactics may be necessary in the first year of application.

- Mating disruption has positive effects on parasitoids

Recent studies conducted in North-eastern Italy

- Impact of naturally occurring biocontrol agents of *P. ficus*.
- Augmentative biological control as an alternative to insecticides.
- Compatibility between augmentative biological control and mating disruption.

Augmentative biological control (exp. 1)

Four treatments were compared:

a) **Release of *Cryptolaemus montrouzieri***;

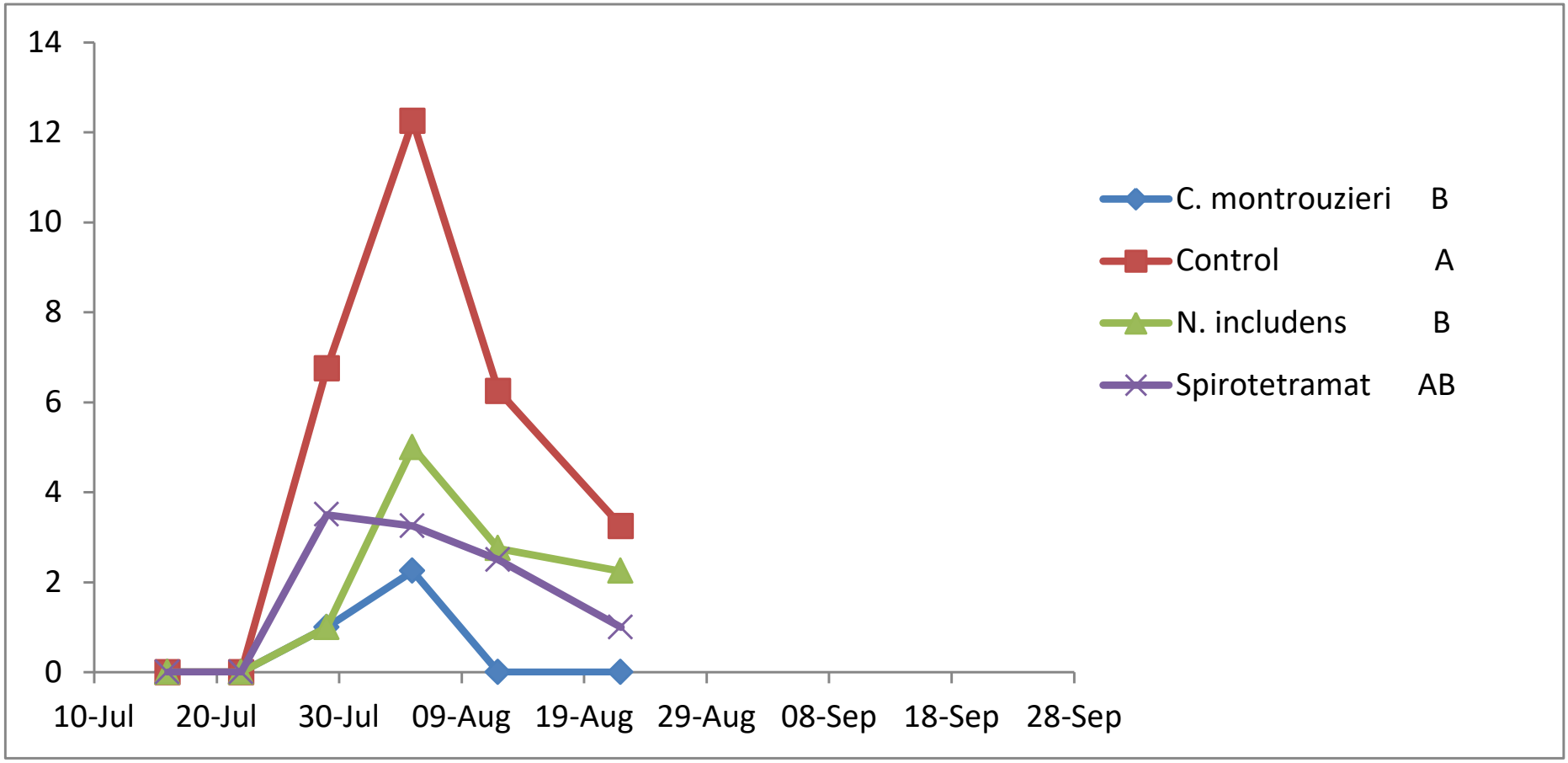
b) **Release of *Nephus includens;***

c) **Spirotetramat**

d) **Control**

- Timing of release: July-August (4 releases of 250 adults/5 vines)
- Experimental design: 4 replicates
- Sampling every 7-15 days

Meolo - 2014
P. ficus females on clusters



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Augmentative biological control (exp. 2)

- Three treatments were compared:

  - Release of *Cryptolaemus montrouzieri*;

