

Classical Biological control against the chestnut gall wasp: Introduction and establishment of the exotic *Torymus sinensis* in France

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Classical Biological Control (CIBC)

Intentional introduction of a exotic
natural enemy for its permanent
establishment

Service

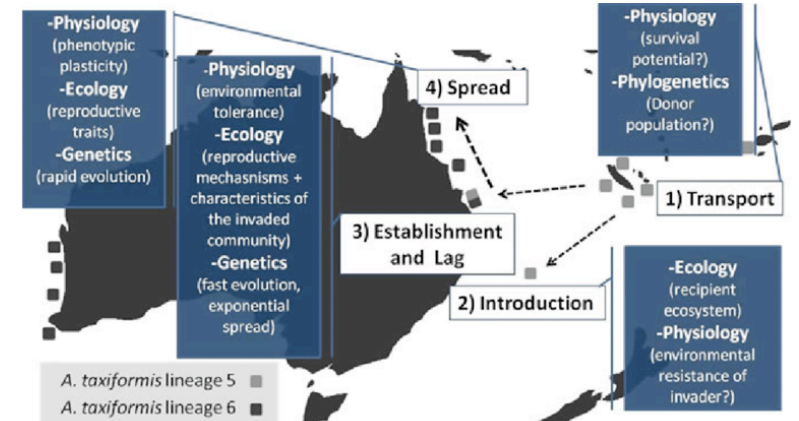
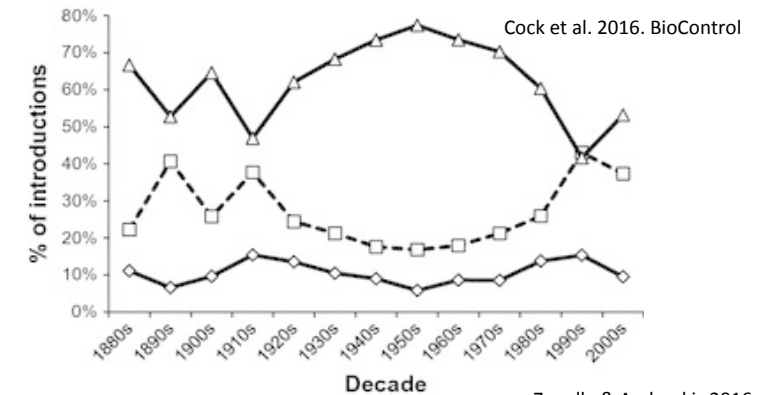
Long-term
control

Exotic
natural
enemies

**Need for optimisation of
methods in CIBC**



**Unique opportunity to study
in natura the factors involved
in the success/failure of
invasive introduced
populations**



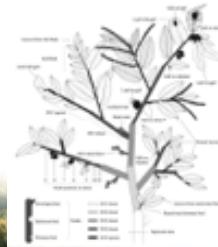
The pest

Dryocosmus kuriphilus



- Invasive gall wasp (Cynipidae) – Native from China
- Specialized on *Castanea* spp.
- Firstly introduced in Europe in 2002 (Italy)
- Reached the main areas of French chestnut production in 2010

Impacts



The BCA

Torymus sinensis



- Exotic parasitoid (Torymidae)
- Native from China
- Specialized on *D. kuriphilus*
- Successfully introduced in several countries (Japan, USA, Italy...)

Creation of a National committee for the control of *D. kuriphilus* in 2010

⇒ Research Institutes
⇒ Technical Institutes
⇒ Chestnut producers
⇒ Forest stakeholders
⇒ Government
⇒ ...

1. Develop biological control using *T. sinensis*
2. Screening of varieties susceptibility to *D. kuriphilus*
3. Assess and document yield losses in order for growers to obtain financial compensations



Creation of the National Federation of Chestnut Producers

Quick deployment of *T. sinensis* releases in France

Substantial financial supports for BC in France (for experimental releases and for wide spreading) [2011-2018]

