Vers une agriculture durable grâce à l'étude des cicadelles

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Professeur agrégé
Titulaire de la Chaire de recherche du Canada sur les Invasions des Insectes Vecteurs et les Maladies Émergentes des Plantes

EdeLab
UNE PLANTE SAINE APPORTE LE BONHEUR

Journées horticoles et grandes cultures
AU CENTRE COMMUNAUTAIRE DE SAINT-RÉMI

Laboratoire de Phytoprotection Durable

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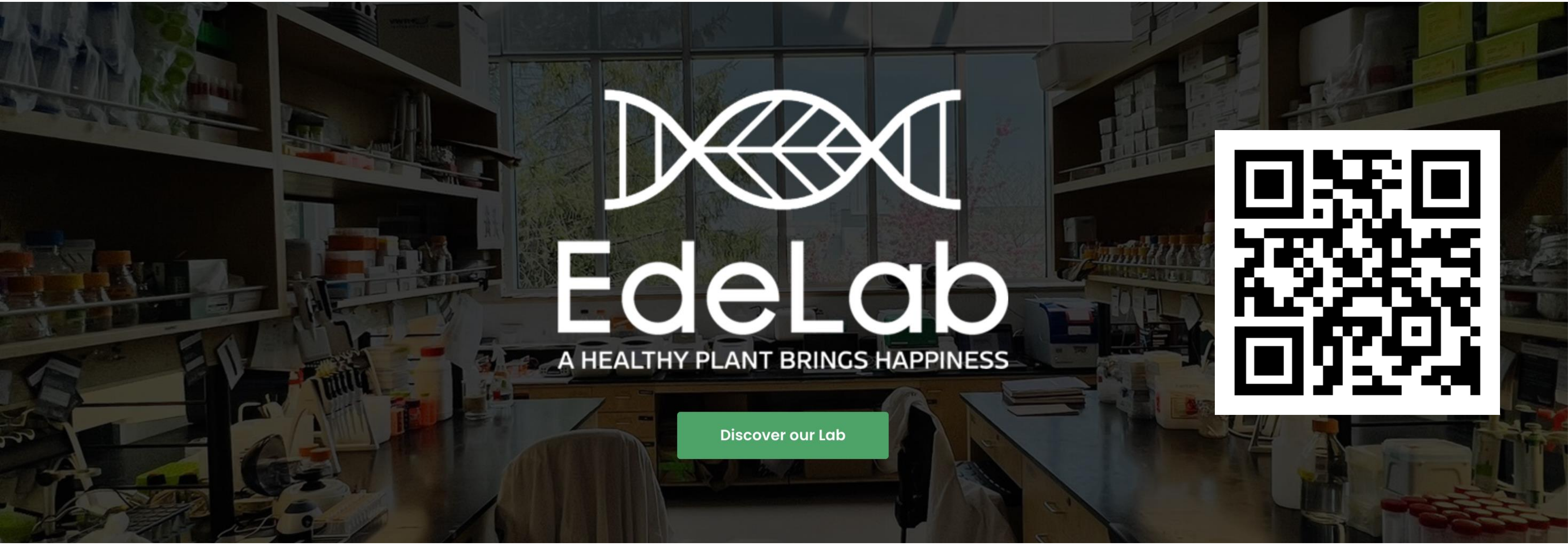
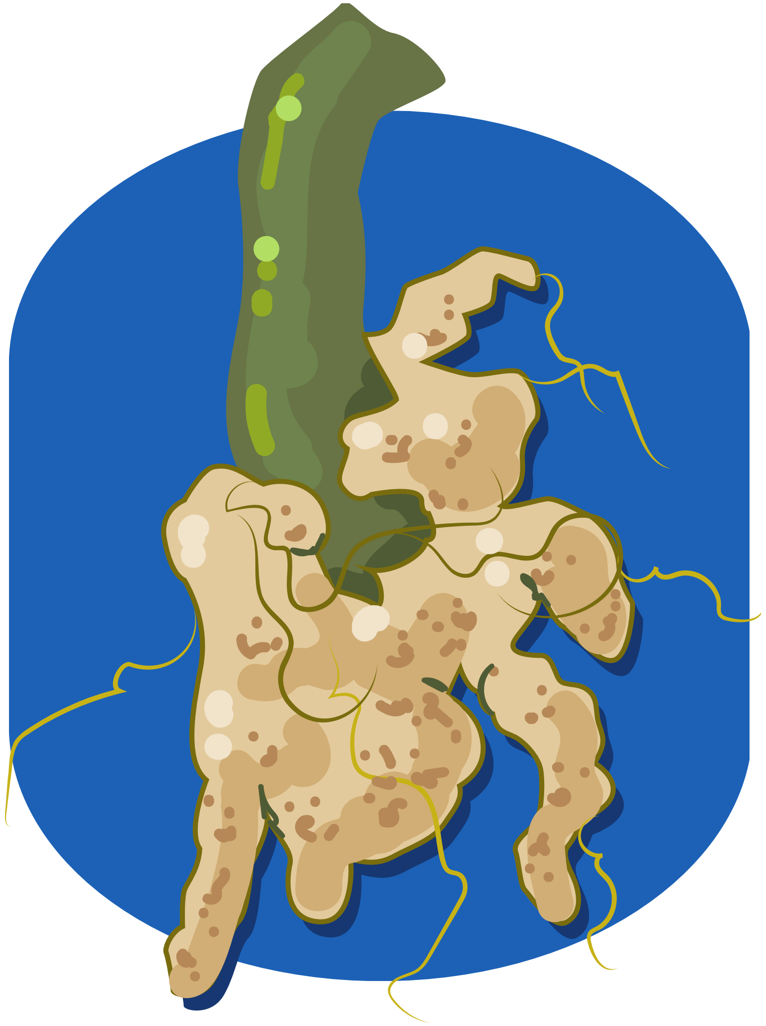
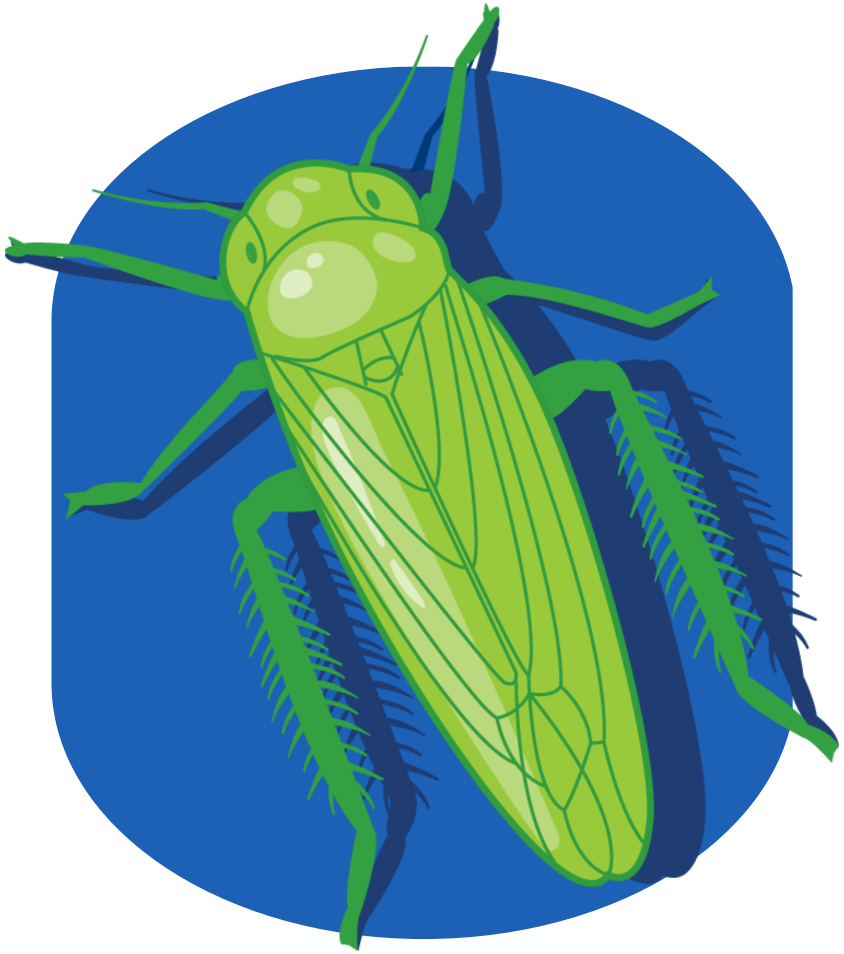


Modèles d'Étude



Maladies



Insectes ravageurs

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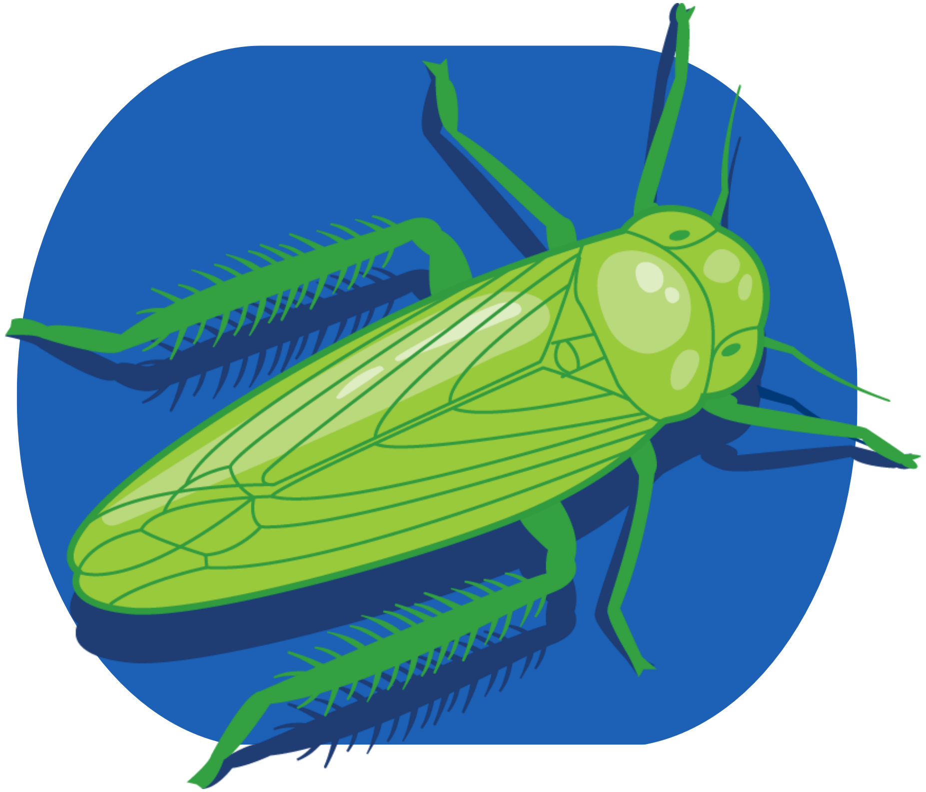


PROGRAMME
INNOV'ACTION
AGROALIMENTAIRE

RQRAD
Réseau québécois de recherche
en agriculture durable

NSERC
CRSNG

Prof. Valérie Fournier

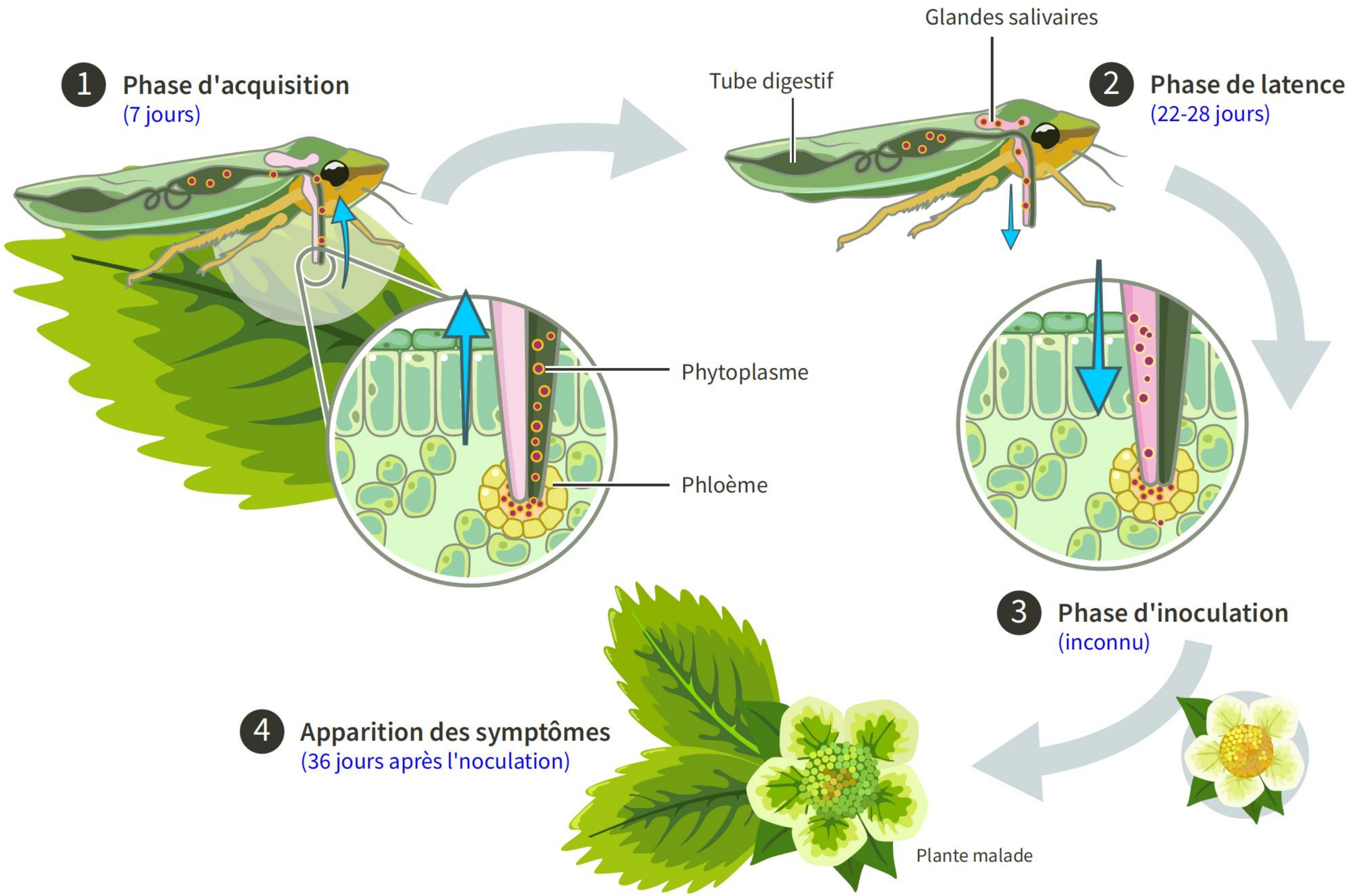
+ Cicadelles

+ Maladies

+ Dommage

+ Insecticides

Cycle de la maladie du pétale vert du fraisier



1962

CLOVER PHYLLODY AND STRAWBERRY GREEN PETAL DISEASES, CAUSED BY THE SAME VIRUS IN EASTERN CANADA[1]

L. N. Chiykowski

Abstract

Experiments were conducted to determine the relationship between clover phyllody and strawberry green petal diseases in Eastern Canada. Clover phyllody virus from naturally infected ladino clover (*Trifolium repens* L.) in Quebec was transmitted by *Aphrodes bicinctus* (Schrank) to strawberry (var. Redcoat and Sparkle) and ladino clover. Symptoms on infected strawberry were typical of green petal. Strawberry plants, naturally infected with green petal, were obtained from Kentville, N.S., La Pocatière, Que., and Charlottetown, P.E.I. The virus was transmitted to ladino clover, red clover (*Trifolium pratense* L.), and strawberry (vars. Redcoat, Guardsman, Senator Dunlap, and Grenadier) by *A. bicinctus* and to ladino clover and aster (*Callistephus chinensis* Nees) by *Macrosteles fascifrons* (Stal).

On the basis of leafhopper transmission and symptomatology, it is concluded that clover phyllody and strawberry green petal diseases in Eastern Canada are caused by the same virus.

+ 60$ millions/an

+ 15 tonnes/an

+ 500 entreprises

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Agriculture, Pêcheries et Alimentation
Québec

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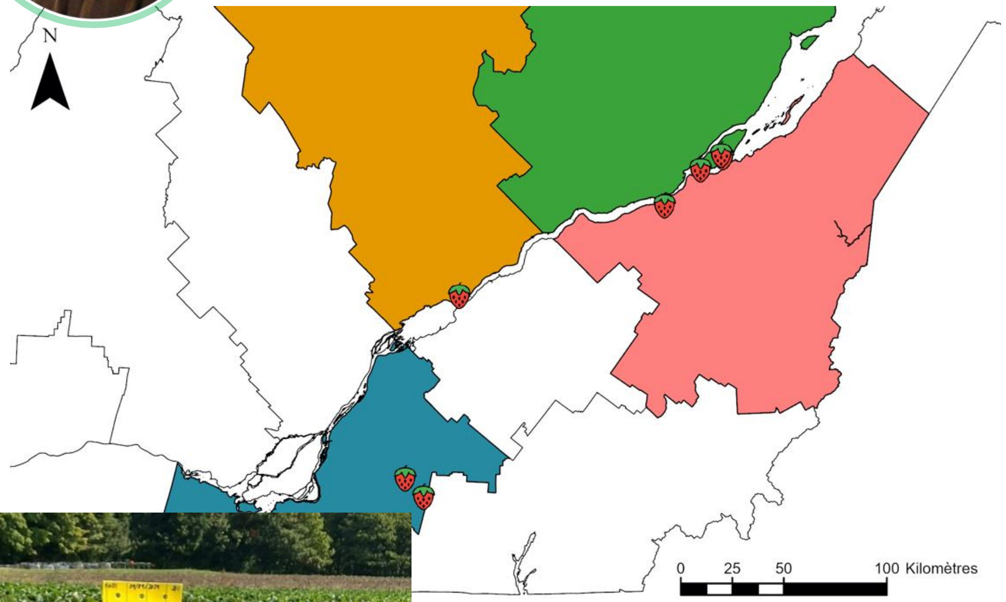
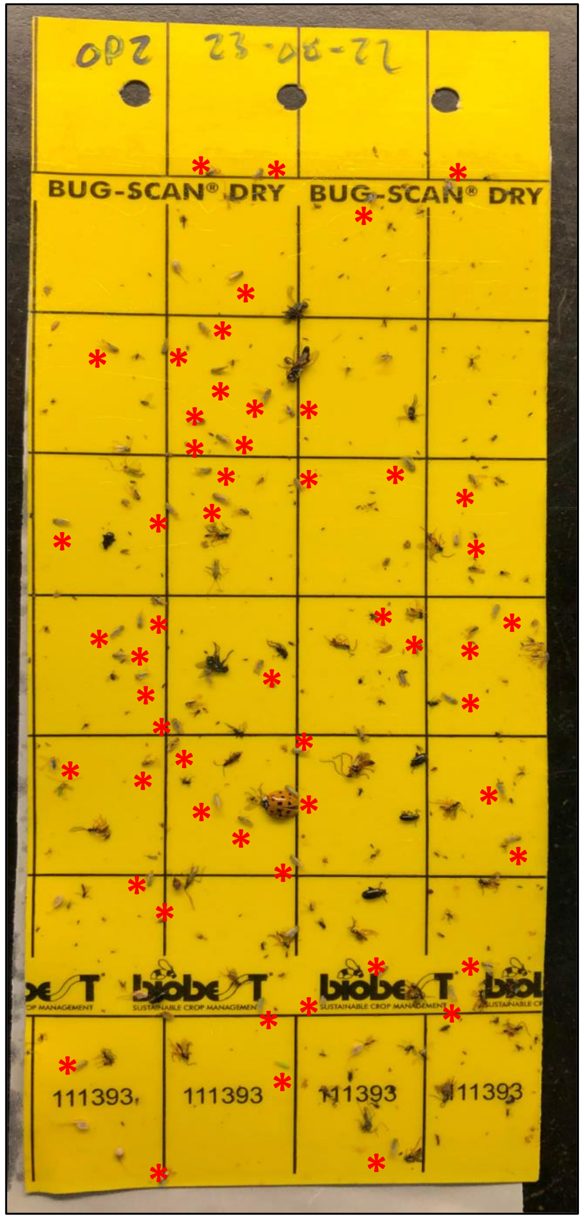
INNOV' ACTION
AGROALIMENTAIRE



- 7 fermes
- Pièges jeunes
- Hebdomadaire



2021+2022: + 33 000

118 Espèces

62 Généra

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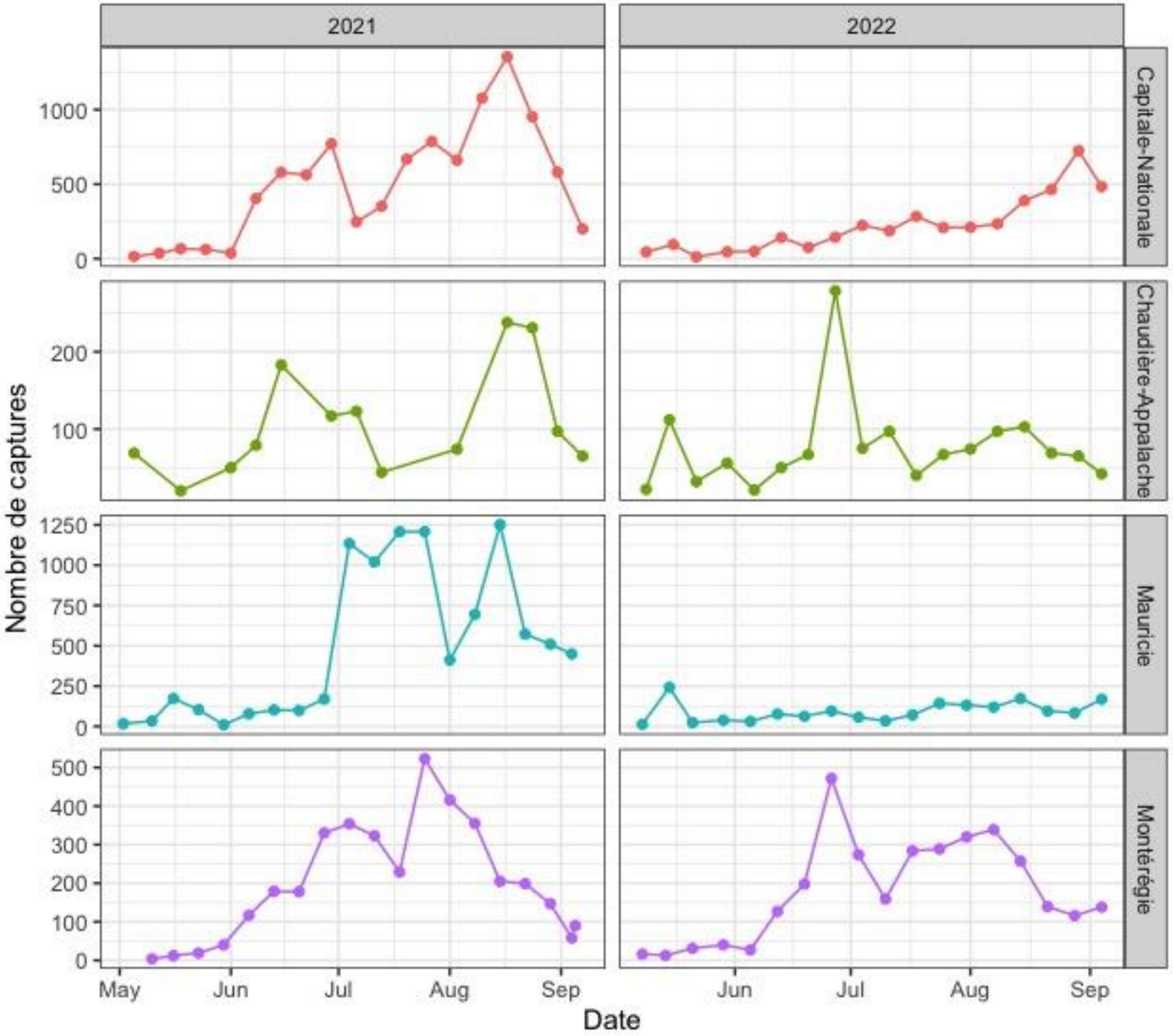