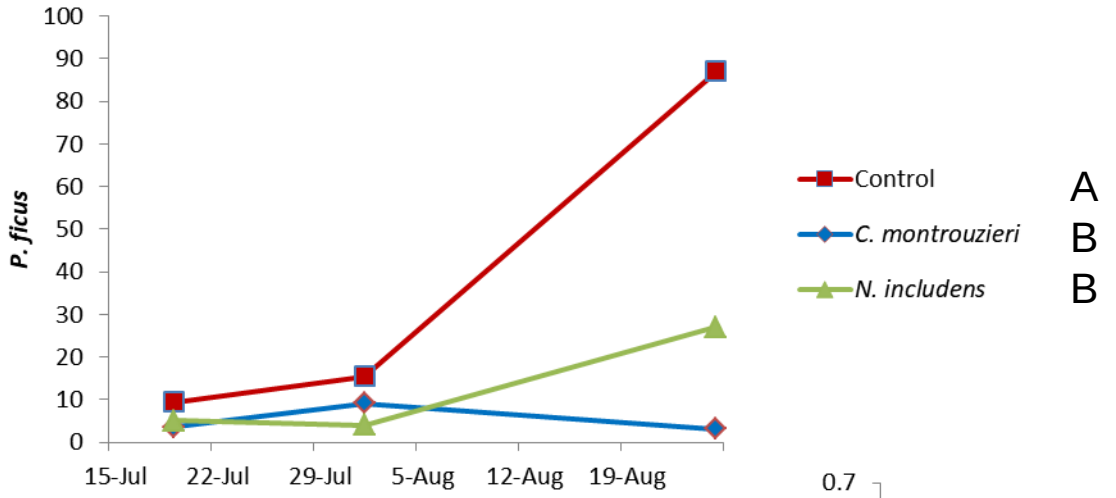
  - Release of *Nephus includens;*

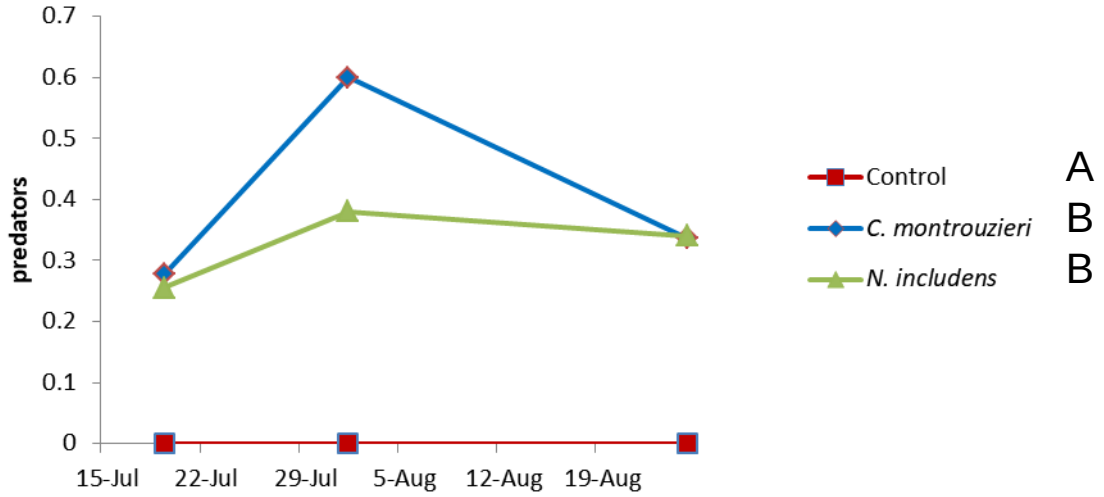
  - Control.

- 4 releases of 100 *C. montrouzieri* and 250 *N. includens* adults/ 8 vines in June and July.
- Randomized block (3 replicates in 2 blocks made by 2 cultivars).
- Sampling in mid-July, mid-August and before harvest

FVG - 2016

P. ficus and predators on clusters





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Augmentative biological control and MD

- Multi-cultivar vineyard in the first year of Mating Disruption (CBC Europe)

- Four treatments were compared:

  - Release of *Cryptolaemus montrouzieri* + MD;

  - Release of *Anagyrus pseudococci* + MD;

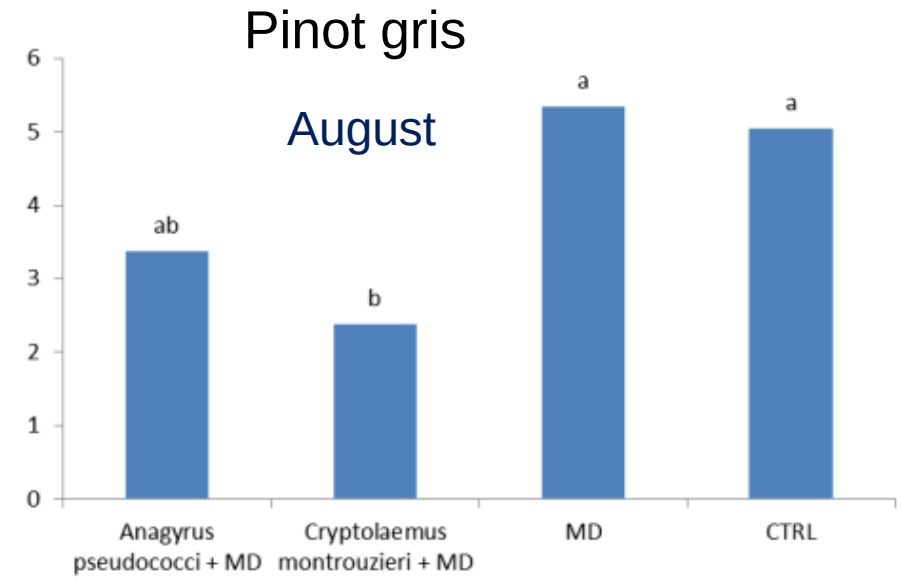
  - MD;

