



Biological Control & Management of Invasive Species

Dra. Yelitza Colmenarez- CABI América Latina



what is CABI?

**CABI is a not-for-profit science-based
development and information
organization**



what does CABI do?

CABI addresses issues of global concern such as food security, through science, information and communication

CAB International (CABI) – 50 Member Countries



Anguilla



Australia



Bahamas



Bangladesh



Bermuda



Botswana



British Virgin Islands



Brunei Darussalam



Burundi



Canada



Chile



China



Colombia



Cote d'Ivoire



Cyprus



DPR Korea



Gambia



Ghana



Grenada



Guyana



India



Jamaica



Kenya



Malawi



Malaysia



Mauritius



Montserrat



Myanmar



The Netherlands



Nigeria



Pakistan



Papua New Guinea



Philippines



Rwanda



Sierra Leone



Solomon Islands



South Africa



Sri Lanka



St Helena



Switzerland



Tanzania



Trinidad & Tobago



Uganda



United Kingdom



Vietnam



Zambia



Zimbabwe



ORGANIZACIÓN INTERNACIONAL
PARA EL CONTROL BIOLÓGICO (IOBC)
SECCIÓN REGIONAL NEOTROPICAL
(NTRS)



**International Organization of Biological
Control
Neotropical Sub Regional Section
IOBC - NTRS**

Coordinated work with Ministries of Agriculture - NPPOs - RPPOs

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Food and Agriculture Organization
of the United Nations



International Plant Protection Convention
Protecting the world's plant resources from pests

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IPPC Secretariat

The Secretariat of the International Plant Protection Convention (IPPC) was established in 1992 by FAO in recognition of the increasing roles of the IPPC.

The Secretariat is hosted by FAO and its Headquarters is in Rome, Italy. The staff of the IPPC Secretariat currently consists of a Secretary, a Coordinator and several professional officers and administrative staff. The Secretariat is also complemented by contracting parties providing staff resources through various contributions.

Mr. Jingyuan Xia is the Secretary to the IPPC.

Contact Details

International Plant Protection Convention Secretariat (IPPC)

Viale delle Terme di Caracalla

00153 Rome, Italy

Tel: +39-06-5705-3388

E-mail: IPPC@fao.org

+ About

+ Who we are

IPPC Secretariat

[What we do](#)

[How we do it](#)

[Who we work with](#)

+ [Why it Matters](#)

[Where we work](#)

+ [History of the IPPC](#)

[Convention, model instruments and related information](#)

[IPPC Seminars](#)

[Media Kit](#)

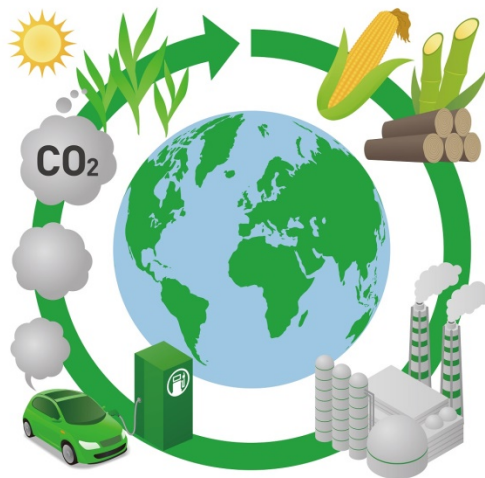
What factors affect food security worldwide?

Which one Do you think would be more significant?

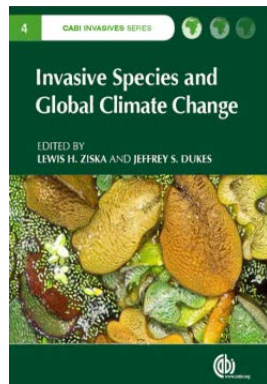


www.shutterstock.com · 604150523

Population growth



Reduction of arable land



Climate change



Latin America & Caribbean

- High Biodiversity
- Intense trade
- Movement of people and products
- New species introduced



What factors affect food security worldwide?

Invasive Species



Helicoverpa armigera



Citrus leafminer



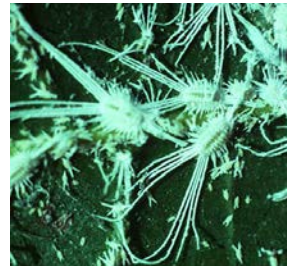
Anastrepha obliqua



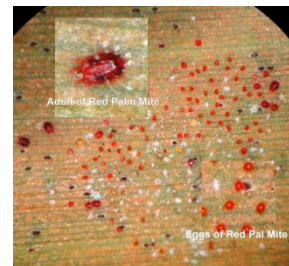
Bactrocera carambolae



Rhynchoporus ferrugineus



Rastrococcus invadens



Red Palm Mite



Lethal Yellowing



Papayae mealybug



Scirtothrips dorsalis



Tropical Race 4



Sago Palm Scale



Neoleucinodes elegantalis



Drosophila Suzukii

Table: The number of species encountered reported exotic, or exotic naturalised / invasive in the Caribbean, presented by country. Exotic = known to be present in the Caribbean in cultivation, captivity or in the wild. Naturalised = known to be established in the wild in at least one Caribbean country. Invasive = established in the wild and reported to be spreading, and / or regarded as a threat to a native species, ecosystem or causing a socio-economic impact. **Kairo, et al., 2003 (CAB International).**

Country	Exotic In	Naturalized or Naturalized and Invasive In
Antigua-Barbuda	45	18
Anguilla	9	9
Aves I.	0	0
British Virgin I.	9	5
Guadeloupe	31	5
Montserrat	26	3
Netherlands Leeward I.	0	0
St. Kitts-Nevis	5	2
St. Martin	2	2
US Virgin I.	42	11
Barbados	60	30
Dominica	34	7
Grenada	37	5
Martinique	37	7
St. Lucia	37	4
St. Vincent	32	2
Haiti	63	18
Navassa	0	0
Bonaire	4	2
Curacao	41	31
Aruba	5	3
Bahamas	159	93
Bermuda	73	68
Cayman I.	7	2
Cuba	60	8
Dominican Republic	186	147
Jamaica	102	52
Puerto Rico	182	157
Turks-Caicos I.	8	6
Trinidad-Tobago	61	23

Enhanced Invasive Species Compendium

The screenshot displays the CABI Invasive Species Compendium website. At the top, there is a navigation bar with the CABI logo, the title 'Invasives Species Compendium', and links for 'Other CABI sites', 'About', 'Mobile', and 'Help'. Below this is a large banner with the title 'Invasive Species Compendium' and a subtitle 'Detailed coverage of invasive species threatening livelihoods and the environment worldwide'. A search bar is present with the text 'fall armyworm' and a search button. Below the search bar are links for 'clear search', 'Advanced search', 'Advanced bibliographic search', 'Smart searches', and 'Login to My ISC...'. The main content area is divided into several sections: 'Topical species in the news' featuring images and titles for Spodoptera frugiperda (fall armyworm), Parthenium hysterophorus (parthenium weed), and Tuta absoluta (tomato leafminer); 'Popular invasive species datasheets' listing Spodoptera frugiperda, Tuta absoluta, Monochamus sutor, Euwallacea fornicatus, and Phthorimaea operculella; 'Latest news' with a tweet from CABI Invasives and a link to 'see more blogs...'; 'Toolbox' containing 'Horizon Scanning Tool', 'Apps', and 'Sign up for country pest alerts'; and 'Resources' with buttons for 'ID guides', 'Posters + leaflets', 'Factsheets', 'Manuals', 'Reports', 'Latest research', 'Useful links + resources', and 'Videos'. At the bottom, there is a footer with 'Contact Us', 'Feedback', 'Accessibility', 'Cookies', 'Privacy Policy', and 'Terms & Conditions', along with the CABI logo and copyright information: '© Copyright 2016 CAB International. CABI is a registered EU trademark.'

www.cabi.org/isc

Enhancements

- Species “portals”
- Improved mapping
- Toolbox
 - Horizon scanning
 - Pest risk analysis (PRA)
- Resources
 - Diagnostics
 - Communication materials
 - Data
- Abstracts
- News

Horizon Scanning Tool (beta)

Prioritizing invasive species threats



The Horizon Scanning Tool is a decision support aid that helps you identify and categorize species that might enter a particular country from another country.