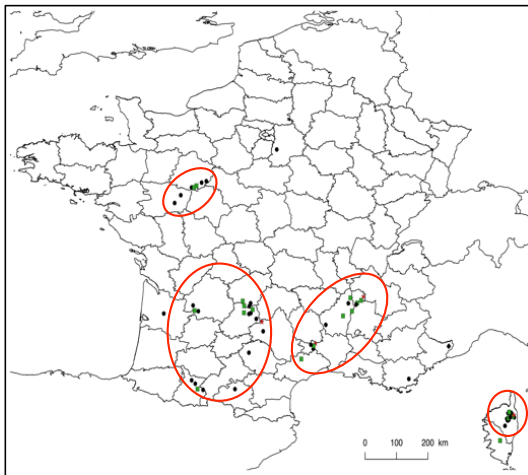
Financial compensation of yield losses

1. Long-Term control of *D. kuriphilus* populations using introductions of *Torymus sinensis*
2. Test different modalities of releases on the establishment success of *T. sinensis*
3. Document the recruitment of native parasitoids by CGW (population dynamics, molecular and morphological diversity) related to potential unintentional effects

Field design

58 release sites - 11 control sites (no release)

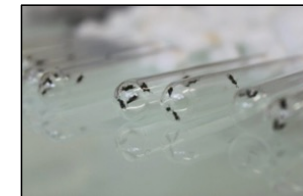
- ⇒ Productive orchards
- ⇒ Traditionnal orchards
- ⇒ Forests stands



Experimental releases

Différents modalités de releases

- ⇒ 1x100 females (n)
- ⇒ 2x50 females (n et n+1)
- ⇒ 1x1 000 females (n)



⇒ *T. sinensis* collected *in natura* (no rearing)



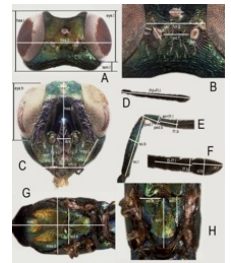
Samplings



- ⇒ 600 000 galls collected (2011-2018)
- ⇒ On *Castanea* and *Quercus* spp.
- ⇒ Area: France + Europe (Italy, Switzerland, Roumania) + Asia (China, Japan)

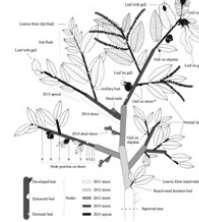
Deep Characterization

- ⇒ Molecular tools: mitochondrial and nuclear markers
- ⇒ Morphological tools: Morphometry, HQ imagery

