Climate change and pest risk assessment

2022 Annual Meeting of the International Pest Risk Research Group

October 10-13, 2022, Athens, Greece

Programme Booklet

in Association with
Benaki Phytopathological Institute, Greece
European and Mediterranean Plant Protection Organization (EPPO),
European Food Safety Authority (EFSA),
University of Thessaly, Greece &
Cervantes Agritech, Australia

Dear Attendee,

Welcome to the 2022 annual meeting of the International Pest Risk Research Group. Followed by a three-year lockdown period caused by worldwide COVID-19 epidemic, we move to Athens, Greece. The theme of our meeting this year is "Climate change and pest risk assessment". Climate change impacts the movement of agricultural and forestry products and the survival of novel invasive threats worldwide. There is emerging evidence that recent historical climatic changes have resulted in dramatic effects on the geographical range and impacts of both endemic and invasive alien pests, making the protection of national borders against new pest invasions increasingly difficult. The economic consequences of climate change will, in turn, change pathways and alter invasive species risk patterns. Climate change has been identified by EFSA and EPPO as the highest priority emerging concern in relation to pest risk modelling and assessment. This year we wish to focus attention on key impacts of climate change on pest risk assessment, to better understand and prepare for the emerging challenges, with a particular focus on the following topics:

- Trends, magnitude and uncertainties in climate change
- The interpretation of climate change scenarios. Appropriate framing of the risk assessment problems and communicating PRA scenarios
- The sensitivity of pests to climate change. How important are the effects of climate change on PRA?
- Evidence for changes in pest ranges and impacts in response to climatic changes, including case studies
- The strengths and weaknesses of different models for estimating species ranges under climate change
- Can current PRA tools include emerging threats due to climate change accurately and adequately, considering establishment, host crop exposure, and the distribution of impacts, etc.?
- How should future climate scenarios be incorporated into PRA?
    - Adaptive management (stress test, contingency plan, targeted surveillance and monitoring of lead variables)?
    - Standard emission scenario?
    - Which GCMs, and how should the results be considered?
- Understanding the appropriate time horizon for PRA
    - How far into the future should a PRA consider?
    - What are the factors that should guide this horizon?
- Monitoring and horizon scanning for emerging pest threats
    - What datasets, models and methods are useful to recognize emerging threats?
    - How can we apply them cost-effectively?
    - How can we identify and characterize emerging threats?
    - How should we curate and share data on changing threats?
- Managing emerging pest threats under substantial climate uncertainty

This meeting would not have been possible without the efforts of the Benaki Phytopathological Institute, Greece, University of Thessaly, Greece, European and Mediterranean Plant Protection Organization (EPPO), European Food Safety Authority (EFSA) and Cervantes Agritech. We thank them all.

We hope you have a thought-provoking and valuable time in Athens, Greece.

Kindly,

Chair: Darren Kriticos, Cervantes Agritech, Australia
Vice-Chair: Denys Yemshanov, Natural Resources Canada, Canadian Forest Service, Canada
Secretary-Treasurer: Melanie Newfield, New Zealand
Communications Officer: Frank Koch, USDA Forest Service, USA
Student Representative: Ruan Carlos Oliveira, Federal University of Ceara, Brazil
Local Organizing Committee:
Panos Milonas, Benaki Phytopathological Institute, Greece
Iro Georgopoulou, Benaki Phytopathological Institute, Greece
Eleni Verykouki, University of Thessaly
Françoise Petter, European and Mediterranean Plant Protection Organization
Giuseppe Stancanelli, European Food Safety Authority

Programme

Day 1 – Monday, October 10, 2022

Location: Ionic Centre, 1st Floor

8:00 *Registration*

Introduction to the meeting (Moderator: Darren Kriticos)

8:30 Welcome to IPRRG 2022 – Darren Kriticos

8:40 Welcome address: *Annoula Mavridou (Director of Hellenic Ministry of Rural Development and Food, Directorate of Plant Produce Protection, Greece)*

9:00 IPRRG: Accomplishments, intentions and meeting outline – *Darren Kriticos*

Technical Session: The value of PRAs and policy perspectives
Moderator: Tomasz Kaluski

9:30 (1) A matter of trust – perceptions of the value of pest risk assessments – *Melanie Newfield, Susanna Finlay-Smits, Christine Reed, & John Kean*.

9:50 (2) The cost of phytosanitary programmes for surveillance of plant pests in the EU - *Berta Sánchez, Fabiola Di Bartolo, Emilio Rodríguez Cerezo & Jesus Barreiro-Hurlé.*

10:10 (3) EPPO approach to climate modelling for establishment in continent-wide PRAs - *Muriel Suffert, Camille Picard, Rob Tanner, Fabienne Grousset, Françoise Petter.*

10:30 Break

11:00 Brief introductions from meeting participants (*In 30 seconds or less, who are you, where are you from, for whom do you work, and why are you interested in this meeting?*)

11:30 (4) Three years experience of commodity risk assessment of high-risk plants: spotting new potential threats - *Ciro Gardi, Alzbeta Mikulova, Giuseppe Stancanelli & Agata Kaczmarek*.

11:50 (5) EFSA Pest categorisations of emerging pests in support of plant health quarantine legislation - *Virag Kertesz, Franz Streissl, Philippe Reignault, Alan MacLeod, Oresteia Sfyra, Andrea Maiorano & Giuseppe Stancanelli.*

12:10 Group photo!

12:20 Lunch

Technical Session: Changing pest threats through time and horizon-scanning (Pt 1)
Moderator: Muriel Suffert

13:50 (6) Irrigation can create new green bridges that promote rapid intercontinental spread of wheat rust pathogens - *Catherine Bradshaw, William Thurston, David Hodson, Tamas Mona, Jacob Smith, Sarah Millington, Gerald Blasch, Yoseph Alemayehu & Christopher Gilligan.*

14:10 (7) Improving irrigation data for pest modelling using Earth observation data and techniques - *Tim Beale, Darren J. Kriticos, Gerardo López-Saldaña & Bryony Taylor.*

14:30 (8) Progress and challenges for real-time pest risk modelling for fruit flies - *Darren J. Kriticos, Anna Szyniszewska, Karol Kozyra, Chronis Velentzas & Nikos T. Papadopoulos.*

14:50 (9) Horizon scanning of plant pests at EFSA: experience and future prospects - *Sara Tramontini, Magali Larenaudie, Evgenia Sarakatsani & Sybren Vos.*

15:10 Break

Technical Session: Changing pest threats through time and horizon-scanning (Pt 2)
Moderator: Panagiotis Milonas

15:40 (10) Emerging pests in the European Union: European Food Safety Authority pest survey toolkit to support EU risk managers - *Tomasz Kaluski, Sybren Vos, Melanie Camilleri, Jose Cortinas, Alice Delbianco, Ignazio Graziosi, Elena Lázaro, Juan A. Navas-Cortés, Stephen Parnell, Francesco Pecori, Martijn Schenk, Evgenia Sarakatsani, Hans-Herman Thulke, Sara Tramontini & Antonio Vicent.*

16:00 (11) How commodity risk assessment for forestry plant pests helps to identify new plant health threats and to assess the efficacy of risk reduction options - *Alzbeta Mikulova, Giuseppe Stancanelli, Paolo Gonthier, Andrea Battisti, Hugo Mas, Daniel Rigling, Giovanni Jacopetti, Fabio Stergulc & Massimo Faccoli.*

16:20 (12) Climate suitability analysis in the context of EFSA Pest Risk Assessment. Current status and future challenges - *Andrea Maiorano, Caterina Campese & Giuseppe Stancanelli.*

16:40 (13) The abundance of Australian plant species under climate change scenarios and conservation interventions - *Anca Hanea, James Camac, John Morgan & Adrienne Nicotra*.

17:00 Announcements

17:10 Adjourn

Day 2 – Tuesday, October 11, 2022

Location: Ionic Centre, 1st Floor

8:30 Welcome to the day

Technical Session: Assessing New Threats in a Changing Climate
Moderator: Melanie Newfield, Ciro Gardi

8:40 (14) Climate change impact on potential global distribution of *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae) - *Iro Georgopoulou, Antigoni Akrivou, Sonia Baldi, Dimitrios Papachristos, Panagiotis Milonas & Darren J. Kriticos.*

9:00 (15) Climate change, abiotic stressors and bark-beetle outbreaks: could cases from Europe be extended to assessing risks from non-native pests? – *Ciro Gardi & Jean Claude Gregoire*.

9:20 (16) No time for complacency: Changing fruit fly threats in a warming world - *Anna M. Szyniszewska, Karol Kozyra, Hanna Gąsiorowska, Noboru Ota, Nikolaos Papadopoulos & Darren J. Kriticos.*

9:40 (17) Phenology and ecology of *Philaenus spumarius* L. inform risk assessment for *Xylella fastidiosa* Wells in Switzerland - *Ramona Maggini, Attilio Rizzoli, Samuele Peduzzi & Dominique Mazzi.*

10:00 (18) The current and emerging potential global distribution of Californian thistle (*Cirsium arvense*) - *Jessica M. Kriticos, Graeme W. Bourdôt, Shona Lamoureaux & Darren J. Kriticos.*

10:20 Break

10:50 (19) Climate change, and changes in trade and pest pathways for biosecurity and food security - *Tom Kompas, Christine Li, James Camac & Ha Van Pham.*

11:10 (20) Uncertainty in pest risk analysis: bane or boon? - *Alan MacLeod*.

11:30 *Climate change and Pest Risk workshop:* Introduction and first session
Focus group meetings to explore content topics, identify potential contributors for the submissions to EPPO Bulletin and agree timelines.
Facilitator: Darren Kriticos

12:10 Lunch – (Students special meeting)

13:20 *Climate change and Pest Risk workshop:* second session
Facilitator: Darren Kriticos

15:30 Break

15:50 Reporting the results of brainstorming discussions in focus groups and setting timelines for submissions.

