10th Annual Meeting

International Pest Risk Research Group

23-26 August, 2016

Parma, Italy

Hosted by

European Food Safety Authority

-Program & Abstracts-

iPRRG

efsa

European Food Safety Authority

Day 1, Tuesday, August 23

8:30 Security, registration and coffee – **Please arrive on time. To pass through EFSA Security, you will need your passport and hotel details and be subject to a baggage search.**

9:00 Welcome to IPRRG 10 – Richard Baker

9:05 Pest risk activities in EFSA – Giuseppe Stancanelli

9:20 Pest risk activities in EPPO – Muriel Suffert

9:35 History of IPRRG: who are we and where are we going? – Richard Baker

10:05 Brief introductions from conference participants (*In 30 seconds or less, who are you, where are you from, who do you work for, and why are you interested in this conference?*)

10:40 Break

New methods to analyze pest risks – Moderator: Darren Kriticos

11:10 A quantitative risk assessment methodology for pest risk analysis – Gianni Gilioli*, Alan MacLeod, Trond Rafoss, Gritta Schrader, & Wopke van der Werf

11:30 BiOR² : a database/software process dedicated to plant pests ranking - Ch. Tayeh*, D. Guinehut, A. Lê Van, X. Tassus, E. Gachet, & C. Manceau

11:50 Pest risk mapping based on spatial and temporal distribution of crop production - J. Tuomola*, H. Huitu, & S. Hannunen

12:10 Options for developing an integrated framework to assess the impacts of exotic plant pests in Europe – M.L.O. Espaldon*, M.C.M. Mourits, W. van der Werf, & A.G.J.M. Oude Lansink

12:30 Development of disease risk assessment on invasive alien species: evaluation of the risk of introduction of new infections and spread of local ones - E. Chinchio*, M. Crotta, & N. Ferrari

12:50 Discussion of morning presentations

13:00 Lunch on own (Sponsored lunch for students; *Facilitator of student lunch – Yu Takeuchi*)

Pathway and spread models – Moderator: Richard Baker

2:30 A pathway model to assess the exposure of European trees to pests introduced with wood trade – J.C. Douma, C. Robinet, L. Hemerik, C. Magnusson, D. Piou, & W. van der Werf*

2:50 Optimizing the surveillance of crop pests through network analysis – M.D. Triska* & M. Renton

3:10 Discussion of early afternoon presentations

3:20 Break

Brown marmorated stink bug, Halyomorpha halys, and IPRRG – Moderator: Richard Baker

3:40 Introduction to Project Stinky – Robert Venette, via WebX

3:50 Multi-model analysis for projecting the global distribution of *Halyomorpha halys* – Senait D. Senay, Craig B. Phillips, Ursula Torres, John Kean, & Susan P. Worner

4:10 Tracking the spread of *Halyomorpha halys* in Italy combining citizen science and spatial modelling – L. Maistrello*, P. Dioli, S. Volani, S. Pasquali, & G. Gilioli

4:30 Phenology and life table parameters of the brown marmorated stink bug in Northern Italy – E. Costi*, T. Haye, and L. Maistrello

4:50 Questions/Discussion about Project Stinky

5:30 Adjourn

	Day 2, Wednesday, August 24
8:30	Arrive for security screening
	Praxis: Plant pathogens & invertebrates – Moderator: Gianni Gilioli
9:00	New foliar and soilborne pathogens recently observed on leafy vegetables for the ready-to-eat sector in Italy - G. Gilardi*, A. Garibaldi, & M.L. Gullino
9:20	Could 16SrIX phytoplasmas associated with almond witches'-broom disease represent an actual risk for Euro-Mediterranean countries? F. Quaglino, Y. Abou-Yawdah, M. Molino Lova, R. Al Achi, E. Choueiri, R. Tedeschi, P. Casati, A. Alma, & P.A. Bianco*
9:40	Climatic and spatial factors associated with citrus black spot disease: a Bayesian approach with INLA – J. Martínez-Minaya, D. Conesa, A. López-Quílez, & A. Vicent*
10:00	Mapping the potential distribution of the invasive apple snails (*Pomacea canaliculata* and *P. maculata*) in European wetlands and freshwater ecosystems. – G. Gilioli, S. Pasquali, L. Mariani, S. Volani*, S. Vos, & G. Schrader
10:20	Discussion of morning presentations
10:30	**Break**
11:00	Introduction to technical excursion - Riccardo Bugiani, Servizio Fitosanitario Regionale (Regional Plant Protection Service), Regione Emilia Romagna, Bologna (Italy)
11:30	Lunch at EFSA

	Technical excursion and social dinner on the Italian Apennine Mountains: the Asian gall wasp in chestnut forest in Corniglio and the spruce bark beetle in Lagdei – Guide: Ciro Gardi, EFSA. Please bring light walking shoes and a jacket. Please notify the organizers of any health concerns.
1:00	Leave EFSA (12:50 at the bus in front of EFSA)
1:30	Arrive Bosco di Corniglio
3:30	Leave Bosco di Corniglio
3:45	Arrive Lagdei
4:00	Excursion Lagdei to Lago Santo and return (coniferous stands and Ips) 3 hours (drinks at Lago Santo)
7:00	Group dinner in Lagdei
9:30	Leave Lagdei
11:00	Return to Parma

	Day 3, Thursday, August 25
9:00	Arrive for security screening
	Inspections and surveillance – Moderator: Giuseppe Stancanelli
9:20	Risk-based sampling: Opportunities for improving inspection methods based on risk - Christina Devorshak, Robert Griffin, & Barney Caton*
9:40	Sampling Interceptions for Risk Identification – A.P. Robinson*
10:00	Developing an International Plant Sentinel Network E. Barham E.*, S. Sharrock, C. Lane, & R. Baker
10:20	Discussion of morning presentations
10:30	**Break**
11:00	Posters (Divide into n groups; authors have 5 minutes with each group) – *Facilitator: Darren Kriticos*
12:30	Lunch (on own)
	Pest risk and climate change – Moderator: Giuseppe Stancanelli
1:30	Towards a set of planetary-scale environmental predictors for supporting the study of forests and their biotic/abiotic disturbances under changing climate patterns - Daniele de Rigo*, & Margherita Di Leo
1:50	~~Estimating pest impacts under climate change: *Spodoptera litura* (F.) performance on brassica crops under elevated CO_2 - Pham Anh Tuan*, Papitchaya Teawkul, & Shaw-Yhi Hwang~~
2:10	Discussion about climate change and pest risk
2:15	IPRRG Business Meeting – *Facilitator: Richard Baker*
3:15	**Break**
3:45	Return to Workgroup Discussion - Project Stinky/Papers from this Conference/Others – *Facilitators: Richard Baker & Darren Kriticos* (cocktails provided)
5:00	**Adjourn – Dinner on own**

	Day 4, Friday, August 26
8:30	Arrive for security screening
	Uncertainty – Moderator: Wopke van der Werf
9:00	Too much information? Assessing the establishment potential of *Hyphantria cunea* in the UK with contradictory thermal data – A. Korycinska & R.H.A. Baker*
9:20	Applying new tools in CLIMEX to explore parameter sensitivity, model uncertainty and inter-annual variation in climate suitability: The potential distribution of *Chilo partellus*, including the effects of irrigation - D.J. Kriticos*, T. Yonow, N. Ota, J. Van den Berg, J., & W.D. Hutchison
9:40	Optimal control of biological invasions with eradication success benchmarks and management of the risk of uncertain program costs – D. Yemshanov, D*, R.G. Haight, F.H. Koch, R. Venette, K. Studens, R.E. Fournier, & J.J. Turgeon
	Addressing epistemological uncertainty with databases Moderator: – Wopke van der Werf
10:00	Databases of host species to support research on plant pests: the case of *Xylella fastidiosa* - Ciro Gardi*, Miren Andueza, Andrea Baù, Ewelina Czwienczek, Ioannis Koufakis, Marco Pautasso, Giuseppe Stancanelli, & Sara Tramontini
10:20	**Break**
10:45	EFSA apple pest database – harmonised data collection in support of pest risk assessments – V. Kertesz*, G. Gilioli, A. MacLeod, S. Blümel, H. Reisenzein, A. Egartner, R.A. Gottsberger, T. Leichtfried, C. Lethmayer, M. Monguidi, M. Oberhuber, U. Persen, F. Riolo, G. Strauss, & J. Wolf
	Pest risk mapping and management – Moderator: Wopke van der Werf
11:05	An integrated spatial analytic framework to manage invasive species in regulatory phytosanitary applications – Y. Takeuchi*
11:25	Discussion of morning presentations
11:35	Conference wrap-up - *Facilitators: Richard Baker & Darren Kriticos*
12:00	**Adjourn**

1) **Alomar, O., A. Batlle, R. García, R. Gil, A. Granollers, S. Jiménez, S., A. Laviña, J.P. Linge; M. Pautasso*, C. Reverté, J. Riudavets, A. Rortais, G. Stancanelli, J. Virgili-Gomà and S. Vos** "MedISys for media monitoring of existing and emerging plant health threats."

2) **Aycart, Juan José.** "*Fusarium oxysporum* wilt on Cavendish, risk analysis for Ecuador."

3) **Bing, Huang Yu and Lin Feng-Chyi.** "Study on climate change impact on the potential geographic distribution and population fluctuation for the fruit flies in Taiwan."

4) **Bugiani, R., A. Butturini, R. Tiso, and T. Galassi** "The Pest and Disease Warning Service of Emilia-Romagna Region under the EU Dir. 128/09."

5) **Bugiani, Riccardo, Loredana Antoniacci, Francesco Spinelli, Irene Donati, Giampaolo Buriani, and Sofia Mauri** "Validation of a forecasting model for the prediction of PSA on kiwifruit in Emilia Romagna Region (Italy)."

6) **Gullino, M.L., Giovanna Gilardi*, and the EMPHASIS consortium.** "EMPHASIS. Tools to identify pest management challenges and promote innovation by adopting a multi-actor approach."

7) **Januario, Stella M. *, Fabio A. Labra, and Sergio A. Estay.** "The role of invaded distribution in reducing model uncertainty: Estimating *Vespula germanica* distribution in South America."

8) **Lei, Ming, Zihua Zhao, Meng Qin, Shouqi Zhao, and Zhihong Li. "**The establishment possibilities of maize pests in China based on self-organizing map."

9) **Paz Silva, C., and S.A. Estay.** "Mapping the risk of establishment of huanglongbing in Chile."

10) **Rostami, F., N. Zandi Sohani, F. Yarahmadi, and K. Avalin Chaharsoghi.** "Effects of Azadirakhtin and Takomi on some biological parameters of *Habrobracon hebetor*."

11) **Samayoa, Ana Clariza*, D. J. Kriticos, and Shaw Yhi Hwang.** "Using temperature transfers treatments to calibrate models of the potential geographical distribution and population dynamics of the black soldier fly, *Hermetia illucens*: exploring suitable composting areas for larvae to recycle food waste."

12) **Teawkul*, Papitchaya, Pham Anh Tuan, and Shaw Yhi Hwang.** "Benefit of *Pieris rapae* on radish plant under elevated temperature."