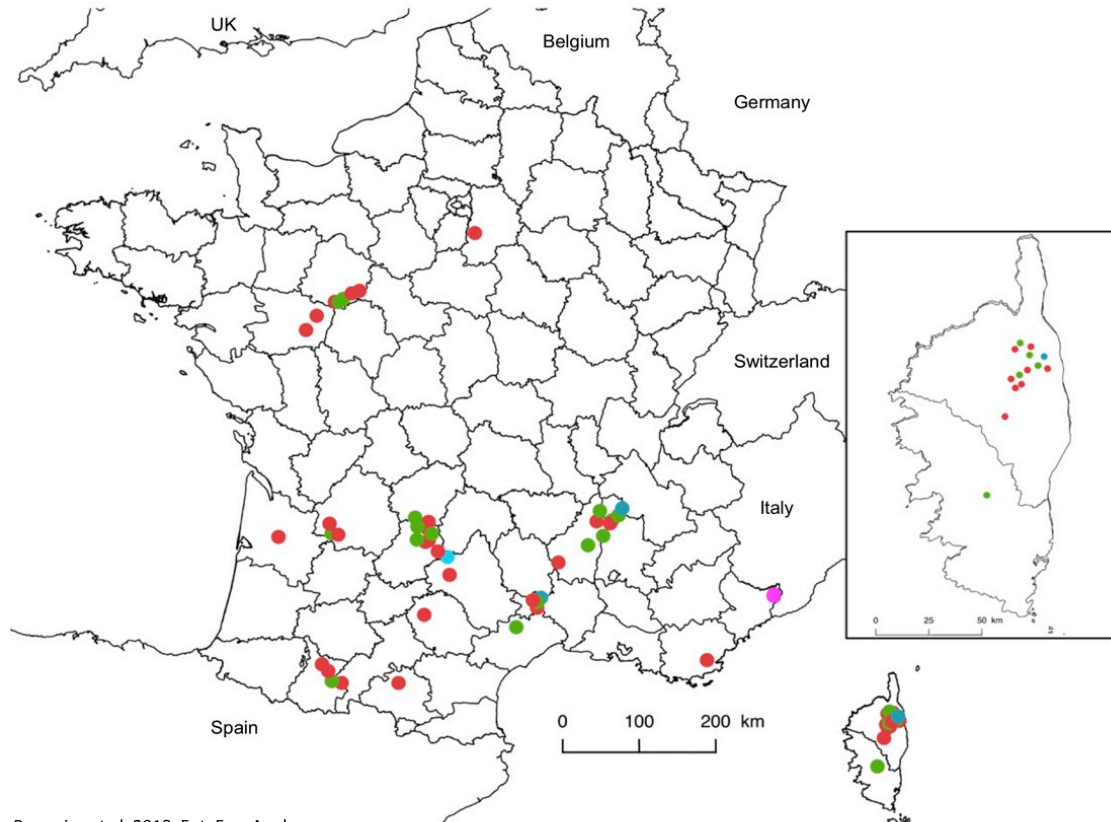


Estimation of CGW infestations

Gehring et al. 2017. JPestScience



- ⇒ Number of buds with galls



Borowiec et al. 2018. Ent. Exp. Appl.

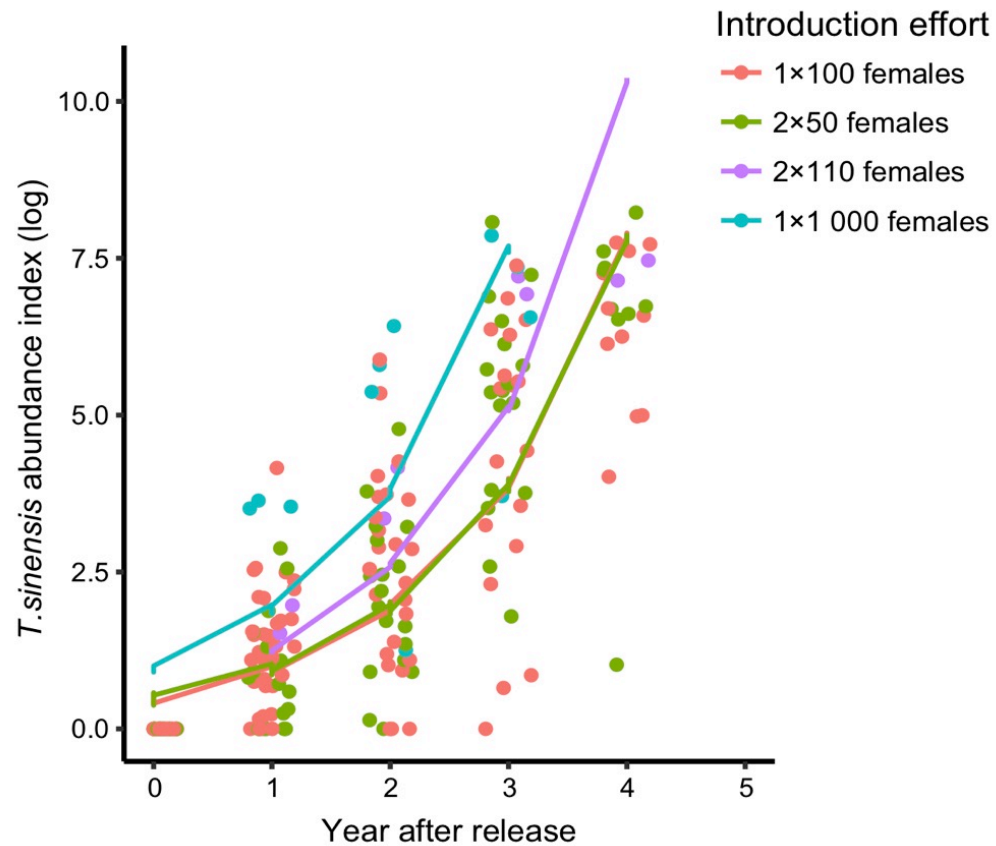
Figure 1 Distribution map of the *Torymus sinensis* releases done between 2011 and 2014 in continental France and Corsica (rescaled in box). Red circles, 1 × 100 females released; green circles, 2 × 50 females released; blue circles, 1 × 1 000 females released; purple circles (extreme southeast of France; Alcotra project), 2 × 110 females released.

=> 15 000 *T. sinensis* released

=> 100% recapture 1 or 2 years after releases, whatever the tested modality

=> High ability of *T. sinensis* to establish and to disperse

Borowiec et al. 2018. Ent. Exp. Appl.