16:30 Poster Session

18:00 Masticha on the roof reception

Day 3 – Wednesday, October 12, 2022

Location: Ionic Centre, 1st Floor

8:30 Welcome to the day and local announcements

8:50 *Technical excursion with lunch (all times are approximate)*

9:00 - Bus to technical excursion

10:00 – 12:00 Technical excursion
12:30 – 13:30 Lunch
13:30 – 17:00 Technical excursion
17:00 – 17:40 Return to Athens

18:30 Group Dinner at Stou Korre restaurant (https://www.stoukorre.gr/portal/)

Day 4 – Thursday, October 13, 2022

Location: Ionic Centre, 1st Floor

8:30 Welcome to the day

Technical Session: Methods in pest risk assessment and surveillance

Moderator: Anna Szyniszewska

8:40 (21) Optimal sampling effort for border pest detection in low risk pathways - *Christopher Baker, Thao Le, Tom Waring & Andrew Robertson.*

9:00 (22) Using an information theoretic framework to quantify uncertainty in climate-based models for predicting the risk of pest establishment - *Sergio Estay, Carmen Silva & Daniela Lopez.*

9:20 (23) Hotspots for plant pests' introduction (HoPPI): identify priority areas to prevent new plant pest invasions - *Maria Chiara Rosace, Martina Cendoya, Davide Nardi, Lorenzo Marini, Andrea Battisti, Antonio Vicent & Vittorio Rossi.*

9:40 (24) A role for process-based population dynamics models in pest risk management: The oriental fruit fly, *Bactrocera dorsalis* - *Eleni Verykouki*, *Anna Szyniszewska, Hanna Gasiorowska, Kyungsan Choi & Darren J. Kriticos.*

10:00 Break

10:20 (25) Incidence of cassava mosaic viruses (African cassava mosaic virus and East African cassava mosaic virus) in whitefly on cassava in Ibadan, Nigeria - *Prisca C. Nwachukwu*, *Lava P. Kumar & Gabriel I. Atiri.*

10:40 (26) The Pest Risk Information Service (PRISE): an Earth observation driven within-crop season early-warning service providing times to intervention against insect crop pests for Sub-Saharan African farmers - *Alyssa Lowry*.

11:00 Voting for the best IPPRG 2022 presentations and posters

11:20 IPRRG Executive Committee Elections

11:40 Presentation of IPPRG 2022 awards for presentations winners

11:50 Working Lunch - *Past, present, and future of IPRRG*

All are invited to attend this important meeting, which provides an opportunity for members to understand the operations of IPRRG, to inform IPRRG leaders of specific needs, and to help shape the direction of the organization. (Please consult the handout for critical information)

1. Membership status (Chair / Secretary-Treasurer)
2. IPRRG finances / balance sheet (Secretary-Treasurer)
3. Communications issues (Chair / Communications Officer)
4. Student issues (Student Representative)
5. When and where is our next annual meeting? (Chair) - Host nominations and proposals for IPPRG 2023 and beyond (open to any IPRRG member)
6. Is there anything else we haven't covered?

14:00 Adjourn

14:10 IPRRG Group Activities (self-organized)

Posters:

Emerging pests in the European Union: The case of ToBFRV surveys in Malta - Melanie Camilleri, Alice Delbianco, Ignazio Graziosi, Tomasz Kaluski & Sybre Vos.

Climate change and pest risk assessment: making it fit for purpose - Martin Damus, Cheryl Corbett & Karen Castro.

Emerging pests in the European Union: Pest Survey Cards as a surveillance tool - Tomasz Kaluski, Alice Delbianco, Ignazio Graziosi, Melanie Camilleri, Evgenia Sarakatsani, Sara Tramontini & Sybren Vos.

Emerging pests in the European Union: European Food Safety Authority IT tools to support EU risk managers - Tomasz Kaluski, Subren Vos, Melanie Camilleri, Jose Cortinas, Alice Delbianco, Ignazio Graziosi, Elena Lázaro, Juan A. Navas-Cortés & Stephen Parnell.

Potential risk levels of invasive *Ophelimus eucalypti* (Gahan) (Hymenoptera: Eulophidae) in America areas - Priscila Kelly Farnezi, Fernanda de Coelho, Phillipe Souza, Ruan Mesquita, Marcelo Picanço, Ricardo Siqueira da Silva.

The potential global distribution of the invasive alien species *Melinis minutiflora* under current and future climates - Josiane C. Maciel, Ricardo S. Silva, Tayná S. Duque, Marinalva Santos, Ruan Mesquita, José B. Santos.

Assessing the confidence in pest freedom gained based on data from several years of pine wood nematode surveys - Mariela Marinova-Todorova, Juha Tuomola, Niklas Björklund, Johanna Boberg & Salla Hannunen.

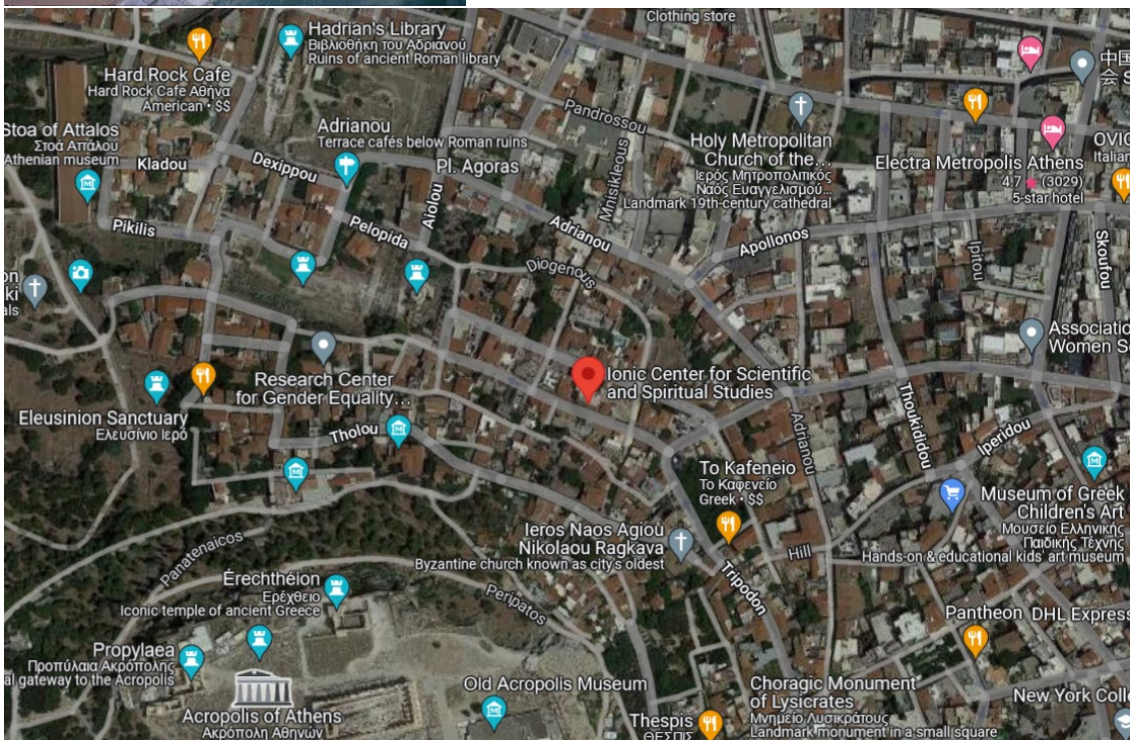
Gaining a mechanistic understanding for threats emergence through horizon scanning - Evgenia Sarakatsani.

The EPPO Platform on Pest Risk Analysis, a tool to foster collaboration on PRA in Europe and beyond - Muriel Suffert & Damien Griessinger.

Global burden of crop loss – Building framework of an evidence-based information system - Anna M. Szyniszewska, Daniel Bebber, Molly Brown, Alice Milne, Nicola Pounder, Jeffrey Ried, Tom M. Chaloner, Alyssa Lowry & Cambria Finegold.

Venue:

The meeting will take place in the Ionic Centre for Scientific and Spiritual Studies, which is located in a neoclassical style building in the Plaka neighborhood, a few minutes' walk from the walls of the Acropolis and the Parthenon – see more information on http://www.ionic.gr/en/history



There are many affordable lodging options close to the Ionic Centre. The list of nearby hotels with relevant location and accommodation information can be downloaded from IPRRG 2022 portal: https://secureservercdn.net/198.71.190.156/y8u.a95.myftpupload.com/wp-content/uploads/2022/09/IPRRG2022_hotel_list.xlsx

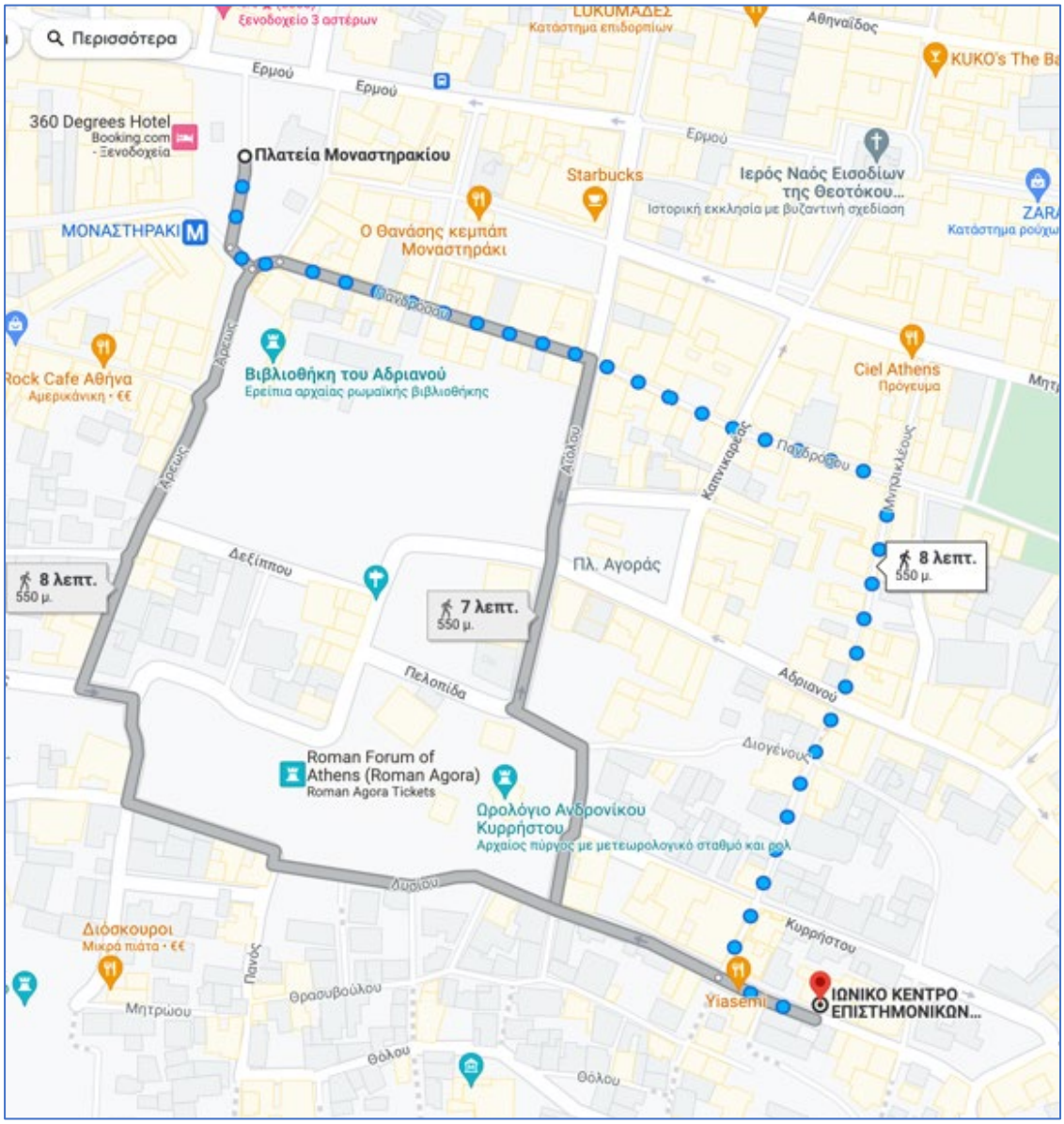
Information about the venue, day tour, dinner.