Using the Horizon Scanning Tool



Targeted users: risk assessors, plant protection officers, quarantine officers, protected area managers and researchers

Potential threats can be prioritized by:

- habitats
- pathways
- plant hosts
- plant parts in trade
- taxonomic group

Results output as a list with links to datasheets in the ISC and CPC. Exportable as .csv for analysis

<https://www.cabi.org/horizonscanningtool>

Supported by USDA

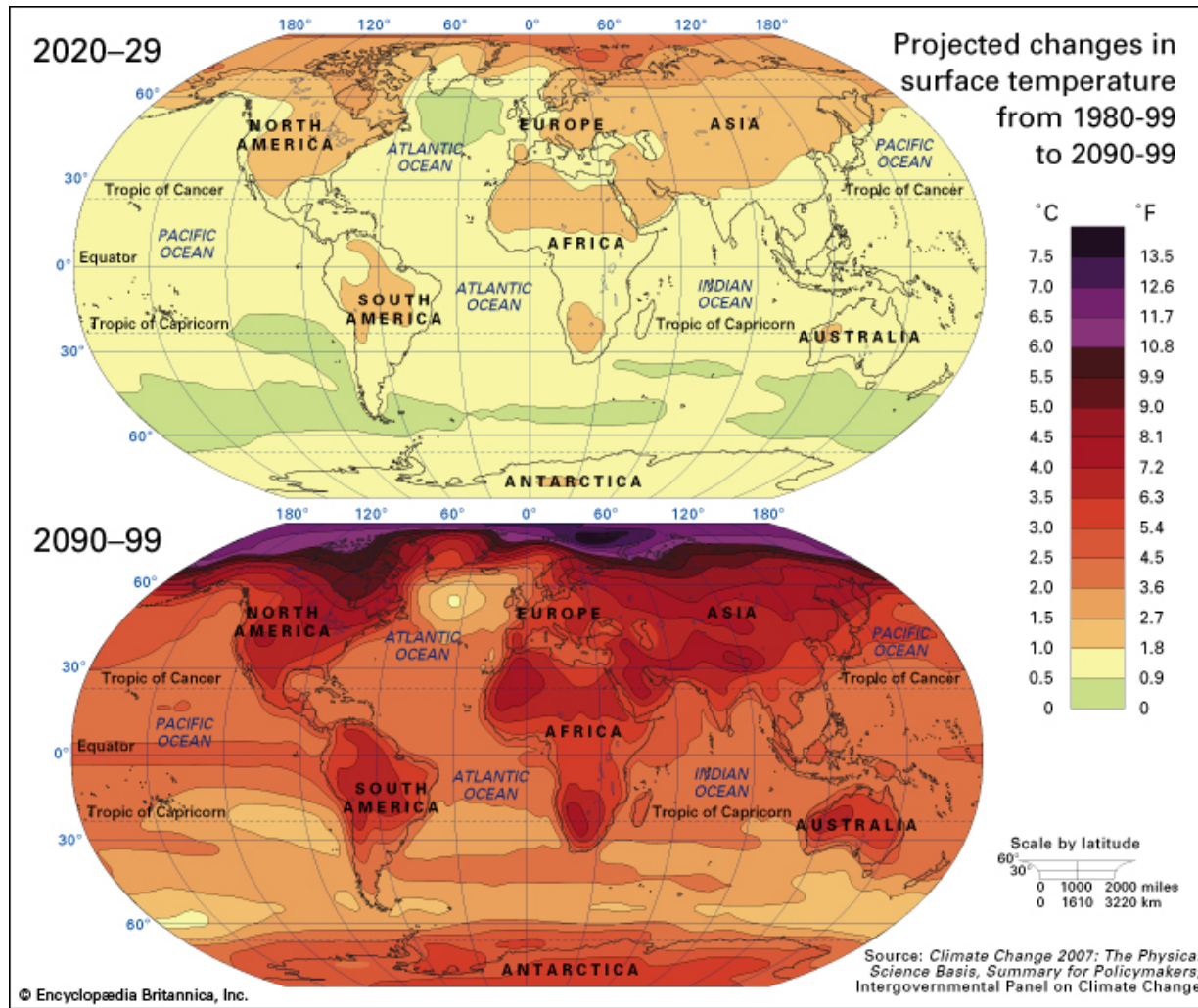
Refine by:		Results: 2382 species found				Current search:		
Source countries	Show: 25 Page: 1 of 96	Download as CSV		Other countries				
Pathways	Preferred scientific name	International common name	Taxonomic group	View datasheet	Japan ✖ China ✖ Korea, DPR ✖ Korea, Republic of ✖ Malaysia ✖ Vietnam ✖ Laos ✖ Papua New Guinea ✖ Singapore ✖ Indonesia ✖			
Plant hosts	Abrus precatorius	rosary pea	Plants	CPC (Full) ISC (Full)	Pathways			
Plant parts in trade	Abutilon theophrasti	velvet leaf	Plants	CPC (Full) ISC (Full)	Container or bulk ✖ Containers and packaging - non-wood ✖ Containers and packaging - wood ✖ Debris and waste associated with human activities ✖ Floating vegetation and debris ✖ Hitchhikers in or on plane ✖ Hitchhikers on land vehicles ✖ Hitchhikers on ship or boat ✖ Machinery and equipment ✖ Mail ✖ Mulch, straw, baskets and sod ✖ People and their luggage/equipment ✖ Ship bilge water ✖ Ship ballast water and sediment ✖ Ship hull fouling ✖ Soil, sand, gravel ✖			
Habitats	Acacia confusa		Plants	CPC (Full) ISC (Full) ?	Involvement of datasheets with risk			
Taxonomic group	Acalolepta cervina	coffee longhorn	Invertebrates	CPC (Basic) ?				
	Acanthophilus helianthi	fly, capsule	Invertebrates	CPC (Full)				
	Acanthocoris scaber		Invertebrates	CPC (Basic) ?				
	Acanthocoris scabrator	squash bug	Invertebrates	CPC (Full) ?				
	Acanthocoris sordidus	winter cherry bug	Invertebrates	CPC (Basic) ?				
	Acantholyda parki		Invertebrates	CPC (Basic) ?				
	Acaphylla steinwardeni		Invertebrates	CPC (Basic) ?				
	Acarus siro	flour mite	Invertebrates	CPC (Full) ?				
	Araia raiata	nine-spined mite	Invertebrates	CPC (Full)				



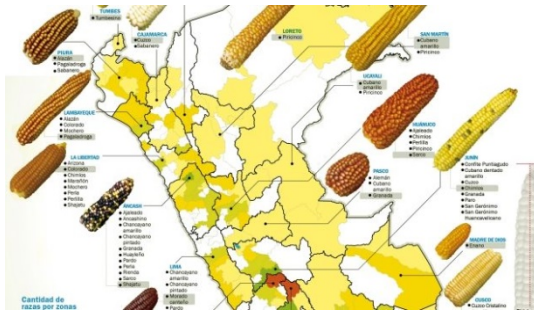
Prioritization of pests and diseases

1. **Bactrocera carambolae** (Diptera: Tephritidae)
2. **Mal de Panamá- *Fusarium oxysporum f. sp. cubense* (race 4)** en Banana — Hongo
3. ***Prodioplosis longifila* (Gagne)** (Diptera: Cecidomyiidae)
4. **Banana bunchy top virus** - (BBTV) – Virus
5. **Coffee berry disease** -*Colletotrichum kahawae* - Fungus
6. ***Haematobia irritans*** (Diptera: Muscidae)
7. **Zebra Chip** –Candidatus *Liberibacter solanacearum* – Bacteria – Transm. *Bactericera cockerelli*
8. **Lethal Yellowing** - Phytoplasma
9. **Phytophthora pod rot** : *Phytophthora megakarya* - Fungus
10. **African cassava mosaic virus** - (ACMV) - Virus
11. **Banana: Xanthomonas wilt- *Xanthomonas campestris* pv. *Musacearum*** - Bacteria
12. **European Canker of apples** - *Neonectria galligena* - Bacteria
13. **Frosty pod rot:** *Moniliophthora roreri* - Fungus
14. **Tomato ringspot virus** - Virus
15. ***Pantoea stewartii* subsp. *stewartii*** en Maíz - Bacteria
16. **Vascular-streak dieback (VSD) in Cocoa:** *Oncobasidium theobromae* - Fungus
17. ***Pseudomonas savastanoi* pv. *Phaseolicola*** en frijol - Bacteria
18. **Bacteriosis Vascular del arroz** - *Xanthomonas oryzae* pv. *Oryzae* - Bacteria
19. **Swollen shoot virus (CSSV) in Cocoa:** transmitted by *Planococcoides njalensis* – Virus
20. **Plum box virus en Durazno** - Virus
21. **Sudden oak death** - *Phytophthora ramorum* - Fungus
22. **Chancro Resinoso del Pino - Pitch canker disease in Pine** - *Fusarium circinatum* - Fungus