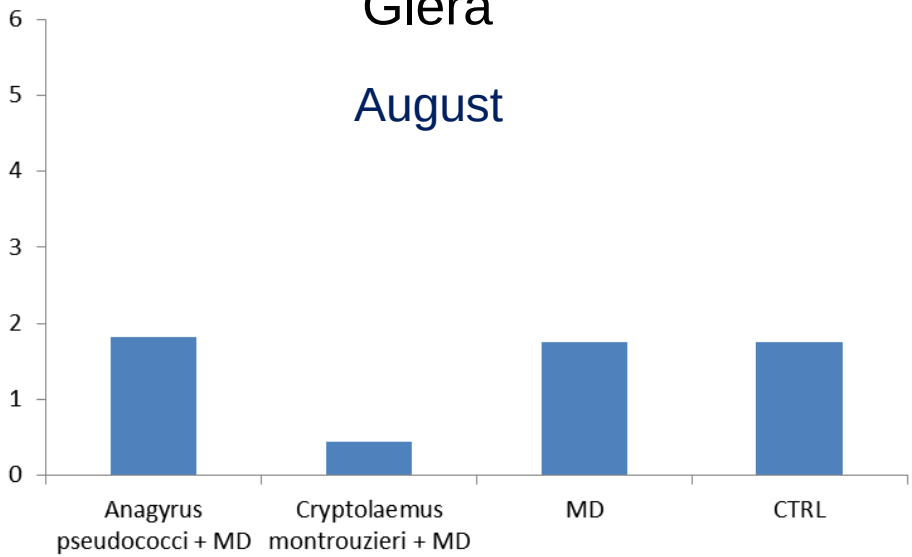
  - Control

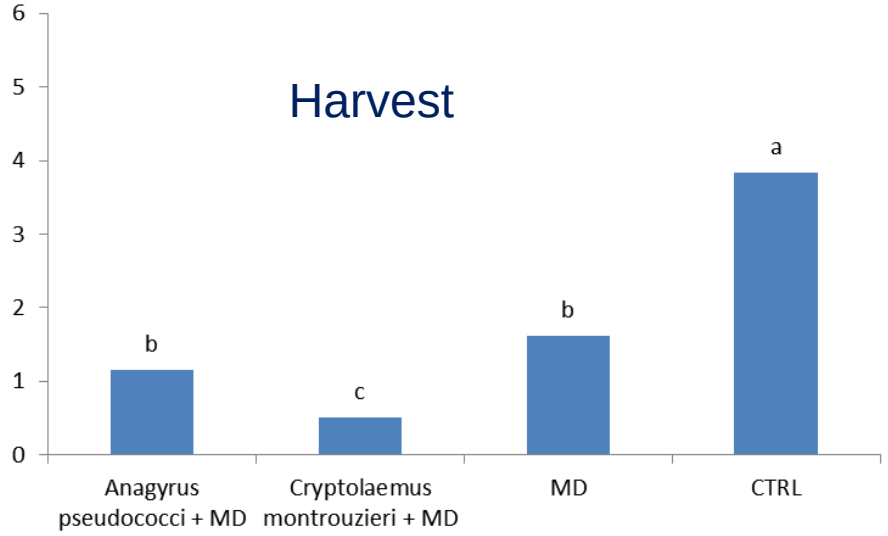
- Randomized block, 5 replicates (1 ha) per treat. and per cv.

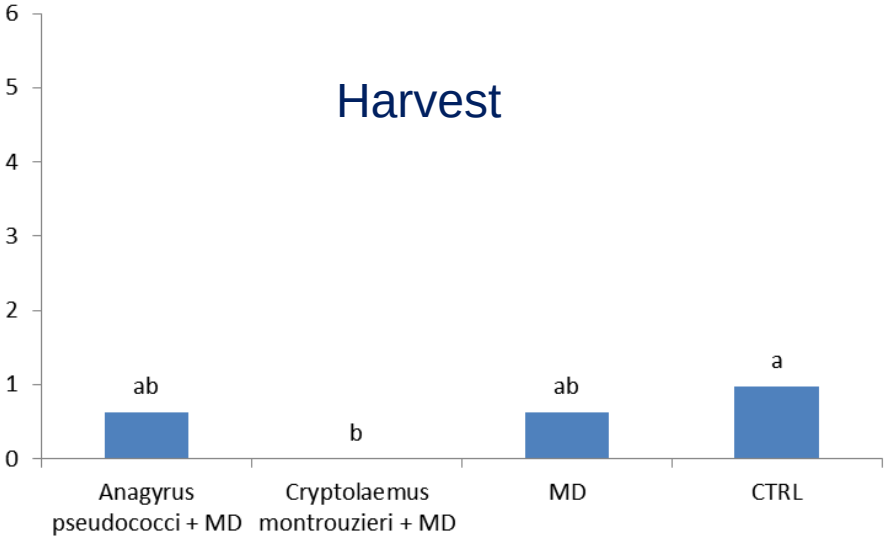
- Releases in June and July (total of 200 *C. montrouzieri*/ha and 2500 *A. pseudococci*/ha), sampling in August and before harvest

Planococcus ficus on clusters









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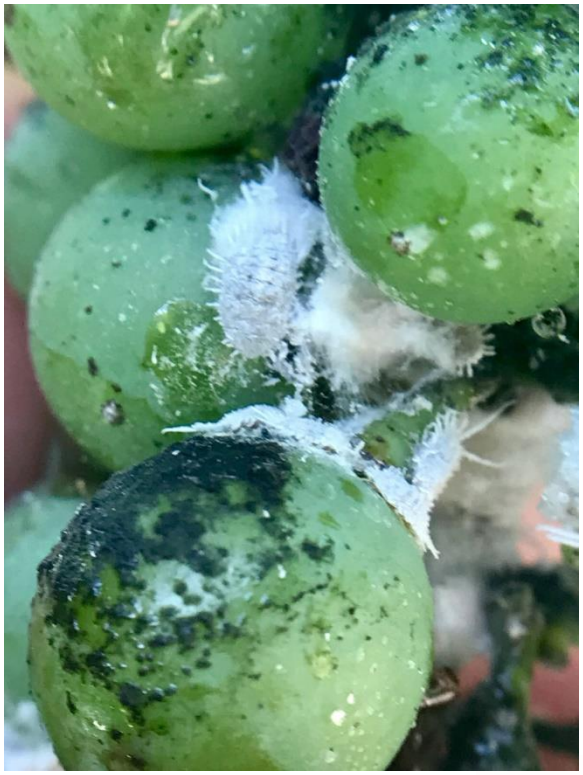
Summary

- Limited impact of naturally occurring antagonists of *P. ficus* in North-eastern Italy (poor host-parasitoid synchronization?).
- Augmentative biological control of *P. ficus* gave results comparable to those of insecticides: both did not eradicated mealybugs.
- Among predators, the best results were obtained with *C. montrouzieri.*
- Mating disruption and biological control are compatible tactics to be considered in *P. ficus* management.