Ionic Center (Lyciou 11, Athens 105 56) is in the historic neighborhood of Plaka at the base of the Acropolis. The Ionic center is easily accessible from the Monastiraki metro station (8-minute walk through the picturesque streets of Plaka, 7-minute walk from the Acropolis metro station and 10-minute walk from Syntagma square.

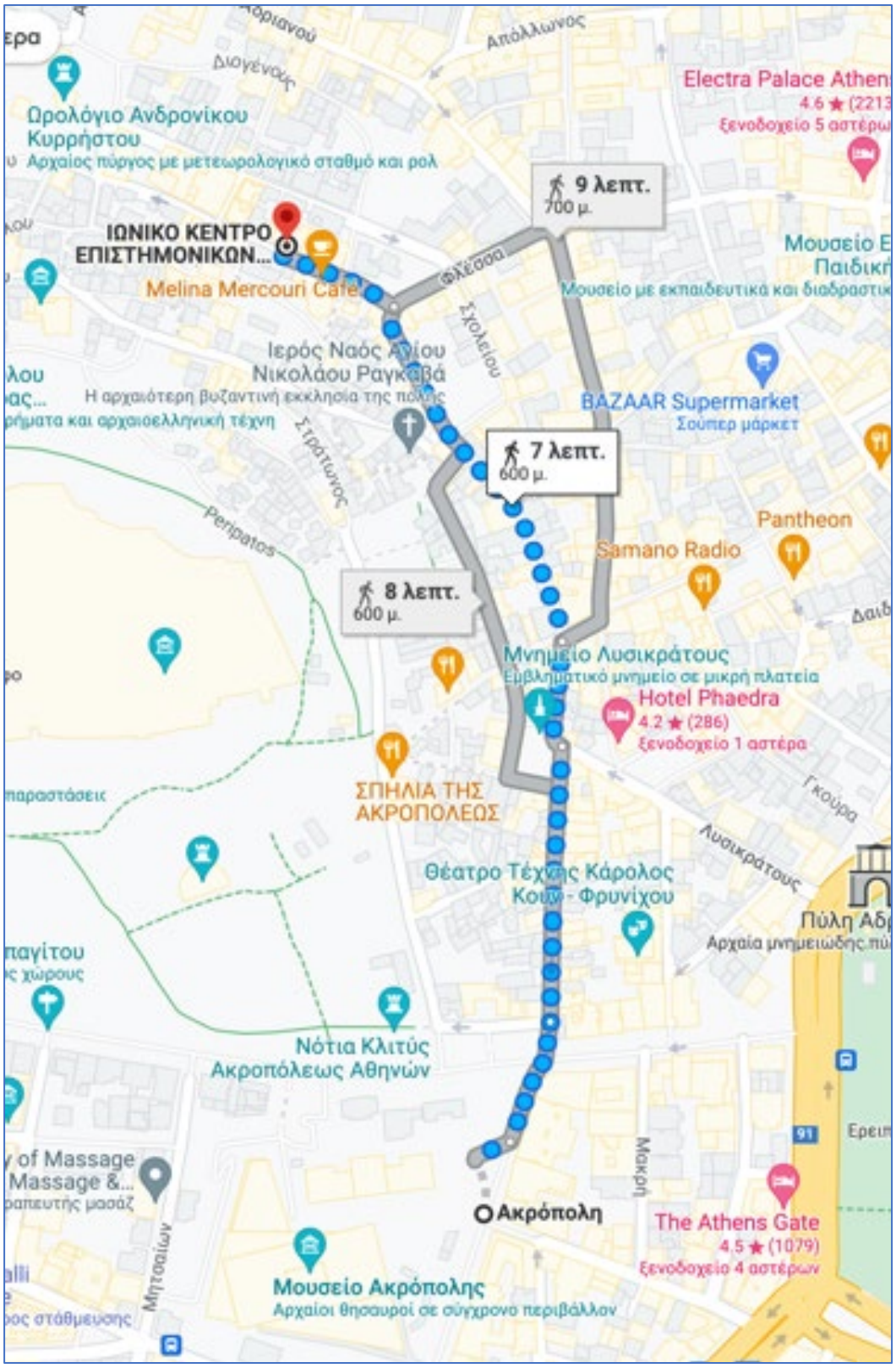
Information about Athens for visitors and travelers can be found in this link: https://www.thisisathens.org/

There are plenty of restaurants and shops in the area and they stay open until very late.

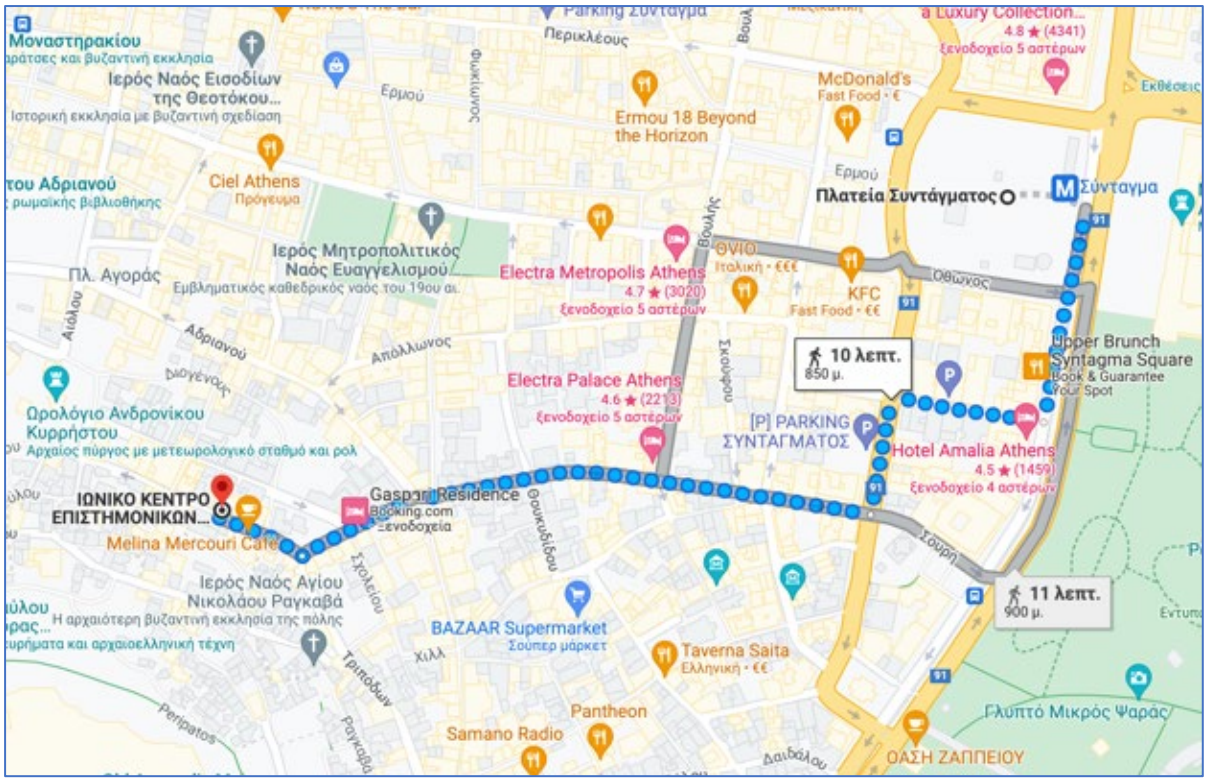
Route from Monastiraki station



Route from Acropolis metro station



Route from Syntagma square:



Technical tour:

Wednesday October 12th is scheduled for a whole-day tour. We will start with a guided tour at the Acropolis from 9:00 to 11:00.