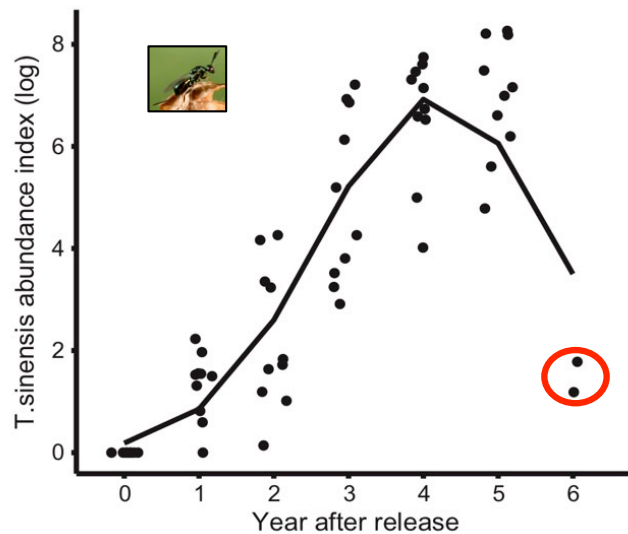


=> Exponential growth of *T. sinensis* population

⇒ No effect of the modality of introduction on *T. sinensis* dynamics

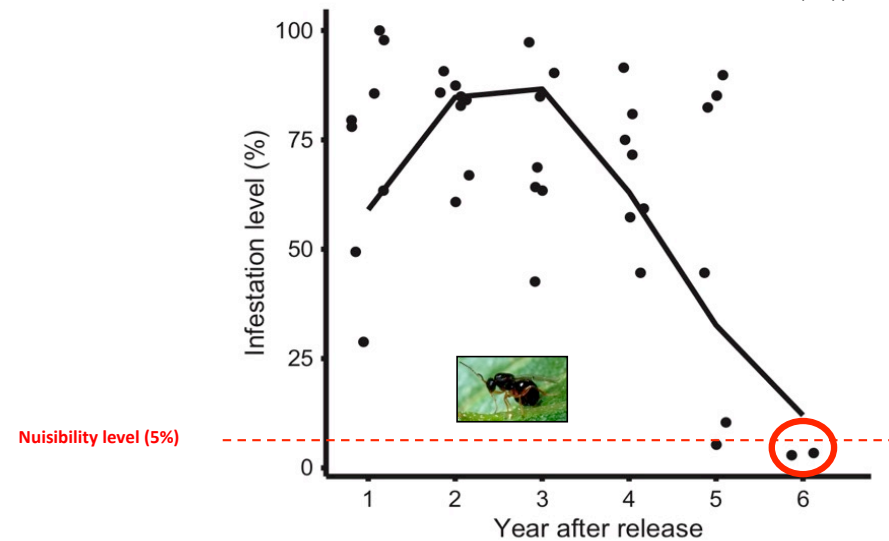
⇒ But slight demographic advantage for the largest introductions

Borowiec et al. 2018. Ent. Exp. Appl.



=> Middle-term dynamics characterized by a decrease of *T. sinensis* populations

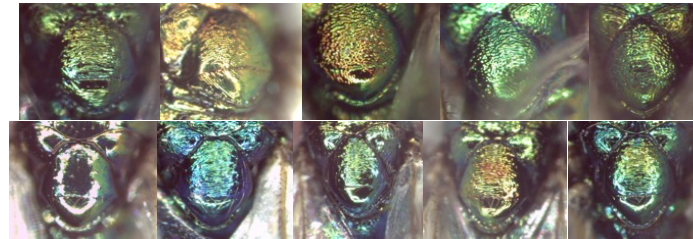
Borowiec et al. 2018. Ent. Exp. Appl.