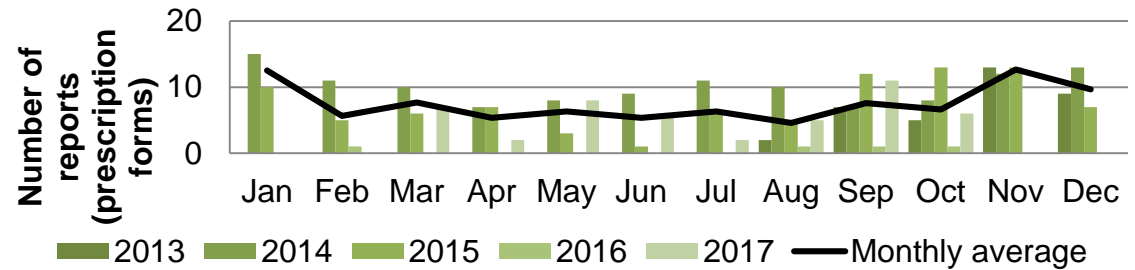
The global scenario- Climate change



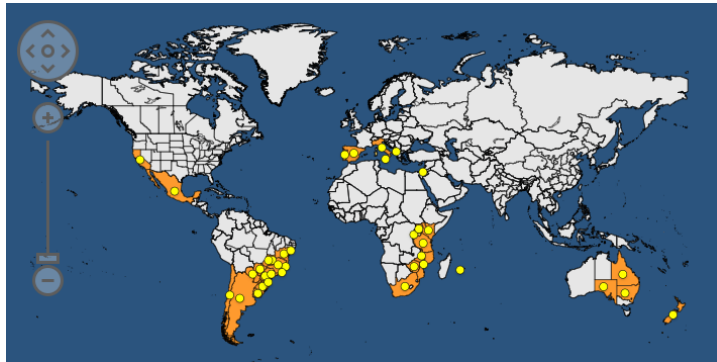
Climate change effects – Different aspects



Crop Distribution



Pest incidence



Introduction new pests



Biological control agents

PRISE- Early warning systems

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Improving lives by solving problems in agriculture and the environment

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PRISE: a Pest Risk Information Service

Pests can decimate crops and are estimated to cause around a 40% loss. These insects, mites and plant pathogens can impact on food security and impede supply chains and international trade. A Pest Risk Information Service (PRISE) aims to solve this problem by using data to help farmers manage pests in up to six countries in sub-Saharan Africa.

[Overview](#)[Results](#)[The team](#)[Donors](#)[Partners](#)[Related news](#)

Modeled Potential distribution of RPM in South America using Maxel

The potential dispersion of *R. indica* to other regions of South America could seriously impact the cultivation of coconuts, bananas, exotic and native palms and tropical flowers such as the Heliconiaceae.

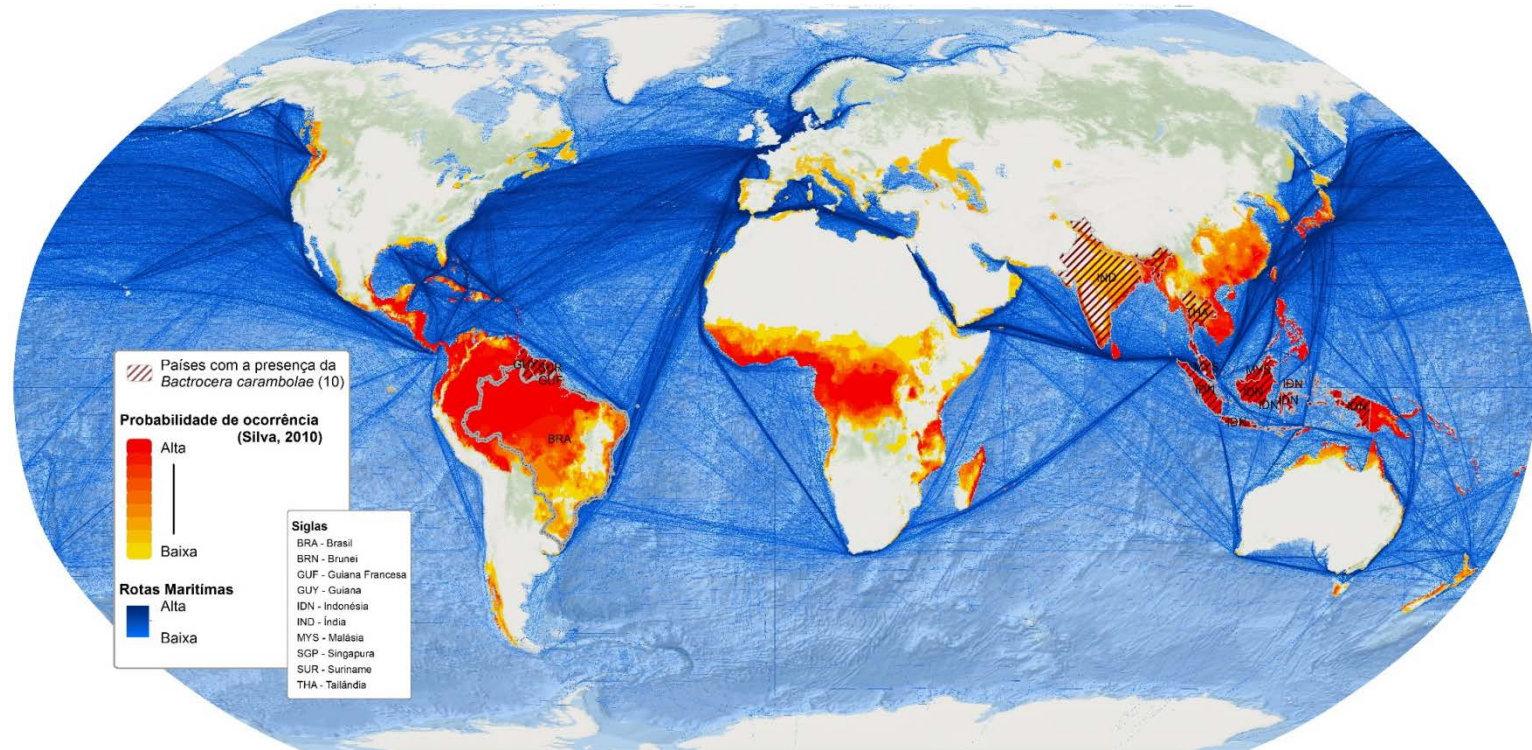


Fig. 4 Modeled potential *Raoiella indica* distribution in South America using Maxent

Source: Amaro & de Moraes, 2012

Climatic conditions and predicted climate change Vs Potential establishment areas around the world