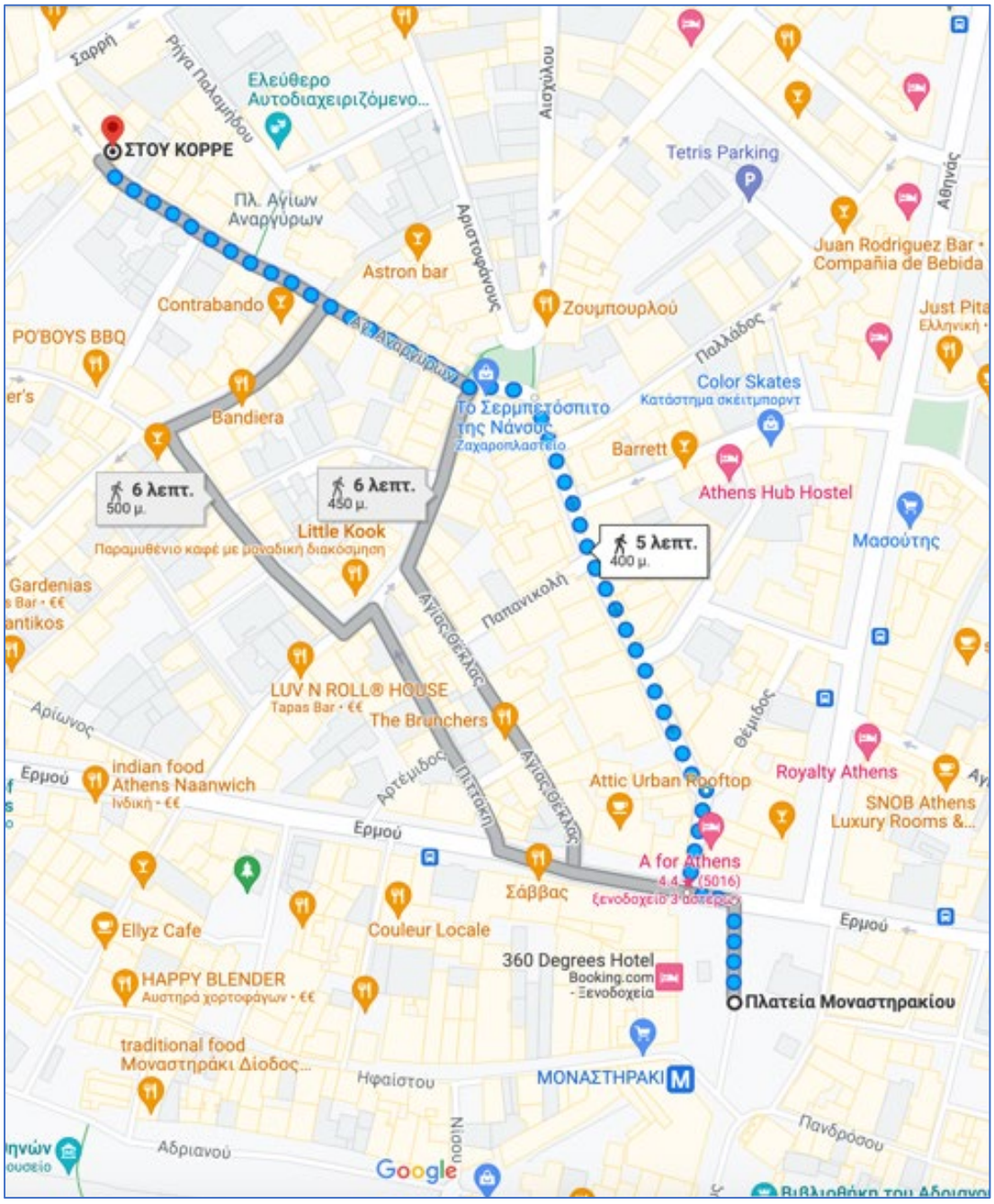
Meeting Place: Group Tour Car Park for the Acropolis
https://goo.gl/maps/YYBhcrwPKD2p839P7
On Rovertou Galli Street.

Meeting Time 08:45-09:00

After the tour of the Acropolis, we will take buses. We will visit sites of *Morus* trees that are infested by *Xylotrechus chinensis* (Coleoptera: Cerambycidae - Tiger longicorn beetle) that has recently invaded Europe and Athens. *Morus* trees are monumental ornamental trees for Athens, and there are more than 25 000 morus trees in Athens center alone. The beetle infestation has caused complete dieback of trees. At the next stop, we will the Customs Office at the port of Piraeus where the phytosanitary inspectors will guide us in the inspection procedures. At the last stop, we will visit the Benaki Phytopathological Institute (BPI) for lunch and a tour at BPI laboratories and activities. Afterwards the bus will return to Syntagma square.

Group dinner:

On Wednesday October 12th, we will have a group dinner at a traditional tavern-restaurant Stou Korre (https://www.stoukorre.gr/portal/) in the Psiri area of Athens near the Monastiraki metro station (see https://www.athensguide.com/psiri.html for more information about the area). The restaurant is within a short walking distance from Monastiraki square.



Oral Presentation Abstracts

(Arranged in order of presentation)

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(1) A matter of trust – perceptions of the value of pest risk assessments

Melanie Newfield[1*], Susanna Finlay-Smits[2], Christine Reed[2], & John Kean[2]

[1]Independent, New Zealand
[2]AgResearch, Pukaha, New Zealand
[*]presenting author: melanienewfield@outlook.com

There are dozens of published pest risk assessments and pest risk assessment frameworks, but only a fraction of those published are actually used in decision-making. A crucial question, then, is 'what makes a pest risk assessment or framework useful to a decision maker?' For this study, 26 decision makers in New Zealand's biosecurity system – central government, local government and industry – were interviewed. The interviews were analysed using a thematic analysis methodology. One key theme was that trust is central to participants' views on risk assessment quality and usefulness. Trust is recognised in the literature about risk communication as being an important factor in whether the public accepts information about risks from government agencies and companies. However, it is less common to find it documented as important in the relationship between adviser and decision maker. These results have implications for how pest risk assessments and frameworks are developed and delivered to those who use them.

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(2) The cost of phytosanitary programmes for surveillance of plant pests in the EU

Berta Sánchez[1*], Fabiola Di Bartolo[1], Emilio Rodríguez Cerezo[1] & Jesus Barreiro-Hurlé[1]

[1]European Commission, Joint Research Centre, Seville, Spain
[*]presenting author: Berta.SANCHEZ@ec.europa.eu

Given the large number of quarantine pests and diseases threatening the Union territory, available resources must be prioritized. In the EU, resources are prioritized on those pests that can have a great impact on the EU which have been identified as priority pests by the Plant Health Regulation [Regulation (EU) 2016/2031]. According to Article 24 of the Plant Health Regulation, EU Member States must carry out annual surveys for each priority pest, including a sufficient number of visual examinations, sampling and laboratory analysis. These phytosanitary surveillance activities imply a cost to Member States, which can differ largely regarding the type of activity undertaken, pest and host under examination, among many other factors. We develop a methodology to calculate the reference unit costs of phytosanitary surveillance activities for EU including visual examination, sample taking and use of traps. The methodology is based on i) data available of the annual EU funding of phytosanitary programmes for surveillance of pests, and on ii) surveys to national plant protection organizations of the EU Members States. A composite unit cost was calculated as the weighted sum of the three sampling activities unit costs (visual examination, sample taking and trapping). Results have been used to simplify and harmonize the co-funding of phytosanitary programmes for surveillance in the period 2021-2027, as part of the measures to strengthen plant health of the Single Market Programme of the European Commission.

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(3) EPPO approach to climate modelling for establishment in continent-wide PRAs

Muriel Suffert[1*], Camille Picard[1], Rob Tanner[1], Fabienne Grousset[1] & Françoise Petter[1]

[1]European Plant Protection Organization (EPPO), Paris, France,
[*]presenting author: ms@eppo.int

EPPO is a Regional Plant Protection Organization covering 52 countries in Europe, the Mediterranean Basin and Central Asia. To help its member countries address emerging pest risks, EPPO conducts pest risk analyses on pests identified during early warning activities.
Climate suitability is an important factor to consider when evaluating the probability of establishment of a species in an area. The way to approach the evaluation of climatic suitability and in particular the need and relevance of climate modelling has been discussed over the years in the EPPO PRA framework and more specifically during the EU Funded project PRATIQUE. During this project a climatic suitability risk mapping decision-support scheme was developed. The benefits of different approaches for climate suitability evaluation as well as the challenges of modelling in a context where data is often scarce and the evaluation involves other factors beyond climate *sensu stricto* (such as the crop environment and production practices) will be presented. With regards to climate change scenarios, the EPPO work conducted for Invasive Alien plants will be presented.

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(4) Three years experience of commodity risk assessment of high Risk Plants: spotting new potential threats

Ciro Gardi[1*], Alzbeta Mikulova[2], Giuseppe Stancanelli[1] & Agata Kaczmarek[1]

[1]European Food Safety Authority, Parma, Italy
[2]University of Padova, Italy
[*]presenting author: ciro.gardi@efsa.europa.eu

In January 2020 EFSA published the first opinion on the commodity risk assessment of a High Risk Plants (HRP), defined in the EU according to the Implementing Regulation (EU) 2018/2019 the European Commission. Thirty month after 31 commodity risk assessment has been performed, listing and checking the pests potentially associated to 19 plant species. The selection of the actionable pests, for which the quantitative assessment of the likelihood to be present in the imported commodity was performed, is based on three main criteria: 1) the commodity species/genus is a host of the pest; 2) the pest is present in the exporting country; 3) the pest is absent (or limited distribution) in the EU or the pest is a quarantine pest in the EU. So far 119 actionable pests have been selected and for those that are not already regulated in the EU, a pest categorisation is performed. The main results of the HRPs commodity risk assessment are presented.

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(5) EFSA Pest categorisations of emerging pests in support of plant health quarantine legislation

Virag Kertesz[1*], Franz Streissl[1], Philippe Reignault[2], Alan MacLeod[3], Oresteia Sfyra[1], & Giuseppe Stancanelli[1]

[1]European Food Safety Authority, Parma, Italy,
[2]French Agency for Food, Environmental and Occupational Health & Safety, Angers, France
[3]Department for Environment, Food and Rural Affairs, York, UK

*presenting author: virag.kertesz@efsa.europa.eu

Within European Union, plant health Regulation (EU) 2016/2031 lays down the conditions for pests to qualify for listing as Union quarantine pests, protected zone quarantine pests or Union regulated non-quarantine pests. In line with the principles of the regulation, pests of concern are being identified by analysis of interceptions and outbreaks, commodity assessments of high-risk plants, derogation requests and horizon scanning. The pests identified as of potential concern need to be categorized to determine whether they fulfil criteria necessary to be regarded as quarantine pests for the EU. The European Commission requested EFSA to provide scientific opinions for such pests, to inform decision making and their potential inclusion in the lists of regulated pests within Commission Implementing Regulation (EU) 2019/2072 and the inclusion of specific import requirements for relevant host commodities, when deemed necessary.
The methodology of rapid and harmonized assessments was developed during the work on previous pest categorization mandates. The assessment is carried out following a framework outlined in a dedicated pest categorization template. It includes the assessment of worldwide occurrence of the pest and its host plants, possible pathways of entry into and spread within the EU, establishment potential, possible impacts on cultivated hosts and the environment, as well as possible mitigation measures. Data and information are obtained via extensive literature searches from peer-reviewed publications, grey literature, different databases such as TRACES, Europhyt and Eurostat, EPPO and CABI resources. To assess climate suitability of the EU for potential pest establishment, a harmonized procedure has been developed based on the Köppen-Geiger climate classification. Working groups focusing on arthropod pests and on pathogens have been established. In order to support the production of a very large number of pest categorizations some of the categorizations are outsourced via tasking grants.
In the first 15 months of the mandate, categorizations have been completed for 46 pests and adopted by the EFSA Scientific Panel on Plant Health. It is expected that nearly a hundred pest categorizations will be delivered by 2023.