E. fabae

M. quadrilineatus

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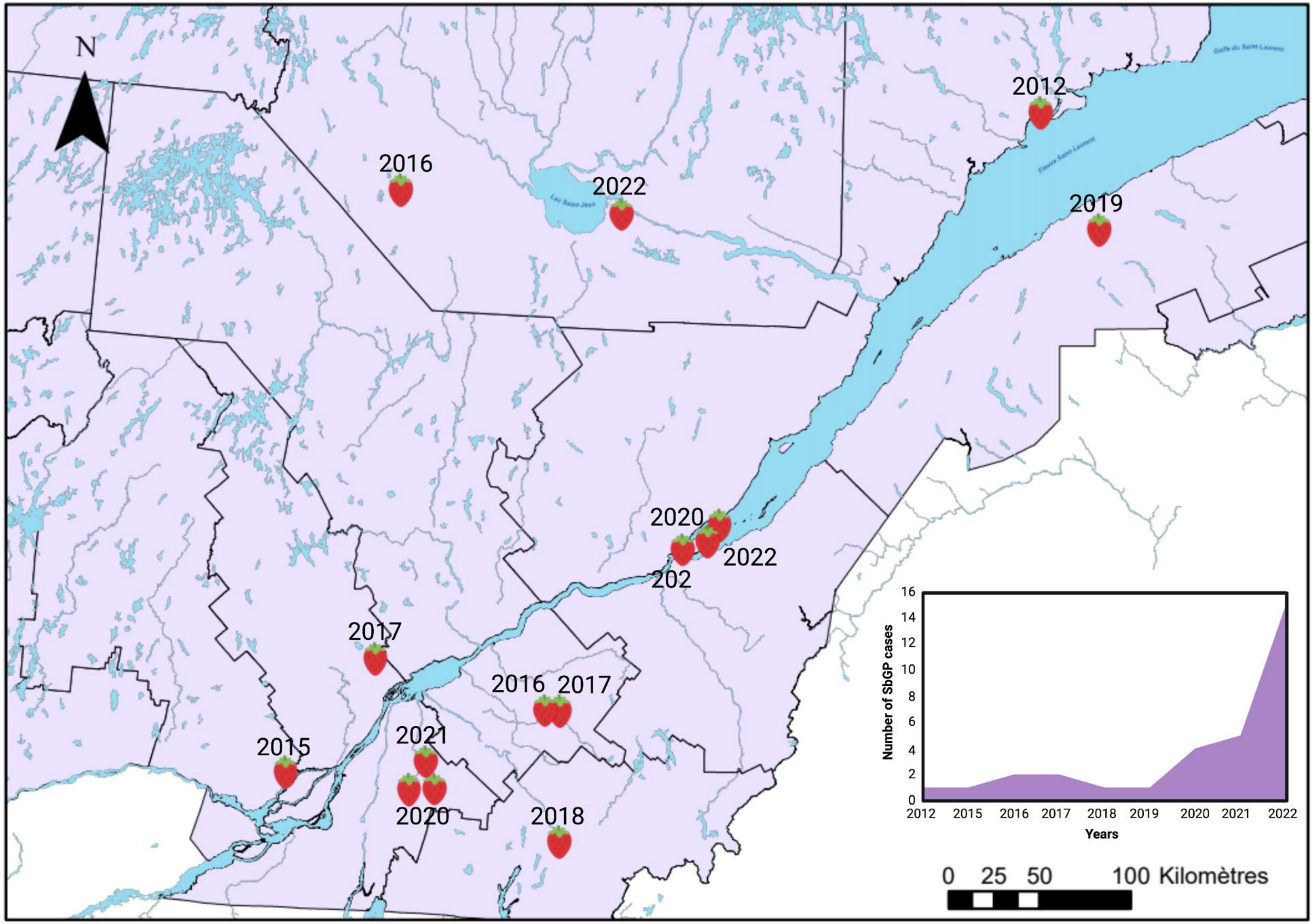
N
2016
2022
2012
2019
2020
2022
202
2017
2016
2017
2021
2015
2020
2018
Number of SbGP cases
0
2
4
6
8
10
12
14
16
2012
2015
2016
2017
2018
2019
2020
2021
2022
Years
0 25 50 100 Kilomètres

Qui est le vecteur de SbGP ?

1. PCR 10% de cicadelles captures en 2021

- 3000 cicadelles
- 500 échantillons

Négative

278 cicadelles dans 7 Généra

Négative

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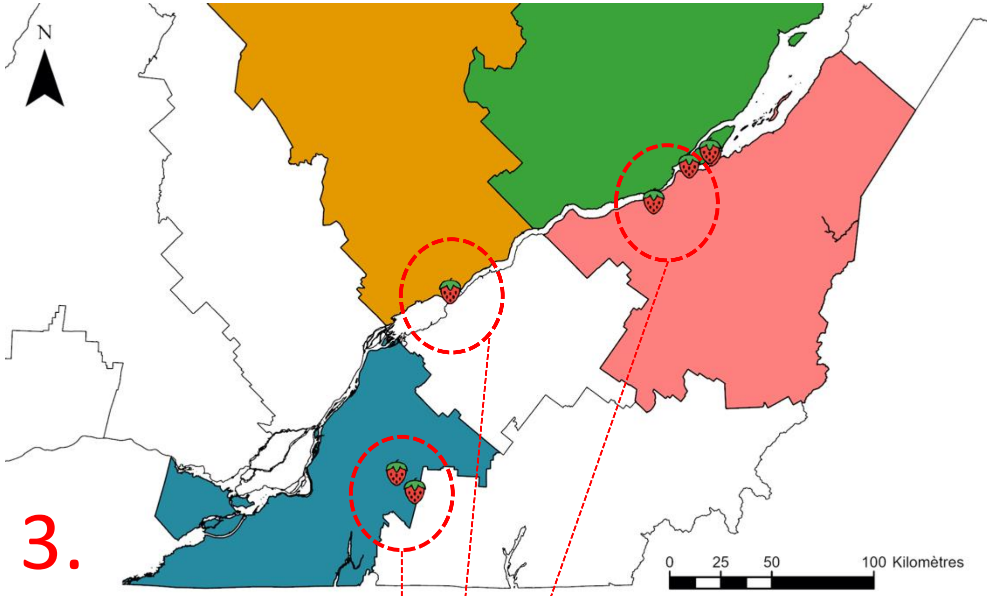
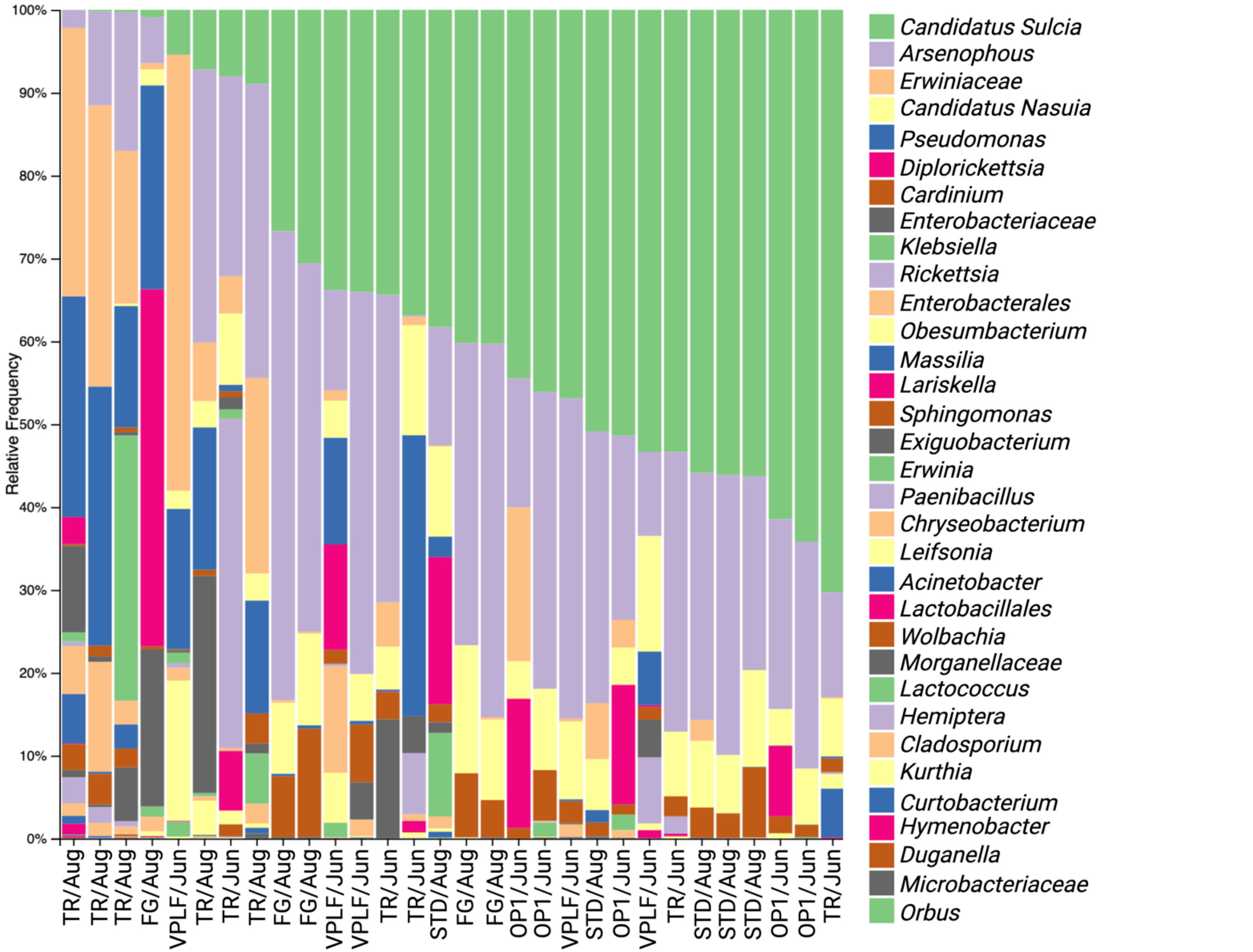
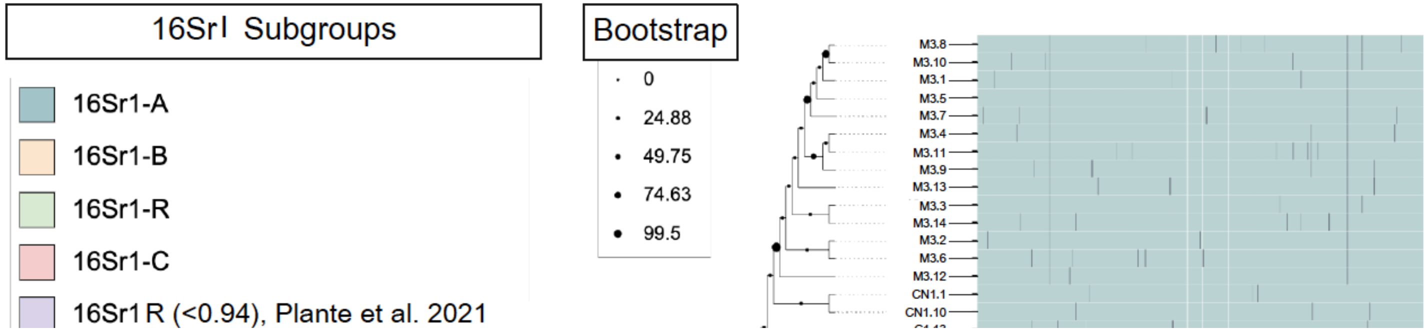


3.



300 from June & August

Erwinia sp., *Pseudomonas* sp., *Rickettsia* sp., *Arsenophous*: agents pathogènes de la fraise

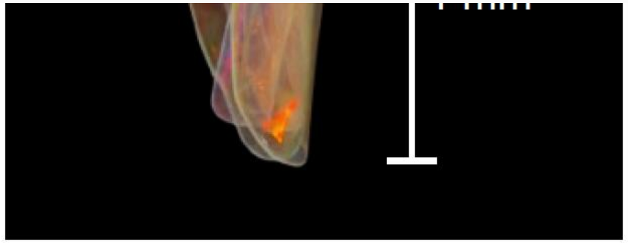


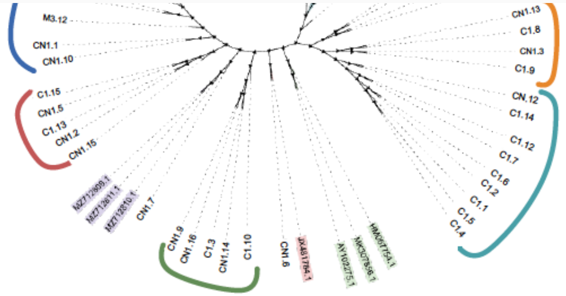
2 days

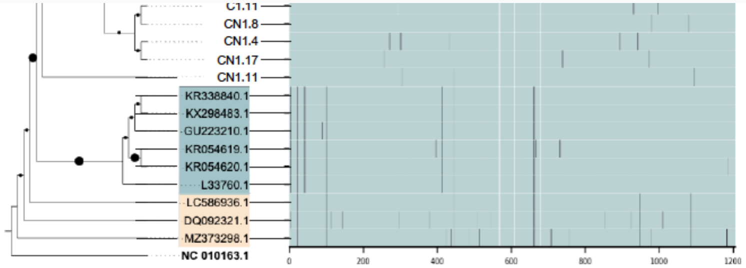
10 days

16 days

Négative

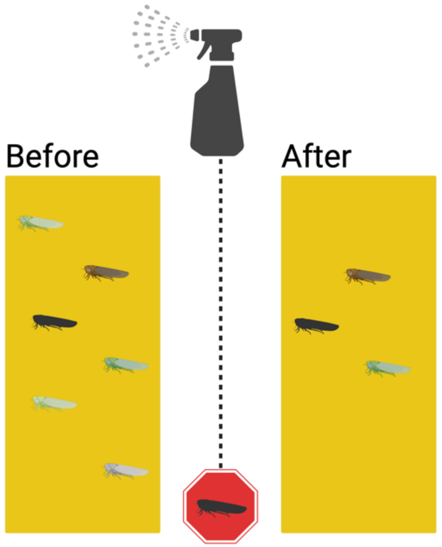


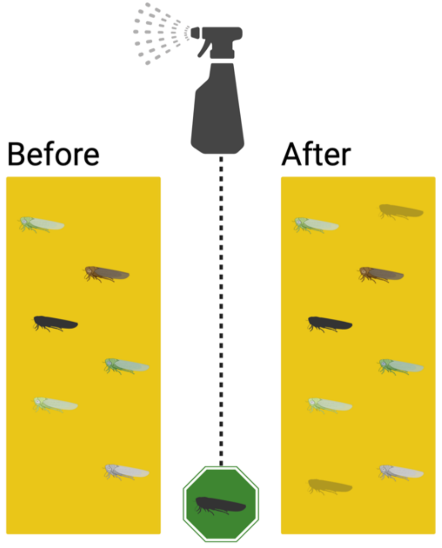


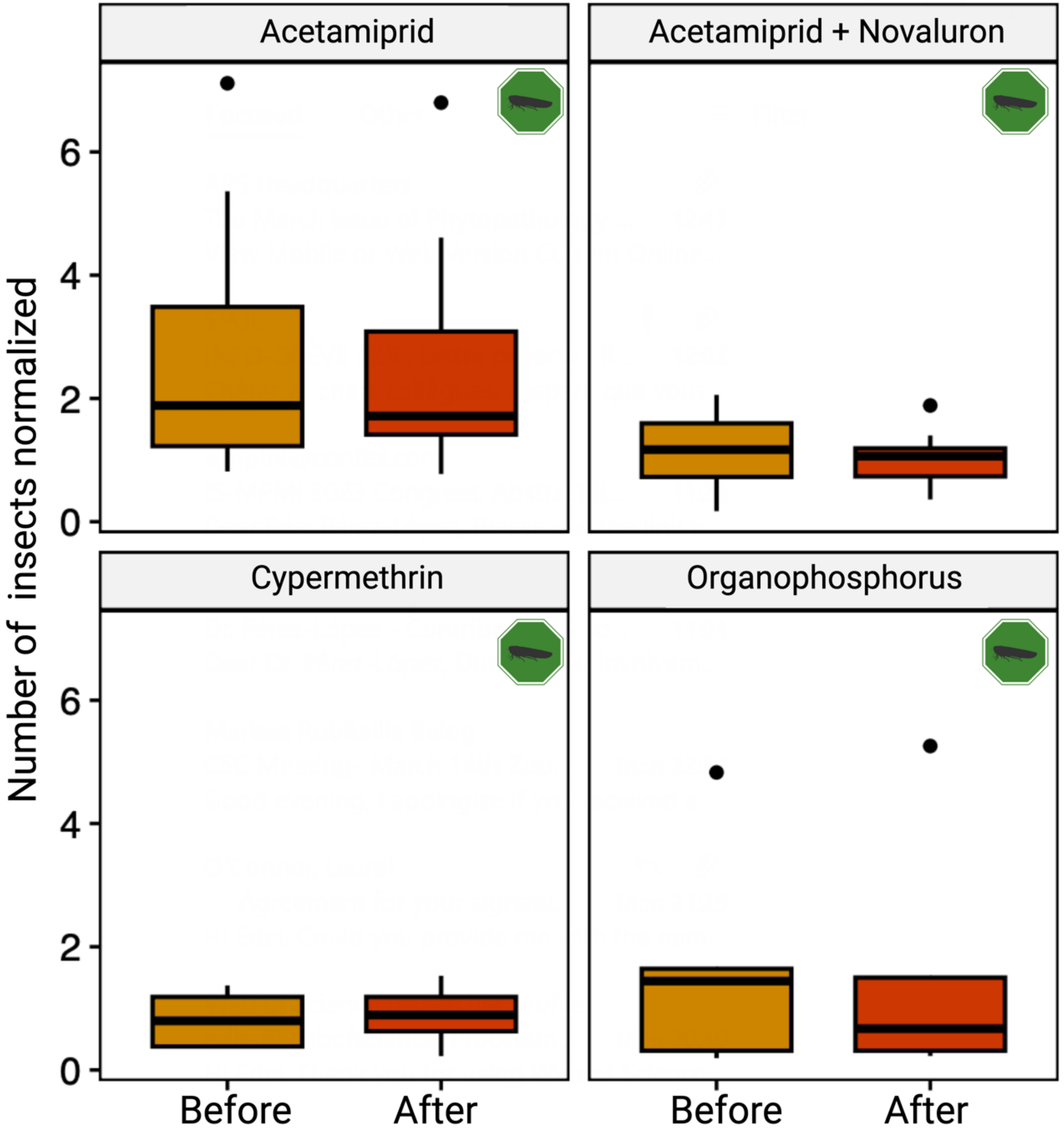


B.

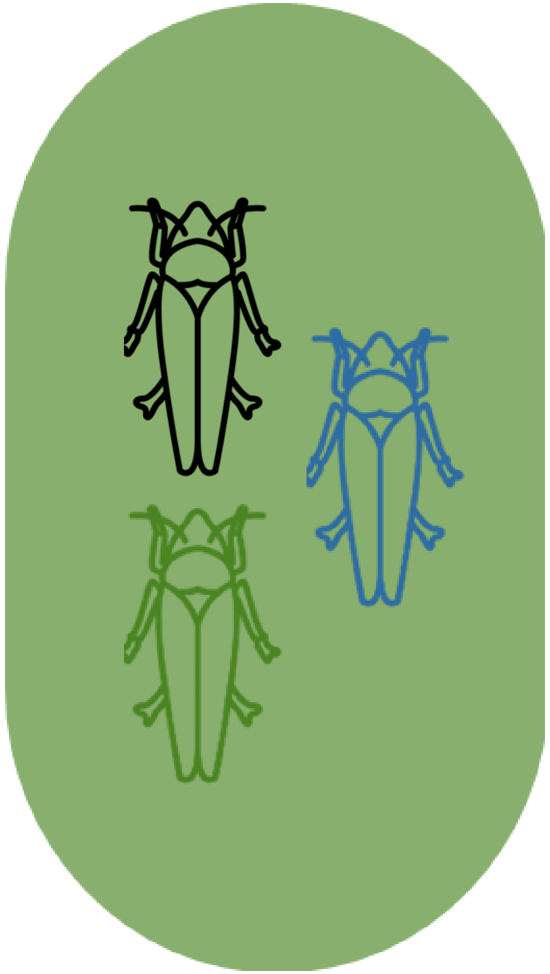

IMIDACROP
350 SC
Novaluron 5.25% +
Emamectin Benzoate 0.9% SC
NOVATIN
INSECTICIDE
CyperMic 25
Contenido Neto: 1 L.
VENENO
NOCIVO