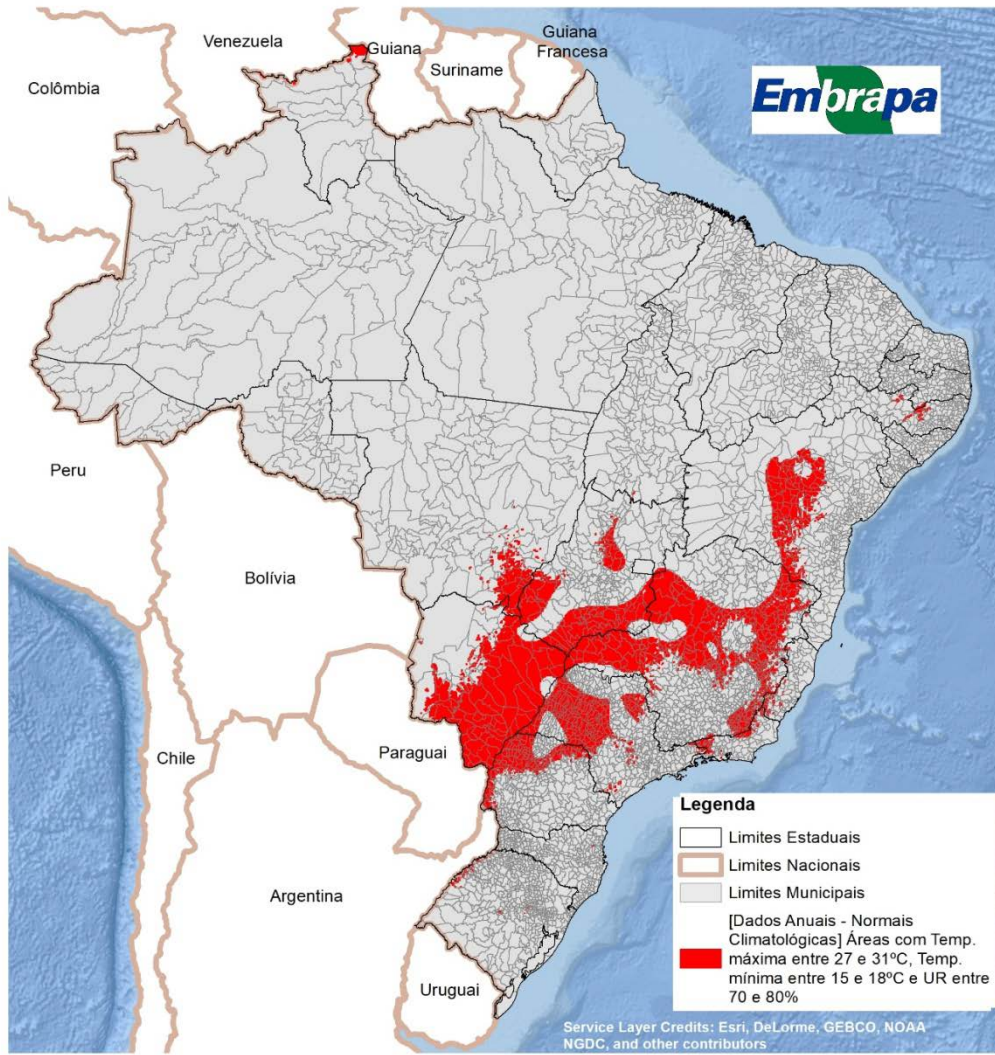
*Presence of *Bactrocera carambolae* and potential regions for the establishment of the specie around the world*



Source: Silva (2010) and Halpern et al. (2008)

Elaborated by: Marinho-Prado et al. (no prelo). EMBRAPA Territorial

Prevention of entry and contingency actions for quarantine pest in Brazil – Influence of predicting increasing temperatures



More suitable areas for the occurrence of *Thaumastocoris peregrinus*

Source: EMBRAPA Territorial, IBGE (2013); INDE (2010); INMET (2016)

Elaborated by: Pessoa et al. (2016)

Prevention of entry and contingency actions for quarantine pest in Brazil – Influence of predicting increasing temperatures



More suitable areas for the occurrence of *Thaumastocoris peregrinus*

At least 1 month with Max Temperature between 27 and 31°C

Source: EMBRAPA Territorial, IBGE (2013); INDE (2010); INMET (2016)

Elaborated by: Pessoa et al. (2016)

The costs: A global problem...

Loss to the world economy as a result of invasive non-native species is estimated at 5% of annual production

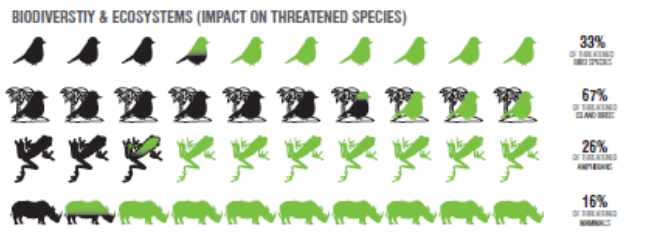


Global costs estimated at > \$1.4 trillion USD

THE IMPACT OF INVASIVE SPECIES ON OUR PLANET

1958

PHRASE "INVASIVE SPECIES" FIRST USED

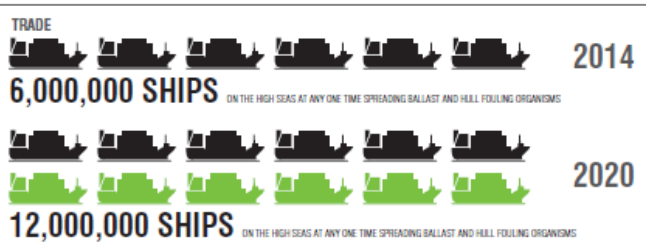


TOURISM

TRAVEL



TRADE



TRANSPORT

2014

ESTIMATED TOTAL COST TO THE PLANET

US\$1.4,000,000,000,000*

* BIOSCIENCE, APRIL 2011

Food Security

- Invasive weeds can reduce crop yields and stock carrying capacity by 90%

Health

- Major impact on humans and animals

Gender

- Weeding is a back-breaking and time consuming task often performed by women

Trade

- 40% of EU Border Rejections due to pesticide residues

Biodiversity

- Biggest threat after habitat loss

What factors affect food security worldwide?

Food Safety - Sustainable production



Farmer's first response to pests and diseases affecting crops = chemical control

Problems with technology of application

Farmers tend to use the same i.a or products of the same chemical group for an extended period of time

Resistant Arthropods Leading the Global List

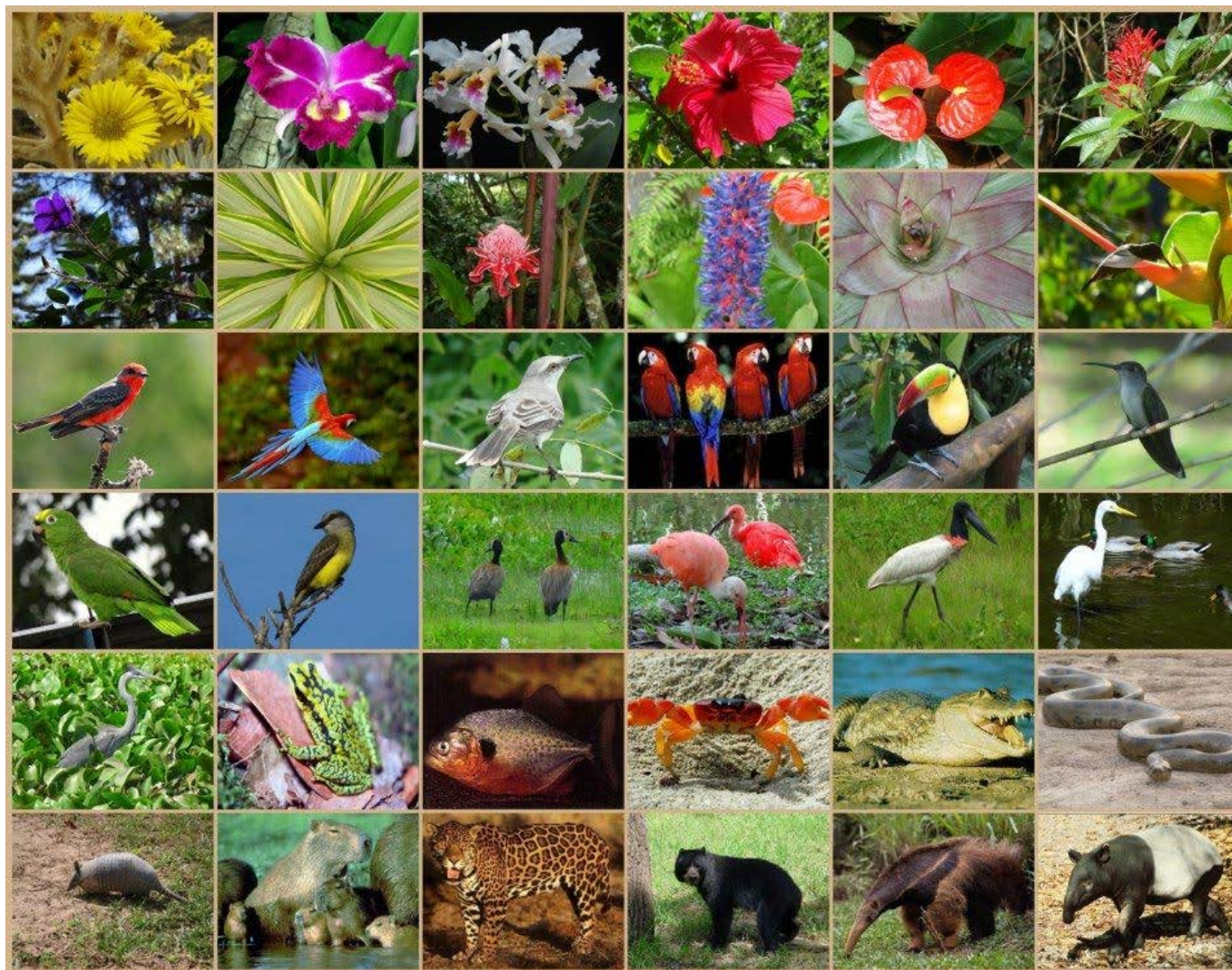
Common Name	Species	Order	No. active ingredients
Two Spotted Spider Mite	<i>Tetranychus urticae</i>	Acari	79
Diamondback Moth	<i>Plutella xylostella</i>	Lepidoptera	76
Green Peach Aphid	<i>Myzus persicae</i>	Hemiptera	68
Colorado Potato Beetle	<i>Leptinotarsa decemlineata</i>	Coleoptera	48
Silverleaf Whitefly	<i>Bemisia tabaci</i>	Hemiptera	39
European Red Mite	<i>Panonychus ulmi</i>	Acari	38
Cotton Aphid	<i>Aphis gossypii</i>	Hemiptera	37
Cotton Bollworm	<i>Helicoverpa armigera</i>	Lepidoptera	33
Tobacco Budworm	<i>Heliothis virescens</i>	Lepidoptera	33
Egyptian Cotton Leafworm	<i>Spodoptera littoralis</i>	Lepidoptera	30