Pseudococcus comstocki:
a new emerging pest of grapes?

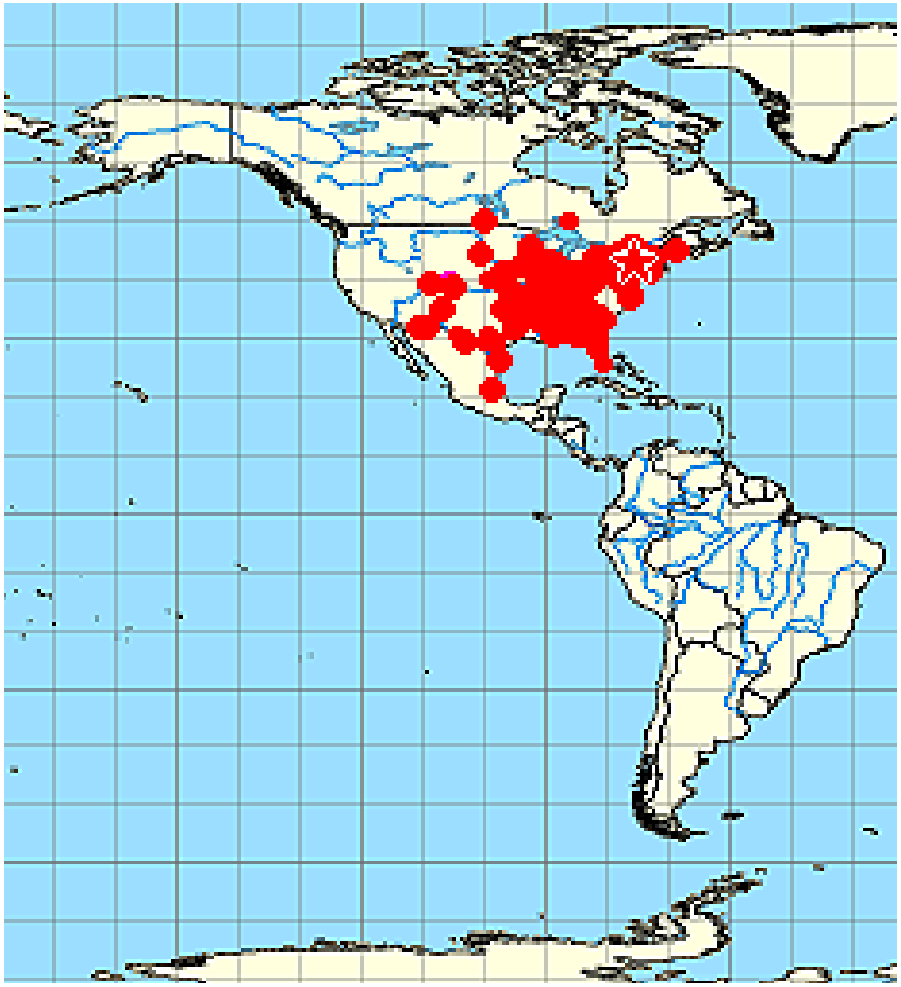
- Native to Eastern Europe, it caused outbreaks about 10 years ago in fruit orchards but was rare in vineyards.



In 2018, severe damage was detected in Italy (Emilia-Romagna region). No problems recorded in 2019…

The American leafhopper *Erasmoneura vulnerata*

Erasmoneura vulnerata is a leafhopper widely distributed in Northern and Central America



Adapted from © 2003-2009 Dmitriev and Dietrich

Erasmoneura vulnerata was detected in Europe in 2004

- *E. vulnerata* was recorded for the first time in Veneto region, North-eastern Italy (Duso et al., 2005); later, it was detected in neighboring regions and in Slovenia.

- At that time moderate populations densities were observed on untreated vines (*Vitis labrusca* and *V. riparia* x *V. labrusca*).

- In contrast, its occurrence in commercial vineyards was negligible.

For more than a decade the economic importance of this species in Italy has remained negligible