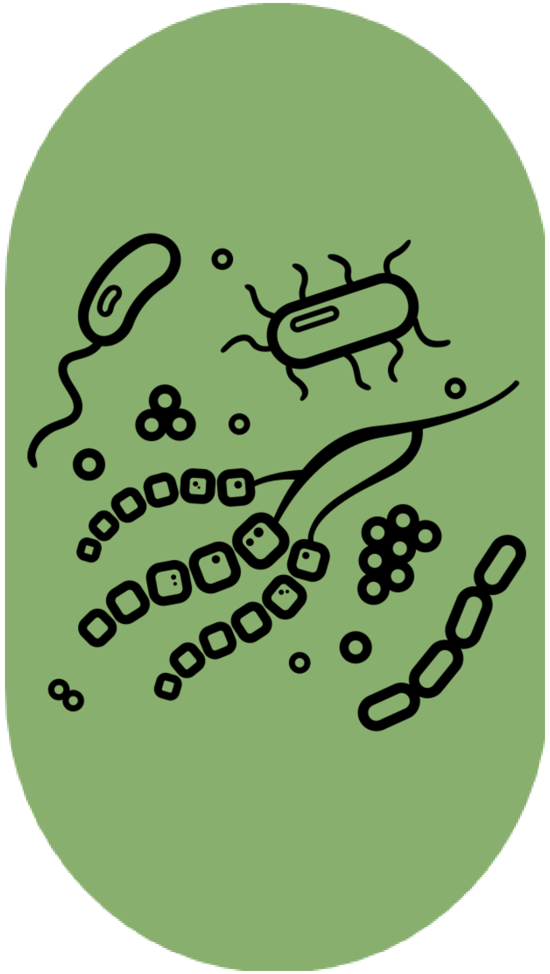

Before
After

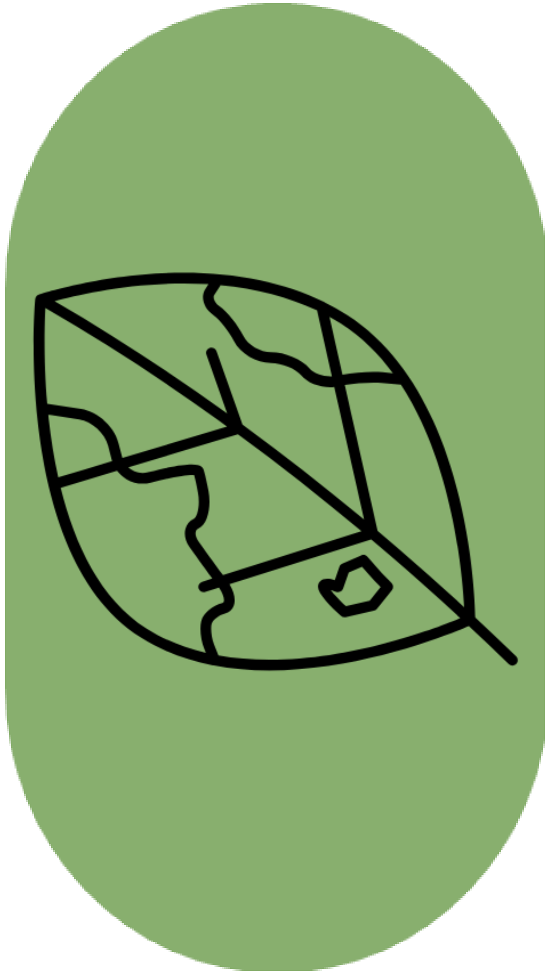

Before
After

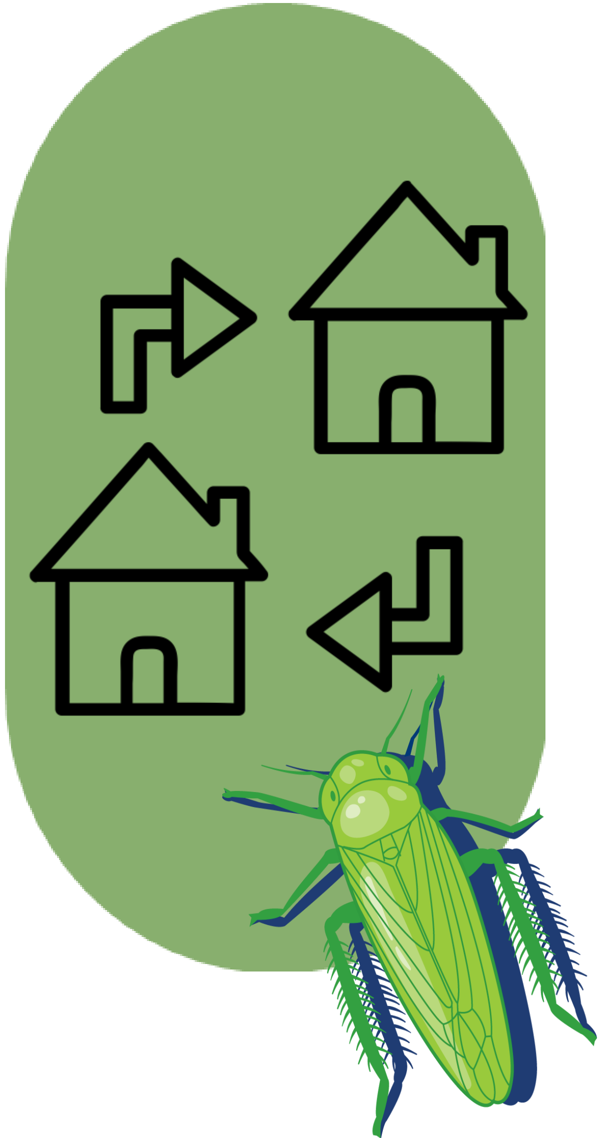

Acetamiprid
Acetamiprid + Novaluron
Cypermethrin
Organophosphorus
Number of insects normalized
0
2
4
6
Before
After

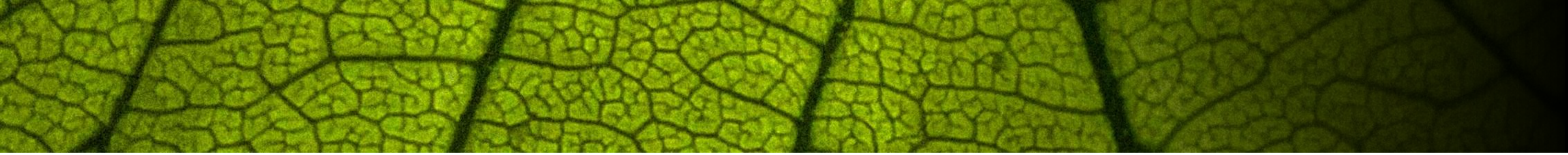
En conclusion











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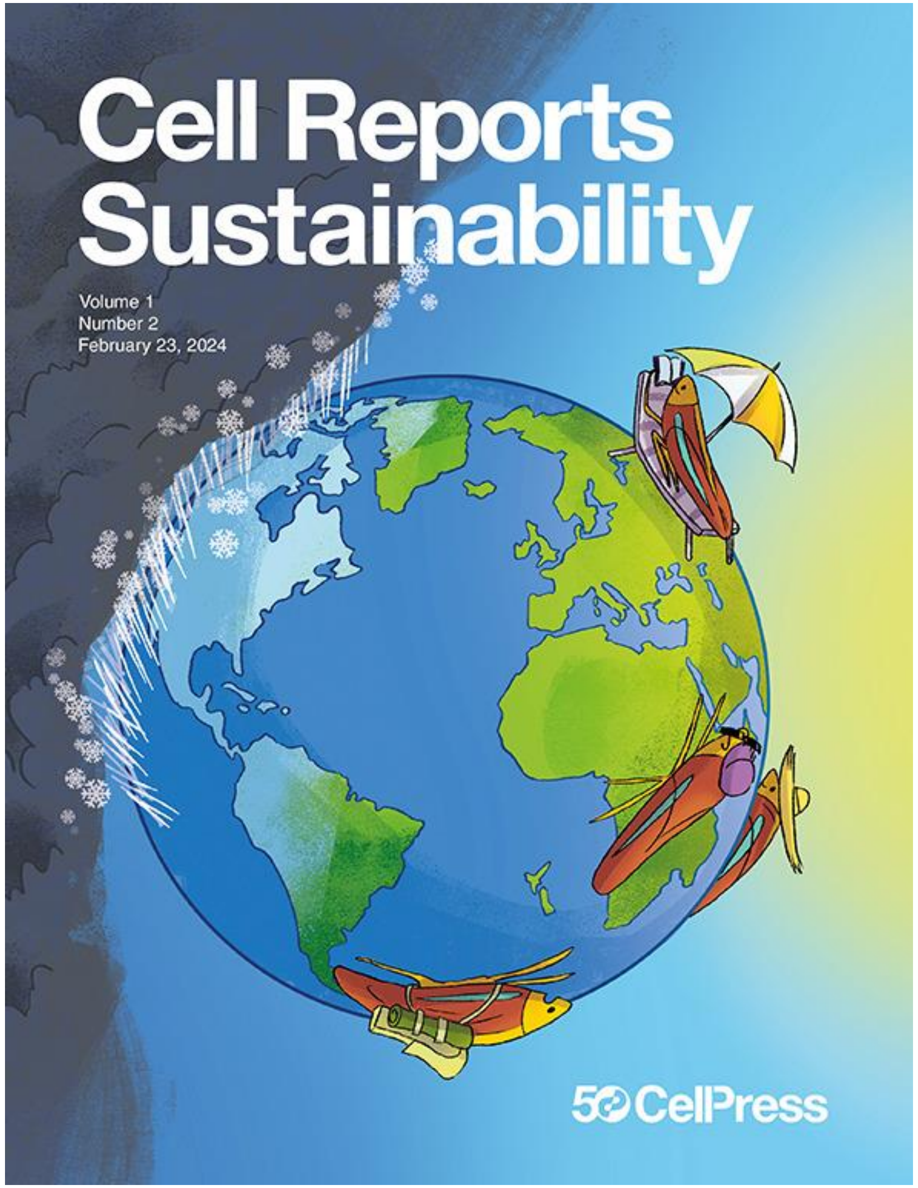

Cell Reports Sustainability

Article

Leafhoppers as markers of the impact of climate change on agriculture

Nicolas Plante,[1,2,3,12] Jeanne Durivage,[1,2,12] Anne-Sophie Brochu,[1,2,3] Tim Dumonceaux,[4,5] Abraão Almeida
Dagoberto Torres,[6] Brian Bahder,[7] Joel Kits,[8] Antoine Dionne,[9] Jean-Philippe Légaré,[9] Stéphanie Tellier,[10]
Frédéric McCune,[1,2] Charles Goulet,[1,2] Valérie Fournier,[1,2] and Edel Pérez-López[1,2,3,11,13,*]

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https://doi.org/10.1016/j.crsus.2024.100029

SCIENCE FOR SOCIETY We have reached a critical tipping point in the climate crisis, requiring us use our resources to stop the progression of global warming and its devastating effects. Agricul top contributor to greenhouse gas emissions, accounts for 8%–10% of total emissions in Canad the United States. The escalation of pest invasions, a consequence of global warming, threatens fo curity in the typically cold northern hemisphere and exacerbates agriculture's impact on climate cha increasing pesticide usage. This study examines the effects of climate change on agriculture using le pers—an insect pest group and disease vectors. We found that leafhopper abundance, migration, a crobiome are sensitive to the effects of climate change and that their control will be increasingl lenging. Our findings indicate that leafhoppers can serve as sentinels of climate change, present opportunity to reduce insecticide usage and promote sustainable agriculture practices.

SUMMARY

Climate change is reshaping agriculture and insect biodiversity worldwide. With rising temperatu insect species are expected to be pushed beyond their current thermal limits, and losses related t and diseases transmitted by them will be experienced in new regions. Here, we propose th change's impact on agriculture can be forecast by studying migratory leafhoppers. From 2021 t measured leafhopper numbers in eastern Canada's strawberry fields to test our hypothesis, that leafhopper species and phytoplasma disease-affected strawberry plants both doubled, tr enced by temperature changes. A further post-insecticide application study reveals that insectic by strawberry growers could be ineffective in controlling leafhopper populations, possibly due t observed in their microbiome. Our research provides evidence that leafhoppers are sensitive to of climate change, making them ideal markers to research the effect of climate change on agricu

INTRODUCTION

Climate change is a significant threat to agriculture.[1] In the coming years, the expected warmer climate will have a serious impact on insect pest distribution and disease incid a risk to food security.[2,3] The impact of climate char biodiversity is complex and variable depending nomic group.[2–5] Increases in temperatures mi

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Cap sur la gestion financière agr
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ONNEZ-VOUS À NOTRE INFOLETTRE

DERNIÈRE INFOLETTRE

temps commence à
resser pour les semis

De nouvelles espèces de cicadelles répertoriées au Québec

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In Quebec's strawberry fields, a tiny insect may forecast big climate impacts: study

LA PRESSE

La Presse, vendredi 23 mai 2025

Montréal 9°C

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ENVIRONNEMENT

Étude de l'Université Laval

La cicadelle aiderait à prévoir l'impact du climat sur l'agriculture

ULaval nouvelles

Recherche

23 février 2024

Les cicadelles gagneraient du terrain au Québec

L'abondance et la diversité de ces petits insectes phytophages augmenteraient à la faveur des changements climatiques

Par : Jean Hamann   Partager :

- Est-il possible de prédire l’abondance des cicadelles et d’identifier le meilleur moment de l’année pour l'intervention phytosanitaire ?

- Peut-on également développer de nouvelles alternatives de biocontrôle ?

Réseau québécois de recherche en agriculture durable

Predictive Tools for Informed Decisions

Since 1996, the Oregon IPM Center has been developing and maintaining a weather and climate driven decision support website to aid pest management and related agricultural needs. Using weather data from over 29,000 weather stations from 100s of weather networks, we now host nearly 150 predictive pest and disease models to help growers know when and where to act.

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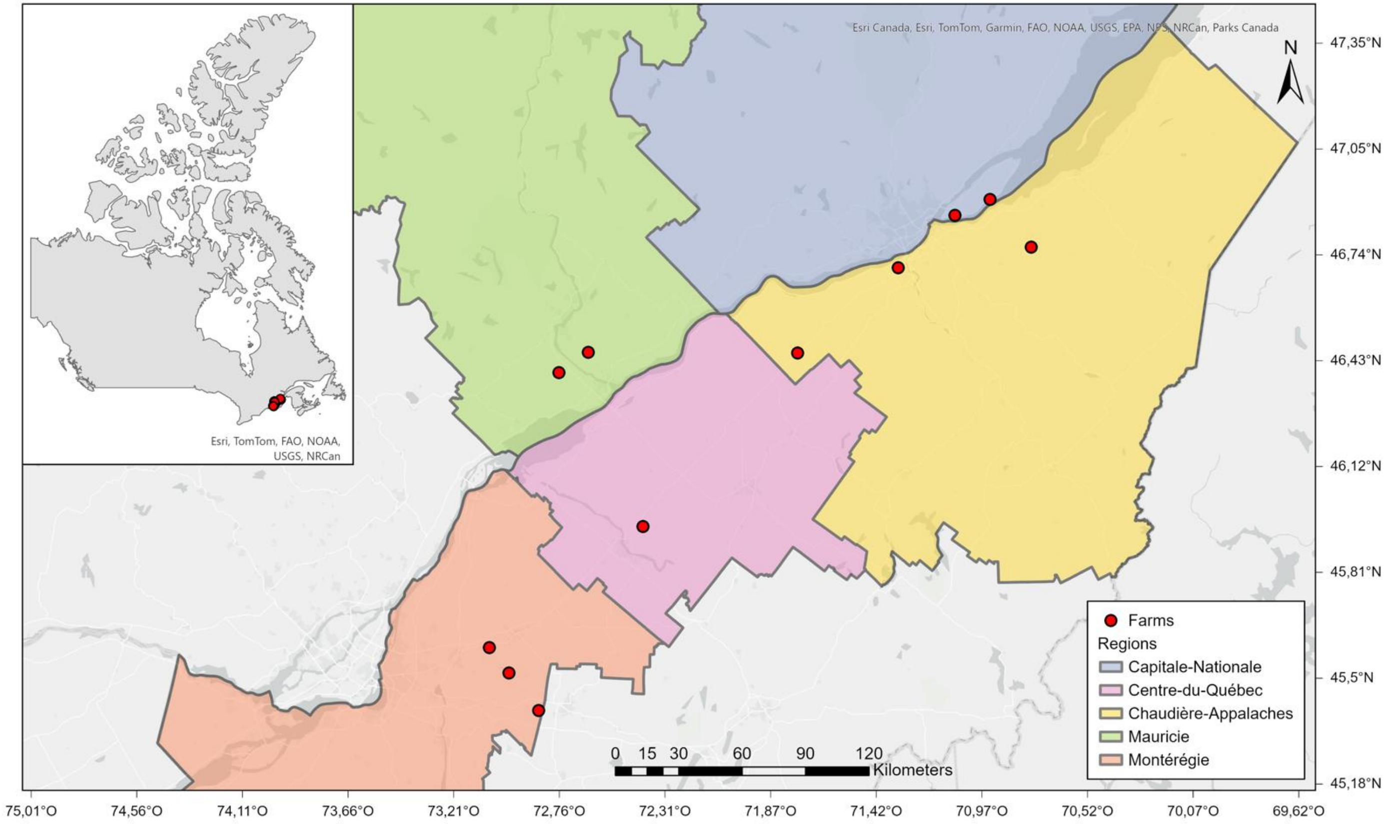
RQRAD
Réseau québécois de recherche en agriculture durable