13) **Vignali, G., S. Barbarotti, P. Piovani*, G. Maresi, and C. Salvadori.** "Ten years of *Ips typographus* in Lagdei forest (Province of Parma): outbreak analysis and forest regeneration."

14) **Zandi-Sohani, Nooshin* and Antoni Szumny. "**Chemical composition and insecticidal effects of *Eucalyptus camaldulensis* and *Eucalyptus microtecha* on two stored product pests."

Session 1 - Introduction

Pest risk activities in EPPO

Muriel Suffert

ms@eppo.int

European and Mediterranean Plant Protection Organization, 21 Boulevard Richard Lenoir, 75011 Paris, France

Over more than 25 years, the European Plant Protection Organization (EPPO) has developed regional standards to harmonize pest risk analysis (PRA) within the European and Mediterranean region. This presentation will cover EPPO's activities on early warning, pest-specific PRAs as well as the development of the methodology for commodity studies (including the EU research project DROPSA). A recent survey on the use of PRA schemes within the EPPO region has been conducted and gives indications for EPPO's future activities on PRA.

History of IPRRG: who are we and where are we going?

Richard Baker*[1], Frank Koch[2], Darren Kriticos[3], Amy Morey[4], Rob Venette[4,5]

richard.baker@defra.gsi.gov.uk

1. Plant Health Risk & Horizon Scanning Team, Department for Environment, Food and Rural Affairs, UK
2. USDA Forest Service, Southern Research Station, USA
3. Health and Biosecurity, CSIRO, Australia
4. University of Minnesota, USA
5. Northern Research Station, USDA Forest Service, USA

The International Pest Risk Research Group, or IPRRG, is a group of research scientists and pest risk practitioners committed to enhancing pest risk modelling and mapping methods, addressing the key challenges faced by the discipline. Since 2007, we have held annual meetings where new developments are presented, discussed, and tested. We communicate findings of the group and its members to a broad international audience that includes policymakers as well as scientists. IPRRG has produced three major group publications and numerous publications from self-organized teams within the group. Focal topics have included climate change, economic impacts, uncertainty and the interface between pest risk science and policy. We also provide technical training in pest risk methods, thereby promoting best practice in their application. As the name suggests, the group is international and open to all, including students, researchers and other professionals. A key future objective is to create a global pest risk assessment for the brown marmorated stink bug, *Halyomorpha halys*. This project is intended to focus the skills and talents of the IPRRG on a pressing global issue and to demonstrate the value of the Group to scientists, managers, and policy makers with interests in biosecurity and pest invasions.

Session 2 - New methods to analyse pest risks

A quantitative risk assessment methodology for pest risk analysis

Gianni Gilioli[1]*, Alan MacLeod[2], Trond Rafoss[3], Gritta Schrader[4], Wopke van der Werf[5]

gianni.gilioli@unibs.it

1 Dipartimento di Medicina Molecolare e Traslazionale, Università degli Studi di Brescia - Viale Europa 11, 25123 Brescia, Italy 2 Department for environment food and rural affairs, Sand Hutton, York, YO41 1LZ, United Kingdom 3 Plant Health and Biotechnology Division, Norwegian Institute of Bioeconomy Research – NIBIO, Pb 115, NO-1431 Ås, Norway 4 European Food Safety Authority, Via Carlo Magno, 1A, 43100 Parma, Italy 5 Wageningen University, Centre for Crop Systems Analysis - Droevendaalsesteeg 1, 6708PB Wageningen, The Netherlands

A quantitative risk assessment method for plant pest risk analysis and the identification and evaluation of risk reduction options is currently under development by the EFSA Plant Health Panel. The method is used by the Panel when responding to requests for scientific opinions regarding risks posed by specific plant pests which can cause harm to plants, plant products, ecosystem services or biodiversity in the EU. The new approach is based on three pillars, making the approach a) adaptive, when conditions for the assessment are changing, b) mechanistic and population based by connecting all steps and sub-steps in the assessment via the abundance of the pest and by integration of risk reducing options (RROs), c) quantitative by combining knowledge and uncertainty, with increased consistency by using quantities measurable in the real world. To conduct the assessment, scenarios are defined that allow the comparison between different situations, e.g. comparison of a scenario under current regulation against a scenario where the pest is deregulated and RROs are removed, or against a more stringent scenario where additional RROs are imposed. An important feature of the method is that it is population based, which means that the impact of the assessed pest is directly linked to the abundance of the pest, which is propagated through the scheme from the cultivation of the host plant in the country of origin to the occurrence in the risk assessment area within the time horizon of the assessment. Being structured flexibly, the framework also allows assessors to focus on specific components of pest risk in cases where a complete risk assessment is not warranted. This new approach is currently being applied to four pilot studies. Examples will be given in the presentation.

BiOR² : a database/software process dedicated to plant pests ranking

Tayeh Ch.*[1], Guinehut D.[1], Lê Van A.[1], Tassus X.[1], Gachet E.[1], Manceau C.[1]

christine.tayeh@anses.fr

(1) Expertise and Biological Risks Unit (ERB), Plant Health Laboratory, French Agency for Food, Environmental and Occupational Health & Safety (ANSES)

Recently, the French Agency for Food, Environment and Occupational Health and Safety (ANSES) was entrusted by the French Ministry for Agriculture to rank a list of plant pathogens in order to achieve pests' categorization. The objective is to prioritize the deployment of resources based on risk and impact of a pest. A new methodology was thus developed: BiOR², which stands for "Biological Organisms data Retrieval and Ranking system". BiOR² associates a database to softwares for multi-criteria analysis. First, the database runs under the database management system (DBMS) PostgreSQL. Its content was collected in a semi-automated manner and consists of 55 tables containing information relative to plants' trade, land use, legislation, pest interceptions and climate classification. The database is linked to a graphic user interface that allows, besides the display of previously entered data, to fill in new data on both host plants and pathogens through a questionnaire. Next, 2800 lines of code enable the link between the available data according to specific criteria and provide a multi-criteria matrix, whose uncertainty can be also quantified by BiOR². A base of 24 criteria, defined according to FAO ISPM N°11 document, covers risk of entry, establishment, spread as well as economic, social and environmental impacts. The ranking is finally achieved through Visual PROMETHEE with the possibility of conducting several scenarios where criteria are assigned different weights. The process was applied to metropolitan France and the French Oversea Departments on respectively 278 and 110 plant pests and pathogens. Results were validated by comparison against results of other models and by a panel evaluation. Overall, BiOR² is intended to be objective, generic, based on sound science, highly adaptable to meet various kinds of questions about the management and impact of pests.

Pest risk mapping based on spatial and temporal distribution of crop production

*Tuomola, J. Huitu, H. Hannunen, S.

juha.tuomola@evira.fi

1. Finnish Food Safety Authority Evira, Risk Assessment Research Unit 2. Natural Resources Institute Finland, Green Technology Unit 3. Finnish Food Safety Authority Evira, Risk Assessment Research Unit

We suggest a method that ranks production areas of a certain crop species according to the relative probability of pest invasion, using information on the spatial distribution of the crop species during the past 5-10 years. The results are presented as risk indices on a 0.5 × 0.5 km grid. The relative probability of pest invasion is assessed flowingly. 1) The probability of pest entry to a cell, in a given year is assumed to depend linearly on the area of the studied crop species in the cell, in that year. 2) The probability of pest spread to the surrounding cells is modeled with a Cauchy dispersal kernel. 3) The probability of pest survival in a cell, in a given year is assumed to depend on the presence of the studied crop species, so that if it is not present in the cell, in that year, the probability is assumed to decrease according to a predetermined proportion. 4) The probability of pest invasion in a cell is assumed to accumulate over the years, so that the probability of invasion at the end of year t (resulting from steps 1-3) is used as the baseline for calculating the probability for the year t+1. Using this method we estimated the areal pest risk to carrot production in Finland, and compared the risk indices to presence-absence data of *Candidatus* Liberibacter solanacearum on carrot fields. Preliminary analysis indicates that the carrot fields in the cells with high index values are more likely to be infected with Ca. L. solanacearum.

Options for developing an integrated framework to assess the impacts of exotic plant pests in Europe

MLO Espaldon*, MCM Mourits, W van der Werf, AGJM Oude Lansink

laya.espaldon@wur.nl

Wageningen University

Various integrated impact assessment (IIA) frameworks are used by governments and intragovernmental agencies to aid in planning and decision making for the management of natural disasters, such as floods or earthquakes, and planned interventions, such as mining operations or housing development. IIA considers economic, environmental and social impacts. IIA takes a hierarchical approach in which the impacts are decomposed in a stepwise manner down to a point at which they are concrete enough to make an assessment using data, expert judgement or models. The completed partial assessment results are combined using decision rules to achieve overarching assessments. IIA has similar objectives as pest risk analyses made by plant health authorities; however, the principles and approaches of IIA have not been widely applied in plant health. An inherent difficulty in the integrated approach is the assessment of non-monetary societal impacts. The classical approach to pest risk analysis follows the steps of entry, establishment, spread and impact, representing the mechanistic pathway towards harm. This approach may not necessarily provide the most effective way to assess the different kinds of impacts that need consideration, such as impacts on plant health, ecosystem functioning, and communities that depend for their livelihoods on agricultural plant production or ecosystem services. The question is what PRA can learn from the practice of IIA. As part of the Horizon 2020 POnTE Project, we will explore options to use IIA to support plant health authorities developing measures for prevention and control that deliver maximum total benefit to society. Applications will focus on *Xylella fastidiosa*, *Candidatus* Liberibacter solanacearum, *Phytophthora* spp. and *Hymenoscyphus fraxineus*.

Development of disease risk assessment on invasive alien species: evaluation of the risk of introduction of new infections and spread of local ones

Chinchio E. *[1], Crotta M.[2], Ferrari, N.[3]

eleonora.chinchio@outlook.it

1 Department of Veterinary Medicine (DIMEVET); Universita' degli Studi di Milano; Via Celoria 10 - 20133 Milano - Italy 2 Veterinary Epidemiology, Economics and Public Health Group, The Royal Veterinary College, Hawkshead Lane, North Mymms, AL9 7TA, Hatfield, UK 3 Department of Veterinary Medicine (DIMEVET); Universita' degli Studi di Milano; Via Celoria 10 - 20133 Milano - Italy

Invasive alien species (IAS) represent one of the main global threats to biological conservation and can heavily affect human activities. To tackle this issue, the European Community has approved Regulation No 1143/2014 to define a common intervention line. According to it, a list of invasive alien species of Union concern has been defined and will be regularly updated in order to define priority interventions. Although infectious diseases have dramatic impacts on human health, economic sustainability of animal farming and biodiversity conservation, they are rarely included into evaluations due to the methodological complexities of their risk assessment. We used raccoon (*Procyon lotor*), coypu (*Myocastor coypus*) and grey squirrel (*Sciurus carolinensis*) as model species to develop a qualitative methodology for disease risk assessment that allows to assign each IAS' pathogen into one out of four risk categories, depending on its impacts and the likelihood of the infection to occur. For each IAS we assessed the risk towards humans, domestic animals and wildlife relative to the introduction of new parasites and the amplification of local ones. Additionally we obtained a total disease risk evaluation for every species that included all these aspects. We also estimated the uncertainty level associated with each risk estimate to point out knowledge gaps. The hazard identification, carried through bibliographic review, identified 377 parasite species showing that raccoon is the IAS infected by the highest number of pathogens. The multiple outcomes produced by our approach showed that raccoon plays the highest risk of introduction and spreading of infections toward humans, livestock and wildlife. Moreover, it is the species with the highest uncertainty. This approach provides a method to explore whether alien species, with relatively low impact on biodiversity and human economy, might indeed entail high disease risks, underlining the importance to consider different aspects in the IAS risk assessment.