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(6) Irrigation can create new green bridges that promote rapid intercontinental spread of wheat rust pathogens

[1*]Catherine Bradshaw, [2]William Thurston, [3]David Hodson, Tamas Mona[4], Jacob Smith[4], Sarah Millington[2], Gerald Blasch[5], Yoseph Alemayehu[6] & Christopher Gilligan[4]

[1]Met Office, Exeter, UK & University of Exeter, Exeter, UK
[2]Met Office, Exeter, UK
[3]International Maize and Wheat Improvement Center, Texcoco, Mexico
[4]University of Cambridge, Cambridge, UK
[5]International Maize and Wheat Improvement Center, Addis Ababa, Ethiopia
[6]Ethiopian Institute of Agricultural Research, Oromia, Ethiopia
*presenting author: catherine.bradshaw@metoffice.gov.uk

Wheat stem rust epidemics caused by the obligate pathogenic fungus *Puccinia graminis f.sp. tritici* have historically driven severe yield losses on all wheat growing continents and, after many decades of control, stem rust is re-emerging as a disease of concern. In 1998, a highly virulent race able to overcome 90% of world wheat cultivars, Ug99, was identified in Uganda. Since initial detection, the pathogen has evolved many new variants and spread to many countries. The original variant spread from East Africa to the Middle East within three years. In 2014, another Ug99 variant (TTKTT), with one of the most complex virulence profiles, was detected in Kenya and also spread from East Africa to the Middle East, but within the same single cropping season. We investigate potential airborne

migration routes to account for the rapid spread of TTKTT in East Africa and beyond to the Middle East by using an integrated model combining meteorology-driven fungal spore dispersion modelling with epidemiological modelling. We find viable pathways in the 2018/19 season that incorporate critical stepping-stone locations in Yemen or Saudi Arabia, but only in the presence of newly irrigated regions in Ethiopia. As irrigation is a common adaptation strategy for climate change, future movement of stem rust races out of East Africa is considered likely as irrigated areas expand. Targeted surveillance and the use of mitigation strategies including the use of durable resistant varieties in regions of irrigation are required to reduce the risks of enhanced dispersal of stem rust to other regions.

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(7) Improving irrigation data for pest modelling using Earth observation data and techniques

Tim Beale[1*], Darren J. Kriticos[2], Gerardo López-Saldaña[3] & Bryony Taylor[1]

[1]CABI, Wallingford, UK
[2]Cervantes Agritech, Canberra, Australia
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Irrigation is emerging as an important competent of many pest risk models. Knowledge of where irrigated areas are located and the intensity or duration of irrigation can play a vital role in the suitability of an area to sustain pest populations. Typically, pest modellers rely on coarse global datasets that are based on national or regional surveys composed of farmer reports and combined with land use mapping initiatives. However, these often only represent a snapshot in time and their spatial accuracy and granularity is not always suitable for pest risk analysis. In a changing climate, models based on out-of-date irrigation data risk can over- or under-estimate current pest risks. In a short proof-of-concept study carried out by CABI, Cervantes Agritech and Assimila, new ways of tackling this problem were explored using novel irrigation datasets developed using Earth observation techniques. Using MODIS (Terra Moderate Resolution Imaging Spectroradiometer) EVI (Enhanced Vegetation Indices) at 1 km spatial resolution and metrological data from ECMWF (European Centre for Medium-Range Weather Forecasts), a time series analysis was built to identify natural, non-irrigated land and unnatural, irrigated crop areas. The outputs were compared with CLIMEX derived soil moisture data and demonstrated as an input to a CLIMEX environmental suitability model of Bactrocera tryoni (Queensland Fruit Fly) in SE Australia. This study shows the potential to use EO data and techniques to improve our knowledge of irrigated areas and through improved pest models can serve to provide agricultural stakeholders more accurate information on areas at risk.

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(8) Progress and challenges for real-time pest risk modelling for fruit flies

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CLIMEX is a popular tool for characterising climatic risks posed by invasive organisms. It is most frequently run using the Compare Locations module, using long-term (30-year) climatic averages. While this type of analysis is useful for informing national and regional biosecurity policies, it is too coarse for informing granular deployment of surveillance resources. In any given jurisdiction, the climate suitability for potential invaders waxes and wanes with the seasons. This has effects on the source area hazards, as well as the suitability of the risk area for establishment or growth. The spatio-temporal variations in the flow of goods and passengers further complicates the patterns of risk. In the European FF-IPM project we have been developing a system for automatically generating weekly maps of the CLIMEX Growth Index for population growth of invasive fruit flies, and a "leader board" table of countries where the fly species is present, ranked by the maximum growth index in the country and the historical pattern of interceptions of fruit flies. The GIW maps inform the cost-effective dynamic deployment of fruit fly traps and the country table can inform inspection effort. The aim is to be able to deploy the traps when it is worthwhile (when conditions are suitable for adult fly activity), and to be able to prioritise inspection effort on goods and passengers coming from countries that are posing a heightened hazard. We will demonstrate the system and highlight some limitations of this set of technologies due to the diffuse pattern of devanning sites, and the present data collection systems for interceptions.

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(9) Horizon scanning of plant pests at EFSA: experience and future prospects

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The plant health team of EFSA received its first mandate from the European Commission on horizon scanning in December 2016. Since then, thanks to the collaboration with the Europe Media Monitor (EMM) team of the Joint Research Centre (JRC) and the cooperation of the French Agency for Food, Environmental and Occupational Health & Safety (ANSES), a dedicated methodology was developed to scan and screen emerging threats in the field of plant health.
EFSA is monitoring more than 19,600 sources (1,517 of which are scientific journals) that provide every day 200-300 items referring to one of the EFSA pre-selected pests (2,137) or to additional ones. The monthly newsletter will finally retain not more than 30-40 articles. This deep articles review allows for a further step: the recognition of new threats, represented by unknown and/or unregulated pests with the potential to threaten European crops and natural environments. Whenever such conditions are encountered, the « new » pest is screened applying the so-called « PeMo » methodology.
PeMo is a fast assessment based on a scoring matrix, that compares the pest under evaluation with already well-known ones: based on the results of this screening, EFSA is able to a) raise the attention of EU risk managers about the potential risk that a given pest represents, or b) keep monitoring it and waiting for more evidence. The continuous evolution of this project supports the timely reaction of EU decision makers in a quickly changing environment.

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(10) Emerging pests in the European Union: European Food Safety Authority pest survey toolkit to support EU risk managers

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Climate change, rising global trade of agricultural and forestry products and intensive tourism have increased the risks of new emerging threats across the globe, resulting in a change of the geographical range of some invasive alien pests. International organizations and their members are developing various legal and procedural solutions to identify and reduce these risks to an acceptable level.
The European Food Safety Authority (EFSA) has been mandated by the European Commission to support Member States in various areas to identify and characterize the risks posed by emerging or re-emerging pests. In this context EFSA developed a methodology for Horizon Scanning which monitors scientific literature and the general media to identify (re-)emerging pests, EFSA also carries out pests categorizations, pest and commodity risk assessments and has developed a pest survey toolkit for quarantine pests. In this presentation authors will focus on the Pest survey toolkit that has been prepared to assist Member States in the preparation and design of surveys on quarantine pests. The presentation will guide the participants through EFSA's methodological framework and the tools developed to address the preparation, design, and reporting of pest surveys. Conference participants will become familiar themselves with the elements of the Pest survey toolkit such as: Pest survey cards, RiPEST (Risk-based Pest Survey Tool), a relational database containing information from the Pest survey cards essential for designing and planning surveys, and a tool for the optimization of multi-pest surveys.

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(11) How commodity risk assessment for forestry plant pests helps to identify new plant health threats and to assess the efficacy of risk reduction options

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The European Food Safety Authority (EFSA) conducts commodity risk assessments for the European Union (EU) territory (for so called "high risk plants") for derogation requests to the EU plant health law, based on dossiers submitted to the EU by third countries. For this type of assessment, EFSA conducts extensive literature searches on pests and diseases associated with the commodity

species, resulting in hundreds to thousands of potentially pests found. These pests are then evaluated for their presence in the exporting country, their association with the commodity, the pathways of movement, and their potential impact in the EU member states. Pests fulfilling such criteria are selected for further evaluation: for each commodity, an assessment of the likelihood of pest freedom is conducted for each of these pests by Expert Knowledge Elicitation (EKE), followed in a second phase by a pest categorisation. Scope of this commodity risk assessment is to support with scientific and technical evidence the phytosanitary decision-making process. Pests for which the limited information does not allow the conduct of the assessment are further monitored thorough the EFSA Horizon Scanning activities. Different cases will be presented showing the importance of conducting commodity assessments to avoid the introduction of new plant pests.