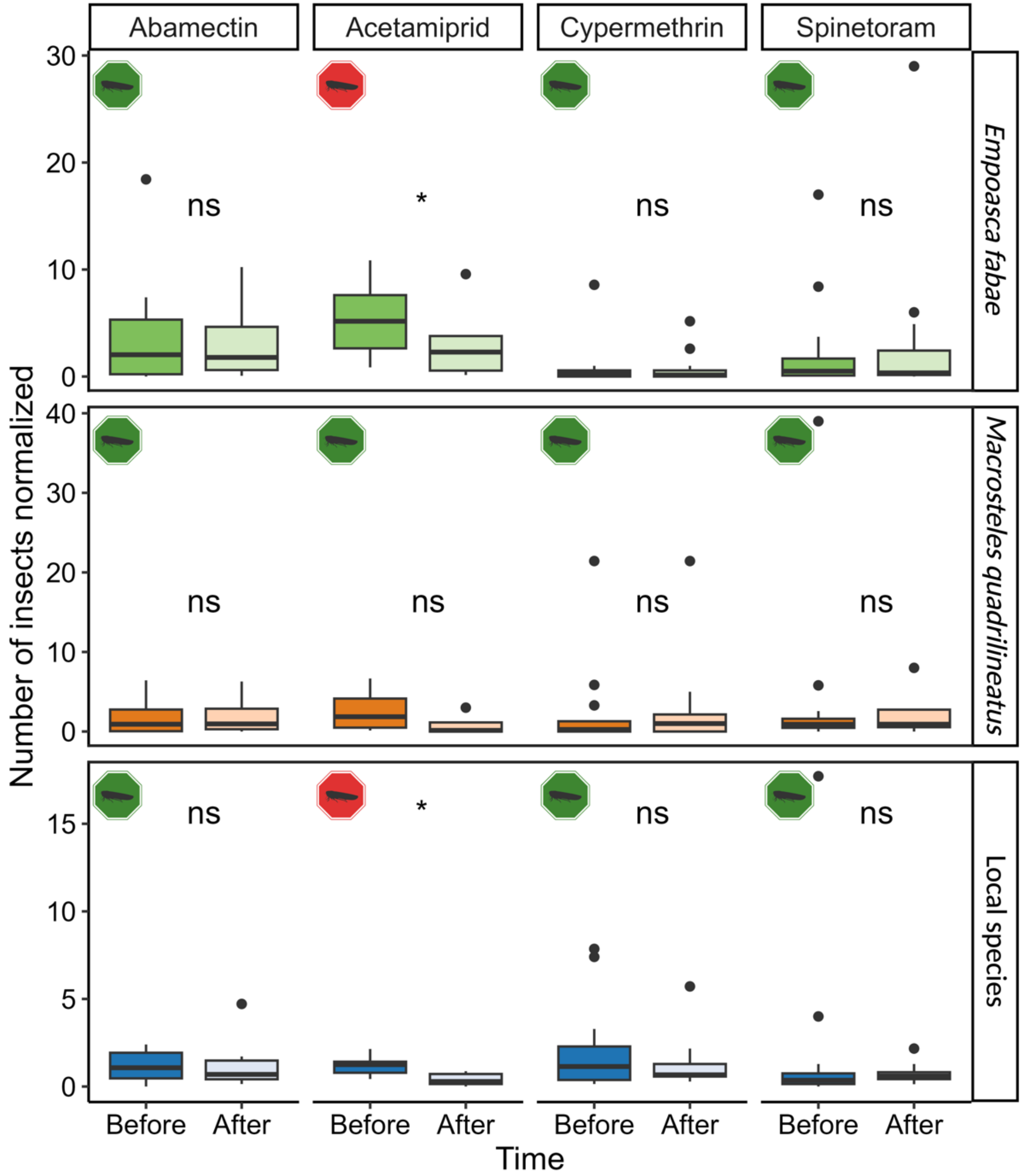
2021-2024:
+ 120 000
120 Species



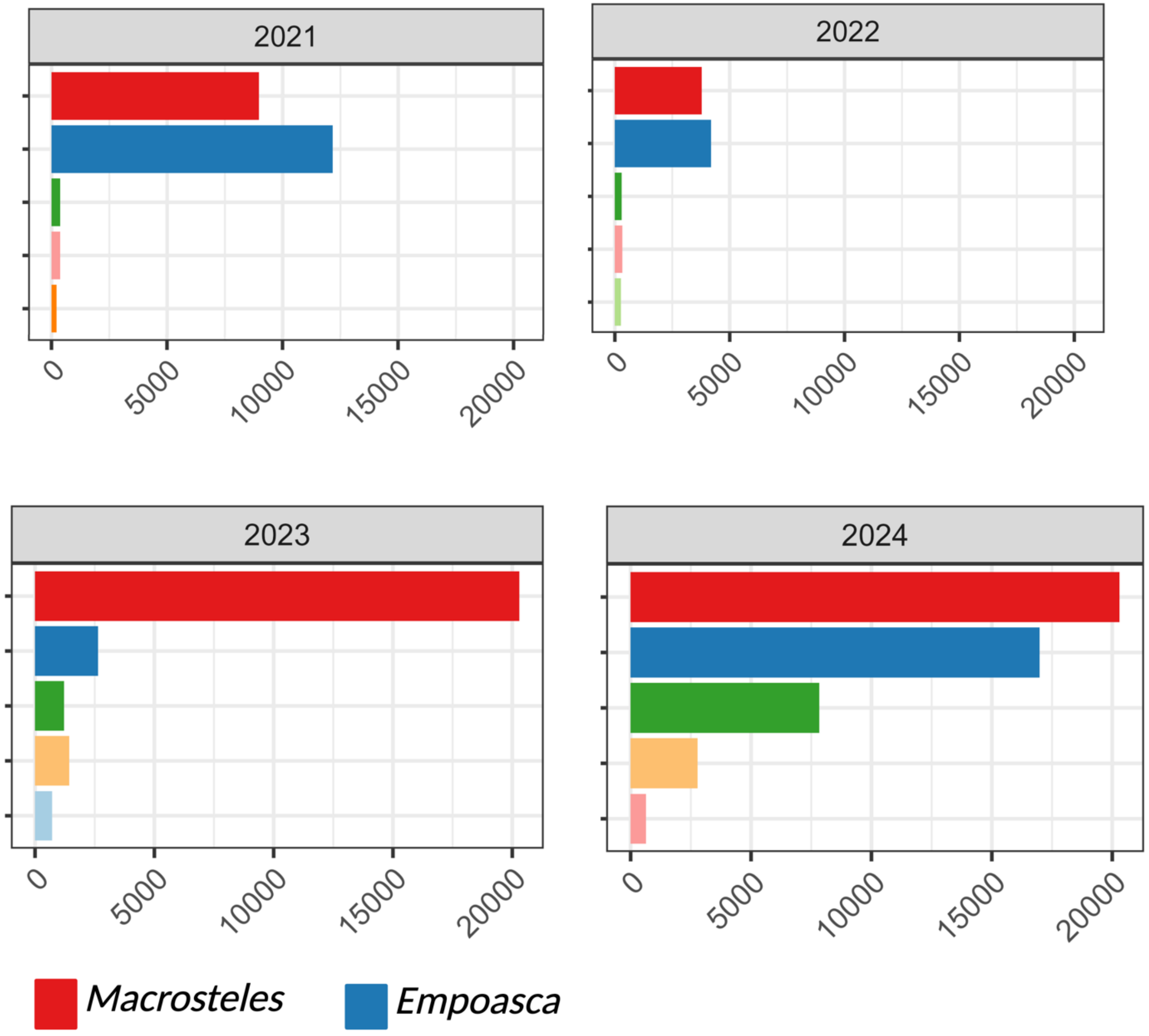
E. fabae

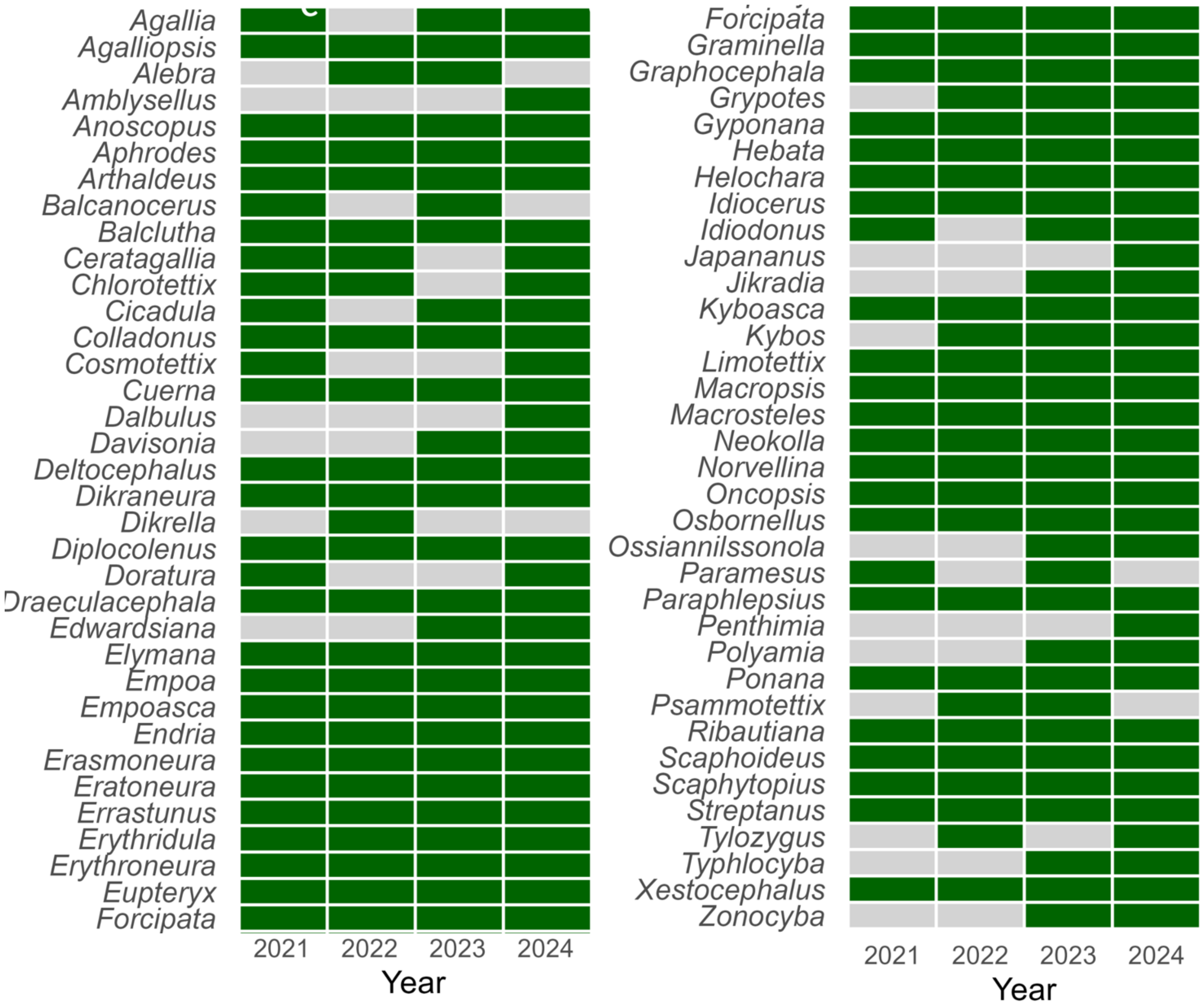
M. quadrilineatus

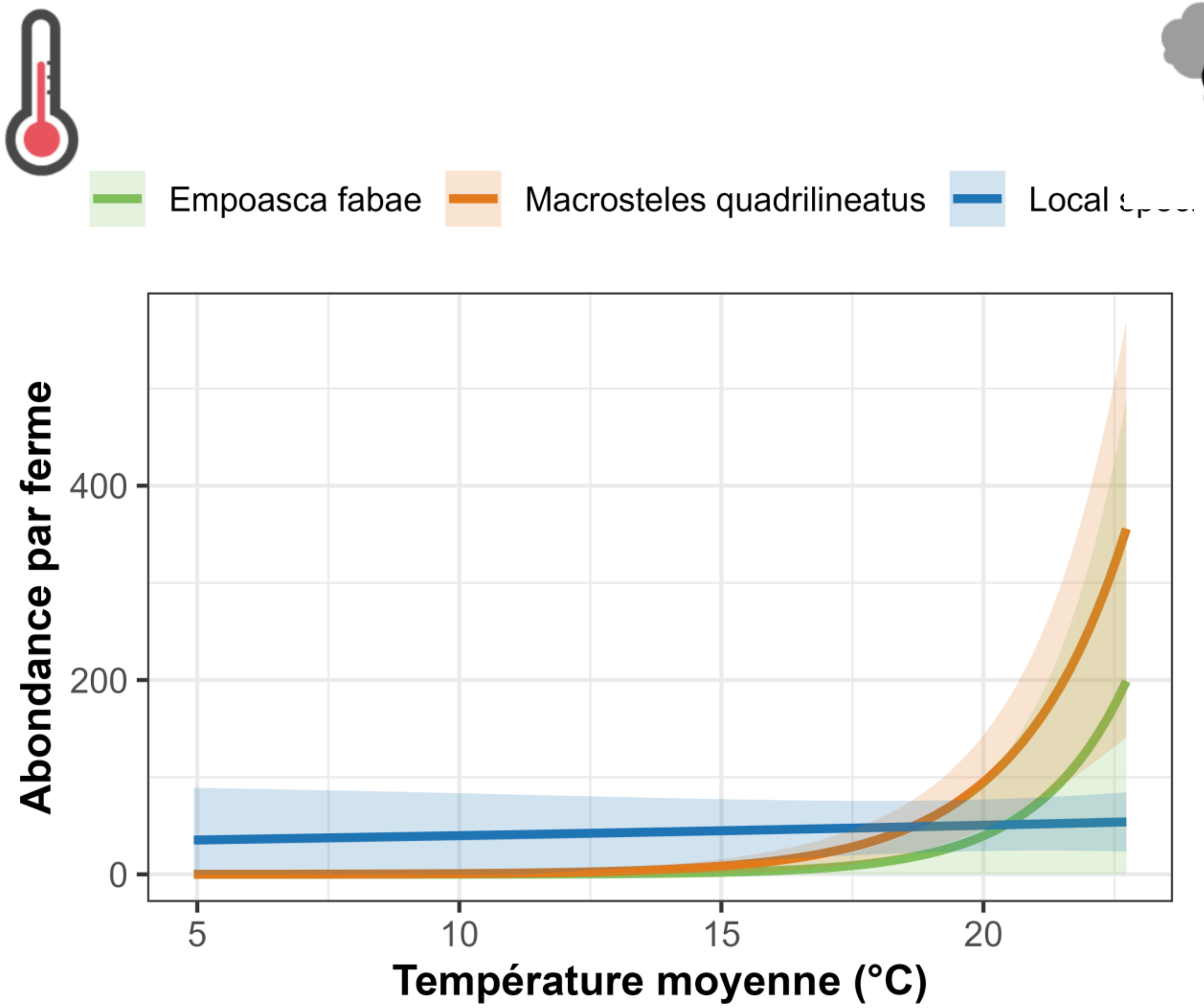
2023
2024
Empoasca fabae
Macrosteles quadrilineatus
Local species
Average number of leafhoppers per site
May
Jun
Jul
Aug
Sept
Oct
Nov
Month

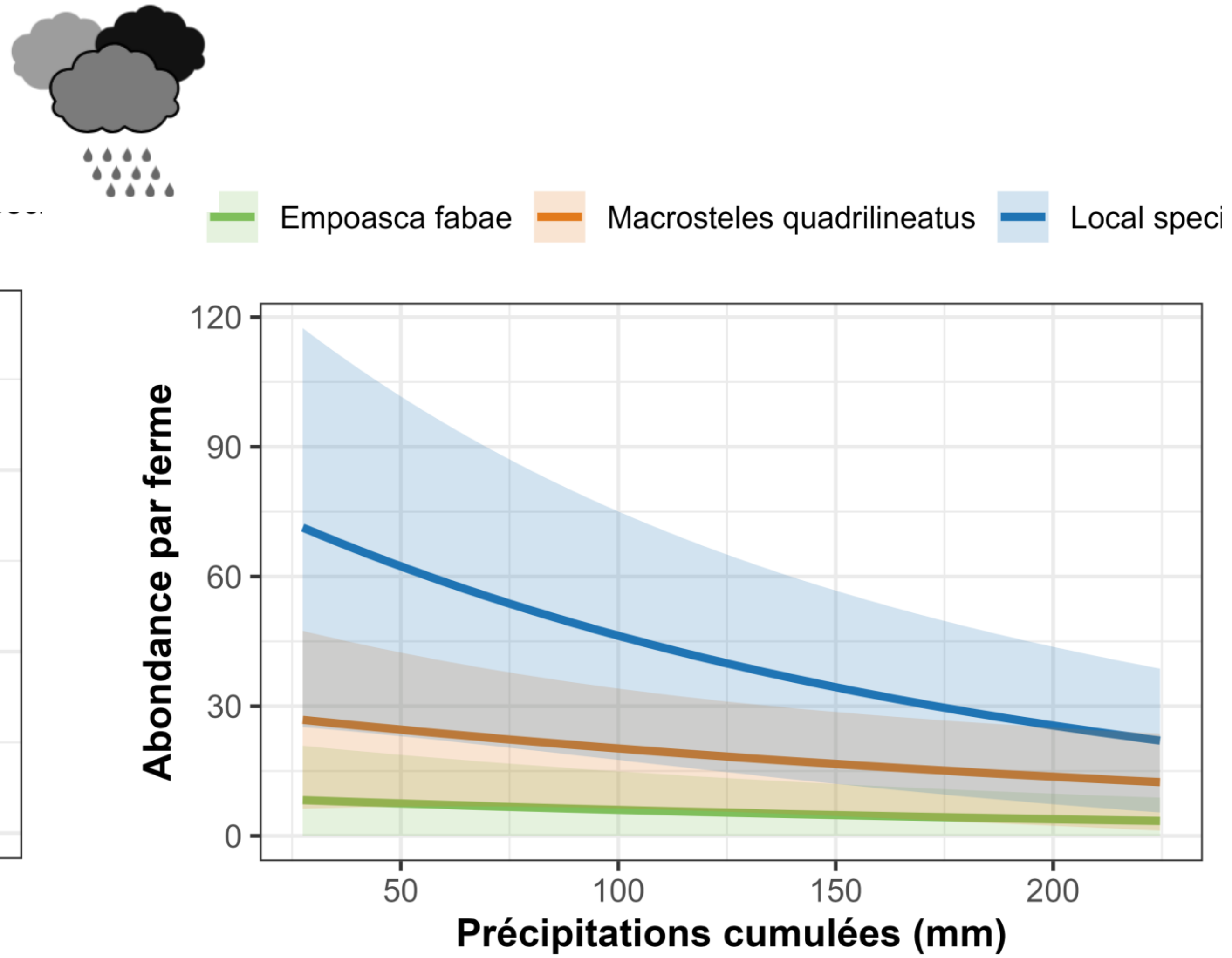


Abamectin
Acetamiprid
Cypermethrin
Spinetoram
ns
*
Empoasca fabae
Macrosteles quadrilineatus
Local species
Number of insects normalized
Before
After
Time


2021
2022
2023
2024
0
5000
10000
15000
20000
Macrosteles
Empoasca


Agallia
Agalliopsis
Alebra
Amblysellus
Anoscopus
Aphrodes
Arthaldeus
Balcanocerus
Balclutha
Ceratagallia
Chlorotettix
Cicadula
Colladonus
Cosmotettix
Cuerna
Dalbulus
Davisonia
Deltocephalus
Dikraneura
Dikrella
Diplocolenus
Doratura
Draeculacephala
Edwardsiana
Elymana
Empoa
Empoasca
Endria
Erasmoneura
Eratoneura
Errastunus
Erythridula
Erythroneura
Eupteryx
Forcipata
Forcipata
Graminella
Graphocephala
Grypotes
Gyponana
Hebata
Helochara
Idiocerus
Idiodonus
Japananus
Jikradia
Kyboasca
Kybos
Limotettix
Macropsis
Macrosteles
Neokolla
Norvellina
Oncopsis
Osbornellus
Ossiannilssonola
Paramesus
Paraphlepsius
Penthimia
Polyamia
Ponana
Psammotettix
Ribautiana
Scaphoideus
Scaphytopius
Streptanus
Tylozygus
Typhlocyba
Xestocephalus
Zonocyba
2021
2022
2023
2024
Year


Empoasca fabae
Macrosteles quadrilineatus
Local
Abondance par ferme
400
200
0
5
10
15
20
Température moyenne (°C)


Empoasca fabae
Macrosteles quadrilineatus
Local speci
Abondance par ferme
120
90
60
30
0
50
100
150
200
Précipitations cumulées (mm)

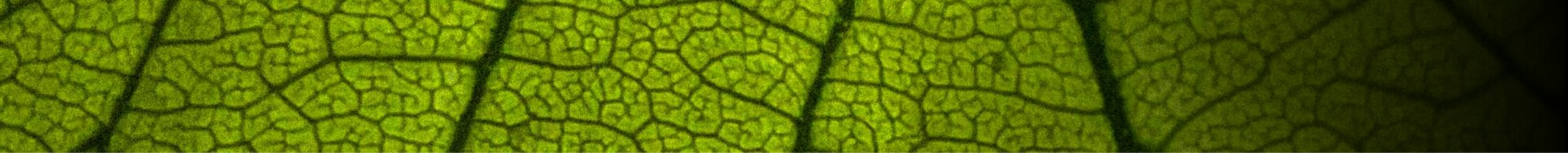
Japananus hyalinus **(cicadelle de l'érable)**

- Très peu d'observations jusqu'à maintenant au Québec
- Se nourrit principalement des érables
- Espèce asiatique introduite au Canada
- Quelques observations rapportées en Ontario

Est-ce que ce type d'introductions peut causer de grands dommages et des pertes économiques ?

Alabama, aout 2025

Minessota 2024



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npj | sustainable agriculture

Article

https://doi.org/10.1038/s44264-024-00020-6

Potential impact of climate change on Nearctic leafhopper distribution and richness in North America

Check for updates

Abraão Almeida Santos[1,2,3,4], Jordanne Jacques[1,2,3,4] & Edel Pérez-López[1,2,3,4]

Climate change significantly contributes to shifts in the geographical range of pests and diseases. Leafhoppers (Hemiptera: Cicadellidae), known vectors of phytoplasmas pathogens, are linked to the transmission of more than 600 diseases affecting a thousand plant species worldwide. Despite this, the potential effects of climate change on leafhopper vectors of phytoplasmas remain a critical knowledge gap. To address this gap, our study investigated the potential impact of climate change on 14 species of Nearctic leafhoppers previously associated with phytoplasma-related diseases. Using the MaxEnt species distribution algorithm and other ecological niche modeling techniques, we assessed (i) the expected species richness under current climate conditions and four future scenarios and (ii) the environmental niche similarity among these species across these scenarios. Our projections suggest that the eastern region of North America holds the potential for the highest species richness, a trend expected to persist across all future scenarios, gradually expanding eastward. Notably, our findings indicate the increasing suitability of northern Canada for more species. Network analysis further revealed a remarkable similarity in environmental niches among most leafhopper species. Moreover, across the four future scenarios, there is a tendency for an increase in this similarity. Altogether, our study underscores the potential persistent presence of Nearctic leafhoppers in their current habitats while pointing to a shift toward northern North America in future scenarios. These findings have significant implications for sustainable pest management practices, prompting a necessary discussion on strategies to mitigate climate change and pest migration's impact on agricultural systems.

Climate change significantly contributes to alterations in species distributions, prompting shifts in their geographic ranges[1,2]. Over the past six decades, crop pests and diseases have notably moved toward northern latitudes globally, progressing at ~2.7 km annually since 1960[3]. This phenomenon is primarily attributed to global warming and trade dynamics[4,5]. However, the response of these organisms to the ongoing environmental changes is intricate and conditional upon various determinants, notably their geographic origins[6–8]. Tropical pest species, for instance, typically exhibit a restricted tolerance to temperature variation and tend to live close to their maximum thermal limits[6,8]. In contrast, temperate species contend with a broader spectrum of climate extremities, including temperature fluctuations[6]. As a result, projections suggest a potential reduction in the suitable habitats for tropical pest species with the anticipated progression of climate warming[6,9]. Conversely, a favorable trend is expected for temperate species, given their ability to adjust to more diverse climatic events[4,6].

Recently, the efforts to assess the impacts of climate change on biological systems have intensified[10]. Species distribution modeling (SDM), also known as ecological niche modeling (ENM), has risen as a crucial tool to explore the potential effects of climate change on the geographic distribution of organisms[11]. However, within entomology, research efforts have predominantly centered around specific orders, such as Lepidoptera and Diptera, while comparatively less attention has been dedicated to others like Hemiptera[10]. This bias may stem from the notorious role Lepidoptera plays in global research and the importance of Diptera as disease vectors for vertebrates[10]. However, Hemiptera also includes significant plant disease vectors, causing substantial damage worldwide[12]. Increased research

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Environmental Entomology, 54(5), 2025, 1124–1135
https://doi.org/10.1093/ee/nvaf070
Advance Access Publication Date: 11 July 2025
Research

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OXFORD

Population Ecology

Seasonal phenology of *Empoasca fabae* (Hemiptera: Cicadellidae) in Québec, Canada

Abraão Almeida Santos[1,2,3,4,*], Fausto Henrique Vieira Araújo[5], Nicolas Plante[1,2,3,4], Ricardo Siqueira da Silva[5,6], and Edel Pérez-Lopéz[1,2,3,4,7,8,*]

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[2]Centre de recherche et d'innovation sur les végétaux (CRIV), Université Laval, Québec City, Québec, Canada
[3]Institute de Biologie Intégrative et des Systèmes (IBIS), Université Laval, Québec City, Québec, Canada
[4]L'Institute EDS, Université Laval, Québec City, Québec, G1V 0A6, Canada
[5]Department of Agronomy, Federal University of the Jequitinhonha and Mucuri Valleys, Diamantina, Minas Gerais, Brazil
[6]Department of Ecological Modelling, Helmholtz Centre for Environmental Research—UFZ Leipzig, Leipzig, Germany
[7]Centro Interdisciplinario de Investigación para el Desarrollo Regional, Unidad Sinaloa, Guasave, Sinaloa, México
[8]Department of Plant, Food, and Environmental Sciences, Faculty of Agriculture, Dalhousie University, Nova Scotia, Canada

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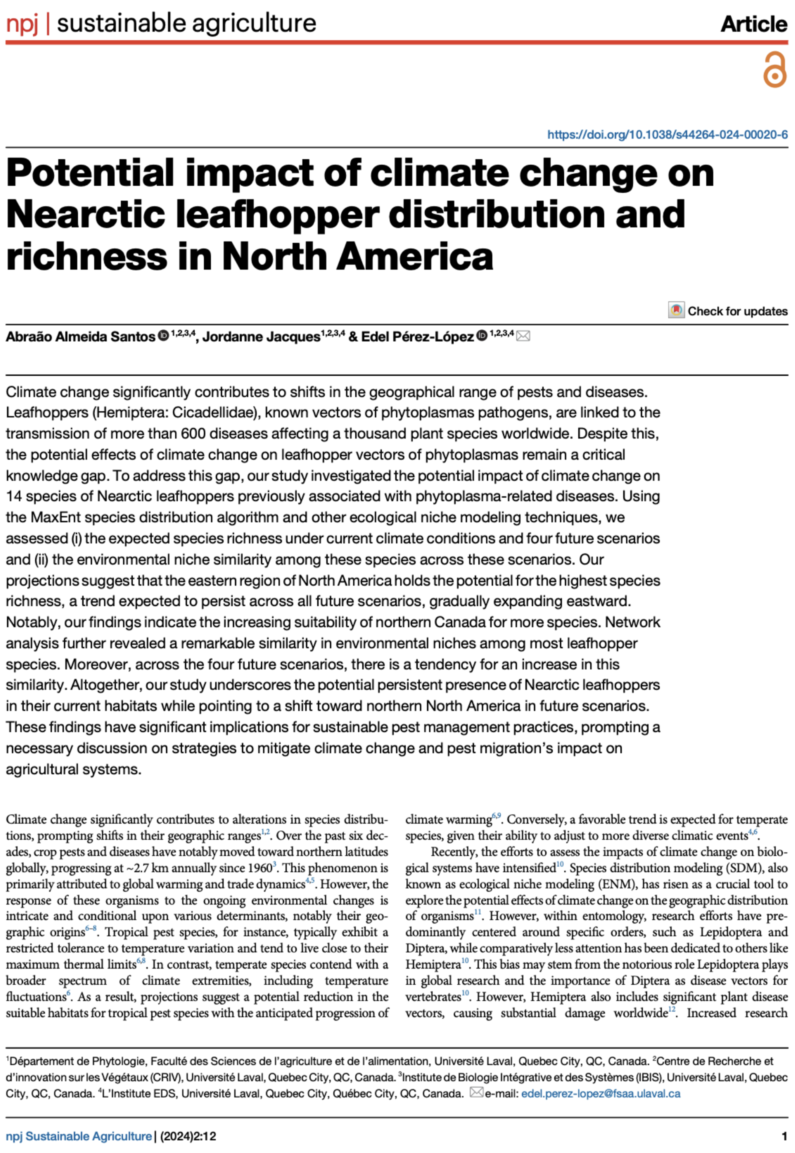
Keywords: leafhoppers, degree-days, species distribution model, migration

Introduction

Ongoing climate change is reshaping insect population dynamics in North America, particularly through shifts in overwintering ranges and seasonal phenology, with diverse consequences depending on species and life history (Maredia et al. 1998, Baker et al. 2015, Walter et al. 2018, Lawton et al. 2022). *Empoasca fabae* (Harris) (Hemiptera: Cicadellidae), the potato leafhopper, is a migratory insect pest species native to North America (DeLong, 1938, Ross et al. 1964) whose phenology is likely influenced by these changes. For instance, increased temperatures have led to the earlier arrival of *E. fabae* in northern areas of the United States (USA) and increased crop damage (Maredia et al. 1998, Baker et al. 2015). Although evidence of effects on overwintering populations is growing, it remains unclear



npj | sustainable agriculture
Article

https://doi.org/10.1038/s44264-024-00020-6

Potential impact of climate change on Nearctic leafhopper distribution and richness in North America

Abraão Almeida Santos [1,2,3,4], Jordanne Jacques [1,2,3,4] & Edel Pérez-López [1,2,3,4]

Climate change significantly contributes to shifts in the geographical range of pests and diseases. Leafhoppers (Hemiptera: Cicadellidae), known vectors of phytoplasmas pathogens, are linked to the transmission of more than 600 diseases affecting a thousand plant species worldwide. Despite this, the potential effects of climate change on leafhopper vectors of phytoplasmas remain a critical knowledge gap. To address this gap, our study investigated the potential impact of climate change on 14 species of Nearctic leafhoppers previously associated with phytoplasma-related diseases. Using the MaxEnt species distribution algorithm and other ecological niche modeling techniques, we assessed (i) the expected species richness under current climate conditions and four future scenarios and (ii) the environmental niche similarity among these species across these scenarios. Our projections suggest that the eastern region of North America holds the potential for the highest species richness, a trend expected to persist across all future scenarios, gradually expanding eastward. Notably, our findings indicate the increasing suitability of northern Canada for more species. Network analysis further revealed a remarkable similarity in environmental niches among most leafhopper species. Moreover, across the four future scenarios, there is a tendency for an increase in this similarity. Altogether, our study underscores the potential persistent presence of Nearctic leafhoppers in their current habitats while pointing to a shift toward northern North America in future scenarios. These findings have significant implications for sustainable pest management practices, prompting a necessary discussion on strategies to mitigate climate change and pest migration's impact on agricultural systems.