Session 3 - Pathway and Spread Models

A pathway model to assess the exposure of European trees to pests introduced with wood trade

Douma JC [1], Robinet C[2], Hemerik L[3], Magnusson C[4], Piou D[5,6], van der Werf W*[1]

christelle.robinet@orleans.inra.fr

1 Centre for Crop System Analysis, Wageningen University, 6700 AK, Wageningen, The Netherlands. 2 INRA, UR633 Zoologie Forestière, F-45075 Orléans, France. 3 Biometris, Department of Mathematical and Statistical Methods, Wageningen University, P.O. Box 16, 6700AA Wageningen, The Netherlands. 4 Norwegian Institute for Bioeconomy Research, N-1431, Ås , Norway. 5 INRA, UMR BIOGECO, F-33610 Cestas, France. 6 Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt, DGAL-SDQPV, Département de la Santé des Forêts, 252 rue de Vaugirard, F-75732 Paris, France.

Travel and trade are the main drivers of the introduction of exotic species into new areas. To explore the role of wood trade in the potential introduction of tree pests, we developed a pathway model and calculated the exposure of trees in Europe to tree pests. The model describes the import, inspection and treatments of wood, as well as the trade among European countries and processing to sawn wood, final product and residues. The model quantifies the frequency of escape of the pest from wood, and the transfer to host trees. This model was designed to be generic, but for illustration, it was applied to round wood of oaks coming from the United-States of America potentially carrying the oak wilt fungus, *Ceratocystis fagacearum* (not present in Europe yet) and to round wood and sawn wood of conifers coming from China potentially carrying the pine wood nematode, *Bursaphelenchus xylophilus* (detected in Portugal in 1999). We show that this pathway model can be used to identify the points along the pathway which mainly contribute to the exposure and to test the effectiveness of various risk reduction options. Pathway modelling is a promising tool to study entry pathways of alien tree pests. First, it is useful to target the data which are necessary to collect to better assess the exposure. Then, it can assist plant health managers in pest risk analyses and support decision makers in their decisions about trade regulation and associated conditions.

Optimizing the surveillance of crop pests through network analysis

Triska, M.D.[1,2]*, Renton, M.[1,2]

maggie.triska@uwa.edu.au

1 School of Plant Biology, The University of Western Australia 2 Plant Biosecurity cooperative Research Centre, Australian Capital Territory

Surveillance strategies are designed to detect new invasions early to increase the likelihood of control or eradication, and thus maintain trade freedom. Current surveillance strategies may be improved through network analyses which identifies highly connected, at risk regions and properties. Network analyses has been successful in tracking the transmission of diseases in livestock and improving surveillance strategies; however, crop related movement is less documented than livestock, and limited data exists on the movement of crops between farms. This is likely why few applied studies assess networks and potential crop pest movement, and we were unable to locate any studies that assessed crop pest movement at the local (farm-farm) scale. Therefore, we modelled a case study of potato-cyst nematode (PCN) within Victoria, Australia and simulated movement and potential pest spread at the landscape (region-region) and local (farm-farm) scales to assess if resulting risk networks could optimize PCN surveillance strategies. Movement between and within potato-growing regions was dependent on Euclidean distance, production type (fresh vs seed potatoes) and time since invasion. To assess surveillance we simulated multiple, realistic and economically viable strategies (ie, annual or biennial surveys at 100, 50, 20 or 10% of farms in all regions, regions where detections occurred or regions where detections occurred plus regions at the perimeter of the state). Additionally, quarantine measures were placed on farms after a detection was obtained. We show that even with limited data, network analysis can be used to identify high risk areas and guide surveillance efforts of crop pests to decrease the time to detection, the resources required for surveillance or management and ultimately the spread of pests to new areas.

Session 4 - Brown marmorated stink bug, *Halyomorpha halys*, and IPRRG

Multi-model analysis for projecting the global distribution of *Halyomorpha halys*

Senait D. Senay[1, 4&6], Craig B. Phillips[3, 4], Ursula Torres[2], John Kean[3, 4], Robert C. Venette[5] and Susan P. Worner[2, 4]

[1] International Science & Technology Practice & Policy (InSTePP), Dept. of Applied Economics, University of Minnesota, 1994 Buford Ave., 248E Ruttan Hall, St. Paul, MN 55108, USA

[2]BioProtection Research Centre, PO Box 85084, Lincoln University, Lincoln 7674, New Zealand

[3]AgResearch Limited, Private Bag 4749, Christchurch 8140, New Zealand

[4]Better Border Biosecurity

[5]Northern Research Station, Forest Service, United States Department of Agriculture, 1992 Folwell Ave., St. Paul, MN 55108

[6]ssenay@umn.edu

ABSTRACT

Halyomorpha halys, brown marmorated stink bug, is a pest of many plants in its native East Asian range. In the last two decades, *H. halys* has become established outside its native range in parts of the USA, Canada and Europe. In this study, we used a multi-modelling approach within a standardized modelling framework to produce a comprehensive prediction of the potential global distribution of *H. halys*. We evaluated how predictions were influenced by differences in presence datasets, models (presence-only and presence-absence), and model performance measures. Different models gave different predictions, which showed the benefit of ensemble methods over single models, and enabled us to present best and worst case scenarios.

Most areas predicted to be climatically suitable for *H. halys* were within the Nearctic and Palearctic eco-zones, except for some areas in South America and Australasia. In New Zealand, most areas predicted to be suitable were in the North Island. However, environmental niche analysis showed *H. halys* is occupying environments outside its native niche. This, coupled with its anthropological association, suggests the distribution of *H. halys* has not yet reached equilibrium, and further assessment of its potential distribution will be necessary should it become established outside its currently predicted environmental range.

Key words: ensemble models, species distribution model, *Halymorpha halys*, invasive species, presence-absence, presence-only

Tracking the spread of *Halyomorpha halys* in Italy combining citizen science and spatial modelling

Maistrello L [1] *, Dioli P.[2], Volani S.[3], Pasquali S.[4], Gilioli G.[3]

lara.maistrello@unimore.it

1 Dipartimento di Scienze della Vita, Centro Interdipartimentale Biogest-Siteia, Università degli Studi di Modena e Reggio Emilia - Via G. Amendola 2, 42122 Reggio Emilia, Italy 2 Museo Civico di Storia Naturale, Corso Venezia 55, 20121 Milano, Italy 3 Dipartimento di Medicina Molecolare e Traslazionale, Università degli Studi di Brescia - Viale Europa 11, 25123 Brescia, Italy 4 CNR-IMATI - Via Bassini 15, 20133 Milano, Italy

Native to Asia, the Brown Marmorated Stink Bug (BMSB) *Halyomorpha halys* (Heteroptera: Pentatomidae) is currently one of the most invasive pests in the world. Extremely polyphagous, once introduced in a new territory, BMSB rapidly becomes a key pest of fruit orchards and other crops. The first detection of BMSB in Italy was in Emilia Romagna in 2012, and now is rapidly dispersing in Northern Italy and in the rest of the country. The detection timely activated a survey that combined active search with citizen science using multimedia channels. Data concerning time and location of the findings and population abundance were collected. The spread of BMSB in Italy was tracked obtaining the current distribution map. To investigate the spatial pattern of dispersal in the early stage of spread, a 116 x 134 km area contain the location of the first detection was considered and divided in 2 x 2 km cells. Rules are specified to define the occupancy of each cell and follow the spread dynamics in a discrete-space and derive a first estimation of the spread rate. Aspects of the temporal population dynamics were investigated estimating the transition probability among different classes of abundance in the cells. Predicting population growth is important since field data in the Northern Italian show that as pest abundance increases the pest becomes a serious threat in fruit orchards. Our findings confirm the potential fast spread of BMSB that could rapidly invade wide areas facilitated by passive transportation at long distance. These preliminary results together with data on phenology, host plants and behaviour collected in the same area could be considered to build more accurate model on the spatial-temporal population dynamics. This model could be used as a tool supporting the design of spread management strategies and guiding crop protection measures.

Phenology and life table parameters of the brown marmorated stink bug in Northern Italy

Costi E.*[1]; Haye T.*[2]; Maistrello L.*[1]

costi.elena@yahoo.it

1 Dipartimento di Scienze della Vita, Centro Interdipartimentale Biogest-Siteia, Università degli Studi di Modena e Reggio Emilia - Via G. Amendola 2, 42122 Reggio Emilia, Italy 2 International Centre for Agriculture and Biosciences (CABI) - Rue des Grillons 1, 2800 Delemont, Switzerland

The Asian brown marmorated stink bug (BMSB) *Halyomorpha halys* (Heteroptera, Pentatomidae) is an highly invasive species with a broad host range, including fruit trees, vegetables, ornamental and wild species. In the United States, where it has been accidentally introduced nearly two decades ago, it has 1-2 generations per year and is considered as one of the major agricultural pests, causing several million dollars losses, especially in orchards. In Switzerland, where it has been present since 2004, it has only one generation and is mainly a dwelling nuisance. In 2012, BMSB was first detected in Emilia Romagna (Italy), one of the most important fruit producing regions in Europe. It is currently spreading all over Northern Italy and rapidly dispersing throughout the rest of the country. In 2015, high BMSB populations were reported in pear orchards, causing severe damage of sometimes 80-100% deformed fruits in the orchard borders. To investigate the phenology of BMSB under outdoor conditions in Northern Italy, field collected adults were overwintered outside in boxes sheltered from precipitation. In spring overwintering mortality and the emergence of adults from their overwintering sites were assessed. Survived adults were then paired and fecundity and development time of eggs and nymphs were recorded throughout the season. BMSB overwintering survival was over 20%, with adults exiting their overwintering sites from March to May. In northern Italy, BMSB has two overlapping generations per year, with important differences in longevity and fecundity. The obtained parameters show the high invasive potential of BMSB, eliciting serious concern for many Italian crop productions. These data are indispensable for the development of models to forecast pest outbreaks in the future.