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(12) Climate suitability analysis in the context of EFSA Pest Risk Assessment. Current status and future challenges

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The European Food Safety Authority (EFSA) conducts plant pest risk assessment (PRA) under the mandate of the European Commission, the European Parliament and the Member States. The analysis of climate suitability is a key element of PRA to provide evidence of suitability to persistence and/or growth of an organism in an area under assessment. We aim to elucidate the climate suitability analysis workflow in the context of EFSA PRA and pest categorisation, including extensive literature search on pest distribution and eco-physiology, data extraction, data analysis, application of climate suitability models under current climate and climate change, publication of results in dedicated repository. Different case studies are presented characterised by different taxonomy, information available, areas of distribution, ecophysiology requirements. Based on these differences, the importance of the availability of a range of tools and models including climate services is discussed.
In particular, the case of the polyphagous pest navel-orange worm *Amyelois transitella* (Lepidoptera: Pyralidae) is be discussed. Starting from 771 scientific documents available, climate suitability analysis was conducted applying a methodology based on the Köppen–Geiger climate classification and the CLIMEX model. Data from the ERA5-Land dataset of the EU Copernicus project were used to estimate number of potential generations during the season favourable for growth. Results showed that suitable climate is present in Southern and Mediterranean areas and Atlantic coasts of France and Spain.
Finally, a project for integrating geospatial data and for the development of climate services for supporting climate suitability analysis is presented

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(13) The abundance of Australian plant species under climate change scenarios and conservation interventions

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Conservation managers are under increasing pressure to make decisions about the allocation of finite resources to protect biodiversity under a changing climate. However, the impacts of climate and global change drivers on species are outpacing our capacity to collect the empirical data necessary to inform these decisions. In lieu of empirical data, we use a structured expert elicitation method (the IDEA protocol) to estimate expected change in abundance of 182 plant species that occur in Australian alpine, arid and temperate environments. We then identify the species most at risk of significant decline in each biome and use expert elicitation to estimate the mitigation effect of conservation interventions such as activity managing populations via facilitated gene movement and translocations to those managing impacts caused by grazing fire and invasive plants and animals.

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(14) Climate change impact on potential global distribution of *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae)

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The pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green), is a highly polyphagous insect species that affects several ornamental plants, but also horticultural and agricultural crops worldwide. It is a pest of southern Asian origin that recently reported, in Rhodes Island, Greece and in Cyprus.
We modelled the potential distribution of *M. hirsutus* using CLIMEX, a process-oriented, climate-based niche model, under an historical climate scenario. Irrigation is critical as a habitat factor for this pest, so an irrigation scenario was applied. To assess the sensitivity of pest modelled distribution to climatic changes, a future climate model was also applied.
The aim of this study was to reveal climatically suitable areas where the pest is currently not known to exist estimating areas at risk. Implementing climate change scenarios, a foresight of pest expansion is provided justifying anticipatory measures where needed. The potential expansion of pest into new areas where economically important crops exist under the effect of future climate scenarios was also studied.
The Mediterranean basin is climatically suitable for pest establishment with the cold stress being the main limiting factor of pest expansion in central and northern European countries. However, climate change affects current pest range, so it is crucial for biosecurity managers to understand the trends and the uncertainties of invasive pest patterns. The models in this study provide the tools for efficient surveillance strategies development, effective use of biological control agents, targeting phytosanitary efforts towards specific areas and eventually being prepared for this invasive pest's potential establishment in the future.

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(15) Climate change, abiotic stressors and bark-beetle outbreaks: could cases from Europe be extended to assessing risks from non-native pests?

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Forests are increasingly affected by factors related to global change worldwide. Future changes in earth's climate will likely include increases in temperature, changes in precipitation, more frequent and severe droughts, and other extreme events, such as wind storms. Pests are responsible for damaging 35 million hectares of forest around the world every year; in the Mediterranean region alone five million hectares are affected by pests annually, according to the UN Food and Agriculture Organization (FAO). Insects and fungal diseases are important disturbances in forests, but the understanding of the role of drought and wind disturbance in outbreaks of these agents is limited. Pest risk assessment of non-native forest pests could use in an integrated manner the criteria developed for the evaluation of potential threat of native forest pests. In particular the effects of climate change bear not only on the pest themselves (e. g., voltinism and dispersal capacity), but also on their relationships with their host trees. Drought stress considerably lowers tree defense, allowing easier pest establishment and faster host death, thus increasing overall pest impact. Here, we attempt to link abiotic stressors to recent bark-beetle outbreaks in Europe and discuss how these finding could apply to risk assessment of non-native organisms.

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(16) No time for complacency: Changing fruit fly threats in a warming world

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Pest risk assessment is a critical tool for informing biosecurity agencies of the threats posed to their jurisdictions. As our climate changes in response to anthropogenic climate change, the threats posed by invasive organisms are changing rapidly. Recent publications have identified statistically significant trends in climate suitability for pests, and jurisdictions are coming under threat from new pests. In this paper, we explore the changing climate suitability patterns for an economically important fruit fly *Ceratitis capitata*, taking into consideration locations in marginal locations of its occurrence with a particular focus on Europe and North America. To assess the model fit, and to aid in interpreting the meaning of the new European distribution records, we used the CRU TS4 climate time series dataset to explore the temporal patterns of climate suitability for this pest from 1970 to 2019. At selected bellwether sites in Europe, we found statistically significant trends in increasing climate suitability, as well as a substantial poleward (northward) expansion in the modelled potential range. The recent geographical records in Italy and France appear to represent a mixture of established and ephemeral populations, consistent with reports of the seasonal range dynamics of *C. capitata* in Europe. In California, we also found a statistically significant trend of northward and altitudinal expansion of areas suitable for medfly in that region. The changes in potential distribution we identify are such that many additional countries have come under threat of permanent invasion in the 30 years between 1975 and 1995. Pest risk models developed using historical climate data centered on 1975 need to be updated using more recent climatologies.

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(17) Phenology and ecology of *Philaenus spumarius* L. inform risk assessment for *Xylella fastidiosa* Wells in Switzerland

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Xylella fastidiosa Wells is among the most dangerous plant pathogenic bacteria in the world and is responsible for many economically important diseases on agricultural crops and ornamental plants, such as grapevine Pierce's disease, phony peach disease, citrus variegated chlorosis and olive quick decline syndrome.
The meadow spittlebug *Philaenus spumarius* L. (Hemiptera: Aphrophoridae) has been identified as the main vector of *X. fastidiosa* in Europe. As this species is widespread throughout the European continent and has not previously posed any threat to agriculture, knowledge about its biology and ecology is scarce, at least for Switzerland.
In order to fill this gap and with a proactive approach toward a potential arrival of *X. fastidiosa*, we are studying the phenology and ecology of *P. spumarius* in Switzerland. The study of its phenology will identify the developmental periods and the host plants of the different life stages under the Swiss climate, thus informing the development of effective management measures. The ecology is studied across the Southern Alps according to a stratified sampling that considers different combinations of environmental factors (climate, geology and topography, summarized by the Swiss Environmental Domains), habitat (vineyards, olive groves, orchards, meadows, pastures) and management type (intensive vs. extensive). Information about the density of *P. spumarius* in the different strata is used to model and predict the potential distribution of the vector in the different agroecosystems of the Swiss agricultural landscape and to inform risk assessment for *X. fastidiosa*.

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(18) The current and emerging potential global distribution of Californian thistle (*Cirsium arvense*)

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Anthropogenic climate change significantly impacts species climate suitability patterns, undermining the value of pest risk assessments based on 1970s climate data. Given the rate of change, it now seems prudent to assess pest risks using both current and future climates. To that end, we consider Californian thistle (*Cirsium arvense*), an invasive plant that causes significant losses in agricultural revenue. This perennial herb, native to western Eurasia and Scandinavia and a small portion of Northern Africa, has invaded large parts of Asia, North America and Oceania. We fitted a climate-based niche model using CLIMEX to model its potential global distribution under historical and future climates. Its potential distribution under current climate is centred on temperate climates, with less suitable habitat extending into subarctic climates. In the northern hemisphere it has largely filled its current potential range. By contrast, in the southern hemisphere there is potential for considerable further spread in South America, Southern Africa and Western Australia. Under the future climate scenario, the potential distribution expands northwards in Canada, Scandinavia and north-western Russia. In the southern hemisphere, the potential for *C. arvense* to expand its range

with a warming climate is curtailed by the southern land extent. In the tropics, changes in rainfall patterns across central Africa reduce the potential distribution to coastal or irrigated areas. Parts of Uruguay, and Argentina remain highly suitable under the future climate scenario, but its potential South American range is otherwise largely restricted to the Andes. Its potential Australian distribution reduces in the arid central region.

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(19) Climate change, and changes in trade and pest pathways for biosecurity and food security

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Given varying global and country-specific impacts, climate change will alter trade patterns and pest pathways, harming agricultural productivity and food security, with potentially devastating economic, environmental and social impacts. This Side Event will provide presentations of recent work and seek group discussion on the impacts of global warming on food security. The recent work highlights five key areas: (1) how different global warming scenarios impact national incomes (through losses in agricultural and labour productivity) in a large dimensional trade and climate model for 140 countries and 60 different commodity sectors; (2) how these losses impact the pattern of exports and imports between countries; (3) how changes in trade patterns impact changes in pest and disease pathways that potentially harm agricultural production; (4) how this impacts biosecurity measures going forward; and (5) losses in food security with both heat and water stress damage functions. Our integrated modelling approach forecasts impacts of climate change on trade futures for Australia and New Zealand, global movement of pests and changing propagule pressure on Australian and New Zealand's borders and is demonstrated on a use case of the Brown Marmorated Stink Bug with general application to a broad range of pests and diseases. Group discussion will centre around different modelling approaches and policy responses to these global warming impacts.

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(20) Uncertainty in pest risk analysis: bane or boon?

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This paper will discuss uncertainty in pest risk analysis identifying the common sources and causes of uncertainty. Inevitably the degree of uncertainty in a pest risk analysis increases as the time horizon, a workshop topic, extends further into the future. Factors influencing the selection of time horizon will be discussed. The tension between the WTO Sanitary and Phytosanitary Agreement's requirement for phytosanitary measures to be based on evidence will be contrasted with the precautionary principle which forms the rationale for much environmental protection. The workshop theme of climate change is very relevant here and there are of course issues around uncertainty to be considered too. The paper will draw examples from past international research projects and reflect on practitioner experiences of having to provide advice to risk managers and policy makers when there is insufficient data to provide a concrete answer. Strategies that have been used to reduce uncertainty in risk assessments will be described, together with methods that embrace

uncertainty. Communicating risk can be challenging, especially when there are substantial uncertainties. The paper will close by describing techniques and providing examples of how uncertain pest risks have been communicated to risk managers and stakeholders in Europe.

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(21) Optimal sampling effort for border pest detection in low risk pathways

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Effective border intervention is an important preventative measure to stop pests arriving and establishing into new areas. However, it is impractical to stop and inspect every entity that could potentially be carrying a pest. One option is to stratify a pathway into 'high' and 'low' risk entities and focus on the high risk. However, low risk is not zero risk, and we may want to still sample the low risk section of a pathway to ensure it is truly low risk and enable us to detect if, or when, the risk status should change. But this raises the question: how much effort should we expend in sampling low risk pathways? In this presentation I will describe how we approach the problem of setting sampling effort to ensure a pathway is below a threshold of risk. The key advance in our work is that we are not aiming to estimate risk precisely, but instead we focus on knowing that risk is below a threshold and on being able to detect a significant change in risk. Our approach allows us to propose less sampling than previous methods and it allows us to provide evidence to regulators to help them set search effort in a manner that is both efficient and effective.