Climate change significantly contributes to alterations in species distributions, prompting shifts in their geographic ranges[1,2]. Over the past six decades, crop pests and diseases have notably moved toward northern latitudes globally, progressing at ~2.7 km annually since 1960[3]. This phenomenon is primarily attributed to global warming and trade dynamics[4,5]. However, the response of these organisms to the ongoing environmental changes is intricate and conditional upon various determinants, notably their geographic origins[6–8]. Tropical pest species, for instance, typically exhibit a restricted tolerance to temperature variation and tend to live close to their maximum thermal limits[6,8]. In contrast, temperate species contend with a broader spectrum of climate extremities, including temperature fluctuations[6]. As a result, projections suggest a potential reduction in the suitable habitats for tropical pest species with the anticipated progression of climate warming[6,9]. Conversely, a favorable trend is expected for temperate species, given their ability to adjust to more diverse climatic events[4,6].

Recently, the efforts to assess the impacts of climate change on biological systems have intensified[10]. Species distribution modeling (SDM), also known as ecological niche modeling (ENM), has risen as a crucial tool to explore the potential effects of climate change on the geographic distribution of organisms[11]. However, within entomology, research efforts have predominantly centered around specific orders, such as Lepidoptera and Diptera, while comparatively less attention has been dedicated to others like Hemiptera[10]. This bias may stem from the notorious role Lepidoptera plays in global research and the importance of Diptera as disease vectors for vertebrates[10]. However, Hemiptera also includes significant plant disease vectors, causing substantial damage worldwide[12]. Increased research

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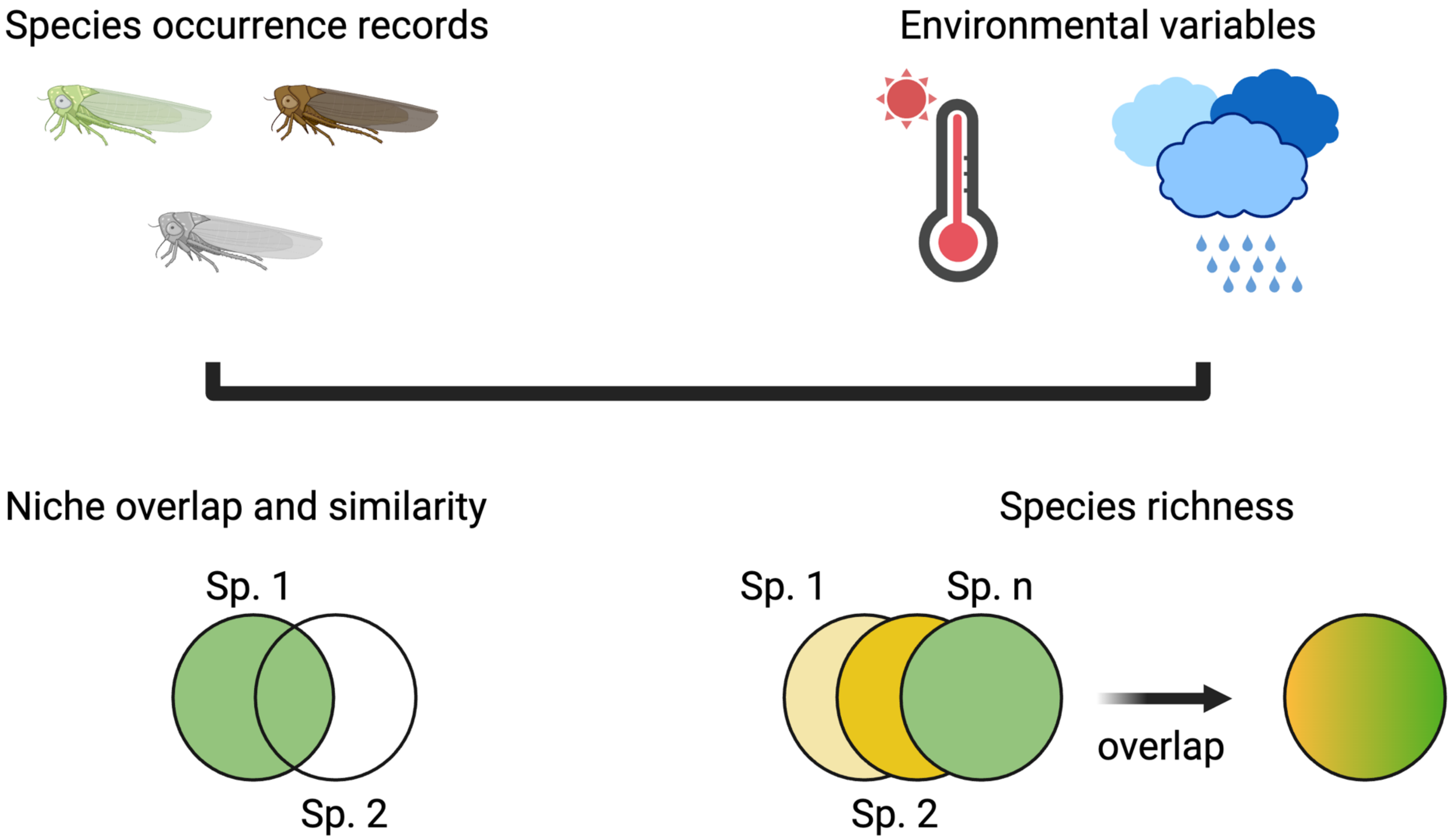
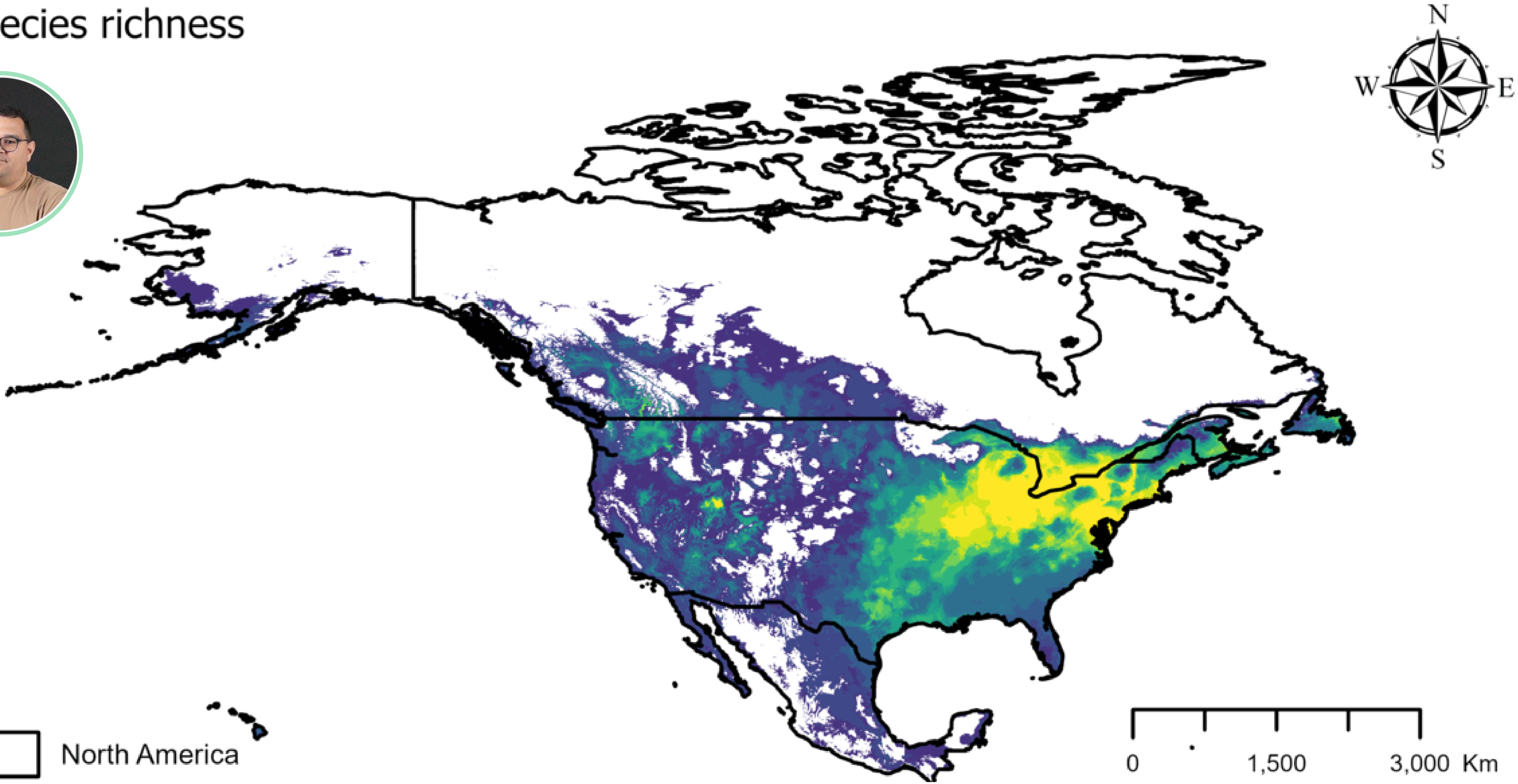
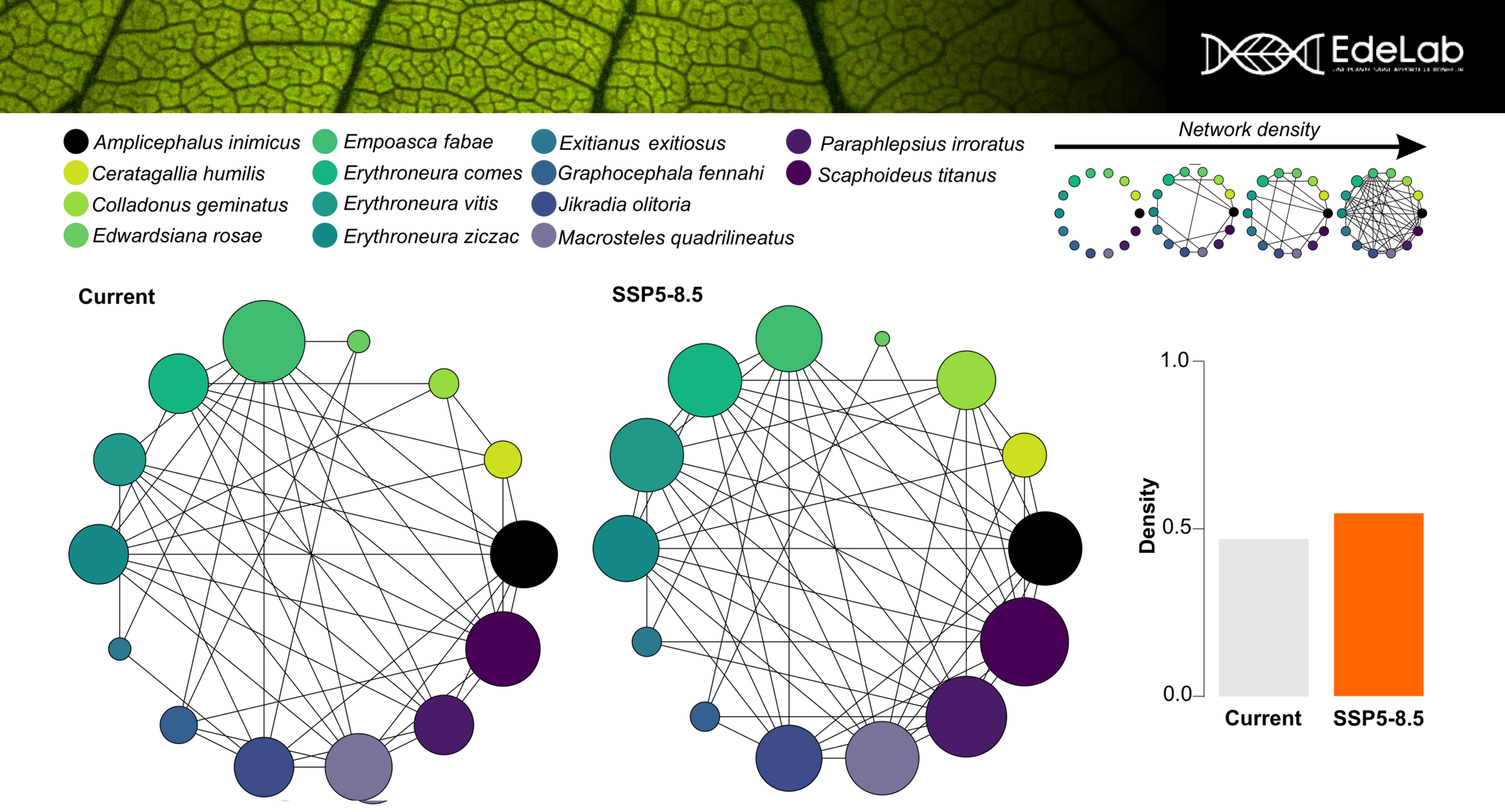


Leafhoppers and climate

EdeLab

Species richness




EdeLab
Amplicephalus inimicus
Ceratagallia humilis
Colladonus geminatus
Edwardsiana rosae
Empoasca fabae
Erythroneura comes
Erythroneura vitis
Erythroneura ziczac
Exitianus exitiosus
Graphocephala fennahi
Jikradia olitoria
Macrosteles quadrilineatus
Paraphlepsius irroratus
Scaphoideus titanus
Network density
Current
SSP5-8.5
Density
1.0
0.5
0.0
Current
SSP5-8.5

EdeLab

Environmental Entomology, 54(5), 2025, 1124–1135
https://doi.org/10.1093/ee/nvaf070
Advance Access Publication Date: 11 July 2025
Research

ENTOMOLOGICAL SOCIETY OF AMERICA
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OXFORD

Population Ecology

Seasonal phenology of *Empoasca fabae* (Hemiptera: Cicadellidae) in Québec, Canada

Abraão Almeida Santos[1,2,3,4], Fausto Henrique Vieira Araújo[5], Nicolas Plante[1,2,3,4], Ricardo Siqueira da Silva[5,6], and Edel Pérez-Lopéz[1,2,3,4,7,8,*]

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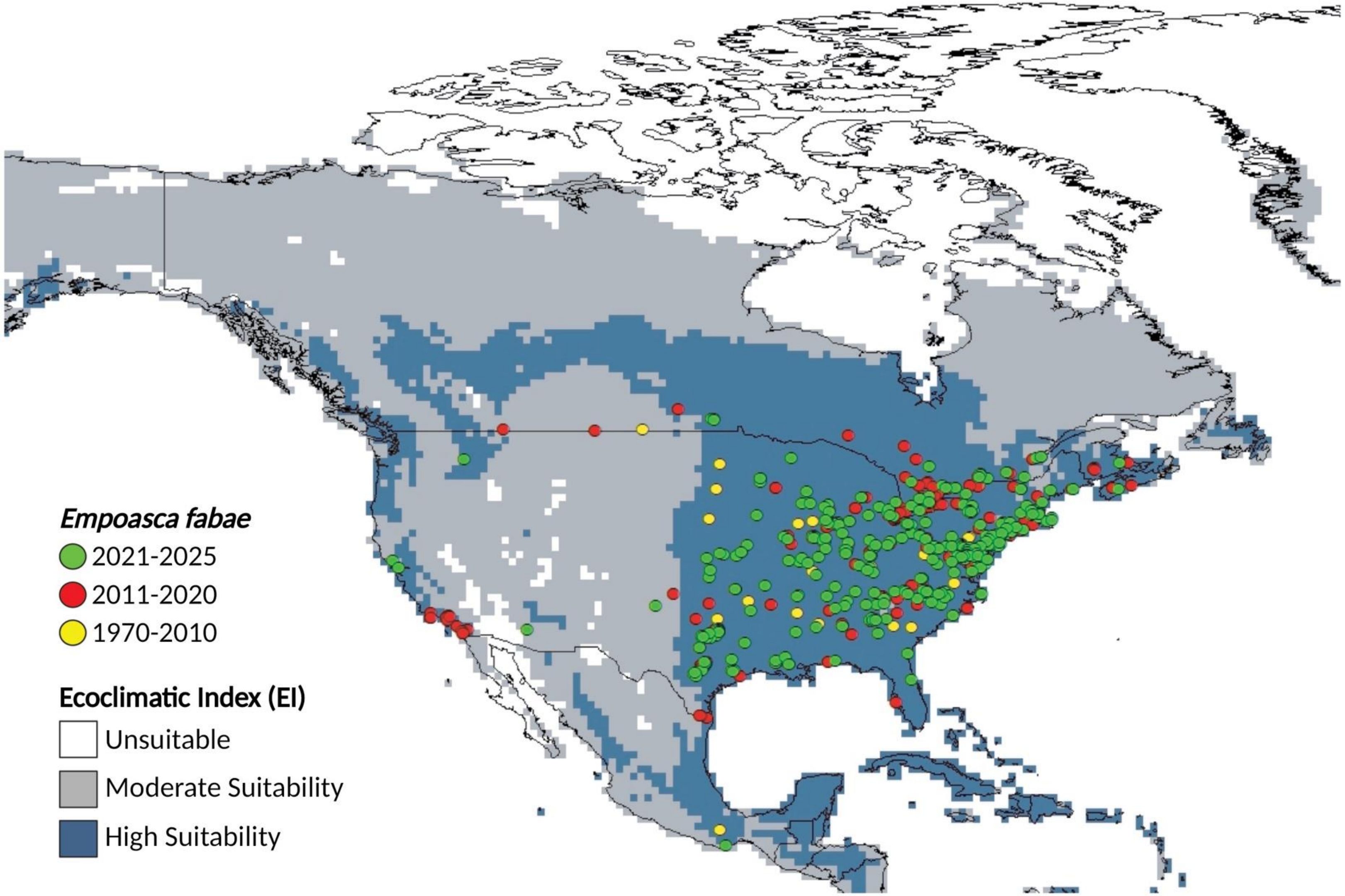
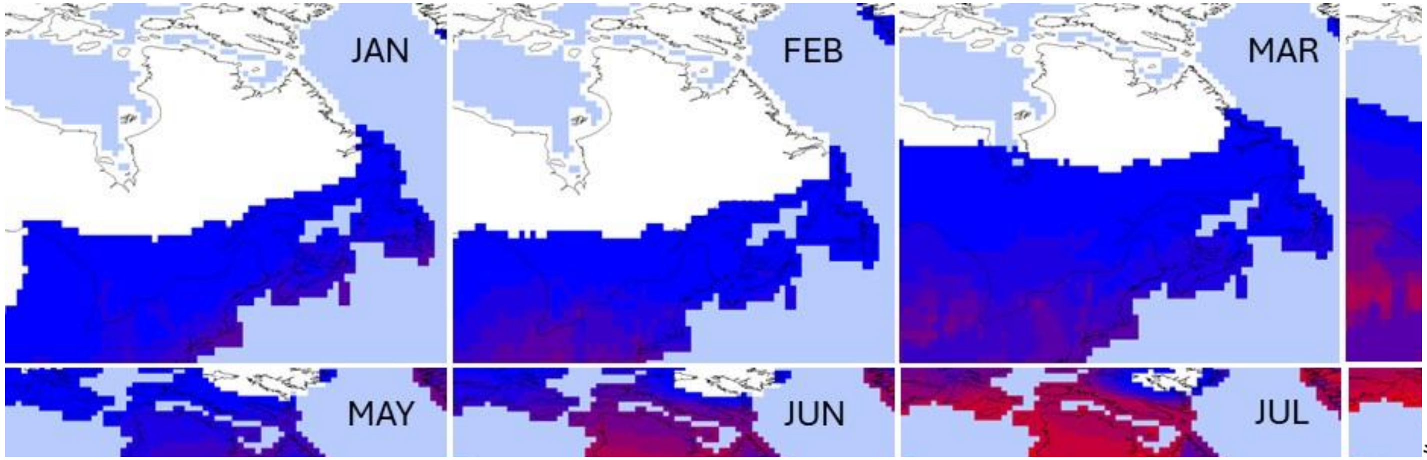
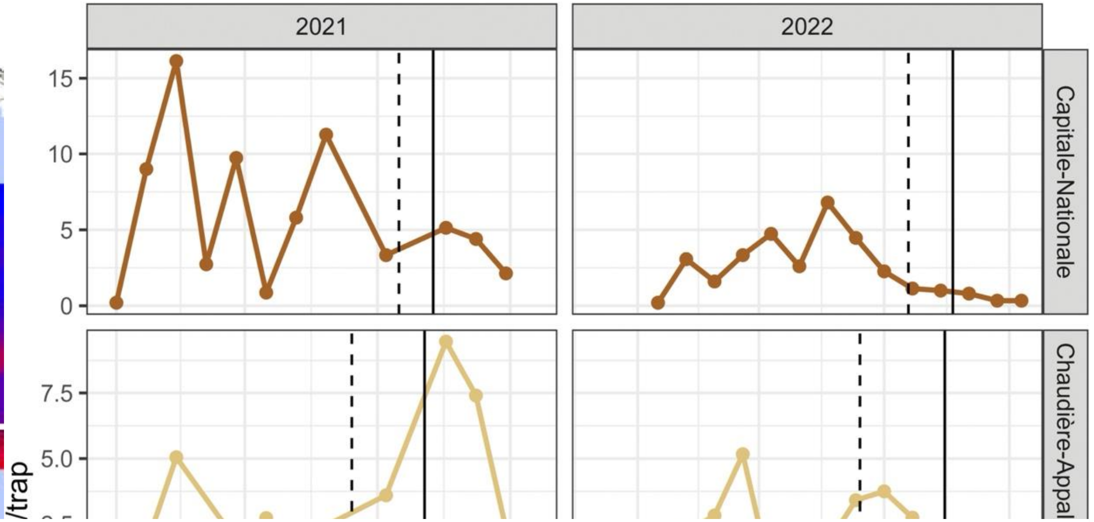
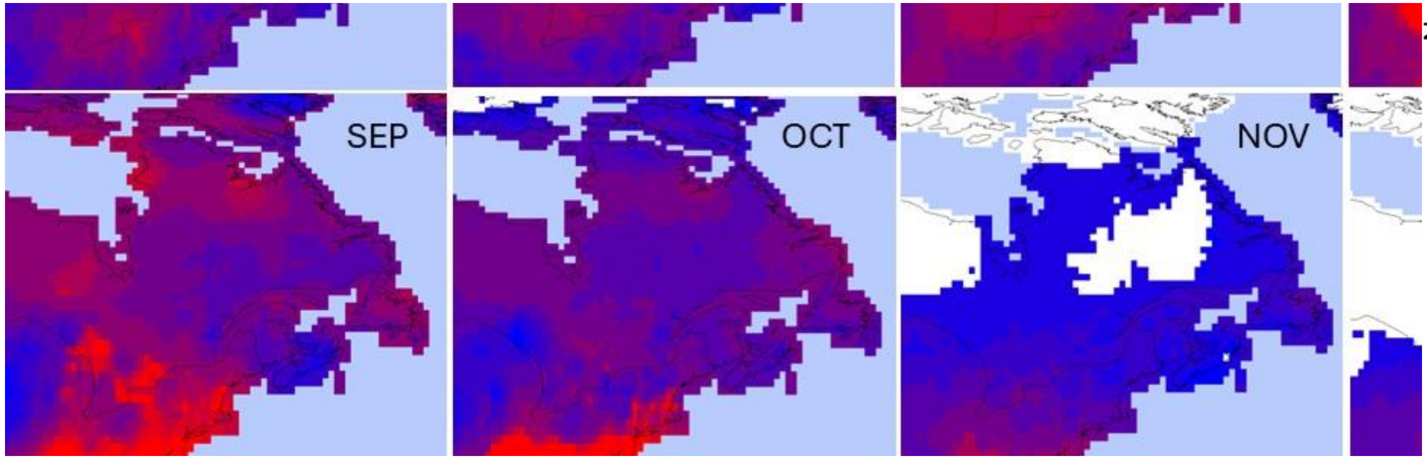
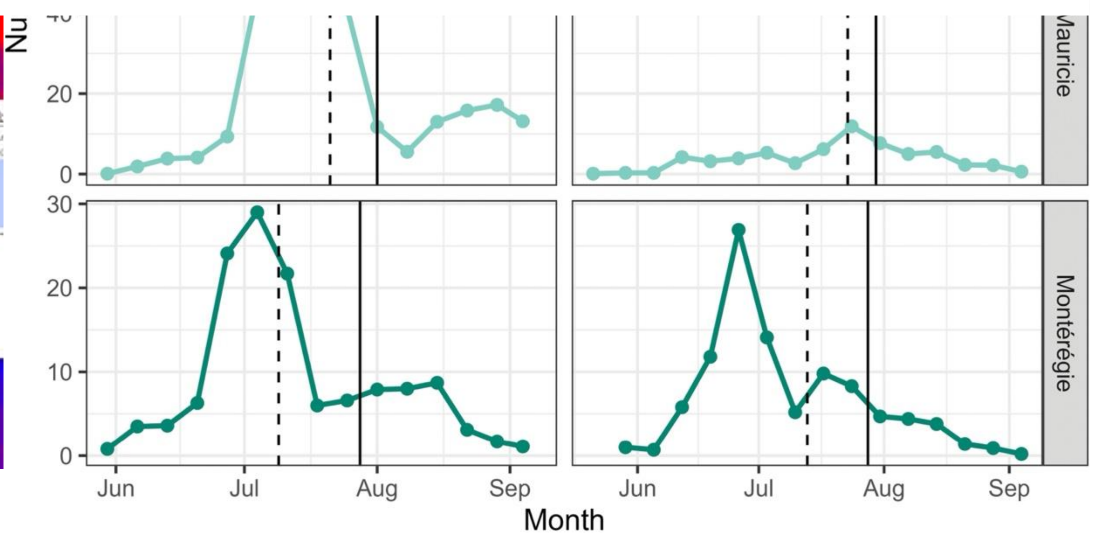