Session 5 - Praxis: Plant pathogens & invertebrates

New foliar and soilborne pathogens recently observed on leafy vegetables for the ready-to-eat sector in Italy

G. Gilardi*, A.Garibaldi, M.L. Gullino

giovanna.gilardi@unito.it

University of Torino, Centre of competence for the Innovation in the agro-environmental sector (AGROINNOVA), Grugliasco (TO), Italy

During the past years new diseases caused by soil-borne and foliar pathogens were observed for the first time in Italy on leafy vegetables for the ready-to-eat products. Italy is the second producer in Europe of fresh-cut leafy vegetables, representing indeed a very interesting case study. Leafy vegetables are particularly exposed to the risk of the emergence of new diseases as a consequence of the dynamism of the sector, the wide range of products, and the use of intensive cultivation techniques. Among foliar diseases *Alternaria alternata* on basil, *Plectosphaerella cucumerina*, *Alternaria japonica* on rocket, *Phoma tropica* on lettuce, *Fusarium equiseti* on lettuce and rocket, *Colletotrichum kahawae* on cultivated rocket, *Myrothecium roridum* on lamb's lettuce and *M. verrucaria* on spinach were observed in the last five years in Italy. Moreover, several new Fusarium wilt agents and damping-off caused by *Pythium aphanidermatum* and *P. irregulare* caused devastating losses in yield and quality under favorable conditions. The possibility of isolating some of these new pathogens from seeds, although from a low percent of them, supports the hypothesis that the rapid spread of new diseases of lettuce, rocket and basil recently observed in Italy is due to the use of infected propagative material. The symptoms of the diseases caused by these fungal pathogens, the biology and physiological characteristics of the causal agents and some information concerning disease management are critically discussed.

Could 16SrIX phytoplasmas associated with almond witches'-broom disease represent an actual risk for Euro-Mediterranean Countries?

Quaglino, F, Abou-Yawdah, Y, Molino Lova, M, Al Achi, R, Choueiri, E, Tedeschi, R, Casati, P, Alma, A, Bianco, PA*

piero.bianco@unimi.it

Department of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, Università degli Studi di Milano, 20133 Milan, Italy (authors 1, 7, 9) Department of Agricultural Sciences, Faculty of Agricultural and Food Sciences, American University of Beirut, 11-0236 Riad El-Solh 1107-2020, Beirut, Lebanon (author 2) AVSI Foundation, St. Fawqa street, Jounieh-Ghadir, Lebanon (author 3) Lebanese Ministry of Agriculture (author 4) Department of Plant Protection, Lebanese Agricultural Research Institute, Tal Amara, P.O. Box 287, Zahlé, Lebanon (author 5) Department of Agricultural, Forest and Food Sciences, Università degli Studi di Torino, 10095 Grugliasco (TO), Italy (authors 6, 8)

Emerging pathogens caused strong epidemics in the last years in Europe (e.g. *Xylella fastidiosa* in South Italy), while recurrences of already present key pathogens (e.g. fruit tree phytoplasmas) are constantly recorded. Unculturable insect-transmitted phloem-limited bacteria have been reported as potentially dangerous for Europe [Janse et al., 2012 (J Plant Pathol 94:S4.5-S4.29)]. *'Candidatus* Phytoplasma phoenicium' (CaPphoe) (EPPO Alert List) is the etiological agent of almond witches'-broom (AlmWB), a disease affecting almond, peach and nectarine in the Middle East. In Lebanon, AlmWB is caused by CaPphoe strain IX-B (CaPphoe/IX-B), transmitted by the leafhopper *Asymmetrasca decedens* and by the cixiids *Tachycixius viperinus* and T. cf. *cypricus* [Abou-Jawdah et al., 2014 (Ann Appl Biol 165:395-403); Tedeschi et al., 2015 (Ann Appl Biol 166:372-388)]; in Iran, AlmWB is caused by both CaPphoe/IX-B and IX-C but insect vectors are still unknown [Salehi et al., 2006 (J Phytopath 154:386-391)]. Available evidences highlighted that CaPphoe/IX-B was never identified outside Middle East. On the other hand, CaPphoe/IX-C is associated with important diseases of other crops (e.g. sesame and lettuce phyllody in Turkey and Iran, respectively) and was reported in other geographic areas, including Italy, in vegetables and wild plants [Martini et al., 2012 (J Plant Pathol, 94:S4.49); Casati et al., 2016 (J Plant Pathol, 98:71-81)]. Thus, the potential adaptation of 16SrIX-C phytoplasma to numerous plant species highlights the elevated risk of its spread not only throughout the Middle East but also in neighboring geographic regions, such as Europe and Mediterranean basin. Interestingly, the wide spread of 16SrIX-C phytoplasmas over large geographical areas suggests the presence of efficient insect vector(s). The knowledge of the insect vectors is one of the crucial keys for managing a disease and to avoid further spreading to other geographical areas.

Climatic and spatial factors associated with citrus black spot disease. A Bayesian approach with INLA

Martínez-Minaya, J.1, Conesa, D.2, López-Quílez, A.2, Vicent, A.1*

vicent_antciv@gva.es

1 Centro de Protección Vegetal y Biotecnología, Instituto Valenciano de Investigaciones Agrarias (IVIA), Moncada 46113, Valencia, Spain. 2 Departament d'Estadística i Investigació Operativa, Universitat de València. Burjassot 46100, Valencia, Spain.

Citrus black spot (CBS), caused by *Phyllosticta citricarpa*, is one of the main fungal diseases of citrus worldwide. The pathogen induces external rind blemishes and premature fruit drop, causing serious economic losses. Some studies suggested that climates in the Mediterranean Basin are not favorable for CBS development while others indicated the opposite. Nevertheless, none of these works considered spatial effects in the models. Hierarchical Bayesian analyses were conducted to identify climatic and spatial factors associated with CBS distribution. South Africa was selected as the case study due to its unique climate diversity. Georeferenced datasets of CBS distribution for 1950 and 2014 were assembled. Climate data were obtained from the WorldClim database. The spatial structure of the data was first explored using Moran's I and Geary's C analyses at increasing distances. Non-spatial models included an informed selection of climatic covariates or principal components. The spatial effect was included in the model as a geostatistical component. Bayesian inference on the parameters and prediction of CBS presence/absence were made by integrated nested Laplace approximation (INLA) for latent Gaussian models. The geostatistical effect was implemented through the stochastic partial differential equation (SPDE) approach. Selection of models was based on WAIC. Models for 1950 were evaluated against CBS distribution in 2014 using receiver operating characteristic curve (ROC) analysis. Moran's I and Geary's C indices were significant at all the distances evaluated (60-900 km). Spatial models outperformed non-spatial models in the 1950 dataset, showing substantially lower WAIC values. Problems of model convergence were detected in 2014 due to the strong spatial structure of CBS data. Spatial models with principal components for 1950 had higher area under the ROC curve and better classification accuracy of CBS distribution in 2014. Our results indicated that models based on climate alone may underestimate the potential geographical distribution of CBS.

Mapping the potential distribution of the invasive apple snails (*Pomacea canaliculata* and *P. maculata*) in European wetlands and freshwater ecosystems.

Gilioli G.[1], Pasquali S.[2], Mariani L.[3], *Volani S.[1], Vos S.[4], Schrader G.[4]

stefania.volani@gmail.com

1 Dipartimento di Medicina Molecolare e Traslazionale, Università degli Studi di Brescia - Viale Europa 11, 25123 Brescia, Italy 2 CNR-IMATI - Via Bassini 15, 20133 Milano, Italy 3 Museo Lombardo di Storia dell'Agricoltura (Mulsa), Facoltà di Agraria, Università di Milano - via G. Celoria, 220133 Milano, Italy 4 European Food Safety Authority - Via Carlo Magno, 1A, 43100 Parma, Italy

Pest risk analysis requires the identification of areas for potential establishment of a pest to assess the risk posed to agriculture and the environment. Pest abundance is considered as a predictor of the magnitude of impacts in the invaded habitat. Maps representing the potential distribution of pest abundance and the suitable habitats potentially affected by the pest provide key information supporting risk managers in their decision making process. In 2010, the apple snail *Pomacea maculata* was detected for the first time in Europe (Ebro Delta, Spain). Apple snails have been reported as a highly invasive species in wetlands and freshwater ecosystems worldwide causing significant impacts on the flora and fauna of the habitats where it is established. Since information on *P. maculata* biology is lacking, a temperature-dependent physiologically-based demographic model has been developed for the closely related species *P. canaliculata*. Based on this mechanistic model the potential distribution and abundance of the apple snails in Europe have been obtained and overlapped with the distribution of wetlands, freshwater ecosystems and protected areas potentially subjected to apple snails' invasion in Europe. Mapping suitable habitats for the apple snails has required an accurate screening of high resolution wetlands and freshwater datasets available at the European level. The Global Inundation Extent from a Multi-Satellites downscaled map (GIEMS-D15) with mean annual minimum and mean annual maximum inundation extent has been selected for the purpose of this study since it derives from traditional wetlands and freshwater datasets. Finally, the Natura2000 sites map has been used to determine protected areas in Europe that include wetlands and freshwater ecosystems which will be more at risk if the apple snails will spread.

Session 6 - Inspections and Surveillance

Risk-based Sampling: Opportunities for improving inspection methods based on risk

Christina Devorshak, Robert Griffin, Barney Caton

Christina.Devorshak@aphis.usda.gov

USDA-APHIS-Plant Protection and Quarantine

Each day, thousands of decisions regarding the phytosanitary status of consignments in both domestic and international trade is determined based on inspection. Inspection is by far the most used phytosanitary measure, which makes it important to understand how it is best used for safe trade. The International Plant Protection Convention (IPPC) adopted International Standard for Phytosanitary Measures (ISPM) No 23 (Guidelines for inspection) in 2005. This was followed by the adoption of ISPM No. 31 (Methodologies for sampling of consignments) in 2008. The guidance provided by the IPPC standards points to inspection as a procedure that is technically justified and fairly applied for risk management. Although it is widely accepted that inspection has a deterrent effect by simply being part of phytosanitary requirements and procedures, the standards also recognize that inspection is a form of sampling and therefore involves the associated statistical dimensions. It is important to understand the relevant statistical concepts and use them to advantage for inspection designs that are both fair to trade and informative to regulatory officials. The United States and Australia in particular have started shifting their inspection designs toward statistically-based sampling that is consistent with the ISPMs. Other countries have similar plans or are interested in strategies that move in the same direction. Sharing views and experiences in this regard will contribute to a better understanding of the conceptual foundation, the operational and regulatory challenges, and responding to stakeholder perceptions that are needed to facilitate international harmonization.

Sampling Interceptions for Risk Identification

Robinson, A.P.*

apro@unimelb.edu.au

1. CEBRA, The University of Melbourne

The Department of Agriculture and Water Resources intercepts pests that may be regulated, and which are therefore actionable from the point of view of biosecurity policy. The Department identifies intercepted pests in order to determine their biosecurity status. The outcome is recorded. Ideally, Departmental data holdings would support analysis to report an estimate of the biological risk presented by regulated activities such as importation of goods and international passenger or mail activity. Such an analysis requires two datasets, namely, information about the amount of regulatory effort, and information about the biological risk of intercepted pests. However, analysis of this kind is impeded by the incompleteness of the data. Not all pests are identified to species or to the level of biosecurity status — some are not because the importer opts for treatment or other remedial action immediately, and others because of operational, technological, or scientific constraints. A variety of unreported factors affects the amount of information that is available about any interception, and the information is missing in a haphazard way. Therefore the available data do not support statistical analysis of biological risk, and the inspectorate cannot accurately evaluate the relative biosecurity risk posed by different pathways. We developed a candidate scheme under which all intercepted specimens are submitted, and a sampling regime is applied to determine which specimens to identify. Here we describe the sampling scheme, outline its strengths and weaknesses against various regulatory activities, and discuss possible extensions.