=> And a decrease of *D. kuriphilus* populations

=> Stabilization of host-parasitoid interactions 5-6 years after first releases

⇒ Wide morphological and molecular variability of *T. sinensis*



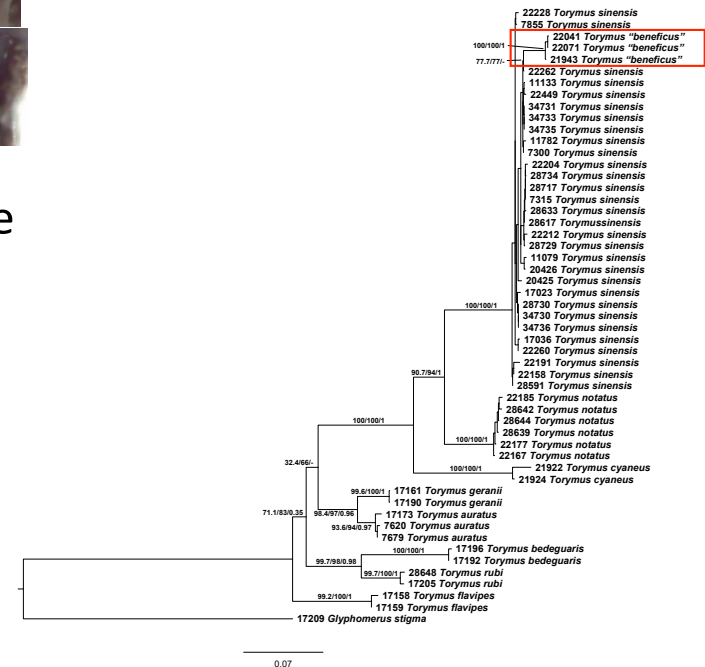
Madalina Viciriu (PhD)



⇒ Few *T. sinensis* collected on oak Cynipids and only on site when control of *D. kuriphilus* was achieved

⇒ No sign of hybridization with close European native *Torymus* (*T. notatus*)

⇒ Few individuals collected that may be hybrids between *T. sinensis* and *T. beneficus* (imported from Japan to Italy)



Viciriu et al. in prep



- ❑ Wide establishment of *T. sinensis* / Efficient (or on going) control of *D. kuriphilus* in France

⇒ **Agronomic success!**

- ❑ Slight effect of propagule pressure on establishment dynamics

⇒ **High intrinsic abilities of *T. sinensis* to efficiently establish and disperse**

- ❑ High diversity of results/deliverables (papers, symposium, workshops, medias....)

⇒ **Scientific « Success »!**

- ❑ “Transitory” convergence between agronomic and scientific issues

- ❑ Spreading of the method very (too) precipitate

- ❑ Need to have a frame that is adequately large (in sites) and long (in time) to accurately:

(1) **Assess the intentional effect of CIBC (establishment, efficacy, dispersal...)**

(2) **Assess the potential unintentional effects of CIBC (impacts of non target species...)**

☐ IPM schemes developed for *D. kuriphilus*?

⇒ CIBC is widely used, also resistant varieties

⇒ But no real IPM guidelines?

☐ New biotic threats for forest nuts and berries?

⇒ *Drosophila sukuzii* / *Halyomorpha halys* (berries) – *Bursaphelenchus xylophilus* (Pinus)...

☐ Impact of climatic change in resilience of forests?

⇒ Increase of establishment success of invasive pests linked to unintentional introductions

⇒ Increasing number of annual generations of pests resulting in increasing damages