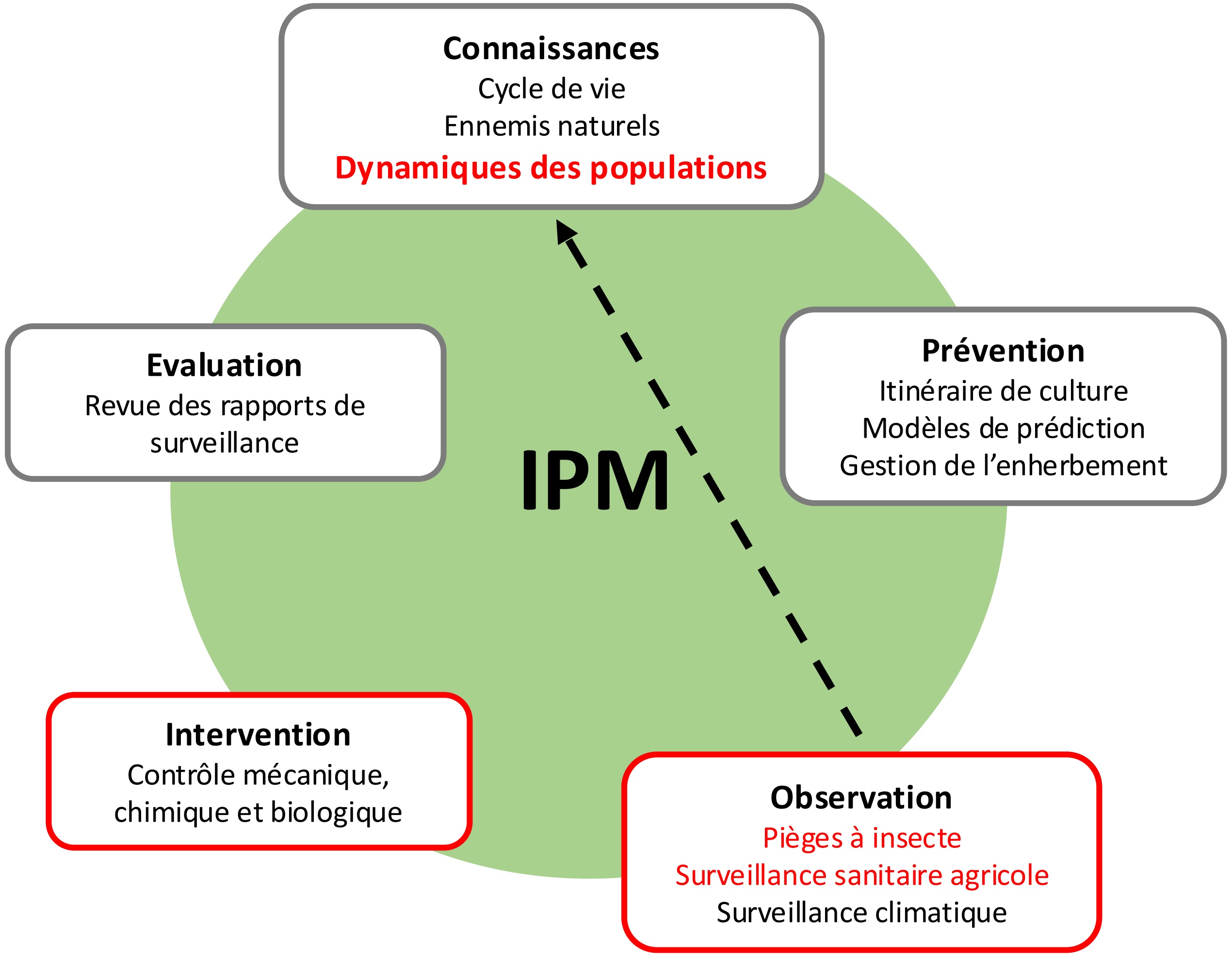
La modélisation continue …





Limites de la surveillance traditionnelle des insectes

EdeLab

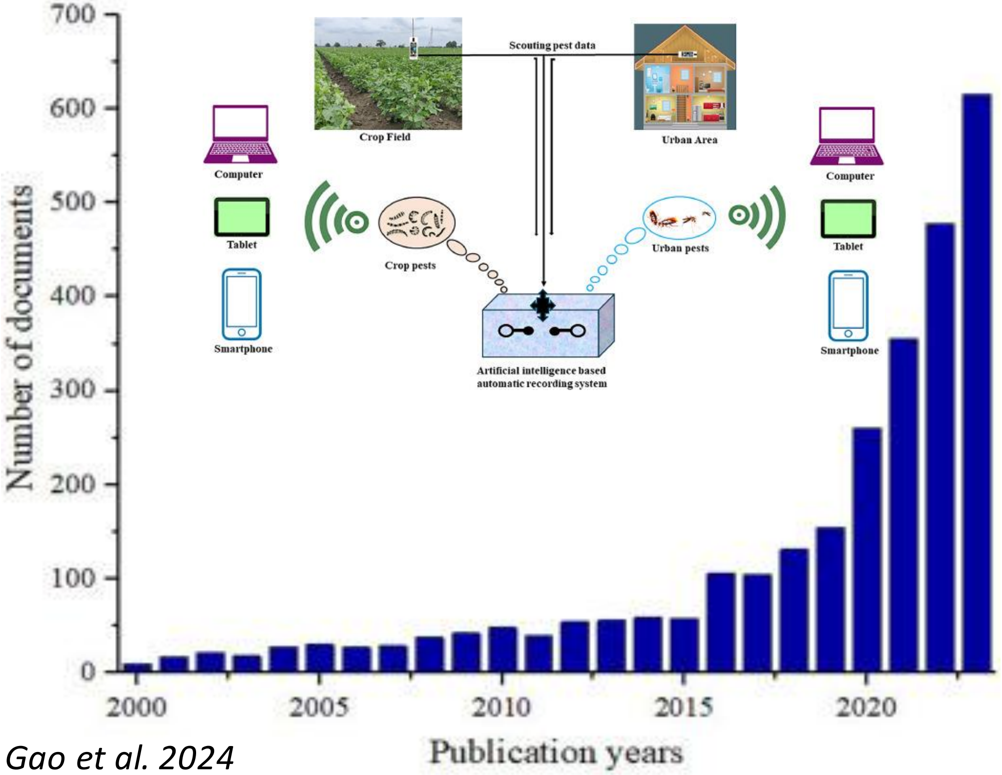


Adapté de *https://www.farmbiosecurity.com.au/what-is-integrated-pest-management/*

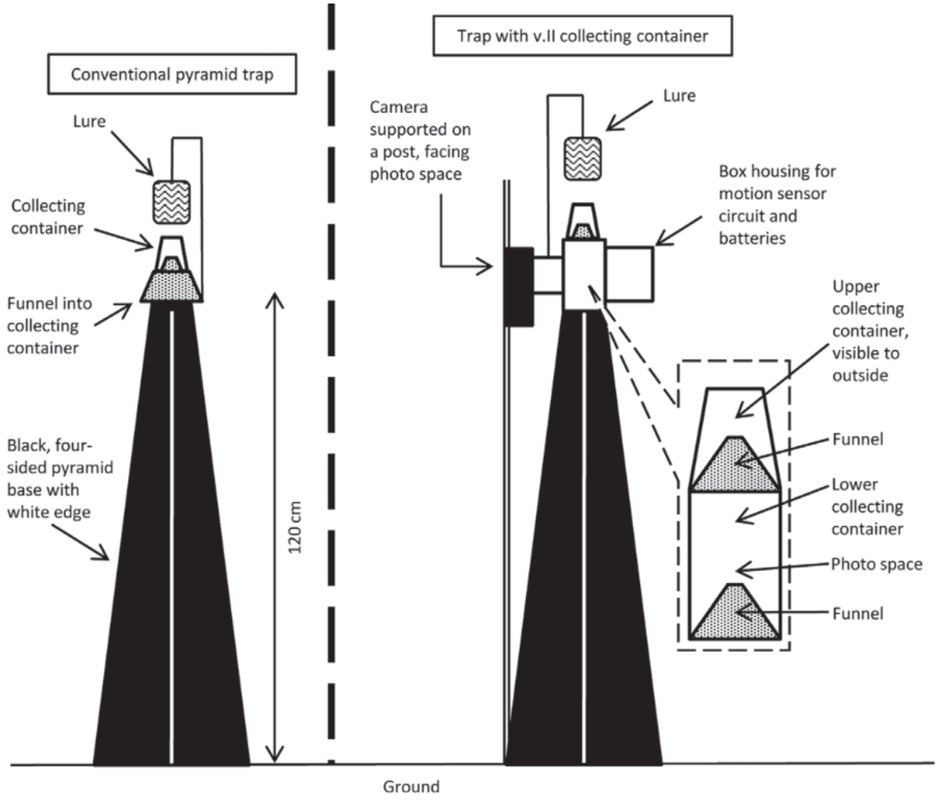
- Faible résolution temporelle et spatiale
- Expertise entomologique

⬇

Retard de l'appréhension des pressions de ravageurs



Gao et al. 2024



Selby et al. 2014

©Trapview

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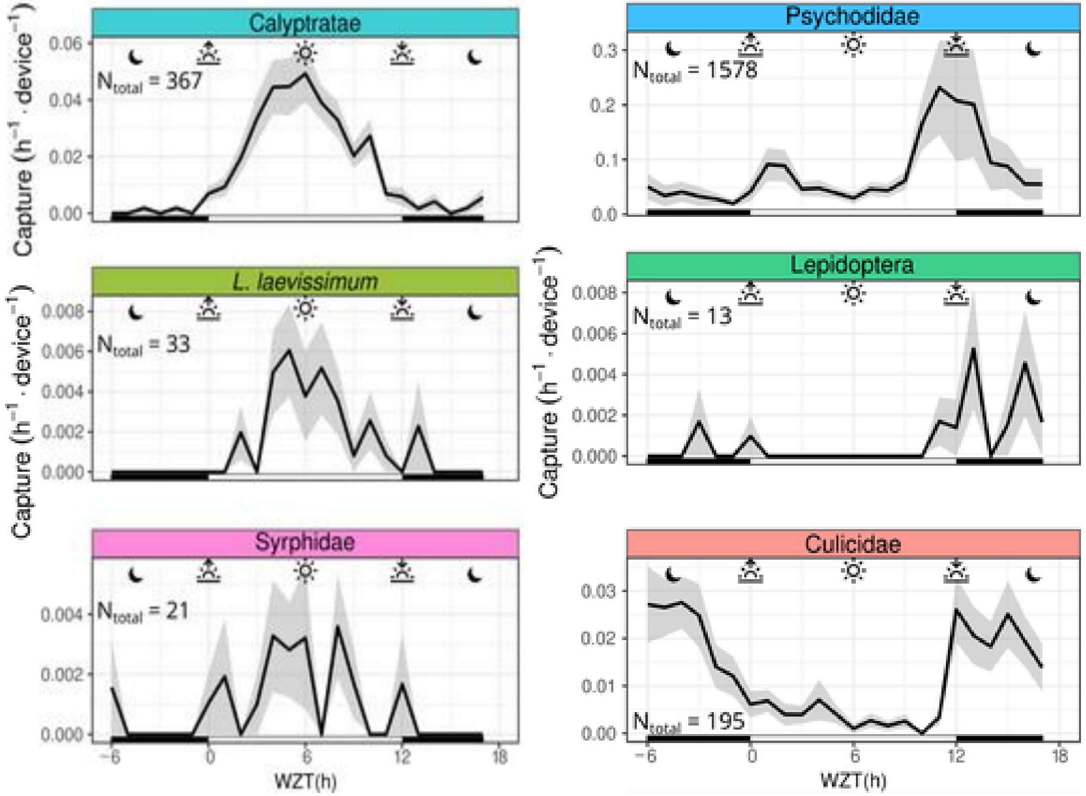
©Biobest

Améliorer la surveillance avec l’intelligence artificielle

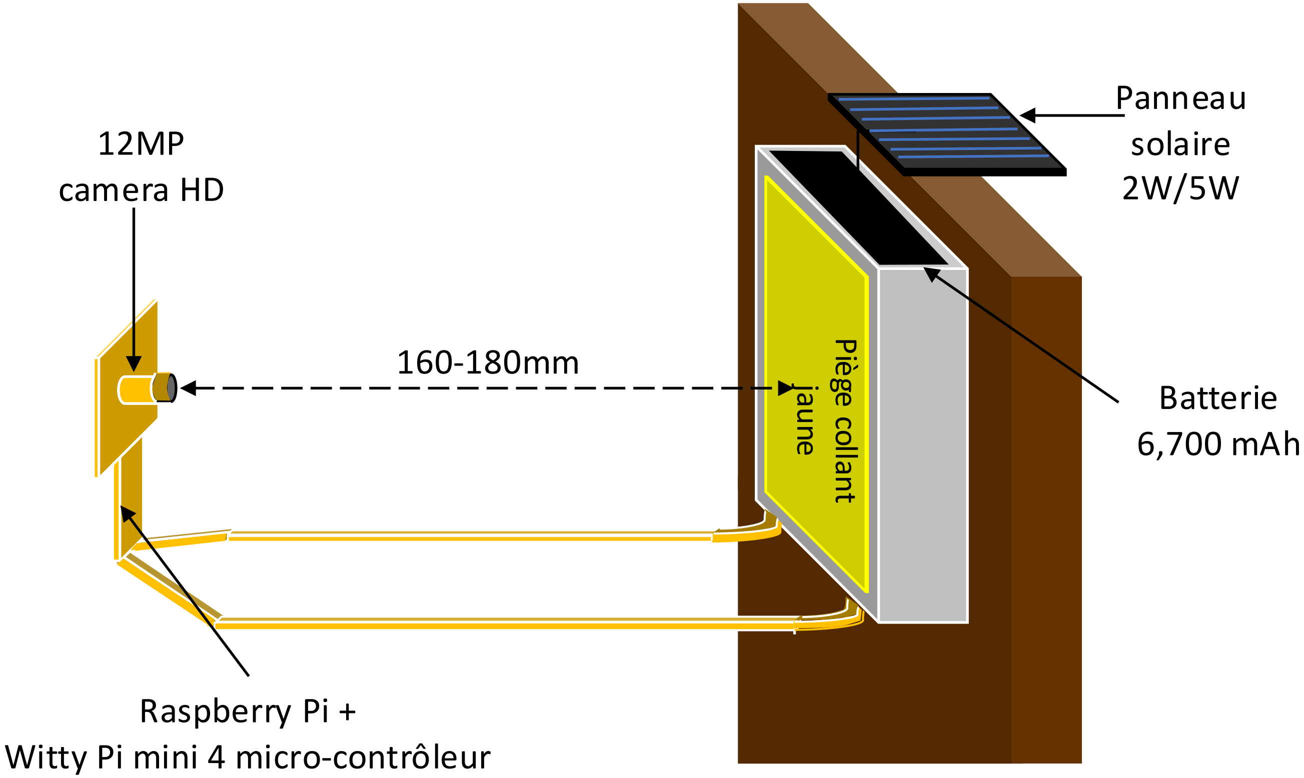
StickyPI

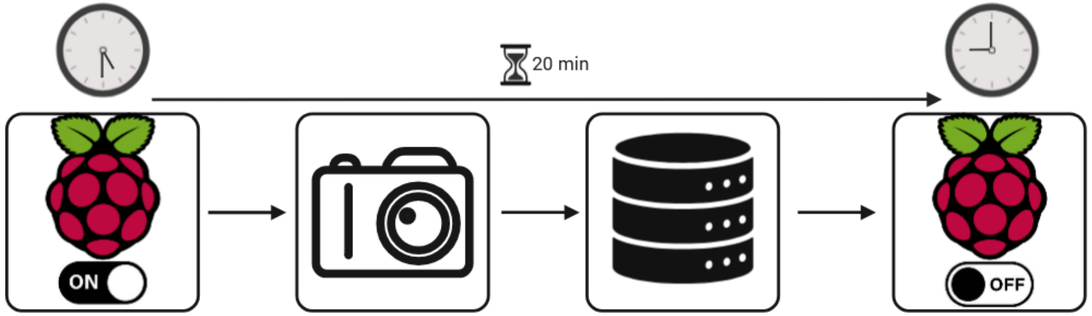


Adapté de *Geissman et al. 2022*

- **Limites économiques:** coût des pièges, abonnement
- **Limites algorithmiques:** validation humaine nécessaire
- **Limites techniques:** Autonomie énergétique, qualité des images, résilience environnementale
- **Limite de déploiement à grande échelle**

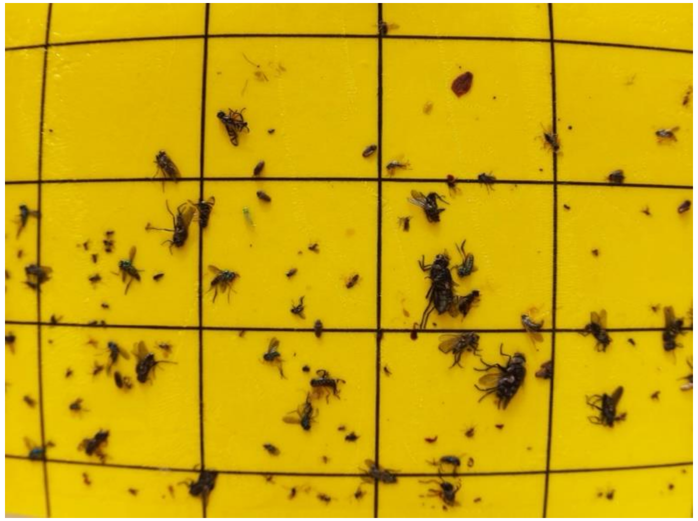
☑ **Images de haute qualité** ☑ **Efficacité énergétique** ☑ **Résistance environnementale** ☑ **Prix abordable**



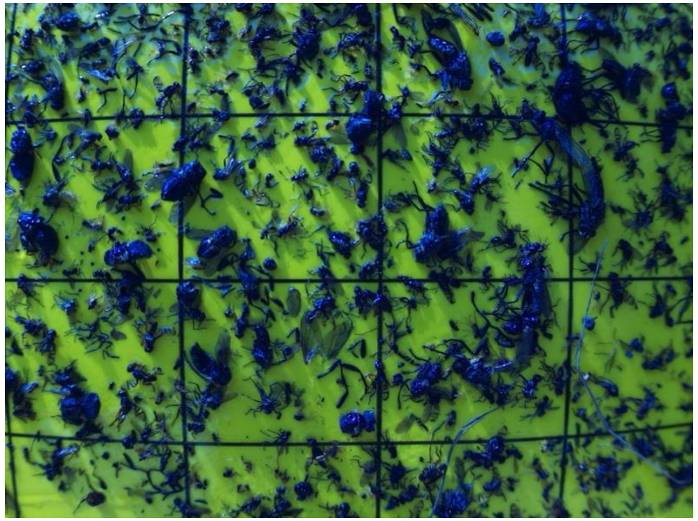


Paramètres	Fréquence
Fréquence d'acquisition	Toutes les 20 minutes
Changement des pièges	Tous les 7 jours
Autonomie de la batterie seule	Environ 12 jours
Autonomie de la batterie avec panneau solaire	Variable selon la météo