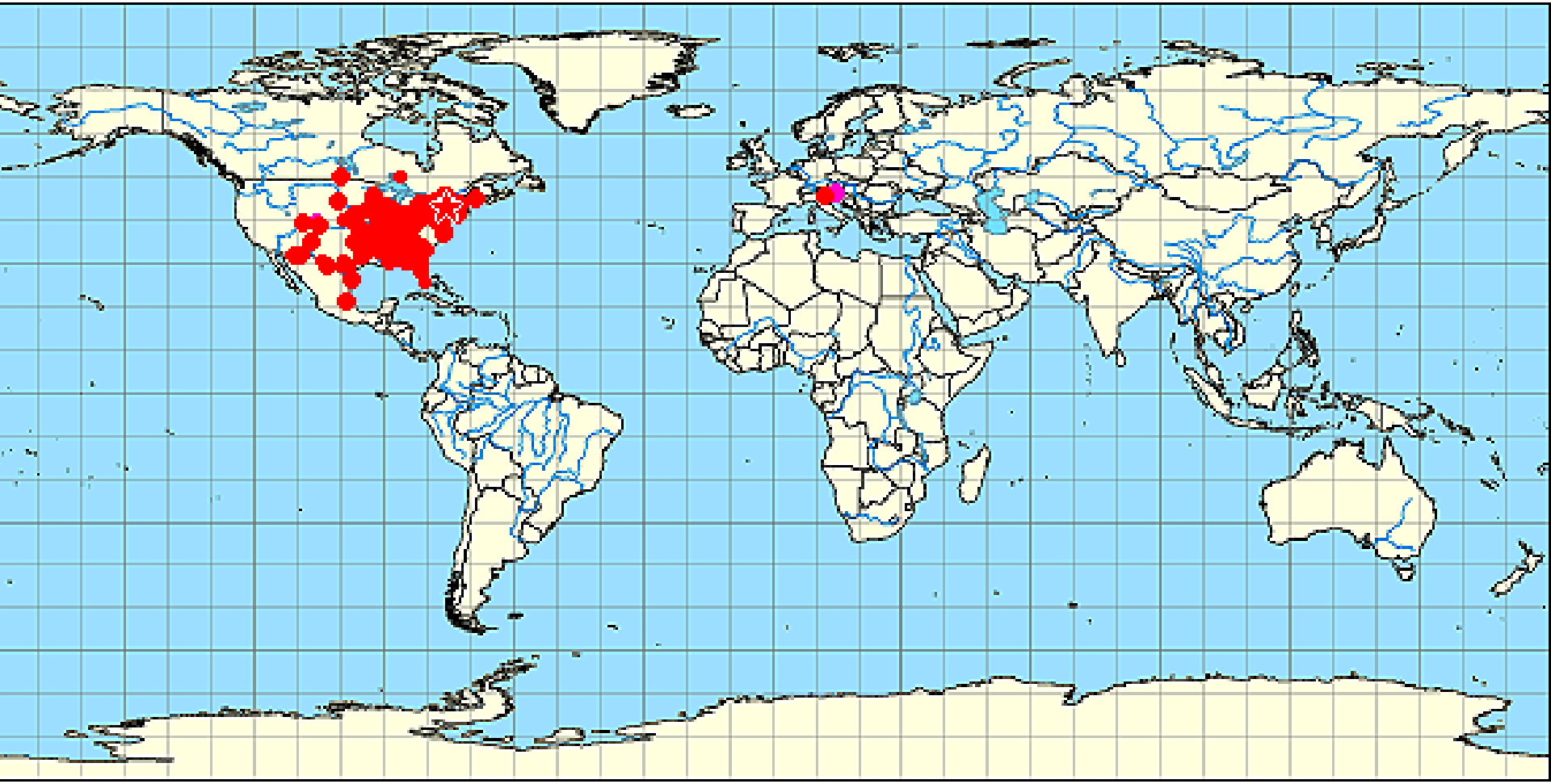
The economic importance of *E. vulnerata* in North America is unclear

- Early studies considered *E. vulnerata* a **serious pest of vines** (Robinson, 1924; Beamer, 1946).

- Since then, **a single publication** mentions this species as a pest in vineyards dominated by *Erythroneura ziczac* (Zimmerman et al. 1996).

- In other studies *E. vulnerata* is reported as a minor species in communities dominated by **other taxa** (e.g., Paxton and Thorvilson, 1996).

Current distribution of *Erasmoneura vulnerata*



Studies on parasitoids of *E. vulnerata* in America

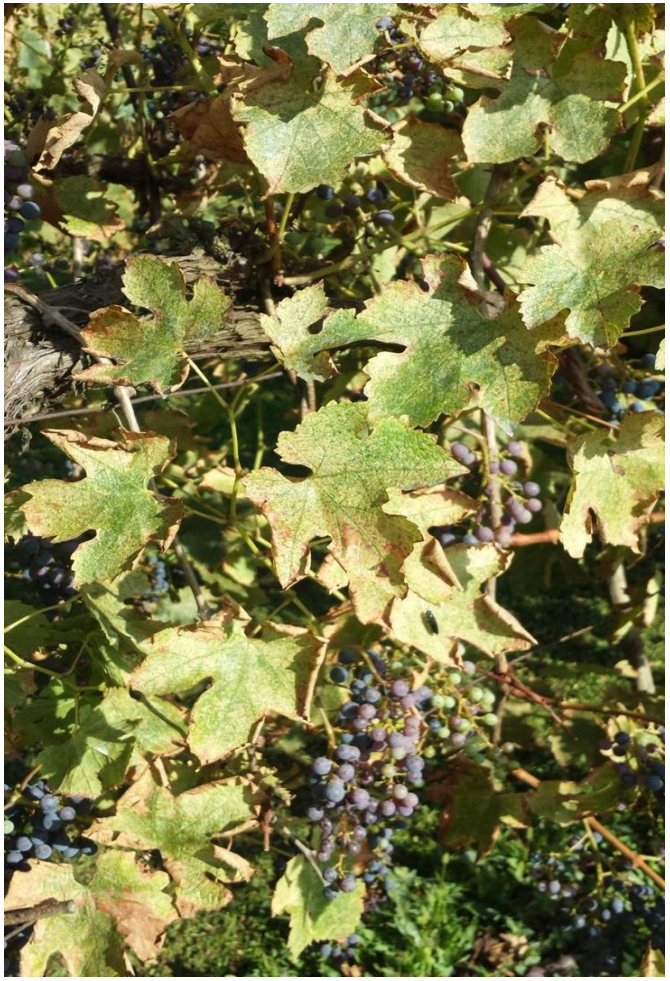
- In Colorado, ***Anagrus epos*** was mentioned to attack *E. vulnerata* eggs but parasitism rates were very low (Zimmerman et al., 1996).

- According to taxonomists (Triapitsyn et al. 2010) this record is questionable as they detected another species, i.e., ***Anagrus vulneratus*** in the same vineyards…

- Results from these studies stress on the need to improve knowledge on leafhopper communities and their antagonists.