Source: Arthropod Pesticide Resistance Database – Michigan State University (2015)



Potential for the Use of Biological Control in LAC

Neotropical Region– High Biodiversity



Neotropical Region

High Biodiversity and high potential for the implementation of biological control programs



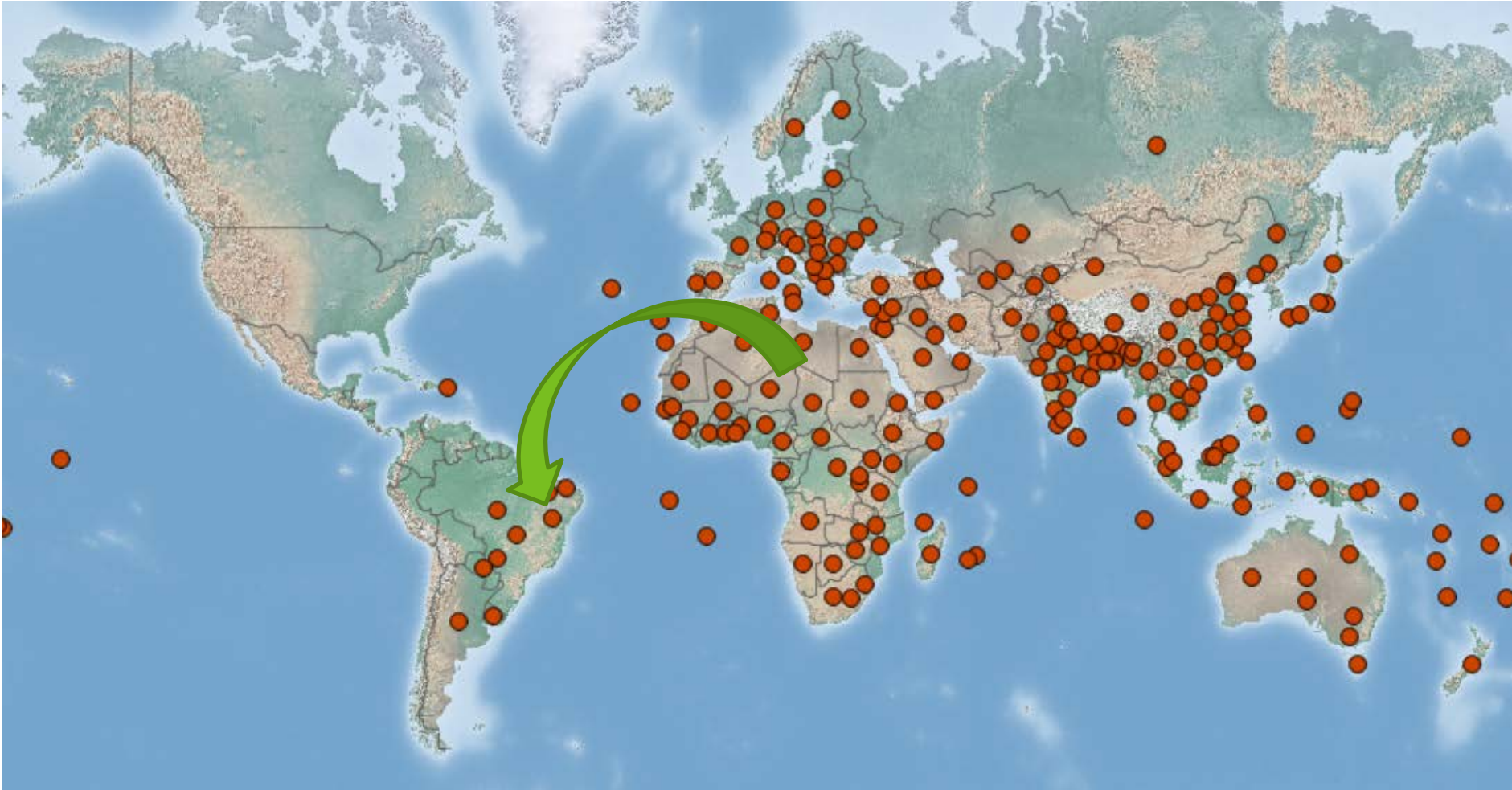
Helicoverpa armigera (Lepidoptera: Noctuidae)



- It was introduced in Brazil in 2013 - Czepak et al. (2013)
- It caused **significant economic losses** attacking key commodities in the country: Soybean, Cotton, corn, among others.
- Despite the efforts to control the pest with chemical control farmers did not get a good control, this was a favourable situation for the use of Biological Control agents.
- More than 2 billions of USD lost in Europe (Ávila et al., 2013)

Helicoverpa armigera (Lepidoptera: Noctuidae)

Distribution



CABI, 2018

Change of practices of control

Chemical vs Biological Control

<https://www.grupocultivar.com.br/artigos/helicoverpa-pelo-brasil-mudanca-de-habitos>

Helicoverpa pelo Brasil: mudança de hábitos

#Grandes Culturas, #Pragas

Whatsapp

Tweetar

Compartilhar 0

G+

Compartilhar



A agricultura brasileira é, historicamente, um dos principais alicerces da economia do País, desde os primórdios da colonização até o século 21, evoluindo dos grandes monocultivos para a diversificação da produção. A atividade agrícola faz parte do setor primário, onde se cultiva e se colhe para subsistência, exportação ou comércio.

Segundo as projeções do agronegócio publicadas pelo Ministério da Agricultura,

Helicoverpa armigera (Lepidoptera: Noctuidae)