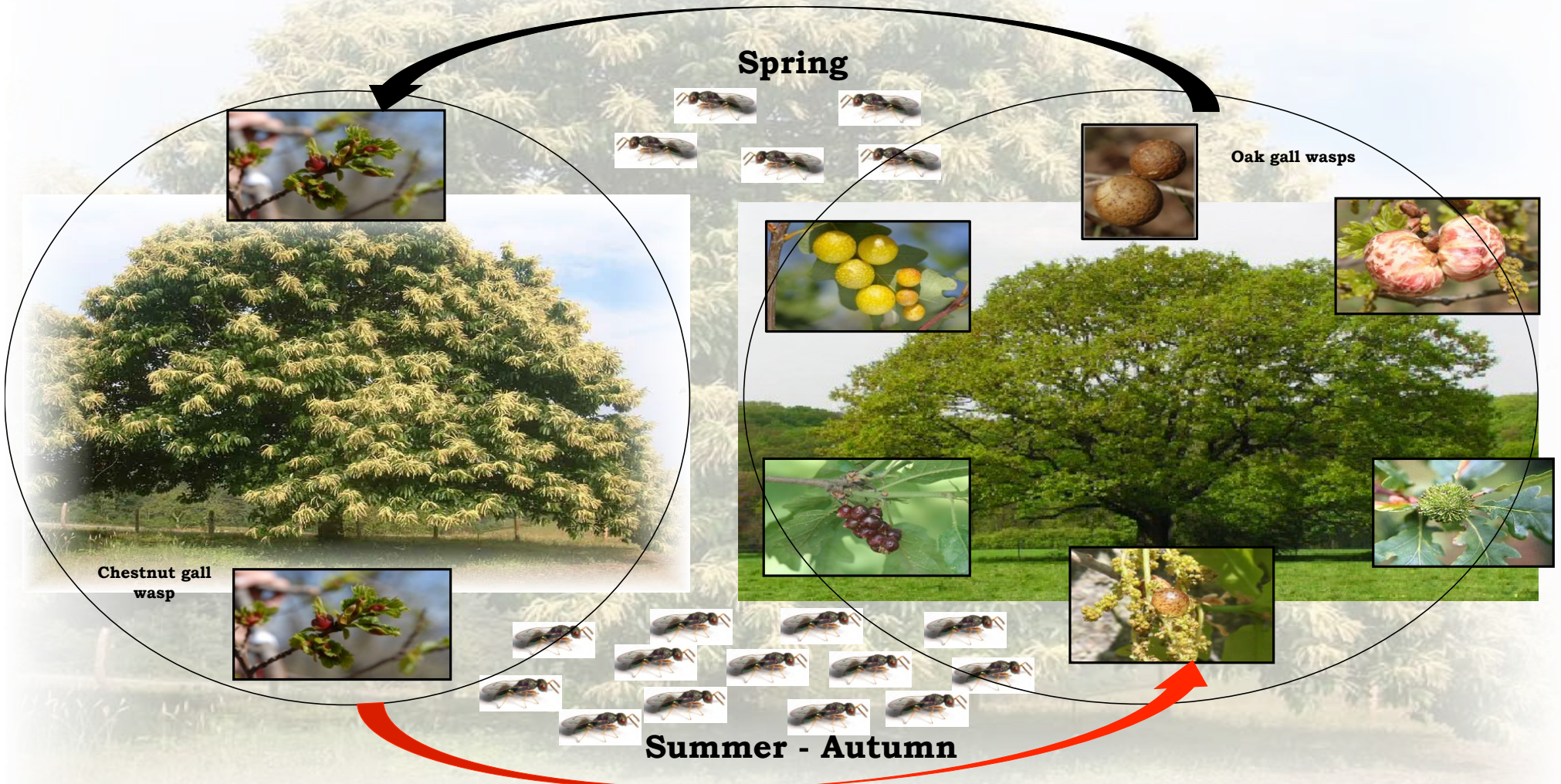
☐ Change in geographical ranges?

⇒ Exponential increase of unintentional introductions of invasive pests

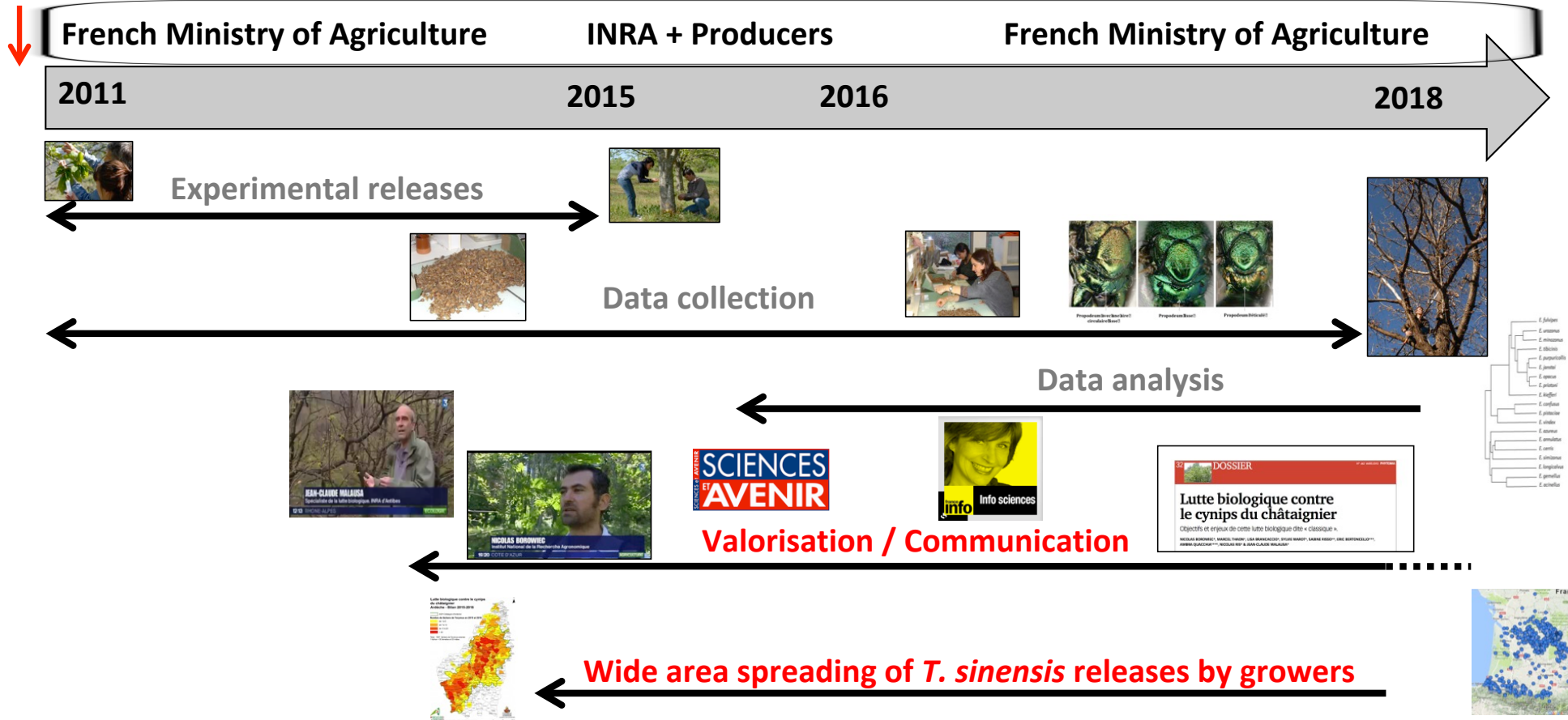
⇒ Increasing distribution of invasive species may lead to a better identification of solutions using international collaborations