Developing an International Plant Sentinel Network

*Barham E.[1], Sharrock S.[1], Lane C.[2], Baker R.[3]

ellie.barham@bgci.org

(1)Botanic Gardens Conservation International, 199 Kew Road, Richmond, TW9 3BW, UK (2)Fera, Sand Hutton, York, YO41 1LZ, UK (3)Department of Environment, Food and Rural Affairs, Sand Hutton, York, YO41 1LZ, UK

Sentinel plant research provides a novel way to predict new and emerging pest and disease threats. Sentinel research is the study of plants in non-native regions for the identification of damage by, or collection of information on, organisms present in that area. The International Plant Sentinel Network (IPSN) has been developed in order to facilitate such research. The network aims to utilise botanic gardens and arboreta; which are currently under-utilised resources. It is estimated 30-40% of all known plant species are housed within living plant collections providing a large scope for studies. Importantly, many of these plants are cultivated outside of their native regions and have been established in these areas for large periods of time allowing the study of specimen trees of varying ages. Botanical institutes also have an important benefit in their well-trained, engaged and passionate staff. Staff work on a daily basis with the plants in their care and are able to recognise, investigate and record any changes in a plant's health. The IPSN has been working for the past 3 years to develop a network of botanic gardens, arboreta, National Plant Protection Organisations and plant health scientists. The network has secured good participation from countries around the world including; Australia, Austria, Brazil, China, Germany, Italy, New Zealand, Poland, Slovakia, South Africa, the UK and the U.S. The project has developed valuable materials for building capacity and capability in contributing gardens and tools for carrying out surveys. The next phase of the IPSN will be to facilitate and coordinate plant sentinel studies in gardens around the world, supporting the efforts of contributing gardens to enable them to quickly and systematically collect meaningful data that can be used by plant health scientists and legislators.

Session 7 - Pest Risk and Climate Change

Towards a set of planetary-scale environmental predictors for supporting the study of forests and their biotic/abiotic disturbances under changing climate patterns

de Rigo, Daniele[1]*]; Di Leo, Margherita[2]

derigo@maieutike.org

[1,2] European Commission, Joint Research Centre [1] Maieutike Research Initiative

Worldwide, forest resources are subject to biotic and abiotic disturbances which may interact with complex patterns, whose modelling is subject to multiple sources of uncertainty that sometime are complicated by the relative scarcity of detailed environmental information harmonised at the global scale. Not rarely, the response of forest pests and their vectors is also influenced by the ecology of forests and the feedback between a particular association of forest tree taxa (including vulnerable hosts) and the local bio-climatic conditions. To exemplify a few known figures, in Europe 3.7 million ha of the overall forested areas are affected by forest damage - including 1.9 million ha damaged by insects and diseases - with varying patterns in different ecological zones. Worldwide, in the sole temperate climatic domain about 70 million hectares of forest are reported as damaged by insect pests (more than twice the corresponding area damaged by severe weather). Biotic and abiotic agents may sometime be interrelated, with uneven trends in different climatic zones and potential complex causal networks such as those involving forest management and land use changes, pest outbreaks and susceptibility to severe wildfires. Local-scale risk assessment exercises may often benefit from coherent, comparable regional/continental studies. Harmonised environmental information is vital to capture both local and wide-scale bio-climatic patterns. Here, we present the preliminary results of a set of planetary-scale environmental predictors based on potential solar irradiation, precipitation-driven drainage and topographic wetness. These predictors exploit the Geospatial Semantic Array Programming paradigm, GRASS GIS and the GNU/Linux environment to overcome non-trivial computational challenges. They are designed to become part of a larger set of predictors with the aim to support better harmonised and comparable studies on the linkage between the bio-climatic conditions of forests and their biotic/abiotic disturbances - now and under climate change scenarios.

Estimating pest impacts under climate change: *Spodoptera litura* (F.) performance on brassica crops under elevated CO_2

Pham Anh Tuan* , Papitchaya Teawkul, Shaw-Yhi Hwang

tuan.nipp@gmail.com

1. Department of Entomology, National Chung Hsing University 2. Department of Entomology, National Chung Hsing University 3. Department of Entomology, National Chung Hsing University

Spodoptera litura (F) is polyphagous defoliator as economically agricultural pest distribute world-wide. Our understanding of the future pest risks posed by this insect is currently based on data of growth and development of *S.litura* in laboratory/greenhouse experiments where larvae are fed with intact foliage under ideal conditions; the performance of the insect is being gauged under the effects of the host plant's "constitutive resistance". When plants suffer damage from multiple predators, they may boost their chemical-based defence capability via "induction resistance"; producing secondary compounds such as alkaloids, glucosinolates that reduce the growth and development of herbivores. We compare the performance of *S. litura* on both constitutive and induced-foliage under ambient [CO_2], finding a significant reduction of growth rate and fecundity on induced-foliage. Under enhanced [CO_2] our studies showed a decline of *S.litura* performance under constitutive-resistance and an increase in larval relative growth rate (RGR) when fed induction-resistant plant material. These findings suggest that patterns of future pest impacts may be affected by atmospheric chemical composition through changes in the ability of plants to synthesise allelochemicals for defence against herbivores. The ability of plants to synthesise quantitative defence compounds relies upon an adequate supply of nitrogen. Plants whose growth has been promoted by exposure to elevated levels of [CO_2] may be limited in their ability to synthesise poisonous metabolites and digestability-reducing compounds. The adjusted C:N in these brassicas appears to render them less nutritious, and less able to defend themselves from intense herbivory. Our results provide a caution to modellers attempting to estimate future pest risks under elevated [CO_2]: there is substantial uncertainty regarding the net outcome of altered insect herbivore population dynamics under elevated [CO_2]. In the absence of clear trends, perhaps an assumption of stationarity in pest impact functions is justified so long as the uncertainties are acknowledged.

Session 8 - Uncertainty

Too much information? Assessing the establishment potential of *Hyphantria cunea* in the UK with contradictory thermal data

Korycinska, A and Baker, R H A*

richard.baker@defra.gsi.gov.uk

Plant and Animal health, Department for Environment Food and Rural Affairs

Modelling and mapping the potential distribution of the fall webworm, *Hyphantria cunea*, a polyphagous lepidopteran pest of woody plants is challenging. This is because at least twelve different combinations of threshold temperatures for development and accumulated degree days have been published from populations in both the native (North America) and the non-native ranges (parts of Europe and Asia). In addition, the thermal requirements for the diapausing generation are reported to differ from the non-diapausing generations. When modelling the thermal suitability of the UK for potential establishment of this pest, only three of the thermal combinations were selected for full analysis and the reasons for excluding the other data from consideration are discussed. Different approaches to depicting the area of potential establishment based on the different threshold values are presented. All three combinations predicted only one generation per year would be possible in the UK but the area at risk ranged from the majority of England to only London. Since the availability of multiple parameter values adds another level of uncertainty to the mapping, methods for highlighting these additional uncertainties to risk managers based on the PRATIQUE guidelines for mapping in situations of uncertainty are discussed. For example, all three different parameter combinations were included on one map, with darker colours showing where all the model outputs considered the areas to be suitable for establishment and paler shades for areas of greater uncertainty. Additional maps illustrating the variation between years were produced for the worst-case scenario. Finally, attempts to validate the potential distribution by comparing predicted and actual generations in areas of the current distribution are outlined.

Applying new tools in CLIMEX to explore parameter sensitivity, model uncertainty and inter-annual variation in climate suitability: The potential distribution of *Chilo partellus*, including the effects of irrigation

*Kriticos, D.J.[1,2,3]; Yonow, T.[1,2,3]; Ota, N.[4]; Van den Berg, J. [5]; Hutchison, W.D.[6]

Darren.Kriticos@csiro.au

1 CSIRO, GPO Box 1700, Canberra, ACT Australia 2 The University of Queensland 3 HarvestChoice, InSTePP, University of Minnesota, St. Paul, MN 55108 USA 4 CSIRO Private Bag 5, Wembley WA 6913, Australia 5 Unit for Environmental Sciences and Management, North-West University, Potchefstroom 2520, South Africa 6 University of Minnesota, St. Paul, MN 55108 USA

In CLIMEX Version 4, a set of powerful tools were introduced to assist the modeller to automate many complex modelling tasks, including fitting parameters, estimating parameter sensitivity, assessing model uncertainty and understanding the effects of seasonal and inter-annual variation in climate on habitat suitability. *Chilo partellus* the spotted stem borer is a notorious pest of a wide range of agricultural crops throughout Africa and southern Asia. We demonstrate the use of several of the new tools available in CLIMEX to estimate the potential distribution of *C. partellus*, and to convey our confidence in the resulting model. We used the Compare Locations/Years model to explore historical weather patterns so that we could align the model with specific historical reports of phenological trapping and observation data. The parameter sensitivity analysis revealed that the most sensitive parameters were all known reliably, and the uncertainty analysis highlighted those areas where the potential range was less confidently estimated. The potential distribution of *C. partellus* spans the tropical, sub-tropical and temperate climate zones, including all of the major cropping zones throughout the globe. Irrigation plays a large part in extending the invasion risk into xeric regions, especially in Africa, Eurasia, the Middle-East, and the USA.

Optimal control of biological invasions with eradication success benchmarks and management of the risk of uncertain program costs

Yemshanov, D.[1]*, Haight R.G.[2], Koch, F.H.[3], Venette, R.[4], Studens, K.[1], Fournier, R.E.[1], Turgeon, J.J.[1]

Denys.Yemshanov@canada.ca

1Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre 1219 Queen Street East, Sault Ste. Marie, ON, P6A 2E5 2USDA Forest Service, Northern Research Station, 1992 Folwell Ave, St. Paul, MN 55108 3USDA Forest Service, Southern Research Station, Eastern Forest Environmental Threat Assessment Center, 3041 Cornwallis Road, Research Triangle Park, NC 27709 USA 4USDA Forest Service, Northern Research Station, 1561 Lindig St., St. Paul, MN 55108

Uncertainty about future outcomes of biological invasions is a major hurdle in the planning of pest management programs. We present a pest management model that incorporates the uncertainty about the spread of a non-native pest and minimizes the expected costs of a pest control program. The model accounts for aspirational eradication success targets and applies the Conditional Value-at-Risk concept to control the uncertainty of the program costs. We demonstrate the approach by assessing the costs of surveys and eradication efforts outside the quarantine area established following the discovery of a residual population of the Asian longhorned beetle (ALB, *Anoplophora glabripennis*), a harmful invasive pest that has been found in the Greater Toronto Area (GTA), Ontario, Canada. We use historical data on ALB spread in GTA to generate a set of stochastic scenarios that characterizes the uncertainty of the pest's extent and impact in the GTA. We then use these scenarios in our optimization model to find the costs of the survey and host tree removal program that achieves a desired probability of eradicating the pest in the managed area while minimizing the expected program costs. We have also applied the model constraint that enables controlling the risk of uncertain program costs when dealing with the uncertain outcomes of pest invasion. Our results provide a practical approach to assess the costs of pest management programs for given assumptions about the uncertainty of the pest's spread, the costs of pest's survey and eradication, a desired probability of eradication success and decision-maker's tolerance for eradication failure. Our model is generalizable and can be applied to a broad range of species and geographic conditions to help support economic decisions on surveillance and control of invasive species under uncertainty.