Management



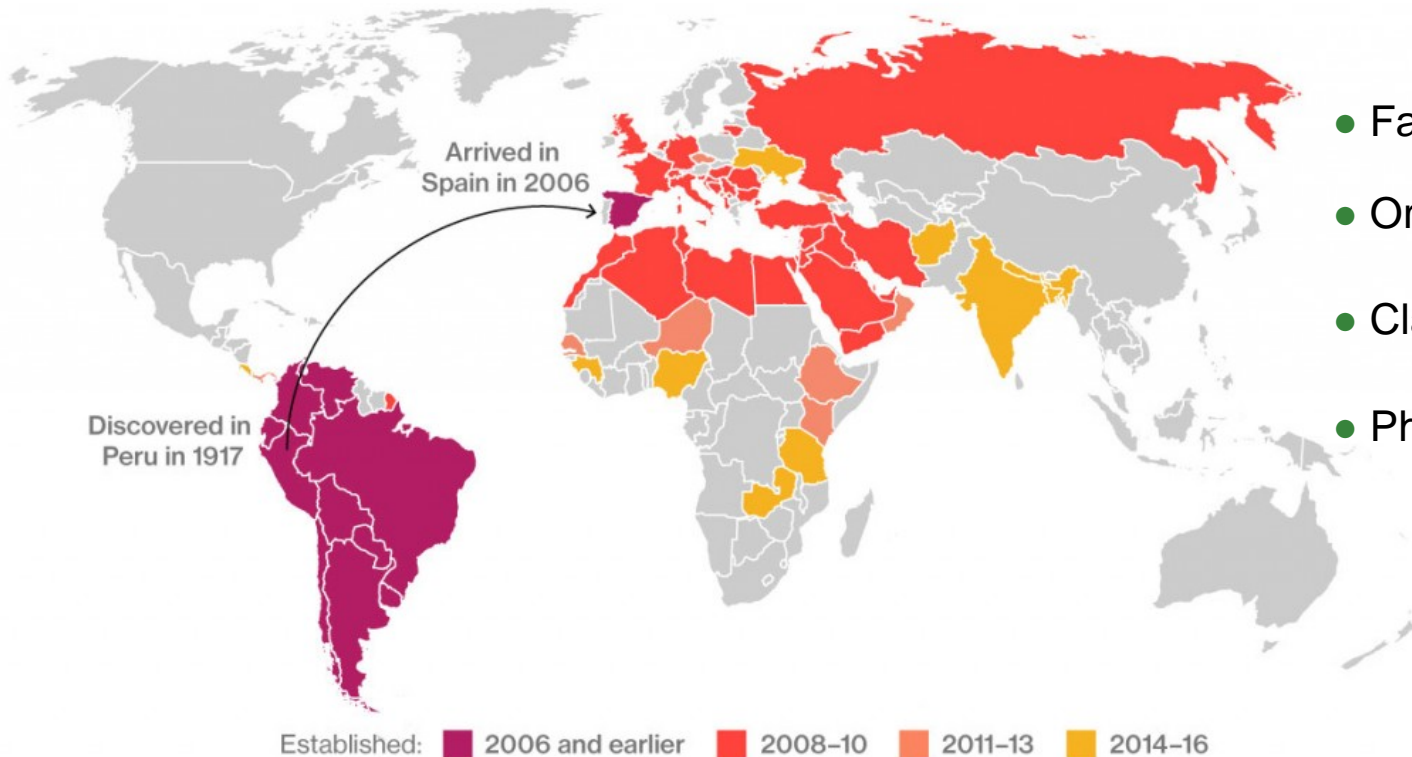
Trichogramma pretiosum

- The biological control program of *H. armigera* has been implemented with the use of inundative releases of *Trichogramma pretiosum*.
- After its introduction to Brazil the adoption of Biological Control as control method increased due the difficulties in controlling the pest with chemical control.
- Cultural practices and use of Entomopathogens are part of the IPM package of control

Tuta absoluta (Meyrick, 1917)

The Pest That's Infesting Tomato Crops

Since 2008, *Tuta absoluta* has spread to 15 African countries and driven up costs for both farmers and consumers



- Family: Gelichiidae
- Order: Lepidoptera
- Class: Insecta
- Phylum: Arthropoda

Sources: European and Mediterranean Plant Protection Organization (2005), Office of International Research, Education, and Development, Virginia Tech

Tuta absoluta damage

Tomato leafminer

- Attacks all aerial parts of the host
- Can be spread by seedlings,
- Economic impact
- Increase in the cost of tomato production (additional costs for crop protection)



Management of *T. absoluta*

Biological Control



Weekly release of the parasitoid
100.000 300.000 parasit./ hectare

+



Bacillus thuringiensis

Potencial vs Use

Natural Enemies of *Tuta absoluta*

Parasitoids of eggs

<i>Trichogramma</i> spp.	Trichogrammatidae	Hym.
<i>Anastatus</i> sp	Eupelmidae	Hym.
<i>Arrhenophagus</i> sp.	Encyrtidae	Hym.
<i>Copidosoma</i> sp.	Encyrtidae	Hym.
<i>Copidosoma desantisi</i>	Encyrtidae	Hym.
<i>Copidosoma hoehleri</i>	Encyrtidae	Hym.

Potencial vs Use

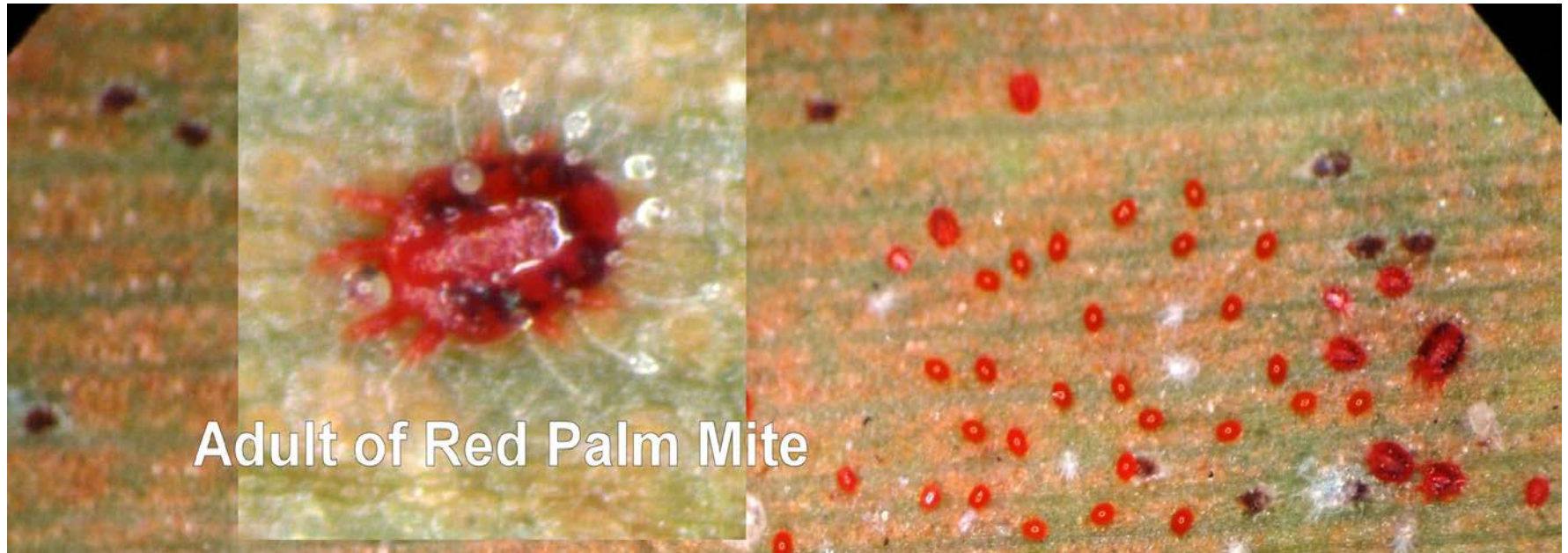
Naturales enemies of *T. absoluta*

Predators reported: Van Lenteren (2016)

<i>Campyloneuropsis infumatus</i>	Miridae	Hem.
<i>Engytatus vaians</i>	Miridae	Hem.
<i>Maccroplophus basicornis</i>	Miridae	Hem.
<i>Orius insidiosus</i>	Anthocoridae	Hem.
<i>Geocoris punctipes</i>	Geocoridae	Hem.