Negative impact of *Dryocosmus kuriphilus* on native communities



Lobbying => Quick acquisition of financial supports



=> Centres Techniques / Stations d'expérimentations



Centre technique
interprofessionnel
des fruits et légumes



=> Chambres d'Agriculture



=> Organismes de Veille Sanitaire



=> Filière Castanéicole



=> Filière « Forêt »



=> Filière Apicole

BOROWIEC/ CIBC chestnut gall wasp

.XX



Scientific partnership

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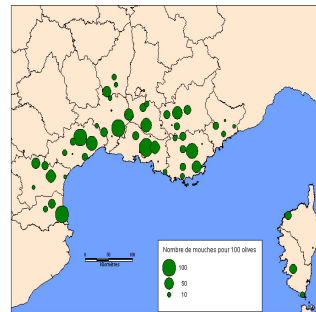
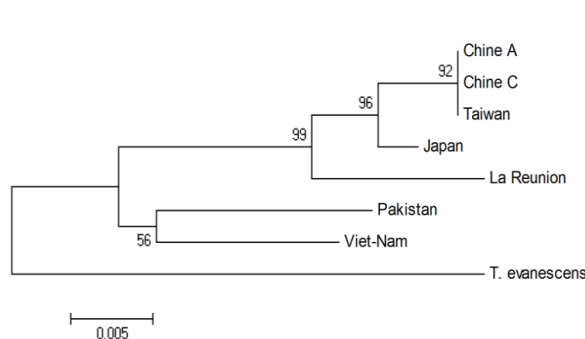
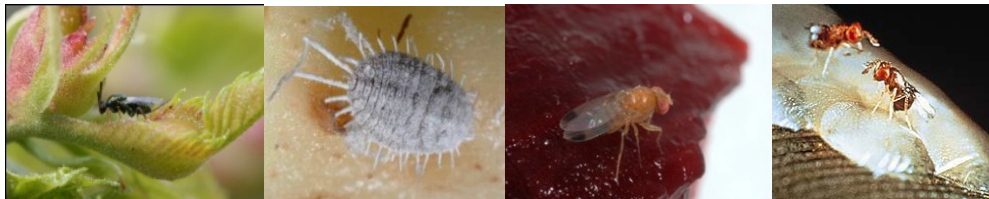
Albino BENTO
José ALBERTO PEREIRA

EUROPE

Research and Development in Biological Control (RDLB)

Team Leader : Nicolas Ris (INRA)

10 permanent (5 Engineers – 5 Technicians) and **3 non permanent** people (1 PhD student)



Main Research Objectives

- Develop **new biological control methods** (mainly Classical BC – Augmentative BC)
- **Integrative characterization** of biological control agents
- **Host a Biological Resources Center** devoted to **egg parasitoids** (BRC-Epcoll)