Session 9 - Addressing epistemological uncertainty with databases

Databases of host species to support research on plant pests: the case *of Xylella fastidiosa*

Ciro Gardi[1]*, Miren Andueza[1], Andrea Baù[1], Ewelina Czwienczek[2], Ioannis Koufakis[1], Marco Pautasso[1], Giuseppe Stancanelli[1], Sara Tramontini[1]

ciro.gardi@efsa.europa.eu

1 - Animal and Plant Health (Alpha) European Food Safety Authority (EFSA) Via Carlo Magno 1A, 43126 Parma - ITALY

Following a request from the European Commission, EFSA developed a database on the host plants of *Xylella fastidiosa*, based on an extensive literature search. The first version of the database compiled by EFSA was a preliminary list of host species, published as annex to the Pest Risk Assessment on *X. fastidiosa*. A self-standing database on *X. fastidiosa* host plants was then published in March 2015, and updated in February 2016. Reliable host lists of generalist plant pests (e.g. *Anoplophora glabripennis*, *Ditylenchus destructor*, *Phytophthora ramorum*), are important for modelling, monitoring and regulatory needs. In the case of *X. fastidiosa*, as for other pest species with high genetic diversity, data related to genetic characterization (subspecies, strains, isolates) require proper evaluation previous to extraction. In the scientific literature this information is often missing, partial or misused and only in recent studies the application of standard methods is a common practice (e.g. Multi Locus Sequence Typing - MLST). The same applies to detection methods, where negative results are not always reported although they are equally or even more relevant than positive ones. Different *Xylella* genotypes have in fact different host ranges and the combination of the two aspects has to be thoroughly considered. These data are crucial to support risk assessment and risk management. The current version of the database includes data from scientific papers and technical reports published up to 20 November 2015 the list of *X. fastidiosa* host plant species consisted of 359 plant species (including hybrids) from 204 genera and 75 botanical families. It is planned to periodically update the database and any contribution from the scientific community (personal communications, new publications, etc) is welcomed. The database is publicly available through EFSA web site.

EFSA apple pest database – harmonised data collection in support of pest risk assessments

V. Kertesz*[1], G. Gilioli[2], A. MacLeod[3], S. Blümel[4], H. Reisenzein[4], A. Egartner[4], R.A. Gottsberger[4], T. Leichtfried[4], C. Lethmayer[4], M. Monguidi[1], M. Oberhuber[4], U. Persen[4], F. Riolo[1], G. Strauss[4] & J. Wolf[4]

Virag.KERTESZ@efsa.europa.eu

1 European Food Safety Authority, Via Carlo Magno 1/A, 43126 Parma, Italy
2 Università di Brescia, Viale Europa, 11, 25123 Brescia, Italy
3 Department for Environment, Food and Rural Affairs, Sand Hutton, York, YO41 1LZ, UK
4 AGES, Austrian Agency for Health and Food Safety GmbH, Spargelfeldstraße 191, 1220 Vienna, Austria

In support of EU trade of plant health related commodities with third countries, EFSA received a request from the European Commission to develop and test a data model to collect and store information for the conduct of pest risk assessments (PRA). For this purpose a pilot study was carried out for the model commodity “apple fruit” collecting data for 12 representative pest and pathogen species from different taxonomic groups with potential impact on apple (Malus domestica) fruit and present in the EU territory since at least 2005 as identified by a stepwise Extensive Literature Search.

The data model focuses on the type of information most important when preparing PRAs, thus it has data sections related to occurrence/abundance, biology, diagnostics, impact and control of the selected pests and pathogens. The data model is modular and relational, linking related parameters so that more complex information can be captured and offers the possibility to use both qualitative and quantitative ratings. About 29 standard terminology catalogues were developed or adapted to serve the data collections. The catalogues and attributes had especially to be optimized and harmonized according to the requirements of the different taxonomic groups of pests which were addressed.

Based on the experiences with the prototype data model, the currently on–going improvements intend to develop a user-friendly, standardized data input and extraction interface to avoid inconsistencies in the data entry and to support data collectors and future users of the database.

Besides the above objectives, the data model will also be used by EFSA for data collections to support its own pest and commodity risk assessments.

Session 10 - Pest Risk Mapping and Management

An integrated spatial analytic framework to manage invasive species in regulatory phytosanitary applications

Takeuchi, Y.*

yu.takeuchi@aphis.usda.gov

USDA APHIS PPQ CPHST PERAL/NCSU CIPM

Non-native pests cause tremendous economic and ecological damage to managed and natural U.S. forests and agricultural landscapes. Many insects and diseases are currently under regulatory control in an effort to prevent outbreaks. However, it is difficult to control and minimize the damages once a non-native pest is established. Quick detection and response are required to mitigate invasive species when they are introduced into the United States. Alternatives to rapid response efforts include port inspection, surveillance and monitoring, shipment treatments and pre-clearance programs; however, the international nature of this approach makes it highly complex, operationally difficult and challenging to coordinate. To ensure more timely responses to pest threats, I developed an integrated spatial analytic framework named Spatial Analytic Framework for Advanced Risk Information Systems (SAFARIS) to manage invasive species for regulatory and management agencies. The SAFARIS is designed to provide a seamless environment for pest predictive models. It supports pest forecast models and tools for researchers, risk analysts, decision/policy makers, rapid-responders, and land managers in need of streamlined and tractable system. The system particularly assists pest survey, pest forecast, pest risk analysis, emergency responses, and economic analysis. It allows to factor in as many factors as possible and be modified for specific pests in a short time without sacrificing critical elements that serve as the foundation for a science-based process, especially consideration of epidemiology, population dynamics, impact and overall risk dynamics.

Rapid identification and prioritization of potential alien plant eradication targets based on climatic suitability, the potential environmental impacts and the management effort.

*Renteria, JL [1,2]; Rouget [1,3], M; Visser, V [3,4]

jlrenteriab@gmail.com

1 Land Use Planning & Management, School of Agricultural, Earth & Environmental Sciences, University of KwaZulu-Natal, Private Bag X1, Scottsville 3209, South Africa. 2 Invasive Species Programme, South African National Biodiversity Institute, Kirstenbosch Research Centre, Cape Town, South Africa. 3 Centre for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, Matieland, 7602, South Africa. 4 SEEC – Statistics in Ecology, Environment and Conservation, Department of Statistical Sciences, University of Cape Town, Rondebosch, 7701, South Africa

Identifying which introduced species have the greatest potential for establishment, spread and impact is critical for prioritizing management resources. Using species distribution modelling and GIS we assessed the climatic suitability and potential impact of 31 plant species listed as eradication targets under South African regulations. Four bioclimatic models and two evaluation techniques were used to predict the potential distribution of each species; this information was combined with the number of localities and the eradication feasibility in a scoring system to rank the species. Three management groups were identified. Group “A” includes species with the highest potential impact and higher likelihood to be eradicated, these species should be a priority for management. Group “B” includes species with a high potential impact but where eradication would be difficult due to the number of known localities. Finally species in group “C” scored a medium to low potential impact but given the nature of the species and the number of known population, eradication is likely to be feasible. This provides a rapid method to prioritize the management towards the eradication of new potential invasive plant species in the country combining the estimated potential impact, known number of populations and the eradication success.

MedISys for media monitoring of existing and emerging plant health threats

Alomar, O.[1]; Batlle, A.[1]; García, R.[2]; Gil, R.[2]; Granollers, A.[2]; Jiménez, S.[1]; Laviña, A.[1]; Linge, J. P.[3]; Pautasso, M.[4]*; Reverté, C.[1]; Riudavets, J.[1]; Rortais, A.[5]; Stancanelli, G.[4]; Virgili-Gomà, J.[2] & Vos, S.[4]

1 Institut de Recerca I Tecnologia Agroalimentàries (IRTA), Generalitat de Catalunya, Spain
2 Universitat de Lleida, Lleida, Spain
3 European Commission, Joint Research Centre (JRC), Institute for the Protection and Security of the Citizen (IPSC), Global Security and Crisis Management Unit, Ispra, Italy
4 Animal and Plant Health Unit, European Food Safety Authority (EFSA), Parma, Italy
5 Scientific Committee and Emerging Risks, EFSA, Parma, Italy

* email: marco.pautasso@efsa.europa.eu

MedISys is a media monitoring system originally developed for tracking news items related to human health. In this talk, we provide an overview of an extension of Medisys to also deal with plant health threats. This project was carried out by the University of Lleida and the Institute for Food and Agricultural Research and Technology (IRTA), Spain, in collaboration with the Joint Research Centre (JRC) and the European Food Safety Authority (EFSA). The search strategy is based on a knowledge representation approach that generated a formal representation of knowledge related to plant health threats. This ontology models plant pests and diseases, together with other concepts related with them: affected crops, hosts, vectors and symptoms. A collection of news sources related to plant health threats was collected to be monitored by MedISys. These sources included already known manually curated webpages but also additional ones discovered by performing global web searches using terms appearing in the ontology. Then, the news items coming from these sources were filtered using MedISys to select those actually about plant health threats. Most of these filters focused on known threats because they used terms associated with specific plant pests and diseases in the ontology. Additional filters for unknown threats were also developed. All these MedISys filters combined provide a mechanism to monitor plant health threats mentions in the media, from online newspapers to social media, ranging from those that explicitly mention a named threat to those talking about unknown ones. Interested users can subscribe to personalized, automatically generated email alerts. A curated newsletter may be developed in the future. In addition, the Medisys web pages are publicly accessible and provide for some plant pests temporal trends, maps highlighting hotspots of media attention, as well as the search terms used for each pest. The tool has the potential to become useful for monitoring the entry and spread of emerging plant health threats, whenever public and media attention comes earlier than scientific research.

***Fusarium oxysporum* wilt on Cavendish, risk analysis for Ecuador**

Aycart, Juan José, Agriculture research manager LOGBAN

aycartjuanjose@gmail.com

Fusarium wilt caused by *Fusarium oxysporum* f. sp. *Cubense* Tropical race 4 (FocR4T) it's the main thread for the commercial cultivation of banana Cavendish subgroup cultivars at Latin America (LA). This soilborne pathogen has vulnerate several countries phytosanitary barriers over Asia and Africa. Cavendish exportation it's the principal exportation crop from Ecuador, with more than 200K Ha of extension. The probability of direct introduction of the disease is low (2.3%), however the consequences can devastate the principal agricultural activity at the coastal provinces of the country. Indirect disease introduction has more important parameters since the human movement with the neighbor countries its 53%. The economic impact on a high production farm, determined the capacity to experiment 1 quarantine event per 2-3 Ha to reach an even economical point (4-8% of production loss). The implementation of a contingency plan with a cost increment of 3% can reduce this capacity, however the long term results of a quarantine can increase theoretically the farm infected commercial life.