2016: first outbreaks of *E. vulnerata* in North-eastern Italy

Symptoms are similar to those caused by other American leafhoppers: leaf discoloration and leaf fall



Factors potentially involved in *E. vulnerata* outbreaks

- Introduction of a new species/new strains
- Improved overwintering due to mild winters
- Decreased susceptibility to pesticides
- Low impact of natural enemies

Recent studies in North-eastern Italy

- Biology and phenology
- Spatial and temporal distribution
- Competition with native leafhoppers
- Role of natural enemies
- Impact of agricultural practices (conventional vs. organic vineyards)
- Damage assessment

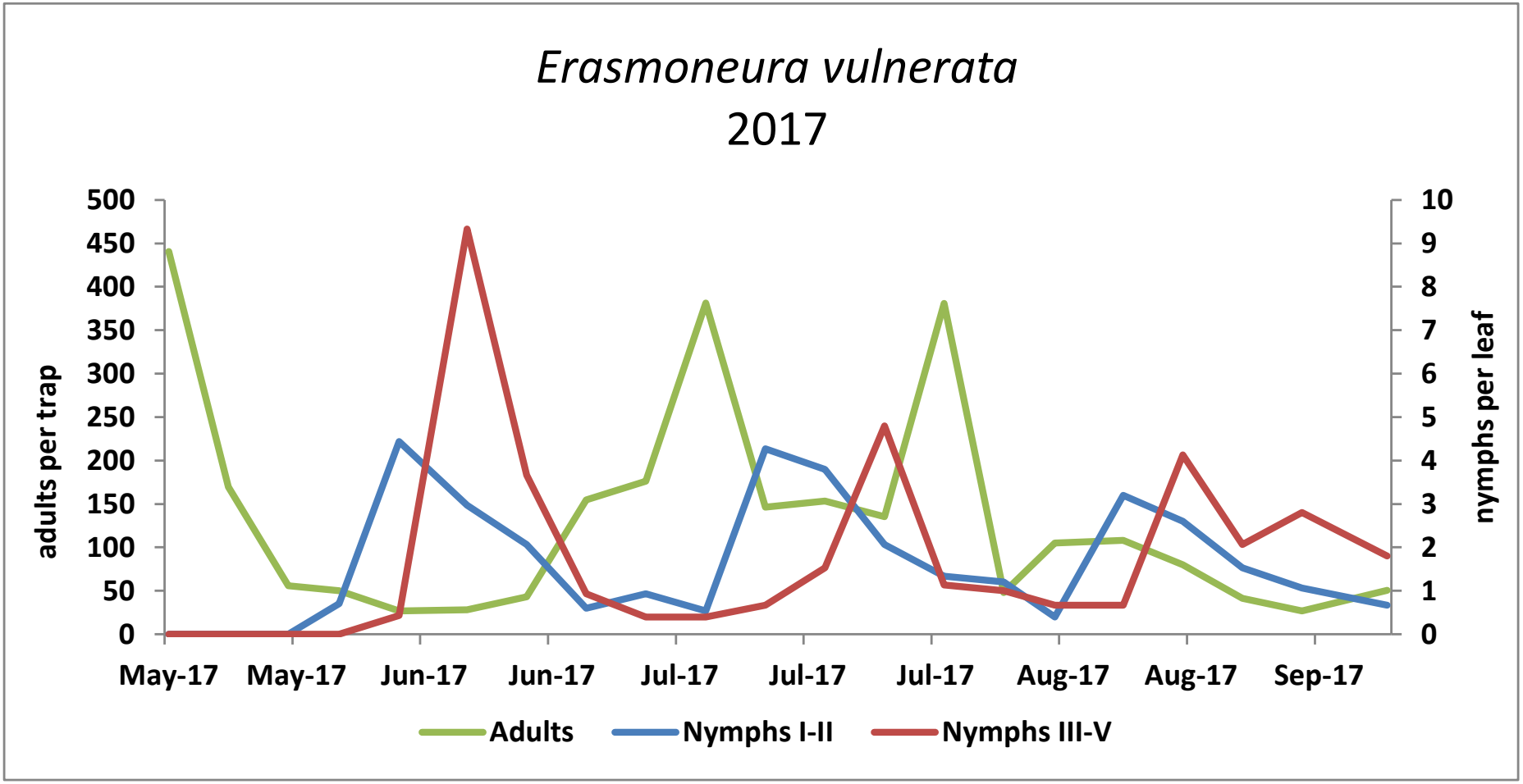
Biology

- At 25°C the **overall development (egg-adult) required 28-29 days** (similar to the American leafhoppers *Erythroneura ziczac* and *Erythroneura elegantula*).