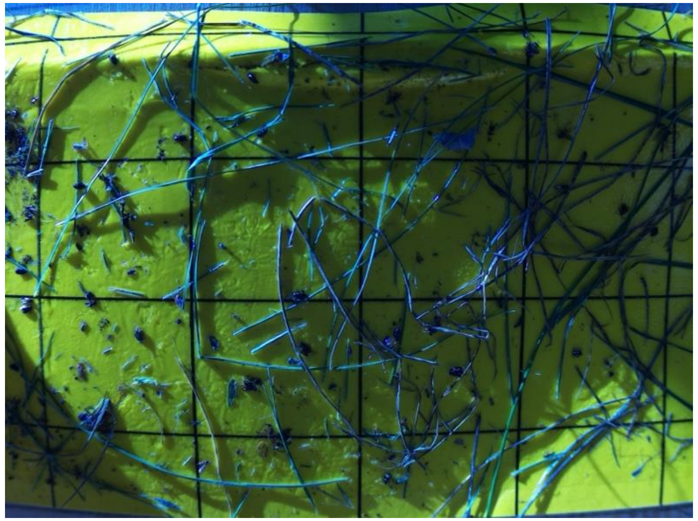
Non challengeant

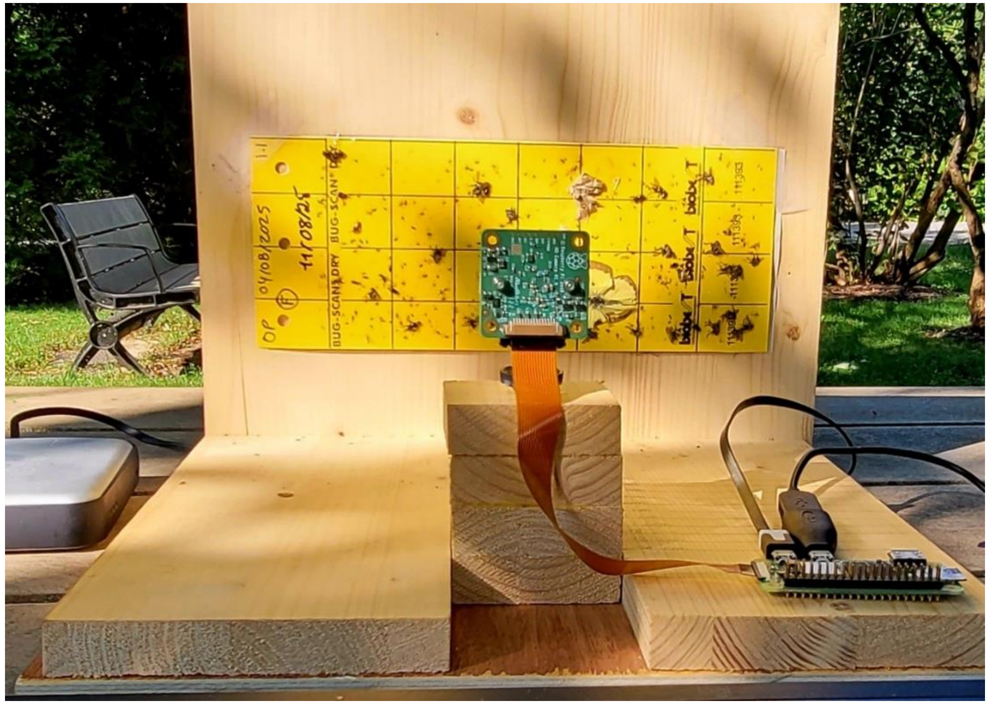


Forte densité d’insectes

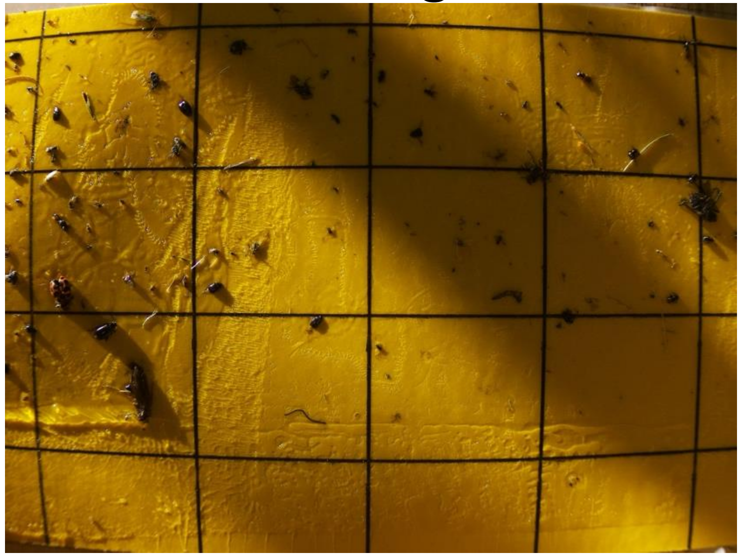


Objets

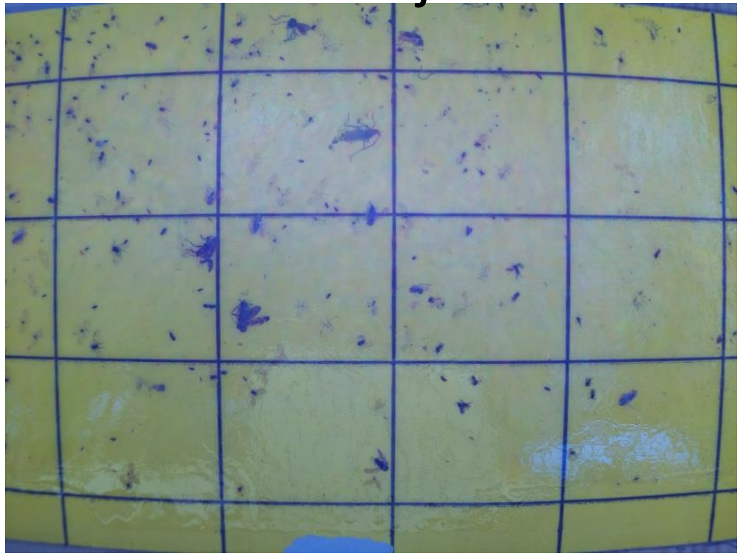


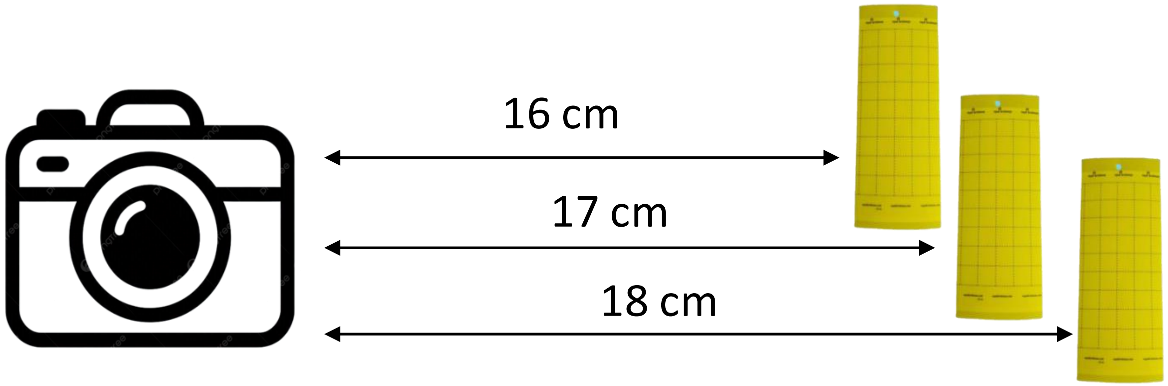


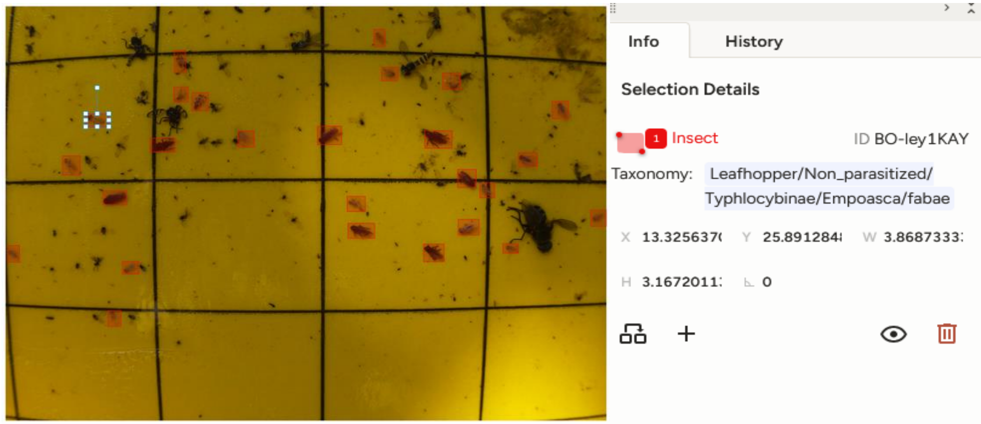
Ombrage



Contre-jour







Label Studio

Développement de l'algorithme

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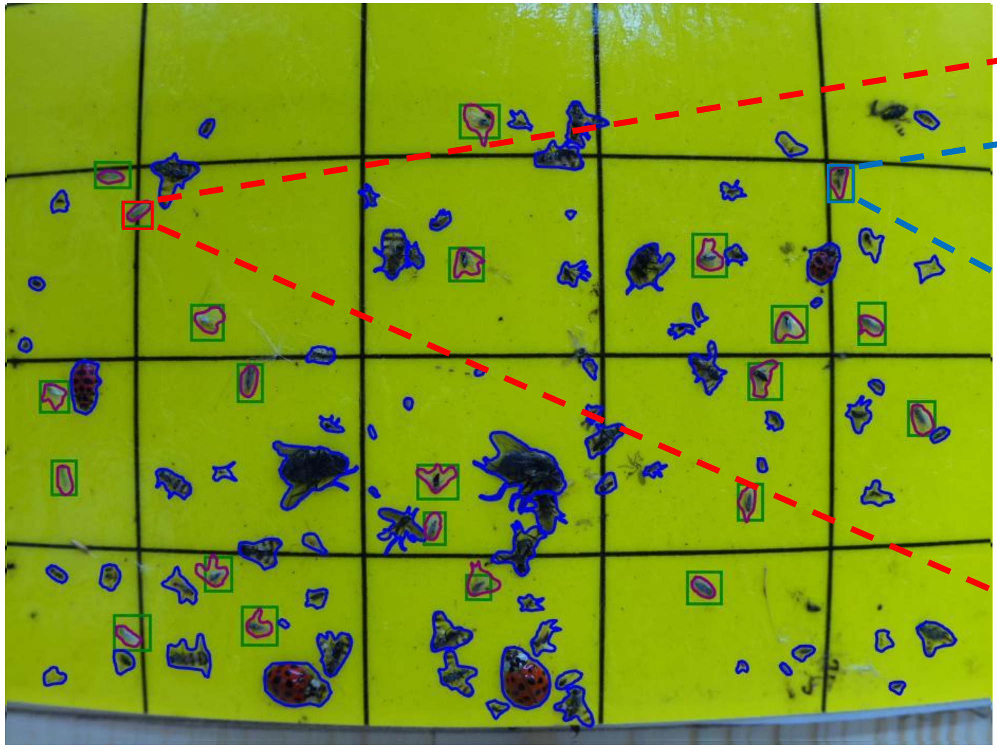
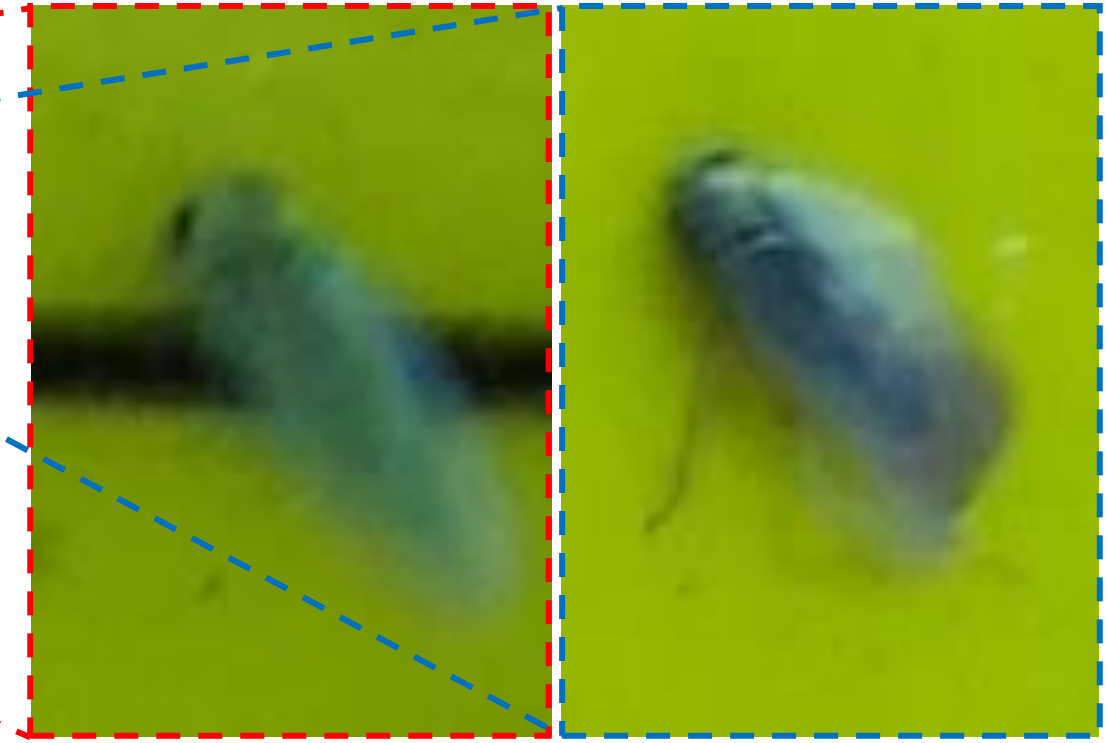


Détection des insectes(***flatbug***)



Classification des cicadelles:

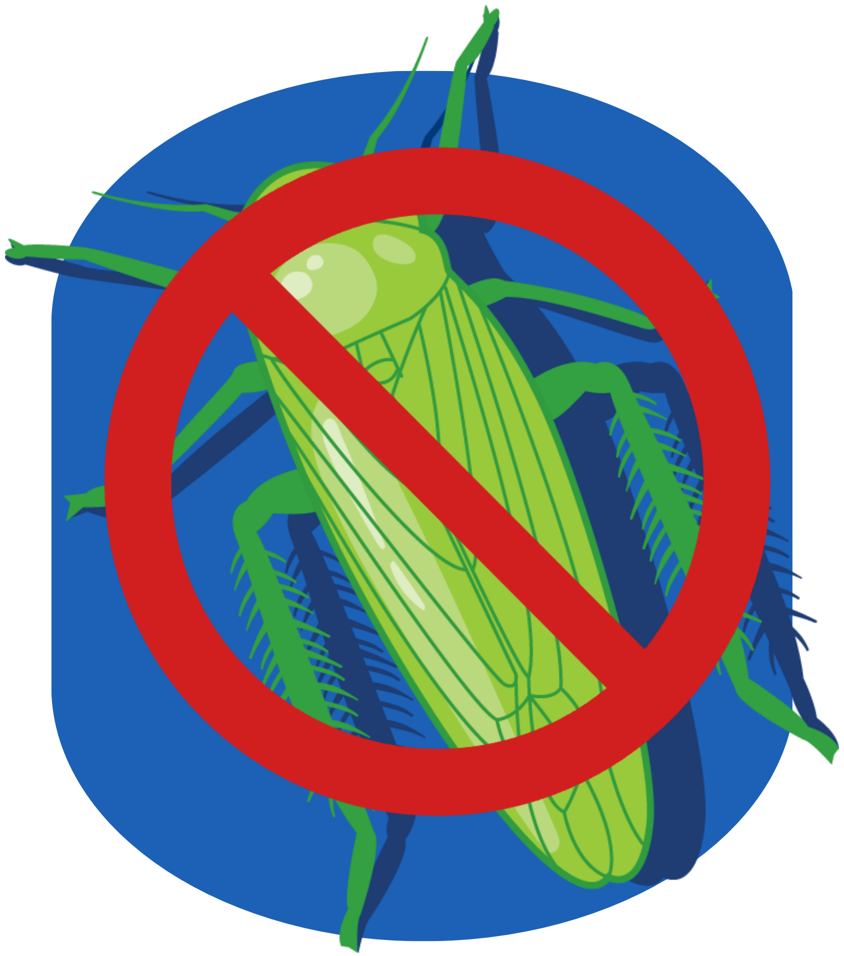
EfficentNet, Transformeurs de vision

Niveau taxonomique 1

-E. fabae
-M. quadrilineatus
-Cicadelles non migratrices
- Autre insecte

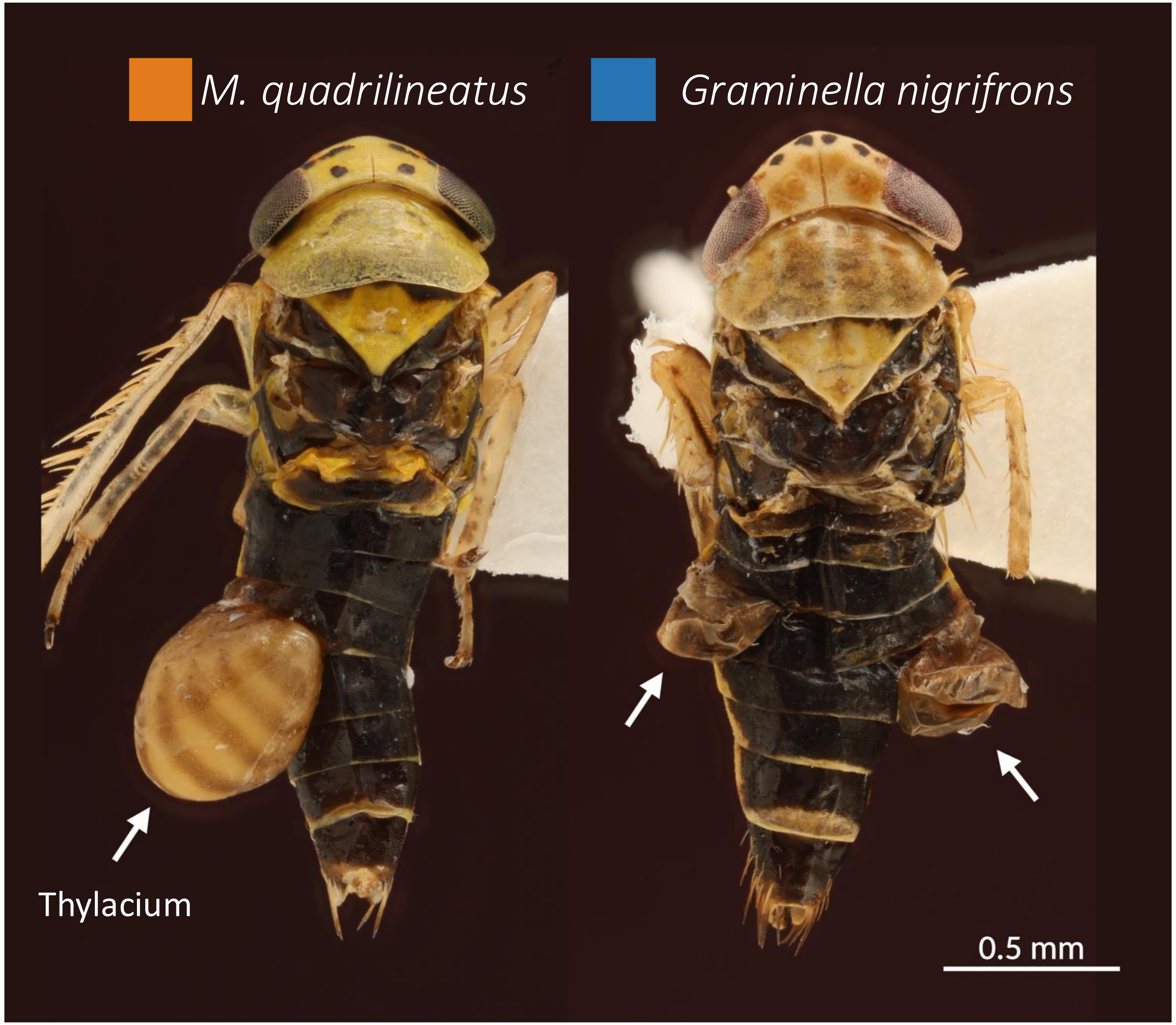
Niveau taxonomique 2

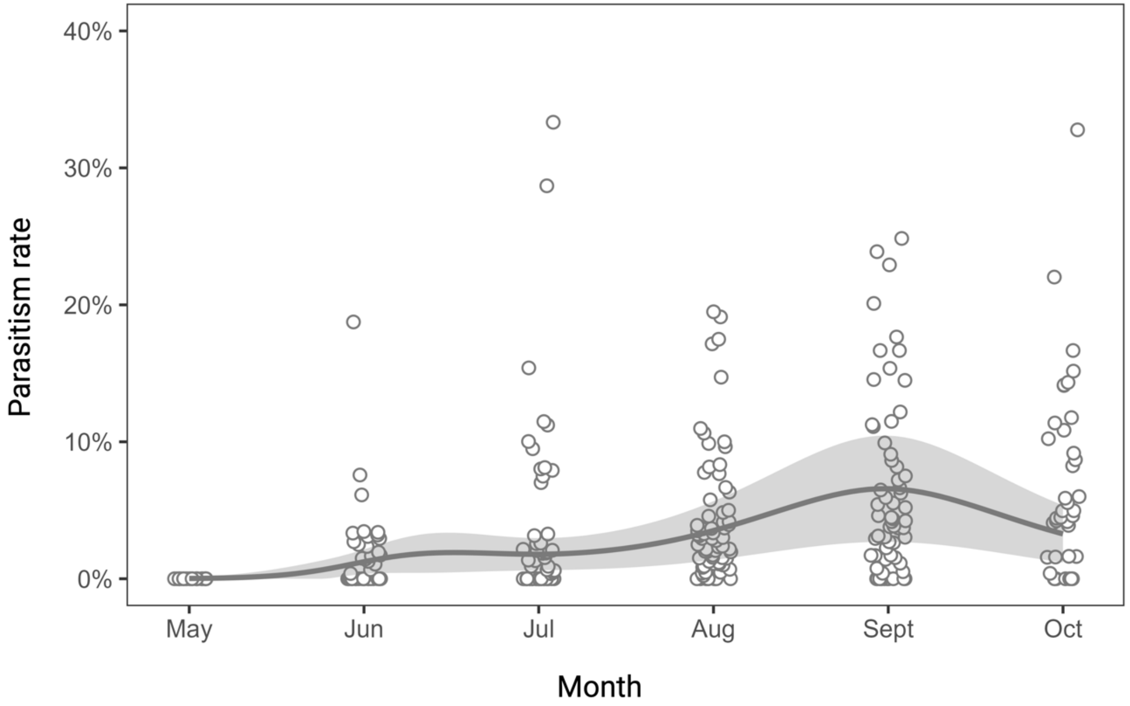
Sous-familles
(10 groupes)



Comment contrôler les cicadelles?

Parasitoïdes vs Cicadelles

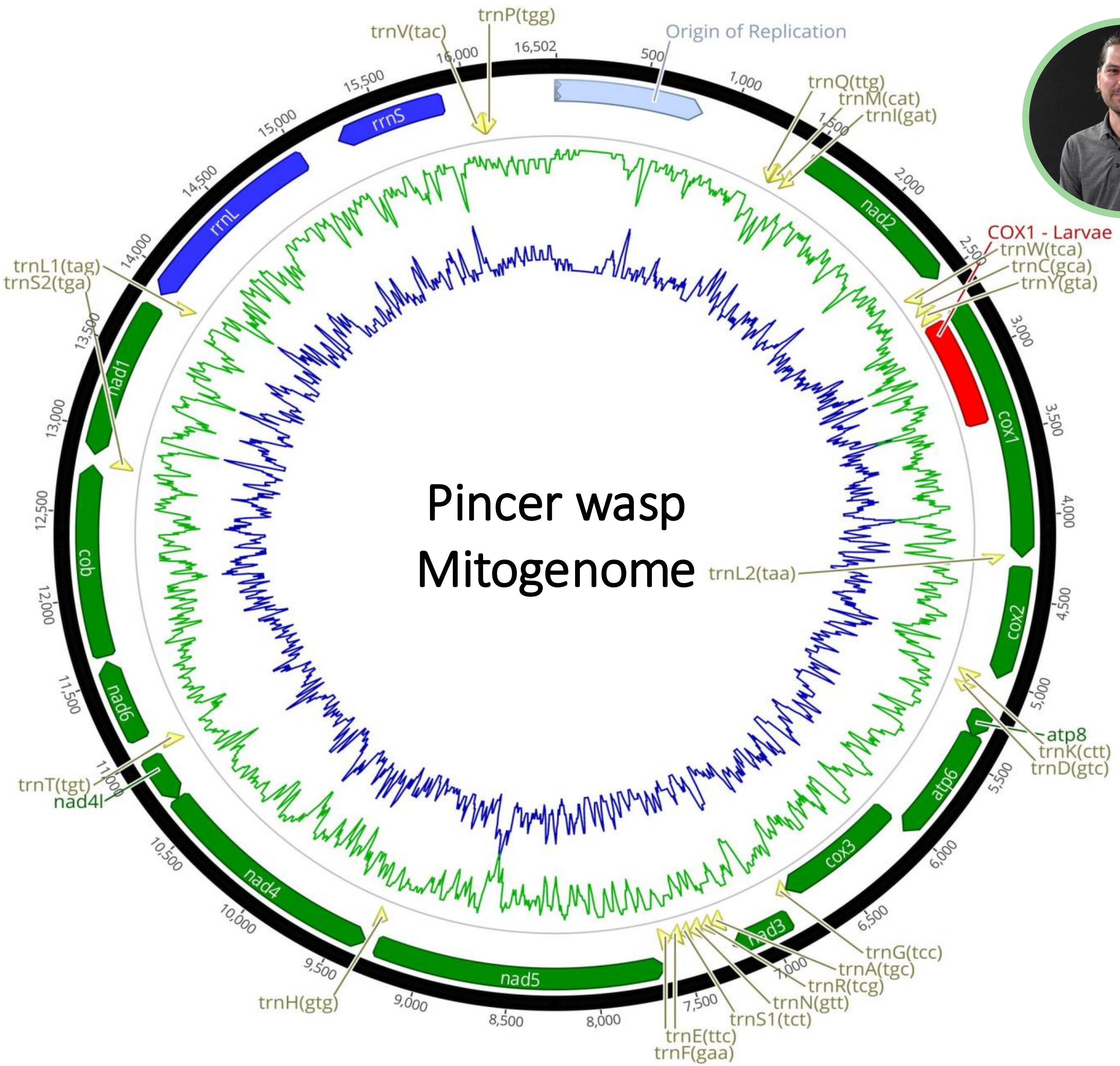




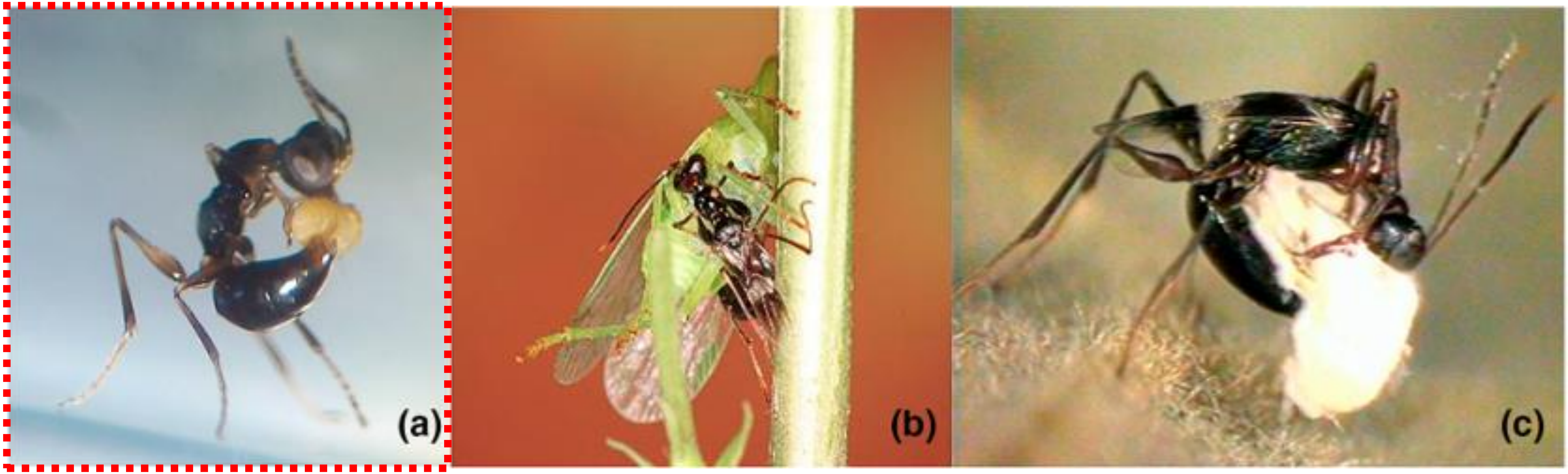
Fulgore tacheté
(*Lycorma delicatula*)

30% parasitisme par *Anastatus orientalis*

Quelle parasitoide?