Study on climate change impact on the potential geographic distribution and population fluctuation for the Fruit flies in Taiwan

Huang Yu Bing and Lin Feng-Chyi

ybhuang@tari.gov.tw

1. Division of Applied Zoology, Agriculture Research Institute, Taichung city , Taiwan

When climate change became a major global issue, researchers start to predict the potential distributions of pest which caused economic damage based on climatic data and biological models of development. The result can be forecasted in the probability of dispersal of pests. It is mainly effective and by forecasting the application in the probability of diffusion for pests. Then, a real-time warning and control measures could be made according to probability of occurrence. It will be useful for the plant protection to manage in cultivation. Based on the potential geographical distribution of species, ecological niche model was the assumption that the species can occur in a particular area with the appropriate survival in the environment, climatic factors, distribution and other biological factors. In recent years, integrating with the application of information management platform, including spatial data, geographic analysis, artificial intelligence applications, data mining, and the development degree-day of pest model was referred to as CLIMEX. In this study as a basis to explore the effect of climatic factors for the geographic distribution on fruit flies and monitoring system in Taiwan. In order to assess the climate change impact on the distribution of pest or other possible risks for native pest. This research focuses on population growth trends of the oriental fruit fly (*Bactrocera dorsalis* (Hendel)) and melon fly (*Bactrocera cucurbitae* (Coquillett)), showed the potential geographic distribution and suitable of bioclimatic indices by using CLIMEX. There are three objects to describe: (1) Comparison of climate change impact on different location. (2) Climate stress effect the geographic distribution of pests. (3) Climatic factor effect on the difference between the weekly growth index and population fluctuation. These objects could be explained the change of geographic distribution with spatial and site specific temporal data year by year for the fruit flies and attempt to set up much more traps to detect the potential invasive species in Taiwan.

The Pest and Disease Warning Service of Emilia-Romagna Region under the EU Dir. 128/09

R.Bugiani, A.Butturini, R.Tiso, T.Galassi

Plant Protection Service – Emilia-Romagna Regione Emilia-Romagna
Via Corticella 133, 40129 Bologna (Italy)

Emilia-Romagna is an administrative Region of Northern Italy, comprising the historical regions of Emilia and Romagna. The utilized agricultural area is 1,064,213 ha.
The fruit orchards cover an overall area of 63.893 ha. The main fruit orchards grown are pome fruits stone fruits and kiwifruit. Grapevine growing is also very important having a regional extension of about 50.000 ha. Olive growing, although not as widespread as in the center and south of Italy, is rather important in the hilly areas, particularly in the eastern part of the region. Crops most widely cultivated are outdoor tomato (for industrial process), potato, strawberry and cereals (particularly soft and durum wheat).
The presence of the plane tree is widespread, throughout the regional territory. Finally, the Emilia-Romagna region is the national leader in nursery productions: plant propagation material of fruit plants, strawberry, grapevine, ornamentals, forestry and horticultural plants are among the most intensively produced and exported.
In the framework of sustainable agriculture, pest forecasting tools comply with the requirements of EU Directive n.128/2009 and EU Reg n.1107/2009. A Warning Service was set up in the Emilia-Romagna region in 1997 in order to provide warnings about pests and diseases of fruit orchards (i.e. apple scab, fire-blight, downy and powdery mildew of grapevine as well as codling moth, oriental fruit moth and european grapevine moth) and extensive crops (i.e. potato and tomato late blight, fusarium head blight and septoria leaf blotch of wheat).
The Service proved to be an effective tool to:
a) Reduce the number of chemical sprays;
b) Determine the right timing for control practices in relation to the real risk of infection or the most susceptible stage of the pest;
c) Successfully integrate the Integrated Production Guidelines.
The Warning Service is based on:
1) a network of georeferenced interpolated meteorological data on a grid of 5x5 km (486 in total) over the regional agricultural area;
2) an information system (FitoSPA) which automatically elaborate the met-data on the bases of the algorithms of each forecasting model. The system produced output about the pest's risk and daily risk maps.
3) A group of expert advisors validating the met-data, supervising the correct interpretations of the output for the weekly issue of Integrated Biological Production Bulletin.
Warnings obtained by using forecasting models are also integrated by information regarding monitoring of commercial fields, volumetric spore traps and pheromone traps. The information about the pest risk is diffused also by means of email, sms, web and aims at meeting the increased demands of technicians and farmers about crop pest risk.

Validation of a forecasting model for the prediction of PSA on kiwifruit in Emilia Romagna Region (Italy)

Riccardo Bugiani [1] , Loredana Antoniacci [1] , Francesco Spinelli [2], Irene Donati [2], Giampaolo Buriani[2] , Sofia Mauri[2]
1 Plant Protection Service, Emilia Romagna Region, Italy
2 DISTA, Bologna University, Italy

Kiwi fruit is an important crop in Emilia-Romagna region with more than 4000 ha of kiwifruit growing. The production is consumed in the domestic market as well as exported abroad.
Bacterial canker caused by *Pseudomonas syringae* pv. *actinidiae* (Psa) is, at present, the most dangerous disease of kiwifruit. The disease can cause rapid wilting of branch and leaders until leading to the death of the plant. Red oozing from wood cankers can be observed at the end of winter on trunks and leaders. Before bud break, from buds and lenticels in affected plants, ooze initially whitish and then reddish in colour, can frequently be observed. In spring, necrotic spots with hydropic halo may appear on leaves while on flower buttons, petioles and sepals necrotic areas can often be observed. Severely affected leaves can fall down prematurely reducing the yield the next year. In the same period, wilting and blighting of the shoots leaders can also occur.
In Emilia-Romagna, the disease was firstly detected in 2009. At present, bacterial canker is present on more than 70% of the kiwifruit growing area. Climatic conditions favoring bacterial growth and a forecasting model to predict the kiwifruit bacterial canker infections weredeveloped in New Zealand. In 2012 such forecasting model was validated in the kiwifruit growing areas of Emilia-Romagna Region exposing micro-propagated potted kiwi plantlets under untreated infected plants from march until November. The plantlets were changed every week and placed in greenhouse at 18°C and checked them for symptom occurrence after incubation period. Over 2013-2015, validation was carried exposing micro-propagated potted kiwi plantlets under untreated infected plants from march until November and check them for symptom occurrence, along with pathogen isolation on selective growing media and PCR determination on isolated bacterial colony.
Validation experiment using trap plants permitted to effectively validate the forecasting model during springtime (from March to June) showing a robust correspondence between the model prediction and the symptom occurrence as well as the bacterial inoculum contaminating the trap plants during the growing season.
In 2015-2016, the forecasting model was therefore introduced and adopted in the Emilia-Romagna Warning service in order to provide farmers and field technician about the Risk on primary PSA infections in spring and the correct timing for copper sprays in the framework of E.U. Directive 128/09 for the “sustainable use of plant protection products”.

Keywords: kiwifruit, bacterial canker, Psa, *Pseudomonas syringae* pv. *actinidiae*, forecasting models, epidemiology

EMPHASIS. Tools to identify pest management challenges and promote innovation by adopting a multi-actor approach

M.L. Gullino, Giovanna Gilardi*, on behalf of EMPHASIS consortium

giovanna.gilardi@unito.it

University of Torino, Centre of competence for the Innovation in the agro-environmental sector (AGROINNOVA), Grugliasco (TO), Italy.

EMPHASIS is a project funded by the European Commission under Horizon2020 Program addressing native and alien pests threats (insect pests, pathogens, weeds) for a range of both natural ecosystems and farming systems. The project consortium gathers 22 partners from 10 countries and it includes research institutes, enterprises, SMEs and international organizations bringing cross-sectorial and complementary expertise. The project aims to ensure a European food security system and the protection of biodiversity and of ecosystems services while developing integrated mechanisms of response measures (practical solutions) to predict, to prevent and to protect agriculture and forestry systems from native and alien pests threats. A cross-cutting approach to participatory research and technology transfer is adopted, in order to strengthen the connectivity between agricultural research and other system actors. The plant/pest ecosystems dealt with are treated with a multi-method approach to design IPM methodology. On-farm testing and participatory learning activities are developed since the beginning of the project, to facilitate co-design, co-development and co-implementation. The Analytical Framework and the Learning Platform, are the first tools resulting from work aimed to identify current plant health challenges and evaluation. The Analytical Framework for pest management challenges and opportunities is based on a DPSIR model (Drivers, Pressures, States, Impacts and Responses) covering the broad range of stakeholders. The Analytical Framework will guide the EMPHASIS work as pest management innovations are developed, tested and demonstrated and will be applied to an agent, pathway and receptor based risk framework (Pathway Risk Analysis) - derived from the EPPO PRA scheme - to identify priority risks. Furthermore, a Learning Platform has been developed to facilitate knowledge sharing and collaboration with stakeholders by providing a forum for knowledge exchange and mutual learning; ultimately allowing the identification of end-user needs and challenges, i.e. opportunities and obstacles to the use of technologies developed.

The role of invaded distribution in reducing model uncertainty: Estimating *Vespula germanica* distribution in South America

Stella M. Januario*[1], Fabio A. Labra [2], Sergio A. Estay [3,4]

sergio.estay@gmail.com

1 Departamento Ciencias Biologicas y Químicas, Facultad de Ciencias, Universidad San Sebastián, Valdivia, Chile. 2 Centro de Investigación e Innovación para el Cambio Climático, Facultad de Ciencias, Universidad Santo Tomas, Santiago Region Metropolitana, Chile. 3 Instituto Ciencias Ambientales y Evolutivas, Facultad de Ciencias, Universidad Austral de Chile, Valdivia, Chile. 4 Center of Applied Ecology and Sustainability (CAPES), Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Santiago, Chile

One the of main questions in pest mapping is whether the information contained in the native distribution is enough to obtain a satisfactory reconstruction of the fundamental niche of the species, and therefore if this information allow us to make confident estimations of potentially invadible regions. In this study we used *Vespula germanica*, one of the most invasive species in the world, as a model species to evaluate: a) If the information contained in the native range is enough to reconstruct the current, stable distribution of this pest in Chile, and b) How much information is provided by other areas where this insects has already invaded. We used an approximation based in the reconstruction of the realized niche in the environmental space using the software NicheA and techniques extracted from information theory. Our results show that by only considering the information contained in the native distribution of *V. germanica* we obtained a poor matching (measure as normalized mutual information) between the predicted and observed distribution of *V. germanica* in Chile. However, the sequential addition of the information contained in the invaded regions significantly improved the matching between the predicted and observed distribution in Chile. Our results stressed the need to use as much information as available in order to obtain valuable information to be used in pest risk assessments.