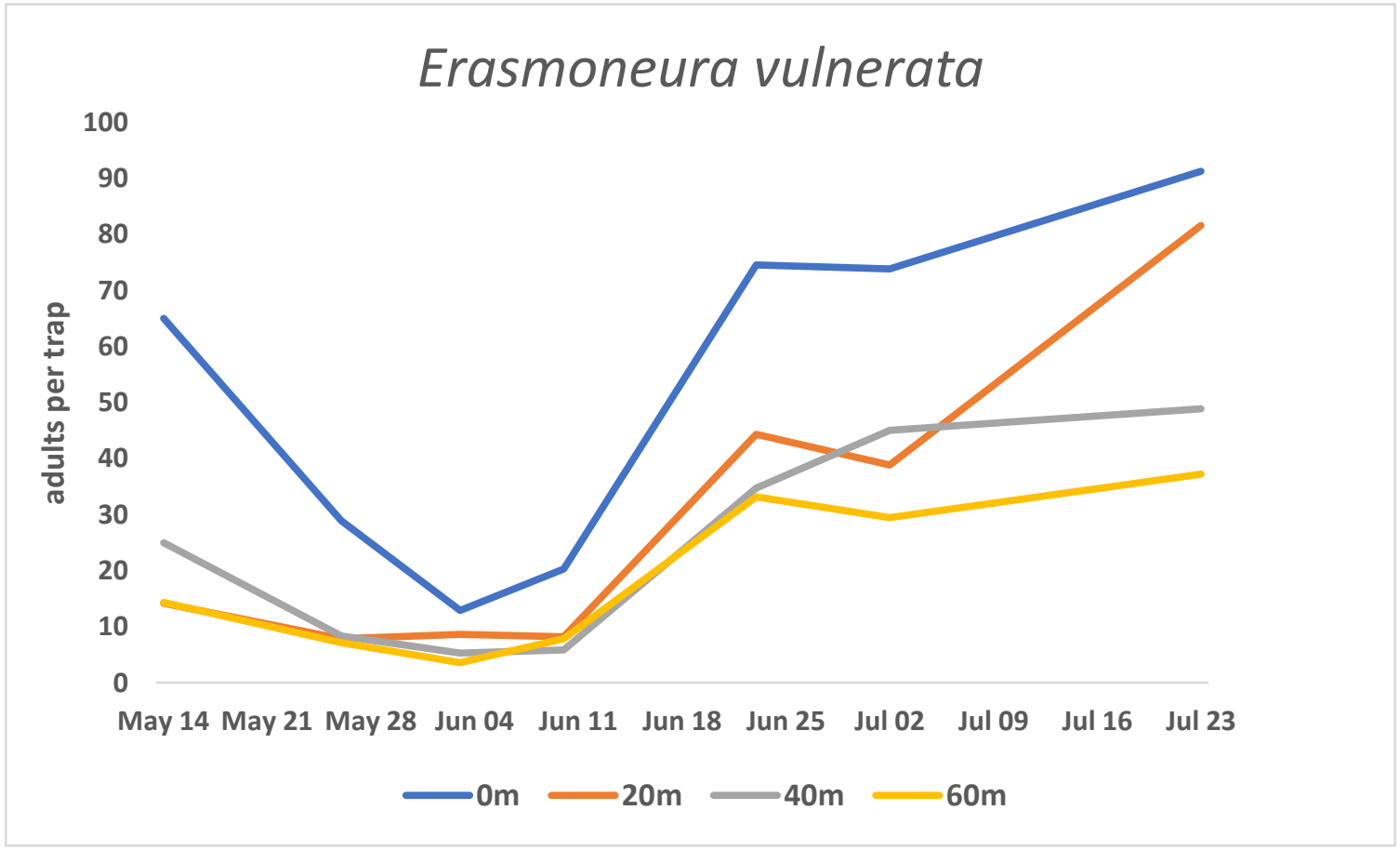
- Total **fecundity attained to 72.28** ± 6.19 eggs per female (higher values compared to native leafhoppers).

- Apparently, there are no data on the fecundity of American leafhoppers occurring in vineyards.

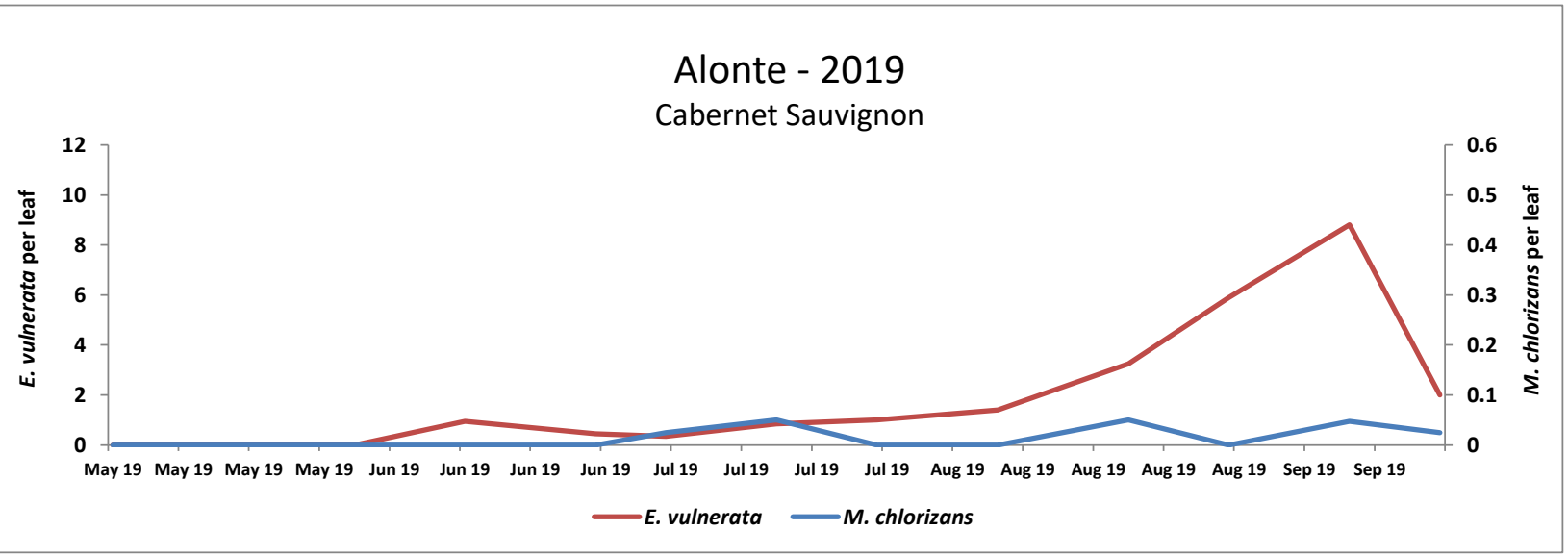
The phenology of *E. vulnerata* in Italy suggests the development of three generations per year