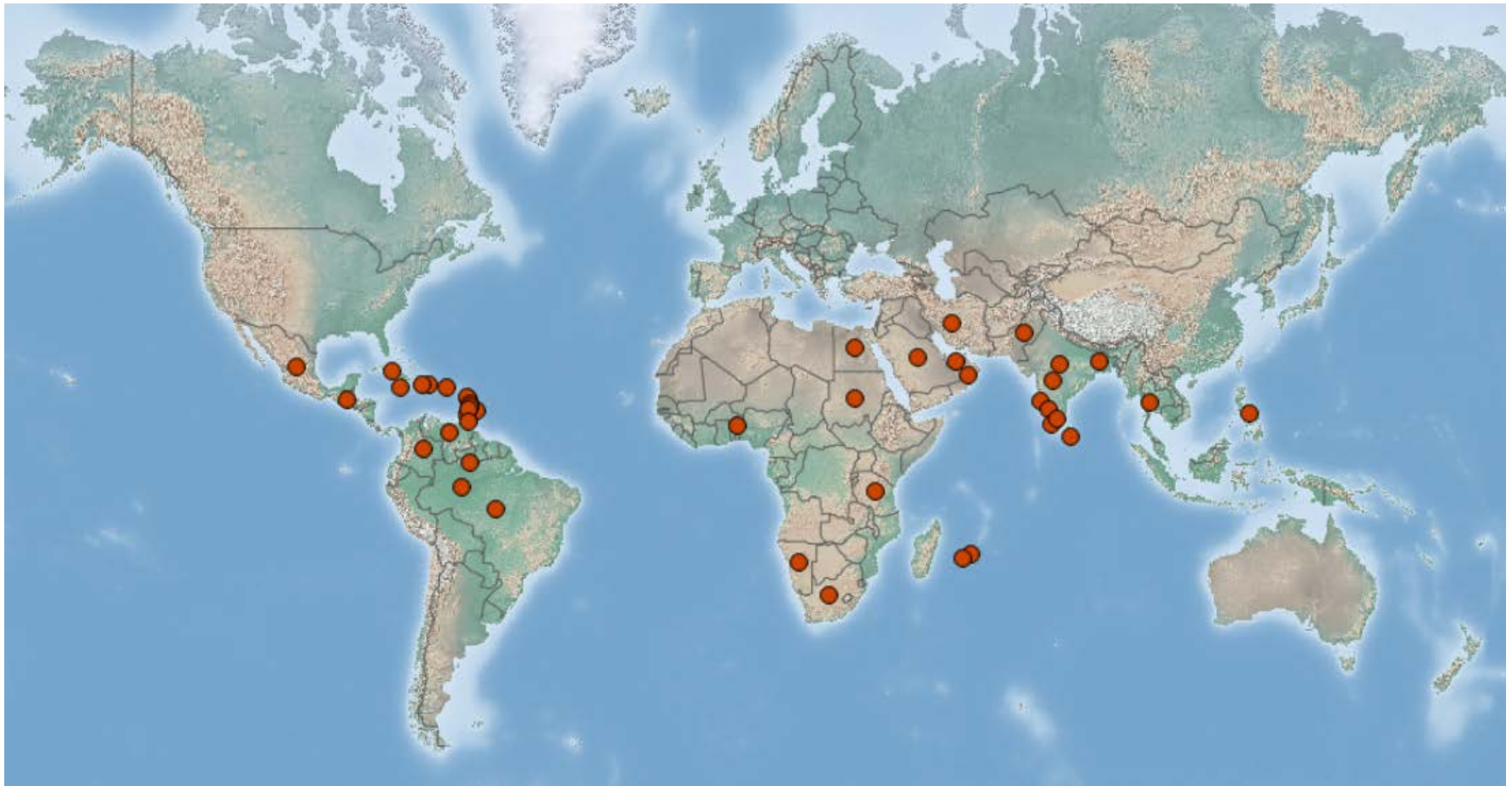


Red Palm Mite – *Raoiela indica* (Acari: Tenuipalpidae)

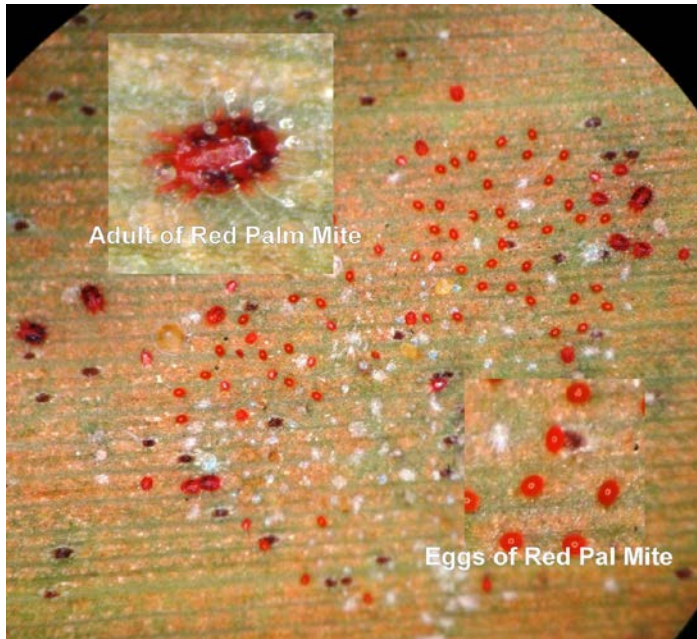


- It was introduced in the Caribbean in 2004 and rapidly spread to several Caribbean countries, United States of America, Mexico, Venezuela, Colombia and Brazil.
- Cause significant damage in Coco production in the Caribbean, affecting also the Banana production in the region

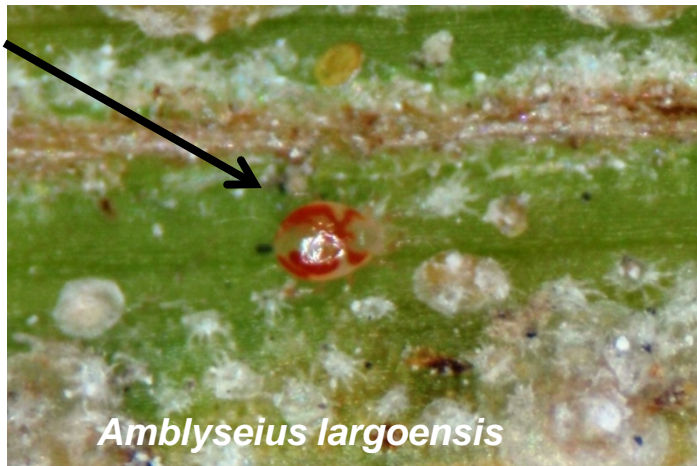
Red Palm Mite – *Raoiela indica* (Acari: Tenuipalpidae)



Red Palm Mite – *Raoiela indica* (Acari: Tenuipalpidae)



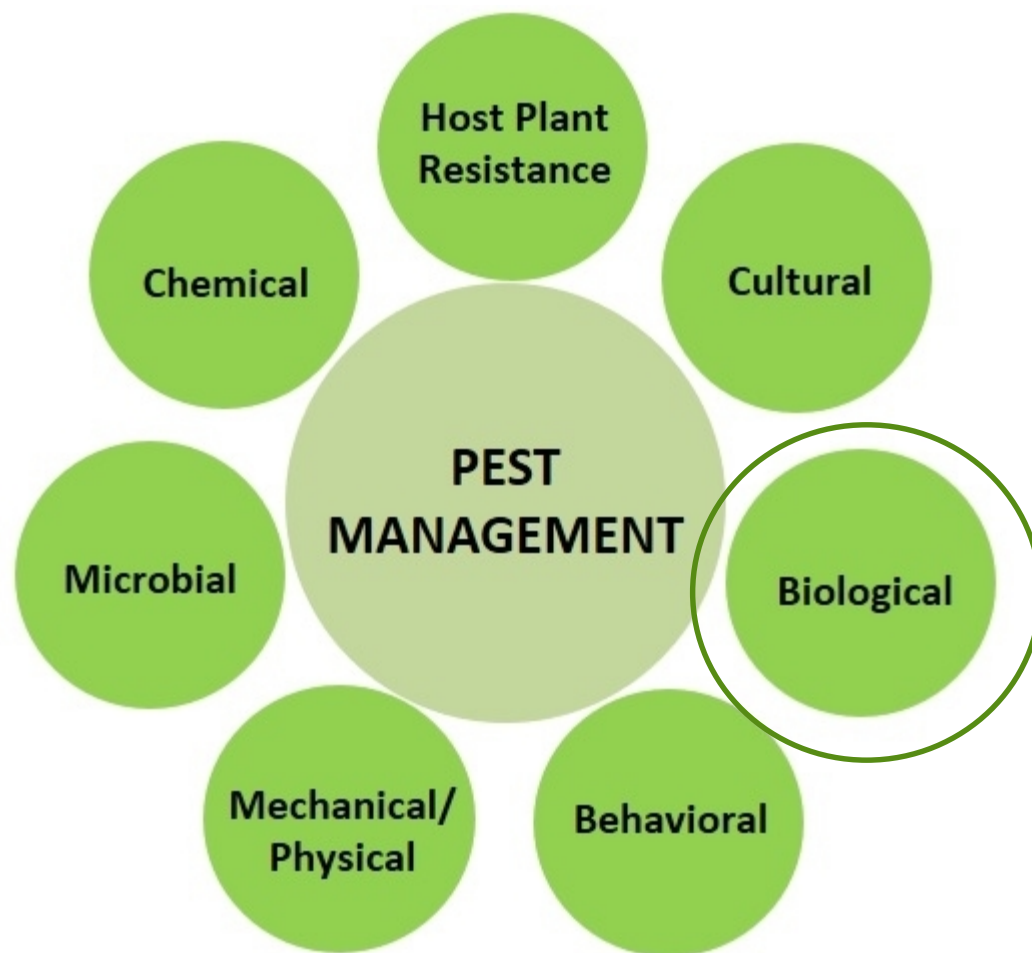
- One of its natural enemies (predatory mites) appears to have been introduced with the pest, identified as *Amblyseius largoensis*
- Other predators identified as N.E of the pest as *Chrysopa* sp., but limited availability in the market