The Establishment Possibilities of Maize pests in China based on Self-organizing Map

Ming Lei[1], Zihua Zhao[1], Meng Qin[2], Shouqi Zhao[2], Zhihong Li[1]

zhzhao@cau.edu.cn

1 Department of Entomology, College of Plant Protection, China Agricultural University, Beijing 100193;
2 The National Agro-Tech Extension and Service Center, Ministry of Agriculture, Beijing 100125

Maize is a common crop all over the world, which is also the most important crops in China. In recent years, the acreage and production are increased greatly in China. Additionally, maize pests bring more biosecurity threats to China due to the increasing trade of maize, especially for maize seed imports and domestic transportation. In the present study, SOM method was used to analyze the potential for establishment of large numbers species of maize pests for China. We built four distribution matrix sheets separately, including 644 species of insects in 320 regions, 251 species of pathogens in 317 regions, 287 species of weeds in 324 regions, 69 species of nematodes in 312 regions, these regions were consisted of countries and provinces in China. According to these basic data, we got the rank of establishment possibility of four kinds pests, especially concentrated on the limited present and absent species for China. For the limited present species, *Melolontha melolontha* (Linnaeus), *Acidovorax avenae* subsp. *avenae* (Manns) Willems et al., *Vernonia cinerea* (L.) Less, *Helicotylenchus dihystera* (Cobb) are important. For the absent species, *Silvanus proximus* Grouvelle、*Cochliobolus ravenelii* J.L.Alcorn、*Chamomilla recutita* (L.) Rauschert and *Rotylenchulus parvus* (Williams) Sher are important. We also examine the risk of maize seed pests during the international trade (Germany to China). *Caulophilus oryzae* (Gyllenhal), *Curtobacterium flaccumfaciens* pv. *flaccumfaciens* (Hedges) Collins & Jones, *Lepidium draba* have great risk. At the same time, we found *Cryptolestes pusillus* (Schonherr), *Ustilaginoidea virens* (Cooke.)Tak.、*Panicum repens* L. are important for domestic transportation. Meanwhile, we got the clustering results of China and China's province, which means China has similar maize species assemblage with India, USA and Brazil, the provinces has similar maize species assemblage with their neighbor provinces. These results can figure out the pest lists of high establishment risk for China and provinces, and can also provide advices to revise the list of quarantine pests and perfecting inspection and quarantine measures for preventing maize pests.

Mapping the risk of establishment of huanglongbing in Chile.

Silva, CP[1]*; Estay SA[1,2]

carmenpazsilva@gmail.com

1 Instituto de Ciencias Ambientales y Evolutivas, Universidad Austral de Chile. Valdivia, Chile 2 Center for Applied Ecology and Sustainability (CAPES), Santiago, Chile.

Huanglongbing (HLB) is an extremely destructive disease affecting citrus trees widespread around the world. The causal agents of this disease, *Candidatus* Liberibacter spp., is dispersed by the psyllids *Trioza erytreae* in Africa,and *Diaphorina citri* in Asia, North America, and South America. In this study we used correlative niche models to predict the potential geographic distribution of HLB, its causal agent *Candidatus* Liberibacter asiaticus (cLas) and its vector *Diaphorina citri* Kuwayama (ACP) at global scale, but with a especial focus in Chile, a disease free country, despite being surrounded by countries with reported presences of these agents . In Chile, citrus plantations represent a sector of great activity in terms of production, exports and employment generation. The cultivated area of citrus fruits correspond to ca.18,000 hectares and the exports reaches 190,000 metric tons. Climate suitability for HLB, Clas and ACP were primarily related to altitude, humidity and precipitations. The models predicted that only restricted areas of Chile are climatologically favorable for ACP and Clas. Mainly the areas under higher risk are located in the northern part of the country, where the main crops is Key lime. Our findings will provide valuable information for improving policies and monitoring strategies for prevention and early detection of these agents.

Effects of Azadirachtin and Takomi on some biological parameters of *Habrobracon hebetor*

Rostami,F.; Zandi Sohani,N.; Yarahmadi, F., Avalin Chaharsoghi, K.

nzandisohani@yahoo.com

1,2,3- Plant Protection Department, Faculty of Agriculture, Ramin Agriculture and Natural Resources University of Khuzestan, Iran. 4-Jahad Agricultural Organization of Khuzestan, Iran.

Habrobracon hebetor (Hym.: Braconidae) is a polyphagous ectoparasitoid which has been studied for control of various lepidopteran pests in crops and stored products. It is used to control cotton bollworm, *Helicoverpa armigera*, and European corn borer, *Ostrinia nubilalis*, in mass rearing programs in Iran. In this study the side-effects of two conventional pesticide, Azadirakhtin and Takomi, was investigated on the longevity, fecundity and sex ratio of *H. hebetor*. Adult wasps were collected from tomato fields and reared on the last instar larvae of the Mediterranean flour moth, *Ephestia kuehniella* (Lep: pyralidae), at laboratory. A pair of newly emerged parasitoid wasps were released into the Petri dishes, on ten *E. kuehniella* larvae, with treated inner surfaces by recommended farm doses of the pesticides (437.5 and 2000 ppm for Takomi and Azadirachtin) in 15 replication. Petri dishes containing new larvae were replaced every day until the death of female wasp and the number of eggs laid were recorded daily. Results showed that pesticides has no negative effect on sex ratio and longevity of *H. hebetor*, but the average number of eggs laid by females were affected by Azadirachtin (32.73, 32.46 and 22.67 in control, Takumi and Azadirachtin, respectively). The sex ratio in the control, Takumi and Azadirachtin was calculated to be 0.44, 0.58 and 0.48, respectively. According to the results, Takumi with less negative effects on *H. hebetor* oviposition rate may be recommended alongside *H. hebetor* for control of *H. armigera* in IPM Programs.

Using temperature transfers treatments to calibrate models of the potential geographical distribution and population dynamics of the Black soldier fly *Hermetia illucens*: exploring suitable composting areas for larvae to recycle food waste

*Ana Clariza Samayoa, D. J. Kriticos and Shaw-Yhi Hwang

anaclariza@gmail.com

1- National Chung Hsing University,250, Kuo-Kuang Road, Taichung 402, Taiwan, R.O.C. 2-CSIRO, GPO Box 1700, Canberra, ACT 2601, Australia 3-National Chung Hsing University,250, Kuo-Kuang Road, Taichung 402, Taiwan, R.O.C.

We demonstrate the use of a novel laboratory technique for estimating population temperature response parameters that can be used to model the growth potential of poikilotherms. We use *Hermetia illucens* as a case study to estimate its potential as an organic waste treatment. Newly-laid egg masses of *H. illucens* were exposed at 28 ° C. Eight day old larvae (from eggs) were then transferred into treatment temperatures (10, 19, 28, 34, and 40 °C) for five days, then moved back to 28 °C (totally 13 days old), until insects reached adulthood. The results were used to estimate the temperature development response function and heat sum to complete a generation. These data were then applied to a CLIMEX model to estimate the a global model of the potential number of generations and potential for population survival at each location under field conditions. The experimental method lends itself to the rapid development of CLIMEX models for pest risk, and avoids many of the pitfalls of constant temperature development rate studies.

Benefit of *Pieris rapae* on radish plant under elevated temperature

Papitchaya Teawkul*, Pham Anh Tuan, Shaw Yhi Hwang

TKPAPITCHAYA@GMAIL.COM

Department of Entomology, National Chung Hsing University

Global climate change has been a very important issue lately. Warming could have very serious impact on crop plant-insect pests-natural enemy tritrophic interactions; however, less is known about these interacting effects. In this research, we examined the interaction of *Pieris rapae* and Radish plant under ambient and elevated temperature. The results indicated that under warming condition, radish plants grew significantly well than those under ambient environment; foliar dry biomass, leaf area, and plant nutrients all increased under elevated temperature treatment. On the other hand, elevated temperature leads to a reduction on foliar defensive and secondary metabolites. In addition, the results also showed that changes in foliar chemistry related to change in insect performance. When larvae of *Pieris rapae* fed on radish foliage under elevated temperature, the caterpillars grew faster and had a shorter developmental period. In conclusion, the results of this research suggest that under warming the prevailing relationship between insect-plant interactions needs to be reconsidered.

Ten years of *Ips typographus* in Lagdei forest (Province of Parma): outbreak analysis and forest regeneration

Vignali G [1], Barbarotti S [2], Piovani P* [2], Maresi G [3], Salvadori C [3]

paolo.piovani71@gmail.com

1 Parco Nazionale Appennino Tosco Emiliano 2 Freelance consultants 3 Fondazione E. Mach, Centro Trasferimento Tecnologico, via E. Mach 1, I-38010 San Michele a/A, Trento.

Some Norway spruce plantations located in the Foresta Demaniale Alta Val Parma (Municipality of Corniglio, province of Parma- Italy) experienced since 2004 a massive outbreak of Norway spruce bark beetle (*Ips typographus*). This outbreak has been triggered by the exceptionally warm and dry summer of 2003. In the following years bark beetle attack extended to whole Alta Val Parma forest area. Six circular study areas have been chosen to test different silvicultural management options to enhance woody species recover after the disturbance. Monitoring of *Ips typographus* population has been carried out between 2007 and 2013 that demonstrated the presence of two complete generations per year. In 2007 captures number was much higher than the risk threshold established for alpine spruce populations (8000 individuals per trap). In the following years the number of captures gradually decreased with a sudden increase in 2011 in correspondence of a dry and warm summer. The best tested option for the resettlement of indigenous broadleaved species was the plantation of saplings of broadleaved species both under cover of dead standing spruces and after cutting of logs. These results confirm the difficulties of establishment of natural regeneration, that is strongly limited by the scarcity of reproductive individuals and by the competition with tall grassy species that have a very fast growth at the beginning of warm season.

Chemical composition and insecticidal effects of *Eucalyptus camaldulensis* and *Eucalyptus microtecha* on two stored product pests

Nooshin Zandi-Sohani [1]*, Antoni Szumny[2]

nzandisohani@yahoo.com

1- Department of Plant Protection, Ramin Agriculture and Natural Resources University of Khuzestan, Mollasani, Iran. Corresponding Author: nzandisohani@yahoo.com 2- Department of Chemistry, Wroclaw University of Environmental and Life Sciences, C.K. Norwida 25/27, 50-375 Wrocław, Poland

Eucalyptus Sp., belonging to Myrtaceae family and native to Australia, is one of the aromatic plants which almost grows all around the world. The essential oil from the leaves of the plant is considered as a defensive material against herbivores and harmful insects. In this study, the essential oil from the leaves of *E. camaldulensis* and *E. microtheca* was extracted using a Clevenger-type apparatus and their chemical composition was analyzed using GC-MS. Also, Fumigant toxicity and repellency of the essential oils were investigated on two stored product pest, *Oryzaephilus surinamensis* and *Rhyzopertha domonica*. According to the results, 1,8-cineol (68.79%) in *E. camaldulensis* and Globulol (34.37%), α-Guaiol (29.70%), ρ-cymene (8.07%) and 1,8-cineole (6.01%) in *E. microtheca* essential oil were the most components, respectively. In fumigant toxicity experiments the LC50 of *E. camaldulensis* essential oil for *Rhyzopertha domonica* and *Oryzaephilus surinamensis* were calculated to be 32.56 and 10.17 (µL/L air) and that of *E. microtheca* were 75.72 and 35.2 (µL/L air), respectively. Furthermore, the repellency of both essential oil on insects increased with increasing the concentration of the oils. The most repellency (86%) occurred by *E. camaldulensis* essential oil for *Rhyzopertha domonica* after 4h. According to these results, the essential oil obtained from the leaves of *E. camaldulensis* showed stronger fumigant insecticidal activity on stored product pest which is probably related to more 1,8-cineole in the composition of its essential oil.