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(22) Using an information theoretic framework to quantify uncertainty in climate-based models for predicting the risk of pest establishment

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Climate-based pest risk models are used to estimate the potential distributions of invasive species, however, the performance of these models is highly variable. This is a critical problem for governmental officials making decisions base on this models because they can potentially underestimate the risk of pest establishment. This problem can be reformulated as a problem of information: how much information about potential distribution can be obtained from the current distribution of a species? As a first step to quantify the magnitude of this problem, we used distribution modelling of *Phoracantha semipunctata* and performed a comparison of the reciprocal prediction ability of models fitted for Chilean and Australian distributions. We used Mutual Information (MI), a measure borrowed from information theory that evaluate the shared information between datasets. This measure of predictability is based on empirical probability distributions, and it does not depend on the particular model used to predict. After fitting models using machine learning algorithms, our results show that, despite their high goodness of fit, the MI shared between models is low (MI<0.2). These results suggest that sometimes no robust estimation of the exotic distribution can be obtained from data of the native distribution. This new approach

points out to the well know problem of transferability, and remarks the high probability of underestimate the risk of establishment of exotic insects based only on climate-based species distribution models.

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(23) Hotspots for plant pests' introduction (HoPPI): identify priority areas to prevent new plant pest invasions

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World trade has highly increased in the last decades, together with a higher risk of introducing new pests, including bacteria, fungi, viruses, and arthropods. Globalisation, climate change, and the reduced resilience in production systems, also play a part in this increasing threat. The introduction pattern of plant pests shows no sign of saturation, and it seems thus inevitable that many more species will enter the EU in the future.
A key challenge in analysing patterns of pest introduction is the poor historical records of the appearance of new species in certain countries. Furthermore, these records are frequently incomplete and difficult to interpret. A comprehensive list of plant pests' introduction in the EU is not currently available and information on introduced pests is scattered among databases and scientific literature. As part of the HoPPI (Hotspot for Plant Pest Introduction) project, co-funded by the European Food Safety Authority, we collected spatial data on plant pest first introduction records along the EU, between 1999 and 2019, and trade data linked to the different pathways, based on a systematic search of the published literature and online databases, such as EASIN and EPPO. The ambition of HoPPI is to identify the factors relevant to defining a hotspot for the introduction of different pests in EU Countries, to help determine priority areas to prevent new plant invasions or support the surveillance activities where the probability of introducing new pests is higher.

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(24) A role for process-based population dynamics models in pest risk management: The oriental fruit fly, *Bactrocera dorsalis*

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Pest risk management spans biosecurity borders. The hazard posed by invasive pest species is ideally managed through efforts to prevent the introduction of the species. When these efforts fail, we are left with management tactics from eradication to business-as-usual crop protection. Process-

based population models can play an important role in assisting all these potential post-border invasion management tactics, providing foresight into phenology and the likely efficacy of different tactics and strategies. Ideally, at least for the most pressing and important potential invaders, the construction of these models would become part of a broader suite of prevention and preparedness activities. In this way they are available for immediate deployment whenever the pest is detected post-border.
The oriental fruit fly *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) is a highly polyphagous pest with strong invasive potential, causing enormous damage to agriculture in Asia, Africa, some Indian Ocean islands and in Hawaii. We created a process-based population dynamics model for *B. dorsalis*, as part of an integrated modelling framework to assist with both pest management and incursion response. An extensive literature review was performed in order to retrieve experimental information related to species responses to variable temperature and humidity regimes and how they impact the development, stage transfer, mortality and fecundity of the species. The cohort-based model implemented in DYMEX represents the life cycle of the pest as a set of consecutive discrete stages described by temperature dependent functions which may also be influenced by humidity, rainfall and soil moisture. We used novel methods to fit functions for progeny production and mortality under varying temperature conditions based on physiological age. To our knowledge this is the most comprehensive model for B. dorsalis based on data obtained from numerous experimental studies. Combined with site-specific weather data it can inform real-time decision-making. We discuss model limitations and the important knowledge gaps related to OFF biology.

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(25) Incidence of cassava mosaic viruses (African cassava mosaic virus and East African cassava mosaic virus) in whitefly on cassava in Ibadan, Nigeria

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Cassava (*Manihot esculenta* Crantz) is an important staple crop in Nigeria. Cassava production is negatively affected by Cassava Mosaic Disease (CMD) caused by cassava mosaic begomoviruses (CMBVs). About 11 species of CMBVs were identified in CMD etiology in Africa. The most widespread species are the African cassava mosaic virus (ACMV) and the East African cassava mosaic virus (EACMV). The insect, whitefly (*Bemisia tabaci* Gennadius), persistently transmits CMBVs and plays an important role in spreading viruses between fields. Information on the incidence of viruliferous whiteflies is limited, knowledge of which would be useful to design appropriate control measures to reduce new virus infections in the field. Thus, to investigate the status of the incidence of viruliferous whiteflies on cassava plants in each geographical location, a survey was conducted in 2020 at IITA, Ibadan-Nigeria.
The field surveys were conducted by random sampling of 10 cassava trial plots along a diagonal transects. Global Positioning System (GPS) was used in recording the coordinates of each field visited. In each of the 10 cassava trial plots, 20 cassava plants were examined for CMD and whiteflies. CMD was scored using a rating scale of 1-5 established by IITA while adult whitefly populations were assessed by counting and recording the number of adult whiteflies on the five youngest apical leaves of each sampled plant. Then whitefly and leaf samples were collected from both symptomatic and asymptomatic cassava plants for virus testing in the laboratory; an Aspirator was used in collecting the whiteflies into microtubes containing 75% ethanol while transparent polythene nylon bags were used in collecting the leaves and all samples were placed in a cooler of

ice. Samples were stored at -20 oC prior to laboratory analysis. A total of 60 cassava plant samples and 120 whitefly samples were tested for ACMV and EACMV using a multiplex PCR.
The CMD prevalence for the 10 differently located cassava fields was 100% and incidence in the 10 fields was between 35% to 50%. A total of 23 cassava varieties were identified in 10 fields, nine of which were asymptomatic. CMD incidence was between 35% to 100% on the 14 symptomatic varieties. The ACMV, EACMV and ACMV+EACMV mixed infection were detected in 25%, 1.7%, 0.8% whitefly samples, and 23.3%, 16.7% and 10% leaf samples, respectively. The proportion of positives were higher for whiteflies collected from symptomatic plants (32.5%) compared to asymptomatic plants (17.5%). Similarly, CMBVs were detected in 65% of symptomatic plant samples and 25% of asymptomatic plant samples. Mean adult whitefly numbers ranged from 3.8 to 4.9 with an overall mean 4.24 and was not significantly different between fields or cassava varieties (P<.001). CMD symptom severity was in the range of 3 to 5 with an overall mean 2.2 and was significantly different (P=0.02) between fields and cultivars. Sequencing of the isolates showed ACMV and EACMV as the only viruses detected in all the sampled cassava fields and the isolates indicated 93-100% nucleotide identity with previously characterized homologous species. Phylogenetic analysis clustered ACMV and EACMV isolates to the previously reported ACMV and EACMV isolates from Nigeria and Africa. The standardized method applied in this study for monitoring CMBVs in cassava fields and the knowledge on virus status in whitefly are useful for understanding the virus-mediated spread of CMD and vector role in disease epidemiology.

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(26) The Pest Risk Information Service (PRISE): an Earth observation driven within crop season early-warning service providing times to intervention against insect crop pests for Sub-Saharan African farmers

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As ectothermic organisms, the development time of insect pests is strongly related to temperature and the environment to which they are exposed. With the increase in frequency of un-seasonable weather events that the world is now experiencing and the general rise in average global temperatures, insect pest phenology can be variable or change within season, especially development times. Thus, tools and information to support farmers and policy makers in making agricultural management decisions will be of vital importance. In temperate countries the use of degree day model approaches to predict key life stages for the optimal use of management interventions is common practice in many countries However, this approach has not been widely used in tropical countries because of the difficulties of factors such as the presence of overlapping generations and a lack of definition of a key information, particularly the time to start the models (the biofix date). Here we describe the modelling approach developed in the Pest Risk Information Service (PRISE) for four countries in sub-Saharan Africa that overcomes these and other problems. We also summarize other features of PRISE such as the use of near real time meteorological data derived from earth observation sources to overcome problems of accessing this information from ground stations in Africa. Opportunities for future areas of expansion and development are given.

Poster Presentation Abstracts

(Arranged in alphabetical order by the first author's last name)

Emerging pests in the European Union: The case of ToBFRV surveys in Malta

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Plant health is increasingly under threat due to the increased human activities and market globalisation, coupled with weather pattern changes and temperature rises due to climate change. These factors lead to the altering of ecosystems and biodiversity loss and favour pest movement and establishment. Plant diseases reduce the yield and quality of agricultural production and cause substantial economic losses and reduce food security at household, national and global levels. Preventing the introduction and spread of plants pests, is more cost effective than controlling and mitigating the impact of pests once they have established in a territory. However, with efficient surveillance, epidemics can be detected at an early stage, in which eradication becomes a realistic proposition. One recently discovered virus which has been the cause of a major epidemic is the Tomato brown rugose fruit virus (ToBRFV), which can naturally infect systemically tomatoes (*Solanum lycopersicum*) and susceptible pepper (*Capsicum annuum* and *Capsicum chinense*). This virus has overcome all three tobamovirus resistance genes (Tm1, Tm2 and Tm22) and uncertainties remain on the L-resistant genes of Capsicum varieties. ToBRFV was first intercepted in Malta in April 2020, following routine surveys conducted on tomato seedlings traded from Sicily. The two most important arable crops in Malta are potato and tomato. Given the importance of tomatoes to the Maltese agricultural sector, effective surveillance strategies for ToBRFV should be implemented and substantiating pest freedom from ToBRFV should be done with significant confidence levels and evidence. By following the statistical sound and risk-based survey approach, recommended by the European Food Safety Authority, the Maltese NPPO would be able to formulate final conclusions which allow the comparison of surveys across time and space, therefore contributing to the harmonisation of surveillance activities, ensuring the early detection of the virus, and safeguarding the Maltese territory from the negative impacts of ToBRFV. Inspections and surveillance.