Integrated Crop Management Sustainability, Food Security and Food Safety

Biological Control as part of Integrated Pest Management



Multidisciplinary collaboration platform

Didactic material - IPM



GUÍA PARA EL MANEJO DE PLAGAS : LISTA VERDE

Gusano minador del tomate

Tuta absoluta



Larva de *T. absoluta* (Marja van der Straten, NVWA Plant Protection Service, Bugwood.org)



Adulto de *T. absoluta* (Marja van der Straten, NVWA Plant Protection Service, Bugwood.org)



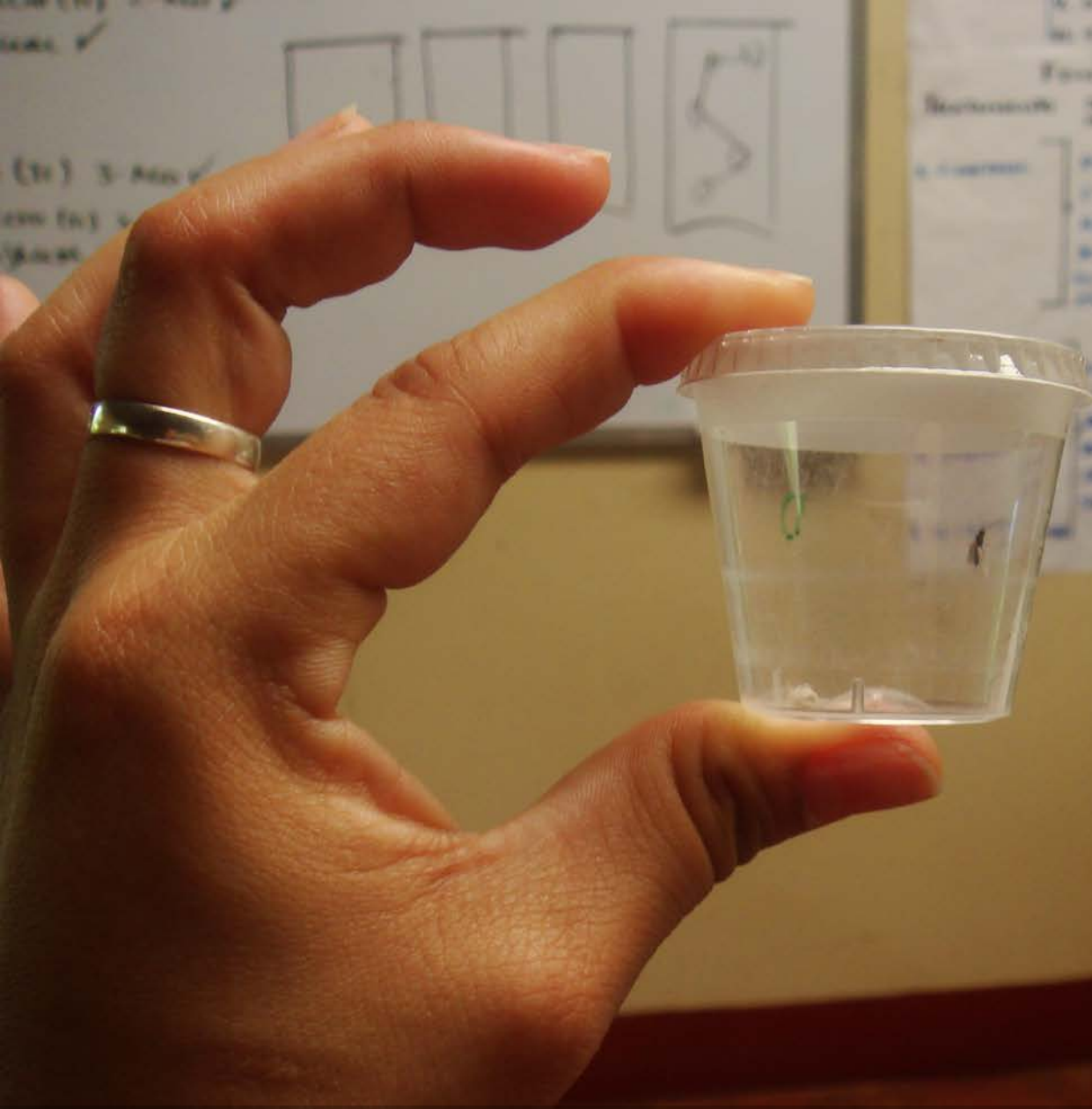
Agujeros de salida en frutos de tomate (Peter Kodwaran, Ministry of Agriculture Livestock and Fisheries, West Pokot)

Prevención	Monitoreo	Medida curativa
<ul style="list-style-type: none"> ◆ Usar plántulas libres de plagas. Inspeccionar nuevas plántulas cuidadosamente antes de trasplantarlas en el campo o en invernaderos ◆ Tapar los marcos de puertas y ventanas del invernadero, y las aberturas con malla a prueba de insectos (con malla inferior a 1.6 mm) ◆ Retirar y destruir las malezas que actúan como plantas hospederas alternativas, ej: <i>Datura</i>, <i>Solanum</i> ◆ Limpiar las herramientas después de su uso en campos infestados ◆ Evitar la rotación de cultivos con solanáceas como berenjenas, papas (patatas), tomates y chiles dulces (pimientos) ◆ Inspeccionar los contenedores de cosecha, cajas de campo y materiales de embalaje. Destruir o desinfectar si se sospecha la presencia de <i>T. absoluta</i> ◆ Destruir los residuos de plantas después de la cosecha (quemar o enterrar) 	<ul style="list-style-type: none"> ◆ Monitorear temprano para los daños causados por <i>T. absoluta</i> en hojas, tallos y frutos, especialmente en la parte superior de la plántula por: <ul style="list-style-type: none"> ○ Huevos en hojas y tallos ○ Minas y excrementos en las hojas, tallos y frutos. Las minas en hojas son anchas y se vuelven marrones y necróticas. Las minas en frutas causan pudrición ○ Agujeros de salida en la superficie de los frutos ○ Adultos en el envés de las hojas ◆ Usar trampas de feromonas, de luz o amarillas adhesivas para detectar temprano la presencia de la plaga ◆ Colocar una trampa de feromonas por un lote de menos de 3 500m² y dos trampas por lote más grande. Colocarla a la misma altura que el cultivo y revisar cada semana y notar los números de adultos capturados. Después de contar los adultos, limpiar las trampas cuidadosamente. Asegúrese de no mojar las feromonas 	<ul style="list-style-type: none"> ◆ Retirar las plantas infestadas y quemar o enterrar a una profundidad de más de 50 cm ◆ No tirar los frutos infestados en los bordes del campo, los puntos de recolección o en los mercados ◆ Aplicar productos del nim en el suelo, parte superior de las hojas o directamente en las larvas para matarlas ◆ Cuando las poblaciones de <i>T. absoluta</i> son bajas (1-3 adultos capturados por semana) usar trampas de agua con feromonas para atrapar en masa los adultos y reducir las poblaciones ◆ Liberación de enemigos naturales como la avispa <i>Trichogramma</i>, hemípteros y ácaros depredadores disponibles en su país

Note: Plaguicidas pueden estar disponibles para el control de esta plaga. Consulte con el Ministerio de Agricultura de su país para saber qué plaguicidas están registrados en su país y las restricciones locales para su uso.

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- Weevil
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
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Continuous Farmers training





Sustainable approaches can significantly reduce the negative effects of conventional systems while contributing to increased Food Security and Food Safety

Join forces - Surveillance and detection Early awareness system



Invasive Species

- Necessary to establish partnership in order to have a regional approach
- Development a platform for information exchange between NPPOs – Scientific community

US Dept of State, Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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