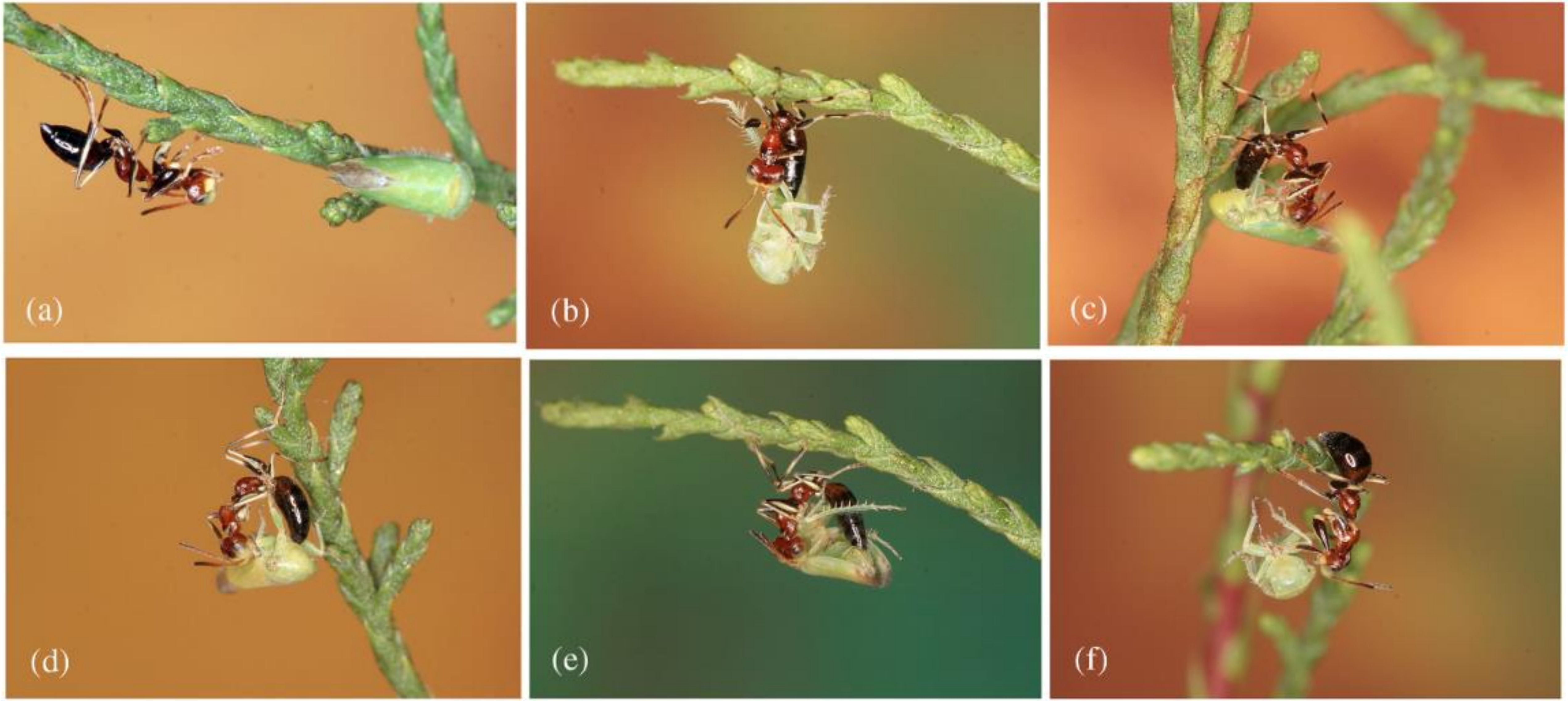


Family Dryinidae



Gonatopus spp.

Virla et al. 2023- Austral Entomology



Gonatopus albolineatus on *Opsius lethierryi*

Virla et al. 2023- Austral Entomology

À la recherche dans les champs

EdeLab

11 Specimens

Gonatopus spp.?

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DEPARTMENT OF AGRICULTURE
DIRECTION DE LA RECHERCHE
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CANADA
960


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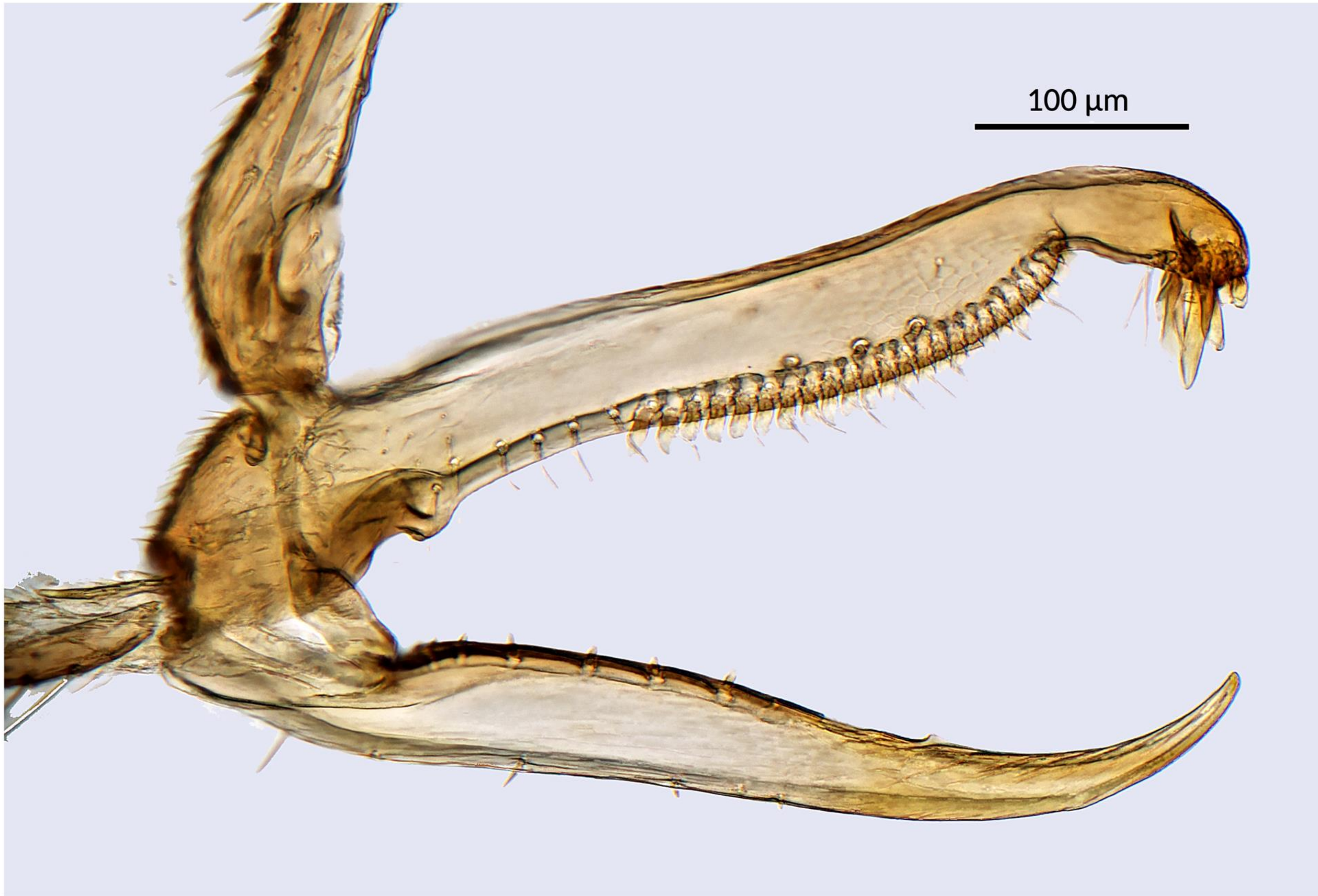
45.317°N 75.720°W
Malaise J.E. O'Hara
USA: AR, Arkansas Co.
Wildlife Refuge, 27.v-10.
vi.2015, N. Schiff, MT

Gonatopus spp.



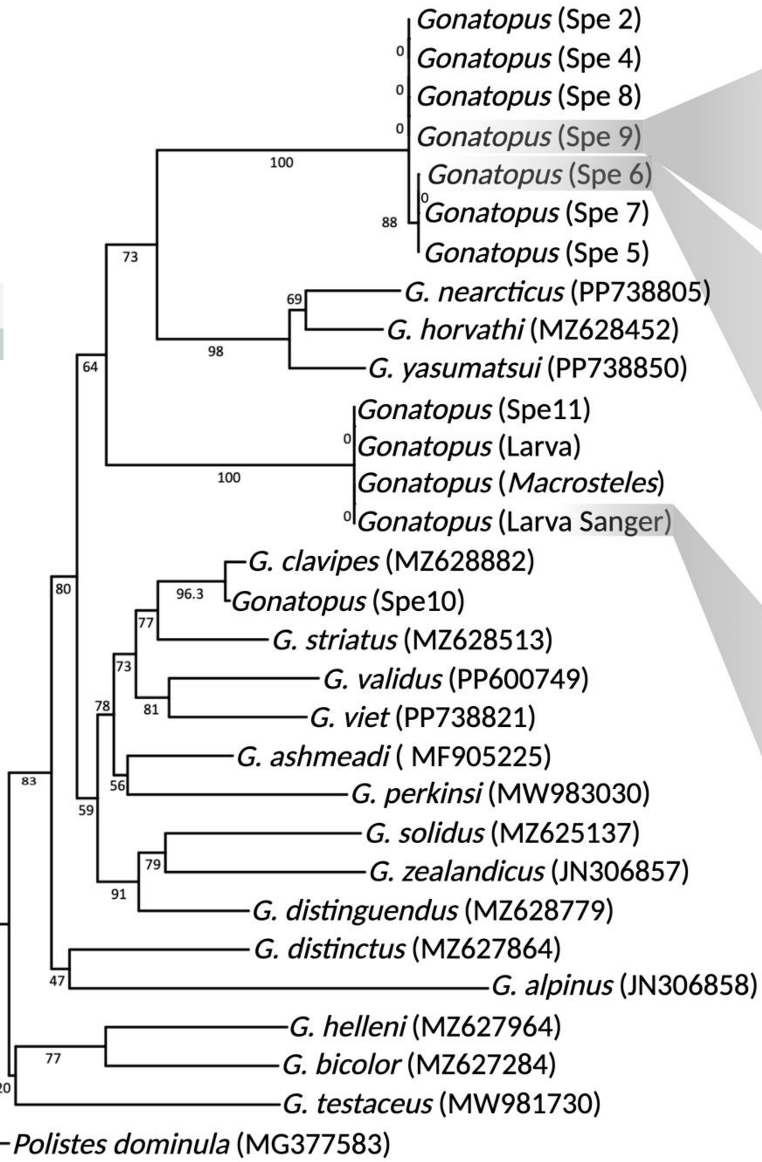
Gonatopus clavipens

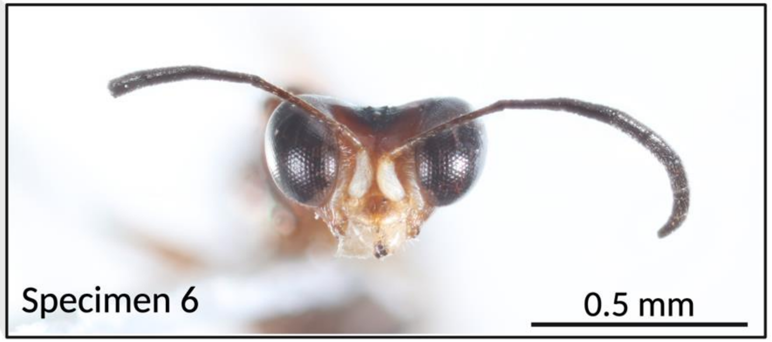
Specimen 10
Gonatopus sp.

- Taxonomically – 3 groups
- DNA very degraded

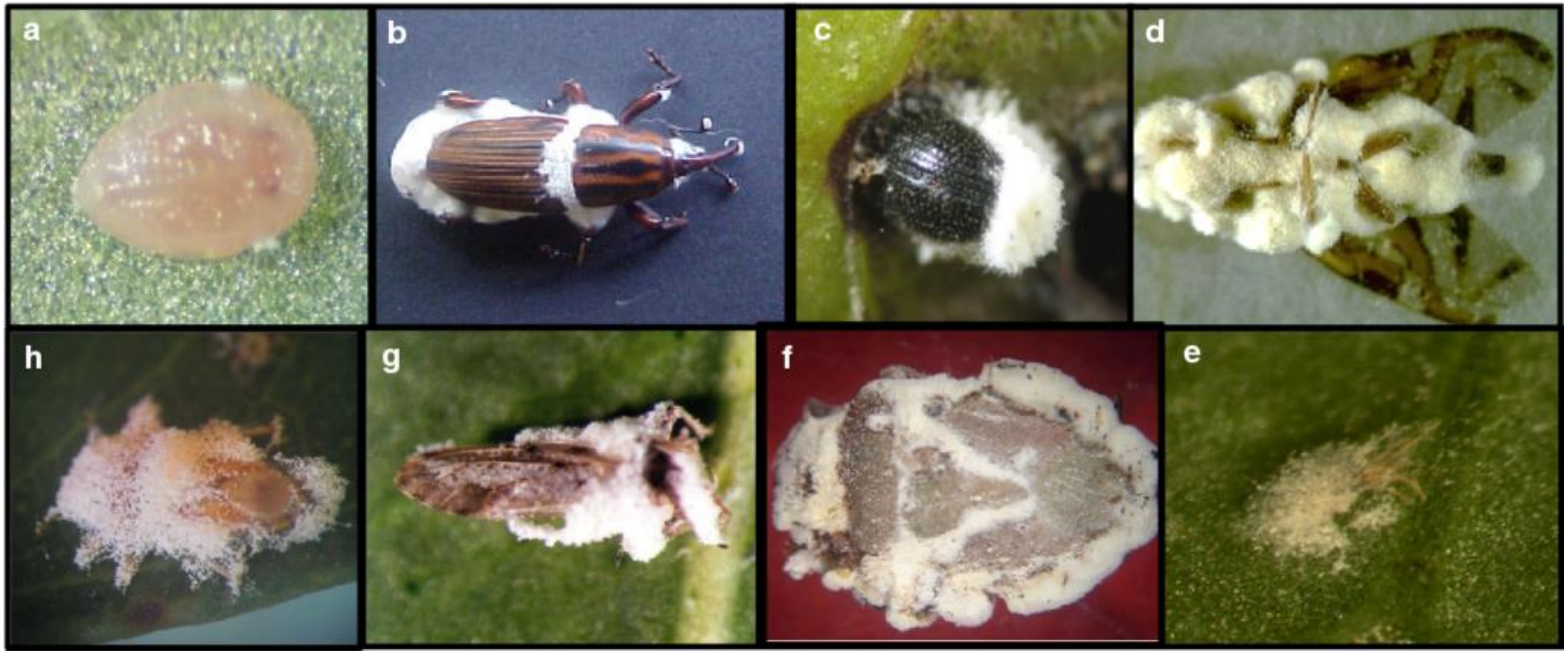
G. Clavipens

Official first mention in Canada





Un troisième acteur inattendu



Picture froom https://www.msbiotech.net/

LeafHope: à réduire l'utilisation des insecticides

EdeLab

LeafHope Predict

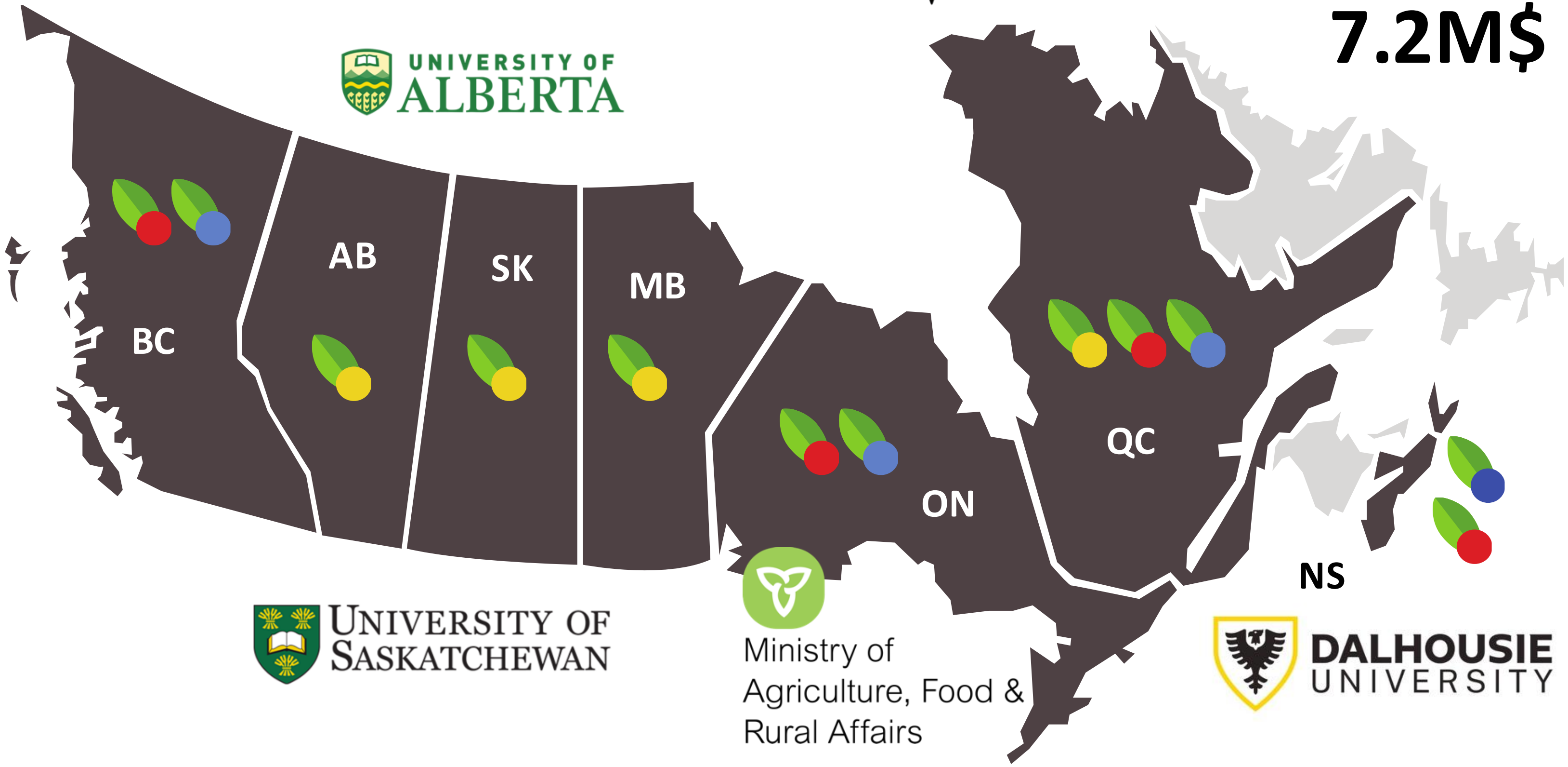
LeafHope Biocontrol

LeafHope Transfer

University of the Fraser Valley

University of Alberta

Université Laval



Leaf Hope

7.2M$

University of Saskatchewan

Ministry of Agriculture, Food & Rural Affairs

Dalhousie University

NSERC CRSNG

Canola Strawberry Blueberry

University of the Fraser Valley
Dr. Lauren Erland

University of Alberta
Dr. Boyd Mori

University of Saskatchewan
Dr. Sean Prager

OMAFRA
Erica Pate

Dalhousie University
Dr. Paul Manning

Université Laval
Prof. Valérie Fournier Dr. Romain Dureau
Dr. Edel Pérez-López (Leader)

Merci!

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Agriculture durable grâce à des partenariats

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Fed	NSERC CRSNG · Innovation Canada Foundation for Innovation / Fondation canadienne pour l'innovation · mitacs
Prov.	Genome Québec · Agriculture, Pêcheries et Alimentation Québec · Relations internationales et Francophonie Québec · FRQ
Prod.	Wild Blueberry Producers Association of Nova Scotia · British Columbia Strawberry Growers Association, Fresh, Ripe and Ready · Manitoba Canola Growers · Ontario Berries · BC blueberries Powered by nature. · canola council of Canada · Alberta Canola · WGRF Advancing Agriculture through Research · Sask Oilseeds · Ferme François Gosselin Île d'Orléans · Ferme Éthier Entreprise familiale · Les Fruits Soleil · Ferme Onésime Pouliot Farm · Demers
Priv.	BASF · UB Ulysse Biotech · Nutrien · Anatis Bioprotection

EdeLab
UNE PLANTE SAINE APPORTE LE BONHEUR

Le travail continue !

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Merci