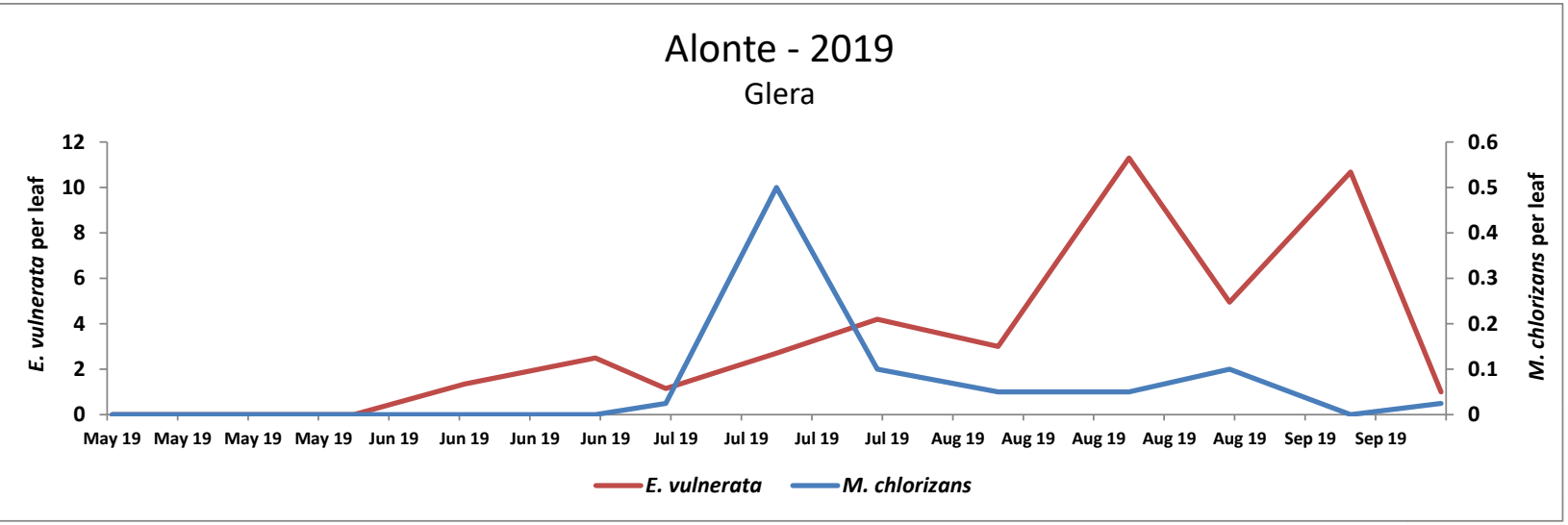


Adult flights show a marked «edge effect» in vineyard colonisation from overwintering sites

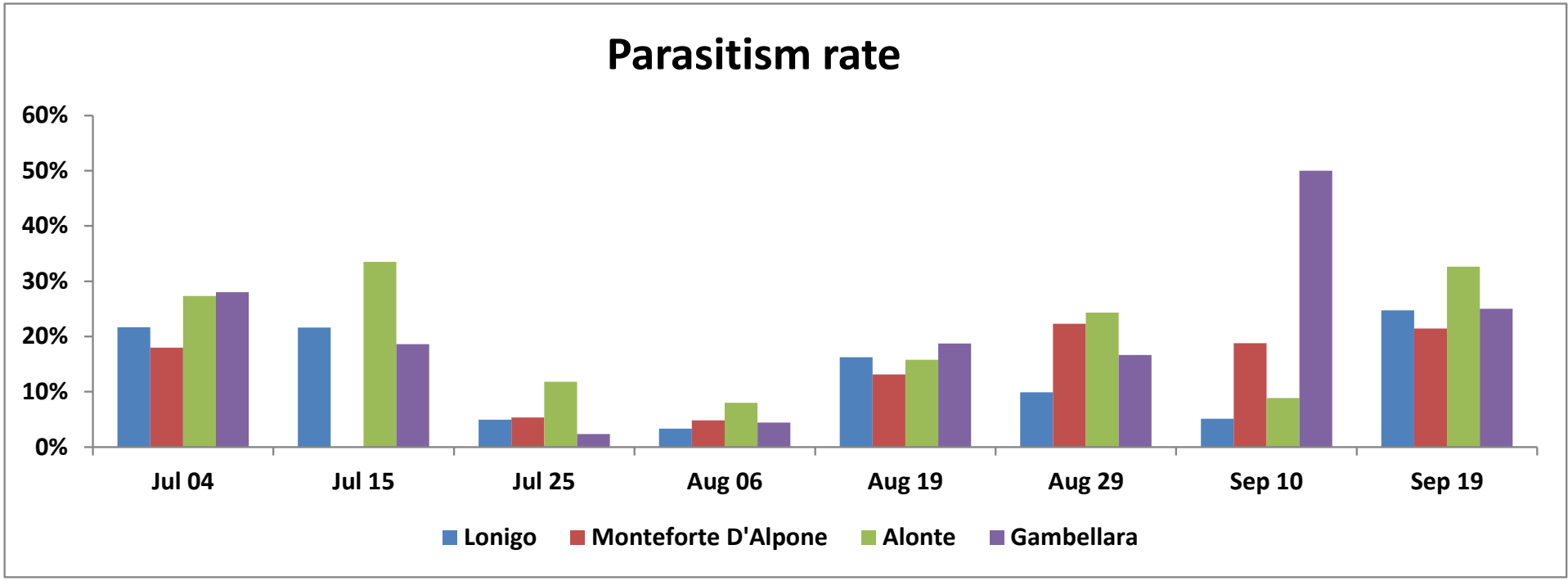


Predator-prey dynamics





Parasitism rates reach moderate values independently from vineyard management



Lonigo and Monteforte are organic vineyards
Alonte and Gambellara are conventional vineyards

Summary

- *E. vulnerata* outbreaks are inducing growers to spray with insecticides (major problems are due to noisy at harvest).

- However, *E. vulnerata* can be managed following basic IPM concepts: monitoring, adoption of economic thresholds, exploitation of natural enemies.

- The surprising response of native egg parasitoids and of generalist predators to this American species shows that the natural control of pests works despite the lack of confidence in this matter...

Acknowledgements

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