Climate change and pest risk assessment: making it fit for purpose

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Climate change is happening and is changing the risk profile of many pests and potential pests. Plant health risk assessors must therefore find some means of incorporating climate change into our processes. The North American Plant Protection Organization (NAPPO) developed an opinion piece several years ago that is still applied and briefly states that the application of climate change to risk assessment should be considered on an as-appropriate basis. So, when is it appropriate? How do we apply it? This poster will present some ideas and detail how the CFIA deals with climate change in its risk assessment process.

Emerging pests in the European Union: Pest Survey Cards as a surveillance tool

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EFSA has developed three integrated tools for the preparation and design of surveillance activities for Union quarantine pests: Pest Survey Cards, RiPEST (Risk-based Pest Survey Tool) and Guidelines for statistically sound and risk based surveys.
The EFSA Pest Survey Cards guide the EU Member States to gather the relevant information for the preparation of surveys of quarantine pests in the EU in conformity with international standards and current EU regulation, and contain up to date information on the pest taxonomy, distribution, biology, plant hosts and potential establishment in the EU, factors associated with increased risk for entry and spread, and detection and identification methodologies.
EFSA was mandated by European Commission to prepare Pest Survey Cards for all the quarantine pests listed in EU 2019/2072, and survey cards covering 85 pests were already published and are available in internet at https://efsa.europa.eu/plants/planthealth/monitoring/surveillance/index

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Emerging pests in the European Union: European Food Safety Authority IT tools to support EU risk managers

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The European Food Safety Authority (EFSA) is developing practical tools to support risk managers in planning, design, optimization and reporting of surveys for plant pests. The Risk-based Pest Survey Tool (RiPEST), relational database and multi-pest survey tool will become available on the r4eu platform (https://r4eu.efsa.europa.eu/).
RiPEST is a comprehensive tool to assist national plant protection organizations in designing risk-based surveillance activities. Detection surveys (substantiating pest freedom of an area), delimiting surveys (defining the boundaries of an infested zone) and buffer zone surveys can each be designed in three steps: preparation, design and implementation. The design can be adapted to the needs of the user and is supported by information that is partially prefilled from a relational database. This relational database is currently under development and will contain relevant information on surveillance activities and plant pests in the form of tables and relations. The tool will be used to support: (i) a crop based multi-pest survey approach; (ii) the single pest survey design using RiPEST tool; (iii) serve as a standalone search tool to find specific information for host (crop) x pest combinations on the sequence of operations to be performed from the field to the laboratory (E.g. information on inspection units, vectors, the sampling matrix, detection methods, laboratory analysis, timing of the inspections, method sensitivity).
EFSA is also developing an algorithm which aims to optimize the use of resources by grouping the number of field visits and samples collected for multi-pest surveys based on the possible time window for surveillance activities and the choice of inspection units.

Potential risk levels of invasive *Ophelimus eucalypti* (Gahan) (Hymenoptera: Eulophidae) in America areas

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Species distribution models help determine areas with the potential risk of occurrence of quarantine species in forests. *Ophelimus eucalypti* (Gahan) (Hymenoptera: Eulophidae) known as gall wasp, causes damage to Eucalyptus Forest plantations, causing defoliation and reduced wood quality. Currently, *O. eucalypti* integrate the list of quarantine pests absent from Brazil and does not occur in the Americas. Therefore, this study aimed to develop a climate model for *O. eucalypti* using CLIMEX in a future climate scenario. A total of 35 occurrence points were found. Its occurrence is recorded in four continents: Oceania, Asia, Africa, and Europe. The regions of North America and South America stand out for presenting areas with high climatic suitability for the occurrence of *O. eucalypti*. In southern Brazil, eucalyptus-producing regions have high climatic suitability. In the future climate scenario, A2 SRES for 2050, a decrease of suitable areas for the occurrence of *O. eucalypti* is observed, but this still indicates regions at risk of invasion in the Americas. These results help develop strategies to prevent the introduction and establishment of *O. eucalypti* in new areas considering the current and future climate.
(This research was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq, Coordenação de Aperfeiçoamento de Pessoal de Ensino Superior – CAPES, Fundação de Amparo a Pesquisa do Estado de Minas Gerais – FAPEMIG e Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM) with the granting of resources to carry out this work.)

The potential global distribution of the invasive alien species *Melinis minutiflora* under current and future climates

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Melinis minutiflora P.Beauv. is an invasive species and impacts the economy, biodiversity, and human well-being. This species is native from Africa and is already well established in Brazil, causing impacts on the local ecosystem, once that it is very resistant to climatic fluctuation and scarcity of nutrients. These conditions can alter the occurrence and behavior of other native species and mainly the fire, where during the dry season, their leaves turn into a dry straw with a high fat content, which becomes a powerful fuel for a fire. The challenges of biological invasion may be intensified by climate change. Climate change may influence the effective management of invasive species. The aim of this study was to use CLIMEX to determine the potential distribution of *M. minutiflora* in the world under current climatic conditions and climate change scenarios for 2030 and 2100. The potential distribution of *M. minutiflora* under current climatic conditions is broad, with suitable climatic conditions expanding in tropical and subtropical regions. *Melinis minutiflora* will grow

poleward and upward as the climate warms. Where climate change results in expanding the species' global potential range, strategies must be analyzed so that strategic control plans for biological invasion are often considered.
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Assessing the confidence in pest freedom gained based on data from several years of pine wood nematode surveys

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In the EU, all countries are required, by legislation, to conduct regular surveys for all quarantine pests. The surveys of priority pests are required to ensure, as far as possible, the timely detection of the pest, with a high degree of confidence. Although many quarantine pests have been surveyed for several years, such as the pine wood nematode (*Bursaphelenchus xylophilus*, PWN), the estimates of statistical confidence rarely take data from previous years into account. This makes achieving the required high degree of confidence challenging. The aim of this ongoing project, funded by EFSA's Partnering Grant, is to build capacity for assessing the probability of pest freedom gained by exploiting data from several years of PWN pest surveys in the participating countries, i.e., Estonia, Finland, Lithuania, Norway and Sweden.
A web application will be build and published that can be used for assessing the statistical confidence of PWN surveys that have been performed in a range of different ways. Supporting material will include examples on how to estimate the parameter values needed for the calculations, which includes some challenges such as: defining a suitable radius of risk areas, determining the relative risk of the risk areas, and defining design prevalence for PWN using observed prevalence of a closely related species. Thereby assisting others who would like to do similar assessments.

Gaining a mechanistic understanding for threats emergence through horizon scanning

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Climate change, increasing global trade and displacement of people as well as new agricultural practices (e.g organic crop production, substitution of monocultures by polycultures, mechanisation) are projected to affect the current distribution of pests. All these may also lead to the increase of host range and impact of already known plant pests or the discovery of new ones.
Horizon Scanning involves the regular screening of media and scientific literature with the aim to monitor quarantine pests and identify emerging pests that could pose a threat to the EU agriculture and forestry. The articles that are selected concern EU quarantine pests, pests in the EPPO lists and new or emerging pests that are non-regulated. For non-regulated pests, spread in new areas and new host plants are the eligible topics for article selection and there are cases that have been

detected through Horizon Scanning, for which the cause of geographic and host range expansion has been reported.
For these non-regulated pests, a clear understanding of the drivers determining their emergence is essential, with the aim to allow an early reaction by risk managers, when necessary. In this poster, the drivers of geographic and host range expansion are presented from these cases of non-regulated pests that have been aired by Horizon Scanning. These findings indicate that Horizon Scanning can be used not only for identifying early signals of pests, but also for the detection of causalities for pest emergence, thus possibly enabling the linkage between different signals of pest emergence with potential causes.

The EPPO Platform on Pest Risk Analysis, a tool to foster collaboration on PRA in Europe and beyond

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The EPPO Platform on Pest Risk Analysis (https://pra.eppo.int/) was launched in September 2018. It allows to share work done on the evaluation of pest risk within the EPPO region and beyond. It includes national Pest Risk Analyses (PRAs) produced by EPPO countries (incl. quick scans, commodities PRAs) on all pests including invasive plants in different languages. Users may also share draft PRAs, or plans for future PRAs in order to help collaboration at an early stage. The Database is regularly updated with new documents being posted. As of June 2022, more than 1700 documents are available, including all PRAs produced by EPPO and the European Food Safety Authority (EFSA). A number of relevant open access scientific articles are also included. Most of the documents are publicly available but registered users may also choose to share documents to a defined group of users. Documents can be retrieved by pest or commodity of concern, date, country, as well as with keywords. Checking new PRAs helps identify emerging pests and using existing PRAs can help reducing workload in different ways. Users from all over the world access the Platform. The Platform has therefore been adapted so that interested non-EPPO countries can join and share their PRAs.

Global burden of crop loss – Building framework of an evidence-based information system

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Crop health is increasingly threatened by climate change and pests, including insects, weeds and pathogens. Reducing crop loss is critical to addressing the rapidly growing demand for food, improving livelihoods, and strengthening value chains. In addition, improving yields reduces the need to clear land for cultivation, thereby lessening agriculture's potential negative impacts on

forests, grasslands, and watersheds and mitigating contributions to greenhouse gas emissions. Precise data on the magnitude and causes of yield loss tend to be outdated, lack broad spatio-temporal coverage and are often based strictly on expert opinion. While crop loss due to biotic and abiotic factors causes significant impacts on food systems globally, we lack robust, actionable evidence on the problem. If we were able to know how much of our food supply we are losing, where we are losing it, and what we are losing it to, then actors across the plant health system could be empowered to take informed action to tackle the most critical problems in their regions. The Global Burden of Crop Loss initiative aspires to bring together scientists, stakeholders, data and ideas to work collaboratively on developing a data-driven methodology to help to quantify the magnitude of yield loss by crop, geography and attribute it to specific biotic or abiotic causes. It aims to provide rigorous, authoritative evidence on the impacts, causes, and risk factors of crop loss. We outline our approaches to quantify yield loss in major crops as a difference in attainable yield in context (attainable yield given local abiotic and socio-economic limitations), and reported crop production data, as well as data and approaches for apportioning losses to specific factors.
